DEPARTMENT OF ENERGY SCIENCE AND TECHNOLOGIES
COURSE SYLLABUS

Course Details					
Code	**Academic Year**			**Semester**	
EBT309	3			5	
Title	**T**	**A**	**L**	**ECTS**	
Introduction to Quantum Energy Systems	3	1	0	6	

Language	German					
Level	**Undergraduate**	X	**Graduate**		**Postgraduate**	
Department / Program	Energy Science and Technology					
Forms of Teaching and Learning	Face-to-face					
Course Type	**Compulsory**		**Elective**	X		
Objectives	The main objective of this course is to introduce quantum energy systems and their properties by presenting fundamental concepts. An introduction to quantum mechanics will be provided, and the operating principles of quantum thermodynamic systems will be examined.					
Content	The course covers the fundamental concepts of quantum mechanics, quantum thermodynamic systems and their properties, quantum thermodynamic processes, work, heat, closed and open quantum systems, quantum heat engines, and refrigerators.					
Prerequisites	None					
Coordinator	Assist. Prof. Dr. Elif Yunt					
Lecturer(s)	Assist. Prof. Dr. Elif Yunt					
Assistant(s)						
Work Placement	None					

Recommended or Required Reading	
Books / Lecture Notes	Quantenmechanik: Einführung, W. Greiner Thermodynamik und Statistische Mechanik, W. Greiner Quantum Computation and Quantum Information, Micheal A. Nielsen and Isaac L. Chuang Quantum Thermodynamics: Emergence of Thermodynamic Behavior Within Composite Quantum Systems, Jochen Gemmer, M. Michel, G. Mahler,Lecture Notes in Physics, 2nd Ed. Springer
Other Sources	Thermodynamics in the Quantum Regime-Fundamental Aspects and New Directions, Felix Binder, Luis A. Correa, Gerardo Adesso, Fundamental Theories in Physics 195, Springer Quantenmechanik: Einführung, W. Greiner Thermodynamik und Statistische Mechanik, W. Greiner

Additional Course Material	
Documents	
Assignments	
Exams	

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Course Composition		
Mathematics and Basic Sciences		%
Engineering	30	%
Engineering Design		%
Social Sciences		%
Educational Sciences		%
Natural Sciences	70	%
Health Sciences		%
Expert Knowledge		%

Assessment

Activity	Count	Percentage (%)
Midterm Exam	1	40
Quiz	4	20
Assignments		
Attendance		
Recitations		
Projects		
Final Exam	1	40
	Total	**100**

ECTS Points and Work Load

Activity	Count	Duration	Work Load (Hours)
Lectures	14	3	42
Self-Study	12	9	108
Assignments			
Presentation / Seminar Preparation			
Midterm Exam	1	2	2
Recitations	14	1	14
Laboratory			
Projects			
Final Exam	1	2	2
		Total Work Load	**168**
		ECTS Points (Total Work Load / Hour)	**6**

Learning Outcomes

1	Students understand the fundamental concepts of quantum thermodynamics and can compare them with classical thermodynamics.
2	Students can analyze energy systems using quantum thermodynamic principles.

3	Students can integrate quantum thermodynamic applications into real-world problems and develop problem-solving skills in this field.
Weekly Content	
1	Mathematical foundations: Probability theory and linear algebra
2	Introduction to quantum theory: Vector formalism
3	Postulates of quantum mechanics
4	Density matrix theory
5	Classical thermodynamics
6	Introduction to quantum thermodynamics
7	Quantum heat engines: Quantum Otto Cycle
8	Midterm Exam
9	Quantum heat engines: Other cycles
10	Nonequilibrium thermodynamic systems: Open quantum systems (theory)
11	Nonequilibrium thermodynamic systems: Open quantum systems (models)
12	Markovian equations (theory)
13	Markovian equations (models)
14	Non-Markovian equations (theory and models)
15	Non-Markovian equations (theory and models)
16	Final Exam

Contribution of Learning Outcomes to Program Objectives (1-5)									
	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**
1	5	5	5	5	5	3	1		
2	5	5	5	5	5	3	1		
3	5	5	5	5	5	3	1		
Contribution Level 1: Low 2: Low-intermediate 3: Intermediate 4: High 5: Very High									

Compiled by:	
Date of Compilation:	