Course Title	**Mathematics**				
Course Code	**REFRIG 0101**				
Course Type	Compulsory, Theoretical				
Level	5B				
Year / Semester of study	1st Year, Semester A				
Teacher's Name	Anna Antoniou Andreas Stefanou Maria Filippou Nikoletta Pittokopiti				
ECTS	4	Lectures / week	4	Laboratories / week	0
Course Objectives	This course aims to provide students with the skills to use mathematics in their daily lives and their workplace. Also, attending this course students will develop their problem-solving abilities in multiple ways and the ability to think and decide in a creative and logical manner.				
Learning Outcomes	Upon the course completion, the students will be able to: • perform mathematical calculations using analytical methods necessary for the technical tasks to be performed and for their cost budgeting purposes. • use appropriate tables, diagrams and mathematical relationships to perform elementary calculations, in collaboration with the supervising engineer, on the dimensioning and installation of components used in the refrigeration installation.				
Prerequisites	**Not applicable**	Corequisites	**Not applicable**		
Course Content Section 1	**Theory:** ➢ **Algebra**				

32 periods Section 2 18 periods Section 3 6 periods	• Numerical operations. Proportions. Measurement units, multiples, submultiples, units conversion. • Solution of 1st degree equations. Solution of a system of 1st degree equations. • Practical applications for calculating quantities in engineering – such as density, pressure, work, power, voltage, heat–. • 1st degree equation plot. Calculation of a linear slope. Interpretation. ➢ **Geometry** • Geometric terms, characteristics, line drawing, measurements, shapes. • Calculation of perimeter and area of planes (triangle, square, parallelogram, rhombus, circle). • Special features of shapes. Pythagorean theorem. Practical applications. • Calculation of the volume of solid bodies - cube, parallelepiped, cylinder-. • Practical applications of calculations in the processes of a refrigeration installation– such as volume of refrigerant within a piping network, length of electrical cable, slope of waste pipe, compressor base structural materials–. • Thales's theorem - similar triangles, properties of parallel lines - practical applications in the installation of refrigeration systems-. ➢ **Trigonometry** • Definition of trigonometric numbers, trigonometric circle. • Relationships of trigonometric numbers of complementary angles, tables of trigonometric numbers, solution of rectangular triangles. Practical applications.
Teaching Methodology	• Teaching Method – In class or Hybrid Training (classroom & online) • Teaching techniques - Lecture, Discussion, Projection • Teaching means - Whiteboard, Computer, Projector • Materials - Digital Discs, Presentation, Markers

Bibliography	• Pinatsis P., Physical Mathematics, Mathbooks Publications, 2011, ISBN: 9789609324618		
Assessment		Participation in the course	10%
		Continuous evaluation (coursework preparation)	20%
		Mid-term examination	30%
		Final examination	40%
Language	Greek		

Course Title	**Technical Design (Mechanical - Electrical)**				
Course Code	**REFRIG 0102**				
Course Type	Compulsory, Laboratorial				
Level	5B				
Year / Semester of study	1st Year, Semester A				
Teacher's Name	Andri Panagiotidou Marios Christoforides Andreas Andreou				
ECTS	3	Lectures / week	0	Laboratories / week	3
Course Objectives	This course seeks to develop the ability of graphic communication and expression, so that students can identify components in technical designs, which are used or combined with other components in a refrigeration installation. Upon completion of the course, students will have the opportunity to interpret and construct simple technical drawings/sketches.				
Learning Outcomes	At the end of the course, students will be able to: • Identify the features of graphic communication and especially its design and types as an organized international "language". • Identify the means, methods and uses of a technical design. • Distinguish the types of technical design, special features and rules of each type and are familiar with their uses. • Apply the ability to read, understand and interpret drawings. • Free-hand sketches and draft technical drawings.				
Prerequisites	**Not applicable**	Corequisites	**Not applicable**		
Course Content	➢ **Technical Design**				

Section 1 18 periods	• Types of drawings. International regulations. Necessary instruments and materials for designing. Standardized drawing paper. Line widths. Types of lines. • Types of drawings and diagrams, their symbols, dimensions. • Concepts of surfaces, lines, points, angles. • Line, halfline, linear segment concept, line drawing, measurement and comparison. • Drawing of basic geometric structures. Characteristics of shapes. • Cross section drawing. Types of cross sections. • Dimensional elements, dimensioning, scales. • Axonometric projections. Drawing of isometric and side projections.
Section 2 24 periods	➢ **Mechanical – Electrical Design** • Sketches of refrigeration components (free hand). • Pipe network design, schematic representation for cooling and air conditioning installations drawings. • Electrical design principles.
Teaching Methodology	• Teaching Method – In class training • Teaching techniques - Lecture, Demonstration, exercises • Teaching means - Whiteboard, Computer, Projector, Autocad Software, Internet, drawing boards, Drawing instruments
Bibliography	• Antoniadis A., 2018. *Engineering Design.* Tziolas Publications. • Harterich Manfred, Leopold Bern, Frey Hansjorg, 2014. *Technical Design, For technicians of thermal installations, oil and fuel gases.* Ion Publications • Bas. Papamitoukas, 2002, Mechanical Drawing, *Publications of Scientific Books and Journals*
Assessment	Participation in the course — 10% Continuous Evaluation (Coursework Preparation) — 20%

		Mid-term examination	30%	
		Final examination	40%	
Language	Greek			

Course Title	**Thermodynamics**				
Course Code	**REFRIG 0103**				
Course Type	Compulsory, Theoretical / Laboratorial				
Level	5B				
Year / Semester of study	1st Year, Semester A				
Teacher's Name	Elina Ioannou Markos Douglas Kostas Gerimos Andreas Andreou				
ECTS	8	Lectures / week	6	Laboratories / week	1
Course Objectives	The aim of the course is for students to gain knowledge about the concept of heat as a form of energy, as well as the exchange of energy between the thermodynamic system and the environment. Upon completion of the course, students will be able to properly manage the magnitudes and concepts associated with thermodynamic changes, with the aim of understanding thermodynamic phenomena and their optimal energy utilization.				
Learning Outcomes	Upon the course completion, the students will be able to: • Identify the basic principles of thermodynamics which are applied in a standard refrigeration installation. • Define the basic principles of thermodynamics which are applied in a standard refrigeration installation. • Solve simple heat transfer and energy balance problems. • Use appropriate tables and diagrams to perform elementary calculations on the dimensioning of components used or combined with other components in the refrigeration installation.				
Prerequisites	**Not applicable**		Corequisites	**Not applicable**	

Course Content Section 1 28 periods	**Theory:** ➢ Basic principles of physics • Physical quantities. Units. States of matter - solids, liquids, gases -. • Divisibility of matter – molecules, atoms. • Body mass and weight. Units. Mass measurement. • Volume. Volume measurement instruments. • Special body weight and density. • Force, Gravity, Law of Universal Gravitation, Weight, Gravitational Acceleration. • Force work. Power. Energy, forms of energy – mechanical, potential, kinetic. Energy conversions. Thermal energy. Energy conservation law. • Pressure. Gas weight. Atmospheric pressure. Measurement of atmospheric pressure. Torricelli experiment. Decrease in atmospheric pressure as a function of altitude. • Pressure within gases. Pressure changes of a gas as a function of volume. Boyle – Mariotte Law. • Gas pressure measurement instruments. Manometers. Absolute and manometric pressure. Vacuum and absolute vacuum. • Molecular phenomena. Molecular forces, cohesion forces, related forces. Surface tension, capillary phenomena. • Exercises.
Section 2 42 periods	➢ **Introduction to Thermodynamics** • Heat. Temperature. Temperature measurement. Thermometers. Temperature scales. Temperature scale conversion. • Thermal expansion. Linear dilation of solids. Bimetallic plates. Applications to measurement instruments. • Gas expansion. Gas expansion under constant pressure. Gay–Loussac Law. • Neutral gas laws. Change in gas pressure during heating under

	constant volume. Charles Law. • Absolute temperature scale. Absolute zero. • Ideal gas law (equation of state). Graph of the gas law equation. Isothermal changes. Adiabatic changes. Dalton Law. • Calorimetry. Definition of Heat. Fundamental law of calorimetry. Special sensible heat. Body thermal capacity. • The three states of matter. – Melting. Melting temperature (latent). Units. – Freezing. Melting and freezing laws. – Sublimation. Steam generation. Evaporation. Boiling. – Saturated vapors. Saturated vapor pressure. Characteristics of saturated vapors. Saturation point. Saturated vapor pressure changes with temperature. – Necessary conditions for sublimation – Sublimation heat (latent). – Boiling. Boiling treaty. Boiling laws. Change in boiling temperature with external pressure. – Condensation. Condensation by cooling, compression mediated condensation. • Heat transmission. Heat ducts. Heat exchangers. Dissemination of heat by conduction, convection, and radiation. • Problem solving. Laboratory demonstrations.
Section 3 28 periods	➢ **Applied thermodynamics** • Thermodynamic system. Environment. Thermodynamic medium. Thermodynamic properties (temperature, pressure, specific volume, internal energy, enthalpy, entropy). • First thermodynamic axiom – Internal energy. Change of internal energy by work and heat change. • Applications of the first thermodynamic axiom. Isothermal gas expansion, adiabatic gas expansion. Heating gas under constant volume and pressure. Continuous conversion of mechanical work into heat and *vice versa*.

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

Thermal machine. Second thermodynamic axiom. Thermodynamic - industrial efficiency factor.
Refrigeration machines. Principle of operation. Refrigeration cycle. Necessity for the use of refrigerant fluids. Circular change in refrigerant fluid. Basic refrigeration cycle processes. Refrigeration system appliances. Change in the thermodynamic properties of a refrigerant fluid during the operation of the refrigeration machine.
Solution of exercises.

</td></tr>
<tr><td>Teaching Methodology</td><td>

Teaching Method – In class or Hybrid Training (classroom & online)
Teaching techniques - Lecture, Discussion, Questions-answers
Teaching means - Whiteboard, Computer, Books
Materials – Experimental apparatus, Presentation, Markers

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

Papaioannou A., Applied Thermodynamics, 2019., Athens: Sofia Publications.
Cenger Yunus & Boles Michael A., 2011. Thermodynamics for engineers. Tziolas Publications.

