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INTERNATIONAL HELLENIC UNIVERSITY

FACULTY OF ENGINEERING

DEPARTMENT OF INDUSTRIAL

ENGINEERING AND MANAGEMENT

STUDY GUIDE 2026-2027

DEPARTMENT OF INDUSTRIAL ENGINEERING AND MANAGEMENT

THESSALONIKI, 2026

EDITING GROUP

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I.H.U. 2026

Table of Contents

FOREWORD 1

1. THE INTERNATIONAL HELLENIC UNIVERSITY 3

1.1 General information 3
1.2 Academic and organizational structure 3
1.3 The Alexandrian Campus of Thessaloniki 5

2. THE CITY OF THESSALONIKI 6

2.1 Geographical and demographic information 6
2.2 Historical information 6
2.3 Useful transportation information 7

3. THE DEPARTMENT OF INDUSTRIAL ENGINEERING AND MANAGEMENT 8

4. THE UNDERGRADUATE STUDY PROGRAM IN THE DEPARTMENT 9

4.1 The aims of the Undergraduate Study Program 9
4.2 Awarded title and level of qualification 9
4.3 Career prospects for graduates 9

5. INFORMATION ON THE CURRICULUM OF STUDIES 10

5.1 Duration of studies 10
5.2 Admission and registration 10
5.3 Academic calendar 10
5.4 Specific arrangements for recognition of previous studies 11
5.5 Course declaration - Renewal of registration 12
5.6 Academic ID - Student pass 12
5.7 Teaching aids and resources 12
5.8 Course of study 12
5.9 Examinations 13
5.10 Diploma thesis 13
5.11 Internship 14
5.12 Degree grade - Declaration of graduation 14
5.13 Graduate certificate - Transcript of records - Diploma supplement 14

6. STAFF OF THE DEPARTMENT 15

6.1 The Staff of the Department 15
6.2 Administration/Secretariat Office: Duties and working hours 17
6.3 The Department's Committees 17
6.4 The role of the Academic Advisor (Tutor) 18
6.5 Evaluation of the educational activities 19

7. FACILITIES OF THE DEPARTMENT 20

7.1 Laboratory spaces and equipment 20
7.2 Teaching classrooms 23
7.3 E-learning 23
7.4 Institutional research laboratories 24

8. PRESENTATION OF THE UNDERGRADUATE STUDY PROGRAM 25
8.1 Overview of the Undergraduate Study Program 26
8.2 Undergraduate Study Program per semester 27

9. POSTGRADUATE STUDY PROGRAMS IN THE DEPARTMENT 32
9.1 Postgraduate study program in Applied Automation Engineering Systems 32
9.1.1 Goals and objectives of the postgraduate study program 32
9.1.2 The postgraduate degree awarded 32
9.1.3 Eligibility criteria of admission 32
9.1.4 Duration of studies 33
9.1.5 Course schedule per semester 33
9.1.6 Number of admissions 34
9.1.7 The staff 34
9.2 Postgraduate study program in Robotics, STEAM and New Technologies in Education 34
9.2.1 Goals and objectives of the postgraduate study program 34
9.2.2 The postgraduate degree awarded 35
9.2.3 Eligibility criteria of admission 35
9.2.4 Duration of studies 35
9.2.5 Course schedule per semester 35
9.2.6 Number of admissions 36
9.2.7 The staff 36

10. DOCTORAL STUDIES IN THE DEPARTMENT 37

11. INTERNATIONAL STANDING AND PARTNERSHIPS 38

12. ERASMUS+ PROGRAMME 41

13. APPENDIX: DETAILED COURSES OUTLINE 43
14.1 1st Semester Courses 43
14.2 2nd Semester Courses 48
14.3 3rd Semester Courses 54
14.4 4th Semester Courses 60
14.5 5th Semester Courses 66
14.6 6th Semester Courses 75
14.7 7th Semester Courses 84
14.8 8th Semester Courses 92
14.9 9th Semester Courses 104

FOREWORD

Dear students,

The Department of Industrial Engineering and Management is one of the largest, most important, and rapidly evolving departments of the School of Engineering of the International Hellenic University, Greece. It has exceptional building facilities and high-level technological infrastructure that is constantly renewed and used for education and research purposes.

As the President, I assure that the Department monitors and participates in international technological progress and constantly adapts its curriculum in order to provide its students with contemporary high-level studies that will ensure them the best conditions for their future professional life. The Department aims at the continuous improvement of the education provided by the constant integration of innovative research results into teaching, supports the participation of student groups in international technological competitions, as well as promotes innovation as an important component of academic education, directly linked to the exploitation of research outcomes.

The Department was recently evaluated by the National Authority for Higher Education with "Excellent" (A), recognizing the high quality of the educational and research activities provided, while the obtained Degree corresponds to Level 7 (Master's) of the European Qualifications Framework. In addition to the undergraduate curriculum, the Department offers postgraduate and doctoral studies.

Additionally, the Department of Industrial Engineering and Management of IHU is now considered equivalent to that of a Polytechnic School, and its graduates receive engineering professional rights, equivalent to those of the similar departments in Xanthi and Chania, Greece.

The current nature of the Department is reflected in this Study Guide, which is the basic handbook for students, especially first-year ones. It includes the five-year program and regulation of the undergraduate studies, the summary of the content of each course, and information about various activities related to the educational process.

The efforts of all of us, including academic, technical, and administrative staff, are continuous and aim to create an academic environment of cooperation and knowledge that will support our students. With your enthusiasm and cooperation, our efforts to continuously improve the level of studies will continue to be fruitful and lead us to ever higher goals.

The President of the Department

Apostolos Tsagkaris
Professor

1. THE INTERNATIONAL HELLENIC UNIVERSITY

1.1 General information

The International Hellenic University (I.H.U.) based in Thessaloniki, was founded by article 1 of Law 3391/2005 (Aʹ 240) and is organized and operates as a Higher Educational Institution (HEI) in the university sector, in accordance with paragraph 1 and indent a' of paragraph 2, article 1, Law 4485/2017 (Aʹ114).

With Law 4610/2019 (Government Gazette 70/A'/7-5-2019) nine (9) Schools were established therein with corresponding Departments in each of them.

Besides, there is a University Center for International Studies in IHU, based in Thessaloniki, which operates as an academic unit of the institution.

The following Departments are established at the University Center for International Studies:

a) Humanities, Social and Economic Sciences, which is part of the School of Humanities, Social and Economic Sciences.

b) Science and Technology, which is part of the School of Science and Technology

The above Departments are located in different cities of Northern Greece. Most of them are mainly concentrated in three campuses: Thermi (where the University headquarters is also located), Sindos and Serres.

1.2 Academic and organizational structure

According to the current legislation, each University is subdivided into Schools, which cover a set of related scientific disciplines, so that the necessary coordination for the quality of the education provided can be ensured. A School is subdivided into individual Departments which also constitute the basic academic units. The units in question cover the subject of a specific scientific field and award the corresponding degree/diploma. The Schools of the International Hellenic University - with their Departments - are as follows:

SCHOOLS	DEPARTMENTS
FACULTY OF ENGINEERING (Graduates can enroll to the Technical Chamber of Greece)	• Department of Industrial Engineering and Management (Thessaloniki) • Department of Environmental Engineering (Thessaloniki) • Department of Information Technology and Electronic Engineering (Thessaloniki) • Department of Computer, Informatics and Telecommunications Engineering (Serres) • Department of Mechanical Engineering (Serres)
SCHOOL OF ENGINEERING	• Department of Surveying and Geoinformatics Engineering (Serres) • Department of Civil Engineering (Serres)
SCHOOL OF ECONOMICS AND BUSINESS ADMINISTRATION	• Department of Business Administration (Serres) • Department of Economic Sciences (Serres)

	• Department of Supply Chain Management (Katerini) • Department of Business Administration, Marketing and Tourism (Thessaloniki) • Department of Accounting and Information Systems (Thessaloniki)
SCHOOL OF SOCIAL SCIENCES	• Department of Library, Archive and Information Science (Thessaloniki) • Department of Early Childhood Education and Care (Thessaloniki)
SCHOOL OF HEALTH SCIENCES	• Department of Biomedical Sciences (Thessaloniki) • Department of Nutritional Sciences and Dietetics (Thessaloniki) • Department of Midwifery Science (Thessaloniki) • Department of Physiotherapy (Thessaloniki) • Department of Nursing (Thessaloniki)
SCHOOL OF DESIGN SCIENCES	• Department of Creative Design and Clothing (Kilkis) • Department of Interior Architecture (Serres)
SCHOOL OF HUMANITIES SOCIAL SCIENCES AND ECONOMIC STUDIES	• Department of Humanities Social Sciences and Economic Studies (Thessaloniki)
SCHOOL OF SCIENCE AND TECHNOLOGY	• Department of Science and Technology (Thessaloniki)

The administrative bodies of each School are the Deanery and the Dean.

The Deanery of each School consists of:

- the Dean of the School,
- the Presidents of the Departments, and
- representatives of Special Technical Laboratory Staff (E.TE.P.), Special Teaching Laboratory Staff (E.D.I.P.), and students.

The Department is managed by:

- the Department's Assembly
- the Management Board, and
- the President of the Department

The Assembly of the Department comprises the Educational Staff members of the Department, the technical staff representatives, undergraduate and postgraduate students.

The governing bodies of the official Departmental Sectors are the Sector Assembly and the Sector Director. The Sector Assembly comprises the Educational Staff members of the Sector and student representatives.

1.3 The Alexandrian Campus of Thessaloniki

The premises of I.H.U. are located in the west side of Thessaloniki next to the town of Sindos of the Municipality of Delta, where the industrial zone of the city is also located. Specifically, the facilities of the University are only 15 kilometers away from the center of Thessaloniki, at the exit of the National Highway Thessaloniki - Athens towards Sindos. Expanding over an area of 1.6 km^2, the Alexander Campus includes the Departments and their secretariats, the classrooms, the auditoriums and the library, the student residences, the restaurant, the gym and the infirmary, the university farm, as well as the central administrative and technical services.

2. THE CITY OF THESSALONIKI

2.1 Geographical and demographic information

The Prefecture of Thessaloniki is located in Central Macedonia and is surrounded by the Gulf of Thermaikos to the west and the Gulf of Strymonikos to the east. In the central-north part of the prefecture, the valley of Mygdonia with Lakes Koroneia and Volvi, which is the second largest lake in Greece, is located. The mountain "Hortiatis" rises in the central-west, the mountain "Vertiskos" in the north, while the mountains of Volvi in the north-east. The Prefecture of Thessaloniki borders on the south-west with the Prefecture of Imathia, on the west with the Prefecture of Pella, on the north with the Prefecture of Kilkis, on the east with the Prefecture of Serres, and on the south with the Prefecture of Halkidiki.

The Prefecture of Thessaloniki was one of the 54 prefectures of Greece, while since 2011 it constitutes the Metropolitan Area of Thessaloniki, one of the 74 regional units of Greece and one of the seven of the Central Macedonia Region. It is the second largest prefecture in area of Northern Greece (after the Prefecture of Serres) and the second largest prefecture in Greece in terms of population. The Metropolitan Area of Thessaloniki is the largest regional unit in the country with over 1,110,000 inhabitants according to the 2021 census.

The city of Thessaloniki is the largest city in area and population of the Central Macedonia Region and the second largest city in Greece. It is the capital of the Metropolitan Area of Thessaloniki, as well as the seat of the Municipality of Thessaloniki (with over 325,000 inhabitants according to the 2021 census), the urban complex of Thessaloniki, the Region of Central Macedonia and the Decentralized Administration of Macedonia and Thrace. The town Sindos, where the I.H.U. Campus is located in Thessaloniki, constitutes the seat of the Municipality of Delta (with over 45,000 inhabitants according to the 2021 census) in the west side of the prefecture.

2.2 Historical information

Thessaloniki was founded in 315 B.C. from the Macedonian general Cassander, who was one of the successors of Alexander the Great, who named the city after his wife and half-sister of Alexander the Great, Thessaloniki. After the death of Alexander the Great, Cassander was proclaimed king of Macedonia in 306 B.C. In the 2nd century B.C., the city was conquered by the Romans and became the seat of the Roman province of Macedonia. Due to its important strategic location, the city constituted the imperial capital during the reign of Galerius. With the completion of the Egnatia Road (120 B.C.), Thessaloniki, as the most populous city of the network, became the most important hub between East and West.

Thessaloniki gained the title of "co-regent" city (along with Constantinople) during the Byzantine Empire and was an important administrative and military center, while it became a hub of intellectual and cultural development with a progression of education, art, literature, philosophy, architecture and sciences, culminating in the 14th century. After the fall of Thessaloniki by the Ottomans in 1432, it remained in the Ottoman Empire for about five centuries. Following the expulsion of the Jews mainly from the Iberian Peninsula in 1492, Thessaloniki became their main destination, thus acquiring its own Jewish community. The establishment of Jews in Thessaloniki highlighted the city as the most important Jewish metropolis until the beginning of the 20th century.

After its liberation and incorporation into the Greek State in 1912, the population of Thessaloniki showed significant changes, indicatively during the Asia Minor Disaster in 1922 and subsequently during the exchange of populations with the departure of the Muslim population and the settlement of refugee populations from Asia Minor and Eastern Thrace. The great fire of 1917 was the worst disaster that the city had suffered in recent years. It completely destroyed buildings of architectural value, shops, churches, mosques and synagogues, as well as thousands of houses in the city center, leaving 72,000 residents homeless.

During World War II, Thessaloniki was occupied by Nazi forces on April 9, 1941, until the city's liberation on October 30, 1944. During the occupation, thousands of residents were tortured, displaced, and executed, including the city's Jews. On June 20, 1978, a strong earthquake was the first to hit a major urban center in Greece, causing a total of 49 deaths and significant property damage. In 1997, Thessaloniki was designated as the Cultural Capital of Europe, while until today it is an important center of culture in Greece, in the Balkans, and in Europe. Notably, fifteen early Christian Byzantine churches of the city were recognized in 1988 as UNESCO World Heritage Sites. The Patron Saint of the city is the Great Martyr Saint Demetrius, also known as "Myroblyte".

2.3 Useful transportation information

The Department of Industrial Engineering and Management of I.H.U. is located on the Alexandrian Campus of Sindos, approximately 15 kilometers away from the center of Thessaloniki. The Urban Transport Organization of Thessaloniki (O.A.S.Th.) has launched three bus lines, line 52 (departing from the Railway Station), line 53 (local bus of Sindos) and line 80 (departing from KTEL), at regular intervals, to serve students.

Useful links:

O.A.S.Th. (City bus services): https://oasth.gr

Thessaloniki Metro: https://www.thessmetro.gr

KTEL (Intercity bus station) "Macedonia": https://ktelmacedonia.gr

International Airport "Macedonia": https://www.skg-airport.gr/en

Hellenic Train (Train lines): https://www.hellenictrain.gr

3. THE DEPARTMENT OF INDUSTRIAL ENGINEERING AND MANAGEMENT

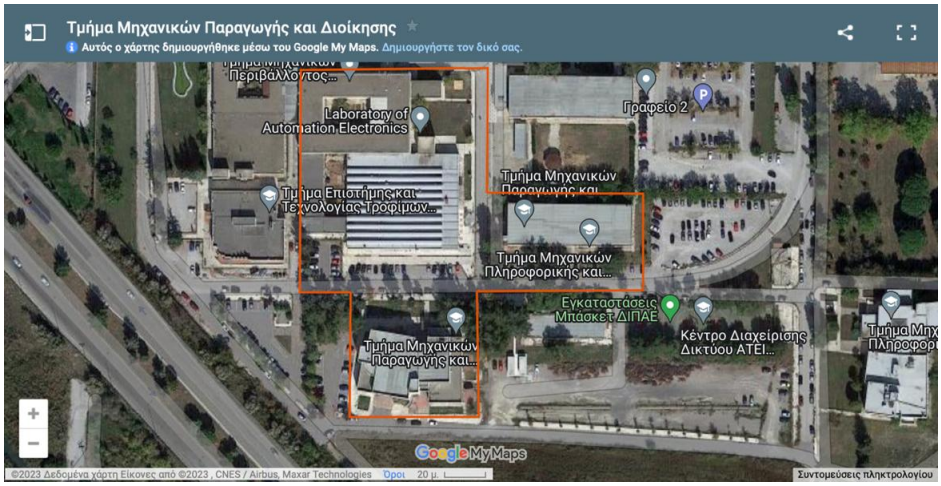
The Department of Industrial Engineering and Management (I.E.M.), School of Engineering, of the International Hellenic University was established in May 2019 by Law 4610 (Government Gazette 70/A'/07-05-2019) "Synergies of Universities and T.E.I., access to higher education, experimental schools, General Archives of the State and other provisions".

Before that, there were the Department of Automation Engineering (1989-2019) and the Department of Vehicles Engineering (1991-2019) of the Alexandrian Technological Educational Institute of Thessaloniki, which were merged. Until September 2026, the total number of Automation Engineering graduates was 1804, that of Automotive Engineering graduates was 2065, and that of Industrial Engineering and Management graduates was 142. The table below shows the number of admitted, graduated, and enrolled students from 2018 to date.

DEPARTMENT	**AUTOMATION / VEHICLES / I.E.M.**		
Year	**Admitted**	**Graduated**	**Enrolled on August 31st**
2018 – 2019	171 / 133 / 0	13 / 25 / 0	978 / 981 / 0
2019 – 2020	0 / 0 / 225	0 / 0 / 0	1085 / 956 / 225
2020 – 2021	0 / 0 / 237	122 / 152 / 17	993 / 864 / 405
2021 – 2022	0 / 0 / 110	37 / 57 / 15	902 / 783 / 492
2022 – 2023	0 / 0 / 140	59 / 54 / 16	839 / 717 / 563
2023 – 2024	0 / 0 / 141	83 / 61 / 19	765 / 668 / 676
2024 – 2025	0 / 0 / 146	63 / 65 / 31	694 / 587 / 718
2025 – 2026	0 / 0 / 176	44/34/44	245/144/857
2026 – 2027	0 / 0 / 149		

The Department of Industrial Engineering and Management is organized in the following Sectors:

- **Sector of Mechanical and Electrical Engineering**
  Director: Ioannis Bazios, Associate Professor
- **Sector of Design and Manufacturing of Products and Systems**
  Director: To be elected
- **Sector of Industrial Management and Information Systems**
  Director: Dimitrios Manolakis, Professor



Top-view of the Industrial Engineering and Management Department's buildings

4. THE UNDERGRADUATE STUDY PROGRAM IN THE DEPARTMENT

4.1 The aims of the Undergraduate Study Program

In particular, the Undergraduate Program of the Department of Industrial Engineering and Management aims to provide future graduates with knowledge and skills to be able to design, implement, improve, and manage systems consisting of raw materials, tools and machines, physical, human, and financial resources, as well as of information systems to create products and services.

The main knowledge areas of the Study Program include, among others:

- Mathematics (linear algebra, calculus, statistics and probability, operational research)
- Physics (statics, dynamics, thermodynamics, fluid mechanics)
- Electrical Engineering and Electronics (circuits, electric field, digital and analog systems, microcontrollers, electric machines, robotics)
- Mechanical Engineering (mechanical structures and functions, technical design, materials technology, machining processes, aerodynamics, environmental engineering)
- Systems Theory and Automatic Control (automatic control systems, signals, modeling, simulation, intelligent control)
- Informatics (computer science, programming, information systems)
- Industrial Management (production and operations management, supply chain and logistics, economics and entrepreneurship)

4.2 Awarded title and level of qualification

The Department's Study Program provides its graduates with the Integrated Master's Degree (five-year studies) in "Industrial Engineering and Management" which corresponds to **Level 7** of the National Qualifications Framework (Law 4763/2020), in full agreement with the European Qualifications Framework (EQF).

4.3 Career prospects for graduates

The graduates of the Department of Industrial Engineering and Management of I.H.U. have the opportunity to work in the public and private sectors, both in Greece and abroad, on the knowledge areas covered by the Department. Notably, the accreditation of the **professional certification as an Engineer in Greece** (Registration at the Technical Chamber of Greece) has been already established.

5. INFORMATION ON THE CURRICULUM OF STUDIES

5.1 Duration of studies

The first cycle of studies in the Department of Industrial Engineering and Management, School of Engineering, of I.H.U. requires attending an Undergraduate Study Program (USP), which includes courses corresponding to a minimum of 300 credits (ECTS). It typically lasts five (5) academic years and culminates in the award of the degree. In each academic year, the student chooses educational activities corresponding to 60 credits (ECTS) (article 30, par. 2b, Law 4009/2011).

The USP studies are conducted with the system of semester courses, which are divided into nine (9) instructional semesters and the 10th that includes the preparation of a Diploma Thesis.

The minimum duration of study is ten (10) academic semesters. The maximum duration of study is the minimum study time, increased by six (6) academic semesters, and therefore sixteen (16) academic semesters. After the completion of the maximum period of study, the Board of Directors of the Department issues an act of deletion (article 76, par. 1, Law 4957/2022).

Students who have not exceeded the upper limit of study may, after applying to the Department Secretariat, interrupt their studies for a period of time that does not exceed two (2) years. The right to interrupt studies may be exercised once or partially for a period of at least one (1) academic semester, but the duration of the interruption may not cumulatively exceed two (2) years, in case it is partially provided. Student status is suspended during the interruption of studies and participation in any educational process is not allowed (article 76, par. 4, Law 4957/2022).

5.2 Admission and registration

Students are those who are registered in the Department of Industrial Engineering and Management of I.H.U. after passing the entrance exams to higher education, by transfer or by qualifying exams in accordance with the current regulations .

The registration of newly admitted students takes place at the Department's Secretariat within the time limits defined each time by the Ministerial Decisions.

The passing candidates of the Panhellenic examinations who completed their registration through the electronic application of the Ministry of Education and Religious Affairs must carry out the identity check at the Secretariats of their Departments, submitting the following supporting documents:

1. Application for registration (printed from the website of the Ministry of Education),

2. Photocopy of identity card (ID),

3. One (1) photo (ID type).

For the remaining categories of new entrants, the required supporting documents are announced on a case-by-case basis.

5.3 Academic calendar

The academic year starts on September 1, every year, and ends on August 31 of the following year. The educational work of every academic year is organized in two semesters, the winter semester and the spring semester, each of which comprises thirteen (13) weeks of teaching and

one examination period (three weeks of exams). For courses and laboratories in which students are assessed through progress tests and/or assignments during the academic year, there is no obligation to offer a re-sit exam in September.

For the Department of Industrial Engineering and Management, the total number of semesters required to complete the program, as specified in the curriculum, is ten (10) semesters:

- Winter semester courses start in the last week of September and end in mid-January, followed by the first exam period of the winter semester.
- Spring semester courses start in late-February and end at the end of May, followed by the first exam period of the spring semester.

The exact dates are specified every year by the university Senate. Every semester has two exam periods:

- Winter semester courses are examined during the exam period January-February; re-sit exams are held in September.
- Spring semester courses are examined during the exam period of June; re-sit exams are held in September.

Every semester, and before the beginning of each exam period, students have the right and obligation to evaluate their courses and instructors, aiming at the improvement of the quality of their studies. More information is available at the website of the Quality Assurance Unit (MO.DI.P-I.H.U.) and the website of their Faculty/Department.

HOLIDAYS:

Courses or exams are not held in the two months of summer holidays (i.e., July and August) and in the following public holidays:

Christmas Holidays: From December 24 to January 6

January 30: Feast of the Three Patron Saints of Education

Clean Monday

March 25: The Annunciation of Virgin Mary / National Anniversary of the 1821 Revolution

Easter Holidays: From Holy Monday to Thomas Sunday

May 1: Labor Day

Holy Spirit Day: Monday after the Pentecost

October 26: Feast of the Patron Saint Demetrius of the city of Thessaloniki

October 28: National Celebration of the "Ohi" Day (rejection of the ultimatum of Mussolini to occupy Greece in 1940)

November 17: National Celebration of the students' uprising in the National Technical University of Athens against the junta in 1973

5.4 Specific arrangements for recognition of previous studies

The minimum duration of studies of the Department of Industrial Engineering and Management of I.H.U. is ten (10) semesters. However, in case of admission through qualifying exams organized by the Department (after having obtained a previous degree), the minimum duration of studies is adjusted according to the semester of admission.

5.5 Course declaration - Renewal of registration

The students can plan their individual study program in each academic semester, indicating the courses that they wish to attend. The selection of courses is submitted by all registered students electronically through the online support system of I.H.U. (http://uniportal.ihu.gr). The students can select the courses of their semester of study, as well as courses of previous semesters, according to the conditions listed below. The maximum number of ECTS that can be selected is determined by the Department's assembly and is listed below. Students have the right to attend and participate in exams only for the courses they have officially selected. Students who have not been registered in certain semester cannot attend, nor be examined, in any course for that semester.

Each course is assigned a number of ECTS depending on its difficulty level. The total number of credits for each semester is 30. The preparation of the thesis corresponds to 30 credits. The maximum number of credits that can be selected by each student per semester is determined as follows:

- Students of the 1st semester can select 30 ECTS and their selection (only for the 1st semester) is made automatically by the Department's secretariat.
- After the 1st semester and till the 9th semester (7th semester for the former Departments of Automation and Vehicle Engineering), students can select up to 42 ECTS in each semester.
- After the 10th semester (8th semester for the former Departments of Automation and Vehicle Engineering), students can select as many courses as they wish without an ECTS limit. In this case, all compulsory courses can be selected in both winter and spring semesters. The elective courses can be selected by choosing only those taught in the current semester (winter or spring).

The students are obliged to renew their registration every semester. The renewal is carried out by submitting a course registration, following the Department's announcement which is posted on its website. The course registration is performed electronically within a specified time span.

5.6 Academic ID - Student pass

Since 24/09/2012, undergraduate, postgraduate and doctoral students of all Universities in the country can electronically apply for the issuance of their academic identity card through the link: Electronic Service for Acquiring Academic Identity - Information Portal (minedu.gov.gr)

5.7 Teaching aids and resources

The educational work is supported by the corresponding coursebooks, which are provided free of charge to the students, through the Electronic Integrated Book Management Service (Eudoxus). Students, after submitting the electronic declaration of courses each semester, also make the corresponding declaration of books on the web portal of the "EUDOXUS" system (http://eudoxus.gr/), with which they declare the coursebooks they wish to receive.

5.8 Course of study

The Study Program supports 104 courses of which 43 are compulsory core courses and 61 are elective courses (each student should select 14 of them).

The educational process of each course includes, among others, theoretical lectures, computational exercises, practice in computer programs, hands-on practice in laboratories, mid-term exams, as well as assignments. At the end of each semester and in September, the students should participate in the final exams of the courses.

ECTS credits: Each course of the Department's Curriculum is characterized by a number of credits. The ECTS credits, which are allocated to each course, are a measure of the workload required to complete the objectives of an Academic Program by each student.

Grade scale: Grading is expressed as a numerical scale from zero to ten (0-10), while five (5) is the minimum passing mark. The final grade is based on the final written exams, but also on mid-term exams, laboratories' participation, assignments, presentations, and other academic activities. The weight of the aforementioned additional assessment measures in the final grade is determined per course by the teaching staff.

5.9 Examinations

The examination periods are three (3) per academic year and have a duration of three (3) weeks each. The January examination period takes place after the end of the winter semester, including the exams of the courses attended during that semester. Accordingly, the June examination period takes place after the completion of the spring semester. The third examination period is that of September, during which the students can be re-examined in all courses selected during the previous academic year, but not passed with a sufficient grade (i.e., at least 5).

During the exams, the students are examined written or orally. The exams are conducted under the responsibility of the teaching staff and their duration cannot exceed three hours per course. At the beginning of the exam, the identity details of the examinees are cross-checked.

Any student who is found to be copying from books or notes or from another student's sheet, discussing with another student or obstructing the smooth organization of the exams will be immediately and irrevocably disqualified from that course. The incident is referred to the relevant Faculty committee in order to determine the related administrative penalty.

5.10 Diploma thesis

The diploma thesis is planned to be conducted during the 10th semester, however, it can be also prepared earlier. It corresponds to 30 ECTS and is performed under the supervision of a faculty member. To undertake the thesis, the student must have completed at least 180 ECTS and at least six (6) semesters of study. The assignments of the diploma theses are made at the beginning of each academic semester.

The standard duration of the diploma thesis is one academic semester. This duration, in no case, can be less than one semester, but it can be extended, depending on the extent and requirements of the topic and the supervisor's decision. Once the thesis has been completed and the supervisor has approved its completeness, the student and the supervisor submit to the Secretariat of the Department the examination application, accompanied by the pdf file and three printed copies of the thesis.

The number of examination dates is at least four (4) per academic year. The theses are publicly supported by the students and any faculty member of the Department has the right to ask questions.

5.11 Internship

The Department of Industrial Engineering and Management provides the students with the possibility to carry out internships in private companies and public sector entities, lasting three (3) months, as an elective course of the 9th semester. The internship is carried out within the framework of the National Strategic Reference Framework program, two (2) times per year (winter-spring semester), and is remunerated.

The students of the former Departments of Automation Engineering and Vehicles Engineering are obliged to carry out an internship of six (6) months.

Responsible Faculty Members:

• Fotios Stergiopoulos (fstergio@ihu.gr) [former Department of Automation Engineering and Department of Industrial Engineering and Management]

• Apostolos Korlos (apkorlos@ihu.gr) [former Department of Vehicle Engineering].

5.12 Degree grade - Declaration of graduation

The degree grade is based on the average of the grades of the courses and the thesis, weighted according to their ECTS. Specifically, the sum of the products "grade × ECTS" is calculated and the result is divided by the total number of ECTS. Given that B_i and $ECTS_i$ are the grade and ECTS of each course i, respectively, N the number of courses that have been successfully examined, and D the grade of the thesis, then the final degree grade is:

$$Degree\ Grade = \frac{\sum_{i=1}^{N} B_i \cdot ECTS_i + D \cdot 30}{Total\ ECTS}$$

It should be noted that if a student has passed additional courses, namely more than those required for receiving the diploma, these additional courses are counted in the final grade.

5.13 Graduate certificate - Transcript of records - Diploma supplement

Students, after completing the study program (compulsory courses, elective courses and thesis, corresponding to at least 300 ECTS), can apply for graduation at the secretariat and receive a copy of the degree, the final transcript of records and the graduation papyrus.

A Diploma Supplement is also issued upon request by the secretariat, either in Greek or in English. It includes the detailed score, the final grade and the ECTS credits, as well as the details of the Department and the student.

6. STAFF OF THE DEPARTMENT

6.1 The Staff of the Department

The staff of the Department of Industrial Engineering and Management of I.H.U. is divided into Academic Staff (D.E.P.), Laboratory Teaching Staff (E.DI.P.), Special Technical Laboratory Staff (E.TE.P.), and Administrative Staff (A.S.) with corresponding responsibilities.

The Department comprises 22 academic, one E.DI.P. and one E.TE.P. members of staff.

The Teaching and Research Staff (Faculty Members) belong to three (3) academic ranks, namely: Professors, Associate Professors, and Assistant Professors, while lecturing is also supported by the Laboratory Teaching Staff and Special Technical Laboratory Staff. At the same time, the educational process of the Department is further supported by temporary educational staff, which includes Scientific Associates, Laboratory Associates, and Academic Scholars.

TABLE OF THE FACULTY MEMBERS			
A/A	**FULL NAME**	**TITLE**	**SUBJECT AREA/ SPECIALIZATION**
1.	KIZIROGLOU MICHAIL	Professor	MICROELECTRONICS AND MICROSYSTEMS TECHNOLOGY
2.	KORLOS APOSTOLOS	Professor	MECHANICAL DRAWING, MATERIAL REMOVAL PROCESSES, CNC MACHINE TOOLS, CAD/CAM APPLICATIONS
3.	KOSMANIS THEODOROS	Professor	VEHICLE ELECTRICAL PROPULSION AND VEHICLE ELECTRONIC SYSTEMS
4.	PAPADOPOULOU SIMIRA	Professor	CONTROL OF MANUFACTURING PROCESSES WITH EMPHASIS ON CHEMICAL PROCESSES
5.	STERGIOPOULOS FOTIOS	Professor	POWER ELECTRONIC SYSTEMS
6.	TRIANTAFYLLIDIS DIMITRIOS	Professor	INDUSTRIAL ELECTRICAL POWER SYSTEMS AND INDUSTRIAL ELECTRICAL INSTALLATIONS AND DEVICES
7.	TSAGKARIS APOSTOLOS	Professor	HUMAN INTERACTION WITH MECHATRONIC SYSTEMS AND THEIR OPTIMIZATION
8.	TZIONAS PANAGIOTIS	Professor	COMPUTER ENGINEERING, DIGITAL SIGNAL PROCESSING, CONTROL THEORY APPLICATIONS
9.	XANTHOS STELIOS	Professor	MEASUREMENT TECHNOLOGY – INSTRUMENTATION
10.	AIVAZIDOU EIRINI	Associate Professor	ECONOMICS AND MANAGEMENT FOR ENGINEERS
11.	BAZIOS IOANNIS	Associate Professor	VEHICLES – VEHICLE GEARBOXES
12.	BIALAS CHRISTOS	Associate Professor	SUPPLY CHAIN MANAGEMENT WITH ERP SYSTEMS AND IMPACT ON FINANCIAL PERFORMANCE
13.	TZIOURTZIOUMIS DIMITRIOS	Associate Professor	INTERNAL COMBUSTION ENGINES
14.	TSONGAS KONSTANTINOS	Associate Professor	ADVANCED MATERIALS AND THEIR APPLICATION IN MECHANICAL CONSTRUCTION

TABLE OF THE FACULTY MEMBERS			
A/A	**FULL NAME**	**TITLE**	**SUBJECT AREA/ SPECIALIZATION**
15.	YFOULIS CHRISTOS	Associate Professor	NON-LINEAR AND OPTIMAL AUTOMATIC CONTROL
16.	AISOPOULOS PAVLOS	Assistant Professor	SOLID MECHANICS WITH EMPHASIS ON VEHICLE APPLICATIONS
17.	LYTRA ALKMINI	Assistant Professor	FLUID MECHANICS
18.	MANSOUR MICHEL TEODOR	Assistant Professor	ROBOTICS, CAD/CAM SYSTEMS, NUMERICALLY CONTROLLED MACHINE TOOLS
19.	PAPADOPOULOU FOTEINI	Assistant Professor	DIGITAL SIGNAL PROCESSING
20.	TAMPOURATZIS NIKOLAOS	Assistant Professor	DIGITAL EMBEDDED SYSTEMS
21.	TSAPLES GEORGIOS	Assistant Professor	OPERATIONAL RESEARCH
22.	ZAGKLIS DIMITRIOS	Assistant Professor	INDUSTRIAL ENVIRONMENTAL ENGINEERING

TABLE OF THE E.DI.P. AND E.TE.P. MEMBERS			
A/A	**FULL NAME**	**CATEGORY**	**SUBJECT AREA/ SPECIALIZATION**
1.	ANDRAS CHRISTOS	Laboratory Teaching Staff	SOCIAL INFORMATION SYSTEMS
2.	KARAFYLLIAS DIMITRIOS	Special Technical Laboratory Staff	DYNAMICS, VEHICLE DYNAMICS, AERODYNAMICS, FLUID MECHANICS

TABLE OF THE ADMINISTRATIVE STAFF		
A/A	**FULL NAME**	**TYPE**
1.	LAZARIDOU CHRISTINA	Head of the Secretariat
2.	RAMPOTAS STERGIOS	Secretary
3.	ZOPOGLOU AIKATERINI	Secretary

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ZIP Code: 57400, Sindos-Thessaloniki

Tel.: (+30) 2310 013939 / 2310 013940
E-mail: info@iem.ihu.gr
URL: http://www.iem.ihu.gr/en/

6.2 Administration/Secretariat Office: Duties and working hours

The Department Secretariat is responsible for student and administrative matters.

Student services are provided on all working days, and during the hours of 11:00 to 13:00, at the offices of the Department's Secretariat, located in the Central Building of the Campus of Sindos.

Student issues include:

- registration procedures
- keeping the students' records, which include their grades, registration renewals every semester, and information about scholarships,
- granting certificates and degrees,
- granting certificates for legal use,
- issuing paper forms required for the students' internship,
- creating/filling in student lists, according to their course enrolment declaration,
- registration cancellations of students who have two consecutive non-renewal of registration or three non-consecutive non-renewal of registration.

Regarding first-year student registrations, transfers and registration of those passing the qualifying exams in the Department of Industrial Engineering and Management of the I.H.U., the following apply:

Registration Renewals - Course Declarations are carried out through the Electronic Secretariat at the beginning of each Semester, and for a period of approximately fifteen (15) days. Each student has their own personal code, obtained from the Department's Secretariat, with which they declare courses electronically.

After the lists of successful candidates in the National Examinations are sent by the Ministry of Education and Religious Affairs, the registration deadline for new entrants is set, which is common for all higher education institutions in Greece. This deadline should not be missed, otherwise latecomers lose the right to register. Registration of new entrants takes place in September.

From November 1 to 15, relevant application forms are submitted for:

- Transfers for financial, social, health reasons, etc., as well as for the children of large families, unless otherwise specified by law.
- Enrolment of Higher Education Graduates, who succeeded in qualifying exams, held every year, at the beginning of December.

6.3 The Department's Committees

Academic Advisors
Fotios Stergiopoulos
Eirini Aivazidou

Internal Mobility Committee
Dimitrios Triantafyllidis
Apostolos Korlos
Eirini Aivazidou

Diploma Thesis Coordination Committee
Dimitrios Triantafyllidis
Dimitrios Tziourtzioumis
Ioannis Bazios

Internship Committee
Fotios Stergiopoulos
Apostolos Korlos
Nikolaos Tampouratzis

Coordinator of Employment Opportunities
Fotios Stergiopoulos

Erasmus+ Program Coordinator
Michail Kiziroglou

Internal Evaluation Committee
Theodoros Kosmanis
Stelios Xanthos
Konstantinos Tsongas
Dimitrios Triantafyllidis

Coordinator for Organization and Planning of the Educational Programme
Christos Andras

Website Administrator
Christos Andras

Coordinator of Communication with Social, Cultural, and Industrial Organizations
Christos Andras

6.4 The role of the Academic Advisor (Tutor)

The institution of the Academic Advisor (Tutor) has been implemented by the Department of Industrial Engineering and Management for a long time. Each year, by decision of the Department, a member of the Teaching and Research Staff (Faculty Member) is designated as an academic advisor for every first-year student to offer information and guidance in study matters. The academic advisor informs the students about their role and invites them to an introductory meeting. Students are encouraged to communicate regularly with their Academic Advisor, discuss educational issues and utilize the tutor's knowledge and experience throughout all the years of their studies.

6.5 Evaluation of the educational activities

The quality of the courses offered by the Department of Industrial Engineering and Management is assessed electronically by the students. Undergraduate and postgraduate students can evaluate each course that they attend per semester at the link: https://modip.ihu.edu.gr of the Quality Assurance Unit (MO.DI.P) of I.H.U. The evaluation process is strictly anonymous (using anonymous codes). This means that no one can have access to the evaluations of each student. Only aggregated data per course, department, and faculty is extracted from the system. Students can also evaluate the administrative services of the University. Each student can rate a course or service only once.

7. FACILITIES OF THE DEPARTMENT

7.1 Laboratory spaces and equipment

In the Department of Industrial Engineering and Management of I.H.U. the following educational laboratories exist:

Title	Building	Room
Laboratory of Aerodynamics	52: Archimedes	6
Laboratory of CAD/CAM/CAE	48: Ctesibius	3009A
Laboratory of Technical Design	48: Ctesibius	3020
Laboratory of Databases and Information Systems	48: Ctesibius	3020
Laboratory of Computer Networks	45: Heron	108
Laboratory of SCADA	48: Ctesibius	3010B
Laboratory of Intelligent Control	45: Heron	219
Laboratory of Electric Machines and Motion	48: Ctesibius	3008B
Laboratory of Electronic Systems	48: Ctesibius	3011
Laboratory of Fluid Mechanics	52: Archimedes	7
Laboratory of Power Electronics	45: Heron	111
Laboratory of Electrical Circuits	48: Ctesibius	3017
Laboratory of Metrology	45: Heron	220
Laboratory of Mechatronics and PLC	48: Ctesibius	3019
Laboratory of Microcomputers and Microcontrollers	45: Heron	219
Laboratory of CNC Machine Tools	48: Ctesibius	3009B
Laboratory of Computer Programming	45: Heron	108
Laboratory of Robotics and Virtual Reality	48: Ctesibius	3009A
Laboratory of Automatic Control Systems	48: Ctesibius	3010
Laboratory of Energy Systems	48: Ctesibius – 45: Heron – 46: Dedalos	6 Rooms
Laboratory of Telecommunications and Digital Signal Processing	45: Heron	120
Laboratory of Hydraulic and Pneumatic Systems	48: Ctesibius	3008A
Laboratory of Physics	41: Central	-

Some of the Department's laboratories, as well as their equipment, are presented below.

