DEPARTMENT OF ENERGY SCIENCE AND TECHNOLOGIES
COURSE SYLLABUS

Course Details								
Code				**Academic Year**			**Semester**	
EBT322				3			5	
Title				**T**	**A**	**L**	**ECTS**	
Refrigeration technology				2	2	0	6	
Language	German							
Level	**Undergraduate**	**X**	**Graduate**		**Postgraduate**			
Department / Program	Energy Science and Technologies							
Forms of Teaching and Learning	Face-to-face							
Course Type	**Compulsory**		**Elective**	**X**				
Objectives	The students learn the basics of refrigerators and heat pumps. The thermodynamic analysis, calculation and optimization of refrigeration processes, the design of various components and parameters as well as the control options for refrigeration systems for the provision of cold and heat are covered. The parameters of these processes are calculated in such a way that technical principles from the study of energy science are applied to evaluate these processes. The absorption refrigeration machine is discussed in detail for the application of combined cooling, heat and power.							
Content	Basics of thermodynamics: 1st and 2nd laws, cycles, phase diagrams, changes in the states of matter. Two-component mixtures: properties, enthalpy of mixing, enthalpy-concentration (h- ξ) diagram, phase transitions, azeotropic mixtures, mixtures with limited miscibility Compression chillers: Working process, measures to improve the coefficient of performance, cascade connection, refrigerant pump operation, humid air Absorption chiller: Ideal comparison process, energy balances, measures to improve the coefficient of performance, rectification. Steam jet chiller: jet apparatus, motive steam consumption, operating behavior, applications Refrigerants: types and properties Types of refrigeration systems: Design of refrigerator components, compressors, evaporators, condensers, control valves and control of refrigeration systems Cryogenics (CO2, LNG, LHG, air), Energy storage through gas liquefaction Calculation examples of refrigeration systems are carried out parallel to the lecture material.							
Prerequisites	Thermodynamics							
Coordinator	Asst. Prof. Dr. Osman Sinan Süslü							
Lecturer(s)	Asst. Prof. Dr. Osman Sinan Süslü							
Assistant(s)								
Work Placement	None							

Recommended or Required Reading	
Books / Lecture Notes	Plank R., .:Handbuch der Kältetechnik von Cube, H. L. :Lehrbuch der Kältetechnik, Band 1 und 2 Verlag C. F. Müller, Karlsruhe 1975 Kalide W.: Thermodynamik der Kühl- und Kälteanlagen. Carl Hanser Verlag München, Wien 1976

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Other Sources	Maurer, T.: Kältetechnik für Ingenieure Hausen, H.; Linde, H.: Tieftemperaturtechnik Urbaneck, T.: Kältespeicher: Grundlagen, Technik, Anwendung

Additional Course Material	
Documents	Weekly presentations of the lectures (powerpoint)
Assignments	
Exams	

Course Composition		
Mathematics und Basic Sciences	20	%
Engineering	30	%
Engineering Design	10	%
Social Sciences		%
Educational Sciences		%
Natural Sciences	10	%
Health Sciences		%
Expert Knowledge	30	%

Assessment

Activity	Count	Percentage (%)
Midterm Exam	1	40
Quiz		
Assignments		
Attendance		
Recitations		
Projects		
Final Exam	1	60
	Total	**100**

ECTS Points and Work Load

Activity	Count	Duration	Work Load (Hours)
Lectures	14	2	28
Self-Study	14	8	112
Assignments			
Presentation / Seminar Preparation			
Midterm Exam	1	3	3
Recitations	14	2	28
Laboratory			
Projects			

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Final Exam	1	3	3
		Total Work Load	**174**
		ECTS Points (Total Work Load / Hours)	**6**

Learning Outcomes	
1	To formulate balance limits, balances, boundary and initial conditions of a system
2	Optimization of air conditioning and refrigeration processes
3	Thermodynamic analysis of various cooling processes and calculation of the coefficient of performance of these processes
4	Application of different temperature levels for cooling processes
5	Design of combined cooling, heating and power systems for different energy sources

Weekly Content	
1	Introduction, compression chillers , multiple-stage chillers, cascade connection
2	Components of refrigeration systems
3	Calculation basis
4	Steam jet refrigeration system, calculation of efficiency, control and operating behavior
5	Binary mixtures, properties, phase diagrams, phase transitions
6	Absorption cooling process, circuit, dephlegmator, internal heat exchanger, calculation
7	Control of the absorption refrigeration system
8	Midterm Exam
9	Adsorption refrigeration systems
10	Peltier refrigerator
11	Philips Sterling chiller
12	LNG, gas liquefaction
13	Evaporation of liquid gas and utilization of the exergy in liquid gas
14	Energy storage through gas liquefaction
15	Calculation examples of refrigeration systems

Contribution of Learning Outcomes to Program Objectives (1-5)

	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**
1	5	5	4	5	4	5	5	5	5
2	4	5	5	4	5	4	5	4	5
3	5	4	5	3	5	5	5	5	5
4	4	5	4	5	5	3	4	3	4
5	1	2	3	2	1	3	4	3	4

Contribution Level	1: Low 2: Low-intermediate 3: Intermediate 4: High 5: Very High

https://obs.tau.edu.tr/oibs/bologna/progLearnOutcomes.aspx?lang=EN&curSunit=5706

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