</td></tr>
<tr><td>Assessment</td><td>
<table>
<tr><td>Laboratory assessment (attendance in laboratory work demonstration)</td><td>40%</td></tr>
<tr><td>Continuous assessment (Coursework, participation in laboratory practical)</td><td>20%</td></tr>
<tr><td>Mid-term examination</td><td>30%</td></tr>
<tr><td>Final examination</td><td>40%</td></tr>
</table>
</td></tr>
<tr><td>Language</td><td>Greek</td></tr>
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Course Title	**Electrical Engineering – Electrical Laboratory**				
Course Code	**REFRIG 0104**				
Course Type	Compulsory, Theoretical / Laboratorial				
Level	5B				
Year / Semester of study	1st Year, Semester A				
Teacher's Name	Andreas Elias Stelios Georgiou Savvas Sarris Michalis Kountouros				
ECTS	5	Lectures / week	3	Laboratories / week	2
Course Objectives	The aim of the course is to introduce the student to the basic knowledge of Electrical Engineering to the analysis framework of electrical installations and the electrical laboratory, in order to acquire basic skills in the use of tools and measurement instruments and to acquire skills on the secure connection of the basic electrical components of an installation.				
Learning Outcomes	By the course completion, the students will be able to: • Identify fundamental concepts, principles, and laws of electricity. • Describe and apply the basic principles of the quantitative electrical measurements. • Practice of basic theories of electricity via experiments. • Use the appropriate tables, theorems, and diagrams to perform calculations related to the installation and maintenance of the electric circuits of home and industrial refrigeration installations. • Use the appropriate tools and/or laboratory instruments to carry out work concerning the installation, testing and maintenance of the				

	electrical circuits of home and industrial refrigeration installations. • Adhere to the technical instructions of the machines and the installations they operate, using manuals. • Apply technical terminology in English.		
Prerequisites	**Not applicable**	Corequisites	**Not applicable**
Course Content Section 1 28 periods	➢ **Direct current** • Introduction to electricity: structure of the atom, electrical charge. Negative, positive ion. Conductive and non-conductive materials. Interpretation of the occurrence of static electricity. Principle of electrical charge conservation. Kulob's law. Unit systems. • Motion of electric charges within conductors. Electricity. • Creation of constant electricity. Electricity sources. Hydraulic analogue. Impact of Electricity. • Electric circuit. Conventional current direction. • Current intensity. Units. Ammeters. • Electric potential difference, Voltage. Hydraulic analogue. Voltmeters. • Ohm’s law - Resistance. Measurement tables – Ohm’s law graph. • Specific electrical resistance (Resistivity). Units. • Electricity energy – Joule’s law. • Electrical Power. Units. Applications of Joule heating. • Electromotive force. Mechanical analogues. Electricity generators. Primary and secondary electrical elements. Battery capacity and internal resistance. Connection of electrical components in series or parallel configuration. • Kirchhoff's Laws. Connection configuration for resistors. Resistors in series and parallel. Equivalent resistance of complex resistor circuits. • Voltage divider and current divider rules.		

	• Examples of analysis of complex resistor circuits powered by a DC source. • Nominal power of electrical components. Actual power and electricity consumption. • Choice of conductor cross section for electrical circuits. • Short-circuit. Fuses and protection measures for electrical appliances. Overcharging. Choice of fuse type. • Resistance variation with temperature. • Capacity. Unit. Capacitor. Capacitor construction. Calculation of their capacity. Types of capacitors. Capacitor charging and discharging during transient phenomena.
Section 2 14 periods	➢ **Electromagnetism** • Electric field**.** Electric field intensity. Electric potential field lines. Electric current flux. • Earth's potential. Voltage and Electric field intensity relationship. Law of electric flux. Coulomb field. • Magnetic field and magnetic potential lines. Magnetic flux and flux density. Magnetic flux and magnetic field strength units. Frame within a magnetic field. Magnetic field effect on moving charge. • Magnetic field origin. Øersted's experiment. Magnetic field intensity. Magnetic field of circular conductor, solenoid, linear current conductor. Forces in an electrical conductor. Coil construction, self-inductance, self-inductance coefficient. Coil uses. • Alternating Current (AC). Time-varying waveforms. Alternating current magnitudes. Alternating current generators. • Analysis of AC circuits with composite loads. Inductive and capacitive reactance. Power, energy, and power factor.
Section 3 28 periods	**Laboratory:** ➢ **Safety, electrical element connections, instruments, measurements, creation of electric circuits, experimental verification of electricity laws.** • Introduction to laboratory equipment and instruments. Rules and measures of protection and safety.

	• Electrical measurements. Analog and digital multimeters. Measurement of voltage, intensity, and resistance in simple circuits (single source and single resistance). • Resistor color codes. Potentiometers and rheostat. Resistors in series and in parallel. • Experimental verification of Ohm's law. • Experimental verification of Kirchhoff's laws. • Experimental verification of Joule's law. • Short-circuits and protective configurations. • Magnetic field of current conductors and coils. Electromagnets. • Types of capacitors. Nominal values and color codes. Capacitor connection configurations. • Oscillometer and signal generator. Measurements of characteristic waveforms. • Measurement of inductive and capacitive reactance in relation to frequency and calculation of the power factor.
Teaching Methodology	• Teaching Method – In class or Hybrid Training (classroom & online) • Teaching techniques - Presentation, Discussion, Practical exercises • Teaching means - Whiteboard, Computer, Books • Materials – Experimental apparatus, Presentation, Markers
Bibliography	• Colliopoulou N. - Loi H.,2004. *Electrotechnia*, Ion Editions. • Alexandros A., 2001. *Electrotechnia & Electronic Technology*, Athens: Ion Editions. • Kanellopoulou I., Bazouras Ch. & Livieratos S., 1995. *Electric Circuits*, (2nd ed.) Papasotiriou Editions • Christophorou E., 2015. *Electrotechnia and Electronic Technology*. Athens: Greek Academic Libraries Association.
Assessment	Participation in the course — 10%

		Continuous Assessment (Coursework)	20%	
		Mid-term examination	30%	
		Final examination	40%	
Language	Greek			

Course Title	**Occupational Health and Safety**				
Course Code	**REFRIG 0105**				
Course Type	Compulsory, Theoretical / Laboratorial				
Level	5B				
Year / Semester of study	1st Year, Semester A				
Teacher's Name	Dimitris Titas Marina Georgiou Kostas Gerimos Michalis Kountouros				
ECTS	3	Lectures / week	3	Laboratories / week	0
Course Objectives	The main objective of the course is for students to understand the basic Health and Safety Principles at Work. Students will get to know the legislation governing Health and Safety at Work and methods for improvement, while they will also solve practical everyday problems associated with health and safety at the workplace.				
Learning Outcomes	At the end of the course, students will be able to: • Know the legislation governing Health and Safety at Work and its methods of improvement. • Solve everyday problems they encounter or are about to encounter everyday problems associated with health and safety at the workplace. • Comply with national and international regulations on occupational health and safety. • Comply with the specific regulations for the management of refrigerants, welding, and fire extinguishing, imposed by national and international legislation. • Follow the technical instructions of the supervising engineer, com-				

	municating in Greek and English. • Follow the technical instructions of the machines and installations they operate, using manuals. • Apply technical terminology in English.		
Prerequisites	**Not applicable**	Corequisites	**Not applicable**
Course Content Section 1 42 periods	**Theory:** • Occupational Safety and Health Principles (Legislative Provisions, Regulations on the Management of Occupational Safety and Health Issues, Occupational Safety and Health Committees) • Risk Assessment Process • Basic principles of workplace inspection • Safety and Health Record Keeping • Minimum specifications for workplaces • Fire safety (measures to avoid fires and explosions, fire fighting • Action and emergency response plans - Marking Ergonomics - Musculoskeletal diseases - Risks during manual handling of loads • Chemical and biological agents • Physical factors (noise, exposure to thermal load, vibrations, radiation, ventilation, lighting, etc.) • Optical Display Screens • Psychosocial risks • Mechanical hazards and work equipment (Machines -Hand Tools - Maintenance - Pressure Equipment), Electrical Hazards • Safety and health in construction projects and work at height • Trafficking of persons and vehicles • Means of personal protection		

<table>
<tr><td></td><td>Risk assessment - Case study</td></tr>
<tr><td>Teaching Methodology</td><td>Teaching Method – In class or Hybrid Training (classroom & online) or full electronic training
Teaching techniques - Discussion, work in groups, case studies, brainstorming
Teaching means - Whiteboard, Computer, projector</td></tr>
<tr><td>Bibliography</td><td>Selountos V., Papaioannou G., Perdios S., Housianakos K., 2010. Fire Safety – Applied fire protection and firefighting elements, "Phoebus" Editions.
Safety and health management of work, Techniques and methods of risk, risk to job security. Ministry of Education and Religious Affairs.
The Health and Safety at Work Law, 1996-2020</td></tr>
<tr><td>Assessment</td><td><table><tr><td>Participation in the course</td><td>10%</td></tr><tr><td>Continuous Assessment (Coursework)</td><td>20%</td></tr><tr><td>Mid-term examination</td><td>30%</td></tr><tr><td>Final examination</td><td>40%</td></tr></table></td></tr>
<tr><td>Language</td><td>Greek</td></tr>
</table>

Course Title	**Computer Applications in the Organization of Refrigeration Installations**				
Course Code	**REFRIG 0106**				
Course type	Compulsory, Laboratorial				
Level	5B				
Year / Semester of study	1st Year, Semester A				
Teacher's Name	Michalis Papachristodoulou Rafael Mavrochilos Panagiota Sidera Kiriakos Georgiou				
ECTS	3	Lectures / week	0	Laboratories / week	3
Course Objectives	Through the course the students will have acquired the necessary skills in the use of computer applications, so that they establish and maintain work organization forms regarding the installation and maintenance of industrial refrigeration systems. Particular emphasis is placed on Office 365 products and especially PowerPoint, Word, Excel. Students will learn how to use the computing applications used in the faculty and which support the other courses (Moodle, Teams, email).				
Learning Outcomes	At the end of the course, students will be able to: • Use basic computational applications to format text, to set up and maintain timetables, to configure calculated tables and to present results to an audience. • Develop work organization forms which concern the installation and maintenance of domestic and industrial refrigeration and air conditioning installations. • Develop estimate sheets which concern the installation and mainte-				

<table>
<tr><td></td><td colspan="3">nance of domestic and industrial refrigeration and air conditioning installations.
• Create attractive presentations for the efficient promotion of their professional activities.
• Use electronic mail and other basic internet services.</td></tr>
<tr><td>Prerequisites</td><td>Not applicable</td><td>Corequisites</td><td>Not applicable</td></tr>
<tr><td>Course Content

Section 1

3 periods

Section 2

3 periods

Section 2

36 periods</td><td colspan="3">➢ Computer System
• Computer hardware. Architectural structure of the computer.
• Peripheral units.
• Software. Types of software.
• Computer categories.
• Computer networks (local, wide area). Broadband technologies in computer networks.
• Internet. Basic services. E-mail.
• Computer system protection.
➢ Computer Usage
• Desktop, navigation, settings.
• File management. Create folders and files. Files compression.
➢ Applications
• Text editing – Create refrigeration process organization and costing forms.
• Basic processing and text formatting actions.
• Design of technical refrigeration work harts – status of a series of air conditioner installation and operation actions, task assignment, job recording, Gantt diagram-
• Design of financial information collection forms for the refrigeration installation - Purchase order, materials order, invoice</td></tr>
</table>

	• Business mail design - drafting technical text, preparing a quote and a cover letter of the offer. Compilation of a curriculum vitae. • Worksheets - Creation of refrigeration process costing sheets • Use worksheets. Use a workbook. Use cells and import data. Format data and worksheets. Use basic formulas to process data. • Use graphs in worksheets. Select and format a graph. Copy graphs in the workbook and into other applications. • Import data, format, and edit using formula and numeric operations. Create and format a composite graph. Import data from other file formats (CSV, TSF) for editing. • Costing of a refrigeration system installation - creation of fixed and variable costs allocation sheets. Identify a break-even point in the business cycle by creating a diagram and using a formula. • Presentation software – Creating slides to promote electromechanical services. • Create and develop a presentation. Slide formatting, color selection, and layout. Use a master slide. Insert and format text and graphs or images. • Slide formatting, text, and paragraphs. Insert a table. Insert and format graphic and graphs. Add animation and effects to the presentation. Add slide transition effects. Run a presentation with a timer. • Creative development of a presentation as a means of public relations and advertising means for the promotion of refrigerant services. Form central message to promote. ➢ **Application connectivity** • Use and connectivity of applications to communicate data in the form of a technical report, using graphs and a presentation. Electronic delivery and data communication. ➢ **Navigating the web** • Search for information with search engines. • Collection, evaluation, utilization of information.
Teaching Methodology	• Teaching Method – In class or Hybrid Training (classroom & online) • Teaching techniques – Lecture, Discussion, work in groups,