Laboratory of Electronic Systems



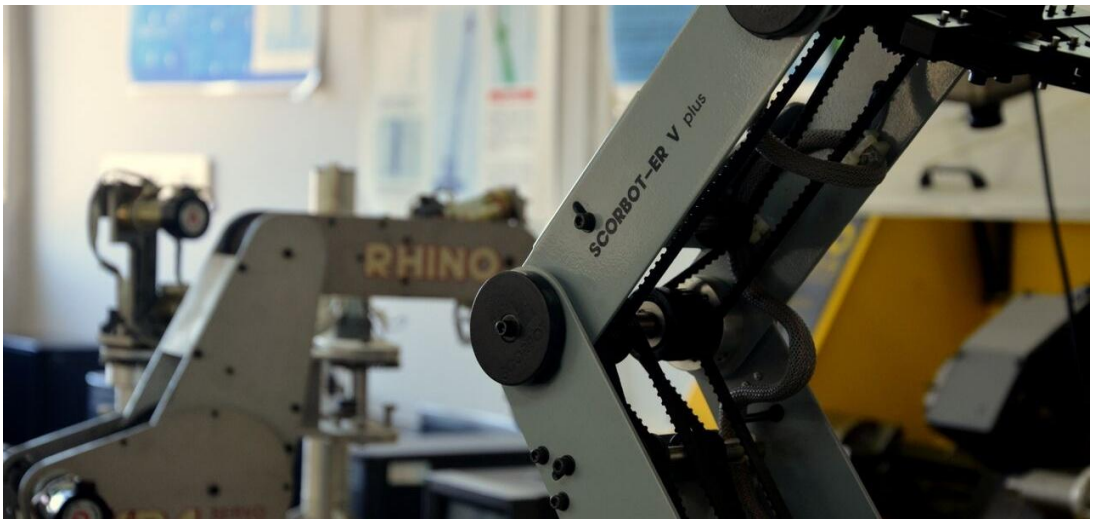
Laboratory of Metrology



Laboratory of Computer Programming



Laboratory of Robotics and Virtual Reality



Laboratory of Automatic Control Systems



Laboratory of Energy Systems



Laboratory of Telecommunications and Digital Signal Processing



Laboratory of Hydraulic and Pneumatic Systems



7.2 Teaching classrooms

The main classrooms of the Department of Industrial Engineering and Management are located:

- in the Heron Building: 108, 121, Informatics Auditorium
- in the Dedalos Building: 42, 43, 47
- in the Central Campus Building: 309, 311, 314.

7.3 E-learning

The students of the Department of Industrial Engineering and Management have the possibility to access all information, digital material, and announcements regarding the courses, as well as to communicate with the teaching staff, through the asynchronous distance learning platform: https://exams-sm.the.ihu.gr. For each semester course, a separate webpage is available on the platform.

7.4 Institutional research laboratories

The Department of Industrial Engineering and Management has the following institutional research laboratories:

- **Energy Systems Laboratory.** Established by Government Gazette 3802/17-08-2021. The objectives and activities of the Laboratory are summarized in supporting the conduct of research to meet the teaching needs in the areas of Electromobility and Vehicle Electronic Systems, Heat Engines, Electric Machines, Electrical Installations and Industrial Automation, Power Electronics, and Renewable Energy Sources. The Laboratory's premises house, among others, electric vehicles developed entirely by its members and student groups. The Laboratory includes six (6) rooms of a total area of 700 sq.m., which are located in three buildings of the Faculty of Engineering of I.H.U. in the Alexandrian Campus (Buildings: Vehicle Engineering, Automation - Informatics, Central).
- **Laboratory of Intelligent Industrial Transformation and Information Systems (i-INFOS).** Established by Government Gazette 6742/31-12-2021. The main research directions and academic areas of the Laboratory cover the fields of Digital Transformation, mainly in industries, Digital Supply Chains, Sustainable Business Operations, and Information Systems.

- **Laboratory of Advanced Materials and Manufacturing Technologies.** Established by Government Gazette 2666/2-5-2024. The primary research directions and academic focus areas of the Laboratory cover the fields of Advanced Materials and Manufacturing Technologies, with an emphasis on shaping mechanical products and optimizing them through modern technological methods. Specifically, it addresses issues related to production system automation, quality control, characteristics and mechanical properties of mechanical products, as well as production processes.

- **Laboratory of Robotics and Automation.** Established by Government Gazette 2790/16-5-2024. The main research directions and academic focus areas of the Laboratory cover the fields of robotics, automation, mechatronic systems and CAD/CAM/CAE, artificial intelligence, machine vision, environmental technology, sensor-measurement systems and quality control, educational robotics and educational technologies, human-machine communication, telemetry systems, data collection, processing, and visualization using classical and intelligent techniques.

- **Laboratory of Embedded Microsystems Synthesis (Synthesys).** Established by Government Gazette 3811/2-7-2024. The key research directions and academic focus areas of the Laboratory cover the fields of electronics, digital systems, embedded systems, mechanical systems synthesis, microelectronics, high-performance reconfigurable systems, application acceleration using specialized architectures, microsystems, and nanotechnology.

8. PRESENTATION OF THE UNDERGRADUATE STUDY PROGRAM

In this section, the Undergraduate Study Program of the Department of Industrial Engineering and Management (courses, teaching hours, workload, credits) per semester of study is briefly presented. The detailed course outlines are presented in the Appendix (Section 13).

8.1 Overview of the Undergraduate Study Program

Semester									ECTS	Sem.	ECTS
1st	2nd	3rd	4th	5th	6th	7th	8th	9th		10th	
Linear Algebra and Complex Numbers Theory	Material Science	Numerical Analysis	Machine Elements I	Metal Forming Processes	Heat Transfer	Information Systems	Modeling and Simulation	Robotics	4-6	DIPLOMA THESIS	30
Physics	Programming for Engineers	Electronic Systems	Transform Theory and Systems	Control Systems I	Methods of Engineering Design Synthesis and CAD/CAM/CAE	Principles of Economy Theory: Micro/macro Economics	Wireless Systems and Networks	Project Management	4-6		
Statics	Electrical Circuits	Strength of Materials	Metrology – Quality Control	Electric Motors and Drives I	Programmable Controllers and Supervisory Systems	Thermal Engines	Microcomputers in Production	Environmental Engineering	4-6		
Technical Drawing	Dynamics	Probability Theory and Statistics	Fluid Mechanics	Databases and Data Structures	Operational Research	Vehicle Technology	Electrical Installations	Human-Mechatronic Systems Interaction	4-6		
Introduction to Computer Science	Applied Thermodynamics	Manufacturing Technology	Production Systems	Elective course	Elective course	Supply Chain Management	CNC Machine Tools	Elective course	4-6		
Calculus	Elective course	Elective course	Elective course	Elective course	Elective course	Elective course	Elective course	Elective course	4-6		
English Terminology (Optional)						Elective course	Elective course	Elective course	4-6		

Mandatory Courses	Elective Courses	Total Courses
43	14	57

General background
Special background

Undergraduate Study Program per semester

1st Semester (6 mandatory and 1 optional courses)

	CODE	COURSE	COURSE TYPE	Theory	Practice works	Laboratory works	Hours per week	Course total	ECTS
1.	11	Linear Algebra and Complex Number Theory	GB (MC)	3	1		4	125	5
2.	12	Physics	GB (MC)	2	2		4	125	5
3.	13	Statics	GB (MC)	2	1		3	100	4
4.	14	Technical Drawing	GB (MC)	2		2	4	125	5
5.	15	Introduction to Computer Science	GB (MC)	3		2	5	125	5
6.	16	Calculus	GB (MC)	4	1		5	150	6
7.	17	English Terminology	GB (OC)	3			3	0	0

NOTES
GB: *General Background*
SB: *Special Background*

MC: Mandatory Courses
EC: Elective Courses
OC: Optional Courses

2nd Semester (5 mandatory and 1 out of 4 elective courses)

	CODE	COURSE	COURSE TYPE	Theory	Practice works	Laboratory works	Hours per week	Course total	ECTS
1.	21	Material Science	GB (MC)	3	1		4	125	5
2.	22	Programming for Engineers	GB (MC)	2		2	4	125	5
3.	23	Electrical Circuits	GB (MC)	5			5	150	6
4.	24	Dynamics	GB (MC)	3	1		4	125	5
5.	25	Applied Thermodynamics	GB (MC)	3	1		4	125	5
6.	26.1	Philosophy of Technology	GB (EC)	3			3	100	4
7.	26.2	Electrotechnical Materials	GB (EC)	2	1		3	100	4
8.	26.3	History of Civilization and Technology	GB (EC)	3			3	100	4
9.	26.4	Multivariable Functions	GB (EC)	2	1		3	100	4

3rd Semester (5 mandatory and 1 out of 3 elective courses)

	CODE	COURSE	COURSE TYPE	Theory	Practice works	Laboratory works	Hours per week	Course total	ECTS
1.	31	Numerical Analysis	GB (MC)	3		2	5	150	6
2.	32	Electronic Systems	GB (MC)	3	2		5	150	6
3.	33	Strength of Materials	GB (MC)	3	1		4	125	5
4.	34	Probability Theory and Statistics	GB (MC)	3	2		5	125	5
5.	35	Manufacturing Technology	GB (MC)	2		1	3	100	4
6.	36.1	Industrial Safety and Health	SB (EC)	3			3	100	4
7.	36.2	Information Society and the 4th Industrial Revolution	GB (EC)	3			3	100	4
8.	36.3	Special Topics on Physics	GB (EC)	2	1		3	100	4

4th Semester (5 mandatory and 1 out of 5 elective courses)

	CODE	COURSE	COURSE TYPE	Theory	Practice works	Laboratory works	Hours per week	Course total	ECTS
1.	41	Machine Elements I	GB (MC)	4	1		5	150	6
2.	42	Transform Theory and Systems	GB (MC)	3			3	100	4
3.	43	Metrology – Quality Control	SB (MC)	3		1	4	125	5
4.	44	Fluid Mechanics	SB (MC)	3		2	5	150	6
5.	45	Production Systems	SB (MC)	3	1		4	125	5
6.	46.1	Micro-Electro-Mechanical Systems	SB (EC)	2	1		3	100	4
7.	46.2	Object Oriented Programming	SB (EC)	2		1	3	100	4
8.	46.3	Advanced Digital Systems	SB (EC)	2	1		3	100	4
9.	46.4	Reliability Management in the Internet of Things	SB (EC)	3			3	100	4
10.	46.5	Reliability and Maintenance	SB (EC)	2	1		3	100	4

5th Semester (4 mandatory and 2 out of 10 elective courses)

	CODE	COURSE	COURSE TYPE	Theory	Practice works	Laboratory works	Hours per week	Course total	ECTS
1.	51	Metal Forming Processes	SB (MC)	3	1		4	125	5
2.	52	Control Systems I	SB (MC)	3	1		4	125	5
3.	53	Electric Motors and Drives I	SB (MC)	6			6	175	7
4.	54	Databases and Data Structures	SB (MC)	2	1	1	4	125	5
5.	55.1	Non-destructive Testing	SB (EC)	3			3	100	4

	CODE	COURSE	COURSE TYPE	Theory	Practice works	Laboratory works	Hours per week	Course total	ECTS
6.	55.2	Embedded Systems	SB (EC)	2	1		3	100	4
7.	55.3	Decision Support Systems	SB (EC)	2	1		3	100	4
8.	55.4	Generalized Systems Theory	SB (EC)	3			3	100	4
9.	55.5	Aerodynamics	SB (EC)	2		1	3	100	4
10.	55.6	Machine Elements II	SB (EC)	2	1		3	100	4
11.	55.7	Hydraulic and Pneumatic Systems	SB (EC)	2	1		3	100	4
12.	55.8	Engineering Software	SB (EC)	2	1		3	100	4
13.	55.9	Computational Fluid Mechanics	SB (EC)	2	1		3	100	4
14.	55.10	Ship Security Systems Management	SB (EC)	2			2	100	4

6th Semester (4 mandatory and 2 out of 9 elective courses)

	CODE	COURSE	COURSE TYPE	Theory	Practice works	Laboratory works	Hours per week	Course total	ECTS
1.	61	Heat Transfer	GB (MC)	3	1		4	125	5
2.	62	Methods of Engineering Design Synthesis and CAD/CAM/CAE	SB (MC)	2	1	2	5	150	6
3.	63	Programmable Controllers and Supervisory Systems	SB (MC)	2	1	2	5	150	6
4.	64	Operational Research	SB (MC)	3	1		4	125	5
5.	65.1	Control Systems II	SB (EC)	2	1		3	100	4
6.	65.2	Industrial Information Systems	SB (EC)	2	1		3	100	4
7.	65.3	Electric Machines and Electric Motor Drives II	SB (EC)	3			3	100	4
8.	65.4	Tribology	SB (EC)	2	1		3	100	4
9.	65.5	Automotive Electrics	SB (EC)	2		1	3	100	4
10.	65.6	Industrial Data Networks	SB (EC)	2		1	3	100	4
11.	65.7	Welding Technology	SB (EC)	2		1	3	100	4
12.	65.8	Signals, Information and Communication	SB (EC)	3			3	100	4
13.	65.9	Artificial Neural Networks and Applications	SB (EC)	2	1		3	100	4

7th Semester (5 mandatory and 2 out of 7 elective courses)

	CODE	COURSE	COURSE TYPE	Theory	Practice works	Laboratory works	Hours per week	Course total	ECTS
1.	71	Information Systems	SB (MC)	2	1		3	100	4

	CODE	COURSE	COURSE TYPE	Theory	Practice works	Laboratory works	Hours per week	Course total	ECTS
2.	72	Principles of Economy Theory: Micro/macro Economics	SB (MC)	4			4	125	5
3.	73	Thermal Engines	SB (MC)	3	1		4	125	5
4.	74	Vehicle Technology	SB (MC)	3			3	100	4
5.	75	Supply Chain Management	SB (MC)	2	1		3	100	4
6.	76.1	Nanotechnology	SB (EC)	2	1		3	100	4
7.	76.2	Physical and Chemical Processes	SB (EC)	3			3	100	4
8.	76.3	Power Energy Systems and Energy Savings	SB (EC)	3			3	100	4
9.	76.4	Optimization Methods	SB (EC)	3			3	100	4
10.	76.5	Advanced Control of Electrical Motors	SB (EC)	2	1		3	100	4
11.	76.6	Automotive Electronics	SB (EC)	2		1	3	100	4
12.	76.7	Control Systems III	SB (EC)	2	1		3	100	4

8th Semester (5 mandatory and 2 out of 13 elective courses)

	CODE	COURSE	COURSE TYPE	Theory	Practice works	Laboratory works	Hours per week	Course total	ECTS
1.	81	Modeling and Simulation	SB (MC)	3	1		4	100	4
2.	82	Wireless Systems and Networks	SB (MC)	3		1	4	100	4
3.	83	Microcomputers in Production	SB (MC)	2		1	3	100	4
4.	84	Electrical Installations	SB (MC)	4			4	125	5
5.	85	CNC Machine Tools	SB (MC)	2	2		4	125	5
6.	86.1	Logistics and Transport	SB (EC)	3			3	100	4
7.	86.2	Process Control	SB (EC)	3			3	100	4
8.	86.3	Finite Elements Method	SB (EC)	2	1		3	100	4
9.	86.4	Off-road Vehicles	SB (EC)	3			3	100	4
10.	86.5	Mechatronics	SB (EC)	2	1		3	100	4
11.	86.6	Renewable Energy Sources	SB (EC)	3			3	100	4
12.	86.7	Vehicle Dynamics	SB (EC)	2	1		3	100	4
13.	86.8	Motion Transmission Systems	SB (EC)	2	1		3	100	4
14.	86.9	Digital Control Systems	SB (EC)	2	1		3	100	4
15.	86.10	Entrepreneurship	SB (EC)	3			3	100	4
16.	86.11	Knowledge Management Systems	SB (EC)	3			3	100	4

	CODE	COURSE	COURSE TYPE	Theory	Practice works	Laboratory works	Hours per week	Course total	ECTS
17.	86.12	Auto-guided Vehicles	SB (EC)	2	1		3	100	4
18.	86.13	Enterprise Resource Planning (ERP)	SB (EC)	1		2	3	100	4

9th Semester (4 mandatory and 3 out of 10 elective courses)

	CODE	COURSE	COURSE TYPE	Theory	Practice works	Laboratory works	Hours per week	Course total	ECTS
1.	91	Robotics	SB (MC)	2	1	1	4	125	5
2.	92	Project Management	SB (MC)	3	1		4	125	5
3.	93	Environmental Engineering	SB (MC)	3			3	100	4
4.	94	Human-Mechatronic Systems Interaction	SB (MC)	3			3	100	4
5.	95.1	Construction Vehicles	SB (EC)	3			3	100	4
6.	95.2	Computer-integrated Manufacturing	SB (EC)	2	1		3	100	4
7.	95.3	Selected Topics on Electrical Motors	SB (EC)	2	1		3	100	4
8.	95.4	Internship	SB (EC)	-	-	-	-	-	4
9.	95.5	Intelligent Systems	SB (EC)	2		1	3	100	4
10.	95.6	Electromobility	SB (EC)	3			3	100	4
11.	95.7	Stochastic Processes	SB (EC)	3			3	100	4
12.	95.8	Microcontrollers	SB (EC)	2	1		3	100	4
13.	95.9	Classical Industrial Automation	SB (EC)	1	2		3	100	4
14.	95.10	Gas Exchange Processes in Heat Engines	SB (EC)	2	1		3	100	4

10th Semester

	CODE	COURSE	COURSE TYPE	Theory	Practice works	Laboratory works	Hours per week	Course total	ECTS
1.	101	Diploma Thesis	SB (MC)	-	-	-	-	700	30

9. POSTGRADUATE STUDY PROGRAMS IN THE DEPARTMENT

Two (2) postgraduate study programs are currently offered in the Department of Industrial Engineering and Management, School of Engineering, of I.H.U.

9.1 Postgraduate study program in Applied Automation Engineering Systems

The Master's Program in "Applied Automation Engineering Systems" (https://automation.dipae.edu.gr) is organized (in Greek language) by the Department of Industrial Engineering and Management of I.H.U. (Government Gazette of establishment 5036/13-11-2020) and is governed by the provisions of the Law 4485/2017, as amended and in force by the provisions of the Law 4610/2019.

9.1.1 Goals and objectives of the postgraduate study program

The Master's Program aims to provide postgraduate level education in applied and advanced automation systems so that graduates acquire a strong scientific background, experience, and know-how for the development of intelligent automation systems. More specifically, the program's **objectives** are:

a) the high-level training of scientists who will be able to staff successfully key areas related to automatic control and industrial production so that they can contribute substantially to the production of integrated solutions,

b) the development and promotion of research in all areas related to applied automatic control systems.

The ultimate goal of the program is the creation of highly trained scientists through the provision of specialized knowledge in applied automation systems, which can be used in the assessment and application of intelligent technologies and the production and development of new technological systems.

The graduates of Master's Program will acquire the required skills for a successful career as high-ranking executives both in the private sector (companies providing services in automatic control systems, design and production departments, management departments of large enterprises) and in the public sector (public organizations, educational institutions, research centers).

9.1.2 The postgraduate degree awarded

The program awards a **Master of Science in "Applied Automation Engineering Systems"**, provided that the graduate student has successfully passed the examinations in the courses prescribed by the relevant program in combination with their participation in all educational and research activities, as defined in the program and in the postgraduate studies regulations of the department, as well as in the postgraduate studies regulations of the I.H.U.

Postgraduate students are given the opportunity after obtaining the M.Sc. to continue their studies in the Department of Industrial Engineering and Management to obtain a Ph.D. degree.

9.1.3 Eligibility criteria of admission

In the Master's program, after consideration of their formal and substantive qualifications, graduates of University Departments are admitted, as provided by the current Greek legislation.

Final-year students can also apply, provided that they will have received their degree or will have finished their studies before the start of the courses.

9.1.4 Duration of studies

The duration of studies is three (3) academic semesters. The first two (2) semesters include studying with flexible forms of learning, while the third semester aims at the preparation of the master's thesis and can be carried out with remote supervision.

The duration of studies must be at least twelve (12) calendar months from the date of registration in the program and the period of time for preparing the master's thesis cannot be shorter than a calendar quarter from the date of receiving the subject of the thesis. The studies of the full-time program correspond to 90 credits (ECTS units).

In the academic calendar, there are three (3) exam periods per year: at the end of each semester (winter, spring), as well as repeat exams in September/October.

9.1.5 Course schedule per semester

The 1st semester includes two (2) compulsory courses and two (2) elective courses, each offering 7.5 credits (ECTS):

- M101 Principles of automatic control
- M102 Data collection and processing
- E1x1 Option 1
- E1x2 Option 2.

1st Semester Elective Courses:

- E101 Precision agriculture and livestock
- E102 Electrification
- E103 Robotics
- E104 Reverse Engineering
- E105 Maintenance Technologies
- E106 Industrial Production Devices and Machines
- E107 Smart Technologies in Supply Chain Management.

The 2nd semester includes two (2) compulsory courses and two (2) elective courses, each offering 7.5 credits (ECTS):

- M201 Mechatronic Systems
- M202 Energy Management
- E2x1 Option 1
- E2x2 Option 2.

2nd Semester Elective Courses:

- E201 Automation Systems in the Food Industry
- E202 Environmental Technologies
- E203 Applied Mechanical Processing Systems
- E204 Process Control
- E205 Production Systems
- E206 Applied Informatics and Big Data Management
- E207 Biomedical Technology.

The 3rd semester includes the preparation of the diploma thesis (30 ECTS).

9.1.6 Number of admissions

The number of admissions is limited to thirty (30) students.

9.1.7 The staff

For the implementation of the master's program, teaching staff of a particularly high level of education are employed, with long teaching, research, and scientific experience in related subjects. Specifically, the teachers are faculty members, laboratory teaching staff and PhD holders of I.H.U., as well as professors and distinguished scientists from other universities in Greece and abroad.

9.2 Postgraduate study program in Robotics, STEAM and New Technologies in Education

The Master's Program in "Robotics, STEAM and New Technologies in Education" (https://steam.dipae.edu.gr) is organized (in Greek language) by the Department of Industrial Engineering and Management of I.H.U. (Government Gazette of establishment 3834/17-08-2021) and is governed by the provisions of the Law 4485/2017, as amended and in force by the provisions of the Law 4610/2019.

9.2.1 Goals and objectives of the postgraduate study program

The Master's Program aims to provide postgraduate level education in robotics, STEAM and new technologies in education so that graduates acquire a strong scientific background, experience, and know-how for the implementation of all these technologies in educational activities. More specifically, the program's **objectives** are:

a) the high-level training of scientists who will be able to staff successfully key areas related to educational robotics and STEAM,

b) the development and promotion of research in all areas related to educational robotics and STEAM.

The ultimate goal of the program is the creation of highly trained scientists through the provision of specialized knowledge in robotics, STEAM, and new technologies, which can be used for educational purposes, as well as for developing new methodologies and teaching techniques.

The graduates of Master's Program will acquire the required skills for a successful career as high-ranking executives both in the private sector (companies providing services in automatic control systems, design and production departments, management departments of large enterprises) and in the public sector (public organizations, educational institutions, research centers).

9.2.2 The postgraduate degree awarded

The program awards a **Master of Science in "Robotics, STEAM and New Technologies in Education"**, provided that the graduate student has successfully passed the examinations in the courses prescribed by the relevant program in combination with their participation in all educational and research activities, as defined in the program and in the postgraduate studies regulations of the department, as well as in the postgraduate studies regulations of the I.H.U.

Postgraduate students are given the opportunity after obtaining the M.Sc. to continue their studies in the Department of Industrial Engineering and Management to obtain a Ph.D. degree.

9.2.3 Eligibility criteria of admission

In the Master's program, after consideration of their formal and substantive qualifications, graduates of University Departments are admitted, as provided by the current Greek legislation. Final-year students can also apply, provided that they will have received their degree or will have finished their studies before the start of the courses.

9.2.4 Duration of studies

The duration of studies is three (3) academic semesters. The first two (2) semesters include studying with flexible forms of learning, while the third semester aims at the preparation of the master's thesis, or the attendance of two (2) additional courses.

The duration of studies must be at least twelve (12) calendar months from the date of registration in the program and the period of time for preparing the master's thesis cannot be shorter than a calendar quarter from the date of receiving the subject of the thesis. The studies of the full-time program correspond to 90 credits (ECTS units).

In the academic calendar, there are three (3) exam periods per year: at the end of each semester (winter, spring), as well as repeat exams in September/October.

9.2.5 Course schedule per semester

The 1st semester includes five (5) compulsory courses, each offering 6 credits (ECTS):

- M101 Educational Robotics
- M102 STEAM and Microcontrollers
- M103 Educational Data Mining and Artificial Intelligence in Educational Technologies
- M104 Educational Research Methodology
- M105 Teaching of Robotics, STEAM, and New Technologies.

The 2nd semester includes five (5) compulsory courses, each offering 6 credits (ECTS):

- M201 Programming of Robotic Systems

- M202 3D Printing and 3D Scanning
- M203 Quality and Evaluation in Education
- M204 Innovation in Education
- M205 Philosophy, Art and Culture for the Completion of STEM.

The 3rd semester includes the preparation of the diploma thesis (30 ECTS) or the attendance of two (2) additional courses (15 ECTS each):

- M302 4th Industrial Revolution and Internet of Things (IoT)
- M303 Novel Learning Environments.

9.2.6 Number of admissions

The number of admissions is limited to one hundred and twenty (120) students.

9.2.7 The staff

For the implementation of the master's program, teaching staff of a particularly high level of education are employed, with long teaching, research, and scientific experience in related subjects. Specifically, the teachers are faculty members, laboratory teaching staff and PhD holders of I.H.U., as well as professors and distinguished scientists from other universities in Greece and abroad.

10. DOCTORAL STUDIES IN THE DEPARTMENT

The Doctoral Studies in the Department of Industrial Engineering and Management of I.H.U. aim to promote scientific knowledge in the areas covered by the Department, through conducting original scientific research, leading to the acquisition of a Doctoral Degree.

Eligibility criteria

Those who meet the following criteria have the right to submit an application for Doctoral Studies in the Department of Industrial Engineering and Management:

- They are graduates and holders of a master's degree of a University department of Greece or recognized as an equal foreign institution, or
- They are graduates or holders of a single and undivided master's degree according to article 46 of the Greek Law 4485/2017.
- In the following exceptional cases, Ph.D. Candidates who do not hold a master's degree are accepted only if:

a) They have a degree after a total of five (5) years of study at a University department of Greece or recognized as an equal foreign institution that provides them with sufficient knowledge to deal with the topic of the proposed doctoral thesis, which is proven by a particularly high score (excellent) in two (2) at least courses related to the topic of the thesis, and

b) They have at least one publication in a reputable international journal that is relevant to the topic of the thesis, or

c) They have significant professional/research experience related to the topic of the thesis.

Duration of studies

The duration for obtaining the Doctoral Degree in the Department of Industrial Engineering and Management is at least three (3) full calendar years from the date of appointment of the three-member advisory Committee.

For Ph.D. candidates who are admitted exceptionally, without holding a master's degree, the minimum time limit for obtaining the Doctoral Degree is four (4) full calendar years from the date of appointment of the three-member advisory Committee.

The maximum time to complete the thesis is set in any case at six (6) years.

11. INTERNATIONAL STANDING AND PARTNERSHIPS

The Department of Industrial Engineering and Management of I.H.U. has a broad presence outside Greece, through collaborations with foreign Universities and Research Institutes, in the context of international research and educational programs. Some of the Department's activities at European and international levels are listed below.

The Department of Industrial Engineering and Management of I.H.U. cooperates closely with corresponding Departments abroad within the framework of the Erasmus Plus program. The Department, in addition to the typical Erasmus Plus mobility program for students and staff members, actively participates in three (3) Erasmus Plus programs, namely two approved in 2019 and one in 2020, of which it has undertaken coordination in one of them (Scientific Coordinator: Professor Th. Kosmanis). All aforementioned Erasmus+ programs lead to the development of English-language study programs (one with a seminar character and two Master's programs). Almost half of the participating students in the seminar program come from the Department of Industrial Engineering and Management of I.H.U., while in the Master's programs all students, originating from countries both inside and outside the European Union, are enrolled at I.H.U. More information about the programs can be found on the related websites:

- E-DRIVE TOUR (https://www.edrivetour.eu/)
- SMARTSEA (https://www.smart-sea.eu/)
- TERRATECH (https://www.terratechmsc.eu).

In addition, Faculty members have collaborated in the past with foreign Universities within Intensive Educational Programs of the LLP/Erasmus, from which the following collaborations resulted:

- participation in the examination committee of a doctoral thesis in the University of Catalunya, Spain (Assoc. Professor Th. Kosmanis, 2017)
- participation in the examination committee of the doctoral thesis in the EPFL University of Switzerland (Assoc. Professor D. Triantafyllidis, 2020).

At the same time, the Department of Industrial Engineering and Management participates in European-funded research programs in collaboration with universities and companies abroad.

Indicatively, the Department participates in Interreg research projects, in collaboration with higher education institutions in the Balkans. During the academic year 2020-2021, there was a collaboration with the Faculty of Engineering of Ss. Cyril and Methodius University of Skopje (North Macedonia) in the context of the project: *"Safe cross-border transportation of hazardous materials: Orphan radioactive sources"*, where the Department was the Coordinator (http://www.strassproject.eu/).

In more detail, foreign Educational Institutions, with which there is cooperation in the context of international research and educational programs, are listed below:

- University of Craiova
- University of Technology and Humanities in Radom
- St. Cyril and Methodius University in Skopje
- University of Salerno
- University of Porto
- University of Salamanca

- Maritime University of Szczecin
- Technical University of Tallinn
- University of Ljubljana
- Catholic University of the Sacred Heart in Milan
- University of Debrecen
- University of Catalunya
- Universitat Pompeu Fabra
- Vidzeme University of Applied Sciences
- Escola Superior Nautica Infante D. Henrique
- University of Tours.

Moreover, across the years, individual collaborations of Faculty members of the Department have been developed with Educational Institutions abroad, either in the context of bilateral collaborations, such as Erasmus Plus mobility of students and staff members, or for performing high-level scientific research (i.e., research projects and scientific publications). Some of the collaborations with foreign Institutions are listed below:

- Imperial College London (United Kingdom)
- University of Cambridge (United Kingdom)
- University of California at Berkeley (U.S.A.)
- Mines Paris Tech (France)
- Université Clermont Auvergne (France)
- Alma Mater Studiorum – University of Bologna (Italy)
- University of Applied Sciences “Technikum Wien” (Austria)
- University of Alcalá (Spain)
- Instituto Superior de Engenharia do Porto (Portugal)
- Czech Technical University (Czech Republic)
- University of Ruse “Angel Kanchev” (Bulgaria).

Indicatively, the research of the Laboratory of Electronic Systems is carried out in the context of a long-term collaboration with Imperial College London (Great Britain). The subject of the research refers to the development of microsystems for sensors, actuators and energy harvesting microgenerators. Relevant industry partnerships include Airbus Group Innovations in Germany, France, and Spain, as well as ABB in Great Britain and Germany. In addition, the Laboratory maintains a close research collaboration with the Laboratory of Advanced Materials for Energy of the University of California at Berkeley (United States of America).

Notably, the Department of Industrial Engineering and Management of I.H.U., targeting at its continuous development, upgrading, and extroversion, as well as aiming to provide students with knowledge and skills demanded by the labor market, participates as a full member in the SAP University Alliances Program. In this context, since 2011 it has been collaborating with the SAP University Competence Center of the Technical University of Munich (Technische Universität München).

Regarding the organization of workshops and conferences, since 2016 the Department of Industrial Engineering and Management of I.H.U. organizes annually the International Workshop on Microsystems. In this conference, research results are presented both by professors and students of Greek universities and by invited researchers from worldwide universities and industries. The conference is held entirely in English, with published proceedings, and is offered

free of charge. Furthermore, the Department participates in the organization of the GREDIT international conference every two years. Finally, Faculty members of the Department participate in international associations, such as the following: European Association for Education in Electrical and Information Engineering (https://eaeeie.org/) and Balkan Environmental Association (B.EN.A.).

12. ERASMUS+ PROGRAMME

To accommodate the students that do not speak the Greek language, a selection of undergraduate courses is also offered in English, either through lectures or through assignments, for the Erasmus+ programme as detailed in the table below.

No	Course Code	Course Name	Semester	ECTS
1	16	Calculus	1 (autumn)	6
2	25	Applied Thermodynamics	2 (spring)	5
3	26.2	Electrotechnical Materials	2 (spring)	4
4	26.4	Multivariable Functions	2 (spring)	4
5	32	Electronic Systems	3 (autumn)	6
6	34	Probability Theory and Statistics	3 (autumn)	5
7	36.1	Industrial Safety and Health	3 (autumn)	4
8	42	Transform Theory and Systems	4 (spring)	4
9	44	Fluid Mechanics	4 (spring)	6
10	45	Production Systems	4 (spring)	5
11	46.1	Micro-Electro-Mechanical Systems (MEMS)	4 (spring)	4
12	55.5	Aerodynamics	5 (autumn)	4
13	61	Heat Transfer	6 (spring)	5
14	63	Programmable Controllers and Supervisory Systems	6 (spring)	6
15	65.3	Electric Machines and Electric Motor Drives II	6 (spring)	4
16	65.8	Signals, Information and Communication	6 (spring)	4
17	73	Thermal Engines	7 (autumn)	5
18	76.1	Nanotechnology	7 (autumn)	4
19	76.3	Electronic Energy Systems and Energy Saving	7 (autumn)	4
20	76.6	Automotive Electronics	7 (autumn)	4
21	76.7	Control Systems III	7 (autumn)	4
22	81	Modeling and Simulation	8 (spring)	4
23	83	Microcomputers in Production	8 (spring)	4
24	86.3	Finite Element Method	8 (spring)	4
25	86.6	Renewable Energy Sources	8 (spring)	4
26	86.7	Vehicle Dynamics	8 (spring)	4
27	86.9	Digital Control Systems	8 (spring)	4
28	86.10	Entrepreneurship	8 (spring)	4
29	93	Environmental Engineering	9 (autumn)	4
30	95.6	Vehicle Electrification	9 (autumn)	4
31	95.7	Stochastic Processes	9 (autumn)	4
32	95.10	Gas Exchange Processes in Heat Engines	9 (autumn)	4

Courses of the Department's Curriculum taught in English.

In parallel, students of the Department move to universities abroad every year to attend one or two semesters of study. The course matching process is carried out by the Erasmus+ academic coordinator during the students' departure stage. The recognition of grades is approved by the Department's faculty assembly after their return. The criteria for course matching are:

1. The level of relevance of the title and content of the course to the corresponding course of the Department. In cases of limited relevance, any specificities regarding the destination University and the quality of its curriculum, as well as the integrity/maturity of its overall transfer are also considered.

2. In cases where a student has attended a course that is part of the engineering sciences but does not correspond to a specific course of the Department's curriculum, this course is recognized as one of the department's elective courses.

3. In any case, the assignment is made to the most relevant course in the Department's curriculum, even if the student has taken this course in the past.

13. APPENDIX: DETAILED COURSES OUTLINE

Specialized information (digital material, announcements) per course can be found on the asynchronous distance learning platform: https://exams-sm.the.ihu.gr. The detailed outline of all courses is provided per semester in the following subsections.

14.1 1st Semester Courses

LINEAR ALGEBRA AND COMPLEX NUMBER THEORY (11)

LEARNING OUTCOMES:

This is a basic introductory course in higher mathematics that offers an important background of knowledge and basic concepts that are considered absolutely necessary for the understanding of the methodology and the scientific foundation of a variety of specialized courses in the science of engineering.

COMPETENCIES:

Research, analysis and synthesis of data and information
Autonomous work
Promoting free, creative and inductive thinking
Adherence to good practice guidelines

CONTENT:

1 - Linear Systems and Tables
- 1.1 Systems of linear equations
- 1.2 Tables
- 1.3 Table operations and properties

2 - Solving linear systems
- 2.1 Elementary tables and equivalent tables
- 2.2 Gaussian sequential deletion method
- 2.3 Determinant method (Cramer rule)
- 2.4 Finding an inverted array

3 - Determinant
- 3.1 Definition
- 3.2 Determinant properties
- 3.3 Inverse array
- 3.4 Other applications of determinants

4 - Diagonalization of tables
- 4.1 Tables and linear representations
- 4.2 Eigenvalues and eigenvectors
- 4.3 Diagonalization of tables
- 4.4 Finding v-th power of an array

5 - Complex Numbers
- 5.1 Basic concepts
- 5.2 Complex Number Algebra
- 5.3 Forms of a complex number
- 5.4 Complex plane
- 5.5 De Moivre and Euler formulas
- 5.6 Fundamental theorem of algebra
- 5.7 Polynomials with complex coefficients
- 5.8 Roots of complex numbers
- 5.9 Complex forces
- 5.10 Logarithm of complex number

6 - Applications in MATLAB environment

TEACHING AND LEARNING ACTIVITIES:

Lectures
Exercises
Project assignments
Online guidance
E-mail communication
Online synchronous and asynchronous teaching platform
Interactive teaching

ASSESSMENT CRITERIA:

Assessment Language: English / Greek
The final grade of the course is formed 100% by the grade of the theoretical part. The grade of the theoretical part is formed by a written final examination. The written final examination of the theoretical part may include: a) Multiple choice questions, b) Solving problems of application of the acquired knowledge, c) Short answer questions, d) Comparative evaluation of theory elements.

BIBLIOGRAPHY:

Higher Mathematics, Kreyszig Erwin, Ed., A.Tziola & Sons SA
Advanced Mathematics, Voskoglou Michalis, Ed., Gotsis K. & Co. EE.
Linear Algebra, Georgiou & Kougias & Megaritis, Ed., A.Tziola & Sons SA
Advanced Mathematics for Engineers, Tsiantos V., Ed., A.Tziola & Sons SA
Advanced mathematics lessons, Bratsos Athanasios
An introduction to linear algebra-for the positive sciences, Charalambous Chara, Fotiadis Anestis
Mathematics I, Elements of linear algebra-differential and integral calculus, Papaioannou Stavros, Vogiatzi Despina

PHYSICS (12)

LEARNING OUTCOMES:

The aim of the course is for students to understand familiar concepts of Classical Mechanics using vector and differential calculus, synthetic thinking and their familiarity with solving complex problems and exercises. It deepens the axioms and fundamental principles of Newtonian Mechanics and presents the analytical techniques of for the description and solution of simple physical systems and fields of forces. The course requires familiarity with Basic concepts of Kinematics and Dynamics, differential and integral calculus. The principles of Mechanics are described in introductory terms and the integrals of motion are defined. Systems of one degree of freedom are studied, both qualitatively and in detail. The following is the mathematical analysis of motion in a field of central forces, and in particular the forces ~ r^{-2}. Many body systems are also described and the problem of two bodies is analysed. Finally, the origin and consequences of non-inertial forces are examined.

Upon completion of the course students

1) will have deepened their knowledge in the fundamental laws of Mechanics and will have understood the strict mathematical framework in which these laws are expressed and the new knowledge that covers the specific object is produced.

2) will have understood how the whole theory of the respective field of knowledge emerges, based on basic principles and using the necessary mathematics

3) will be familiar with new ways of modelling and processing complex mechanical systems and finding equations of motion.

COMPETENCIES: *Literature review, Critical review of bibliography, Adaptation to new situations, Autonomous work, Teamwork – distribution and delegation of responsibilities, Promoting free, creative and inductive thinking, Adherence to good practice guidelines*

CONTENT:

Units and Vectors (Standards and units. Dimensions. Vectors. The unit vector. The position vector. Components of a vector. Scalar and vector products. Types of vectors. The derivative of a vector. Examples – Problems).

Motion of a Particle (Rectilinear motion. Average and instantaneous velocity, acceleration. Motion in a plane. Physical coordinates. General motion in space. Coordinate systems. Motion of a projectile. Circular motion. Examples – Problems).

Newtonian mechanics (axioms, laws of dynamics and vector form of the differential equations of motion. Conservation laws. Examples – Problems).

Frames of Reference (Relative velocity. Galilean transformation. Inertial and accelerated frames of reference. Inertial forces. Examples – Problems).

Energy and Conservation Laws (Impulse. Energy. Work. Conservative forces. Kinetic energy. Potential energy. Power. Linear momentum. Angular momentum and torque. Examples – Problems).

Dynamics: (equilibria and their stability. Study of conservative 1 degree-of-freedom system, using the method of Potential. Phase diagrams).

Applications to 1 degree.of.freedom (d.o.f) systems (harmonic oscillator, pendulum, systems with friction, forced oscillations. Examples – Problems).