<table>
<tr><td></td><td>Demonstration
• Teaching means - Whiteboard, Computer, projector,Office 365</td></tr>
<tr><td>Bibliography</td><td>• Cox, J. Lambert, C., 2011. Greek Microsoft Word 2010 Step by Step, Klidarithmos Editions.
• Karolidis, D., 2011. Microsoft Office Excel 2010, Avakas Publications.
• Goultidis, Ch., 2013. PowerPoint Presentations 2010, Klidarithmos Editions.
• Kaniklidis, A., 2013. ECDL Standard: Computer Essentials. A one plus educational services.
• Christou, Ch., 2011. The complete ECDL teaching book 5: Microsoft Windows 7, Office 2010, Internet Explorer 9. EduCYBER Editions.</td></tr>
<tr><td>Assessment</td><td><table>
<tr><td>Participation in the course</td><td>10%</td></tr>
<tr><td>Continuous Evaluation (Work Preparation)</td><td>20%</td></tr>
<tr><td>Mid-term examination</td><td>30%</td></tr>
<tr><td>Final examination</td><td>40%</td></tr>
</table></td></tr>
<tr><td>Language</td><td>Greek</td></tr>
</table>

Course Title	**Compression Refrigeration Technology I - Refrigeration Laboratory I**				
Course Code	**REFRIG 0201**				
Course Type	Compulsory, Theoretical / Laboratorial				
Level	5B				
Year / Semester of study	1st Year, Semester B				
Teacher's Name	Neoklis Antoniou				
ECTS	8	Lectures / week	2	Laboratories / week	5
Course Objectives	The students through the teaching of the course will have acquired the necessary scientific knowledge and skills that enable them to work in areas of the field in terms of calculation, construction, and configuration of refrigeration installations. Students will also be able to develop the control methodologies of these systems and their applications.				
Learning Outcomes	Upon completion of the course, the students will be able to: • Describe the basic features and properties of all the materials, components and units used in a refrigeration installation. • Identify the way in which all components work together for the efficient operation of a refrigeration installation. • Assemble the refrigeration units and adapt all the auxiliary components and devices, required for its operation, following technical instructions and construction plans. • Describe electric circuits and the automatic control components applied in a refrigeration installation.				
Prerequisites	**Not applicable**	Corequisites	**Not applicable**		
Course Content Section 1	**Theory** ➢ **Basic Thermodynamics**				

22 periods	• Refrigeration cycle - mechanical refrigeration, refrigeration devices, high side, low side, overheating, compression heat. • Mollier diagram. Representation – interpretation and plotting of refrigeration cycle processes on the Mollier diagram.
Section 2 6 periods	➢ **Categories of refrigeration systems** • Categorization methods. Purpose, description, characteristics of refrigeration systems, applications.
	Laboratory
Section 3 46 periods	➢ **Parts of the Refrigeration System** • Purpose, description, structural characteristics, method of application and connection to the refrigeration system. Their function. – Compressors. • Classification of compressors based on structure-mode of operation (hermetic reciprocating, semi-hermetic, open type, screw-shaped, rotary, centrifugal)-. • Compressor parts (motor, rotor, stator, input, springs, cam, piston, cylinder, output, valves, springs, shell, terminals, input and output tubes, base). • Differences, how different types of compressors work. • Technical characteristics of single-phase hermetic compressors (power, velocity, cylinder capacity, refrigerating capacity, chamber temperatures, low - high pressure). • Compressor lubrication. • Required properties of compressor oil. • Choice of lubricating oil for different types of compressors. ➢ Condensers • Types of condensers (air-cooled, water-cooled, with fan, cooling towers). • Operation of an air-cooled condenser.

	• Gas condensation temperature. • Condenser operating pressure. • Gas subcooling. • Condenser cell surface control. • Operation of a water-cooled evaporation condenser. ➢ Evaporators. • Types of evaporators (water-cooled, air-cooled). • Air-cooled evaporator function. • Gas evaporation temperature. • Evaporator operating pressure. • Gas overheating. ➢ Measuring devices (Choke devices) Role of measuring devices, installation method, operating method, operating characteristics, advantages – disadvantages. • Capillary tube. • Automatic release valve. • Thermostatic release valve. • Electronic release valve. • Thermostatic release valve with external balancing line. ➢ **Control, regulation and protection devices**.
Section 4 14 periods	• Purpose, description, operating method, characteristics and applications in the refrigerating system. • Four-way valve • Fluid collector • Oil separator • Fluid flow indicator • Refrigerant filter • Electromagnetic valve fluid tube • Pressure switch • Thermostat • Service Valves • Manometers
Section 5	➢ **Electric circuits of the refrigeration system - electrical diagrams** - Electric circuits of the hermetic compressor (main - auxiliary winding, capacitors, relays, overload switches)

<table>
<tr><td>10 periods</td><td>- Description and operation of electrical elements and electric circuits of a refrigeration system

• General switch
• Thermostat
• Mechanical parts start-up system
• Protection of electric circuits and phases
• Relay – Contactor
• Magnetic contacts
• Defrosting system
• Communication systems</td></tr>
<tr><td>Teaching Methodology</td><td>• Teaching Method – In class teaching
• Teaching techniques – Lecture, Discussion, work in groups, Demonstration, Simulations,
• Teaching means - Whiteboard, Computer, projector, Visits in appropriate industries, Laboratory apparatus</td></tr>
<tr><td>Bibliography</td><td>• Anastasiadis P., S., 1994. Industrial Refrigeration. Anastasiadis Panagiotis S. Editions.
• Bagianos I., 1959. Refrigeration Industry. 2nd volume.
• Alexis K. George, 2008. Refrigeration Technology. Stamoulis Editions.
• Vrachopoulos M., 2000. Refrigeration Devices. Ion Editions.</td></tr>
<tr><td>Assessment</td><td><table>
<tr><td>Participation in the course</td><td>10%</td></tr>
<tr><td>Continuous Assessment (Coursework)</td><td>20%</td></tr>
<tr><td>Mid-term examination</td><td>30%</td></tr>
<tr><td>Final examination</td><td>40%</td></tr>
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<tr><td>Language</td><td>Greek</td></tr>
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Course Title	**Technical Design (CAD)**				
Course Code	**REFRIG 0202**				
Course Type	**Compulsory, Laboratorial**				
Level	**5B**				
Year / Semester of study	**1st Year, Semester B**				
Teacher's Name	Ploutarchos Evlogimenos				
ECTS	5	Lectures / week	0	Laboratories / week	5
Course Objectives	By teaching the course, the aim is to acquaint the students with the basic principles and design tools available in AutoCAD. Students will be able to create simple mechanical drawings, take measurements on existing designs for bidding purposes and finally make minor changes to complex mechanical-electric designs.				
Learning Outcomes	At the end of the course, students will be able to: • Recognize the possibilities of the computer as a modern design tool • Recognize simple introductory design applications using the computer. • Draw technical drawings using a computer.				
Prerequisites	**REFRIG 0102**	Corequisites	**Not applicable**		
Course Content Section 1 70 periods	➢ **Computer Design (Mechanical - Electrical Design)** • Basic principles of digital design. Introduction to the AUTOCAD design program. The design environment. • Design commands. The basic settings. Design modes (absolute Cartesian coordinates, relative Cartesian coordinates, polar coordinates, ortho). Drawing of 2D shapes. • The modification commands. Designing with the modification commands. • Orthographic projection and isometric drawing.				

	• Design of mechanical components in the orthographic and isometric projection. • Design of mechanical assembly components in the orthographic projection (block command, insert image, etc.). • Design of mechanical components of an assembled mechanism, symbols and make block, insert block, explode commands etc. • Learning the characteristics of basic mechanical components and presenting tables of standard mechanical elements – threads, standardization of screws, nuts, screw connections, roller bearings, sliding bearings, wedges, axles, axle fuses, straps, gears, pulleys, tolerances, fittings, surface quality, sealing materials, illustrated welding planning. • Design of network installations, schematic and symbolic representations for cooling networks and plumbing. • Drawing of electrical symbols and electrical circuits. • Drawing of electromechanical components and electromechanical circuit of refrigeration installation (cooling cycle devices, valves, relays, thermal elements, pressure switches, switches). • Creation of layers. • Drawing of a domestic air conditioning installation and electromechanical services.
Teaching Methodology	• Teaching Method – In class training • Teaching techniques - Lecture, Demonstration, exercises • Teaching means - Whiteboard, Computer, Projector, Autocad Software, Internet, drawing boards, Drawing instruments
Bibliography	• Yiannis T. Kappos, 2014. *Practising AutoCAD, Klidarithmos Publications*. • Tsempeklis, Spyros / Sarafis, Elias, 2010, *Technical drawing using AutoCAD, Disigma Publications*
Assessment	

Participation in the course	10%
Continuous Evaluation (Coursework Preparation)	20%
Mid-term examination	30%

		Final examination	40%	
Language	Greek			

Course Title	**Electric Machines**				
Course Code	**REFRIG 0203**				
Course Type	Compulsory, Theoretical / Laboratorial				
Level	5B				
Year / Semester of study	1st Year, Semester B				
Teacher's Name	Stelios Georgiou				
ECTS	5	Lectures / week	2	Laboratories / week	3
Course Objectives	Attending this course, the students will acquire the necessary scientific and technical knowledge of the characteristics, use and principle of operation of transformers and electric machines, as well as of the control of modern electrical driving systems.				
Learning Outcomes	At the end of the course, students will be able to: • Identify the types, features and operation principle of transformers as well as their use in the transfer and transmission of electric energy. • Identify the types of direct current machines, their operation principle as generators and motors, and their special features. • Perform calculations of their basic electric and mechanic quantities. • Apply the basic principles of electrical engineering and electrical machines and use appropriate tables, theorems and diagrams to perform elementary calculations, in cooperation with the supervising engineer, concerning the installation and maintenance of electric circuits of domestic and industrial refrigeration installations. • Use appropriate laboratory tools and instruments to carry out work relating to the installation, control, and maintenance of electric circuits of domestic and industrial refrigeration installations. • Conduct efficient electrical control of modern electrical systems as				

<table>
<tr><td></td><td colspan="3">well as control systems of industrial installations.

• Describe the features of inverter technology and its importance in the operation of modern refrigeration installations.

• Follow the technical instructions of the machines and installations they operate.

• Apply technical terminology in English.</td></tr>
<tr><td>Prerequisites</td><td>Not applicable</td><td>Corequisites</td><td>Not applicable</td></tr>
<tr><td>Course Content

Section 1

6 periods</td><td colspan="3">Theory:

➢ Transformers

• Single-phase transformers. Principle of operation and use of transformers. Power, voltage, and current relationship between primary and secondary. Construction of a single-phase transformer. Leakage and ways of limiting them.

• Three-phase transformers. Components, connections, and standardization of transformers. Self-transformers and their applications.</td></tr>
<tr><td>Section 2

22 periods</td><td colspan="3">➢ Electric Machines

• DC Electric Machines: Historical review and uses of DC machines Principle of operation of the DC generator and the DC motor. Construction structure and basic components of the DC machines Relevant English terminology.

• Types of DC machines: Windings and ways of activating.

• Characteristics of DC machines: Nominal quantities (voltage, power, losses, and efficiency factor). Basic equations of voltage, current and speed of DC generators. Basic equations of torque, current, speed of DC motor.

• Adjusting the operation of DC motors: Ways to start, modulate turns, change rotational direction, and the DC motor brakes.

• Alternators: Power pair and principle of operation of the alternator. Characteristics of sinusoidal alternating voltage and current. Structural elements of alternators and frequency/turns relationship and field pole pairs.</td></tr>
</table>

	• Asynchronous Single-phase Motors (ASPM) : Rotating magnetic field, and principle of operation of the ASPM. Asynchronous single-phase motors with collector. Construction, connection, and adjustment of the ASPM turns. • Introduction to three-phase systems. Phase and polar voltage. Star connection and delta connection. Power of the three-phase current. • Three-phase motors: Principle of operation and construction of an asynchronous three-phase motor (ATPM). Terminals, and three-phase motor connection. • Introduction to STAR and DELTA connection. **Laboratory:**
Section 3 6 periods	➢ **Transformers** • Measurements of electrical transformer quantities. Voltage, power and resistance to primary and secondary. • Damage to the transformers. Symptoms and ways to repair faults.
Section 4 21 periods	➢ **Single-phase - three-phase motors** • Identification of parts of DC machines. Marking of DC machine terminals. Measurements for the correction of the terminals of the stator and the armature. • Disassembly and assembly of DC motors. Maintenance of mechanical parts of the motor. • Experimental verification of the relationship between the voltage, speed, and torque of DC motors. • Start-up control and adjustment of DC motor speed. • Connections for changing the rotational direction of DC motors. • Identification, marking and connection of the terminals of the exchanger. Protection measures for the safe operation of power generators. • Failures and proper operation control of asynchronous single-phase motors. • Maintenance and repair of single-phase and three-phase motors.

<table>
<tr><td>Section 5

15 periods</td><td>

Ways to start, protect, and change the rotational direction of three-phase motors.

➢ Compressor electric motors

- Applications of electric motors in refrigeration installations

compressor movement
condenser fan movement - vaporizers
pump movement (liquid refrigerant, water, water-cooled condensers
lubrication oil pump movement

- Inverter technology. Inverter features, operation. Impact on the operation of refrigeration installation.

Automatic control and protection of compressor electric motors
Protective devices - control of intensity, temperature
Control devices
Compressor cooling power adjustment

</td></tr>
<tr><td>Teaching Methodology</td><td>

Teaching Method – In class teaching
Teaching techniques – Lecture, Discussion, work in groups, Demonstration, Simulations,
Teaching means - Whiteboard, Computer, projector, Visits in appropriate industries, Laboratory apparatus

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

Malatestas V. Pantelis, 2015, Electric Machines, Tziola Publications
Stephen J. Chapman, 2019, Electric Machines AC-DC, Tziola Publications

</td></tr>
<tr><td>Assessment</td><td>
<table>
<tr><td>Participation in the course</td><td>10%</td></tr>
<tr><td>Continuous Assessment (Coursework)</td><td>20%</td></tr>
<tr><td>Mid-term examination</td><td>30%</td></tr>
<tr><td>Final examination</td><td>40%</td></tr>
</table>
</td></tr>
<tr><td>Language</td><td>Greek</td></tr>
</table>

Course Title	**Refrigerant Fluids - Environmental Protection**				
Course Code	**REFRIG 0204**				
Course Type	Compulsory, Theoretical / Laboratorial				
Level	5B				
Year / Semester of study	1st Year, Semester B				
Teacher's Name	Elina Ioannou Neoklis Antoniou Kostas Gerimos				
ECTS	3	Lectures / week	3	Laboratories / week	0
Course Objectives	The main objective of the course is to provide students with all the necessary knowledge regarding the types, features and properties of refrigerant fluids, to make them understand all the regulations governing their correct management and apply the management of refrigerant fluids in the operation of refrigeration systems.				
Learning Outcomes	At the end of the course, students will be able to: • Describe the types, features and composition of refrigerant fluids. • Identify the role of refrigerant fluids in the operation of a refrigeration installation. • Comply with national and international regulations on the safe use of refrigerant fluids. • Acknowledge the environmental impact of refrigerant fluids and apply its protection measures. • Comply with national and international regulations on environment protection. • Follow the technical instructions of the supervising engineer.				

<table>
<tr><td></td><td colspan="3">• Apply technical terminology in English.</td></tr>
<tr><td>Prerequisites</td><td>Not applicable</td><td>Corequisites</td><td>Not applicable</td></tr>
<tr><td>Course Content

Section 1

6 periods</td><td colspan="3">Theory:

➢ Basic concepts of chemistry.

• Physical and chemical phenomena. Molecules and atoms. Periodic table of elements. Metals, non-metals.

• Main chemical elements and basic inorganic and organic compounds-chemical symbols, types, properties- (oxygen, hydrogen, water, nitrogen, chlorine, hydrochloride, fluoride, carbon, carbon dioxide, carbon monoxide, methane, propane, butane, acetylene, acetone).

Section 2

24 periods

➢ Refrigerant fluids

• The role of refrigerant fluids in the refrigeration installation.

• Selection of refrigerant - criteria.

• Necessary properties of refrigerant fluids.

• Nomenclature of refrigerants. Categories of refrigerants according to their chemical composition (CFC, HCFC, HFC, HC) and hazard (ASHRAE). Characteristics.

• Mixtures of refrigerants.

• Diagrams and tables of fluid – steam of refrigerant.

• Volumetric refrigeration capacity. Thermal comparison of refrigerants.

➢ Environmental protection

• Environmental impact of refrigerant fluids (depletion of the ozone layer, global warming).

Section 3

12 periods

• Environmental regulations (Montreal Protocol, Kyoto, EC 517/2014).

• Zeotropic gases (azeotropic gases, pure, quasi-azeotropic) and boiling point glide. Ozone Depletion Potential (ODP), Global Warming Potential (GWP).</td></tr>
</table>

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

- Safe management of fluorinated gases (use in refrigeration systems, transport, storage).

</td></tr>
<tr><td>Teaching Methodology</td><td>

- Teaching Method – In class teaching
- Teaching techniques – Lecture, Discussion, work in groups, Demonstration, Simulations,
- Teaching means - Whiteboard, Computer, projector, , Laboratory apparatus

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

- Charitonidis, N., 2007. *Energy saving in refrigeration complexes. Improvement of the Energy Efficiency of Electric-powered Systems in the Industry.*
- Ksiros, G., 2014*. Management of Greenhouse Refrigeration Substances.* Small Business Institute (GSEBEE).
- *The refrigeration technician*. [online] Available at: http://opsiktikos.gr/
- Ministry of Environment, Energy and Climage Change – [online] Available at: https://ypen.gov.gr/
- European regulations EC507/2014
- Iatridis, M., 1996, *The refrigeration manual.* Rational Energy Use.

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

Participation in the course	10%
Continuous Assessment (Coursework)	20%
Mid-term examination	30%
Final examination	40 %

</td></tr>
<tr><td>Language</td><td>Greek</td></tr>
</table>

Course Title	**Mechanical Engineering Laboratory - Welding Laboratory**				
Course Code	**REFRIG 0205**				
Course type	Compulsory, Theoretical / Laboratorial				
Level	5B				
Year / Semester of study	1st Year, Semester B				
Teacher's Name	Panagiotis Panagiotou				
ECTS	6	Lectures / week	1	Laboratories / week	4
Course Objectives	The course aims at providing the students with all the necessary knowledge, skills, and capabilities in order to properly plan the welding process and become familiar with the basic tools and devices, so that they can perform welding processes.				
Learning Outcomes	Upon the completion of the course, the students will be able to: • Operate machine-shop tools and machineries. • Use appropriate tables and diagrams to perform elementary calculations on the dimensioning of components that can be manufactured in the machine-shop and used or cooperate with other components in the refrigeration installation. • Identify (become familiar with) the capabilities of machinery to form components required for the implementation of welding processes of refrigeration installations. • Apply welding techniques for refrigerant fluid piping and metal structures of the refrigeration installation, using appropriate tables and diagrams.				
Prerequisites	**Not applicable**		Corequisites	**Not applicable**	
Course Content	**Theory:** ➢ **Mechanical Engineering Laboratory – Machine-shop**				

Section 1 14 periods	• Laboratory instruments and tools – description, characteristics, use, maintenance, accident prevention-. • Measuring dimensions. Metric, Anglo-Saxon system, relationship. Length measurement instruments – tapes, rules, pachymeters, micrometers-. Pachymeter, micrometer operation principle. • Engraving instruments and means – engravers, center punch, compass scriber–. Engraving process. • Restraint tools - benches, vise, clamps-. • Impact tools. • Tools for tightening screws and nuts. Types and description of screws. Types and description of screwdrivers. Keys – with fixed opening, tubular, adjustable opening, piping keys, special keys-. • Hand saws, metal saws, saw ribbons. • Cutters – metal scissors, pliers, tweezers-. • Files • Drills – hand drills, electrical hammer drills – measurement of drill bits – grinding. • Internal thread taps, handles. ➢ **Welding.** • Welding classification • Fusion welding - autogenous, heterogeneous - soft, hard ➢ **Copper tubes for refrigerant fluids.** • Specifications - standardization of copper tubes. • Standardization of dimensions. • Natural properties of copper.
Section 2 56 periods	**Laboratory:**

	➢ Welding • Acetylene - oxygen, LPG, propane mixture, butane - oxygen welding equipment • Bottles. Description, characteristics, protective measures. Tools and means of welding. • Components – regulation and control tools. Manometric diffusers, oxygen-acetylene bottle shutter, control valves, flexible tubes, torch, blowtorch, nozzles, spark plug, fillers materials. • Use of equipment. Turning ON - OFF the equipment, operating pressures. Nozzle selection. Flow settings. Safety rules. Use of protective equipment – safety goggles, gloves, uniform-. • Execution of welding. • Oxygen – acetylene flame. Oxidative, reductive, neutral flame. Flame temperatures. • Fuel ignition. Problems during ignition. Adjusting the fuel flow to the torch. Flame characteristics for mixtures of fuel of different composition (oxygen - LPG flame, LPG flame - air). Advantages, disadvantages of using mixed fuel flame. • Diffusion and overflow of copper tubes. Use of copper welding rods. Types of rods, form, chemical composition. The role of increased silver content in copper welding. • Welding of copper tubes, copper components. • Welding in various places. Capillary phenomenon. Welding color, direction, speed parameters. • Quality control. • Welding defects – limited adhesion to the joint, lack or excess material, excessive melting, overheating of copper pieces-. • Sealing control with Nitrogen.
Teaching Methodology	• Teaching Method – In class teaching • Teaching techniques – Lecture, Discussion, Demonstration, practical exercises • Teaching means - Whiteboard, Computer, projector, Laboratory apparatus, welding equipment

<table>
<tr><td>Bibliography</td><td>Parikos, G., Steinmuller, A., Brehme, D., Fischer, U., 2008. Welding Technology. Athens: European Technological Editions.
Haidemenopoulos, G., Introduction to Welds, 2010. Tziolas Publications.
Benatar, A., Bonten, C., Grewell, D. and Tuechert, C., 2001. Welding. Munich: Hanser Verlag.</td></tr>
<tr><td>Assessment</td><td><table>
<tr><td>Participation in the course</td><td>10%</td></tr>
<tr><td>Continuous Evaluation (Coursework Preparation)</td><td>20%</td></tr>
<tr><td>Mid-term examination</td><td>30%</td></tr>
<tr><td>Final examination</td><td>40%</td></tr>
</table></td></tr>
<tr><td>Language</td><td>Greek</td></tr>
</table>