Central forces (conservation of angular momentum, effective potential and study of the equivalent 1 d.o.f system. Examples – Problems)

Motion of Systems (Mechanical system of particles. Internal and external forces. Internal energy. Center of mass. Center of mass frame of reference. Momentum, energy and angular momentum of a system. Collisions. Systems of variable mass. Examples – Problems).

TEACHING AND LEARNING ACTIVITIES: *Lectures, Exercises, Online guidance, Projected presentations, E-mail communication, Online synchronous and asynchronous teaching platform, Bibliography study & analysis, Tutoring, Interactive teaching, Homework*

ASSESSMENT CRITERIA: Assessment Language: English / Greek

The final grade of the course is formed by 100% by the grade of the written final examination.

The written final examination of the theoretical part may include: Solving problems of application of the acquired knowledge, Short answer questions etc

BIBLIOGRAPHY:

University Physics with Modern Physics by Hugh D. Young, Roger A. Freedman, Tom Sandin, A. Lewis Ford. Publisher: Pearson Education

Classical Mechanics, Tom W. B. Kibble & Frank H. Berkshire. Publisher: Imperial College Press

STATICS (13)

LEARNING OUTCOMES:

This course aims to provide students with a basic understanding of the fundamental principles of statics and to give them the ability to use these principles in solving engineering statics problems. Upon successful completion of the course the student will be able to:

- Resolve the force into its components and determine the resultant of force systems.
- Draw accurate free-body diagrams and apply the equations of equilibrium to solve for unknown quantities.
- Calculate support reactions and determine internal forces in two and three-dimensional trusses.
- Determine internal effects in beams and frames and draw axial force, shear force, bending moment and torsional moment diagrams.
- Determine the centroid and calculate the moment of inertia of composite areas.
- Distinguish the difference between static and kinematic friction and solve problems involving dry friction.

COMPETENCIES: Search, Analysis and synthesis of data and information, independent work, Using corresponding technologies.

CONTENT:

- Fundamental Concepts and Principles: Principles of mechanics, Scalars and vectors, Units.
- Analysis of Force Systems: Rectangular components, Moment and couple, Resultants, Equivalent systems.
- Statics of Particles: Equilibrium conditions, Free body diagram.
- Distributed Forces: Centers of mass and centroids, Area moments of inertia.
- Statics of Rigid Bodies: Equilibrium of rigid body, Free body diagram, Reactions at supports and connections, Constraints and statical determinacy.
- Analysis of Structures: Analysis of trusses, Method of joints, Method of sections, Analysis of frames and machines.
- Internal Effects in Beams: Loads and supports, Relations among external loads and internal effects, Internal forces and moments diagrams.
- Friction: Dry friction, Coefficients of friction, Angles of friction, Applications of friction in machines (Wedges, Screws, Belts, Disk friction).

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA:

Assessment Language: Greek.

Final Written Problem-Solving Exam.

BIBLIOGRAPHY:

Beer, Ferdinand P. & Johnston, E. Russell Jr. & Mazurek, David F., "Vector Mechanics for Engineers: Statics", 7th Edition, McGraw-Hill, 2016.
R. C. Hibbeler, "Engineering Mechanics: Statics", 14th Edition, Pearson Prentice Hall, 2016.
Andrew Pytel, Jaan Kiusalaas, "Engineering Mechanics: Statics", 4th Edition, Cengage Learning, 2016.

ENGINEERING DRAWING (14)

LEARNING OUTCOMES:

Knowledge of relevant standards relating to mechanical drawing.
Have the ability to think in three dimensions
Illustrate their ideas using sketches
Create view and cross sectional views of simple assemblies
Create engineering drawings of simple and complex mechanical designs.
A key learning outcome of the course is for the student to have the required skill that will allow him to document his thoughts in engineering drawings so that he can easily communicate with other engineers. The student should have the required knowledge to read engineering drawings and make the required corrections and adjustments to them.

COMPETENCIES:

Autonomous work
Adaptation to new situations
Decision making
Promoting free, creative and inductive thinking
Research, analysis and synthesis of data and information

CONTENT:

Engineering drawing equipment.
Basic drawing knowledge, scales.
Engineering drawing views
Engineering drawing sectional views and special views
Dimensions
Engineering drawing of mechanical components
Engineering drawing of bolts, threads and nuts
Engineering drawing of spring elements and gears
Tolerances and their representation on engineering drawings
Design of spring elements
Engineering drawing of mechanical assemblies

TEACHING AND LEARNING ACTIVITIES:

Lectures
Laboratory
Project assignments
E-mail communication
Homework

ASSESSMENT CRITERIA: Assessment Language: English / Greek

Mandatory assignments of engineering drawing throughout the semester.
Final exam on the theoretical aspects of the course (80%)
Examination on the accurate creation of engineering drawing through practical work (20%)

BIBLIOGRAPHY:

Simmons C., Maguire D., Manual of Engineering Drawing, 4th Edition, Elsevier, 2014
Richard G Budynas, Keith J Nisbett, Mechanical Engineering Design, 10th Edition, McGraw-Hill Education, 2014

INTRODUCTION TO COMPUTER SCIENCE (15)

LEARNING OUTCOMES:

Upon successful completion of the course the student will:
- understand the fundamentals of computer architecture and organization
- be able to evaluate the value of binary and hexadecimal numerical representations
- understand and design flowcharts
- have a good knowledge of fundamental data types, input/output, selection and repetition structures, processing of data organised in arrays
- have to knowledge to implement simple algorithms
- be able to understand, modify and design computer programs.

COMPETENCIES:

Ability to use integrated development environment to produce computer programs
Independent work, Teamwork – distribution of responsibilities

CONTENT:

Introduction to Computer Architecture and Organisation
Numerical Systems
System and Applications Software, Computer Programming Languages
Computer Program representation, Flowcharts
Introduction to C/C++ programming language
Input/Output
Variables, Constants, Operators, Operands, expressions, basic mathematical functions

Control statements
Iteration loops
Arrays
Characters, Strings
Laboratory Exercises and applications in C/C++

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: Greek/English
The final grade of the course is formed by 80% by the grade of the theoretical part and by 20% by the grade of the laboratory part.
1. The grade of the theoretical part is formed by a written final examination, which may include:
Short answer questions, Program Analysis, Short programs development, Solving problems of application of the acquired knowledge,
2. The examination of the Laboratory Exercises is carried out with the continuous evaluation of the laboratory skills and the theoretical knowledge that were acquired in the course by the method of continuous evaluation and submission of weekly assignments

BIBLIOGRAPHY:

Introduction to Computer Science, Lecture Notes, D.E. Manolakis (Greek language)
English Language Textbooks
Object Oriented Programming in C++, R. Lafore, CourseSams Publishing
C++ How to Program (Early Objects Version), Paul Deitel, Harvey Deitel, 10th Edition, 2017, Pearson
Problem Solving with C++, Walter Savitch, Kenrick Mock (contributor, 10th Edition, 2018, Addison-Wesley Professional
Journals:
Computing in Science & Engineering (co-published by IEEE and AIP)
IEEE Transactions on Computers
IEEE Transactions on Software Engineering
Science of Computer Programming
Material from Internet:
www.tutorialspoint.com/cprogramming/
http://www.tutorialspoint.com/cplusplus/
http://www.learn-c.org/
http://www.cplusplus.com/
http://www.learncpp.com/
http://www.cprogramming.com

CALCULUS (16)

LEARNING OUTCOMES:
The course is designed to provide the basic tools of advanced mathematics, including mainly elements of differential and integral calculus of functions of one variable. In particular, it focuses on the detailed presentation of mathematical concepts, theorems and propositions but also on problem-solving techniques related to them. For this purpose, extensive use is made of examples that find use in practical applications from the field of engineering.
As a background course, it offers the engineer the mathematical knowledge and the way of thinking in order to develop his / her ability to express mathematically and to face methodological practical problems.
Consistent and successful course attendance has as expected learning outcomes for the student:
to achieve the gradual theoretical logical subtraction from the real numbers, in the sense of the variable, in the definition of a function, in the sense of the differential of a function,
to connect and be able to study the representations of a function (analytical form, graphical representation, verbal description),
to understand theoretically and in practice the basic theorems of differential calculus,
to understand the concept of the integral of a function and relate it to practical applications,
to learn all the necessary techniques related to the differentiation and integration of functions,
to identify and distinguish problem-solving methods related to the differentiation and integration of functions,
to make him/her capable to apply the above methods to engineering problems,
to analyze and interpret the obtained results,
to be able to attend, without significant learning gaps, more specialized courses of the department.

COMPETENCIES:
Research, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations
Independent work, Teamwork – distribution of responsibilities, Intellectual competences, Societal competence

CONTENT:
• Foundation of the real number system. Field and order axioms, the least upper bound axiom and the Archimedean principle.
• Monotone and bounded real-valued functions, continuation of a real-valued function, Bolzano theorem, and intermediate value theorem, extreme value theorem, uniform continuity.
• Elements of set theory, the system of real numbers.
• Function derivative, derivative calculus and higher order derivatives, Rolle, Mean Value, and L'Hospital theorems, local extrema.
• The Riemann integral, integral properties (sum-difference rule, triangular inequality, linearity), differentiability and continuity, integral at points of discontinuity of the integrable function, integrability of continuous functions, mean value theorem, indefinite integral, fundamental theorem of integral calculus.
• Integration techniques (variable change, integration by parts, etc.), logarithm and exponential function, generalized integrals, examples and applications.
• Subsets of R, accumulation points, sequences of real numbers, monotonic sequences, subsequences and Cauchy's convergence criterion, Bolzano-Weierstrass theorem, convergence theorems for sequences.
• Series of real numbers, series with positive terms, convergence and absolute convergence tests of series. Taylor's theorem and Taylor series.

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Projected Presentations, Online Synchronous and Asynchronous Teaching Platform.
ASSESSMENT CRITERIA: Assessment Language: Greek / English. Final Written Examinations. Evaluation criteria: Application of definitions, algorithms or propositions. Combination and synthesis of concepts and proof or computational procedures. Taking initiatives to implement problem-solving strategies.
BIBLIOGRAPHY: Calculus, Fourth Edition, by Michael Spivak Thomas' Calculus, 14th edition, by Joel Hass, Christopher Heil, Maurice Weir Calculus, Second Edition, by William Briggs, Lyle Cochran, Bernard Gillett

ENGLISH TERMINOLOGY (17)
LEARNING OUTCOMES: Upon successful completion of the course, students will be able to do the following: KNOWLEDGE Understand texts in the English language relevant to the discipline of industrial engineering Have greater fluency in writing technical texts in English Be more fluent in searching bibliography and information using English keywords Be able to participate in discussions, technical presentations in English Have acquired knowledge for writing, reading and analysis of technical studies, reports, specification sheets in English
COMPETENCES: Search, analysis and synthesis of data and information, using the necessary technologies, Respect for diversity and multiculturalism
CONTENT: Familiarization of students with terminology through authentic texts and exercises with the following topics: - the profession of an industrial engineer - rotary electric motors, electric generators, transformers, transducers - CAD applications - CAM applications advantages and disadvantages - automatic control systems - robotics technology - sensors, actuators, end effect devices - principles, levels and functions of the administration - staff training and management philosophy - writing a CV and an application letter - preparation for a job interview Review of grammar and syntax (theory and exercises) - verb tenses - passive voice - auxiliary/elliptical verbs - conditional sentences
TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, , E-mail communication, Online Synchronous and Asynchronous Teaching Platform.
ASSESSMENT CRITERIA: Assessment Language: English /Final written examination
BIBLIOGRAPHY: Book [102125853]: English for Mechanical Engineering EAP, Altini, Agapi Book [12635947]: English for Electrical Engineering and Automation - A Dynamic Tool for Mastering the Technical Language, Peppa Ifigenia

14.2 2nd Semester Courses

MATERIALS TECHNOLOGY (21)
LEARNING OUTCOMES: After successful completion of the course, students are expected to be able to: identify and describe basic materials used in industrial production know the correlation of structure and mechanical behavior of materials be familiar with the basic mechanisms of material failure
COMPETENCIES: Apply knowledge in practice Retrieve, analyze and synthesize data and information, with the use of necessary technologies Make decisions Works autonomously
CONTENT: Construction metal materials. Structure of metals and interference in relation to mechanical behavior. Chemical and physical methods of structural interference. Manufacturing and operational behavior. Special, industrial and light alloys. Applications and uses of metallic materials. Simple and complex materials necessary for the construction and operation of mechanical structures. Methods of preparation, formulation and processing of these materials. Structure, physical, chemical and mechanical properties of ceramic materials. Basic principles of dyeing mechanical structures and paint systems. Standardization of materials, standards. Study of metal structures and imperfections using metallurgical microscopy and ultrasounds. Measurements of properties of metals and alloys after thermal, mechanical and chemical treatments. Chemical tests of alloy composition and strength of metals in corrosion. Plastic molding. Measurement of the properties of non-metallic materials. Strength of non-metallic materials to conditions of application and to acids, bases and organic solvents. Quality control of mechanical parts of machines. Treatment of the metal surface before applying coating color.
TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.
ASSESSMENT CRITERIA: The final grade of the course is 100% of the grade of the theoretical part by a written final examination. The written final examination of the theoretical part may include: • Solving problems of application of the acquired knowledge • Short Answer Questions
BIBLIOGRAPHY: Course Bibliography (Eudoxus) The Science and Engineering of Materials, 7th Ed., Askeland Donald, Wendelin Wright, 2017, Cengage Learning, ISBN-10: 0357447883 Materials Science and Engineering: An Introduction, 10th Edition, William D. Callister Jr. and David G. Rethwisch, ISBN-13: 978-1119721772, 2020 Materials:Engineering, Science, Processing and Design, M. Ashby, H. Shercliff and D. Cebon, 4th Ed., ISBN: 9780081023778, 2018

PROGRAMMING FOR ENGINEERS (22)
LEARNING OUTCOMES: Upon successful completion of the course the student will: - obtain a deep knowledge of modular programming based on subprograms - understand the use of pointers - be able to write programs for processing data organized in text files - be familiar with string manipulation - know about composite data types defined by the programmer (structures) - be able to analyze and develop complex programs
COMPETENCIES: Competency in analyzing and developing complex modular programs based on subroutines, new structured data types defined by the programmer and data stored in text files. Independent work, Teamwork – distribution of responsibilities
CONTENT: Functions: declaration, definition, and call Function Parameters: Call by value, Call by reference, Call by address Scope of variables Function Overload Pointers, Dynamic Memory allocation Multidimensional Arrays Alphanumeric as C-Strings (arrays) and as C++ objects Introduction to Data Files Structures Laboratory Exercises and applications in C/C++
TEACHING AND LEARNING ACTIVITIES: Lectures, Lab Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.
ASSESSMENT CRITERIA: Assessment Language: Greek/English The final grade of the course is formed by 70% by the grade of the theoretical part and by 30% by the grade of the laboratory part. 1. The grade of the theoretical part is formed by a written final examination, which may include: Short answer questions, Program Analysis, Program development, Solving problems of application of the acquired knowledge,

2. The examination of the Laboratory Exercises is carried out with the continuous evaluation of the laboratory skills and the theoretical knowledge that were acquired in the course by the method of continuous evaluation and submission of weekly assignments

BIBLIOGRAPHY:

Programming for Engineers, Lecture Notes, D.E. Manolakis (Greek language)

English Language Textbooks

Object Oriented Programming in C++, R. Lafore, CourseSams Publishing

C++ How to Program (Early Objects Version), Paul Deitel, Harvey Deitel, 10th Edition, 2017, Pearson

Problem Solving with C++, Walter Savitch, Kenrick Mock (contributor, 10th Edition, 2018, Addison-Wesley Professional

Journals:

Computing in Science & Engineering (co-published by IEEE and AIP)

IEEE Transactions on Computers

IEEE Transactions on Software Engineering

Science of Computer Programming

Material from Internet:

www.tutorialspoint.com/cprogramming/

http://www.tutorialspoint.com/cplusplus/

http://www.learn-c.org/

http://www.cplusplus.com/

http://www.learncpp.com/

http://www.cprogramming.com

CIRCUIT ANALYSIS (23)

LEARNING OUTCOMES*:*

Upon successful attendance of the course the student should be able to:

- classify a circuit as concentrated or distributed
- possess fundamental concepts of signal theory
- recognize and possess the properties of the basic two terminal elements in time and in frequency
- understand the operation of simple electrical circuits and the basic concepts governing them, such as load, potential, current, voltage, resistance
- understand fundamental circuit theorems and general circuit analysis methods in time and frequency
- understand and estimate AC one- and three-phase electrical power circuits,
- perform simple calculations on simple first-order transition circuits in time

COMPETENCIES: Research, analysis and synthesis of data and information, using corresponding technologies, decision making, team work, implementing criticism and self-criticism, promotion of free, creative and inductive thinking

CONTENT:

1. Basic concepts and principles of Electrical Engineering, electric field, magnetic field, concentrated and distributed circuits, wavelength, radiation, field propagation velocity. Elements of circuit topology (branch, loop, node, potential, voltage, current, coupled reference directions, power flow, Kirchhoff's laws.
2. Tellegen's theorem, separation groups. Two-terminal elements, linear and nonlinear elements, voltage sources, current sources, dependent and independent sources. Resistor, capacitor, inductor, open circuit, short circuit, switch.
3. Passive and active elements. Transformer. Two-terminal circuits, port, poles, equivalence of circuits, in-line and parallel connections of R, L, C, source connectors. Simple model of real voltage and current source, equivalence of voltage and current sources, Norton and Thevenin equivalent circuits, [Millman theorem].
4. Introduction to signal theory, types of signals, Fourier analysis, mean and root mean square value, step function, Dirac function, sampling theorem.
5. Circuits in the field of frequency, rotating vectors, operations with rotating vectors, transformation of R, L, C in frequency, circuit function, equivalent circuits, voltage and current divider, scalar circuits, RLC and GLC resonance. Resonance.
6. Generalised circuit analysis methods. Simple loop method in the field of frequency. Impedance matrix, Cramer method. Node method in frequency. Complex conductivity matrix. Examples. Input and transfer conductivity. Input and transfer impedance.
7. Output impedance and conductivity, voltage and current transfer functions. Connecting circuits in cascade.
8. AC Power. Active, reactive, complex and apparent power. Units of measurement. Power as a sinusoidal function. Frequency of electrical power. Power triangle. Reactive power compensation. Compensation as a special case of resonating. Parallel compensation vs. series compensation.
9. Maximum power transfer theorem. The case of the given consumer as opposed to the given amplifier. Matching. Why power lines are not adjusted.
10. Three-phase circuits. Polar voltage, phase voltage, line currents, phase currents. Y-Y, Y-Δ, Δ-Y, Δ-Δ connections. Relationship between polar and phase magnitudes. Neutral current in a symmetric three-phase system. Grounded and non-grounded neutral. Neutral brake. Phase brake. Two-phase break.
11. Power in three-phase systems. Power measurement with Aron connection.
12. Transient phenomena in electrical circuits. Resistor, capacitor and inductor models in time. Differential equations. Unguided first-order circuits. Natural response. Stability. Time constant. Recovery time. Linearity. Examples.
13. First Order circuits driven by DC or AC source. Zero Input Response. Zero State Response. Stability. Initial and final state method. Impulse response, step response.

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: English / Greek

The final grade of the course is formed by the grade of the written final examination which includes:

Solving problems of application of the acquired knowledge, Short answer questions etc

BIBLIOGRAPHY:

Nikos I. Margaris, Electric Circuit Analysis. Tziola Publishing, 2010. (in Greek)
Nilsson Riedel, Electric Circuits, 9th edition, Prentice Hall, 2011. (in English and Greek)
Alexander C., Sadiku M., Fundamentals of Electric Circuits, 6th edition, McGraw Hill, 2019. (in English and Greek)

DYNAMICS (24)

LEARNING OUTCOMES:

This course covers the kinematics and kinetics of particles and rigid bodies in two and three dimensions, as well as an introduction to vibrations of mechanical systems and aims to equip students with the analytical skills required to solve engineering dynamics problems by applying basic principles and methods of mechanics. Upon successful completion of the course the student will be able to:

- Analyse the kinematics of particles and rigid bodies.
- Draw free-body diagram for a particle or a rigid body in motion.
- Determine the dynamic response of the system to applied loadings, using Newton's laws.
- Apply the principle of work-energy and the principle of impulse-momentum to solve particle, system of particles and rigid-body kinetic problems.
- Solve impact problems using the principle of impulse and momentum and the coefficient of restitution.
- Determine mass moments and products of inertia of a rigid body for specified axes.
- Define the inertia tensor, principal coordinates and the principal moments of inertia.
- Solve three-dimensional rigid body kinetics problems.
- Derive mathematical models for simple vibration systems.
- Define free vibration and solve problems of simple harmonic motion.
- Explain and solve problems of forced vibrations.

COMPETENCIES: Search, Analysis and synthesis of data and information, independent work, Using corresponding technologies.

CONTENT:

- **Kinematics of Particles:** Position vector velocity and acceleration, Rectilinear motion, Curvilinear motion, Derivative of vector function, Rectangular components of velocity and acceleration, Normal and tangential coordinates, Polar coordinates, Relative motion.
- **Kinetics of Particles:** Newton's second law of motion, Equations of motion, Kinetic energy of a particle, Conservative Forces and potential energy, Principle of work and energy, Conservation of energy, Linear and angular momentum, Linear and angular impulse, Principle of impulse and momentum, Conservation of momentum.
- **Dynamics of Particle Systems:** A Motion of the center mass of a system of particles, Principle of work and energy for a system of particles, principles, Principle of linear impulse and momentum for a system of particles, Conservation of energy and momentum, Impact, Relative motion.
- **Mass Moment and Product of Inertia:** Mass Moment of inertia by integration, Mass products of inertia, Parallel-Axis theorems, Moment of inertia about an arbitrary axis, Inertia tensor Principal moment and principal axes of inertia.
- **Planar Kinematics of Rigid Bodies:** Planar rigid-body motion, Translation, Rotation about a fixed axis, General plane motion, Absolute and relative plane motion analysis, Instantaneous center of rotation in plane motion, Motion relative to a rotating reference frame.
- **Planar Kinetics of Rigid Bodies:** Equations of motion for a rigid body, Kinetic energy of a rigid body, Work-Energy principle and conservation of mechanical energy, Linear and angular momentum in plane motion, Principle of impulse and momentum for the plane motion of a rigid body, Conservation of angular momentum, Rigid body impact.
- **Rigid-Body Dynamics in Three Dimensions:** Angular momentum and kinetic energy of a rigid body in three dimensions, Euler's equations of motion, Rotation about a fixed point, Fixed-axis rotation, General motion, Gyroscopic motion.
- **Mechanical Vibrations:** Free vibrations of particles, Undamped and damped systems, Equation of motion, Natural frequency, Damping ratio, Forced vibration of particles, Resonance, Vibration of rigid bodies, Energy methods.

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA:

Assessment Language: Greek.
Final Written Problem-Solving Exam.

BIBLIOGRAPHY:

J. L. Meriam, L. G. Kraige, "Engineering Mechanics: Dynamics", 7th Edition, John Wiley & Sons Inc., 2012.
R. C. Hibbeler, "Engineering Mechanics: Dynamics", 14th Edition, Pearson Prentice Hall, 2015.
Ferdinand P. Beer, E. Russell Johnston Jr., Phillip J. Cornwell, Brian P. Self, "Vector Mechanics for Engineers: Dynamics", 11th Edition, McGraw-Hill, 2018.

APPLIED THERMODYNAMICS (25)

LEARNING OUTCOMES:

After successful completion of the course, the student should be able to:
-describe the laws of thermodynamics
-judge the properties of pure substances
-analyze thermodynamic processes with the application of thermodynamics laws in closed and open thermodynamic systems
-be able to solve problems that concern pure substances and vapours

COMPETENCIES:

Research, analysis and synthesis of data and information, Adaptation to new situations, Decision making, Autonomous work, Exercise criticism and self-criticism, Promoting free, creative and inductive thinking

CONTENT:

Using thermodynamics, defining systems, describing systems and their behavior
Evaluating thermodynamic properties, phase and pure substance, phase change, vapor-liquid-saturation tables, ideal gas model

Energy and the first law of thermodynamics
Energy balance for closed systems
Energy analysis of thermodynamic cycles
Control volume analysis using energy, conservation of mass, conservation of energy
The second law of thermodynamics, irreversible and reversible processes
Entropy balance for closed systems
Entropy rate balance for control volumes
Isentropic processes, isentropic efficiencies
Exergy analysis, exergy of a system, introduction to thermoeconomics
Vapor power systems, introduction to vapor power plants, the Rankine cycle
Refrigeration and heat pump systems, vapor refrigeration systems, absorption refrigeration

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: Greek
The final grade of the course is formed by 100% by the grade of the theoretical part.
The grade of the theoretical part is formed by a written final examination.
The written final examination of the theoretical part may include:
Solving problems of application of the acquired knowledge, Short answer questions etc

BIBLIOGRAPHY:
Michael J. Moran, Howard N. Shapiro: Fundamentals of Engineering Thermodynamics 8th Ed. John Wiley & Sons Inc. 2014.
Bejan Adrian: Advanced engineering thermodynamics, 4th Ed. John Wiley & Sons Inc. New Jersey, 2016.
Eastop T.D., McConkey A.: Applied Thermodynamics for Engineering Technologists, 5th Ed. Longman. New York, 1993.

PHILOSOPHY OF TECHNOLOGY (26.1)

LEARNING OUTCOMES:
Knowledge
Understanding:
- the basic content of the branches of Philosophy
- the basic issues dealt with by Philosophy
- the Physiognomy of Technology
- the Physiognomy of Science
- the Relationship between Technology and Science
- the Philosophy of Technology
- the Philosophy of Science

Skills
Improvement of ability to:
- recognize the role of technology and its teleological orientation
- recognize the role of science and its causal orientation
- delve into issues that require philosophical reflection
- distinguish the difference between the technological and the scientific method
- handle the philosophical treatment of ethical problems associated with technology

COMPETENCIES:
Increased self-reflexive mood, increased capacity to cultivate literacy, increased capacity to develop critical ability, increased level of awareness and self-awareness, increased internal motivation to self-actualization and self-fulfillment, increased internal motivation to social contribution
Search, analysis and synthesis of data and information using the necessary technologies
Adaptation to new situations
Autonomous work
Promoting free, creative, deductive, inductive, and abductive thinking

CONTENTS:
Introduction to Philosophy, The Concept of Philosophy, Methods of Philosophy, Short History of Philosophy, Division of Philosophy, General Philosophy, Theology, Metaphysics, Logic, Philosophy, Special Philosophy, Special Philosophy of Science, Philosophy of Technology, Philosophy of Science, Philosophy of Techno-Science.

TEACHING APPROACH: Lectures, Computer Slides, Use of online teaching aids (e-class).

ASSESSMENT CRITERIA: Language: Greek. Final Written Examinations
Assessment criteria
- Short Answers in Questions regarding Philosophical Issues as well as issues on the Philosophy of Technology and Science

BIBLIOGRAPHY:
Philosophy and Technology, Mitcham C., ISBN-10: 0029214300, 1983.
Science, Technology and Philosophical Thinking, I. N. Markopoulos, University Studio Press, 2018. (in Greek)
Philosophy of Technology. Ihde D., In: Kemp P. (eds) Philosophical Problems Today. Philosophical Problems Today, vol 3. Springer, Dordrecht. https://doi.org/10.1007/1-4020-3027-4_3, 2004
Visions of STS: Counterpoints in Science, Technology, and Society Studies, Stephen Cutcliffe & Carl Mitcham, ISBN 10: 0791448452, State University of New York, 2001.

ELECTROTECHNICAL MATERIALS (26.2)

LEARNING OUTCOMES:
KNOWLEDGE

Understanding of the fundamental electronic properties of materials
Connection of the matter structure to the fundamental electronic properties of materials
ABILITIES
Calculation of material properties
Ability to read, understand and use material property specifications
Understanding of the functional concept of electrical and electronic devices, based on material properties
Identification, comparison, selection and use of electrotechnical materials in the development of production systems

COMPETENCES: Search, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations
Independent work, Teamwork – Respect to the natural environment, Promotion of free, creative and inductive thinking

CONTENT:
1. Objectives, Significance and Interest
2. Atomic forces and bonds
3. Crystal Structures 1 (Basics)
4. Crystal Structures 1 (Structure types)
5. Metals
5. Semiconductors
6. Polymers
7. Thermal properties of materials
8. Dielectric properties of materials
9. Thermoelectricity, Piezoelectricity, Ferroelectricity
10. Magnetic properties of materials
11. Artificial structures
12. Application example: Materials in a Smartphones
13. Summary

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: English / Greek
Public Presentations
Practical mid-term examination
Final Written Examinations
Evaluation criteria:
Ability to calculate properties of materials
Ability to evaluate and select materials based on their specifications
Understanding of the functional concept and the performance parameters of electrical and electronic devices
Ability to carry out projects and to present their results

BIBLIOGRAPHY:
Principles of Electronic Materials and Devices, 4th Edition, Safa Kasap, ISBN-10 : 0078028183, 2017
Materials Science and Engineering: An Introduction, 10th Edition, William D. Callister Jr. and David G. Rethwisch, ISBN-13: 978-1119721772, 2020
Introduction to Solid State Physics 8th Edition, Charles Kittel, ISBN-13: 978-0471415268, 2004
Microelectronic Circuits, Sedra Adel, Smith Kenneth, Tony Chan Carusone and Vincent Gaudet, 8th Edition, ISBN-10: 0190853506, 2020

HISTORY OF CIVILIZATION AND TECHNOLOGY (26.3)

LEARNING OUTCOMES:
The aim of the course is to provide the student with the necessary knowledge and stimuli to understand basic features of human culture (Myths, writing, money, etc.), how they developed, what consequences their development had on the evolution of societies. The course is largely interdisciplinary and basically concerns history, but is also related to sociology, anthropology, economics, science, philosophy.
The aim of the course is for students to have a macroscopic understanding of the overall historical, social, scientific, and economic context in which they will be called upon to develop and act as scientists, professionals, and people.
Upon successful completion of the course the student will be able to:

- Understands the basic stages that characterize the evolution of human history.
- Describes basic phenomena and characteristics of important historical phases of human history.
- Knows the characteristics and importance of basic parameters that constitutes culture (writing, religion, etc.).
- Demystify the role of phenomena such as slavery, war and realize the real causes of its appearance in human history.
- Understand how abstract mechanisms work, necessary today, such as trade, money, etc.
- To develop critical ability in relation to the dynamics of human civilization, the differences, and similarities with today.

COMPETENCIES:
Research, analysis and synthesis of data and information
Literature review
Adaptation to new situations
Working in an interdisciplinary environment
Respect for diversity and multiculturalism
Respect for the natural environment
Exercise criticism and self-criticism
Demonstration of social, professional, and moral responsibility and sensitivity to gender issues
Promoting free, creative, and inductive thinking
Teamwork – distribution and delegation of responsibilities

CONTENT:
1. Introduction, brief history of humanity.
2. The forager man, Neanderthal

3. Homo Sapiens – Neolithic revolution
4. Myths and fantasy class
5. Cognitive revolution
6. Writing, organization, numbering
7. Agricultural revolution
8. Globalization, unification of humanity, empires
9. Money, trade, religion
10. Scientific progress, colonialism
11. Capitalism, credit and development, wars, and slavery.
12. Industrial Revolution, Energy, Raw Materials, Overproduction and Demand, Consumerism and New Ethics
13. Post-industrial society, information society

TEACHING AND LEARNING ACTIVITIES: Lectures, Project assignments, Projected presentations, E-mail communication, Interactive teaching, online synchronous and asynchronous teaching platform.

ASSESSMENT CRITERIA: Assessment Language: English / Greek
The final grade of the course is formed by 100% by the grade of the theoretical part. The grade of the theoretical part is formed by a written final examination.
1. The written final examination of the theoretical part may include multiple choice questions, solving problems of application of the acquired knowledge, short answer questions, essay development questions, comparative evaluation of theory elements
2. Optional work by the form of project will be given to those students who wish to specialize, study and present issues that interest them. Her participation in the final grade will cover 30%

BIBLIOGRAPHY:

- Harari Noah Yuval, Sapiens A Brief history of Humankind, ISBN: 978-960-221-665-1, Alexandria, 2017, [59395938]
- Cardwell Donald, History of Technology, ISBN:978-960-375-572-2, Metexmio, 2004, [24148]
- Vakalios Thanasis, Technology, Society, Civilization, ISBN: 978-960-8295-01-8, Armos, 2002, [3185]
- Armand L. & Drancourt M., Technique and Civilization, PapaZisis, Athens 1969.

MULTIVARIABLE FUNCTIONS (26.4)

LEARNING OUTCOMES:
The course is designed to provide the basic tools of advanced mathematics, including mainly elements of differential and integral calculus of multivariable functions. In particular, it focuses on the detailed presentation of mathematical concepts, theorems and propositions but also on problem-solving techniques related to them. For this purpose, extensive use is made of examples that find use in practical applications from the field of engineering.
As an elective course, it offers the engineer the opportunity to satisfy his / her interest in mathematics by further cultivating the mathematical way of thinking by developing skills of mathematical transcendence and methodology and applying them to the solution of practical problems on two and three dimensions.
Consistent and successful course attendance has as expected learning outcomes for the student:
to achieve the gradual theoretical logical subtraction from the real functions of one variable into real functions of two, three and more variables,
to enable him to understand and process three-dimensional data with the help of representations of functions in 3d-space,
to provide him with methods for the study and analysis of multivariable functions,
to understand the concepts of double and triple integrals and connect them with practical applications,
to identify and distinguish problem-solving methods related to the differentiation and integration of multivariable functions,
to make him / her capable to apply the above methods to engineering problems,
to analyze and interpret the obtained results.

COMPETENCIES: Research, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations
Independent work, Teamwork – distribution of responsibilities, Intellectual competences, Societal competence

CONTENT:
Multivariable functions, definition, limits, continuity.
Vectors and Analytic geometry of space, equations of lines and planes.
Partial derivatives and basic theorems.
Total differential, gradient, implicit differentiation, tangent planes.
The chain rule, coordinate systems.
Taylor's formula for multivariable functions.
Curves in space and component functions
Extreme values of multivariable functions.
Double and triple integrals.
Substitutions in multiple integrals, polar, cylindrical, spherical coordinates
Applications in Engineering, in Physics.

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Projected Presentations, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: Greek / English. Final Written Examinations. Submission of weekly assignments.
Evaluation criteria: Application of definitions, algorithms or propositions. Combination and synthesis of concepts and proof or computational procedures. Taking initiatives to implement problem-solving strategies.

BIBLIOGRAPHY:

1. Thomas' Calculus, 14th edition, by Joel Hass, Christopher Heil, Maurice Weir
2. Vector Calculus, 3rd edition by Jerold E. Marsden, Antony J. Tromba

14.3 3rd Semester Courses

NUMERICAL ANALYSIS (31)

LEARNING OUTCOMES:

The aim of this course is to teach the student the necessary tools for the numerical solution of mathematical problems, the application of numerical methods and the implementation of these solutions with programs on PC. For this reason in the course laboratory the MATLAB software package is used, which makes it possible to implement and study the methods presented in theory. Upon successful completion of the course the student will be able to:

- understands the effect of truncation - rounding errors and method errors on numerical results as well as number systems and their representation
- selects the appropriate arithmetic method to use in each problem,
- implements algorithms for solving nonlinear equations
- implements algorithms for solving linear systems with direct and iterative methods,
-recognizes and implements basic data interpolation methods
-recognizes and implements basic regression methods
-knows and implements basic methods of arithmetic integration
- knows and implements basic methods for solving differential equations and systems of differential equations
-recognizes and uses MATLAB software and its tools with ease.

COMPETENCIES:

Research, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations
Independent work, Teamwork – distribution of responsibilities, Intellectual competences, Societal competence

CONTENT:

Introduction to Numerical Analysis,
Numerical Calculations and Errors,
Numerical Solution of Nonlinear Equations (Bisection Method, String Method, Newton Method)
Numerical solution of systems of equations
Numerical Solution of Systems of Linear Equations. Immediate Methods: Gaussian deletion,
Gauss-Jordan, LU factorization.
Repetitive Methods: Jacobi, Gauss-Seidel, successive over-relaxation.
Numerical Solution of Systems of Nonlinear Equations, Newton-Raphson method
Interpolation (Polynomial approach, Lagrange interpolation etc)
Approach (Minimum Squares)
Numerical Integration (Table Rule, Complex Table Rule, Simpson 1/3 & 3/8, Romberg Algorithm,
Integration by Gauss)
Numerical Solution of Ordinary Differential Equations (Euler Method. Improved Euler Method.
Runge-Kutta Methods: 2nd, 3rd and 4th order,Finite difference method.)
Systems of Ordinary Differential Equations.
Laboratory Exercises and applications in MATLAB

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: English / Greek

The final grade of the course is formed by 70% by the grade of the theoretical part and by 30% by the grade of the laboratory part.
1. The grade of the theoretical part is formed by a written final examination.
The written final examination of the theoretical part may include:
Solving problems of application of the acquired knowledge, Short answer questions etc
2. The examination of the Laboratory Exercises is carried out with the continuous evaluation of the laboratory skills and the theoretical knowledge that were acquired in the course by the method of continuous evaluation and submission of weekly assignments

BIBLIOGRAPHY:

Numerical Methods for Engineers 7th Edition by Steven Chapra, Raymond Canale, Boston: McGraw-Hill Higher Education.
Numerical Analysis, Tenth Edition, Richard L. Burden, J. Douglas Faires, Annette M. Burden, Cengage Learning Boston, USA
Numerical Analysis Using MATLAB® and Excel®, Third Edition, Steven T. Karris, Orchard Publications

ELECTRONIC SYSTEMS (32)

LEARNING OUTCOMES:

KNOWLEDGE
Functionality of the basic analogue electronics building blocks
Applications of the basic analogue electronics building blocks
Functionality of the basic digital electronics building blocks
ABILITIES
Calculation and modelling of simple analogue electronic circuits
Simulation of simple analogue electronic circuits
Design of combinational digital systems
Identification, analysis, design and implementation of applied analogue circuits and digital systems

COMPETENCES:

Search, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations
Independent work, Teamwork – distribution of responsibilities

CONTENT:

Analogue Part: Digital Part:

1. Introduction to Electronic Systems
2. Basic concepts (circuits and systems)
3. Diode
4. Bipolar Junction Transistor
5. Field Effect Transistor
6. Basic Circuits: Switches and amplifiers
7. DC and small signal models
8. Operational amplifiers
9. Digital Gates and CMOS
10. Analog to Digital Converters and Digital to Analog Converters
11. Oscillators
12. Applications
13. Summary

1. The Binary System
2. Logic Gates
3. Boole Algebra
4. Design Of Combinational Digital Systems
5. Basic Combinational Circuits: Half Adder, Full Adder, Decoder, Coder, Rom, Code Translators, 8-Bit Equality Comparator.
6. Design Errors
7. Characteristics Of Digital Integrated Systems
8. Basic Memory Units: The Flip-Flop
9. Basic Sequential Circuits: Registers And Counters
10. Simulation Of Combinational Circuits
11. Assembly And Testing Of Digital Circuits

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: English / Greek
* Analogue Part:
Public Presentations
Practical mid-term examination
Final Written Examinations
* Digital Part:
Final Written Examinations (50%)
Written Test of Progress in Binary System, Boolean Logic Gates And Algebra (25%)
Presentation of Work to An Audience (25%)
* Evaluation criteria:
Ability to Identify and Describe the Operation / Applications of Electronic Devices
- Ability to Solve Electronic Circuit Exercises
- Circuit Simulation Skills
- Skills of Assignment Preparation and Presentation

BIBLIOGRAPHY:
Microelectronic Circuits, Sedra Adel, Smith Kenneth, Tony Chan Carusone and Vincent Gaudet, 8th Edition, ISBN-10: 0190853506, 2020
Digital Electronics Principles and Applications, Roger L. Tokheim, Patrick E. Hoppe, 9th Edition, ISBN-10: 1260597865, 2021
Digital Electronics: A Practical Approach, W. Kleitz, 9th Edition, ISBN-10: 1292025611, 2013
Microelectronic Circuit Design, Jaeger Richard - Blalock Travis, 5th Edition, ISBN-10: 0073529605, 2015

STRENGTH OF MATERIALS (33)

LEARNING OUTCOMES:
This course aims to provide students with a basic understanding of the fundamental principles of mechanics of engineering materials, enable them to determine stresses and strains produced in structural members by external loads and acquire the ability to apply the basic concepts of mechanics of deformable bodies in engineering applications and design problems. Upon successful completion of the course the student will be able to:
- Use of stress-strain graphs to extract material properties.
- Understand the fundamental concepts of stress and strain transformation.
- Determine principal stresses and maximum shear stress in a general two dimensionally stressed system by analytical and graphical methods.
- Compute stress and deflections due to axial, transverse, torsional and combined loading conditions of a beam.
- Calculate shear stresses and their distribution in thin-walled section beams.
- Calculate thermal stress and strain.
- Analyse of statically indeterminate beams.
- Apply Euler's formula to predict buckling load of columns with typical end conditions.
- Understand different failure criteria for designing of safe structural members.