Course Title	**Practical Training I**				
Course Code	**REFRIG 0206**				
Course type	Practical Training				
Level	5B				
Year / Semester of study	1st Year, Semester B				
Teacher's Name	Program Coordinator				
ECTS	6	Lectures / Week	-	Laboratories / week	-
Course Objectives	The practical training aims at the primary professional training of students in basic positions in the field of Electromechanical and Refrigeration Installations in the Industry. Students will gain relevant industrial experience and additional knowledge and skills relevant to the profession. Also, the practical training will give students the opportunity to apply the taught theories in practice by undertaking basic tasks and responsibilities at the chosen workplace.				
Learning Outcomes	At the end of the practical training, students are able to: • Develop basic professional skills • Understand the nature, opportunities and requirements of the profession and industry • Establish contacts and relationships with key professionals in the sector • Start and lay the foundations for the development of their professional careers.				
Prerequisites	Not applicable	Corequisites	Not applicable		
Course Content	Students will be inducted in the sector of Electromechanical and Refrigeration Installations in the Industry				
Teaching Methodology	Employment for six weeks in companies dealing with Electromechanical and Refrigeration Installations in the Industry				
Bibliography	Not Applicable				
Assessment	Students will be evaluated through their performance in their work and the completion of the intern booklet.				
Language	Greek				

Course Title	**Compression Refrigeration Technology II – Refrigeration Laboratory II**				
Course Code	**REFRIG 0301**				
Course type	Compulsory, Theoretical / Laboratorial				
Level	5B				
Year / Semester of study	2nd Year, Semester A				
Teacher's Name	Konstantinos Kiriakou Panikos Ellinas				
ECTS	8	Lectures / week	2	Laboratories / week	5
Course Objective	The students with the teaching of the course will have acquired the necessary scientific knowledge and skills, required for domestic and industrial compression refrigeration installations, their maintenance and operation control as well as the repair of their defects.				
Learning Outcomes	At the end of the course, students will be able to: • Perform all the processes necessary to assemble and install the main and auxiliary devices and components required for the operation of a refrigeration system, using the appropriate tools, devices and tools. • Perform elementary calculations on the refrigeration needs of a space during the installation of a refrigeration unit, as well as its smooth operation, using the appropriate tables and diagrams. • Identify possible defects of a refrigeration installation, the appropriate control and measurement tools as well as the laboratory equipment. • Choose ways to fix such defects and ways to maintain a refrigeration unit. • Apply technical terminology in English.				
Prerequisites	**REFRIG 0201**		Corequisites	**Not applicable**	

Course Content Section 1 28 periods	**Theory:** ➢ **Basic thermodynamics.** • Refrigeration cycle. Main and auxiliary parts of a refrigeration appliance. • Mollier diagram. • Illustration of a refrigeration cycle in the Mollier diagram - necessary operating parameters (steam temperature, overheating, condensation temperature, subcooling). Diagram interpretation - detection of thermodynamic state-. • Use of a Mollier diagram to detect and identify malfunctions of the refrigeration system - condensation pressure, vapor pressure, fluid circulation, non-condensed gases, vaporizer temperature.
Section 2 40 periods	**Laboratory** ➢ **Basic processes** • Components, valves connection. Use of tools - dynamo keys, clamping torque-. • Processing of fluid piping of different dimensions. Hard welding-copper tube welding. • Nitrogen refrigeration system pressure control. Control of the tolerance and sealing of a refrigeration system. Manometers use. • Use of the vacuum pump. Create a vacuum in a refrigeration system. • Procedure for complete recovery of fluorinated gases from refrigeration systems and their storage in appropriate cylinders. • Loading of a refrigeration system using refrigeration manometers. • Use of electronic scale and safe process of filling recovery cylinders. • Recording of the parameters of the refrigeration system (pressures, temperatures). Calculation of overheating and subcooling. Calculation of the amount of fluorinated gas using an electronic scale. • Tolerance control - leakage of a refrigeration system. Direct and indirect leakage control method in refrigeration systems. • Safety measures in the use of fluorinated gases.

Section 3 15 periods	• Use of the electronic scale and safety in the process of filling the recovery cylinders. • Appropriate use of vacuum pump, vacuuming a refrigeration system. • Load control of a refrigeration system using refrigeration manometers. • Direct and indirect leakage control method in refrigeration systems. ➢ **Installation** • Problems during the installation of the refrigeration system. • Installation procedure - Selection of suitable external internal unit placement, provision for maintenance, refrigeration pipe handling, selection and connection of electrical cables, installation of electrical components - automation, communication-sewage piping. • Final test-trial operation, protection. Perform measurements – voltage, intensity, pressure of depression, sorption, temperatures at the points of the refrigeration cycle-. • Analyze faults during installation and ways to solve them.
Section 4 15 periods	➢ **Maintenance - refrigeration system failures** • Diagnosis of faults using manometers. • Diagnosis - interpretation of main faults based on the refrigeration cycle (high pressures, non-condensed gases in the refrigeration circuit, refrigerant overfilling, problems during condensation of the fluid, reduced heat transfer to the vaporizer, defective operation of regulation devices). • Use of measurement instruments – multimeter, ampere tweezer - to control and repair malfunctions (voltage, current, overload, defective operation of refrigeration system valves, contacts, electrical components). • Corrective actions to restore the smooth operation of the refrigeration system. • Handling vibrations and noise. • Analysis of errors during compressor operation.
Teaching	• Teaching Method – In class teaching

<table>
<tr><td>Methodology</td><td>• Teaching techniques – Lecture, Discussion, work in groups, Demonstration, Simulations,
• Teaching means - Whiteboard, Computer, projector, Visits in appropriate industries, Laboratory apparatus</td></tr>
<tr><td>Bibliography</td><td>• Kouremenos, D., 2003. Refrigeration Machines and Installations. 3rd ed. Evgenidis Foundation.
• Asimakopoulos, A., 1990. Air-conditioning. Antonios Asimakopoulos Nik. Editions.
• Johnshon J. & Puzio H., 1997. Maintenance of Refrigeration and Air-conditioning Installations. Ion Editions.
• Asimakopoulos, A., 2001. Refrigeration Installations Technology. Antonios Asimakopoulos Nik. Editions.
• Iatridis, M., 1996. Refrigeration Manual. Rational Energy Use.
• Good Practice Guide. Commercial Refrigeration Plant: Energy Efficiency Installation, Energy Efficiency Office, 1992.</td></tr>
<tr><td>Assessment</td><td><table>
<tr><td>Participation in the course</td><td>10%</td></tr>
<tr><td>Continuous Evaluation (Work Preparation)</td><td>20%</td></tr>
<tr><td>Mid-term examination</td><td>30%</td></tr>
<tr><td>Final examination</td><td>40%</td></tr>
</table></td></tr>
<tr><td>Language</td><td>Greek</td></tr>
</table>

Course Title	**Absorption Refrigeration Technology I - Fluid Mechanics**				
Course Code	**REFRIG 0302**				
Course Type	Compulsory, Theoretical / Laboratorial				
Level	5B				
Year / Semester of study	2nd Year, Semester A				
Teacher's Name	Markos Douglas Ploutarchos Evlogimenos				
ECTS	5	Lectures / week	5	Laboratories / week	0
Course Objectives	The students through the teaching of the course will have acquired the necessary scientific knowledge so as to work in areas of the subject in terms of calculation, construction, and configuration of absorption refrigeration installations. Students will also be able to acquire the necessary theoretical knowledge pertained to the Fluid Mechanics field so as to interpret phenomena during fluid movements in absorption systems.				
Learning Outcomes	At the end of the course, students will be able to: • Describe the basic concepts, principles, and laws of Fluid Mechanics. • Identify the importance of implementing the principles and laws of Fluid Mechanics in an absorption refrigeration installation. • Perform elementary calculations related to fluid movements during the operation of a refrigeration installation, using tables and diagrams. • Describe the basic features of the component materials used in an absorption refrigeration installation and use appropriate tables and diagrams to perform elementary calculations, in cooperation with the supervising engineer, on their dimensioning. • Identify the differences between compression and absorption refrig-				

	eration systems.		
Prerequisites	**Not applicable**	Corequisites	**Not applicable**
Course Content Section 1 18 periods	**Theory:** ➢ **Hydrostatics** • Definitions and basic concepts of fluid mechanics. • Definition of pressure. Units. Fluid bodies. Compressible, incompressible fluids. • Liquids in equilibrium. Hydrostatic pressure. Fundamental principle of hydrostatic pressure. Pressure transmission. Pascal's principle. Hydraulic press. Communicating vessels. Strength exerted to the bottom and walls. Archimedes' principle. ➢ **Hydrodynamics - Flow in pipelines** • Rheumatic line. Vein. Inflow. Units. • Flow laws. Law of continuity. Bernoulli's Law. Energy conservation law. Applications. • Real fluid. Internal friction – viscosity. • Flow-mechanical impact losses, mixing and friction. Pressure loss factor. • Laminar and turbulent flow in circular ducts. Swirls. Boundary layer. Velocity distribution. Reynolds number. • Calculation of pressure loss in circular ducts. Friction factor. Roughness of duct surface. Moody's Chart. ➢ **Absorption Refrigeration Cycle** • System parts. Description. Function, technical characteristics. - Generators, absorbers, condensers, evaporators-. • Refrigeration mixtures. Chemical ingredients. How they behave during the operation of the system and during the application of Fluid Mechanics laws.		
Section 2 18 periods			
Section 3 34 periods			

<table>
<tr><td>Section 4

14 periods</td><td>

- Absorption refrigerator electric circuit.
- Comparison of compression and sorption refrigeration cycle.
- Absorption refrigerator failures-maintenance

Laboratory:

Laboratory Exercises in the field of Fluid Mechanics

- Equations of state for liquids and their experimental determination.
- Mass and Volume flow rate
- Static and Dynamic Pressure Equations, Bernoulli equation.

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<tr><td>Teaching Methodology</td><td>

- Teaching Method – In class or Hybrid Training (classroom & online)
- Teaching techniques - Presentation, Discussion, demonstration, simulations
- Teaching means - Whiteboard, Computer, Books, Visits at appropriate sites
- Materials – Experimental apparatus, Presentation, Markers

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

- Flydzanis N., 2015. *Introduction to Fluid Engineering*. Athens: Greek Academic Libraries Association.
- Avlonitis D. & Avlonitis S., 2020. *Fluid Mechanics*. 5th edition. Athens: Ion Editions.
- Georgios A., 2007. *Refrigeration Technology*. Stamoulis Editions.

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

Participation in the course	10%
Continuous Assessment (Coursework)	20%
Mid-term examination	30%
Final examination	40%

</td></tr>
<tr><td>Language</td><td>Greek</td></tr>
</table>

Course Title	**Automatic Control of Refrigeration and Air-conditioning Installations**				
Course Code	**REFRIG 0303**				
Course type	Compulsory, Theoretical / Laboratorial				
Level	5B				
Year / Semester of study	2nd Year, Semester A				
Teacher's Name	Ploutarchos Evlogimenos				
ECTS	5	Lectures / week	2	Laboratories / week	3
Course Objectives	Through the course the students will have acquired the necessary scientific knowledge, skills and capabilities regarding the fundamental principles of automatic control, the technology and the principles of operation of the auxiliary units used in the installations of automatic control systems and the basic technological processes by which the control of automation systems is achieved.				
Learning Outcomes	At the end of the course, students will be able to: • Describe (Appl)y the basic principles of automation (and measuring). • Identify the components installed in the refrigeration control systems. • Design basic control circuits. • Perform elementary calculations concerning the operation control of domestic and industrial refrigeration installations, using the appropriate tables and diagrams. • Use the appropriate laboratory tools and instruments to carry out work relating to the control, installation, and maintenance of the electrical circuits of refrigeration installations. • Assemble basic automation components for the operation control of				

<table>
<tr><td></td><td colspan="3">domestic and industrial installations.

• Follow the technical instructions of the machines and installations they operate, using the appropriate manuals.