COMPETENCIES:
Search, Analysis and synthesis of data and information, independent work, Using corresponding technologies.

CONTENT:
- **Introduction to Stress and Strain Analysis:** Equilibrium of deformation body, Normal stress, Shear stress, Allowable stress design and factor of safety, Design of simple connections, Deformation, Strain, Components of strain.
- **Mechanical Properties of Materials:** Tensile and compression test, Normal stress-strain diagrams, Young's modulus, Yielding, Plastic deformation, Breaking strength, Hook's Law, Poisson's ratio, Shear stress-strain diagram, Shear modulus.
- **Geometrical Properties of Sections:** Centre of gravity, Moment of inertia, Polar moment of inertia, Radius of gyration, Product of inertia, Principal moment and principal axes of inertia, Mohr's circle for moment of inertia.
- **Axial Load:** Saint-Venant's principle, Elastic deformation of an axially loaded member, Thermal effects on axial deformation, Stresses in inclined Planes, Stress concentrations.
- **Bending of Beams:** Symmetric members in pure bending, Unsymmetrical bending analysis, Stress concentration, Bending deflection, Elastic curve, Double integration method.
- **Shear Stress in Beams:** Shear flow, Shear center, Shear Stress distribution, Shear stress in thin-walled cross-sections.
- Torsion: Torsion of circular shafts, Angle of twist, Torsion of thin-walled cross-sections.
- **Transformation of Stress and Strain:** Plane stress, Stress transformation for plane stress, Principal stresses and principal planes, Maximum shear stress and corresponding plane, Mohr's circle for plane stress, Plane strain, Transformation of strains in a plane. Mohr's circle for plane strain.
- **Statically Indeterminate Structures:** Displacement method, Energy Methods, Castigliano's theorem, Superposition method.
- **Combined Loadings:** Failure theories, Equivalent stress.

- **Buckling:** Buckling of columns, Critical load, Euler's formula.

TEACHING AND LEARNING ACTIVITIES:
Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA:
Assessment Language: Greek.
Final Written Problem-Solving Exam.

BIBLIOGRAPHY:
Ferdinand P. Beer, E. Russell Johnston, John T. DeWolf, David Mazurek, "Mechanics for Materials", 7th Edition, McGraw-Hill, 2014.
R. C. Hibbeler, "Mechanics of Materials", 9th Edition, Pearson Education, 2013.
Barry J. Goodno, James M. Gere, "Mechanics for Materials", 9th Edition, Cengage Learning, 2018.

PROBABILITY THEORY AND STATISTICS (34)

LEARNING OUTCOMES:
This course is designed as an introduction to the basic concepts of Probability Theory and Statistics, introducing the fundamentals for the analysis of probability models. Probabilistic modeling is widely used in the engineering sciences as it is a prerequisite for data processing and drawing conclusions and is fundamental to decision making. Students are invited to study the theoretical foundations of probability theory and mathematical statistics and will understand types of practical problems involving uncertainty, related to engineering as well to other scientific fields such as medicine and economics.
On completion of the course, students should be able to:
(a) manipulate the basic concepts of probabilities and calculate them in terms of the possible results of an event;
(b) understand and apply the basic methodologies for analyzing and solving uncertainty problems using models of random variables;
(c) analyze statistical data by hypothesis testing and parameter estimating and draw conclusions; and
(d) attend, without significant gaps, more specialized industrial engineering and management courses.

COMPETENCIES:
Research, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations, Decision making, Working in an international environment, Independent work, Teamwork – distribution of responsibilities, Working in an interdisciplinary environment, Practicing criticism and self-criticism, Promoting free, creative and inductive thinking.

CONTENT:
Probability Theory as a framework for describing and analyzing uncertainty. An overview of Set Theory. Basic Probability Models and Axioms. Independent events. Basic Listing Principle. Combinatorial Principles, Discrete Probability Calculation Applications.
Conditional Probability, Total Probability Theorem, Multiplication Rule, Bayes Theorem. Statistical Independence.
Random Variables: Definition of discrete and continuous random variables, Cumulative Distribution Function, Probability Mass Function, Probability Density Function.
Discrete Random Variables: Moments, Basic Distributions.
Continuous random variables: Moments, Basic Distributions.
Normal Random Variables: Properties, Standard Normal Distribution.
Multiple Random Variables: Joint and Marginal Distributions, Statistical Independence, Derived Distributions: Sum of Independent Random Variables. Joint Moments.
Boundary Theorems: Markov and Chebyshev Inequalities, Laws of Large Numbers, Central Limit Theorem.
Descriptive Statistics: Frequency Tables, Barcharts, Histograms, Stemplots, Dot Diagrams, Location Measures, Variability Measures.
Statistical Inference, Parameter Estimation, Point Estimation (Moments Method, Maximum Likelihood Estimation), Confidence Intervals. Linear Regression.

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: English / Greek
The grade of the course is formed 100% by a written final examination including problem solving, graphs, diagrams and calculations based on data.

BIBLIOGRAPHY:
Introduction to Probability, 2nd E, Dimitri P. Bertsekas and John N. Tsitsiklis, ISBN-13: 978-1886529236.
Probability and Statistics, Murray R. Spiegel (Schaum's Outlines), ISBN-13: 978-0071350044
Probability, Random Variables, and Stochastic Processes, 4th E, Athanasios Papoulis, S. Unnikrishna Pillai, ISBN-13: 978-0071226615

MANUFACTURING TECHNOLOGY (35)

LEARNING OUTCOMES:
Upon successful completion of the course, the student should be able to:
identify and describe basic machine tools used in modern manufacturing applications
acquire the principles of metrology and dimensional measurements
acquire skills of manufacturing and machining various parts using simple tools
be able to distinguish the appropriate processing for various manufacturing designs of parts, while at the same time looking for alternative manufacturing solutions in terms of the processes used
be able to prepare the appropriate planning of the processing phases

COMPETENCIES:
Research, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations
Independent work, Teamwork – distribution of responsibilities, Intellectual competences, Societal competence

CONTENT:
Casting procedures and materials. Casting phenomena during solidification-crystallization, castability, casting methods with consumable and permanent mold. Feeding system design. Casting defects. Casting equipment. Die casting presses. Casting tools.
Sintering. Powder metallurgy. Tools.

Machine tools: Overview of conventional material-removal processes. Turning. Milling. Drilling. Planning. Cutting fluids. Cutting with single-point and multipoint cutting tools of clearly defined geometry. Mechanics of chip formation. Cutting tools and tool wear. Machinability. Mechanics of grinding. Grinding wheels and grinding wheel wear. Cutting forces, temperature field generation, cutting geometry, cutting tool materials, wear and cutting life. Metrology: Overview on measurements, measuring instruments, measurement errors, tolerance and fitting systems, standard lengths, dimensional and angle control, dimensional tolerances, shape and position, surface quality measurement. Surface roughness.
Laboratory applications:

- Metrology control of parts.
- Metal casting.
- Manufacturing a mechanical part using machine tools.

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: English / Greek
The final grade of the course is formed by 70% by the grade of the theoretical part and by 30% by the grade of the laboratory part.
1. The grade of the theoretical part is formed by a written final examination.
The written final examination of the theoretical part may include:
Solving problems of application of the acquired knowledge, Short answer questions etc
2. The examination of the Laboratory Exercises is carried out with the continuous evaluation of the laboratory skills and the theoretical knowledge that were acquired in the course by the method of continuous evaluation and submission of weekly assignments

BIBLIOGRAPHY:
Metal casting a simple casting manual for small foundry, Chastain S., Vol. 1, 2004.
The complete handbook of sand casting, Ammen C. A., 1979, McGraw-Hill.
Science and Engineering of Casting Solidification, Stefanescu D. M., Second Edition, 2009, Springer.
Materials Processing during Casting, Fredriksson H., Akerlind U., 2006, John Wiley & Sons Ltd.

INDUSTRIAL HEALTH AND SAFETY (36.1)

LEARNING OUTCOMES:
After successfully studying this course student will be able to:
Understand basic concepts on Industrial Safety and Health and apply the knowledge to protect employees' health.
Prevent and estimate risk of an occupational accidents
Understand and use Personal Protective Equipment (PPE)
Understand and use and handle Hazardous Materials
Understand apply Ergonomics

COMPETENCIES:
Students will develop the following competences:
Search analysis and synthesis of data and information with relevant technologies
Autonomy and responsibility
Communication and social competences
Study and work in international environment
Study and work in Interdisciplinary environment
New research ideas

CONTENT:
Introduction to Industrial Management and Safety
Occupational accident
Personal Protective Equipment
Hazardous Materials
Fire Protection
Radioactivity
Electromagnetic Radiation
Noise
Lighting
Ergonomics
Estimate occupational risks

TEACHING AND LEARNING ACTIVITIES:
Face to face lectures
Project assignment
Hands on practice with equipment.
Synchronous and asynchronous communication
Teaching support with
Synchronous and asynchronous Learning Management System (LMS)
Communication with e-mail

ASSESSMENT CRITERIA: Multiple-choice final exams. Project assignment (individually or to a group of 2 students)

BIBLIOGRAPHY:
Health and Safety at Work: An Essential Guide for Managers - Jeremy Stranks, MPG Books Ltd, Bodmin, Cornwall (2008)
Introduction to health and safety at work, Phil Hughes and Ed Ferrett., Routledge Taylor & Francis Group (2016)

INFORMATION SOCIETY AND 4TH INDUSTRIAL REVOLUTION (36.2)

LEARNING OUTCOMES:

The aim of the course is to equip the student with the necessary knowledge and stimuli, to understand the basic parameters, dimensions of the modern socio-economic environment, the globalized information society.
The course is interdisciplinary, will not be heavily involved in specialization and analysis of concepts, but is an overview of all the latest developments in science and technology (especially IT) and how these developments affect the social and economic development. Reference will be made to several phenomena, such as Moore's law, which will give the necessary sense of historical continuity of scientific progress.
The aim of the course is for students to understand the big picture, the overall social, scientific, and economic context in which they will be called to develop and act as scientists, professionals, and people.
They will learn about the changes that are already visible in the workplace and the challenges posed by automation and the challenge of artificial intelligence.
Upon successful completion of the course the student will be able to:

- Understands key features of modern technological developments that define the information society.
- Knows and can describe basic phenomena and laws that distinguish the operation of individual areas of social and scientific phenomena.
- Distinguishes the basic directions that technological and scientific research has taken and the stakes that arise for the evolution of societies.
- Develop critical ability in relation to the general social, economic, and professional environment.

COMPETENCIES:
Research, analysis and synthesis of data and information
Literature review
Adaptation to new situations
Working in an interdisciplinary environment
Respect for diversity and multiculturalism
Respect for the natural environment
Exercise criticism and self-criticism
Demonstration of social, professional, and moral responsibility and sensitivity to gender issues
Promoting free, creative, and inductive thinking
Teamwork – distribution and delegation of responsibilities

CONTENT:
1. Introduction, goals, brief history of humanity. Social development and technology. Industrial Revolution. 1st era of machines- Muscular strength. 2nd age of machines-mental power.
2. From the 1st to the 4th industrial revolution, stages, and stations. The information society.
3. What is the effect of the industrial revolution on humanity? How much better is our world and why?
4. Clarification of terms: Fordism, neo-Fordism, modernity, postmodernity.
5. Examples of technological advances. The capabilities of machines threaten the human field of action.
6. Moore's law, the power of exponential improvement in the digital world. Big Data.
7. Digitization and its effects on the economy. The "free" business model. The limits of innovation. Artificial and human intelligence. Examples of fields of conflict and superiority.
8. Computer abundance. Productivity, labor, GDP from a new digital perspective! Digital assets. Copyright.
9. Digital gap. New inequalities in the information society. Skills, work-capital, and wages. The future of work. Effects of abundance and inequality. Technological unemployment. Globalization.
10. Network Effects. The market of the type "the winner gets it all". Normal distribution and Power Low distribution.
11. Acting together with the machines. What do computers not know how to do? Educating people. Changes in education.
12. Concerns about the political adaptations of societies. Education, Investment incentives, research, financing, infrastructure, taxation.
13. Suggestions-discussion for the future. Negative income tax. Peer economy and artificial intelligence. Risks and natural limits.

TEACHING AND LEARNING ACTIVITIES: Lectures, Project assignments, Projected presentations, E-mail communication, Interactive teaching, online synchronous and asynchronous teaching platform.

ASSESSMENT CRITERIA: Assessment Language: English / Greek
The final grade of the course is formed by 100% by the grade of the theoretical part. The grade of the theoretical part is formed by a written final examination.
1. The written final examination of the theoretical part may include multiple choice questions, solving problems of application of the acquired knowledge, short answer questions, essay development questions, comparative evaluation of theory elements
2. Optional work by the form of project will be given to those students who wish to specialize, study and present issues that interest them. Her participation in the final grade will cover 30%

BIBLIOGRAPHY:
[41955675]: The wonderful age of new technology, Brynjolfsson Eric, McAfee Andrew
[50658376]: The New Digital Age, Eric Schmidt, Jared Cohen
[16078]: Connected, N. CHRISTAKIS, J. FOWLER
[86055966]:21 lessons for the 21st century, Yuval Noah Harari

SPECIAL TOPICS ON PHYSICS (36.3)

LEARNING OUTCOMES:
Students will be able to understand in depth the principles and laws of thermodynamics and fluid mechanics and electromagnetism. They will have initially established the necessary mathematical formalism to describe the above laws. They will be able to describe the state of a fluid and interpret the basic laws. They will be able to construct motion equations for simple simplified models. They will be able to solve problems on these models. They are introduced to the content of the terms of thermodynamics through the treatment of the laws of ideal gas and heat engines, they become familiar with the basic concepts of classical thermodynamics, they extend its method to areas of physics other than gas, they are introduced to the equilibrium problems initial experience of modelling in the analysis of physical problems. They also come in contact with a first approach to the phenomena of the microcosm, the description of phenomena and experiments on light, electrons, atoms and crystals and finally with terms and concepts of Quantum Physics and Crystal Structure, the theories-foundation for the description of the phenomena of the microcosm.

COMPETENCIES: Literature review, Critical review of bibliography, Adaptation to new situations, Autonomous work, Teamwork – distribution and delegation of responsibilities, Promoting free, creative and inductive thinking, Adherence to good practice guidelines

CONTENT:
Fluid Mechanics, Pascal Principle, Archimedes Principle

Flow laws, Real fluids, Viscosity Exercises in Fluid Mechanics Heat, temperature. Thermometers, the ideal gas temperature scale. Reversible and irreversible process. Ideal gasses, equation of state, thermal motion of molecules, the Maxwell distribution. The Van der Waals gas. The first law of thermodynamics, work, heat, heat capacity calorimetry. Processes of an ideal gas. Second law of thermodynamics. Heat engines, Carnot cycle. Entropy. Electric charge, Coulomb's law. Electric field, Gauss's theorem. Electric potential Planck's theory of blackbody radiation. Energy quantization. Photons. Photoelectric effect. Compton effect. Pair production. X-rays production and diffraction. Bragg scattering. Moseley's law. Auger electrons. Absorption coefficient. The solid state structure. Experimental methods for the study of crystalline structure using X-rays. Molecular bonds. Molecular spectra.
TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.
ASSESSMENT CRITERIA: Assessment Language: English / Greek The final grade of the course is formed by 100% by the grade of the written final examination. The written final examination of the theoretical part may include: Solving problems of application of the acquired knowledge, Short answer questions etc.
BIBLIOGRAPHY: Fluid Mechanics, Robert A. Granger (Dover). Concepts of Modern Physics,Arthur Beiser, McGraw-Hill Education. Physics for Scientists and Engineers with Modern Physics. Serway, R.A. and Jewett, J.W. (2014) 9th Edition, Cengage Learning, Boston. Heat and Thermodynamics 7th Revised edition by Mark W. Zemansky; Richard H. Dittman, THE McGRAW-HILL COMPANIES, INC.

14.4 4th Semester Courses

MACHINE ELEMENTS I (41)

LEARNING OUTCOMES:

Upon successful completion of the course the student should

• be able to identify and describe the basic elements of a machine

• be able to apply the principles and rules of machine components and mechanical design through the analysis of simple machine components.

COMPETENCES:

• Search, analysis and synthesis of data and information, using the necessary technologies

•Decision making

• Autonomous work

• Exercise criticism and self-criticism

• Promoting free, creative and inductive thinking

CONTENT:

1. Introduction
2. Basics of strength of materials
3. Fatigue lifetime calculation
4. Axles and shafts
5. Calculation of resistance to static and dynamic loads
6. Calculation of initial dimensions and maximum operating speed
7. Processing of materials
8. Tolerances and joints
9. Surface roughness
10. Standardization and screw calculations
11. Rolling bearing calculation
12. Welding calculation
13. Modern computational methods

TEACHING AND LEARNING ACTIVITIES:

Face to face and/or distance lectures

Learning process support through the online learning platform of the course, which includes:

a) slides of the lectures,

b) recitations and detailed solutions of the main exercises for each sub-unit,

c) teaching notes adapted to the physiognomy of the offered study program,

d) communication with students via e-mail.

ASSESSMENT CRITERIA:

Students will be assessed with a written final exam that will include problem solving with a combination of knowledge of theory, calculations and critical evaluation (100%).

BIBLIOGRAPHY:

1. Machine Elements I, I. Stergiou and K Stergiou, 2003, in Greek

2. Machine Elements, Ch. A. Papadopoulos, 2nd Ed. Tziolas, 2015, in Greek

TRANSFORM THEORY AND SYSTEMS (42)

LEARNING OUTCOMES:

The course is designed as an introduction to the basic concepts of analysis and synthesis of linear systems, using the mathematical tools provided by the theory of transformations. On completion of the course, students should be able to:

(a) recognize the basic properties of systems and apply them when solving problems;

(b) interpret and process mathematically, both in time domain and in frequency domain (spectrum), the characteristics of analog and discrete signals as well as the characteristics of linear and time invariant (LTI) systems;

(c) draw the pole-zero diagram of the transfer function of an LTI system and analyze the effect of their position;

(d) calculate the output of an LTI system (for a given input) both in time and frequency domains, by using the appropriate transformations;

(e) model problems of different fields of science (engineering, economics, etc.) through linear and time-varying systems and to analyze them in time and frequency;

(f) formulate the sampling theorem as well as its consequences and apply it to the solution of signal and simple discrete system problems;

(g) interpret the discrepancies between the predicted and measurable behavior of the discrete systems; and

(h) attend, without significant gaps, more specialized industrial engineering and management courses.

COMPETENCIES:

Research, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations, Decision making, Working in an international environment, Independent work, Teamwork – distribution of responsibilities, Working in an interdisciplinary environment, Practicing criticism and self-criticism, Promoting free, creative and inductive thinking.

CONTENT:

Signals and Systems: definitions, classification, types of representation. The complex Fourier Series and the Fourier Transform. The Discrete Time and the Discrete Fourier Transform. Basic system properties: linearity, time invariance, causality, stability. Impulse and step response of a system, convolution. Difference equations and differential equations. Analysis of signals and systems in frequency domain. Spectral representation: magnitude and phase diagrams. Frequency response. Frequency selection filters. Laplace Transform and z-Transform. Transfer function. Pole-zero diagrams. Connecting LTI systems: parallel, cascade and feedback connection. The Nyquist–Shannon sampling theorem. Pulse Width Modulation. Design and implementation of discrete time systems with block diagrams. Parameter accuracy. Applications and examples.

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: English / Greek
The grade of the course is formed 100% by a written final examination including problem solving, graphs, diagrams and calculations based on data.

BIBLIOGRAPHY:
Signals and Systems - 2nd E, Oppenheim, Willsky, Nawab, ISBN 0-13-814757-4.
Signals, Systems and Transforms,4th E, CHARLES L. PHILLIPS , JOHN M. PARR, EVE A. RISKIN, ISBN-13: 978-0-13-198923-8.
Signal Processing & Linear Systems, 2nd E, B.P. Lathi, ISBN-13: 978-0195158335.

METROLOGY-QUALITY CONTROL (43)

LEARNING OUTCOMES:
The aim of the course is to provide the student with the necessary knowledge to understand the basic principles of operation of a measurement system and to perform measurements in which he will be able to determine their quality. Also to ensure the quality assurance of a product or service through quality control
Knowledge: Introduction to the science of metrology with emphasis on electrical measurements. Ways to perform measurements of different quantities and calculations of these uncertainties. Principles of operation of analog, electronic, digital measuring instruments. Knowledge around sensor systems and their interconnection circuits (active passive) with recording instruments. Quality Control, Quality Assurance. Quality control tools.
Skills: Calculation of measurement uncertainties (direct-indirect). Error calculations using classical error theory. Operation of analog, electronic, digital measuring instruments with emphasis on electrical measurements. Implementation of sensor interface circuits with recorders. Use of quality control tools
Competences: Implementation of measuring instrumentation by developing capabilities of measuring various physical quantities, calibrating and calculating uncertainties. Quality assurance of measurements and quality control of instruments and automation systems.
Design of a product or service quality assurance system.

COMPETENCIES:
Research, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations
Independent work, Teamwork – distribution of responsibilities, Intellectual competences, Societal competence

CONTENT:
- Introduction to Metrology, Static - Dynamic characteristics of measuring instruments
- Classical error theory,
- Measurement uncertainty, Type A, B uncertainty,
- Uncertainties in analog-digital instruments, Uncertainty of direct-indirect measurement
- Classification-types of measuring instruments, Analog - Digital instruments,
- Transducer sensors, Measurement of motion, level, volume, weight, temperature, flow pressure,
- Passive, active interconnection circuits.
- Introduction to quality and quality control
- Control charts - terminology
- Variable control charts
- Attributes control charts
- The sampling technique - acceptance sampling
- Quality assurance standards - quality control tools.

Laboratory Exercises: Oscilloscope, Potentiometer, Measurement Errors, Operational Amplifiers, Non-inverting, Follower, Inverting, Summing, Differential amplifier, Input Bias Current, slew rate, Non-inverting voltage conversion to current, Differential voltage converter to current, Differentiator, Integrator, Measuring sensors

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: English / Greek
The final grade of the course is formed by 70% by the grade of the theoretical part and by 30% by the grade of the laboratory part.
1. The grade of the theoretical part is formed by a written final examination.
The written final examination of the theoretical part may include:
Solving problems of application of the acquired knowledge, Short answer questions etc
2. The examination of the Laboratory Exercises is carried out insitu in order to evaluate laboratory skills and the theoretical knowledge that were obtained during the course teaching

BIBLIOGRAPHY:
Metrology and Quality Control, Avinash M Badadhe, Technical Publication Pune.
The Measurements Instrumentation and Sensors Handbook, Editor John Webster, CRC Press
Introduction to Statistical Quality Control, Sixth Edition, Douglas Montgomery, John Wiley and Sons

FLUID MECHANICS (44)

LEARNING OUTCOMES:
Note: The English Version of the 1-page Syllabus of this course is not yet available.

COMPETENCIES:

CONTENT:

TEACHING AND LEARNING ACTIVITIES:

ASSESSMENT CRITERIA:

BIBLIOGRAPHY:

PRODUCTION SYSTEMS (45)
LEARNING OUTCOMES: Students will demonstrate an understanding of production as a process of converting or transforming resources into products; demonstrate an understanding of the manager's concern in planning, organizing, directing, and controlling productive operations to meet organizational objectives; They will also understand productivity measures, quality and costs, both direct and indirect, and they will use a variety of problem-solving techniques to aid in effective decision making.
COMPETENCES: Search, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations Independent work, Teamwork – distribution of responsibilities
CONTENT: Operations management and productivity Quality and statistical process control Forecasting demand methods Design goods and services Process strategies and capacity planning Location strategies and layout strategies Human resources strategy Supply-chain management Inventory management Aggregate scheduling Material requirements planning management Principles of project management Maintenance and reliability
TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.
ASSESSMENT CRITERIA: Assessment Language: Greek Public Presentations of group projects (30%) Final Written Examinations (70%) Evaluation criteria: Ability to analyse and design a production system. Apply principles of process and capacity planning. Understand human resource management. Use the principles of supply-chain and inventory management.
BIBLIOGRAPHY: Scheduling: Theory, Algorithms and System, M. Pinedo, Springer, 2008; Production and Operations Analysis, 6th Edition, McGraw-Hill/Irwin Series Operations and Decision Sciences, Steven Nahmias, 2008. Operations Management, Stevenson, W.J., 12th Edition. McGraw-Hill Education, 2015. Production Systems Engineering, J. Li and S.M. Meerkov, Springer, 2009. Facilities Planning, James A. Tompkins, John A. White, Yavuz A. Bozer, J.M.A. Tanchoco. Product Design and Development, th Edition, K.Ulrich, S. Eppinger. Engineering Design Methods: Strategies for Product Design, 4th Edition, N. Cross, Wiley, 2008.

MICROELECTROMECHANICAL SYSTEMS (46.1)
LEARNING OUTCOMES: KNOWLEDGE Understanding of the Micro-Electro-Mechanical-Systems (MEMS) fabrication processes Understanding of operating principles of micro-sensors, micro-actuators and micro-generators Understanding of the main successful examples of MEMS technology ABILITIES Design of MEMS devices Process flow design for the fabrication of MEMS. Evaluation of the prospects for new microsystems Use of MEMS methods and services in the production process
COMPETENCES: Search, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations Independent work, Teamwork – Respect to the natural environment, Promotion of free, creative and inductive thinking
CONTENT: 1. Introduction to MEMS 2. Importance and capabilities 3. Scaling 4. MEMS materials 5. Micromachining techniques 6. Lithography 7. Process flows 8. MEMS Electronics 9. MEMS Mechanics 10. MEMS Application 1 (Micro-Energy) 11. MEMS Application 2 (Micro-Robots) 12. MEMS Foundries 13. Summary

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: English / Greek
Public Presentations
Practical mid-term examination
Final Written Examinations
Evaluation criteria:
Ability to design MEMS Systems
Ability to design fabrication process flows.
Ability to select and apply MEMS devices in real applications

BIBLIOGRAPHY:
Microsystem Design, Stephen D. Senturia, ISBN: 9780306476013, 2001
Introduction to Solid State Physics 8th Edition, Charles Kittel, ISBN-13: 978-0471415268, 2004

OBJECT-ORIENTED PROGRAMMING (46.2)

LEARNING OUTCOMES:
Upon successful completion of the course the student will:
- Obtain a deep knowledge of object-oriented programming, inheritance, dynamic data structures, implement data processing algorithms in object-oriented approach
- be able to analyze and develop complex programs that follow the object -oriented approach

COMPETENCIES:
Competency in analyzing and developing object-oriented programs.
Independent work, Teamwork – distribution of responsibilities

CONTENT:
Introduction to object-oriented programming
Constructors and Destructors
Function and Operator Overload
Inheritance
Recursive Functions
Algorithms
Exception Handling
Linked lists
Laboratory Exercises and applications in C/C++

TEACHING AND LEARNING ACTIVITIES: Lectures, Lab Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: Greek/English
The final grade of the course is formed by 60% by the grade of the theoretical part and by 40% by the grade of the laboratory part.
1. The grade of the theoretical part is formed by a written final examination, which may include:
Short answer questions, Program Analysis, Program development, Solving problems of application of the acquired knowledge,
2. The examination of the Laboratory Exercises is carried out with the continuous evaluation of the laboratory skills and the theoretical knowledge that were acquired in the course by the method of continuous evaluation and submission of weekly assignments

BIBLIOGRAPHY:
Object-Oriented Programming, Lecture Notes, D.E. Manolakis (Greek language)
English Language Textbooks
Object Oriented Programming in C++, R. Lafore, CourseSams Publishing
C++ How to Program (Early Objects Version), Paul Deitel, Harvey Deitel, 10th Edition, 2017, Pearson
Problem Solving with C++, Walter Savitch, Kenrick Mock (contributor, 10th Edition, 2018, Addison-Wesley Professional
Journals:
Computing in Science & Engineering (co-published by IEEE and AIP)
IEEE Transactions on Computers
IEEE Transactions on Software Engineering
Science of Computer Programming
Material from Internet:
www.tutorialspoint.com/cprogramming/
http://www.tutorialspoint.com/cplusplus/
http://www.learn-c.org/
http://www.cplusplus.com/
http://www.learncpp.com/
http://www.cprogramming.com

ADVANCED DIGITAL SYSTEMS (46.3)

LEARNING OUTCOMES:
KNOWLEDGE
Functionality of the digital sequential electronics building blocks
Applications of the digital electronics building blocks
ABILITIES
Synthesis of sequential digital circuits

Simulation of advanced digital electronic circuits
Identification, analysis, design and implementation of applied advanced digital circuits

COMPETENCES:
Search, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations
Independent work, Teamwork – distribution of responsibilities

CONTENT:
1. Latch, Flip/Flop
2. Shift registers
3. Asynchronous and synchronous counters
4. Moore and Mealy circuits
5. Mealy circuits synthesis: state assignment and coding
6. State elimination of redundant states
7. Asynchronous circuits analysis
8. Asynchronous circuits synthesis
9. Races and hazards
10. Simulation of combinational circuits
11. Assembly and testing of digital circuits
12. Digital circuits optimization

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected presentations, E-mail communication, Social networks, Online synchronous and asynchronous teaching platform.

ASSESSMENT CRITERIA: Assessment language: English / Greek
Final Written Examinations (50%)
Written Test of Progress in Binary System, Boolean Logic Gates And Algebra (25%)
Presentation of Work to An Audience (25%)
Evaluation criteria:
Ability to identify and describe the operation / applications of digital electronic devices
- Ability to solve digital circuit exercises
- Digital circuit simulation skills
- Skills of assignment preparation and presentation

BIBLIOGRAPHY:
Microelectronic Circuits, Sedra Adel, Smith Kenneth, Tony Chan Carusone and Vincent Gaudet, 8th Edition, ISBN-10: 0190853506, 2020
Digital Electronics Principles and Applications, Roger L. Tokheim, Patrick E. Hoppe, 9th Edition, ISBN-10: 1260597865, 2021
Digital Electronics: A Practical Approach, W. Kleitz, 9th Edition, ISBN-10: 1292025611, 2013
Microelectronic Circuit Design, Jaeger Richard - Blalock Travis, 5th Edition, ISBN-10: 0073529605, 2015

RELIABILITY MANAGEMENT ON THE INTERNET OF THINGS (46.4)

LEARNING OUTCOMES:
The aim of the course is to teach students both the necessary theoretical knowledge and the practical tools of the Internet of Things as well as trustworthiness management in it.
Upon successful completion of the course students will:
- be able to apply knowledge in practice, search, analyze and synthesize data and information using the necessary technologies
- be able to recognize and distinguish the principles and key features of trustworthiness on the Internet of Things and its development and use methodologies
- be able to describe the principles of trustworthiness and the Internet of Things, analyze and design systems and evaluate, compare and select the most appropriate methods in each case they study
- be familiar with methods of developing trust management systems and the Internet of Things
- is able to make decisions and work individually and / or in teams to design, develop and manage system applications

COMPETENCIES:
Research, analysis and synthesis of data and information
Using corresponding technologies
Setting objectives
Project design
Setting priorities
Decision making
Monitoring results
Autonomous work
Developing new research ideas
Adherence to good practice guidelines

CONTENT:
• Introduction to the Internet of Things and trust management
• Infrastructure and equipment of the Internet of Things
• Internet of Things applications
• Reference architecture, scaling, standardization and trustworthiness
• Artificial Intelligence Technologies and Intelligent Agents on the Internet of Things
• Knowledge Representation and Communication
• Trustworthiness management models
• Game Theory, Social Choice Theory
• Negotiation
• Argumentation / Logical Argumentation

• Interoperability and Ontological Approaches • Embedded Systems, Development Platforms, Operating Systems • Learning, Systems Development, Simulation, Practical Part, Examples
TEACHING AND LEARNING ACTIVITIES: Lectures Exercises Project assignments Online guidance Projected presentations E-mail communication Online synchronous and asynchronous teaching platform Interactive teaching
ASSESSMENT CRITERIA: Assessment Language: English / Greek The final grade of the course is formed by a written final exam and project. The written final exam may include: Solving problems of applying the acquired knowledge, Short answer questions, multiple choice questions.
BIBLIOGRAPHY: Kalovrectis K. (2018) Basic Structures of Embedded Systems. Markella I. ISBN: 978-960-7996-80-0 Kalovrectis K., (2018) Measurement and Control Sensors, 3rd Edition. PUBLICATIONS A. TZIOLA & SONS SA ISBN: 978-960-418-758-4 Russell S. & Norvig P. (2009). Artificial Intelligence: A Modern Approach (3rd Edition). Pearson, UK. ISBN 0136042597

RELIABILITY AND MAINTENANCE (46.5)
LEARNING OUTCOMES: Students are expected to understand the importance of the maintenance and process improvement functions within industry. Also, to understand the various methodologies used in industry to estimate the level of reliability and remaining life of a critical component and system at a certain point in time, using statistical and mathematical techniques. They will be capable of conducting a reliability study and make recommendations with respect to the maintenance plan.
COMPETENCES: Search, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations Independent work, Teamwork – distribution of responsibilities
CONTENT: Issue analysis and data visualization techniques, Summary statistics and probability distribution theory Statistical Hypothesis testing – Student's t-test Simple and multiple linear regression Component reliability and Weibull analysis System reliability Condition Monitoring and Physical Degradation Models Maintenance Theory Technical Process Identification, Characterization and Modeling
TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.
ASSESSMENT CRITERIA: Assessment Language: English / Greek Public Presentations of group projects (30%) Final Written Examinations (70%) Evaluation criteria: Ability to determine system reliability. Apply reliability and maintenance principles of process analysis and design. Identify component reliability and use physical degradation models.
BIBLIOGRAPHY: Modarres, Kaminsky and Krivtsov, Reliability Engineering and Risk Analysis – A practical guide, Macmillan, ISBN 978-0-8493-9247-4. Production Systems Engineering, J. Li and S.M. Meerkov, Springer, 2009. Facilities Planning, James A. Tompkins, John A. White, Yavuz A. Bozer, J.M.A. Tanchoco.

14.5 5th Semester Courses

METAL FORMING PROCESSES (51)

LEARNING OUTCOMES:

- Understanding the underlying physical processes and the effects of temperature and friction during the plastic deformation of metallic materials.
- Learning the basic principles and laws of the theory of plasticity and applying them to assess the deformation potential, the required force and work and the final properties of the work pieces.
- Getting acquainted with the main methods of metal forming as well as the design and use of relevant machinery and tools.
- Developing the ability to plan, to select the appropriate material and equipment and to perform the necessary calculations for the production of the desired parts.

COMPETENCIES:

Research, analysis and synthesis of data and information
Using corresponding technologies
Decision making
Autonomous work
Promoting free, creative and inductive thinking

CONTENT:

Classification and application of metal forming processes.
Effects of plastic deformation on the crystal lattice of metallic materials, shifting of lattice defects, hardening and aging of metals, stress - strain curves. Annealing, recrystallization, cold and hot plastic deformation.
Friction and lubrication in forming processes, surface protection, types of lubricants and their application.
Elements of the theory of plasticity: yield criteria, fracture, stress – strain relation, continuity equation, plastic flow rule, equivalent stress and equivalent strain, calculation of force and work.
Forming processes: Forging, extrusion, rolling, cutting, bending, deep drawing.
Cutting and shaping tools.
Design and operation of metal forming machines: shearing machines, sheet bending machines, tube bending machines, punches, screw presses, eccentric presses, hydraulic presses.

TEACHING AND LEARNING ACTIVITIES:

Lectures
Exercises
Laboratory
Projected presentations
E-mail communication
Online synchronous and asynchronous teaching platform
Interactive teaching

ASSESSMENT CRITERIA: Assessment Language: Greek
Final written examination including theoretical part (70%) and solving exercises (30%).

BIBLIOGRAPHY:

T.Z. Blazynski: Plasticity and Modern Metal-forming Technology, 1989, Elsevier, ISBN 978-1-85166-272-2
S. Kalpakjian, S. Schmid: Manufacturing Engineering and Technology Prentice Hall; 5th edition

CONTROL SYSTEMS I (52)

LEARNING OUTCOMES:

The course develops a basic understanding of the fundamental concepts of control systems theory from a mathematical and physical point of view. Extensive reference is made to the concepts of mathematical modelling and dynamic behaviour of systems, in both time and frequency domains. The course introduces and completes the basic theory of analysis of continuous time control systems based on the mathematical model of the transfer function. The consolidation of the course material creates the basic background and is a prerequisite for the understanding of related courses that follow in the curriculum, such as Control Systems II, Control Systems III, Process Control and Digital Control Systems.
Upon successful completion of the course the student will be able to:

- understand the use of feedback in controlling closed loop systems and the advantages it offers;
- examine stability using a variety of methods and predict the response time characteristics of systems of any order;
- apply the process of mathematical representation and analysis of closed loop systems both in the time and frequency domains;
- attend more specialized courses of the theory and practice of automatic control systems.
- recognizes and uses MATLAB software and its tools with ease

COMPETENCIES:

Research, analysis and synthesis of data and information using corresponding technologies, decision making, adaptation to new situations, promoting free, creative and inductive thinking, independent work, teamwork

CONTENT:

Laplace transform, inverse Laplace transform, method of residuals.
Basic concepts of open and closed loop automatic control systems, advantages of the use of feedback, real-world examples.
Mathematical representation of systems in the time domain, mathematical models, models of physical systems.
Block diagrams, transfer functions, time response characteristics.
Characteristics of closed loop systems, steady state errors.
Mathematical representation of systems in the frequency domain (frequency response, Bode diagrams, Nyquist diagrams, Nichols chart).
Introduction to the concept of stability, Routh-Hurwitz and Nyquist stability criteria, root locus.
Exercises and applications in MATLAB

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: English / Greek
The final grade of the course is formed 100% by the grade of the theoretical part.
The grade of the theoretical part is based on a written final examination.
The written final examination of the theoretical part may include:
Solving problems of application of the acquired knowledge, Short answer questions etc

BIBLIOGRAPHY:
Control Systems Engineering , Norman Nise
Modern Control Systems, Dorf & Bishop
Feedback Control of Dynamic Systems , Franklin & Powell
Modern Control Engineering, Ogata
Analog and Digital Control System Design: Transfer-Function, State-Space, and Algebraic Methods , C.T. Chen
Automatic Control Systems, Kuo
Design of Feedback Control Systems, Stefani, Bahram Shahian, Clement J. Savant

ELECTRICAL MACHINES AND MOTOR DRIVE SYSTEMS I (53)

LEARNING OUTCOMES: The aim of the course is to provide theoretical and descriptive experience on the basic principles of electrical machines technology and the technology of the electronic power converters for motor driving. In particular, it puts emphasis on the documentation of the various types of electrical motors that have a significant role in industrial technological applications, the analysis of their operating principles, their construction details and their mathematical modelling. Furthermore, the course focuses also on electrical energy conversion applications with direct use in an industrial environment and motion applications such as AC/DC and DC/DC power supplies and DC/AC inverters, presenting their operational characteristics, their construction details and modelling principles.
Being a course with a specific scientific and technological area focus, it offers to the new Industrial & Management Engineer the background for the comprehension and the implementation of various applications that refer to motor drive systems and their speed and torque control. In addition, it provides the opportunity to understand the use of power electronics converter systems for motor drives. The consistent and successful completion of the course, has the expected outcome to enable the student to:
a) identify the type of an electrical machine, classify it and be in a position to electrically connect it.
b) comprehend the basic properties of each type of an electrical machine and determine its mechanical and electrical behaviour.
c) select, based on technoeconomic criteria, the optimal type of electric motion for a particular application.
d) calculate the efficiency of a motor drive system.
e) take decisions on preventive and repressive maintenance of electrical motors.
f) be in a position to classify the various power electronic converters based on their characteristics and the type of application.
g) be in position to understand the basic operational specifications of an existing (currently in use) power electronic converter and to set the necessary specifications of new converters based on the intended application.
h) comprehend the operational characteristics of a converters, the potential impact of their operation on power quality in an industrial environment and the ways to alleviate the consequences.
i) understand the construction characteristics and the structure of the converters, so that, if possible, to be in a position to replace parts or perform maintenance.
j) understand the basic principles of power converters use for industrial control of energy supply and motion systems.
k) be in a position to perform basic design of power converters use, depending on the application.

COMPETENCES: Practical application of knowledge, search, analysis and synthesis of information and data using appropriate technologies; Adjustment to new situations; Decision making; Autonomous work; Team work; Work in an interdisciplinary environment.
Design and project management; promotion of free, creative and inductive thinking; priorities setting; production of new research ideas; compliance to guidelines of good practices.

CONTENT: 1. Basic principles from rotating systems mechanics: angular speed, mechanical power of a rotating shaft, moment of inertia, Newton's law for rotation, energy, mechanical work, power, principle of energy/power conservation. Introduction: basic families of motor drives converters and indicative applications, basic mathematical principles (DC and rms values of voltage and current waveforms).
2. Basic principles from electromagnetic fields theory (electrotechnology). Magnetic flux production. Permanent magnets, electromagnets, ferromagnetic materials, magnetization (hysteresis) curve. DC and AC electrical circuits, using switches: state-space analysis and equations, plotting of current waveforms, basic calculations and examples.
3. Faraday's induction law, Laplace force on a current carrying conductor, electromotive (emf) force on a conductor that moves inside a magnetic field. Magnetic flux density and intensity.. Measurement units Wb, T, A/m. Basic power electronics switches in motor drives converters: diode, thyristor, power transistor, IGBT, MOSFET, GTO, characteristics and applications examples.
4. Transformers. Power diodes: use, selection, basic circuits with power diodes (single and three phase), ripple calculations, capacitor charging/discharging issues, examples. Diode converters specifications.
5. The simplest electrical machine: two conductors inside a constant magnetic field. Voltage production, torque production. Brushes. The general case for more conductors. Equations $E=k\omega\phi$ and $T=kI\phi$. Structure of a DC machine. Thyristors: use, selection, basic circuits with controlled AC/DC motor drive converters (single or three phase) using thyristors, ripple calculations, examples. Thyristor converters specifications.
6. Armature reaction, distortion of magnetic field, reduction of magnetic flux under load conditions, solutions applied. Winding types, lap and wave windings. Construction details: axis (shaft), bearings, fan, commutator, brush holders, cooling fins, technological materials. The principle of "power quality": harmonics in power networks, origin, presence in dc and ac systems, effects, harmonic standards requirements, THD.
7. Type of DC motors excitations: permanent magnets (PM), separately-parallel-in series-compound excited machines. Speed/torque characteristic for each type of excitation. Typical applications of each type of the machines. Introduction to single phase inverters with power transistors: basic operational principles, principles of modulation, PWM, applications and examples.
8. Speed control in a DC motor. Variable speed drives (DC drives): principle of operation and industrial applications. PWM operating principles, basic control parameters, implementation of sinusoidal PWM and applications in DC/AC converters. PWM harmonics. Examples and design.

9. AC machines classification map. Terminology. The permanent magnet synchronous machine as a reversed DC machine. Rotating magnetic field. Brushless commutation in the stator. Similarities and differences with the DC machine. Three phase inverters with power transistors: basic operating principles, 6 pulse and PWM operation. Applications in motor drive systems. Introduction to basic motor control principles.
10. Introduction to the permanent magnet synchronous motor: PMAC, PMSM and BLDC machines. Drives requirements for operating synchronous motors. Starting torque and acceleration procedure. Description of a basic servo drive. Speed control. AC motor drives operating principles – control methods.
11. Short introduction to separately excited synchronous machines as generators. Special machines for servomotor systems: step motor, synchro machine etc. Short introduction to induction motors. Capability of producing a magnetic field from the rotor without PM or electromagnets. DC/DC step down (buck) converter: operating principle, design, application, voltage control
12. The rotating transformer. Types of rotor winding in an induction motor: squirrel cage and wound rotor machines. Slip. The nameplate of an induction motor. Star (Y) and Delta (D) connection. Terminal box. DC/DC step up (boost) converter: operating principle, design, application, voltage control.
13. The equivalent circuit of an induction motor. Parameters that influence the magnetizing current. Speed control with VFD. Speed/torque characteristic for a squirrel cage and wound rotor machine. Wound rotor machine application in contrast to the squirrel case. Power losses in an induction motor. Examples, exercises. Operating principles of DC motor drives – control methods.

TEACHING AND LEARNING ACTIVITIES: Class theory, teaching in discussion groups and students' active participation. The lectures are supported by presentations of the total content, while the whiteboard is used: a) for further elaboration of selected thematic sections, b) for the promotion of the students' active participation in step-by-step problems solving and examples process.

ASSESSMENT CRITERIA: The course grade is formulated by a final written exam which may contain: multiple choice questions, problems solving based on knowledge acquired, short answers' questions, comparative assessment of theoretical principles.

BIBLIOGRAPHY:

1. Chapman S., «Electric Machinery Fundamentals», 5th Edition, ISBN-13: 978-0073529547, McGraw Hill
2. Fitzgerald, Kingsley, Umans, "Electric Machinery", 6th Edition, ISBN-13: 978-0071230100, McGraw Hill
3. Mohan N., Undeland T and Robbins W, "Power Electronics: Converters, Applications and Design", ISBN-13: 978-0471226932, John Wiley & Sons Inc.

DATABASE SYSTEMS AND DATA STRUCTURES (54)

LEARNING OUTCOMES:

KNOWLEDGE
Introduction to Database Systems and Data Structures
Assessment of database architectures and their use in ICT applications
Database Entities and Database Schema Design
Relational databases and Entity Relationship Diagram Design
Introduction to the SQL programming language
Identification of the basic user roles in modern Database Systems
Data and Information
ABILITIES
Analysis, design and implementation of Database Systems
Designing and implementing Entity Relationship Diagram models
Assessment database architectures
Using data structures in databases

COMPETENCES:

Search, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations
Independent work, Teamwork – distribution of responsibilities

CONTENT:

Theory:

1. Introduction to Database Systems
2. Introduction to Data Structures
3. Relational Database – Data Modelling
4. Database Entities and Data Structures
5. Database Constraints
6. Database Design Diagram
7. Introduction to SQL (Structured Query Language) a standardized programming language
8. Complex SQL queries
9. Database indexes, Database Views, Query optimization,
10. Non-relational Databases (NoSQL databases)
11. Big Data management
12. Information retrieval and Data Mining
13. Databases Management Systems – Database Security

Lab:

1. Introduction to database management tools and technologies
2. Access database management system
3. Hands-on for building a relational database
4. Data entry in database systems
5. Creating simple and complex queries
6. Manipulating data using sql queries

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: English / Greek
Theory (70%)
Public Presentations
Practical mid-term examination
Final Written Examinations
Lab (30%)
Public Presentations
Final Examinations

Evaluation criteria:
- Ability to Design and Implement Relational Databases
- Ability to program in SQL
- Ability to design a database
- Skills for managing databases
- Skills for Assignment Preparation and Presentation

BIBLIOGRAPHY:

Modern Database Management Hardcover by Jeffrey A. Hoffer (Author), V. Ramesh (Author), Heikki Topi ISBN: 978-960-418-502-3
Database Management Systems, 3rd Edition Raghu Ramakrishnan (Author), Johannes Gehrke (Author) ISBN: 978-960-418-411-8

NON-DESTRUCTIVE TESTING (55.1)

LEARNING OUTCOMES:

Learning goals:
Presentation of fault types and the fundamental natural and mechanical material characteristics that can be identified / measured using non-destructive testing methods
Presentation of the main methods of non-destructive testing and material measurement techniques
To become proficient in method selection and device design, and use appropriate instrumentation to conduct non-destructive tests and measurements
To proficiently evaluate NDT results
Design and implement quality control of materials and products. To perform measurements at different scales without destroying the measured object.

COMPETENCES:

Search, analysis and synthesis of data and information using the appropriate technologies, Adaptation to new situations and technical problems, Team work, Working in an international environment, Working in a multi-disciplinary environment, Production of novel research ideas

CONTENT:

CONTENTS:

1. Introduction to non-destructive testing (NDT)
2. Visual and optical testing
3. Liquid penetrant testing
4. Magnetic particle testing
5. Electromagnetic – Eddy current testing
6. Radiographic testing
7. Radiation protection
8. Ultrasonic testing
9. Thermal / infrared testing
10. Acoustic emissions
11. X-ray florescence analysis, XRF testing
12. Educational visit to a relevant company

Presentation of student projects - discussions

TEACHING AND LEARNING ACTIVITIES: Theory is taught in the classroom (face-to-face lectures), Use of slide presentations. Internet searches, Communication between teacher and students by e-mail, Experimental testing using measuring instruments, Submission of student projects, Educational visit to a relevant company

ASSESSMENT CRITERIA: Assessment Language: English / Greek
Written final examinations with multiple choice questions, essay-type questions and problem solving.
Optional Project: Presentation of a non-destructive testing (NDT) -related topic by either an individual student or a group of two students. If chosen, this project counts for 50% of the final examination mark.
Students must pass the final written examinations regardless of whether the optional project is chosen.
Transparent evaluation of examination results including explanations of student mistakes or shortcomings.

BIBLIOGRAPHY:

Nondestructive Testing, Theodoros Matikas [in Greek]
Handbook of Nondestructive Evaluation, Charles Hellier
Introduction to Nondestructive Testing: A Training Guide, Paul Mix
Industrial Radiology: Theory and Practice (Non-Destructive Evaluation Series), R. Halmshaw

EMBEDDED SYSTEMS (55.2)

LEARNING OUTCOMES:

KNOWLEDGE
Functionality of the embedded system building blocks
Applications of the embedded systems
Internet of Things
ABILITIES
Synthesis and programming of embedded systems
Interfacing peripherals to a microcontroller
Use of Internet of Things with embedded and /or external services

COMPETENCES:

Search, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations
Independent work, Teamwork – distribution of responsibilities

CONTENT:

1. Embedded systems architecture
2. Elements of programming languages: Assembly, C++, Python, Rust
3. Arduino
4. General purpose I/O
5. Interrupts
6. Pin Change Interrupts, Keyboard interface
7. Asynchronous serial communication
8. 8 bits timers
9. 16 bit timers
10. Measures of time and frequency with timers
11. PWM (Pulse Width Modulation)
12. ADC (Analog to Digital Converter)
13. LCD interface
14. SPI (Serial Peripheral Interface)
15. TWI (Two Wire Interface - I2C)
16. Libraries
17. (IoT) Internet of Things

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected presentations, E-mail communication, Social networks, Online synchronous and asynchronous teaching platform.

ASSESSMENT CRITERIA: Assessment language: English / Greek
Final written examinations (25%)
Written test of progress in interrupts and timers (25%)
Presentation of work to an audience (50%)
Evaluation criteria:
- Ability to identify and describe the operation / applications of embedded applications
- Ability to implement embedded applications
- Ability to interface an embedded system to the cloud
- Skills of assignment preparation and presentation

BIBLIOGRAPHY:
Book [978-960-602-270-8]: Embedded Systems, N. Nikolaidis, Kyriakidis Bros - Editions S.A.
Microcontrolers. Exercises, Experiments and Applications with ATmega32, N. Nikolaidis, Kyriakidis Bros - Editions S.A., ISBN 978-960-602-217-3, 2018

DECISION SUPPORT SYSTEMS (55.3)

LEARNING OUTCOMES:
Students will demonstrate an understanding of decision taking processes; The course is devoted to introduce decision support systems; show their relationship to other computer-based information systems, demonstrate DSS development approaches, and show students how to utilize DSS capacities to support different types of decisions.

COMPETENCES:
Search, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations
Independent work, Teamwork – distribution of responsibilities

CONTENT:
Decision Making and Computerized Support
Management Support Systems
Characteristics and Capabilities of DSS;
Components of DSS;
The Data Management Subsystem;
The Model Management Subsystem;
The User Interface (Dialog) Subsystem;
The Knowledge-Based Management Subsystem;
DSS Hardware; DSS Classifications
DSS Modeling; Static and Dynamic Models;
Certainty, Uncertainty, and Risk; Influence Diagrams;
DSS Modeling with Spreadsheets; Decision Analysis of a Few Alternatives (Decision Tables and Decision Trees);
Mathematical Programming Optimization.
Business Intelligence: Data Warehousing, Data Acquisition,
Data Mining, Business Analytics, and Visualization
Introduction to DSS Development; The Traditional System Development Life Cycle; Alternative Development Methodologies; Prototyping:
Knowledge Management
Artificial Intelligence and Expert Systems:
Knowledge Acquisition, Representation, and Reasoning

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: Greek
Public Presentations of group projects (30%)
Final Written Examinations (70%)
Evaluation criteria:
Ability to analyse and design a decision support system. Apply principles data mining, business analytics and visualization. Understand artificial intelligence applications in decision support

BIBLIOGRAPHY:

F. Burstein, C. Holsapple, 'Handbook on Decision Support Systems 2', Springer, 2008.
Operations Management, Stevenson, W.J., 12th Edition. McGraw-Hill Education, 2015.
Production Systems Engineering, J. Li and S.M. Meerkov, Springer, 2009.
Engineering Design Methods: Strategies for Product Design, 4th Edition, N. Cross, Wiley, 2008.

GENERALISED SYSTEMS THEORY (55.4)

LEARNING OUTCOMES:

General Systems Theory is a discipline of seeing the "whole", recognizing patterns and interrelationships, and learning how to innovate a more effective, efficient and creative system solution. This course will acquaint students to basic concepts of systems thinking. The primary emphasis will be the introduction of basic systems thinking fundamentals, i.e. defining a systems perspective about any situation or problem, solving problems with that perspective, describing and modeling a problem, and designing and improving upon system solutions. After completing this course students will be able to:

- Establish a basic understanding of general systems terminology, theories, processes, methods, language and tools.
- Evaluate when it is appropriate to apply thinking methods, i.e. reductionist methods (data collection, scientific method, etc.) as opposed to applying systems thinking methods (Systems Engineering, Breakthrough Thinking/Smart Questions, etc.)
- Describe and model solutions that will enable system thinking (mind maps, feedback & causal loops, behavior over time diagrams, etc.)
- Apply systems engineering and analysis techniques to various problems. (socio - technical, supply chain, value chain / lean, etc.)

COMPETENCES:

Search, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations
Independent work, Teamwork – distribution of responsibilities

CONTENT:

Introduction: Definitions & Concepts, System Principles & Concepts (Reductionist vs Holistic), Key Terminology
A View from the Past to Present: General Systems Theory, System Science, Systems Approaches, Cybernetics
Dealing with Complexity: Hierarchy, Evolution, Description, Emergence, Adaptive Complex Systems
Process & Methods I: Hard, Soft, Evolutionary, and Complex Adaptive Systems
Process & Methods II: Systems Engineering & System Concept & Design
Case Study: Describing and Understanding the Problem, Translating system objectives and the future solution description into a problem statement.
Creative / Brainstorming Tools: Lateral Thinking, Systems Thinking Diagrams (ex. Mind Maps)
Problem – Solving Tools: Decision Analysis, Casual Analysis,
Systems Thinking Tools (Feedback, Causal Loops, N^2 charts, etc.),
Software Tools (ex. Stella, IThink, Vensum, Systemigram, etc.)
Systems Implementation: Spiral vs incremental implementation, Timely system implementation
Planning system design and technical implementation: Prioritize system capability phasing, Technology Road-mapping
Applications I: Socio-Technical System
Applications II: Value Chain / Lean
Application III: Global Warming

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: Greek
Public Presentations of group projects (30%)
Final Written Examinations (70%)
Evaluation criteria:
Ability to analyse and design a general system. Use appropriate system tools for systems implementation. Transfer general systems theory concepts and applications to different contexts.

BIBLIOGRAPHY:

Virginia Anderson and Lauren Johnson (1997) Systems Thinking Basics: From Concepts to Causal Loops (Pegasus)
Bela H. Banathy (2000) The Guided Evolution of Society NY: Plenum/Kluwer Academic
Ludwig von Bertalanffy (1968) General System theory: Foundations, Development, Applications, George Braziller New York
Peter Checkland Jim Scholes (1990) Soft Systems Methodology in Action. (Wiley) ISBN 0-471-92768-6
Peter Checkland Jim Sue Holwell (1998) Information, Systems and Information Systems. (Wiley) ISBN 0-471-95820-4
Jamshid Gharajedaghi Systems (2005) Thinking, Second Edition: Managing Chaos and Complexity: A Platform for Designing Business Architecture (Butterworth-Heinemann)

AERODYNAMICS (55.5)

LEARNING OUTCOMES:

Note: The English Version of the 1-page Syllabus of this course is not yet available.

COMPETENCIES:

CONTENT:

TEACHING AND LEARNING ACTIVITIES:

ASSESSMENT CRITERIA:

BIBLIOGRAPHY:

MACHINE ELEMENTS II (55.6)

LEARNING OUTCOMES:

Upon successful completion of the course the student should
• be able to identify and describe the various drive systems and their uses
• be able to select and calculate the necessary technical quantities of the drive systems, in order to analyze and synthesize mechanical structures.

COMPETENCES:
• Search, analysis and synthesis of data and information, using the necessary technologies
• Decision making
• Autonomous work
• Exercise criticism and self-criticism
• Promoting free, creative and inductive thinking

CONTENT:
1. Introduction
2. Typical sizes of gear wheels
3. Types of gear wheels
4. Involute gear tooth geometry
5. Tooth undercuts
6. Marginal number of teeth
7. Tooth damage - lubrication
8. Spur and helical gears
9. Conical and worm - wheel gear drives
10. Forces acting on gear wheels
11. Fracture toughness and tooth wear analysis and calculation
12. Belt drives
13. Chain drives

TEACHING AND LEARNING ACTIVITIES:
Face to face and/or distance lectures
Learning process support through the online learning platform of the course, which includes:
a) slides of the lectures,
b) recitations and detailed solutions of the main exercises for each sub-unit,
c) teaching notes adapted to the physiognomy of the offered study program,
d) communication with students via e-mail.

ASSESSMENT CRITERIA:
Students will be assessed with a written final exam that will include problem solving with a combination of knowledge of theory, calculations and critical evaluation (100%).

BIBLIOGRAPHY:
1. Machine Elements II, I. Stergiou and K Stergiou, 2002, in Greek
2. Machine Elements, Ch. A. Papadopoulos, 2nd Ed. Tziolas, 2015, in Greek

HYDRAULIC – PNEUMATIC SYSTEMS (55.7)

LEARNING OUTCOMES:

Knowledge

Understanding:
- the basic concepts and principles of Fluid Mechanics
- the operational characteristics of hydraulic and Pneumatic elements
- how to implement hydraulic and pneumatic circuits through a combination of valves, cylinders, etc. for automation applications

Skills

Acquisition of proficiency in:
- the identification of hydraulic and pneumatic elements
- reading diagrams of hydraulic and pneumatic circuits
- the implementation of hydraulic and pneumatic circuits

Abilities

Analysis and synthesis of hydraulic and pneumatic systems as well as capability to implement automatic operations

COMPETENCIES:
Search, analysis and synthesis of data and information using the necessary technologies
Adaptation to new situations
Autonomous work
Teamwork

CONTENTS:
Basic Concepts and Principles, Hydraulic and Pneumatic Components, Pumps, Motors, Pistons, Tanks, Filters, Accumulators, Directional Valves, Push button Valves, 2, 3, 4, and 5 Port (Way) Valves, 2 and 3 Position Valves, Pressure Valves, Flow Valves, Choke Valves, Check Valves, Roller Valves, Analog Valves, Hydraulic and Pneumatic Circuits for Automation.

TEACHING AND LEARNING ACTIVITIES:
Lectures, Laboratory Exercises.
Slides, Demonstrations with the aid of hydraulic and pneumatic hardware
Use of computer simulations
Use of online teaching aids

ASSESSMENT CRITERIA:
Language: Greek
Final Written Examinations

Assessment criteria
- Ability to calculate magnitudes in static and dynamic hydraulic and pneumatic conditions
- Ability to assess hydraulic and pneumatic behavior
- Ability to analyze and synthesize hydraulic and pneumatic circuits and systems

BIBLIOGRAPHY:

Applied Fluid Mechanics 7th Edition, Mott Robert, Untener Joseph, ISBN-10: 0132558920 Pearson, 2014
Fundamentals of Fluid Mechanics 7th Edition, Munson, Okooshi, Huensch, Rothmayer, ISBN-10: 1118116135, Wiley, 2012

ENGINEERING SOFTWARE (55.8)

LEARNING OUTCOMES:

The learning objectives is to:

- Introduce the student to Software used in the study and problem solving in the field of Industrial Engineering and Management.
- Provide him with the appropriate knowledge and skills to be able to simulate and solve problems in the various fields of engineering science (eg Applied Mathematics, Automated Control Systems, Signals and Systems, Electrical Circuits, etc.).
- Use the Computer Control (CC) and MATLAB (Simulink) software for the above procedures, in addition to the standard method.

COMPETENCIES:

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Working independently
Teamwork
Project planning and management
Production of new research ideas

CONTENT:

The taught modules concern:

1. Introduction to Matlab and Simulink
2. Signal creation
3. Even and odd signals
4. Signal power calculation
5. Fourier Series signal analysis
6. Frequency response of Transfer Functions
7. Generating Time Functions - Solving Differential Equations
8. Transfer Function simulation
9. First order analogue system simulation
10. Second order analogue system simulation
11. Block Diagrams
12. Digital Control Systems
13. Sampling
14. Digital signal creation
15. First order digital system simulation
16. Second order digital system simulation
17. Control of Analogue Systems
18. Control of Digital Systems
19. Simulation of non-Linear Control Systems

TEACHING AND LEARNING ACTIVITIES:

Presentation with Software and a whiteboard. Contact by e-mail. Solution of exercises and Case Studies with Simulation Software.

ASSESSMENT CRITERIA:

Final exams (100%): Study of an integral system with analysis and synthesis of his elements according to the study methods examined during the course.
Project in special cases.

BIBLIOGRAPHY:

1) Course Notes
2) Modern Control Systems. Dorf, Richard C., Bishop, Robert 2018.
3) Theory and Problems of Feedback and Control Systems with Applications to the Engineering, Physical and Life Sciences. DiStefano, Joseph J., Stubberud, Allen R., Williams, Ivan J.
4) KJ. Astrom, B. Wittenmark, Computer Controlled Systems. Prentice Hall 1984.
5) J. d' D'Azzo, C. H. Houpis, Linear Control System Analysis and Design. Mc. Graw-Hill 1986.
6) B. Friedland, Control System Design. Mc. Graw-Hill 1986.
7) B.C.Kuo, Automatic Control Systems. Prentice-Hall 1987.
8) R. Gayakwad, L. Sokoloff, Analog and Digital Control Systems. Prentice Hall 1988.
9) Norman S. Nise, Control Systems Engineering. Wiley, 2006.
10) Control System Toolbox, Getting Started Guide, MathWorks, 2014.
11) Program CC5 Manual.

COMPUTATIONAL FLUID DYNAMICS (55.9)

LEARNING OUTCOMES:

Understanding the concepts of calculating flow around and through fields, using numerical methods to solve the equations that govern them.
Understanding the fundamental techniques of finite differences and finite volumes.
Obtaining the ability to use integrated computational fluid dynamic software packages to compute the internal and external flows.

Methodical recording, analysis and presentation of results.

COMPETENCIES:

Apply knowledge in practice
Retrieve, analyze and synthesize data and information, with the use of necessary technologies
Make decisions
Work autonomously
Work in teams
Work in an international context
Design and manage projects

CONTENT:

- Introduction to Computational Fluid Mechanics and its use as an optimization tool for mechanical structures.
- Presentation of the differential mass and energy transfer equations describing a flow field. Mathematical description of convection and diffusion. The concept of turbulence, the modeling of turbulence, turbulence intensity, turbulence scale length, Reynolds and turbulence models.
- Presentation and use of turbulence models used in the vehicle industry with appropriate commercial Computational Fluid Dynamics software.
- Define the structured and unstructured computational discretization (mesh). Quality and development of discretization for solving fluid mechanics fields.
- Designing a computational model to solve it with tools of computational fluid mechanics. Improve the quality of mesh calculations. Aspect ratio, inflation and skewness.
- Method of finite differences, finite element method and finite volume method.
- Initial conditions, boundary conditions and convergence criteria. Discretization shapes and under-relaxation factors.
- Resolving non-steady streaming fields. Display of the flow field, velocity vectors and streamlines, pressure and temperature contours.
- Presentation of modern advanced methodologies of computational fluid mechanics. Programming on a parallel environment for high performance computing. The MPI parallel programming protocol.
- Applications in streams around structures to improve aerodynamic behavior, as well as in streams within pipelines.
- The theoretical knowledge of the course will be applied utilizing an appropriate commercial software and computational coursework will be assigned during the semester for application to mechanical structures.

TEACHING AND LEARNING ACTIVITIES:

Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.
Laboratory Exercises in a laboratory area with the appropriate equipment. Practice and development of coursework using CFD software.

ASSESSMENT CRITERIA: Assessment Language: English / Greek
Coursework in a finite element software, 40% on the final score.
Final written examination in the Theoretical Lectures, 60% of the total grade.

BIBLIOGRAPHY:

Computational Fluid Mechanics, G. Bergeles. (in Greek)
Notes and Slides Computational Fluid Dynamics

SHIP SECURITY SYSTEMS MANAGEMENT (55.10)

LEARNING OUTCOMES:

Note: The English Version of the 1-page Syllabus of this course is not yet available.

COMPETENCIES:

CONTENT:

TEACHING AND LEARNING ACTIVITIES:

ASSESSMENT CRITERIA:

BIBLIOGRAPHY:

14.6 6th Semester Courses

HEAT TRANSFER (61)
LEARNING OUTCOMES: After successful completion of the course, the student should be able to: -understand steady and transient heat conduction -analyze and understand the mechanisms of convection and radiation -be able to solve problems that concern heat transfer
COMPETENCIES: Research, analysis and synthesis of data and information, Adaptation to new situations, Decision making, Autonomous work, Exercise criticism and self-criticism, Promoting free, creative and inductive thinking
CONTENT: Introduction and basic concepts Heat conduction equation Steady heat conduction Heat transfer from finned surfaces Transient heat conduction Fundamentals of convection External forced convection Internal forced convection Natural convection over surfaces, inside enclosures and over finned surfaces Boiling and condensation Heat exchangers Fundamentals of thermal radiation Radiation heat transfer, infrared thermography applications
TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.
ASSESSMENT CRITERIA: Assessment Language: Greek The final grade of the course is formed by 100% by the grade of the theoretical part. The grade of the theoretical part is formed by a written final examination. The written final examination of the theoretical part may include: Solving problems of application of the acquired knowledge, Short answer questions etc
BIBLIOGRAPHY: Bergman T.L., Lavine A.S., Incropera F.P., and DeWitt D.P.: Introduction to Heat Transfer, John Wiley & Sons, 6th Ed. 2011. Bergman T.L., Lavine A.S., Incropera F.P., and DeWitt D.P.: Fundamentals of Heat and Mass Transfer, John Wiley & Sons, 7th Ed. 2011

METHOD OF ENGINEERING DESIGN AND CAD/CAM/CAE (62)
LEARNING OUTCOMES: Knowledge Understanding: - Engineering Design Principles - The Principles of Engineering Design of Operation (EDO) - The Methodology of Engineering Synthesis for Operation and the Implementation of the EDO Methodology in complex systems - Computer Aided Design (CAE) - Computer Aided Design and Graphics (CAD) - the role of Numerical Analysis in simulation and optimization - Fundamental Numerical Analysis methods for CAD/CAE (e.g., Newton-Raphson, Runge-Kutta, etc.) - Main ideas of the Finite Element method - Basic Principles of CAD/CAM/CAE systems - Production and Manufacturing Design philosophy, CIM, FMS Skills Acquisition of proficiency in the: - identification of the primary characteristic magnitudes and the principal variables that govern the structure of functional engineering modules - analysis and synthesis of technological systems aiming to achieve operation based on defined specifications - simulation of engineering systems with the aid of methods of Numerical Analysis - Engineering Design of 2D and 3D forms - selection and utilization of CAD/CAM/CAE systems Abilities Analysis, design, and implementation of complex engineering systems and of applications based on the EDO methodology, CAD/CAM /CAE, and on Reverse Engineering
COMPETENCIES: Search, analysis and synthesis of data and information using the necessary technologies Adaptation to new situations Autonomous work Teamwork
CONTENTS: Engineering Design theory, Functional Design theory, Dynamic systems modelling theory with bond-graphs, Proportionality and dualism theory, Followers-Amplifiers, Connection of stages, Impedance matching, Basic manufacturing principles of material forming, Approaches to shape-

representation and Graphics, CAD, CAM, and CAE Systems, Production Planning, FMS, CIM, Elements of Applied Numerical Analysis for Computer Simulation of Engineering Systems, Introduction to Linkages and Mechanism Design, Synthesis of Mechanical Systems, Electromechanical Systems, Electronic Systems, Hydraulic and Pneumatic Systems, Synthesis of Complex Systems.

TEACHING APPROACH:
Lectures, Laboratory Exercises
Slides, Use of computer simulations and of CAD Software
Use of online teaching aids

ASSESSMENT CRITERIA:
Language: Greek
Lab Exercises and Projects
Final Written Examinations
Assessment criteria
- Ability to identify and describe the characteristic magnitudes and variables that govern the structure of functional engineering modules
- Ability to choose suitable Numerical Analysis methods
- 2D and 3D Engineering Modelling Design Skills

BIBLIOGRAPHY:
- Principles of CAD/CAM/CAE, Kunwoo Lee, ISBN-10 : 0201380366, Pearson 1st Ed., 1999
- CAD/CAM Systems and 3D Modeling, N. Bilalis and E. Maravelakis, 2nd Ed. Kritiki Editions, 2014 (in Greek)

PROGRAMMABLE CONTROLLERS AND SUPERVISORY SYSTEMS (63)

LEARNING OUTCOMES:
The course focuses on the use of Programmable Logic Controllers (PLCs) as well as supervisory control systems (SCADA) in manufacturing and industry. It aims to highlight advanced principles of programming and application of these technologies and to present programming ways to solve complex problems with the help of advanced techniques. During the courses, industrial communication networks (Profibus, Industrial Ethernet, Profinet) are used, which are configured so that the PLCs can communicate with third party devices. Students create their own supervisory programs to control automation systems using either standard market SCADAs, or developing their own interfaces, with or without OPC Server to communicate with controller data. During the courses, reference will be made to PLC and DCS systems, showing the industry trends in both small and large installations, while implementing some of these applications in the laboratory. Upon successful completion of the course the student will be able to: • understand the operation of the PLC, DCS and SCADA systems • have highly specialized knowledge, some of which is cutting edge knowledge in a field of work and research that is the basis for original thinking, creation and innovation. • designs, develops and implements integrated automation systems with the help of PLC and SCADA • has a critical awareness of knowledge issues in the field of PLC and SCADA systems and their interconnection with different fields and technologies. • determine the operating requirements of PLC systems • check the correctness of specifications and evaluate systems • Possess specialized problem-solving skills, which are required in research and / or innovation in order to develop new knowledge and processes and to integrate knowledge from different fields .

COMPETENCES:
Managing and transformation of work or study environments that are complex, unpredictable and require new strategic approaches. Taking responsibility for contributing to professional knowledge and practices and / or for evaluating team performance strategy. Project design and management. Decision making. Search, analysis and synthesis of data and information, using the necessary technologies. Autonomous work. Teamwork. Working in an international environment. Work in an interdisciplinary environment. Production of new research ideas. Exercise criticism and self-criticism. Promotion of free, creative and inductive thinking.

CONTENT:
• Introduction to PLCs - Software and Hardware configuration
• PLC programming
• Development of structured programs
• Timers, Comparators and Counters
• Subroutines and PLC
• Networking
• Advanced Logic Controller (PLC) Issues
• Structured programming - internship - project creation, P.I.D. controller, Control Functions, Datablock data storage, Troubleshooting, Organization block.
• COMMUNICATION PROTOCOLS PLC - INDUSTRIAL NETWORKS
• Industrial communication networks (ASI, Profibus, Industrial Ethernet, Profinet), Use of profibus communication and data programming through it., PLC networking
• OPERATION AND SUPERVISORY SYSTEMS (SCADA)
• Real-time systems, definition, communication (access, master-slave relationship), determination of scan time and sampling
• Control system components, sensors, actuators, local and remote controllers, algorithms, control, monitoring, recording, management, RTU / MTU communication methods
• Communication with open architecture (OPC) standards, Structure, interface levels, OPC data recovery guides, data sharing
• Operation Interface Design (HMI), for different scale systems, emergency management, alarms, status screens, control, graphics, reports, parallel use
• Interface with process data archiving systems and information systems.

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: English / Greek
The final grade of the course is formed by 70% of the grade of the theoretical part and by 30% of the grade of the laboratory part. The grade of the theoretical part is formed by a written final examination. The written final examination of the theoretical part may include: Multiple choice questions, Solving problems of application of the acquired knowledge, Short answer questions, Comparative evaluation of theory elements. The examination of the Practice Exercises is carried out with the continuous evaluation of the laboratory skills and the theoretical knowledge acquired in the context of the teaching of the course with the method of continuous evaluation.

BIBLIOGRAPHY:

• Automation using PLC, Beretas Ioannis, published by Tziolas , • Programmable PLC controllers, Collins Denis, published by Tziolas (in Greek)
• Programmable logic controllers, Petruzella Frank D., Published by Tziolas, • Solutions in programming and installation P.L.C., Christos Papazaharias, published by Brettos • Industrial Informatics, King Robert - Eric, Koumbias Stavros

OPERATIONAL RESEARCH (64)

LEARNING OUTCOMES:

Main aim of this course is the students' familiarization with the way of thinking and the logic of the scientific management by understanding, using and applying the models and the techniques of Operational Research (OR). With the completion of the course students are expected to:
• Understand the concept and the logic of OR models
• Acquire complete theoretical and practical knowledge of the models and algorithms of the more important OR techniques
• Practice in the analysis and tackling of real problems and case studies • Interpret and apply the results of problems' solutions
• Solve problems and case studies with the use of specialized software (POM-QM)
• Understand and practice in sensitivity analysis of problems' optimal solution

- To understand the structure and the characteristics of the main mathematical models of OR
- To acquire complete theoretical and practical knowledge of the models and algorithms of OR techniques and mathematical algorithms
- To select the appropriate model for the solution of a given problem
- To apply the appropriate model in both ways; with 'paper and pencil' and the use of specialized software
- To evaluate and interpret the results of problems' solutions
- To compare the results of problems' solutions with alternative data and to come to rational conclusions

COMPETENCIES:

- Search, analysis and synthesis of data and information with the use of appropriate techniques and algorithms
- Decision making
- Promotion of free, creative and inductive thinking
- Monitoring results
- Use of specialized software for solving OR problems as well as interpreting the acquired results

CONTENT:

• Introduction to Operational Research (the nature of OR – Mathematical models and algorithms)
• Linear Programming (mathematical model, problems formulation, the Simplex method, graphical solution, sensitivity analysis)
• Transportation and Transshipment Problems (mathematical model, initial feasible solution, optimal solution algorithm, special cases, solution of given problems and case studies)
• Stock Control (interpretation, costs analysis, main variables and terminology, main stock control systems, systems graphical representation, calculation of main variables)
• Production Systems Planning (assignment problems – task scheduling in one, two or three media – production line balancing)

TEACHING AND LEARNING ACTIVITIES:

- Face to face theoretical and practical lectures
- Problem solving by hand from the teacher
- Individual and group problem solving by the students
- Solving case studies
- Problem solving via the use of specialized software – Interpretation of results – Sensitivity analysis

ASSESSMENT CRITERIA:

Assessment Language: English / Greek
The final grade is formed by a written final examination.
The written final examination of the course may include:
Formulating and/or solving problems of application of the acquired knowledge, short answer questions etc
Especially for foreign students (e.g. studying through Erasmus programme) it is possible to be assessed by undertaking a project.

BIBLIOGRAPHY:

Recommended Bibliography through "Eudoxus"

1. Dantzig, G.B. and Thapa, M., "Linear Programming 2, Theory and Implementation", N.Y.: Springer – Verlag, 1997.
2. Hillier, F. and Lieberman, G., "Introduction to Operations Research", 8th edition, N.Y.: Mc Graw – Hill, 2004.
3. Lockyer, K. G., "Production Control in Practice", London: Pitman Pub, 1975.
4. Raturi, A. and Evans, J., "Principles of Operations Management", 1st edition, South Western, 2005.
5. Taha, H. A., "Operations Research, an Introduction", 9th edition. Prentice Hall, 2010.
6. Zipkin, P.H., "Foundations of Inventory Management", N.Y.: Mc Graw-Hill/Irwin, 2000.

CONTROL SYSTEMS II (65.1)

LEARNING OUTCOMES:

The course provides an introduction to the state space systems theory which is the basis for understanding the analysis and design techniques used in the modern theory of automatic control systems.
The course focuses on a thorough understanding of the basic of state space concepts so that it is possible to analyse the behaviour of a control system from a mathematical and physical point of view, using the most complete mathematical model of internal state equations.
The consolidation of the course material creates the basic background and is a prerequisite for the understanding of related courses that follow in the curriculum, such as Control Systems III, Process Control and Digital Control Systems.
Consistent and successful attendance of the course has as expected result to make the student competent:
- to understand the mathematical representation and analysis of multivariable control systems in the state space;
- analyse stability and time response by solving state equations;
- to attend more specialized courses of modern theory of automatic control systems;

- to recognize and use MATLAB software and its tools with ease.

COMPETENCIES:
Research, analysis and synthesis of data and information using corresponding technologies, decision making, adaptation to new situations, promoting free, creative and inductive thinking, independent work, teamwork

CONTENT:
Multivariable systems, state-space equations, mathematical representation in state space of various physical systems and examples. General solution of state equations, eigenvalues and eigenvectors, stability in the state space, transfer functions/tables derivation, transformations between different forms. Similarity transformations, canonical forms of state equations and corresponding block diagrams, state space trajectories. Controllability and observability, introduction to observers. Exercises and applications in MATLAB.

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: English / Greek
The final grade of the course is formed by 100% by the grade of the theoretical part.
The grade of the theoretical part is based on a written final examination.
The written final examination of the theoretical part may include:
Solving problems of application of the acquired knowledge, Short answer questions etc

BIBLIOGRAPHY:
Control Systems Engineering , Norman Nise
Modern Control Systems, Dorf & Bishop
Feedback Control of Dynamic Systems , Franklin & Powell
Modern Control Engineering, Ogata
Analog and Digital Control System Design: Transfer-Function, State-Space, and Algebraic Methods , C.T. Chen
Automatic Control Systems, Kuo
Design of Feedback Control Systems, Stefani, Bahram Shahian, Clement J. Savant

INDUSTRIAL INFORMATICS (65.2)

LEARNING OUTCOMES:
KNOWLEDGE
Introduction to Industrial Information Systems and the Industry 4.0 ecosystem
Data aggregation and manipulation in Industrial Information Systems
OPC server and Node Red Programming Language
Data and Information retrieval
ABILITIES
Identification, analysis, design and implementation of Industrial Information Systems
Industry 4.0 technologies
Assessment of software tools and architectures for developing Industrial Information Systems
Web based programming for developing basic Industrial Information Systems

COMPETENCES:
Search, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations
Independent work, Teamwork – distribution of responsibilities

CONTENT:
Theory:
14. Introduction to industrial processes, industrial informatics and Industrial Information System
15. Centralized, Distributed and Real-Time Industrial Systems
16. Automation Pyramid From sensors to Enterprise Resource Planning Systems (CIM/PLC/SCADA/ERP)
17. Industrial Informatics and Python
18. Architecture of Industrial Information Systems (2 and 3 layer architecture) - OPC Server architecture
19. Business Process Management tools
20. Introduction to Node Red programming
21. Advanced topics in Node Red
22. Industry 4.0 – IoT and Multi Agent Systems
23. ERP Systems
24. Maintenance Software Tools and Algorithms
25. Middleware Software Tools – Service Oriented Computing – Web Services
26. Simulation Tools

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: English / Greek
Theory
Public Presentations
Practical mid-term examination
Final Written Examinations
Evaluation criteria:
- Ability to understand the drivers for developing Industrial Information System
- Ability to design the architecture of modern industrial information systems
- Skills for developing applications using node red and opc server architecture
- Skills for creating business process management diagrams
- Skills of Assignment Preparation and Presentation

BIBLIOGRAPHY: Industrial Informatics by King Robert Eric

ELECTRICAL MACHINES AND MOTOR DRIVE SYSTEMS II (65.3)

LEARNING OUTCOMES: The course represents a continuation of the Electrical Machines and Motor Drives I course, aiming to expand on the study of motor introduction and their use, along with motor drive systems, in industrial applications. Therefore, the course emphasizes on further issues that involve the production of electrical energy at a large scale using synchronous generators, as well as on electric motion using synchronous motors, single phase motors, step motors, switched reluctance and permanent magnet motors. In the beginning, basic principles of these electrical machines are presented (voltage production for generators and torque production for motors), followed by the analysis of modern control methods by use of respective motor drives.
As a selective course it provides valuable experience and technical know-how to the new industrial and management engineer as regards the area of electric motion which corresponds to a founding stone of industry, owing to the vast plethora of electrical machines and motor drives applications.
The consistent and successful completion of the course, has the expected outcome to enable the student to:
a) understand the importance of electrical machines applications in various industrial processes
b) know about the current technological developments as regards electrical machines and motor drives for precise and efficient control
c) know about indicative uses and application examples so that he/she can proceed to specification requirements drafting.
d) be in a position to understand the nature of problems that can arise from the operation of electrical machines.
e) assess basic technoeconomic data and application results of electrical machines.