• Apply technical terminology in English.</td></tr>
<tr><td>Prerequisites</td><td>Not applicable</td><td>Corequisites</td><td>Not applicable</td></tr>
<tr><td>Course Content

Section 1

28 periods</td><td colspan="3">Theory:

➢ Automation for domestic use and systems for industrial use.

• Historical evolution of automation systems. Reference to systems.

• Two-state sensors: Applications and principle of operation of the different types of two-state sensors, such as limit-switches, proximity sensors, thermostats, thermal protection relays, float switches, optical sensors (photodiodes-photocells), etc.

• Components of classical automation systems: Applications and principle of operation of the relay, the contactor, the time delay relay, the push button, the buzzer, the indication lamp, etc.

• Operation of the various electrical actuators: Applications and principle of operation of the electromagnet, electro valve, motors, pump, etc.

• Automatic control systems of open and closed loop. Advantages of closed loop systems. Examples of open and closed loop systems.

• Automation systems for domestic use: Description of standard automation applications for domestic use, such as lighting control, heating/air conditioning, alarm system, etc.

• Simple automation systems for industrial use. Description of standard automation applications for industrial use, such as fluid level control, robotic arm control, etc.

• Operation of the various types of sensors – converters (Pressure, Temperature, Rounds, Angle, Position, Humidity, Torque, Flow, PH).

• Applications of different types of sensors – converters (Pressure, Temperature, Rounds, Angle, Position, Humidity, Torque, Flow, PH) in automation systems. Practical examples of such applications.

• PLC basic operating principles. PLC and sensors connection.</td></tr>
</table>

<table>
<tr><td>Section 2

42 periods</td><td>Laboratory:
Introduction to laboratory equipment and instruments. Rules and measures of protection and safety.
Observation and control of the operation of various two-state sensors.
Observation and control of operation of various components of classic automation systems. Connections and control of operation of a circuit with a time switch, buzzer, and an indicator lamp.
Observation and control of the operation of various electrical actuators. Connection and circuit operation control with two-state sensor and electrical actuator.
Process control (e.g., water heating) using open loop control (with timer), closed loop control (with thermostat). Connection and control of the operation of the circuit.
Implementation of a simple alarm system – activation of buzzer when a window opens. Connection and control of the operation of the circuit.
Automation system to control the water level in a container. Activate pump when the water level drops below a certain point and turn off when the level goes up.
Study of typical sensor characteristics using the manufacturer’s data.
Automation system to control the temperature of water in a container. Activate a thermal element when the water temperature drops below a certain level and turn it off when it rises to another level. Connection and control of the operation of the circuit.</td></tr>
<tr><td>Teaching Methodology</td><td>Teaching Method – In class teaching
Teaching techniques – Lecture, Discussion, work in groups, Demonstration, Simulations, Exercises
Teaching means - Whiteboard, Computer, projector, Laboratory apparatus</td></tr>
<tr><td>Bibliography</td><td>Malatestas, P., 2017. Automatic Control Systems, Tziolas Publications.</td></tr>
<tr><td>Assessment</td><td><table><tr><td>Participation in the course</td><td>10%</td></tr><tr><td>Continuous Evaluation (Work Preparation)</td><td>20%</td></tr></table></td></tr>
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		Mid-term examination	30%	
		Final examination	40%	
Language	Greek			

Course Title	**Centralized systems and Cogeneration Systems**				
Course Code	**REFRIG 0304**				
Course type	Compulsory, Theoretical / Laboratorial				
Level	5B				
Year / Semester of study	2nd Year, Semester A				
Teacher's Name	Kostas Gerimos				
ECTS	4	Lectures / week	3	Laboratories / week	0
Course Objective	Upon completion of the course, students will have acquired the necessary knowledge and skills, so that they can be employed in areas related to the installation, maintenance and operation of central cooling and air conditioning systems for spaces and facilities. At the same time, students will know the methodologies for the correct selection of the systems and applications in question.				
Learning Outcomes	At the end of the course, students will be able to: • Describe the basic operating principles of central cooling and heating systems. • Choose the appropriate system that will be able to satisfy the cooling / heating needs of an installation. • Recognize and apply ways to save and recover energy in applications of central cooling systems, combined with cogeneration systems. (Solar Energy Cooling Systems, Geothermal Systems, Marine Energy Systems) • Describe and identify the individual parts of a central cooling system. • Recognize faults and problems that may occur in said systems and be able to resolve and correct them				

Prerequisites	**Not applicable**	Corequisites	**Not applicable**
Course Content	**Theory:** ➢ **Chillers / Heat Pumps** • Main and auxiliary parts of these systems. • The different types used (Air-cooled, Water-cooled systems) • Applications of these systems (Cooling/Heating of buildings, Heating of swimming pool water/water for use, industry) • Heat recovery systems and applications • Geothermal, cooling towers • ICE GEL systems ➢ **Variable Refrigerant Flow/Variable Refrigerant Volume Systems – VRF/VRV and Multi-Split Air Conditioners** • Types of systems • Description and technical characteristics of these systems. Various Applications and selection of the system that will best serve the needs of a space/installation • Systems that can be combined with a VRF/VRV (hydrobox, Air to Air heat Recovery Units) ➢ **Central condensation systems – Condensing Units** • Types of systems • Description and technical characteristics of these systems. • Applications and Systems that can be combined with a Condensing Unit system ➢ **Air Handling Units** • Types of systems • Description and characteristics of the main parts of these systems • Applications • Heat recovery and fresh air intake systems		

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

Humidity Control
VAV (Variable air volume) air flow control systems
Small Air Management Units - Heat Recovery - HRU (Heat Recovery Units)

Close Control Units systems
Types of systems
Description and technical characteristics of these systems.
Applications (Server rooms, Banks, Communication Centers nits)

</td></tr>
<tr><td>Teaching Methodology</td><td>

Teaching Method – In class teaching
Teaching techniques – Lecture, Discussion, work in groups, Demonstration, Simulations,
Teaching means - Whiteboard, Computer, projector, Visits in appropriate industries, Laboratory apparatus

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

Georgios, A., 2007. Refrigeration Technology. Stamoulis Editions.
Dincer I,. 2020. Refrigeration Systems and Applications, Thessaloniki. Tziolas Publications.

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<tr><td>Participation in the course</td><td>10%</td></tr>
<tr><td>Continuous Evaluation (Work Preparation)</td><td>20%</td></tr>
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<tr><td>Final examination</td><td>40%</td></tr>
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</td></tr>
<tr><td>Language</td><td>Greek</td></tr>
</table>

Course Title	**Arc and Resistance Welding Technology**				
Course Code	**REFRIG 0305**				
Course type	Compulsory, Theoretical / Laboratorial				
Level	5B				
Year / Semester of study	2nd Year, Semester A				
Teacher's Name	Panagiotis Panagiotou				
ECTS	6	Lectures / week	2	Laboratories / week	3
Course Objectives	The teaching of the course aims to provide the students with all the necessary knowledge, skills and capabilities related to the basic principles of arc and resistance welding technology. Students will also be able to operate the welding devices and properly perform the welding process so as to achieve appropriate seams according to specifications.				
Learning Outcomes	At the end of the course, students will be able to: • Describe the different welding methods. • Describe the arc sheathed cable and resistance welding processes. • Describe the welding process nomenclature and the classification of welding electrodes. • Use machine-shop tools and machinery. • Apply welding parameters. • Use welding machines to perform seams. • Comply with personal and group protection measures. • Apply welding techniques for refrigerant fluid piping and metal structures of the refrigeration installation.				

Prerequisites	**REFRIG 0205**	Corequisites	**Not applicable**
Course Content Section 1 28 periods	**Theory:** **Welding Technology** ➢ **Introduction.** • History and background. Types of welding. Welded connections. Welding characteristics. Types of welded connections. Welding process. Basic methods of electric arc welding. • Solid materials structure. Basic elements of metal crystallization and phase transformation. • Diagram of iron - carbon. • Zone melting. Thermally affected zone. Problems related to the solidification of the welded metal. • Mechanical properties of metal - weld connections. • Welding electrode nomenclature. Vendor lists. Determination of chemical composition of electrodes and mechanical properties (flow limit - elasticity limit, tensile strength- breakage limit, impact resistance). • Types of Electrodes – AWS and ISO 2560 electrode standardization. Role of coating. • Welding design - symbolisms. • Welding geometry. ➢ **Welding discontinuities - description, causes, ways of avoiding.** • Porous, slag inclusions, incomplete melting, incomplete penetration, undercut, underfilling, coating, crater, splashes, cracks. • Quality control of welds – destructive, non-destructive tests. • Compliance levels based on ISO 5817. ➢ Standard sizes of beams, laminates, profiles. • Standard dimensions.		

Section 2 42 periods	• Natural steel properties **Laboratory** ➢ **Arc welding using the MMA method.** • Clothing and protective equipment. • Instruments, accessories and tools for welding. Welding machines. Operating principle, AC sources - transformers, rectifiers, regulatory circuits-. Inverter technology. Forceps and grounding ducts, hammers, brushes. • Selection of electrode based on chemical composition, mechanical properties, and metal thickness. • Welding positions. • Configuration of the edges of pieces to be welded. Mechanical treatments. • Basic welding parameters (current intensity, arc height, electrode angle, speed). • Create a voltaic arc. Negative, positive polarity. • Electrode ignition. Execution of straight surface seams on flat sheets of various widths. Visual seam control. • Problems during the welding process. Low, high welding speed, arc height. Metal warm-up. Overheating during welding. Arc blast - workarounds-. • Welding pieces in a horizontal cervical position (type connection 'T' – Fillet). • Welding pieces in a flat frontal position ('Butt weld' connection). ➢ **Resistance welding process** • Types, Equipment, relevant Parameters
Teaching Methodology	• Teaching Method – In class • Teaching techniques – Lecture, Discussion, Demonstration, exercises

<table>
<tr><td></td><td>Teaching means - Whiteboard, Computer, projector, welding equipment</td></tr>
<tr><td>Bibliography</td><td>

Parikos, G., Steinmuller, A., Brehme, D., Fischer, U., 2008. Welding Technology. Athens: European Technological Publications.
Heiedemenopoulos, G., 2010. Introduction to Welds, Tziolas Publications.
Benatar, A., Bonten, C., Grewell, D. & Tuechert, C., 2001. Welding. Munich: Hanser Verlag.

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<tr><td>Participation in the course</td><td>10%</td></tr>
<tr><td>Continuous Evaluation (Work Preparation)</td><td>20%</td></tr>
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<tr><td>Final examination</td><td>40%</td></tr>
</table>
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<tr><td>Language</td><td>Greek</td></tr>
</table>

Course Title	**Instruments for Measuring, Automation and Control of Refrigeration Installations**				
Course Code	**REFRIG 0401**				
Course type	Compulsory, Theoretical / Laboratorial				
Level	5B				
Year / Semester of study	2nd Year, Semester B				
Teacher's Name	Kostas Gerimos				
ECTS	5	Lectures / week	1	Laboratories/ week	4
Course Objectives	Attending this course, students will have acquired the necessary scientific knowledge, skills, and abilities so that they apply the basic principles of the science of measurement and automation and use the correct measuring instruments, study technical manuals of measuring instruments and make the necessary measurements, controls and adjustments for the smooth operation of domestic, industrial and professional refrigeration systems.				
Learning Outcomes	At the end of the course, students will be able to: • Describe the basic automation principles applied in a standard refrigeration installation. • Apply the basic principles of measurement and automation science. • Choose the appropriate measuring and control tools used in the refrigeration technologies. • Use appropriate theories and circuit diagrams to perform elementary calculations concerning the control of the operation of domestic and industrial refrigeration installations. • Design control circuits for refrigeration systems. • Choose components and automatic control devices applied in a refrigeration installation, using appropriate tables and diagrams.				