COMPETENCES: Practical application of knowledge, search, analysis and synthesis of information and data using appropriate technologies; Adjustment to new situations; Decision making; Autonomous work; Team work; Work in an interdisciplinary environment.
Design and project management; promotion of free, creative and inductive thinking; priorities setting; production of new research ideas; compliance to guidelines of good practices.

CONTENT:
1. Introduction to synchronous machines: operating principles, construction, applications
2. Synchronous generators: equivalent circuit, torque and power calculations
3. Voltage and frequency control of synchronous generators, parallel operation
4. Transient conditions in synchronous generators
5. Synchronous motor and its driving: equivalent circuit and steady state operation
6. Start-up of synchronous motors, applications in reactive power compensation
7. Single phase motors: creation of a magnetic field and start-up
8. Single phase motors: equivalent circuit, speed control
9. Other type of motors and drive systems: switched reluctance motors
10. Other type of motors and drive systems: step motors
11. Permanent magnet machines (PMSM, brushless DC) and drive systems: construction and operation
12. Permanent magnet machines: equivalent circuits and applications
13. Drive systems for permanent magnet motors.

TEACHING AND LEARNING ACTIVITIES: Class theory, teaching in discussion groups and students' active participation. The lectures are supported by presentations of the total content, while the whiteboard is used: a) for further elaboration of selected thematic sections, b) for the promotion of the students' active participation in step-by-step problems solving and examples process.

ASSESSMENT CRITERIA: The course grade is formulated by a final written exam which may contain: multiple choice questions, problems solving based on knowledge acquired, short answers' questions, comparative assessment of theoretical principles.

BIBLIOGRAPHY:
1. Chapman S., «Electric Machinery Fundamentals», 5th Edition, ISBN-13: 978-0073529547, McGraw Hill
2. Fitzgerald, Kingsley, Umans, "Electric Machinery", 6th Edition, ISBN-13: 978-0071230100, McGraw Hill
3. Mohan N., Undeland T and Robbins W, "Power Electronics: Converters, Applications and Design", ISBN-13: 978-0471226932, John Wiley & Sons Inc.

TRIBOLOGY (65.4)

LEARNING OUTCOMES:
- Understanding the physical processes and laws governing friction and wear in technical contacts, aiming to improving their durability, performance and effectiveness.
- Learning the behaviour of the main technical materials under friction and wear (metals and alloys, ceramics, polymers) in order to select the appropriate materials according to the operating conditions.
- Understanding the function and learning the theory of solid, fluid (hydrostatic, hydrodynamic, elastohydrodynamic) and gas lubrication.
- Getting familiar with the design, operation and application of the various types of bearings.
- Getting acquainted with the various types of lubricants in order to be able to select the appropriate lubricant for each application.

COMPETENCIES:
Research, analysis and synthesis of data and information
Decision making
Autonomous work
Promoting free, creative and inductive thinking

CONTENT:
Structure and decisive parameters of tribological systems.
Composition and geometrical characteristics of the technical surfaces.
Mechanical, chemical and thermal processes during sliding of contacting solid surfaces.
Types, mechanisms, parameters and laws of solid friction.
Frictional behaviour of the main technical materials (metals and alloys, ceramics, polymers, solid lubricants).
Transition phenomena in friction contacts.
Sliding and rolling friction, free rolling and traction rolling.
Types, mechanisms, parameters and laws of wear.
Behaviour of the main technical materials under wear conditions.

Hydrostatic, hydrodynamic, elastohydrodynamic, aerostatic and aerodynamic lubrication, marginal and partial lubrication.
The Reynolds equation.
Journal and roller bearings.
Solid lubrication.
Classification, properties and application of lubricants.

TEACHING AND LEARNING ACTIVITIES:
Lectures
Exercises
Projected presentations
E-mail communication
Online synchronous and asynchronous teaching platform

ASSESSMENT CRITERIA: Assessment Language: Greek
Written final examination

BIBLIOGRAPHY:

• I.M. Hutchins, p. Shipway, Tribology, Friction and Wear of Engineering Materials, 2nd Ed., 2017, Butterworth-Heinemann, ISBN: 9780081009109
• B. Bhushan, Principles and Applications of Tribology, 2nd Ed., 2013, John Wiley & Sons, ISBN: 978-1-119-94454-6
• P.I. Blau, Friction Science and Technology: From Concepts to Applications, 2nd Ed., 2008, CRC Press, ISBN 9781420054040
• Wilfried Dresel, Theo Mang, Lubricants and Lubrication, 2017, Wiley-VCH, ISBN:9783527326709

AUTOMOTIVE ELECTRICS (65.5)

LEARNING OUTCOMES:
With the successful attendance of the course the student must be able
- to recognize and describe the basic automotive lighting circuits, charging circuits, starting circuits and ignition circuits
- to understand and correctly estimate the devices of automotive electric systems
- to calculate the requirements of automotive electric systems
- to satisfactorily present a subject related to automotive electric systems
- to develop simplified automotive lighting and ignition systems and handle special measuring and diagnostic devices
- to analyse the structure of an automotive electric system and redesign it

COMPETENCIES:
Research, analysis and synthesis of data and information, using corresponding technologies, decision making, team work, implementing criticism and self-criticism, promotion of free, creative and inductive thinking

CONTENT:
- Automotive electronic drawing elements: Symbols, elements, grounding, connections, automotive drawings study.
- Automotive Electrical Systems: Historical background, presentation of different electrical systems in vehicle types.
- Lighting systems. Purpose, categories. Incandescent, iodine, vacuum lamps. Conductors, cross section calculation, voltage drop calculation, fuses. Lighting circuit analysis: Course, intersection, parking, direction, braking (stop), reversing, etc., trailers. Control instruments. Light regulator. Legislation.
- Electricity generation and storage systems: Inputs, role of the system in the vehicle, circuits
- Batteries: battery connections, construction and specifications, size calculations, properties, faults. Rated voltage, operating voltage, open circuit voltage, starting current, battery capacity, charging status, charging / discharging mode.
- Automotive generators: DC generators (dynamos). AC generators (Alternators). Constructional and functional characteristics. Rectifier. Voltage regulators (electromagnetic regulator, electronic voltage regulator). Related circuits.
- Starting system: Automotive starters, operation, categories, construction characteristics, starting current calculations.
- Ignition systems: Categories, ignition coils, distribution angle, operation angle, Dwell angle. Conventional ignition. Inductive electronic ignition. Electronic capacitive ignition. Piezoelectric electronic ignition. Distributorless Ignition System (DIS), Integrated Electronic Ignition. Ignition switch sensors: pulse generators, inductive, Hall effect, photoelectric.

Laboratory experiments:
- Static automotive generator diagnosis (dynamo, alternator). Alternator dynamic behavior.
- Starter.
- Conventional ignition. Electronic ignition. Hall sensor electronic ignition. Voltage and current waveform analysis, distribution, operation and Dwell angle calculation, troubleshooting.

TEACHING AND LEARNING ACTIVITIES:
Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform. The course is supported by equipment for the experimental verification of the theory and measurement of parameters of energy sources and electronic ignition systems of ICEs.

ASSESSMENT CRITERIA:
Assessment Language: English / Greek
The final grade of the course is formed by 70% by the grade of the theoretical part and by 30% by the grade of the laboratory part.
1. The grade of the theoretical part is formed by a written final examination. The written final examination of the theoretical part may include: Solving problems of application of the acquired knowledge, Short answer questions etc
2. The examination of the Laboratory Exercises is carried out with the continuous evaluation of the laboratory skills and the theoretical knowledge that were acquired in the course by the method of continuous evaluation and submission of weekly assignments
For the award of credits, both the total grade of the course and the independent grade in each of the assessment methods 1, 2 must be at least five.
The assessment criteria are accessible to students from the course website.

BIBLIOGRAPHY:

1. T. Denton, Automobile electrical and electronic systems. 4th edition, Routledge, 2012.
2. J. Halderman and C. Mitchell, Automotive Electricity and Electronics. Prentice Hall, 2004.
3. Robert Bosch GmbH, Bosch Handbook for Automotive Electrics - Automotive Electronics. 5th Edition, 2007.

4. W. Ribbens, Understanding Automotive Electronics. Society of Automotive Engineers Inc., 2003.
5. J. Erjavec, Automotive Technology: A Systems Approach. CENGAGE Delmar Learning, 2004.
6. B. Hollembeak, Today's Technician: Automotive Electricity and Electronics (Classroom and shop manual set). CENGAGE Delmar Learning, 2006.
7. Robert Bosch, Motor-Vehicle Batteries and Electrical Systems (The Bosch Yellow Jackets). Robert Bosch GmbH, 2003.

INDUSTRIAL DATA NETWORKS (65.6)

LEARNING OUTCOMES:
The aim of the course is to provide the student with the necessary knowledge regarding the principles of operation of industrial data networks as well as their design based on communication standards and protocols.
Knowledge:
- Understanding the design, communication methods, applications of structures and operation of Industrial Data Networks.
Abilities:
- design and calculations of Industrial Data Networks and their routing paths.
- diagnosis of networking problems and problem detection.
- structure analysis of the communication systems protocols.
- Analysis and presentation of the OSI Model hierarchy and the TCP / IP protocol suite through experimental results.
- analysis, design and implementation of communication methods for industrial network systems.

COMPETENCIES:
Research, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations
Independent work, Teamwork – distribution of responsibilities, Intellectual competences.

CONTENT:
· Introduction to Industrial Data Networks.
· Transmission Elements (Codes, Synchronization, Speed, Troubleshooting), Local Area Networks (Media, Topologies, Access Techniques)
· Interconnecting Local Area Networks (Repeaters, Bridges, Switches, Routers)
· Model TCP / IP Protocol (OSI) , Networks), Internet (Routers, NAT Protocol)
· Hierarchical Levels of Industrial Communication Networks (Field Level, Control Level, Information Level).
· Transmission Methods (Baseband, Broadband, Carrierband). , Control Level, Information Level).
· Topologies and Structure of Industrial Networks (Point to Point, Bus, Star, Ring, Tree, Grid and Repeaters, Transceivers, Bridges, Switches, Routers). · Networking Devices (Repeaters, Transceivers, Bridges, Switches, Routers)
· Networking Technologies and Protocols (CANopen, Modbus Ethernet TCP / IP, Asi, Industrial Ethernet, Profibus, Interbus, DeviceNet etc., Frames and OSI Model-Comparison)
· Main Methods of Accessing Medium Metad (Master-Slave, Token Ring, Random Access), Medium Access Control Methods (CSMA / CD, CSMA / CA) · Application Level Protocols (HTTP, FTP, DNS, SNMP, BOOTP, TELNET, MODBUS, UNITE, I / O Scanning).
Laboratory exercises:
· Network Settings, Execution of diagnostic commands (Network Diagnostic Commands)
· Routing, Net Paths, Routing Tables (Network Diagnostic Commands)
· Structure of OSI Standard and Multi-Level Protocols (Wireshark).
· Structure of TCP/IP (Ipv4/IPv6) (Wireshark).
· Frame structure and protocol headers (ARP, IP, TCP, UDP, DNS, SMTP, FTP, HTTP etc.)
· Packet analysis (Wireshark).
· Communication through packet exchange (Wireshark).

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: English / Greek
The final grade of the course is formed by 70% by the grade of the theoretical part and by 30% by the grade of the laboratory part.
1. The grade of the theoretical part is formed by a written final examination.
The written final examination of the theoretical part may include:
Solving problems of application of the acquired knowledge, short answer questions comparative evaluation of the theory elements etc.
2. The examination of the Laboratory Exercises is carried out with the continuous evaluation of the laboratory skills and the theoretical knowledge that were acquired in the course by the method of the continuous evaluation of the weekly lab exercises.

BIBLIOGRAPHY
Communications, Industrial Networking and TCP/IP: © 2012, IDC Technologies & Ventus Publishing ApS (bookboon.com)
Interconnections: Bridges, Routers, Switches, and Internetworking Protocols, 2nd Edition, Radia Perlman, Sun Microsystems, Inc.: ©1999, Addison-Wesley
Internetworking with TCP/IP, Volume One, 6th Edition, Douglas Comer: © 2013, Pearson.

WELDING TECHNOLOGY (65.7)

LEARNING OUTCOMES:
Students are expected to
- acquire the knowledge of the fundamentals of welding and the different welding methods.
- understand the main principles of Metallurgy of welding and the effect of various welding parameters in the structure and properties of welds.
- to identify the discontinuities of welds and understand how to prevent and detect them.

COMPETENCIES:
Research, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations
Independent work, Teamwork – distribution of responsibilities, Intellectual competences, Societal competence

CONTENT:

Introduction. Types of welds. Symbolism of welds. Energy sources for welding. Electrical sources. Arc welding. TIG. MIG. Resistance welding. Electroslag welding. Chemical sources. Oxyfuel gas welding. Thermit welding. Optical sources Electron Beam welding. Laser beam welding. Solid state sources. Explosion welding. Ultrasonic welding. Friction welding. Diffusion welding. Electrode. Characteristics of the welding arc. Metallurgy of welds. Metal transfer. Thermal phenomena during welding. Heat flow in welding. Distribution of temperature. Remaining stresses and deformations. Peak temperatures distribution. Cooling rates. Solidification rates. Weld thermal cycle. Quality welding control (destructive and non-destructive control methods). Cracks. Geometric discontinuities. Lack of fusion. Lack of penetration. Inclusions. Porosity.
The course includes hands-on workshops for metal welding using various techniques and microstructural evaluation of the welds.

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: English / Greek
The final grade of the course is formed by 70% by the grade of the theoretical part and by 30% by the grade of the laboratory part.
1. The grade of the theoretical part is formed by a written final examination.
The written final examination of the theoretical part may include:
Solving problems of application of the acquired knowledge, Short answer questions etc
2. The examination of the Laboratory Exercises is carried out with the continuous evaluation of the laboratory skills and the theoretical knowledge that were acquired in the course by the method of continuous evaluation and submission of weekly assignments

BIBLIOGRAPHY:
Principles of welding: Processes, Physics, Chemistry, and Metallurgy, MESSLER R. W., 2004, Wiley-VCH.
Welding processes handbook, Weman K., 2012, second edition, Woodhead Publishing

SIGNALS, INFORMATION AND COMMUNICATION (65.8)

LEARNING OUTCOMES:
The course is designed as an introduction to the basic principles of communication relating to recording, storing and transmitting information via analog and digital communication systems. On completion of the course, students should be able to understand and evaluate the most important design issues and choices that arise when building a communication system. Namely, should be able to:
(a) analyze signals concerning communication systems and to measure their basic quantities in both time domain and frequency domain;
(b) describe the basic limitations on the compression and transmission of signals and information, perform simple calculations to assess these limitations and understand their significance in relation to transmission problems;
(c) identify the basic subsystems as well as their behavior and operation in the design of communication systems;
(d) compare and select transmission methods and techniques according to the requirements of actual transmission problems; and
(e) interpret the discrepancies between predicted and measurable behavior of communication systems.

COMPETENCIES:
Research, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations, Decision making, Working in an international environment, Independent work, Teamwork – distribution of responsibilities, Working in an interdisciplinary environment, Practicing criticism and self-criticism, Promoting free, creative and inductive thinking.

CONTENT:
Basic concepts: definitions and brief review of Fourier transform theory. Sampling in time. Representation of digital signals in both time and frequency domains. Signal bandwidth. Modulation techniques. Communication system design: constraints, legislation and market. Introduction to information theory. Entropy. Basic principles of data transmission. Channel capacity and noise. Natural channel modeling: sources and examples of channel degradation. Data transmission. Digital modulation ASK, FSK, PSK. Source encoding. Sampling Theorem. Quantization Noise. Compression and error protection techniques. Channel encoding and block encoding. Multiple access with frequency/time/code division. Communication networks and signalling protocols. Applications and examples.

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA:
Assessment Language: English / Greek
The grade of the course is formed 100% by a written final examination including problem solving, graphs, diagrams and calculations based on data.

BIBLIOGRAPHY:
Digital Communications: Design for the Real World, Andrew Bateman, ISBN-13: 978-0201343014
Analog and Digital Communications (Schaum's Outlines), 2nd E, Hwei P. Hsu, ISBN-13: 9780071402286
Modern Digital & Analog Communication Systems, 4th E, Lathi,B. P., Ding,Zhi, ISBN-13: 978-0195384932

NEURAL NETWORKS & APPLICATIONS (65.9)

LEARNING OUTCOMES:
- To introduce the student to the concept of Artificial Neural Networks and Machine Learning which is their main field of application.
- know their different types, their structure and applications, as well as their performance limits.
- Be able to use Neural Network simulation software and create applications.

COMPETENCIES:
Search for, analysis and synthesis of data and information, with the use of the necessary technology
Working independently
Team work
Project planning and management
Production of new research ideas

CONTENT:
The taught modules concern:
• Basic concepts
• Artificial Neural Networks

• Perceptron and ADALINE networks • The Multi-Layer Perceptron Network and the Back-Propagation Rule • Self-Organized Map Networks (SOM) • Radial Base Function Networks (RBF) • Hebbian learning models • Implementing Neural Networks in Matlab and other Software • Learning and Generalization • Deep Learning • Applications of Artificial Neural Networks
TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.
ASSESSMENT CRITERIA: Project 100%
BIBLIOGRAPHY: Neural Networks & Machine Learning. Haykin, Simon. Papasotiriou Editions, ISBN13: 9789607182647 Neural Network Design. Martin T. Hagan, Howard B. Demuth, Mark Hudson Beale, Orlando De Jesús. ISBN13: 9780971732117. https://hagan.okstate.edu/NNDesign.pdf Artificial Neural Networks. Konstantinos Diamantaras. Klidarithmos Editions, ISBN : 978-960-461-080-8 Neural Network Toolbox (Matlab). Mark Hudson Beale, Martin T. Hagan, Howard B. Demuth.

14.7 7th Semester Courses

INFORMATION SYSTEMS (71)

LEARNING OUTCOMES:
KNOWLEDGE
Introduction to Information Systems and their use in digital supply chains
Assessment of technologies and architectures for implementing Information Systems
Programming languages and technologies for implementing Information Systems
Identification of the basic user roles in modern Information Systems
Understand Business Process Management (BPM) tools
ABILITIES
Identification, analysis, design and implementation of Information Systems
Modelling operational activities using BPM tools
Assessment software tools and architectures for developing Information Systems
Web based programming for developing basic Information Systems

COMPETENCES:
Search, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations
Independent work, Teamwork – distribution of responsibilities

CONTENT:
Theory:

1. Introduction to Information Systems for modern digital supply chains
2. Management Information Systems and Warehouse Management Information Systems -Enterprise Resource Planning Systems
3. Technological tools for developing Information Systems
4. Architecture of Information Systems (2 and 3 layer architecture)
5. Databases - Data and Information (data sovereignty and GDPR)
6. Interoperability and Information Systems
7. Methodologies for software development - Project Management
8. Unified Modelling Language theory and tools
9. Business Process Management theory and tools
10. Assessment of Information Systems
11. Implementing Information Systems in Enterprises
12. Social Information Systems
13. Design principles for Information Systems

Lab:

1. Introduction to web based tools and technologies
2. Web servers (apache/IIS)
3. Server side and Client side web based programming tools (HTML, CSS, PHP/ASP, Javascript)
4. Databases and Information Systems
5. Project for developing basic information systems

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: English / Greek
Theory (70%)
Public Presentations
Practical mid-term examination
Final Written Examinations
Lab (30%)
Public Presentations
Final Examinations
Evaluation criteria:
- Ability to understand the drivers for developing Information System
- Ability to design the architecture of modern information systems
- Skills for developing web based information systems
- Skills for designing and managing Information Systems
- Skills of Assignment Preparation and Presentation

BIBLIOGRAPHY:

- Management Information Systems by Jane P. Laudon and Kenneth C. Laudon 12th Edition ISBN 13: 978-0-273-78997-0
- Essentials of Systems Analysis and Design Joseph S. Valacich, Joey F. George, Jeffrey A. Hoffer ISBN 978-960-418-449-1

PRINCIPLES OF ECONOMIC THEORY: MICRO-MACRO ECONOMY (72)

LEARNING OUTCOMES:
Understanding basic knowledge and concepts of financial figures.
Understanding the behavior of microeconomics and macroeconomics.
Understanding how an economy works as a whole.
Understanding the interdependence of all economic units (consumers and businesses) and different forms of economic markets.
Understanding the role of institutions, such as the Financial system, international markets, Trade unions and the State machinery.

On the one hand we build the rest of the other courses of the study program, on the other hand we make them able to better understanding of economic developments, both domestically and internationally.

COMPETENCIES:

Acquisition of the foundations of microeconomic and macroeconomic theory.
Acquisition of fluency in understanding the economic developments in our country.
Acquisition of comprehension of fiscal figures.
Acquisition of fluency in understanding international economic developments.
Recognition, Analysis, planning and implementation of applied financial statements.
Search, analysis and synthesis of data and information, using the necessary technologies.
Adaptation to new situations
Autonomous work.
Teamwork.

CONTENT:

1. Analysis of key economic terms**.**
2. Analysis of supply and demand of goods**.**
3. Analysis of consumer and producer behaviour**.**
4. Analysis of the system of preferences, balance of the consumer.
5. Analysis of the effects of income change, prices on demand and types of elasticity.
4. Analysis of market forms and competition (Perfect and Non Competition) and market equilibrium short-term and long-term**.**
5. Analysis of the macroeconomic cycle and circuit of an economy**.**
6. Analysis of key macroeconomic variables.
7. Analysis of macroeconomic measures such as GDP, unemployment, inflation, government budget, public debt, deficits, etc.)
8. Analysis of complex aggregate demand and aggregate supply**.**
9. Balance product and national income analysis.
10. Function analysis of the multiplier as well as its impact on fiscal policy.
11. Presentation of the financial sphere of the economy and the balance of the money and securities market.
12. Analysis of general equilibrium and economic fluctuations.
13. Macroeconomic equilibrium analysis through growth theory.
14. Analysis from the beginning of factors that allow capital accumulation and how the economy is evolving in the long run.
15. Analysis of the definition of income and employment, the role of investment and the impact of international trade.

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: English / Greek
- Ability to identify and describe operation / applications of economic forms of purchase and their functions.
- Ability to solve exercises
- Skills of small and macroeconomic economic analysis
- Skills of preparation and presentation

BIBLIOGRAPHY:

1. M. Moussa «Macroeconomics: Special Issues in Public Finance and Fiscal Law», published by Ziti & Co. OE Thessaloniki 1st ed./2006. Book Code in Eudoxus: 59380115
2. N. Varsakelis, « Microeconomic Theory, Applications & Exercises», published by Markou I.G. & Co., Thessaloniki 2012. Book Code in EYDOXO: 22816800.
3. Parkin Michael, Powell Melanie, Matthews Kent: "Principles of Economics" Edition: 1st ed.

THERMAL ENGINES (73)

LEARNING OUTCOMES:

After successful completion of the course, the student should be able to:
-explain how and why an IC engine works. Recognize the basic types of engines and basic differences in their characteristics
-understand the mechanics and dynamics of the powertrain
-recognize the importance of minimizing various types of friction losses in an ICE and increase its efficiency
-understand the basic requirements on engine exhaust emissions abatement
-explain how and why a turbomachine works
-recognize the basic types of turbomachinery
-know the basic differences between a turbine and a pump, understand the dynamics and velocity triangles for each type of machine

COMPETENCIES:

Research, analysis and synthesis of data and information, Adaptation to new situations, Decision making, Autonomous work, Exercise criticism and self-criticism, Promoting free, creative and inductive thinking

CONTENT:

Introduction: Basic principle, definition of a turbomachine, coordinate system, relative velocities
Velocity diagrams for an axial flow compressor stage, the fundamental laws
Compressible flow analysis, flow coefficient, performance characteristics for high speed machines
Thermodynamic analysis of internal combustion engines (Otto cycle, Diesel cycle, Dual cycle)
Introduction: Basic principles, historic evolution of internal combustion engine, engine classifications, engine operating cycles, engine components
Engine design and operating parameters
Kinematics and force analysis of internal combustion engines
Thermochemistry of fuel-air mixtures
Diesel and gasoline fuel injection systems, fuel jet behavior, droplet distribution, droplet vaporization–ignition, gasoline direct injection engines (GDI)
Engine friction and lubrication. Introduction to tribology
Pollutant formation and control in spark ignited and diesel engines

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: Greek/English
The final grade of the course is formed by 70% by the grade of the theoretical part and by 30% by the grade of the laboratory part.
1. The grade of the theoretical part is formed by a written final examination.
The written final examination of the theoretical part may include:
Solving problems of application of the acquired knowledge, Short answer questions etc
2. The examination of the Laboratory Exercises is carried out with the continuous evaluation of the laboratory skills and the theoretical knowledge that were acquired in the course by the method of continuous evaluation and submission of weekly assignments

BIBLIOGRAPHY:

1. J. B. Heywood: Internal Combustion Engine Fundamentals. McGraw Hill International Editions, 1988.
2. K. Mollenhauer and H. Tschoeke: Handbook of Diesel Engines. Springer-Verlag. London, 2010.
3. Woodruff E.B, Lammers H.B., Lammers T.F.: Steam Plant Operation, 8th Ed. McGraw-Hill Professional, 2004.

VEHICLE TECHNOLOGY (74)

LEARNING OUTCOMES:
The course aims to enable students to:
• recognize the components of the suspension, braking and steering systems
• analyze and compose the mechanisms that make up the above systems
• analyze the kinematics of the above systems
• recognize the principles of operation of systems
• recognize the interaction during operation
• recognize the future trend regarding systems technology

COMPETENCES:
•Search, analysis and synthesis of data and information, using the necessary technologies
•Decision making
•Autonomous work
•Exercise criticism and self-criticism
•Promoting free, creative and inductive thinking

CONTENT:
14. Introduction
15. Vehicle dynamics
16. Wheel connection
17. Suspension systems
18. Steering system
19. Vehicle assistance systems
20. Braking systems
21. Power boost braking
22. Hydraulic braking systems
23. Pneumatic braking systems
24. System failures and diagnosis methods
25. Maintenance of vehicle systems

TEACHING AND LEARNING ACTIVITIES:
Face to face and/or distance lectures
Learning process support through the online learning platform of the course, which includes:
a) slides of the lectures,
b) recitations and detailed solutions of the main exercises for each sub-unit,
c) teaching notes adapted to the physiognomy of the offered study program,
d) communication with students via e-mail.

ASSESSMENT CRITERIA:
Students will be assessed with a written final exam that will include problem solving with a combination of knowledge of theory, calculations and critical evaluation (100%).

BIBLIOGRAPHY:

Bohner Max, Gscheidle Rolf, Wolfgang Keil, Expertise in Automotive Engineering, 2007, ION Publishing Group, 2007 (in Greek)
Th. Zachmanoglou, G. Kapetanakis, P. Karampilas and G. Patsiavos, Automotive Technology beyond 2000, 2000, IDEEA Institute (in Greek)

SUPPLY CHAIN MANAGEMENT (75)

LEARNING OUTCOMES:
The aim of this course is to teach theoretical and practical concepts regarding the management of the supply chain.
Upon successful completion of the course the student will be able to:
- understand the basic business processes with the supply chain
- understand the basic concepts of planning, executing and controlling the supply chain
- understand the standard business processes that are executed as part of the Sales and Operations Planning, Material Requirements Planning, Procurement, Production Planning, Inventory Management, Warehouse Management, Sales and Distribution, as well as their interconnection and integration
- understand the pivotal role of information systems for the successful management of supply chains
- gain knowledge on how to evaluate the supply chain performance and how to apply best business practices

COMPETENCIES:
Research, analysis and synthesis of data and information using corresponding techniques, Adaptation to new situations
Independent work, Teamwork – distribution of responsibilities, Intellectual competences, Social competences

CONTENT:
Sales and Operations Planning (SOP)
Material Requirements Planning (MRP)
Procurement Management
Inventory Management
Production Planning
Sales and Distribution
Warehouse Management
Supply chain controlling

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: Greek
The final grade of the course is based on a written final exam that consists of multiple choice questions

BIBLIOGRAPHY:
Blanchard D. (2012), Supply Chain Management Best Practices, Wiley
Kurbel K. (2013), Enterprise Resource Planning and Supply Chain Management, Springer Verlag
Relevant journals:
Journal of Supply Chain Management
Supply Chain Management: An International Journal
Journal of Operations and Supply Chain Management
Journal of Operations Management

NANOTECHNOLOGY (76.1)

LEARNING OUTCOMES:
KNOWLEDGE
Understanding of methods for fabricating systems in small scales
Understanding of the physical laws that dominate in small scales
Understanding of the operating principles of nanotechnology and meta-material devices
Understanding of the operating principles of single electron devices, spintronic devices and quantum computers
Understanding of the basic successful nanotechnology applications
ABILITIES
Perception of the physical world in the scales of 1 meter, 1 milli meter, 1 micro-meter and 1 nano-meter.
Evaluation of nano-system fabrication methods based on the viability of mass production
Calculation, design and evaluation of nano-material and nanotechnology product specifications.
Design of basic nano-electronic circuits and quantum computers.

COMPETENCES:
Search, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations
Independent work, Teamwork, Respect to the natural environment, Promotion of free, creative and inductive thinking

CONTENT:
1. Introduction, significance, examples
2. Parallel fabrication techniques
3. Serial fabrication techniques
4. Self-assembly and exotic methods
5. Bottom-up and molecular nanotechnology / Metamaterials
6. Single-electron nanoelectronics
7. Quantum computers
8. Spintronics
9. Carbon nanotubes
10. Two-dimensional materials: Graphene and MoS2
11. Applications of Nanotechnology
12. Microscopy techniques
13. Accessibility, real technologies and roadmap

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA:
Assessment Language: English / Greek
Public Presentations
Practical mid-term examination
Final Written Examinations
Evaluation criteria:
Ability to calculate nano-material properties
Ability to calculate properties of nano-devices
Ability to select nano-materials, develop devices/applications and calculate their performance

BIBLIOGRAPHY:
Fundamentals of Nanoelectronics, George W. Hanson, ISBN-13: 9788131726792, 2009
Quantum Computing, Ioannis G. Karafyllidis, ISBN: 978-960-603-002-4, 2015

PHYSICAL AND CHEMICAL PROCESSES (76.2)

LEARNING OUTCOMES:
The course develops a basic understanding of basic physical and chemical processes.
Extensive reference is made to mass transfer operations and basic homogeneous reactors.
Upon successful completion of the course the student will be able to:
understand physical separation processes - classification
understand chemical processes – classification
understand the principles of conservation of mass, components and energy
understand gas liquid mass transfer operations
understand the basic design of distillation (single stage, multistage) and gas absorption
understand liquid-liquid operations
understand liquid-liquid extraction
understand the classification of chemical reactions and reactors
understanding the principles of conservation of mass and energy in chemical processes
and will have the ability of:
mathematical modelling of basic physical and chemical processes based on energy and mass balances.

COMPETENCIES:
Research, analysis and synthesis of data and information using corresponding technologies, decision making, adaptation to new situations, promoting free, creative and inductive thinking, independent work, teamwork

CONTENT:
1.Physical processes-classification
2. Mass and energy balances (implementation in basic processes)
3. Mass transfer separation processes
Gas-liquid operations:
4. Distillation (single- and multi-stage)
Mathematical modelling
Basic design of a distillation column
5. Gas Absorption
Liquid-Liquid operations
6. Liquid extraction
7. Chemical Processes
8 Classification of chemical reactions and reactor types
9. Mass and energy balances in chemical processes
10. Mathematical modelling and basic design equations of Ideal batch reactors
11. Mathematical modelling and basic design equations of ideal stirred tank reactors

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA:
Language: Greek
The final grade of the course is formed 100% by the grade of the theoretical part.
The grade of the theoretical part is based on a written final examination.
The written final examination of the theoretical part may include:
Short Answer Questions, Development Questions, Problem Solving
Evaluation criteria:
Ability to describe and understand the operation of simple processes
- Ability to identify and mathematically describe simple processes
- Ability to solve mass and energy balance problems

BIBLIOGRAPHY:
1. Physical Processes, Markos I. Assael and Maria X. Magiliotou Tziolas, ISBN13: 9789607219725, 2015
2. Basic Principles and Calculations in Chemical Engineering, 8th Edition, Himmelblau D., Riggs J., Pearson, 2012

ENERGY ELECTRONIC SYSTEMS – ENERGY SAVING (76.3)

LEARNING OUTCOMES: The aim of the course is to provide basic practical knowledge as regards various applications of electronic systems for energy management and saving in industrial production processes. These systems are currently more frequently used and applied in industries with high electrical and thermal energy consumption. In addition, the area of energy saving and relative techniques in industry, is an area of great significance for the operation of modern industries, as energy is a key part (and in some cases the most important) of the daily operating expenses and therefore of the cost of the end product.
The course introduces and presents modern practices for electrical energy management in industry as well as targeted interventions and solutions for the improvement and more efficient use of energy. Areas that will be covered include the introduction of electric vehicles, power electronic converters for special purposes, high efficiency power supply units, UPS systems, power quality and harmonics issues in industry, active filters technologies, electronic control of reactive power, induction heating, heat and electricity cogeneration systems, BMS systems and efficient utilization of energy storage systems.
As a selective course, it offers valuable experience and expertise to the new industrial and management engineer, as regards a developing field of electronics applications with focus on the management and saving of energy. The consistent and successful completion of the course, has the expected outcome to enable the student to:
a) understand the importance of energy and the systems for its management and saving, as a key component of every production process.

b) know about the latest technological developments as regards systems that efficiently manage energy offering solutions to industry.
c)be in a position to understand the problems of non-efficient energy use and to be able to propose, design and study specialized approaches.
d) assess basic technoeconomic information and results of energy management and saving systems.

COMPETENCES: Practical application of knowledge, search, analysis and synthesis of information and data using appropriate technologies; Adjustment to new situations; Decision making; Autonomous work; Team work; Work in an interdisciplinary environment.
Design and project management; promotion of free, creative and inductive thinking; priorities setting; production of new research ideas; compliance to guidelines of good practices.

CONTENT:
1. Introduction: electronic management of energy and systems-applications
2. Power converter systems for electric vehicles
3. Current source inverters – applications
4. Switching mode power supplies
5. UPS technologies and characteristics
6. Multilevel converters – technologies and industrial applications
7. Analysis of power quality characteristics in industry: voltage and frequency disturbances, harmonic issues
8. Harmonic filters technologies – passive and active filters in industrial applications
9. Electronic control of reactive power (TSC, static var compensators)
10. Induction heating – applications in production processes
11. Energy saving technologies: power and heat cogeneration systems
12. Energy saving technologies: BMS systems
13. Energy saving technologies: Energy storage systems management.

TEACHING AND LEARNING ACTIVITIES: Class theory, teaching in discussion groups and students' active participation. The lectures are supported by presentations of the total content, while the whiteboard is used: a) for further elaboration of selected thematic sections, b) for the promotion of the students' active participation in step-by-step problems solving and examples process.

ASSESSMENT CRITERIA: The course grade is formulated by a final written exam which may contain: multiple choice questions, problems solving based on knowledge acquired, short answers' questions, comparative assessment of theoretical principles.

BIBLIOGRAPHY:
1. Mohan N., Undeland T and Robbins W, "Power Electronics: Converters, Applications and Design", ISBN-13: 978-0471226932, John Wiley & Sons Inc.
2. Rashid M, "Power Electronics: Circuits, Devices & Applications", 4th Edition, ISBN-13: 978-0133125900, Pearson

OPTIMIZATION TECHNIQUES (76.4)

LEARNING OUTCOMES:
This course aims at the essential and comprehensive presentation of the basic and advanced optimization techniques and applications that are necessary for production engineers. It focuses on the ever-increasing need of engineers in industry to reduce production costs that make a modern industry viable in the face of international competition. It explains the possibility of using systematic technical decisions that can help in the efficient design and production of products with significant cost savings. The possibility of using such techniques in a variety of different fields of application and in a wide range of industries is emphasized, and the important role that PCs play in solving large-scale optimization problems and complexity, due to the rapid advancement of technology.
Upon successful completion of the course the student will be able to:
- understand the mathematical background on which the basic and advanced optimization techniques necessary in modern production engineering are based,
- distinguish the key features in a real project or a project case study and formulate a realistic optimization problem
- acquire the necessary skills of using computer tools that can solve various types of optimization problems using a computer
- develop teamwork skills and abilities that allow the combination of optimization methods with modern computer design tools, to improve the creative process of conceptual and detailed design of modern production systems.

COMPETENCIES:
Research, analysis and synthesis of data and information using corresponding technologies, decision making, adaptation to new situations, Promoting free, creative and inductive thinking, independent work, Teamwork.

CONTENT:
Introduction to mathematical programming. Necessary conditions for optimality with and without constraints. Lagrange multipliers, KKT (Karush-Kuhn-Tucker) conditions, optimization algorithms and termination criteria. Linear programming (Simplex method, duality, canonical form, Matlab examples).
Network optimization (introduction to network theory, minimum path and maximum flow problems, Matlab examples).
Integer programming (cutting planes method, branch and bound method, dual programming, mixed integer programming, Matlab examples).
Constrained optimization (polynomial approximation, Newton, Marquardt, quasi-Newton).
Nonlinear programming (penalty functions, sequential linear approximation, quadratic programming, Matlab examples)

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: English / Greek
The final grade of the course is formed by 80% by the grade of the theoretical part, and 20% by the grade of project work.
The grade of the theoretical part is based on a written final examination.
The written final examination of the theoretical part may include:
Solving problems of application of the acquired knowledge, Short answer questions etc

BIBLIOGRAPHY:
Optimization, Algorithms and Applications, Rajesh Kumar Arora
Optimization in Operations Research 2nd Edition, Ronald Rardin
Introduction to Mathematical Optimization, Matteo Fischetti
Linear and Integer Optimization, Theory and Practice, Third Edition, Gerard Sierksma, Yori Zwols

ADVANCED CONTROL OF ELECTRICAL MACHINES (76.5)

LEARNING OUTCOMES:
The aim of the course is to provide the student with the necessary knowledge regarding the principles of operation of vector control as well as its application in the control of AC electric machines.
Knowledge:
- Understanding the design, operation and control methods of electric motors through transformations between reference system variables (voltage, current, flux, back-EMF).
- Understanding the applications of vector control in the production process, in industry and in general in motion and energy conversion applications.
Skills:
- Acquisition of design and calculation of simple electrical and mechanical equivalent mathematical models of electric machines.
- Acquisition of fluency in the design of controllers and diagnosis of problems of estimation of non-measurable variables of the electric motor.
- Acquisition of structure analysis of the simple observers.
- Analysis and presentation of the response and overall performance of the control based on simulation results.
- Design and implementation of the advanced vector control methods for AC electric motors.

COMPETENCIES: Research, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations Independent work, Teamwork – distribution of responsibilities, Intellectual competences, Societal competence.

CONTENT:
Theoretical section:
· Introduction to Wireless Networks · Introduction to Vector Control (Vector Control or Field Oriented Control-FOC), Principle of Operation of Vector Control,
· Reference Systems (abcs, αb0s, dq0s and γδ0s), Clark and Park Transforms),
· Current / Torque Control and Flow Control, Vector Control Classification (Indirect FOC and Direct FOC),
· Vector Control of Asynchronous and Modern Machines (Speed and Torque Control),
· Advantages of Vector Control (Response and Strength of Control; per Ampere (MTPA), Speed Range Expansion · Flux or Field Weakening,
· Electric Power Converters, 3-phase Inverters, Sinusoidal PWM (Simulink Model of Inverter),
· Space Vector PWM (SVPWM), Comparison of Space Vector and Sinusoidal PWM. · State Observers, Sensorless Control,
Tasks - Practice Exercises:
· Analysis of the structure of the Vector Control (Matlab / Simulink),
· Park Transformation and Inverse Park Transformation (Matlab / Simulink),
· Simulation of Observers of Electrical Engine Conditions (Matlab / Simulink),
· Flow and Torque Estimation, Angular Position and Current Estimation (Matlab / Simulink).

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: English / Greek
The final grade of the course is formed 100% by the grade of the theoretical part and the intermediate examination or project.
1. The written final examination of the theoretical part may include:
Solving of application problems, short answer questions, comparative evaluation of the theory elements etc.
2. The continuous evaluation of the theoretical knowledge that were acquired in the course by the method of project including the modelling and vector control of a 3-phase electrical machine.

BIBLIOGRAPHY:

1. Analysis of electric machinery and drive systems, Paul Krause, Oleg Wasynczuk, Scott Sudhoff, Steven Pekarek: 3rd Edition, © 2013, IEEE.
2. Electrical Machine Drives Control: An Introduction, **Juha Pyrhönen, Valéria Hrabovcová, R. Scott Semken,** ©2016, John Willey & Sons Ltd.
3. Electric Motors and Drives: Fundamentals, Types and Applications, Austin Hughes, 3rd Edition, ©2006, Austin Hughes. Published by Elsevier Ltd.
4. Motor Handbook, Fang Qi, Daniel Scharfenstein, Claude Weiss (Institute for Power Electronics and Electrical Drives, RWTH Aachen University), Clemens Müller, Ulrich Schwarzer (Infineon Technologies AG), Version 2.1, © 2019, infineon, iSEA, RWTH Aachen University.

AUTOMOTIVE ELECTRONICS (76.6)

LEARNING OUTCOMES: With the successful attendance of the course the student must be able
- to recognize and describe the basic structural elements of ICE control circuits, ABS circuits, transmission system circuits
- to recognize and describe the operation principles of automotive electronic systems
- to understand and correctly estimate the devices of automotive electronic systems
- to calculate the requirements of automotive electronic systems
- to satisfactorily present a subject related to automotive electronic systems

COMPETENCIES: Research, analysis and synthesis of data and information, using corresponding technologies, decision making, team work, implementing criticism and self-criticism, promotion of free, creative and inductive thinking

CONTENT:
- Automotive electronic drawing elements: Symbols, electronic control units, sensors, actuators, control systems, automotive integrated circuits
- Electronic control unit: building blocks, primary and secondary functions. Integrated automotive electronic systems. Sensor and actuator elements, closed and open loop operation.
- Engine control system: engine control module, sensors and actuators historical evolution, Jetronic, Motronic.
- Control systems: ABS anti-lock braking system, Transmission system, Vehicle stability control systems.
- Vehicle auxiliary systems. fans, windshield wipers, electric windows, electromagnetic locks, air conditioning system, instrumentation (operating principles and connections)
- In-vehicle communication: introductory concepts, Controller Area Network (CAN), Local Interconnects Network (LIN).

Laboratory applications:

- Motronic electronic engine control systems (for direct and indirect injection), Basic Sensors: EGO, speed, temperature, throttle, engine load measurement (VAF, MAF, MAP), knock sensor, etc. (Operating principles, construction, faults). Basic Actuators: fuel injectors, fuel pump, idle regulator, EGR. (Principles of operation, construction, failures).
- Antilock Braking System (ABS): electrical circuit analysis, measurements

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform. The course is supported by equipment for the experimental verification of the theory and measurement of automotive electronics parameters of ICEs.

ASSESSMENT CRITERIA:
Assessment Language: English / Greek
The final grade of the course is formed by 70% by the grade of the theoretical part and by 30% by the grade of the laboratory part.
1. The grade of the theoretical part is formed by a written final examination. The written final examination of the theoretical part may include: Solving problems of application of the acquired knowledge, Short answer questions etc.
2. The examination of the Laboratory Exercises is carried out with the continuous evaluation of the laboratory skills and the theoretical knowledge that were acquired in the course by the method of continuous evaluation and submission of weekly assignments
For the award of credits, both the total grade of the course and the independent grade in each of the assessment methods 1, 2 must be at least five.
The assessment criteria are accessible to students from the course website.

BIBLIOGRAPHY:

1. T. Denton, Automobile electrical and electronic systems. 4th edition, Routledge, 2012.
2. J. Halderman and C. Mitchell, Automotive Electricity and Electronics. Prentice Hall, 2004.
3. Robert Bosch GmbH, Bosch Handbook for Automotive Electrics - Automotive Electronics. 5th Edition, 2007.
4. W. Ribbens, Understanding Automotive Electronics. Society of Automotive Engineers Inc., 2003.
5. J. Erjavec, Automotive Technology: A Systems Approach. CENGAGE Delmar Learning, 2004.
6. B. Hollembeak, Today's Technician: Automotive Electricity and Electronics (Classroom and shop manual set). CENGAGE Delmar Learning, 2006.

CONTROL SYSTEMS III (76.7)

LEARNING OUTCOMES:
The aim of the course is to provide an introduction to the process of designing continuous time compensators/controllers so that given specifications are met. Various synthesis techniques, analytical and graphical, are presented using both mathematical models, i.e. transfer function and state space. Various types of controllers (series, feedback and input) and combinations of them are studied. Empirical techniques are also presented, in case the mathematical model of the system is not available
Consistent and successful attendance of the course has as expected result to make the student competent:
- to design compensators of different types (series, input, feedback or a combination thereof) to meet given design specifications / objectives with different techniques, with any mathematical model, or even when the mathematical model is not available;
- confirm the design by simulation in MATLAB / SIMULINK environment;
- implement compensators with active or passive elements and face the practical difficulties and limitations that arise.

COMPETENCIES: Research, analysis and synthesis of data and information using corresponding technologies, decision making, adaptation to new situations, Promoting free, creative and inductive thinking, independent work, Teamwork

CONTENT: Introduction to controller design : Basic specifications in the time domain. Types of controllers-compensators. Categories of control problems. Closed loop block diagrams with different configurations. Effect of disturbances, noise and sensitivity functions. Basic design tools (Root locus, Bode diagrams). Root locus design. Phase lead/lag compensators. Two and Three term controllers (PI,PD,PID). Frequency domain design techniques. Pole placement design techniques. Exercises and applications in MATLAB.

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA:
Assessment Language: English / Greek
The final grade of the course is formed by 80% by the grade of the theoretical part, and 20% by the grade of project work.
The grade of the theoretical part is based on a written final examination.
The written final examination of the theoretical part may include:
Solving problems of application of the acquired knowledge, Short answer questions etc

BIBLIOGRAPHY:

1. Control Systems Engineering , Norman Nise
2. Modern Control Systems, Dorf& Bishop
3. Feedback Control of Dynamic Systems , Franklin & Powell
4. Modern Control Engineering, Ogata
5. Analog and Digital Control System Design: Transfer-Function, State-Space, and Algebraic Methods , C.T. Chen
6. Automatic Control Systems, Kuo
7. Design of Feedback Control Systems, Stefani, Bahram Shahian, Clement J. Savant

14.8 8th Semester Courses

MODELLING AND SIMULATION (81)

LEARNING OUTCOMES:

The course focuses on modern trends and methods related to mathematical modeling and simulation of a variety of dynamic systems, which are found in practice in many different fields of application in industry and employ the production engineer. It covers the classical modelling theory in engineering curricula, where continuous time representations are used, and the basic modelling techniques of different types of dynamic systems (electrical, mechanical, thermal, hydraulic, etc.) with the fundamental principles (first principles), the methods of solving the corresponding linear or non-linear equations, and simulation methods with various numerical integration techniques on a digital computer.

In addition, basic systems identification techniques based on experimental data after sampling are covered and parametric estimation of discrete time parameters with least squares techniques, with emphasis on the practical application of the computer recognition process in MATLAB / SIMULINK environment. Finally, simulation techniques for problems with a stochastic character (discrete events, random number generators, Monte Carlo) and related result analysis techniques are examined, with emphasis on specialized systems of interest to the production engineer, from the point of view of business research.

Consistent and successful attendance of the course has as expected result to make the student competent:

- to represent systems in the form of a mathematical model based on fundamental principles and make transformations from one form to another;
- to determine and calculate the time response as well as the stability of dynamic systems of different types, by solving the relevant equations and numerical integration in PC,
- to formulate appropriately and use simulation techniques in problems of a contemplative character as well as to have the ability to analyze results and design experiments and evaluate results from the point of view of business research.
- to implement all the above with appropriate programming and visualization in MATLAB / SIMULINK environment with the help of specialized toolboxes.

COMPETENCIES:

Research, analysis and synthesis of data and information using corresponding technologies, decision making, adaptation to new situations, Promoting free, creative and inductive thinking, independent work, Teamwork

CONTENT:

1 - System Modelling
- 1.1 Description of dynamic systems (inputs, outputs, disturbances)
- 1.2 Extraction of a mathematical model from basic principles (electrical, mechanical, electromechanical, thermal, hydraulic)
- 1.3 Frequency response models
- 1.4 Linear and non-linear state space models
- 1.5 Linearization techniques of nonlinear systems

2 - System identification
- 2.1 Introduction to least squares methods
- 2.2 Model fitting to Input-Output Data
- 2.3 Parameter estimation of parametric models
- 2.4 Selection of input signals (steps, PRBS, white noise)
- 2.5 Representative Examples and Solutions with MATLAB

3 - Simulation
- 3.1 Simulation models
- 3.2 Types of simulation
- 3.3 Continuous-time modeling
- 3.4 Simulation through equations and block diagrams
- 3.5 Development of discrete-time models
- 3.6 Development of simulation programs
- 3.7 MATLAB / SIMULINK simulation models
- 3.8 Sampling methods
- 3.9 Random Number Generators
- 3.10 Monte Carlo method
- 3.11 Analysis of results
- 3.12 Simulation of specialized systems (inventory, production and queues)

Exercises and applications in MATLAB.

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: English / Greek

The final grade of the course is formed by 80% by the grade of the theoretical part, and 20% by the grade of project work.

The grade of the theoretical part is based on a written final examination.

The written final examination of the theoretical part may include:

Solving problems of application of the acquired knowledge, Short answer questions etc

BIBLIOGRAPHY:

1. Principles of Modeling and Simulation, a multidisciplinary approach, Eds. Sokolowski, Banks, Wiley, 2009
2. Modeling and Simulation Fundamentals, Theoretical Underpinnings and Practical Domains, Eds. Sokolowski, Banks, Wiley, 2010
3. Discrete-Event System Simulation, Fifth Edition Jerry Banks, John S.Carson, Barry L.Nelson, David M.Nicol, Prentice Hall, 2005

WIRELESS SYSTEMS AND NETWORKS (82)

LEARNING OUTCOMES:

The aim of the course is to provide the student with the necessary knowledge regarding the principles of operation of wireless systems and networks as well as their design based on communication standards and protocols.

Knowledge:

-Understanding the design, communication methods and operation of Wireless Networks PC.

-Understanding the applications of network structures in industry.

Skills:

-Acquisition of design and calculation of simple wireless computer networks.

-Acquisition of control and diagnosis of problems of wireless network systems.

-Acquisition of the analysis of the structure of communication systems protocols.

-Analysis and presentation of the TCP / IP protocol hierarchy through experimental results.

-Analysis, design and implementation of applied methods of communication of wireless computer systems.

COMPETENCIES:

Research, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations
Independent work, Teamwork – distribution of responsibilities, Intellectual competences, Societal competence

CONTENT:

· Introduction to Wireless Networks
· Wireless LAN Technologies (Narrowband, Spread Spectrum, Frequency Hopping Spread Spectrum, Direct Sequence Spread Spectrum)
· Wi-Fi, IEEE 802.11 Standards (802.11a, 802.11b, 802.11g, Wireless LAN Frequency Spectrum) Modes of Ad Hoc-Infrastructure, Networking Devices (Access Point, Router)
· WLAN Performance, Wireless Sensor Network Applications
· Signal Coding Techniques
· Multiple Code Division Access Energy Saving
· Architectures, Communication Protocols, Network Services, Node Architecture
· Standard: ISA100 Wireless, Wireless HART (ANSI / ISA-100.11a-2011), Wireless Systems for Industrial Automation: Control Process and Communication Data, Troubleshooting
· Detection and Correction of Errors in Data Transmission
- Laboratory exercises:
· Structure analysis of communication protocols in Wireless Networks (Network Diagnostic Commands/Wireshark).
· Network structure and communication problem diagnosis (Network Diagnostic Commands/Wireshark).
· Header Structure of Multilevel Protocols (Wireshark)
· Internet and Transfer Protocols IP, TCP, UDP (Network Diagnostic Commands/Wireshark)
· TCP Connections (Network Diagnostic Commands/Wireshark).

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA:

Assessment Language: English / Greek
The final grade of the course is formed by 70% by the grade of the theoretical part and by 30% by the grade of the laboratory part.
1. The grade of the theoretical part is formed by a written final examination.
The written final examination of the theoretical part may include:
Solving problems of application of the acquired knowledge, short answer questions, comparative evaluation of the theory elements etc.
2. The examination of the Laboratory Exercises is carried out with the continuous evaluation of the laboratory skills and the theoretical knowledge that were acquired in the course by the method of the continuous evaluation of the weekly lab exercises.

BIBLIOGRAPHY:

1. Wireless Communications Networks and Systems, Cory Beard and William Stallings: © 2016, Pearson Global Edition.
2. Wireless Communications and Networking, Vijay K. Garg 1st Edition: © 2007, MORGAN KAUFMANN PUBLISHERS.
3. Wireless Communications, Andrea Goldsmith: © Online July 2012 (Print Publication Year 2005), Cambridge University Press.

MICROCOMPUTERS IN PRODUCTION (83)

LEARNING OUTCOMES:

KNOWLEDGE
Functionality of the microcomputer building blocks
Programming the microcomputers with assembly language
ABILITIES
Understanding of numbering systems and codes
Understanding the structure and design of simple microcomputer systems
Programming ATmega32 based microcomputer in assembly language

COMPETENCES:

Search, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations
Independent work, Teamwork – distribution of responsibilities

CONTENT:

1. Binary, hexadecimal and BCD numbering systems, two's complement arithmetic
2. Computer structure: memories, registers, adder, accumulator, arithmetic and logic unit, information buses, CPU, I/O port, microcomputer structure, bus timing signals, memory interfacing, address decoders
3. AVR Studio program
4. Memories of the ATmega32 microcontroller: program memory, register file, SRAM, EEPROM
5. Simple arithmetic operations
6. Unconditional and conditional absolute and relative jump
7. Complicated arithmetic operations
8. Indirect addressing
9. Stack and subroutines
10. Loop structures
11. Shift and rotate instructions
12. Structured assembly

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected presentations, E-mail communication, Social networks, Online synchronous and asynchronous teaching platform.

ASSESSMENT CRITERIA:

Assessment language: English / Greek
Final written examinations (40%)
Written test of progress in arithmetic systems and computer structure (20%)
Grade point average of laboratory exercises (40%)
Evaluation criteria:

- Ability to identify and describe the structure of a simple computer system
- Ability to implement simple computer systems
- Ability to program in assembly language
- Skills of assignment preparation and presentation

BIBLIOGRAPHY:

Microcontrolers, Exercises, Experiments and Applications with ATmega32, N. Nikolaidis, Kyriakidis Bros-Editions S.A., ISBN:978-960-602-217-3, 2018
Structured Computer Organization, 6th Edition, Andrew Tanenbaum, Todd Austin, Pearson, 2012, ISBN-13: 978-0132916523
Computer Organization, Hamacher, V. Carl, Zaky, Safwat G., Vranesic, Zvonko G., McGraw-Hill Companies, 1995, ISBN 10: 007025883X

ELECTRICAL INSTALLATIONS (84)

LEARNING OUTCOMES:

The course is designed to provide the theoretical and practical knowledge on the basic principles of electrical installations with an emphasis on industrial installations. It concentrates on the chapters of electrical power systems regarding power distribution on the level of medium and low voltage and on some simple automation configurations based on relays. Upon successful completion of the course the student will be able to:
a) Recognize the category of the grounding method of a power system.
b) Understand the importance and the impact of the various voltage levels.
c) Have a clear understanding of the dangers involved in the construction, operation and maintenance of electrical installations.
d) Understand the design of a typical power distribution system on the medium and low voltage level.
e) Read and comprehend a schematic of a power distribution system.
f) Calculate the required conductor cross-section in a typical electrical installation.
g) Estimate the proper protection of a power line.

COMPETENCES:

Using corresponding technologies
Research, analysis and synthesis of data and information
Decision making
Autonomous work
Teamwork – distribution and delegation of responsibilities
Working in an international environment
Working in an interdisciplinary environment
Project design
Adherence to professional ethics
Promoting free, creative and inductive thinking

CONTENT:

1. Aspects of electric power production, transmission and distribution. Generators, transformers, transmission lines. Voltage levels: High, Medium and Low voltage.
2. Nominal values of three-phase systems. 20/0.4 kV transformers in Dyn configuration. IT, TT, TN-C, TN-S, TN-C-S grounding systems.
3. Dangers and measures against electric shock. Safe voltage levels. Often mistakes in installations. Proper and improper neutral grounding. Residual Current Device.
4. Safety measures during operation and maintenance of electrical installations. Step voltage, touch voltage. Reference to norms and regulations: ELOT, HD 384, Cenelec, IEC, ITU.
5. Typical domestic and industrial power distribution. Switchgear, types of switches, types of fuses. Relays and conductors. Thermal relays and thermomagnetic circuit breakers.
6. Components of automation panels and installations: time relays, limit switches, inductive and capacitive sensors, counters, various types of relays, PLCs.
7. Marking and numeration of contacts. Schematic symbols.
8. Power cables: basic types and usages. Color code of installation power cables. Cable types and cable colors inside power and automation panels.
9. Calculation of current carrying capacity of cables, installation conditions and methods, operational conditions, electrical, thermal and mechanical strain.
10. Examples of power cables calculations.
11. Sizing of switchgear and fuses. Protection of power lines and installations.
12. Examples: simple automation circuits, Star/Delta starter, motor reversing.
13. Presentation of exemplary installations. Presentation of good practice guidelines.

TEACHING AND LEARNING ACTIVITIES: Lectures, Projected Presentations, E-mail and facebook communication, Online Synchronous and Asynchronous Teaching Platform. Recorded lectures available.

ASSESSMENT CRITERIA: Assessment Language: Greek
Final written examination with short answer questions and more elaborate questions (problem solving).

BIBLIOGRAPHY:

1. Petros Ntokopoulos, Electrical Installations of Medium & Low Voltage Consumers., Ziti Pelagia and Co., ISBN: 960-431-155-7, 2002 (in Greek)
2. Seip Gunter G., Electrical Installations Handbook, ISBN-10: 3800914670, Publicis; 2nd edition, 1987.

CNC MACHINE TOOLS (85)

LEARNING OUTCOMES:

Upon completion of the CNC Machines Tools class, students will be able to:
utilize industrial technology concepts and practices in current drawing standards,
write correctly and effectively within technical reports,
apply basic workplace computational procedures and quantitative analysis,
produce technical sketches and drawings,

illustrate knowledge of technical concepts and standards,
apply processes and materials used by industry,
demonstrate an understanding of fundamental manufacturing methods, industrial processes and safe use of equipment,
apply technical concepts, industrial processes and principles as required
apply general technical drafting and design principles.
adapt NC code to component requirements and machine tool machining capabilities.
simulate the machining phases of the mechanical part and improve the manufacturing program, for optimal machining.
automatically generate an NC program, based on an existing design CAD, using a CAM program and configure NC code to optimize processing.

COMPETENCIES:
Research, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations
Independent work, Teamwork – distribution of responsibilities, Intellectual competences, Societal competence

CONTENT:
Numerical controlled (NC) machine tools. Operations and programming of NC machine tools. Definition of Numerical Control. Advantages of CNC machines. Types of CNC Machine Tools. Components of NC systems. Spindle drives. DC motors. Stepping motors. Servo motors. Absolute and Relative Cartesian Coordinate System and polar coordinate system. Reference points. Machine zero. Work zero. Tool zero. Tool offsets. Basic motions. Linear and circular interpolation. Tool radius compensation. Tool information. Spindle speeds and feed-rates. Preparatory functions and G codes. Miscellaneous functions and M codes. Sample programs for turning and milling. Advanced programs with canned cycles: peck drilling, thread, slot and pocket cutting, circular and rectangular array of holes. Modern developments: Subprograms and program section repeats, Parametric programming, Macros. CAM definition. Functions of CAM. Integrated CAD/CAM organization. Programming of CNC machine tools with CAD/CAM systems. Generation of CNC codes from CAD models. Post processors.

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA:
Assessment Language: English / Greek
The final grade of the course is formed by 100% by the grade of the theoretical part.
The grade of the theoretical part is formed by a written final examination.
The written final examination of the theoretical part may include:
Solving problems of application of the acquired knowledge, Short answer questions etc

BIBLIOGRAPHY:
CNC Machining Handbook Building, Programming, and Implementation, Overby A., 2011, McGraw-Hill.
Machining and CNC technology, Fitzpatrick M., 2014, Third edition, McGraw-Hill.
CNC programming handbook, Smid P., 2003, second edition, Industrial Press, Inc.
Programming of CNC machines, Evans K., 2007, third edition, Industrial Press, Inc.
Introduction to Computer Numerical Control (CNC), Valentino J., Goldenberg J., 2002, third edition, Prentice Hall.

LOGISTICS AND TRANSPORT (86.1)

LEARNING OUTCOMES:
Note: The English Version of the 1-page Syllabus of this course is not yet available.

COMPETENCIES:

CONTENT:

TEACHING AND LEARNING ACTIVITIES:

ASSESSMENT CRITERIA:

BIBLIOGRAPHY:

PROCESS CONTROL (86.2)

LEARNING OUTCOMES:
The course develops a basic understanding of the fundamental concepts of process control theory from a mathematical and physical point of view. Extensive reference is made to the concepts of mathematical modelling, dynamic behaviour and control of physical and chemical basic units.
Upon successful completion of the course the student will be able to:
understand and develop mathematical models and control algorithms for basic chemical and physical processes
understand the role of variables in simple systems of physical and chemical processes.
understand the basic elements of the basic control loops in processes.
understand the concepts of mathematical modelling
understand state space models (nonlinear, linear), linearization and transfer functions.
understand the concept of controller design based on the mathematical model of each process.
understand different control schemes: feedback, feed forward, cascade, ratio control
understand specific structures for the control of multivariable systems in processes.
and will have the ability of:
mathematical modelling and classification of system variables for controlling simple process systems
linearization of non-linear mathematical models of simple processes
simulation of simple process systems
determining the parameters of conventional controllers
composition of controllers supported by a mathematical model
Designing feedforward controllers, cascade controllers, and specific controller structures for simple processes
Methodical writing, analysis and presentation of results.

COMPETENCIES: Research, analysis and synthesis of data and information using corresponding technologies, decision making, adaptation to new situations, promoting free, creative and inductive thinking, independent work, teamwork

CONTENT:

1. Introduction to process control
2. Mathematical modelling for process control
3. State space models and linearization
4. Feedback control loop (sensors, controllers, final control elements)
5. PID control algorithm
6. PID parameter tuning: Ziegler – Nichols, Cohen-Coon, model based methods
7. Model based control
8. Feedforward control
9. Cascade control
10. Control of MIMO processes
11. Special control structures for multi variable processes.

TEACHING AND LEARNING ACTIVITIES Lectures, Exercises, Online guidance, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Language: Greek
The final grade of the course is formed 100% by the grade of the theoretical part.
The grade of the theoretical part is based on a written final examination.
The written final examination of the theoretical part may include:
Solving problems of application of the acquired knowledge, Short answer questions etc

BIBLIOGRAPHY:
Marlin T.E., "Process Control", McGraw-Hill, second edition, 2000.
Chau P.C., "Process Control – A First Course with MATLAB", Cambridge University Press, 2002
Corriou J.P., Process Control–Theory and Applications, Springer, 2010,
Luyben M. & Luyben W., Essentials of Process Control, Mc Graw-Hill, 1997

FINITE ELEMENT METHOD (86.3)

LEARNING OUTCOMES:
After successful completion of the course, students are expected to be able to:
To know the basic concepts of numerical solution of mechanical problems with the finite element method
Determine mass and stiffness matrices
Implement programming knowledge and numerical methods to solve engineering problems
To interpret the analysis results (displacements, moments, stress) based on the assumptions of the problem
The aim of the course is to acquire the basic concepts of simulation mechanical models utilizing the finite element method to solve them.

COMPETENCIES:
Apply knowledge in practice
Retrieve, analyze and synthesize data and information, with the use of necessary technologies
Make decisions
Work autonomously
Work in teams
Work in an international context
Design and manage projects

CONTENT:

- Introduction to the finite element method
- Discretization for continuum mechanics
- Stiffness matrix for elements and structures
- Direct stiffness method
- Galerkin method
- Boundary conditions
- Shape functions
- One-dimensional, two-dimensional and three-dimensional elements
- Stress and strain analysis
- Numerical integration
- Programming
- Development of Finite Element models utilizing an appropriate commercial software, examples and coursework

TEACHING AND LEARNING ACTIVITIES:
Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.
Laboratory Exercises in a laboratory area with the appropriate equipment. Practice and development of coursework using FEA software.

ASSESSMENT CRITERIA:
Assessment Language: English / Greek
Coursework in a finite element software, 40% on the final score.
Final written examination in the Theoretical Lectures, 60% of the total grade.

BIBLIOGRAPHY:
Book [11335]: Finite Elements Gkotsis K. Paschalis, Ziti Pelagia & Co., ISBN13: 9789604319527, 2013 (in Greek)
Book [12347118]: S. Moaveni, Finite Element Analysis: Theory and Application with ANSYS, 5th Edition, Pearson, ISBN: 0135212103, 2020

OFF-ROAD VEHICLES (86.4)

LEARNING OUTCOMES:

- Understanding the behaviour of vehicles on uneven and yielding terrain (off-road) and the related challenges, constraints and demands on their mobility.
- Getting acquainted with the operation and design of the various types of off-road vehicles (jeeps, trucks, tractors, tracked vehicles).
- Understanding the performance and learning the basic principles of design of the propulsion, power transmission, steering and braking systems of off-road vehicles including track systems, various types of gearboxes and differentials, hydrostatic transmission systems, all-wheel drive systems, hydromechanical and hydrostatic steering systems, hydraulic and pneumatic braking systems.
- Acquiring the ability to design, evaluate, overhaul and maintain off-road vehicles and their subsystems.

COMPETENCIES:

Research, analysis and synthesis of data and information
Decision making
Autonomous work
Promoting free, creative and inductive thinking

CONTENT:

Mechanical behaviour of soil, interaction between wheel/track and terrain.
Adhesion, traction and motion resistance of wheels and tracks, longitudinal and lateral slip.
Configuration, suspension and tension o f tracks.
Engine performance, engine speed regulation, air filtration.
Under-load shifting gearboxes.
Multiple-selection gearboxes.
Power-split gearboxes.
Transfer cases.
Power take-offs.
Open and limited-slip differentials.
Torque-sensitive and speed-sensitive differentials.
All-wheel drive systems.
Axles and final transmissions.
Hydromechanical and hydrostatic steering systems.
Hydraulic and pneumatic braking systems.
Endurance brake systems.

TEACHING AND LEARNING ACTIVITIES:

Lectures
Projected presentations
E-mail communication
Online synchronous and asynchronous teaching platform.

ASSESSMENT CRITERIA:

Assessment Language: Greek
Final written examination

BIBLIOGRAPHY:

J. Y. Wong, Terramechanics and Off-Road Vehicle Engineering, 2rd ed., John Wiley & Sons, 2010, ISBN 978-0-7506-8561-0
G. Lechner, H. Naunheimer, Automotive Transmissions, Springer, 1999, ISBN 3-540-65903-X
M. Mitschke, H. Wallentowitz, Dynamik der Kraftfahrzeuge, 4. Aufl., Springer, 2004, ISBN 3-540-42011-8
M. J. Nunney, Light and Heavy Vehicle Technology, 4th ed., Butterworth – Heinemann, 2007, ISBN 978-0-7506-8037-0
S. Bennet, I. A. Norman, Heavy Duty Truck Systems, 4th ed., Thomson Delmar Learning, 2006, ISBN 978-1-4018-7064-5

MECHATRONICS (86.5)

LEARNING OUTCOMES:

The course focuses on the design and development of mechatronic systems, including in most cases applications in production and industry. It aims to highlight advanced principles of programming, integration and implementation of these technologies and to present programming ways to solve complex problems with the help of advanced techniques.
During the courses, industrial communication networks (Profibus, Industrial Ethernet, Profinet) are used, which are configured so that the PLCs can communicate with third party devices. Learners create their own supervisory programs to control automation systems using either standard market SCADAs, or developing their own interfaces, with or without OPC Server to communicate with controller data.
Upon successful completion of the course the student will be able to:

- understands the operation of Mechatronics systems
- has highly specialized knowledge, some of which is cutting-edge knowledge in a field of work and research that forms the basis for original thinking, creation and innovation.
- to design, develop and implement integrated mechatronic systems
- has a critical awareness of knowledge issues in the field of mechatronics and its connection with different fields and technologies.
- to determine the operating requirements of Mechatronics systems
- to check the correctness of the specifications and to evaluate systems
- Possess specialized problem-solving skills, which are required in research and / or innovation in order to develop new knowledge and processes and to integrate knowledge from different fields.

COMPETENCES:

Managing and transformation of work or study environments that are complex, unpredictable and require new strategic approaches. Taking responsibility for contributing to professional knowledge and practices and / or for evaluating team performance strategy. Project design and management. Decision making. Search, analysis and synthesis of data and information, using the necessary technologies. Autonomous work. Teamwork. Working in an international environment. Work in an interdisciplinary environment. Production of new research ideas. Exercise criticism and self-criticism. Promotion of free, creative and inductive thinking.

CONTENT:

• Introduction to mechatronics
• Applications of mechatronics systems
• Uses of mechatronics systems
• Analysis of mechatronic systems
• Use of electrical and electronic parts
• Use of mechanical subsystems
• Development of programming applications for mechatronic systems
• Programming of mechatronic systems
• Mechatronics system design
• Mechatronics system simulation
• Optimization of mechatronics systems
• Implementation and control of mechatronic systems
• Evaluation of mechatronics systems

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: English / Greek
The final grade of the course is formed by 70% of the grade of the theoretical part and by 30% of the grade of the laboratory part. The grade of the theoretical part is formed by a written final examination. The written final examination of the theoretical part may include: Multiple choice questions, Solving problems of application of the acquired knowledge, Short answer questions, Comparative evaluation of theory elements. The examination of the Practice Exercises is carried out with the continuous evaluation of the laboratory skills and the theoretical knowledge acquired in the context of the teaching of the course with the method of continuous evaluation.

BIBLIOGRAPHY:
Mechatronics, 6th Edition, Bolton William ISBN: 978-960-418-818-5 Distributor (Publisher): A. TZIOLA PUBLICATIONS & SONS SA
Mechatronics, Nesculescu D.
Automation, Production Systems, And Computer-Integrated Manufacturing, January 1, 2016, Mikell P. Groover
Computer Integrated Manufacturing (3rd Edition) 3rd Edition, by James A. Rehg (Author), Henry W. Kraebber (Author), 978-0131134133

RENEWABLE ENERGY SOURCES (86.6)

LEARNING OUTCOMES:
The course aims to provide basic practical knowledge as regards the applications of renewable energy sources (RES), as these currently represent an important part of the development of electrical power production technologies, with significant importance due to their environmental friendly nature and the introduction of distributed generation systems. Furthermore, their application is more and more present in industrial processes units, aiming to save resources, reduce the operational cost and the environmental impact (or equivalently improve the environmental profile) of a unit.
The course focuses on basic principles of electrical energy production systems using solar photovoltaics (PV), wind generators (WG), hydroelectric systems and biomass/biogas systems, giving emphasis on study, design and control issues.
As an elective course it provides valuable experience and expertise to the new industrial and management engineer as regards a developing field of electrical energy systems technology, with increasing penetration level and various applications that require study, design, operation, monitoring and maintenance from well trained application engineers. The consistent and successful completion of the course, has the expected outcome to enable the student to:
a) be in a position to understand the importance of RES systems for the environment and the economy
b) possess knowledge as regards new developments in electrical energy production and use systems as well as distributed generation systems
c) be acquainted with the basic parts of a RES-based electrical production system
d) be in a position to perform basic design of a RES-based electrical production system.

COMPETENCES: Practical application of knowledge, search, analysis and synthesis of information and data using appropriate technologies; Adjustment to new situations; Decision making; Autonomous work; Team work; Work in an interdisciplinary environment.
Design and project management; promotion of free, creative and inductive thinking; priorities setting; production of new research ideas; compliance to guidelines of good practices.

CONTENT:
- Introduction: RES types, their importance for the environment and economy, current status of the international market.
- Distributed generation systems, development and use in modern electrical power production, transmission and distribution systems.
- Solar energy: basic principles of solar radiation, solar cell, PV panel (I-V, P-V characteristics), basic equations
- Wind energy: basic description, quantitative assessment, part of wind generators
- Hydroelectric stations: basic description, types of hydroturbines and operational principles
- Biomass energy: types of biomass and energy content
- Electrical energy storage systems: basic battery types, other systems (supercapacitors, flywheels, hydrogen storage)
- PV electrical energy production systems: panels, mounting systems, balance of plant (BOS), basic design, examples, applications
- Wind generator systems: mounting, balance of plant systems, basic design, examples, applications
- Hydroelectric stations: basic parts, grid connection, examples
- Biomass based systems: basic parts of a station, thermodynamic cycles, examples
- Geothermal energy: basic parts, examples.
- Combination of RES systems: autonomous power systems, design, examples.

TEACHING AND LEARNING ACTIVITIES: Class theory, teaching in discussion groups and students' active participation. The lectures are supported by presentations of the total content, while the whiteboard is used: a) for further elaboration of selected thematic sections, b) for the promotion of the students' active participation in step-by-step problems solving and examples process.

ASSESSMENT CRITERIA: The course grade is formulated by a final written exam which may contain: multiple choice questions, problems solving based on knowledge acquired, short answers' questions, comparative assessment of theoretical principles.

BIBLIOGRAPHY:
1. Boyle G., "Renewable Energy: Power for a Sustainable Future", ISBN-13: 978-0199545339, Oxford University Press.

2. Jenkins N, Ekanayake J., "Renewable Energy Engineering", ISBN-13: 978-1107680227, Cambridge University Press
3. Masters J. M., "Renewable and Efficient Electric Power Systems", ISBN: 978-1-118-63350-2, IEEE Press

VEHICLE DYNAMICS (86.7)

LEARNING OUTCOMES:
Note: The English Version of the 1-page Syllabus of this course is not yet available.

COMPETENCIES:

CONTENT:

TEACHING AND LEARNING ACTIVITIES:

ASSESSMENT CRITERIA:

BIBLIOGRAPHY:

MOTION TRANSMISSION SYSTEMS (86.8)

LEARNING OUTCOMES:
• Understanding the operation, design and construction of the drive systems of automotive vehicles and its individual components.
• Acquisition of the ability of elaborating design studies and modification of car transmission systems and replacement of its individual components.

COMPETENCES:
•Search, analysis and synthesis of data and information, using the necessary technologies
•Decision making
•Autonomous work
•Exercise criticism and self-criticism
•Promoting free, creative and inductive thinking

CONTENT:
Introduction
Vehicle approvals
Composition of the automotive drive system
Principles of clutches
Torque converter
Driving resistance forces
Manual transmissions
Planetary gearboxes
Automatic transmissions
Continuously variable transmissions
Drive shafts and articulated joints
Differential systems

TEACHING AND LEARNING ACTIVITIES:
Face to face and/or distance lectures
Learning process support through the online learning platform of the course, which includes:
a) slides of the lectures,
b) recitations and detailed solutions of the main exercises for each sub-unit,
c) teaching notes adapted to the physiognomy of the offered study program,
d) communication with students via e-mail.

ASSESSMENT CRITERIA:
Students will be assessed with a written final exam that will include problem solving with a combination of knowledge of theory, calculations and critical evaluation (100%).

BIBLIOGRAPHY:
Bohner Max, Gscheidle Rolf, Wolfgang Keil, Expertise in Automotive Engineering, 2007, ION Publishing Group, 2007 (in Greek)
Th. Zachmanoglou, G. Kapetanakis, P. Karampilas and G. Patsiavos, Automotive Technology beyond 2000, 2000, IDEEA Institute (in Greek)3. G. Lechner, H. Naunheimer, Automotive Transmissions, 1999, Springer
H. B. Pacejka, Tyre and Vehicle Dynamics, 2nd Edition, 2006, Butterworth – Heinemann

DIGITAL CONTROL SYSTEMS (86.9)

LEARNING OUTCOMES:
The aim of the course is to present the modern technology of industrial controllers implemented with digital computer systems. The course focuses on understanding the basic concepts and characteristics of the operation of digital control systems, so as to provide the necessary background for the design and implementation of industrial controllers using a computer.
Consistent and successful attendance of the course has as expected result to make the student competent:
- to understand the basic concepts and characteristics of the operation of digital controllers in order to be able to take advantage of their advantages, but also to be aware of their weaknesses
- to be able to use a computer to control and analyze a production process in a real industrial environment;
- to be able to attend, without significant gaps, the material of more specialized courses of modern theory of automatic control systems (optimal, non-linear and adaptive).

COMPETENCIES:

Research, analysis and synthesis of data and information using corresponding technologies, decision making, adaptation to new situations, Promoting free, creative and inductive thinking, independent work, Teamwork

CONTENT:

1 – Introduction
- 1.1 Introduction to computer-controlled systems
- 1.2 The Z-transform and inverse Z-transform
- 1.3 Sampling and hold
- 1.4 Block diagrams

2 – Analysis of digital control systems
- 2.1 Pulse transfer functions for sampled-data systems
- 2.2 Digital Root locus and pole locations
- 2.3 Steady-state errors of sampled-data systems
- 2.4 Frequency response of sampled-data systems
- 2.5 Sampling frequency calculation rules
- 2.6 Antialiasing filter design
- 2.7 Stability criteria for discrete-time systems (modified Routh, Jury)

3 – Digital controller realization
- 3.1 Difference equations
- 3.2 Discrete-time computer code

4 – Design by emulation (analog design discretization)
- 4.1 Discrete-time performance specifications
- 4.2 Methods of Discretization of analog controllers

5– Direct digital design
- 5.1 Digital PID design techniques
- 5.2 Pole placement digital design
- 5.3 The method of Ragazzini

6–State-space design
- 6.1 State-space discretization
- 6.2 Controllablity and observability in discrete-time
- 6.3 Pole placement design in discrete-time
- 6.4 Observers in discrete-time

7– Optimal control of digital controllers
- 7.1 Deadbeat control design
- 7.2 Ripple-free deadbeat control design

8 – Simulation of digital control systems
- 8.1 Digital and hybrid simulation diagrams
- 8.2 MATLAB/SIMULINK examples and case studies

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA:

Assessment Language: English / Greek
The final grade of the course is formed by 80% by the grade of the theoretical part, and 20% by the grade of project work.
The grade of the theoretical part is based on a written final examination.
The written final examination of the theoretical part may include:
Solving problems of application of the acquired knowledge, Short answer questions etc

BIBLIOGRAPHY

1. Analog and Digital Control System Design: Transfer-Function, State-Space, and Algebraic Methods , C.T. Chen
2. Digital control of dynamic systems, Franklin
3. Digital control engineering, Fadali
4. Digital control systems, Kuo
5. Digital Control Systems, Houpis

ENTREPRENEURSHIP (86.10)

LEARNING OUTCOMES:

Understanding basic knowledge and concepts of entrepreneurship.
Understanding concepts of innovation.
Understanding how entrepreneurship works as a whole.
Understanding the recognition and development of a business idea.
Understanding business risk assessment and management.
Understanding the Creativity and Innovation Process.
Understanding the concept of social entrepreneurship and the development of social enterprises.

COMPETENCIES:

Acquisition of knowledge and skills related to the whole cycle of the business process.
Acquisition of business opportunity.
Acquisition of ease of its evaluation until the mobilization of resources.
Acquisition of business model development and business canvas.
Acquisition of business plan creation.
Acquisition of the ability to find resources and formulate agreements.
Acquisition of the choice of a sustainable development model and investigation of exit strategies.
Acquisition of evaluation of sources of financing in all phases of the business process.
Acquisition of software creation or analysis for the creation of financial statements of a business plan.
Search, analysis and synthesis of data and information, using the necessary technologies, Adaptation to new situations.
Presentation of assignment (individual work which is evaluated with a maximum grade of 3 points).
Group work.

CONTENT:

1. Introduction to the concept of Entrepreneurship and technology.
2. Analysis of the Economy and Competitiveness.
3. Introduction and analysis of the concepts of entrepreneurship & the Business environment.
4. Analysis of the types, content, nature, processes, origin and typology of entrepreneurship.
5. Analysis of Copyright and Industrial Property.
6. Analysis of Innovation and Entrepreneurship.
7. Analysis of innovation and creativity process.
8. Analysis of methods and tools to improve innovation and creativity.
9. Analysis of Innovation in Greece.

10. Software workshop for the creation of financial statements of a business plan and a business canvas (Business Model Canvas).
11. Establishment of the company.
12. Business development.
13. Finding resources - Financing in all phases of the business process.
14. Analysis of exit or closure strategies, merger of a company.