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<tr><td></td><td colspan="3">

- Apply technical terminology in English.

</td></tr>
<tr><td>Prerequisites</td><td>REFRIG 0303</td><td>Corequisites</td><td>Not applicable</td></tr>
<tr><td>Course Content

Section 1

14 periods</td><td colspan="3">

Theory:

➢ Automation technology

- Basic physical quantities related to automation technology. Units of physical quantities, multiples, and sub-multiples. The international unit system.
- Basic features and operation principles of sensors.
- Recoding of sensor signals.

➢ Measurement procedure

- Overview of sensors and measuring tools of standard quantities: temperature, humidity, force, level, pressure, flow, speed, displacement etc.
- Study of measuring faults’ impact.
- Study of typical sensor characteristics using manufacturer’s data.
- Measurement of typical sensor characteristics and comparison with manufacturer’s data.
- Sensors – PLC connection.
- Digital measurement and recording systems.
- Recording systems and measuring process using a PC – B.M.S. -

Laboratory:

➢ Introduction to laboratory equipment and instruments. Rules and measures of protection and security.

➢ Control and automation components in refrigeration and air conditioning installations - description, purpose, mode of operation, connection to refrigeration apparatus.

- Thermostats:
- Types and operating analysis of each type of thermostat:

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

Section 2 35 periods	• Thermostats with bimetallic laminate • Gas thermostats • Electronic thermostats • Thermal elements • Thermistor • Use of temperature control mechanisms in refrigeration and air conditioning systems • Low and high voltage fluid thermostats • Indoor and outdoor, high, and low voltage thermostats • Space-liquid thermostats with varying Ohmic resistance (temperature sensor) • Safety thermostats • Measurement and temperature control of liquids • Measurement and temperature control of air • Pressure switches: • High- and Low-Pressure Control Mechanisms. Pressure switches. • Liquid pressure control switch • Differential air pressure control switch • Oil pressure control pressure switch • Measurement and control of pressure in liquids. • Measurement and control of differential pressure in an airway. • Oil pressure measurement and control (in compressor) • Flow control devices • Liquid flow switch • Air flow switch • Flow control in an airway and tube • Level control devices • Pear-type float switch • Float switch with rigid arm • Level switch with electrodes • Liquid level control • Apparatus for controlling relative air humidity • Space • Airway • Measurement and control of relative humidity • Air humidification device in an airway • Liquid supply control devices • Electromagnetic valves (NO and NC) • Valves with servo motor ➢ **Measurements, operation control, modulation**

<table>
<tr><td>Section 3

21 periods</td><td>• Recording of thermodynamic parameters indicators of refrigeration systems
• Smooth operation control
• Detection - diagnosis of malfunctions
• Failures of refrigeration system automation devices and controls
• Repair – replacement
• Feedback
• Preventive control</td></tr>
<tr><td>Teaching Methodology</td><td>• Teaching Method – In class
• Teaching techniques – Lecture, Discussion, work in groups, Demonstration, exercises
• Teaching means - Whiteboard, Computer, projector, laboratory apparatus</td></tr>
<tr><td>Bibliography</td><td>• Kalaitzakis K. & Koutroulis E., 2010. Electric measurements and sensors. Klidarithmos Editions.
• Kalovrektis, K., 2010. Measuring and Control Sensors. Tziolas Publications.</td></tr>
<tr><td>Assessment</td><td><table>
<tr><td>Participation in the course</td><td>10%</td></tr>
<tr><td>Continuous Evaluation (Work Preparation)</td><td>20%</td></tr>
<tr><td>Mid-term examination</td><td>30%</td></tr>
<tr><td>Final examination</td><td>40%</td></tr>
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<tr><td>Language</td><td>Greek</td></tr>
</table>

Course Title	**Industrial Refrigeration Installations - Compression Refrigeration Laboratory III**				
Course Code	**REFRIG 0402**				
Course type	Compulsory, Theoretical / Laboratorial				
Level	5B				
Year / Semester of study	2nd Year, Semester B				
Teacher's Name	Kostas Gerimos				
ECTS	8	Lectures / week	3	Laboratories / week	4
Course Objectives	Students with the teaching of the course will have acquired the necessary scientific knowledge, skills, and capabilities, so that they are able to perform tasks related to the installation, maintenance and repair of food refrigeration chambers and central air conditioning systems of food industries and other professional places.				
Learning Outcomes	At the end of the course, students will be able to: • Identify the types of refrigeration chambers, the equipment installed, and the operation parameters required for the chamber operation and the preservation of different kinds of food. • Detect the temperatures required for the storage of each kind of food. • Draw the refrigeration cycle on a Mollier diagram based on the necessary thermodynamic parameters. • Check the resistance and sealing of a refrigeration system. • Assemble the refrigeration installation units and adapt all the auxiliary components, devices, control instruments and metal structures required for its operation. • Identify and detect the malfunctions of an industrial installation using				

	the appropriate control and measuring instruments. • Apply corrective actions to repair any faults as well as preventive actions of maintenance and control, so as to secure the smooth operation of an industrial installation. • Apply technical terminology in English.		
Prerequisites	**Not applicable**	Corequisites	**Not applicable**
Course Content Section 1 10 periods Section 2 18 periods	**Theory:** ➢ **Basic thermodynamics.** • Use of Mollier diagram as a useful auxiliary tool of the refrigeration technician required for the smooth operation of a refrigeration system, the detection of malfunctions and the application of corrective actions. ➢ **Industrial refrigeration installations - Food chambers - Food manufacturing, packaging and storage industries** • Types of chambers. Description, technical characteristics. Applications. • Chamber parts. Installation description. How to assemble. Dimensions. • Food groups requiring low temperatures. Typical temperatures for storing any kind of food. • The primary role of refrigeration for the long-term preservation of food. Low temperature as the most important factor in food preservation (inhibiting the growth of microbes, chemical effects, metabolism), as well as the prolongation of the lifetime of sensitive food groups (fruits, vegetables). The role of humidity. Retention times. Tables. **Laboratory:** ➢ **Industrial installation refrigeration appliances**. – Industrial plant compressors. • Technical description.		

Section 2 35 periods	• Typical operating curves of industrial compressors. • Lubrication of industrial compressors. • Industrial compressor electric motors and their automatic operation control. – Condensers. • Types, technical characteristics. – Vaporizers. • Types, technical characteristics. – Choking devices. • Types, technical characteristics, applications. ➢ **Control systems** • Control devices, regulation, and protection of industrial refrigeration installations (types, technical characteristics, applications). • Electrical panel. Operating parameters. • Internal chamber configuration parameters depending on the type of food to be stored. ➢ **Maintenance-faults** • Diagnosis of faults using manometers. • Diagnosis - interpretation of main faults based on the refrigeration cycle (high pressures, non-condensed gases in the refrigeration circuit, refrigerant overfilling, problems during fluid condensation, reduced heat transfer to the vaporizer, defective operation of regulation devices). • Use of measurement instruments – multimeter, ampere tweezer -to control and repair malfunctions (voltage, current, overload, defective operation of cooling system valves, contacts, electrical components). • Corrective actions to restore the smooth operation of the refrigeration system. • Analysis of errors during compressor operation.

<table>
<tr><td>Section 3
35 periods</td><td>➢ Preparation of certification for the use of Fluorinated Greenhouse Gases
• Practical application of exam questions related to pool.
• Practical practice in the refrigeration units of the laboratory.</td></tr>
<tr><td>Teaching Methodology</td><td>• Teaching Method – In class
• Teaching techniques – Lecture, Discussion, work in groups, Demonstration
• Teaching means - Whiteboard, Computer, projector, Danfoss software, laboratory apparatus</td></tr>
<tr><td>Bibliography</td><td>• Asimakopoulos A., 2015. Air Conditioning Cooling Laboratory Exercises. Antonios Asimakopoulos Nik. Editions.
• William M. Johnson & John A. Tomczyk, 2003. Refrigeration Installations I. Ion Editions.
• William M. Johnson & John A. Tomczyk, 2003. Refrigeration Installations II. Ion Editions.
• Kanakakis, E., 2017. Refrigeration – Air Conditioning Installations – Ventilation, 2nd ed. Evgenides Foundation.
• E.O.P.P.E.P., Refrigeration, ventilation and air conditioning installations technician. MINISTRY OF EDUCATION, RESEARCH AND RELIGIOUS AFFAIRS.
• Katsaprasakis, D. & Moniakis, M., 2015. Heating – Refrigeration – Air Conditioning. Greek Academic Libraries Association.</td></tr>
<tr><td>Assessment</td><td><table>
<tr><td>Participation in the course</td><td>10%</td></tr>
<tr><td>Continuous Evaluation (Work Preparation)</td><td>20%</td></tr>
<tr><td>Mid-term examination</td><td>30%</td></tr>
<tr><td>Final examination</td><td>40%</td></tr>
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<tr><td>Language</td><td>Greek</td></tr>
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Course Title	**Technical and Economic Analysis of Refrigeration Installations**				
Course Code	**REFRIG 0403**				
Course type	Compulsory, Theoretical / Laboratorial				
Level	5B				
Year / Semester of study	2nd Year, Semester B				
Teacher's Name	Ploutarchos Evlogimenos				
ECTS	5	Lectures / week	1	Laboratories / week	4
Course Objective	Students with the teaching of the course will have acquired the necessary scientific knowledge, skills and capabilities, so that they are able to calculate refrigeration loads of domestic spaces and industrial refrigeration installations, design and measure and cost components and technical equipment for an industrial refrigeration installation.				
Learning Outcomes	At the end of the course, students will be able to: • Design a psychrometric chart with the necessary thermodynamic parameters. • Identify a likely malfunction of the refrigeration system, using the psychrometric chart. • Perform calculations of refrigeration loads, based on charts and tables. • Design the refrigeration installation and its electric circuits, in accordance with the needs of the refrigeration installation space. • Choose the appropriate devices and components based on the calculations and planning they perform. • Install a domestic and professional refrigeration installation, by assembling and adjusting all devices, components and measuring and				

<table>
<tr><td></td><td colspan="3">control tools, based on a detailed study.

• Identify the cost sources of a refrigeration installation.

• Perform the costing of a refrigeration installation using the PC.

• Apply technical terminology in English.</td></tr>
<tr><td>Prerequisites</td><td>REFRIG 0106</td><td>Corequisites</td><td>Not applicable</td></tr>
<tr><td>Course Content

Section 1

14 periods

Section 2

56 periods</td><td colspan="3">Theory:

➢ Psychrometry

• Interpretation - reading of a psychrometric chart.

• Changes in fluid states in the psychrometric chart. Thermodynamic parameters (dry air, vapor, moist air, relative humidity, enthalpy, dew point, gas laws).

• Principles of heat convection for the calculation of coolant load in an air-conditioned area.

• Calculation of coolant load using the psychrometric chart (sensible, latent heat).

Laboratory:

➢ Installation study - Calculations

• Examination of sites and calculation of loads.

• Characteristics of spaces and sources of heat loads.

• Calculation of coolant load - external loads, internal loads-.

• Calculation conditions – winter, summer, maximum, normal-.

• Corrective factors. Features of space structure. Number of employees. External conditions. Air penetration.

• Actual thermal load – use of tables.

• Principles of heat transfer for the calculation of coolant load in a refrigeration chamber.</td></tr>
</table>

	• Internal industrial calculation conditions - use of tables. ➢ **Selection of compressor motor** • Determination of the power of the compressor's electric motor. Calculation of real absorbed Power (single-phase, triple-phase system). Voltage drops. • Calculation of the motor feed cross section. Pipe selection. • Motor protection – hypertension, short circuit, lack of voltage-. ➢ **Design of a refrigeration plant using a computer** • Select a compressor based on the design study of the calculation of the coolant load. Evaluation of market catalogues. • Selection of condenser and vaporizer based on the design study of the calculation of the coolant load. • Selection of refrigerant based on the design study of the calculation of the coolant load. • Selection of control and protection choke devices based on the design study of the calculation of the coolant load. • Evaluation of cooling system indicators - energy efficiency, noise-. Evaluation of operation parameters. ➢ Dimensioning of piping and refrigeration installation components. ➢ Electric circuit design and selection of electrical elements and automation components for the refrigeration installation. ➢ Design of metal structures - bases, supports - refrigeration installation. • Anti-vibration compressor motor support. ➢ **Installation costing using a computer** • Cost allocation. Direct, indirect costs. Fixed, variable costs. • Create an installation cost spreadsheet. • Create an expense allocation table – labor, materials, general costs.

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- Graph of fixed, variable costs. Identification of the break-even point.

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<tr><td>Teaching Methodology</td><td>

- Teaching Method – In class or Hybrid Training (classroom & online)
- Teaching techniques – Lecture, Discussion, Questions and answers.
- Teaching means - Whiteboard, Computer, projector, Office 365, Autocad

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

- Asimakopoulos A., 2015. *Air Conditioning Cooling Laboratory Exercises*, Antonios Asimakopoulos Nik. Editions.
- William M. Johnson & John A. Tmczyk, 2003. *Refrigeration Installations I*. Ion Editions.
- William M. Johnson & John A. Tmczyk, 2003. *Refrigeration Installations II*. Ion Editions.

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<tr><td>Assessment</td><td>
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<tr><td>Participation in the course</td><td>10%</td></tr>
<tr><td>Continuous Evaluation (Work Preparation)</td><td>20%</td></tr>
<tr><td>Mid-term examination</td><td>30%</td></tr>
<tr><td>Final examination</td><td>40 %</td></tr>
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<tr><td>Language</td><td>Greek</td></tr>
</table>

Course Title	**Basic Elements of Domestic and Industrial Electrical Installations**				
Course Code	**REFRIG 0404**				
Course type	Compulsory, Theoretical / Laboratorial				
Level	5B				
Year / Semester of study	2nd Year, Semester B				
Teacher's Name	Stelios Georgiou				
ECTS	5	Lectures / week	2	Laboratories / week	3
Course Objectives	Attending this course, students will have acquired the necessary technological knowledge, skills and abilities related to the installation, maintenance and control of domestic and industrial electrical installations.				
Learning Outcomes	At the end of the course, students will be able to: • Use the basic principles of electromechanical design and perform calculations on the dimensioning of mechanical and electrical components used in electrical and mechanical installations. • Use appropriate tools and measuring instruments required for an industrial electrical installation. • Choose all necessary components and electrical machinery among the electromechanical designs of industrial installations. • Comply with all safery regulations and installation specifications. • Identify the different energy production, transmission, and distribution stages. • Use the appropriate tools and measuring instruments to carry out work related to the installation, control, and maintenance of electric circuits of domestic and industrial refrigeration installations. • Apply technical terminology in English.				
Prerequisites	**REFRIG 0104**	Corequisites	**Not applicable**		
Course Content	**Theory:** ➢ **Domestic electrical installations**				

Section 1 12 periods	• The power grid. Reference to the relevant regulations. Protective measures in electrical installations. • Electricity transmission cables. Standard conductor cross sections. Nominal cable voltage and operating voltage. Permitted cable voltage. Color codes and cable diameter. Calculation of cable cross sections. Installation cable calculation tables. • Piping. Lighting circuits. Plug circuits. Supply circuit and distribution board. • Grounding. Dangerous voltages. Grounding methods. Grounding conductors. • Grounding control.
Section 2 8 periods	➢ **Industrial electrical installations** • Differences between domestic and industrial electrical installations. Reference to the relevant regulations. Power supply from a low-voltage grid and a medium-voltage grid. Ways of manufacturing electrical industrial installations. Power factor and power factor correction capacitors.
Section 3 8 periods	➢ **Automation installations** • Control and signaling components. Surge protection switches. Contactor - structure, operation, and maintenance. • Basic automation circuits in the industry. Connections, electric circuits of single-phase and three-phase motors. • Controls and measurements - use of the necessary instruments.
Section 4 42 periods	**Laboratory:** ➢ **Practical training in the implementation of domestic installations** • Preparation of electricity transmission cables and their connection to components of electrical domestic installations, such as switches and sockets. ➢ **Practical training in the implementation of industrial installations** • Components and materials of low-voltage industrial installations and their handling: cables, insulating materials and components of

	conductor connection. Piping and piping components. Lighting switches, sockets, and industrial-type outlets. Switches and panel fuses. Automatic panel switches, safety coupling switches, coupling switches and protective surge, short-circuit and voltage drop switches. • Basic automation circuits in the industry. Connections, electric circuits of single-phase and three-phase motors. STAR and DELTA connection to three-phase motors. • Electric motor installations. ➢ **Checks and measurements.** • Use of the necessary instruments. ➢ **Protection of electric motors**. • Component control and electric motor protection. • Adjust a protective surge switch. Disassembly, maintenance and assembly of contactor.
Teaching Methodology	• Teaching Method – In class • Teaching techniques – Lecture, Discussion, work in groups, Demonstration • Teaching means - Whiteboard, Computer, projector, Laboratory apparatus
Bibliography	• Bitzionis B., 2014. *Industrial Electrical Installations*. Tziolas Publications. • Kritsotakis K., 2012. *Protection of Electrical Installations*, Tziolas Publications. • Electrical Installations Technology, Part B: Industrial Installation, Cyprus Ministry of Education and Culture. • Laboratory Practical on Electrical Installations, Cyprus Ministry of Education and Culture.
Assessment	Participation in the course: 10% Continuous Evaluation (Work Preparation): 20%

		Mid-term examination	30%	
		Final examination	40%	
Language	Greek			

Course Title	**Occupational Legislation and Ethics – Quality Assurance**				
Course Code	**REFRIG 0405**				
Course type	Compulsory, Theoretical				
Level	5B				
Year / Semester of study	2nd Year, Semester B				
Teacher's Name	Kostas Gerimos Elina Ioannou				
ECTS	3	Lectures / week	3	Laboratories / week	0
Course Objectives	Attending this course, the students will have acquired the necessary scientific knowledge so that they properly handle all the provisions of international and national legislation concerning the installation, inspection and control of the proper operation of industrial refrigeration installations with respect to the environment and humans.				
Learning Results	At the end of the course, students will be able to: • Describe the principles of professional code of contact. • Write technical texts and professional correspondence. • Identify the European qualifications framework related to the Refrigeration Technician's occupation. • Comply with the specific regulations for the management of fluid refrigerants, welding and fire extinguishing, imposed by national and international legislation. • Comply with national and international regulations on the environment. • Issue a control certificate of proper operation of a refrigeration installation provided for in the relevant regulations. • Identify the necessity of the adoption of the basic principles of quality				

<table>
<tr><td></td><td colspan="3">assurance during their careers.</td></tr>
<tr><td>Prerequisites</td><td>Not applicable</td><td>Corequisites</td><td>Not applicable</td></tr>
<tr><td>Course Content

Section 1

28 periods</td><td colspan="3">

Occupational Legislation and Ethics

Organizations, bodies, services, professional associations and chambers related to the profession of a technician of refrigeration and air-conditioning installations in:

- National level
- European level
- International level
Legislation and instructions related to the profession of a technician of refrigeration and air-conditioning installations in:
- National level
- European level
- International level
Qualification’s framework, certification of qualifications, professional licenses and certificates of private organizations related to the profession of a technician of refrigeration and air-conditioning installations in:

- National level
- European level
- International level
Trade and Labor Law: Basic rules of commercial and labor law, labor safety legislation. Department of Labor Inspection. Accident prevention, responsibilities, and penalties. Individual and collective labor law. Dispute Resolution of Technicians.
Professional Ethics: Intellectual Property, foundations of Intellectual Property, copyright, patents, and trade secrets. Software piracy. Professional and ethical responsibilities, codes of ethics and professional conduct.
Drafting of Technical Texts and Professional correspondence: Official and informal correspondence. Letters providing information, instructions, prices, technical characteristics, and specifications. Complaint Letters.
Preparation of offers, project delivery terms, payment terms, offer cover letter.
Preparation of CV, employment cover letter.

</td></tr>
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<table>
<tr><td>Section 2

14 periods</td><td>➢ Quality management

• Quality definition based on the international ISO standards. Quality systems. Historical progression. The importance of adopting a quality assurance system as a means of more effective communication, control, and achievement of customer’s expectations.

• Advantages of implementing an evidence-based quality assurance system. Its role in the more efficient conduct of refrigeration processes, in reducing the costs and in enhancing the competitiveness of business activities.</td></tr>
<tr><td>Teaching Methodology</td><td>• Teaching Method – In class or Hybrid Training (classroom & online)
• Teaching techniques – Lecture, Discussion, case studies, brainstorming
• Teaching means - Whiteboard, Computer, projector</td></tr>
<tr><td>Bibliography</td><td>• Iatridis, M., 1996. Refrigeration Manual. Rational Energy Use.
• Good Practice Guide. Commercial Refrigeration Plant: Energy Efficiency Installation, Energy Efficiency Office, 1992.
• E.O.P.P.RE.P., Refrigeration, ventilation and air conditioning installations technician, MINISTRY OF EDUCATION, RESEARCH AND RELIGIOUS AFFAIRS.
• Katsambakakis, D. & Moniakis, M., 2015. Heating – Refrigeration – Air Conditioning. Greek Academic Libraries Association.</td></tr>
<tr><td>Assessment</td><td><table>
<tr><td>Participation in the course</td><td>10%</td></tr>
<tr><td>Continuous Evaluation (Work Preparation)</td><td>20%</td></tr>
<tr><td>Mid-term examination</td><td>30%</td></tr>
<tr><td>Final examination</td><td>40%</td></tr>
</table></td></tr>
<tr><td>Language</td><td>Greek</td></tr>
</table>

Course Title	**Practical Training II**				
Course Code	**REFRIG 0406**				
Course type	Practice				
Level	5B				
Year / Semester of study	2nd Year, Semester D				
Teacher's Name	Program Coordinator				
ECTS	6	Lectures / Week	-	Laboratories / week	-
Course Objectives	The practical training aims at the initial professional training of students in key jobs in the field of Refrigeration – Air Conditioning Installations. Students will gain relevant industrial experience and additional knowledge and skills relevant to the profession. In addition, the practical training will give students the opportunity to apply taught theories in practice by performing basic tasks and responsibilities in the selected workplace.				
Learning Outcomes	At the end of the practical training, students are able to: • Develop basic professional skills • Understand the nature, opportunities and requirements of the profession and industry requirements • Establish contacts and relationships with important professionals in the sector • Start and lay the foundations for the development of their professional careers.				
Prerequisites	REFRIG 0206	Corequisites	Not applicable		
Course Content	Students will be active in the field of Refrigeration and Air Conditioning Installations.				
Teaching Methodology	Employment for six weeks in companies dealing with Refrigeration and Air Conditioning Installations.				
Bibliography	Not Applicable				
Assessment	Students will be evaluated through their performance in their work and the completion of the internship booklet.				
Language	Greek				