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations or Presentation of assignment, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: English / Greek
Exams and Teamwork (Business Plan)

BIBLIOGRAPHY:

1. Storey David, Greene Francis, Hassid Joseph and Fafaliou Irini, "Entrepreneurship for small and medium enterprises", published by KRITIKI. Book Code in Eudoxus: 32997689
2. Emma Murray, Heidi neck and Christopher Neck, "Entrepreneurship - Mentality and Application", published by Kritiki. Book Code in EYDOXO: 94645251
3. Mariotti Steve - Glackin Caroline, Theriou George (ed.) Entrepreneurship and Small Business Administration, 2nd Edition ISBN: 978-960-418-639-6 Publications A. Tziola & Sons SA Book Code in Eudoxus: 59382671

KNOWLEDGE MANAGEMENT SYSTEMS (86.11)

LEARNING OUTCOMES:

The aim of the course is to teach students both the necessary theoretical knowledge and the practical tools of knowledge management systems.
Upon successful completion of the course students will:
- be able to apply knowledge in practice, search, analyze and synthesize data and information using the necessary technologies
- be able to recognize and distinguish the principles and key features of knowledge management systems and their development and use methodologies
- be familiar with methods of developing knowledge management systems
- be able to make decisions and work individually and / or in teams to design, develop and manage knowledge management systems applications

COMPETENCIES:

Research, analysis and synthesis of data and information
Using corresponding technologies
Setting objectives
Project design
Setting priorities
Decision making
Monitoring results
Autonomous work
Developing new research ideas
Adherence to good practice guidelines

CONTENT:

• Introduction to Knowledge Management Systems
• Principles of Knowledge Representation and Reasoning
• Structured Representations
• Rule Systems
• Characteristics, Structure and Operation of Knowledge Management Systems
• Development Process, Models, Knowledge Extraction
• Ontology Development Methodology
• Verification and Validation Check
• Advanced Reasoning
• Knowledge Systems Applications
• Rule System, Practical Part, Examples, Software

TEACHING AND LEARNING ACTIVITIES:

Lectures
Exercises
Project assignments
Online guidance
Projected presentations
E-mail communication
Online synchronous and asynchronous teaching platform.
Interactive teaching

ASSESSMENT CRITERIA:

Assessment Language: English / Greek
The final grade of the course is formed by a written final exam and project.
The written final exam may include: Solving problems of applying the acquired knowledge, Short answer questions, multiple choice questions.

BIBLIOGRAPHY:

1. W. Ertel, Introduction To Artificial Intelligence, Grigorios Chrysostomou Fountas, 2/2019, ISBN: 9789603307969
2. I. Vlachavas, P. Kefalas, N. Vassiliadis, F. Kokkoras, I. Sakellariou. Artificial Intelligence - Third Edition, University of Macedonia Publications, ISBN: 978-960-8396-64-7, 2006/2011.
3. Jackson P. Introduction to Expert Systems (3rd edition). Addison Wesley, ISBN 0-201-87686-8

AUTOMATED GUIDED SYSTEMS (86.12)

LEARNING OUTCOMES:

KNOWLEDGE

Introduction to the ecosystem of autonomous vehicles
Functionality of the basic principles of autonomous navigation
Functionality of the basic routing and path planning algorithms
Applications of indoor and outdoor autonomous vehicles
Technological tools for autonomous vehicles

ABILITIES

Identification, analysis, design and implementation of applied autonomous vehicles
Modelling of simple environments for navigation and path planning
Simulation and real-world environments for vehicle navigation
Assessment of hardware and software tools for autonomous vehicles
Programming in Python

COMPETENCES:

Search, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations
Independent work, Teamwork – distribution of responsibilities

CONTENT:

Theory:

1. Introduction to Autonomous Systems and Autonomous Vehicles
2. Introduction to the Python programming language
3. Basic concepts of routing and path finding algorithms
4. Python structures for implementing path finding algorithms
5. The ecosystem of Autonomous Vehicles (chassis, electrical and electronic components, hardware and software components, sensors)
6. Simulation tools for Autonomous Vehicles
7. Raspberry Pi and Linux
8. Robot Operating System
9. Simultaneous Localization and Mapping (SLAM) for creating the Occupancy Grid Map (OGM)
10. The Gazebo emulation tool
11. Mathematical models and tools for Autonomous Vehicles
12. Planning and Scheduling algorithms
13. Project: Python, Raspberry, ROS, Algorithms

Lab:

1. Introduction to python and python programs
2. Routing and path finding algorithms
3. Python for implementing routing algorithms
4. Raspberry Pi and Linux
5. Assembly of an autonomous vehicle prototype

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: English / Greek. Theory:

Public Presentations
Practical mid-term examination
Final Written Examinations
Lab
Public Presentations
Final Examinations
Evaluation criteria:
- Ability to Identify and Describe the Operation / Applications of Autonomous Vehicles
- Ability to program in the Python programming language
- Simulation Skills for working with autonomous vehicles
- Skills for working with real-world equipment (raspberry, vehicle chassis)
- Skills of Assignment Preparation and Presentation

BIBLIOGRAPHY:

Automated Guided Vehicle Systems, Second revised and expanded edition, DOI 10.1007/978-3-662-44814-4, Günter Ullrich
Learning ROS for Robotics Programming, Aaron Martinez-Enrique Fernandez.
Lecture Notes

ENTERPRISE RESOURCE PLANNING (ERP) SYSTEMS (86.13)

LEARNING OUTCOMES:

The aim of this course is to teach the fundamentals of planning and execution of business processes involving the supply chain and the value chain by utilizing Enterprise Resource Planning Systems and to gain practical hands-on experience in using these systems in a virtual business environment.
Upon successful completion of the course the student will be able to:
- understand the process and methodology of selecting, designing and implementing ERP Systems
- perform transactions in an ERP System in order to mirror various business processes within a company that relate to supply chain and financial functions

COMPETENCIES: Research, analysis and synthesis of data and information using corresponding techniques, Adaptation to new situations Independent work, Teamwork – distribution of responsibilities, Intellectual competences, Social competences
CONTENT: Introduction to ERP Systems Standard integrated business processes related to manufacturing companies and to commercial companies Planning, execution and control of integrated business processes within a manufacturing company including sales and distribution, material requirements planning, procurement, inventory management, production planning, billing and financials management using an ERP System such as SAP Planning, execution and control of an integrated business process within a commercial company including sales and distribution, material requirements planning, procurement, inventory management, billing and financials management using an ERP System such as SAP
TEACHING AND LEARNING ACTIVITIES: Lectures, Lab exercises using an ERP System such as SAP, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.
ASSESSMENT CRITERIA: The final grade of the course is based on a final exam that consists of tasks to be performed using an ERP System such as SAP (70%) and multiple choice questions covering the theoretical part of the lectures (30%)
BIBLIOGRAPHY Enterprise Resource Planning Systems, Daniel E. O'Leary, University of Southern California (2000) Relevant journals: Journal of Enterprise Resource Planning Systems

14.9 9th Semester Courses

ROBOTICS (91)
LEARNING OUTCOMES: Knowledge Understanding: - the structure and architecture of typical robotic systems - the operation of representative robotic systems - the applications of basic robotic systems - Virtual Reality applications Skills Acquisition of proficiency in: Path guidance of robotic systems Simulation of robotic systems Programming of robotic systems
COMPETENCIES: Analysis, design, and implementation of robotics applications Search, analysis and synthesis of data and information using the necessary technologies Adaptation to new situations Autonomous work Teamwork
CONTENTS: Classification of Robotic Systems, Robotic Arms, Robotic Fingers, Walking Devices, Omnidirectional Wheels, Self-Guided Robotic Vehicles (AGVs and AMRs), Robot Kinematics, Robot Dynamics, Inverse Kinematics and Dynamics, Kinematic Singularities, Identification of kinematic and dynamic parameters, Selected topics of Mechanism theory, Motion Control, Force Control, Compliance and Impedance Control, Path generation and tracking, Robot-based assembly operations, Remote Center Compliance (RCC), Cooperating robots, Robot programming, Brief Introduction to Machine vision (Digital Image Processing and Pattern recognition), Nanorobotics, Medical robotics, Various robotic applications, Haptic devices, Brief Intro to Virtual reality and its applications.
TEACHING APPROACH: Lectures, Laboratory Exercises, Projects Slides, Use of computer simulations Use of online teaching aids
ASSESSMENT CRITERIA: Language: Greek Lab Exercises and Projects Final Written Examinations Assessment criteria Ability to: - identify and describe the operation of robotic devices and robotic systems - simulate robotic arms - control robotic arms - program robotic systems
BIBLIOGRAPHY: John J. Craig, Introduction to Robotics: Mechanics and Control (3rd Edition), Pearson, ISBN-10: 0201543613, 2004 Maja J. Mataric, The Robotics Primer, MIT Press, ISBN 978-0-262-63354-3, 2009 Related Scientific Journals: - IEEE Journal of Robotics and Automation. - ASME Journal of Dynamic Systems, Measurement, Control. - International Journal of Robotics Research. - ASME Journal of Mechanical Design.

PROJECT MANAGEMENT (92)
LEARNING OUTCOMES: The aim of this course is to teach theoretical and practical concepts regarding the management of projects, emphasizing on activities related to organizing, planning, executing and controlling of projects. The course introduces fundamental knowledge regarding the management of projects based on the international project management standard of PMI (Project Management Institute). Upon successful completion of the course the student will be able to: - understand the methodology of planning, executing and controlling a project - apply tools and techniques of project management and understand their role in the successful completion of a project within the set time frame and within the set budget - utilize respective methodologies in order to determine basic parameters of a project, such as critical paths, floats and performance indicators - calculate and analyse basic cost parameters and indices of a project
COMPETENCIES: Research, analysis and synthesis of data and information using corresponding techniques, Adaptation to new situations Independent work, Teamwork – distribution of responsibilities, Intellectual competences, Social competences
CONTENT: Feasibility Study

Project Initiation, Planning, Execution, Monitoring & Control, Closure
Integration management
Scope management
Cost management
Time management
Quality management
Human resources management
Communications management
Risk management

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CIRTERIA: Assessment Language: Greek
The final grade of the course is based on a written final exam that consists of multiple choice questions

BIBLIOGRAPHY

1. A Guide to the Project Management Body of Knowledge (PMBOK® Guide) – Fourth Edition, Project Management Institute (2008)
2. Gido, J. and Clements, J.P., "Successful Project Management", Cincinnati, Ohio: South-Western College Publishing, 1999.
3. Meredith, J.R. and Mantel, S.J., "Project Management", 4th edition, John Wiley and Sons, 2000.
Relevant journals:
Project Management Journal
International Journal of Project Management
The Journal of Modern Project Management

ENVIRONMENTAL ENGINEERING (93)

LEARNING OUTCOMES:
Learning goals:
Understanding of the fundamental principles of environmental engineering.
Use of the Life Cycle Analysis programme and its application in various situations.

COMPETENCES: Search, analysis and synthesis of data and information using the appropriate technologies, Adaptation to new situations and technical problems, Autonomous work, Team work, Working in an international environment, Working in a multi-disciplinary environment, Production of novel research ideas

CONTENT:
1. Introduction to environmental engineering
2. Natural resources and sustainability
3. Air pollution – Air quality
4. Water pollution – Water quality
5. Soil pollution
6. Solid – liquid – gaseous wastes
7. Radioactivity – Radioactive waste
8. Energy and the environment
9. Life Cycle Analysis
10. Tools of environmental management
11. Environment and environmental impacts
12. Educational visit to a relevant company
13. Presentation of student projects - discussions

TEACHING AND LEARNING ACTIVITIES: Theory is taught in the classroom (face-to-face lectures), Use of slide presentations. Internet searches, Communication between teacher and students by e-mail, Experimental testing using measuring instruments, Submission of student projects, Educational visit to a relevant company.

ASSESSMENT CRITERIA:
- Written final examinations with multiple choice questions, essay-type questions and problem solving.
- Optional Project: Presentation of an environmental engineering-related topic by either an individual student or a group of two students. If chosen, this project counts for 50% of the final examination mark.
- Students must pass the final written examinations regardless of whether the optional project is chosen.
- Transparent evaluation of examination results including explanations of student mistakes or shortcomings.

BIBLIOGRAPHY:

Environmental Protection Techniques – Principles of Sustainability, N. Mousiopoulos, L. Dziachristos & Th. Slini [in Greek].
Introduction to Environmental Engineering, A.S. Stasinakis [in Greek].

HUMAN MECHATRONIC SYSTEM INTERACTION (94)

LEARNING OUTCOMES:
The aim of the course is to review theoretical models related to human interaction with mechatronic systems and study of technologies, methods and tools for the design and development of interactive systems. The course introduces, reviews and analyzes mechatronic systems. Introduction, overview of the Cognitive area of Human-Machine Communication. Modeling of man as a user of computer system and mechatronic systems. Reference to cognitive models, perception and representation, attention and memory, representation and organization of knowledge, mental models, mental user models, user group models. Interaction technologies: Input / output devices, interaction style, direct control, collaboration support systems, virtual

reality, assistive technology for people with disabilities. Reference to interactive system design methodologies and dialog description methods, interface design, usability and accessibility of web applications. Machine-human interaction evaluation techniques.
Upon successful completion of the course, students will be able to:
• Understand the basic principles governing human interaction with mechatronic systems
• Understand the basic principles of user interface.
• Know the principles and methods used to design easy-to-use interactive systems.
• Know the user interface implementation architectures.
• Know the principles that govern interactivity in virtual reality.

COMPETENCES:
Managing and transformation of work or study environments that are complex, unpredictable and require new strategic approaches. Taking responsibility for contributing to professional knowledge and practices and / or for evaluating team performance strategy. Project design and management. Decision making. Search, analysis and synthesis of data and information, using the necessary technologies. Autonomous work. Teamwork. Working in an international environment. Work in an interdisciplinary environment. Production of new research ideas. Exercise criticism and self-criticism. Promotion of free, creative and inductive thinking.

CONTENT:
• Introduction, review and analysis of mechatronic systems.
• Introduction, overview of the Cognitive area of Human-Machine Communication.
• Modeling of man as a user of computer systems and mechatronics systems. The human factor - Ergonomics
• Interaction technologies: Input / output devices, interaction style, direct control, collaboration support systems, virtual reality, support technology for people with disabilities.
• Interface analysis, Voice interfaces, Tactile and non-tactile interfaces, Brain Computer Interaction
• Other forms of interaction, Augmented Reality Technologies, Wearable technologies
• Interface development, Interface evaluation
• Interactive systems design methodologies and dialogue description methods, interface design, usability and accessibility of web applications.
• Human-machine interaction evaluation techniques.

TEACHING AND LEARNING ACTIVITIES:
Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA:
Assessment Language: English / Greek
Written final exam (100%) that includes questions from all the sections of the course.
The written final exam may include:
Multiple choice questions,
Solving problems of application of the acquired knowledge,
Short answer questions,
Comparative evaluation of theory elements.

BIBLIOGRAPHY:
N. Avouris. Introduction to human-computer communication. Diavlos Publications. 1st edition.
Dix Alan, Finlay Janet, Abowd Gregory D., Beale Russell. Human-computer communication, Edition: 3rd edition / 2007,
Kunwoo Lee, Basic Principles of CAD / CAM / CAE Systems, KLIDARITHMOS LTD

CONSTRUCTION MACHINES (95.1)

LEARNING OUTCOMES:
- Understanding the operation and the principles of design of the main construction machines (rollers, tractors, loaders, bulldozers, graders, excavators), their propulsion, transmission, steering and braking systems, as well as their working systems.
- Developing the ability to evaluate, modify and maintain construction machines.
- Developing the ability to select the appropriate construction machines for a given task.

COMPETENCIES:
Research, analysis and synthesis of data and information
Project design
Decision making
Autonomous work
Promoting free, creative and inductive thinking

CONTENT:
Types and uses of construction machinery, evaluation and selection criteria.
Rollers: Ground and asphalt compaction, rollers with drums and rollers with tyres, vibration and oscillation of drums.
Tractors, wheeled and tracked: drawbar pull efficiency, steering systems for tracked tractors.
Loaders, wheeled and tracked: propulsion and loading systems.
Bulldozers: design and setup of the blade and the ripper, transmission and steering systems.
Graders: design and setup of the blade, frame, axles and transmission systems.
Excavators: frame and carriage, propulsion systems, excavation methods and systems, tools.

TEACHING AND LEARNING ACTIVITIES:
Lectures
Projected presentations
E-mail communication
Online synchronous and asynchronous teaching platform

ASSESSMENT CRITERIA:
Assessment Language: Greek
Final written examination

BIBLIOGRAPHY: Technical manuals of Caterpillar, Bomag, Hamm, Volvo, Komatsu etc.

COMPUTER INTEGRATED MANUFACTURING (CIM) (95.2)

LEARNING OUTCOMES:

The course focuses on the integration of systems with each other with the help of computer devices, including in most cases applications in production and industry. It aims to highlight advanced principles of programming, integration and implementation of these technologies and to present programming ways to solve complex problems with the help of advanced techniques.

During the courses, industrial communication networks (Profibus, Industrial Ethernet, Profinet) are used, which are configured so that the PLCs can communicate with third party devices. Learners create their own supervisory programs to control automation systems using either standard market SCADAs, or developing their own interfaces, with or without OPC Server to communicate with controller data.

Upon successful completion of the course the student will be able to:

• understands the operation of CIM systems

• has highly specialized knowledge, some of which is cutting edge knowledge in a field of work and research that is the basis for original thinking, creation and innovation.

• to design, develop and implement integrated automation systems

• has a critical awareness of knowledge issues in the field of CIM systems and their interconnection with different fields and technologies.

• determine the operating requirements of CIM systems

• check the correctness of specifications and evaluate systems

• Possess specialized problem-solving skills, which are required in research and / or innovation in order to develop new knowledge and processes and to integrate knowledge from different fields.

COMPETENCES:

Managing and transformation of work or study environments that are complex, unpredictable and require new strategic approaches. Taking responsibility for contributing to professional knowledge and practices and / or for evaluating team performance strategy. Project design and management. Decision making. Search, analysis and synthesis of data and information, using the necessary technologies. Autonomous work. Teamwork. Working in an international environment. Work in an interdisciplinary environment. Production of new research ideas. Exercise criticism and self-criticism. Promotion of free, creative and inductive thinking.

CONTENT:

• Introduction to CIM

• Applications

• Completion of systems

• Integration techniques

• PLC connection to Databases

• PLC interconnection with CNC machine tools

• PLC integration with ERP programs

• Completion of PC with PLC, CNC, Robotics systems

• Use of programming in CIM systems

• Development of programs

• Internet connection

• Data recording and monitoring

• Industrial applications

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: English / Greek

The final grade of the course is formed by 70% of the grade of the theoretical part and by 30% of the grade of the laboratory part. The grade of the theoretical part is formed by a written final examination. The written final examination of the theoretical part may include: Multiple choice questions, Solving problems of application of the acquired knowledge, Short answer questions, Comparative evaluation of theory elements. The examination of the Practice Exercises is carried out with the continuous evaluation of the laboratory skills and the theoretical knowledge acquired in the context of the teaching of the course with the method of continuous evaluation.

BIBLIOGRAPHY:

• Consolidated production with PC, Skitidis F., 978-960-6674-01-3

• Flexible systems of mechanical formulations supported by computers (Computer Integrated Manufacturing - CIM), Bouzakis Konstantinos - Dionysios, Grigoriadou Marianthi, Giannopoulos Georgios, Mitsi Sevasti, Efstathiou Kyriakos

• Automation, Production Systems, And Computer-Integrated Manufacturing, January 1, 2016, Mikell P. Groover

• Computer Integrated Manufacturing (3rd Edition) 3rd Edition, by James A. Rehg (Author), Henry W. Kraebber (Author), 978-0131134133

SELECTED TOPICS OF ELECTRICAL MACHINES (95.3)

LEARNING OUTCOMES:

The aim of the course is to provide the student with the necessary knowledge regarding the principles of conventional operation of AC electric machines and their control considering the existence of errors.

Knowledge:

- Understanding the design, operation and control methods of electric motors through the development of electric motor models in fixed and rotating reference systems.
- Understand the use of observers and analysis of current signals in order to detect and diagnose operating errors.

Skills:

- Acquisition of design and calculation of simple electrical and mechanical equivalent mathematical models of electric motors.
- Acquisition of fluency in the design of observers-indicators of the operating conditions of the electric motor.
- Acquisition of skills in the analysis of the structure of simple observers.

- Methodical analysis and presentation of errors and the influence they have on the performance of the machine (eg torque fluctuations, additional harmonic stator currents, etc.) through simulation results.
- Analysis, design and implementation of advanced methods for error detection and diagnosis in AC electric motors.

COMPETENCIES:
Research, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations
Independent work, Teamwork – distribution of responsibilities, Intellectual competences.

CONTENT:
Theoretical part:
· Mathematical Models of 3-phase Electric Machines (Inductive and Modern),
· Per Unit System,
· Simple Electrical Equivalent Circuits, Control and Limitations during Operation,
· Operation in Transitional and Steady State in a two-axis system, V / f Control),
· Formulation of square pulses in voltage inverters (PWM inverters),
Advantages of Vector Control (Response and Strength of Control; per Ampere (MTPA), Speed Range Expansion · Flux or Field Weakening,
· Electric Power Converters, 3-phase Inverters, Sinusoidal PWM (Simulink Model of Inverter), Production of 3-phase power supply, Harmonic analysis of the supply-driving voltage, effects on the generated electric torque.
· Analysis of the behavior of electric motors in different fault conditions,
· Advanced control of operating conditions for fault diagnosis, signal processing, variable measurements,
· Procedure for determination and fault estimation (current signal analysis, development of appropriate models, observers of variables, etc.),
Tasks - Practice Exercises:
· One Phase Error Analysis, Short-circuit of the winding part (Matlab / Simulink),
· Error Analysis of the Magnetic Field of the Rotor (Matlab / Simulink),
· Simulation of the Electric Motor Fault (Matlab / Simulink),
· Development of Error Observers (Matlab / Simulink).

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA:
Assessment Language: English / Greek
The final grade of the course is formed 100% by the grade of the theoretical part and the intermediate examination or project.
1. The written final examination of the theoretical part may include:
Solving of application problems, short answer questions, comparative evaluation of the theory elements etc.
2. The continuous evaluation of the theoretical knowledge that were acquired in the course by the method of project including the fault modelling of a 3-phase electrical machine.

BIBLIOGRAPHY:

1. Analysis of electric machinery and drive systems, Paul Krause, Oleg Wasynczuk, Scott Sudhoff, Steven Pekarek: 3rd Edition, © 2013, IEEE.
2. Electrical Machine Drives Control: An Introduction, Juha Pyrhönen, Valéria Hrabovcová, R. Scott Semken, ©2016, John Willey & Sons Ltd.
3. Electric Motors and Drives: Fundamentals, Types and Applications, Austin Hughes, 3rd Edition, ©2006, Austin Hughes. Published by Elsevier Ltd.
4. Motor Handbook, Fang Qi, Daniel Scharfenstein, Claude Weiss (Institute for Power Electronics and Electrical Drives, RWTH Aachen University), Clemens Müller, Ulrich Schwarzer (Infineon Technologies AG), Version 2.1, © 2019, infineon, iSEA, RWTH Aachen University.

PRACTICAL TRAINING (95.4)

LEARNING OUTCOMES:
The course aims to provide practical expertise and focused knowledge to the students in the framework of their enrollment by actors of the Public or Private sectors in topics related to the study programme of the Department. Students are employed based on the Greek National Strategic Reference Framework (NSRF) or other Framework programmes that may be available and are compensated for their services.
As an elective course it provides valuable experience and expertise to the new industrial and management engineer as regards practical knowledge tailored to the needs of the actual market, therefore assisting their future employment.

COMPETENCES: Practical application of knowledge; Adjustment to new situations; Decision making; Autonomous work; Team work; Work in an interdisciplinary environment; Design and project management

CONTENT: The content of the course is directly related to the field of work of the student provided by their employers and can involve and relate to a group of other courses of the study programme of the Department. The field of work of the student must be within the scope of study of an Industrial Engineer and Manager.

TEACHING AND LEARNING ACTIVITIES: Daily, working hours presence to a workplace, based on a specific contract. The degree of utilization of ICT depends on the field of work, however it should be considered as granted in a modern production facility. The student is employed for a period of 3 months after signing a specific contract provided by the NSRF or other funding programmes. During this period, he/she follows common employee working environment regulations. A member of the academic staff is assigned as a supervisor to oversee the course of developments in the trainee programme.

ASSESSMENT CRITERIA: Assessment is provided by the employer, who comments on the conformity of the students to the working environment and its regulations as well as its overall performance. A specific assessment booklet is provided which also contains a list of main works undertaken by the student on a weekly basis. Also the supervising member of the academic staff provides an assessment and provides an overall grade.

BIBLIOGRAPHY: -

INTELLIGENT SYSTEMS (95.5)

LEARNING OUTCOMES:
The aim of the course is to teach students both the necessary theoretical knowledge of intelligent systems as well as allow them to get familiar with practical laboratory tools.
Upon successful completion of the course students will:

- have knowledge of the basic concepts in the field of intelligent systems
- be able to apply knowledge in practice, search, analyze and synthesize data and information using the necessary technologies
- define, analyze and describe the development of an intelligent system in one or more applications that have been taught
-distinguish the characteristics of a problem which will lead them to its successful modelling
- produce solutions based on techniques of fuzzy systems and neural networks
- be able to follow the basic principles of systems development with the technologies that have been taught to compose and propose appropriate applications.

COMPETENCIES:
Research, analysis and synthesis of data and information
Using corresponding technologies
Setting objectives
Project design
Setting priorities
Decision making
Monitoring results
Autonomous work
Developing new research ideas
Adherence to good practice guidelines

CONTENT:
• Introduction to Intelligent systems
• Fuzzy Logic - Fuzzy Sets
• Participation Functions, Mathematical Representation
• Transactions between Fuzzy Sets (application of operators)
• Relationships between Fuzzy Sets, Fuzzy Inference
• Export rules (clustering, k-means algorithm)
• Fuzzy Conclusion (modus ponens, Synthetic Rule of Conclusion)
• Artificial Neural Networks
• Perceptron, Convergence Theorem
• Linear Neural Networks
• Feedforward networks
• Backpropagation learning algorithm
• Deep learning
• Matlab Software / Matlab Toolbox

TEACHING AND LEARNING ACTIVITIES: *Lectures, Exercises, Laboratory, Project assignments, Online guidance, Projected presentations, E-mail communication, Online synchronous and asynchronous teaching platform, Interactive teaching*

ASSESSMENT CPITERIA: Assessment Language: English / Greek
The final grade of the course is formed by 70% by the grade of the theoretical part and by 30% by the grade of the laboratory part.
1. The grade of the theoretical part is formed by a written final examination and project.
The written final examination of the theoretical part may include:
Solving problems of applying the acquired knowledge, Short answer questions, multiple choice questions.
2. The examination of the Laboratory Exercises is carried out with laboratory progress in the middle of the semester and laboratory examinations at the end of the semester.

BIBLIOGRAPHY:
1. P. Tzionas. Intelligent Control, Tools and Applications. (in Greek)
2. I. Vlachavas, P. Kefalas, N. Vassiliadis, F. Kokkoras, I. Sakellariou. Artificial Intelligence - Third Edition, University of Macedonia Publications, ISBN: 978-960-8396-64-7, 2006/2011. (in Greek)
3. Diamantaras, K. (2007). Artificial Neural Networks. Athens, Greece

VEHICLE ELECTRIFICATION (95.6)

LEARNING OUTCOMES: With the successful attendance of the course the student must be able
- to identify and describe the structure of electric or hybrid electric vehicles
- to correctly understand and estimate the data of an electrical powertrain
- to calculate demands of an electrical powertrain
- to satisfactorily present a subject related to vehicle electrification
- to analyze the structure of an electric vehicle and redesign it

COMPETENCIES: Research, analysis and synthesis of data and information, using corresponding technologies, decision making, team work, implementing criticism and self-criticism, promotion of free, creative and inductive thinking, environmental respect

CONTENT:
Introductory elements: brief throwback to electrification, electric vehicles and hybrid electric vehicles. Factors leading to their study and introduction to the market.
Electric vehicles (EVs): architectural structures of EVs. Electrical powertrain structural elements.
Energy storage system. Types of energy sources and their applications. Source hybridization.
Batteries: types of batteries. Characteristic sizes regarding electrification (service life, operating voltage, capacity, state of charge/discharge, charge/discharge rate). Model of realistic battery. Applications. Practical issues (charging, battery change, maintenance).
Supercapacitors: Function. Types of supercapacitors. Characteristic sizes regarding electrification (service life, operating voltage, capacity, state of charge/discharge, charge/discharge rate). Applications. Practical issues.
Other energy sources: fuel cells, solar panels, ultra-high speed flywheels.
Charging system: types of charging systems. On and off board chargers. Charging levels. Fast chargers. Conductive, inductive and wireless charging. Cost. V2G technology.

Propulsion system. Propulsion power and drive characteristics, electric motors, motor drives.
Electric motors: types of motors in electric vehicles (dc motors, ac motors, induction motor, BLDC motors and PMSM, SRM), basic principles of their operation and applications. Operation in generator area.
Motor drives, power electronics, inverters, DC/DC converters, DC/AC.
Regenerative braking. Principles of regenerative braking. Dynamic braking of electric motors, braking energy in a city cycle. Implementation strategies.
Hybrid electric vehicles: types of hybrid electric vehicles (micro, mild, full, plug-in), combinations of powertrains (series, parallel, series-parallel), modes of operation. Internal combustion engines for hybrid vehicles. Coupling forms: related technology. Application example: Toyota Prius.
Energy management system in vehicles with more than one power source. Basic types of operation. Related algorithms. Energy flow management and distribution in more than one source.
Electric and hybrid electric vehicles in practice
Examples of electric and hybrid electric vehicles
Laboratory application: electric tricycles.

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform. The course is supported by indicative small scale electric vehicles.

ASSESSMENT CRITERIA:
Assessment Language: English / Greek
The final grade of the course is formed by 70% by the grade of the theoretical part and by 30% by team small scale projects' assessment.
1. The grade of the theoretical part is formed by a written final examination. The written final examination of the theoretical part may include: Solving problems of application of the acquired knowledge, Short answer questions etc.
2. Team small scale projects are carried out using the acquired theoretical knowledge
For the award of credits, both the total grade of the course and the independent grade in each of the assessment methods 1, 2 must be at least five. The assessment criteria are accessible to students from the course website.

BIBLIOGRAPHY:
1. M. Ehsani, Y. Gao and A. Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles", Fundamental, Theory And Design, 2nd ed., CRC Press: Boca Raton, 2010.
2. I. Husain, Electric and Hybrid Vehicles Design Fundamentals. CRC Press, 2003.
3. J. Erjavec and J. Arias, Hybrid, Electric and Fuel Cell Vehicles. Thomson Delmar Learning, 2007.
4. S. Leitman and B. Brant, Build your own Electric Vehicle. McGraw Hill, 2009.
5. Fuhs, Hybrid Vehicles and the Future of Personal Transportation. CRC Press, 2009.
6. Rodrigo Garcia-Valle, João A. Peças Lopes, (Eds.), Electric Vehicle Integration into Modern Power Networks. Springer Verlang, 2012. (ISBN 978-1-4614-0134-6)
7. K. Jost (editor), "Global vehicles: Tokyo concepts", SAE Automotive Engineering International, pp. 16-32, December 2007.
8. K. Jost (editor), "Global vehicles: On the cover", SAE Automotive Engineering International, pp. 10-18, November 2008

STOCHASTIC PROCESSES (95.7)

LEARNING OUTCOMES:
The course is designed as an introduction to the mathematical modeling of the uncertainty in production systems problems. Students are invited to study the basic principles of stochastic process analysis by applying mathematical modeling, analysis and problem solving that take into account randomness in systems variables. After a brief review of probability theory, it focuses on processes of an "arrival" or "completion" nature as well as processes that evolve over time with possible dependencies on the past. Stochastic signals are defined and classified, the basic concepts of stationarity and ergodicity are introduced, while systems with stochastic inputs in various domain representations (t, ω, s) are examined and analyzed. On completion of the course, students should be able to recognize and analyze sequences of events that occur over time and, understand and apply basic methodologies of stochastic process analysis by modeling the relative problems. The course also provides the basic background for understanding and implementing a number of applications related to communication and control signals and systems with stochastic inputs. Moreover, is a basic prerequisite for advanced courses in organization of production and in operations research as well as in automation engineering.

COMPETENCIES: Research, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations, Decision making, Working in an international environment, Independent work, Teamwork – distribution of responsibilities, Working in an interdisciplinary environment, Practicing criticism and self-criticism, Promoting free, creative and inductive thinking.

CONTENT: A brief review of key elements of probability theory and distributions. Basic concepts of Random Processes. Discrete- /continuous-time and discrete /continuous state space models of processes. Arrivals in discrete time: Bernoulli process. Arrivals in continuous time: Poisson process. Markov chains: Definition of Markov models. Transition probability tables. Chapman-Kolmogorov equations. Markov Chains: Periodicity. Balance equations. Stochastic signals: definition, classification. Expected values: Mean, autocorrelation. Stationarity. Ergodicity. Autocorrelation and crosscorrelation properties. Spectral power density. Linear system response to stochastic input. Gaussian process. White noise. Applications and examples.

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: English / Greek
The grade of the course is formed 100% by a written final examination including problem solving, graphs, diagrams and calculations based on data.

BIBLIOGRAPHY:
- Introduction to Probability Models, 11th E, Sheldon Ross, Academic Press, ISBN-13: 9780124079489.
- PROBABILITY, RANDOM VARIABLES, AND STOCHASTIC PROCESSES, 4th E, Athanasios Papoulis, S. Unnikrishna Pillai, ISBN-13: 978-0071226615.
- Introduction to Stochastic Processes with R, Robert Dobrow, Wiley, ISBN-13: 9781118740651.

MICROCONTROLLERS (95.8)

LEARNING OUTCOMES:
KNOWLEDGE
Functionality of the microcontroller system building blocks

Peripheral interfacing
Applications of the microcontroller systems in production
ABILITIES
Synthesis and programming of microcontroller systems
Interfacing peripherals to a microcontroller

COMPETENCES: Search, analysis and synthesis of data and information, using corresponding technologies, Adaptation to new situations
Independent work, Teamwork – distribution of responsibilities

CONTENT:

1. The JTAG ICE
2. Input / Output ports of the microcontroller ATmega32
3. Interrupts
4. Timer 0 and 2
5. Timer 1
6. Measures of time and frequency with the timers
7. 7 segments display interfacing
8. Hex keyboard interfacing
9. LCD screen interfacing
10. Pulse width modulation (PWM)
11. Analog to digital conversion (ADC)
12. Asynchronous serial communication – RS232
13. PID controller project

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected presentations, E-mail communication, Social networks, Online synchronous and asynchronous teaching platform.

ASSESSMENT CRITERIA:
Assessment language: English / Greek
Final written examinations (40%)
Written test of progress in interrupts and timers (20%)
Grade point average of laboratory exercises (40%)
Evaluation criteria:
- Ability to identify and describe the structure of a microcontroller
- Ability to implement simple microcontroller systems
- Ability to interface common peripherals
- Skills of assignment preparation and presentation

BIBLIOGRAPHY:
Microcontrolers. Exercises, Experiments and Applications with ATmega32, N. Nikolaidis, Kyriakidis Bros - Editions S.A., ISBN 978-960-602-217-3, 2018Structured Computer Organization, 6th Edition, Andrew Tanenbaum, Todd Austin, Pearson, 2012, ISBN-13: 978-0132916523
Computer Organization, Hamacher, V. Carl, Zaky, Safwat G., Vranesic, Zvonko G., McGraw-Hill Companies, 1995, ISBN 10: 007025883X

CLASSICAL INDUSTRIAL AUTOMATIONS (95.9)

LEARNING OUTCOMES:
The course is designed to provide the theoretical and practical knowledge on the principles of classical industrial automations. Emphasis is given on relay based automations, while some reference is made to PLC automations. Upon successful completion of the course the student will be able to:
1. Have a good knowledge of the material, elements and components used in Classical Industrial Automations (CIA) and be able to recognize them.
2. Have a clear image of the dangers involved in the construction, operation and maintenance of CIAs.
3. Design a simple, typical industrial automation system.
4. Read and design in detail the auxiliary circuit of a CIA and specify the power circuit.
5. Produce a Bill of Materials.
6. Estimate the cost of materials and cost of constructions of an automation panel.
7. Locate and solve a malfunction in an automation panel.
8. Follow up on the technological advancements in fields such as PLCs, industrial electrical components, etc.

COMPETENCES: Practical application of theoretical knowledge
- Research, analysis and synthesis of data and information
- Decision making
- Autonomous work
- Teamwork
- Working in an international environment
- Working in an interdisciplinary environment
- Project design
- Adherence to professional ethics
- Promoting free, creative and inductive thinking

CONTENT:

1. Safety during operation or maintenance of installations. The electromechanical relay: principle of operation, properties, contact types, pin numeration, types of relays.
2. Relay markings, contact numeration, schematic symbols. Presentation of an exemplary circuit of a direct induction motor starter.
3. Contact index, schematic on multiple pages with cross-references of circuit elements. Induction motor inversion.
4. Automatic star/delta starter.
5. Consecutive starting and stopping of two motors.
6. Three one-directional conveyor belts.
7. Proximity switches, optical proximity sensors, counters.

8. Automated door gate.
9. Tannery drum.
10. Color mixing.
11. Vehicle loading.
12. Three motors in consecutive starting order.
13. Repetitive Lesson.

TEACHING AND LEARNING ACTIVITIES:
Lectures for the theoretical part. If the number of attending students allows it there will be visits to the CIA Lab, during the Exercise Lessons. Otherwise the exercises will be explained in class. Projected Presentations, E-mail and facebook communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA: Assessment Language: Greek
Optional intermediate written examination. Obligatory final written examination which includes problem solving, designing and calculations, critical and more elaborate questions.
Optional weekly homework.
Percentage of each assessment criteria is announced in the beginning of each semester.

BIBLIOGRAPHY:
1. Petros Ntokopoulos, Electrical Installations of Medium & Low Voltage Consumers., Ziti Pelagia and Co., ISBN: 960-431-155-7, 2002 (in Greek)
2. Seip Gunter G., Electrical Installations Handbook, ISBN-10: 3800914670, Publicis; 2nd edition, 1987.

GAS EXCHANGE PROCESSES OF THERMAL ENGINES (95.10)

LEARNING OUTCOMES:
After successful completion of the course, the student should be able to:
-understand why turbomachine blades are shaped like they are
-appreciate the basic fundamentals of sensibly scaling turbomachines that are larger or smaller than a prototype
-understand the basics of combustion (pre-mixed and diffusion flames in the various types of engine combustion chambers)
-understand the flow in the cylinder, flow through valves and ports, the role of turbulence
-be introduced to more advance engineering work involving engine thermodynamics, fluid mechanics and heat transfer

COMPETENCIES:
Research, analysis and synthesis of data and information, Adaptation to new situations, Decision making, Autonomous work, Exercise criticism and self-criticism, Promoting free, creative and inductive thinking

CONTENT:
Thermodynamics of gas-turbine cycles, gas power systems, Brayton cycle
Dimensional analysis and performance laws, flow coefficient and stage loading, specific speed and specific diameter
Diffusion and diffusers
Design methods for radial flow turbomachines
Combustion in spark-Ignition engines, thermodynamic analysis, computation of fuel burning rates by analysis of indicator diagram
Flame structure, propagation, engine knock
Combustion in diesel engines, IDI and DI combustion chambers
Ignition delay
Heat transfer in reciprocating engine cooling systems, computation of thermal loading of engine components (piston, cylinder head, cylinder liners, exhaust valves
Charge motion within the cylinder
Gas exchange processes, flow through valves and ports
Supercharging and turbocharging a reciprocating internal combustion engine

TEACHING AND LEARNING ACTIVITIES: Lectures, Exercises, Online guidance, Projected Presentations, E-mail communication, Online Synchronous and Asynchronous Teaching Platform.

ASSESSMENT CRITERIA:
Assessment Language: Greek
The final grade of the course is formed by 70% by the grade of the theoretical part and by 30% by the grade of the laboratory part.
1. The grade of the theoretical part is formed by a written final examination.
The written final examination of the theoretical part may include:
Solving problems of application of the acquired knowledge, Short answer questions etc
2. The examination of the Laboratory Exercises is carried out with the continuous evaluation of the laboratory skills and the theoretical knowledge that were acquired in the course by the method of continuous evaluation and submission of weekly assignments

BIBLIOGRAPHY:
1. N. Watson and M.S. Janota: Turbocharging the Internal Combustion Engine. Macmillan Press, 1982.
2. Turton R.K.: Principles of Turbomachinery, 2nd Ed. Chapman & Hall. London, 1995.
3. Lewis R.I.: Turbomachinery Performance Analysis, Arnold Wiley, 1996.