



OSTİM TEKNİK
ÜNİVERSİTESİ
ANKARA

FACULTY OF ENGINEERING
COURSE SYLLABUS FORM

Doküman No	MF.FR.003
Revizyon Tarihi	13.11.2024
Revizyon No	01
Sayfa No	1 / 7

NE 314 NANOSCALE TRANSPORT PHENOMENA

Course Code	Course Name	Semester		
NE 314	Nanoscale Transport Phenomena	Fall <input type="checkbox"/>	Spring <input checked="" type="checkbox"/> Summer <input type="checkbox"/>	
Hours			Credit	ECTS
Theory	Practice	Lab	3	5
3	0	0		

Course Details	
Department	Nanotechnology Engineering
Course Language	English
Course Level	Undergraduate <input checked="" type="checkbox"/> Graduate <input type="checkbox"/>
Mode of Delivery	Face to Face <input checked="" type="checkbox"/> Online <input type="checkbox"/> Hybrid <input type="checkbox"/>
Course Type	Compulsory <input checked="" type="checkbox"/> Technical Elective <input type="checkbox"/>
Lecturer(s)	
Course Objectives	<p>■ to introduce students to the fundamental principles governing heat, mass, and charge transport at the nanoscale, where classical continuum theories often break down and quantum and statistical effects become significant by differing from macro-transport. The course aims to develop a deep understanding of how transport mechanisms differ at reduced dimensions and in nanostructured materials such as thin films, nanowires, and quantum dots. Topics include ballistic vs. diffusive transport, phonon and electron conduction, thermoelectric effects, and size-dependent thermal and electrical properties. Students explore the implications of nanoscale transport in emerging technologies, including nanoelectronics, energy conversion devices, and biomedical systems and more.</p>
Course Content	<p>■ Nanoscale Transport Phenomena undergraduate course includes parallel treatments of photons, electrons, phonons, and molecules as energy carriers, aiming at fundamental understanding and descriptive tools for energy and heat transport processes from nanoscale continuously to macroscale. Topics include the energy levels, the statistical behavior and internal energy, energy transport in the forms of waves and particles, scattering and heat generation processes, Boltzmann Transport Equation and derivation of classical laws, deviation from classical laws at nanoscale and their appropriate descriptions, with applications in nano- and microtechnology.</p>
Course Method/Techniques	Lecture <input checked="" type="checkbox"/> Question & Answer <input checked="" type="checkbox"/> Presentation <input type="checkbox"/> Discussion <input checked="" type="checkbox"/>



Prerequisites/ Corequisites	Nanophysics
Work Placement(s)	No work placements.
Textbook/References/Materials	
<ul style="list-style-type: none">Chen, Gang. Nanoscale Energy Transport and Conversion: A Parallel Treatment of Electrons, Molecules, Phonons, and Photons. Oxford University Press, 2005. ISBN: 9780195159424.Nanoscale Thermodynamics: An Introduction, Kjelstrup and Bedeaux, Springer.Introduction to Nanoelectronics: Science, Nanotechnology, Engineering, and Applications, Vladimir V. Mitin, Viatcheslav A. Kochelap, Michael A. Stroscio, Cambridge University Press.Additional course notes on Heat & Mass Transport.	

Course Category			
Mathematics and Basic Sciences	<input type="checkbox"/>	Education	<input checked="" type="checkbox"/>
Engineering	<input checked="" type="checkbox"/>	Science	<input type="checkbox"/>
Engineering Design	<input checked="" type="checkbox"/>	Health	<input type="checkbox"/>
Social Sciences	<input type="checkbox"/>	Profession	<input checked="" type="checkbox"/>

Weekly Schedule		
No	Topics	Materials/Notes
1	Introduction to Macro Scale Heat & Mass Transport	
2	Classical Fundamentals, Analogical Reasoning	
3	Intro to Nanotechnology and Nanoscale Transport Phenomena	
4	Simple Kinetic Theory for Gases, Mean Free Path, Dimensionless Numbers	
5	Density of States, Quantum Mechanics, Nano-size Effects	
6	Phonon Transport in Materials	
7	Phonon Transport in Materials	
8	MIDTERM	
9	Electron Transport in Materials	
10	Electron Transport in Materials	
11	Thermoelectric Effects	
12	Nanoscale Heat Transfer, Radiative	
13	Energy Conversion Devices	
14	Nanofluidics & Devices	
15	Molecular Transport, Inspired Systems	
16	FINAL	



Assessment Methods and Criteria		
In-term studies	Quantity	Percentage
Attendance	14	--
Lab	--	--
Practice	--	--
Fieldwork	--	--
Course-specific internship	--	--
Quiz/Studio/Criticize	1	5 %
Homework	1	10 %
Presentation / Seminar	0	-
Project	1	35 %
Report	0	--
Seminar	--	--
Midterm Exam	0	--
Final Exam	1	50 %
Total		100%
Contribution of Midterm Studies to Success Grade		50 %
Contribution of End of Semester Studies to Success Grade		50 %
Total		100%

ECTS Allocated Based on Student Workload			
Activities	Quantity	Duration (Hrs)	Total Workload
Course Hours	14	3	42
Lab	0	0	0
Practice	0	0	0
Fieldwork	0	0	0
Course-specific Work Placement	0	0	0
Out-of-class study time	10	5	50
Quiz/Studio/Criticize	1	1	1
Homework	0	0	0
Presentation / Seminar	0	0	0
Project	1	23	23
Report	0	0	0
Midterm Exam and Preparation for Midterm	0	0	0
Final Exam and Preparation for Final Exam	1	10	10
Total Workload			126
Total Workload / 25			126/25



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ECTS Credit

5.04 \cong 5



Course Learning Outcomes

No	Outcome
L1	Apply fundamental physical principles (including quantum mechanics, statistical mechanics, and thermodynamics) to describe and analyze energy and charge transport mechanisms at the nanoscale, involving electrons, phonons, photons, and molecules.
L2	Solve transport problems using appropriate models such as the Boltzmann Transport Equation (BTE), Landauer formalism, and quantum confinement principles for nanoscale systems, and distinguish between ballistic and diffusive regimes.
L3	Interpret and evaluate nanoscale transport phenomena in real-world energy conversion and nanoelectronic devices, including thermoelectrics, photovoltaics, and molecular junctions, through analytical methods, numerical simulations, and research literature.

Contribution of Course Learning Outcomes to Program Competencies/Outcomes

Contribution Level: 1: Very Slight, 2: Slight, 3: Moderate, 4: Significant, 5: Very Significant

#	PO-1		PO-2		PO-3		PO-4		PO-5			PO-6			PO-7						PO-8		PO-9		PO-10			PO-11		Total #	
	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2	5.3	6.1	6.2	6.3	7.1	7.2	7.3	7.4	7.5	7.6	8.1	8.2	9.1	9.2	10.1	10.2	10.3	11.1	11.2		
L1	5	5														5					4										19
L2	5	5		4			5	5				3				5					4										36
L3	5	5		4								3				5					4										26
Total=																												81			

#	PROGRAM ÇIKTILARI ve ALT BİLEŞENLERİ
1.1.	Matematik, fen bilimleri ve ilgili mühendislik disiplinine özgü konularda yeterli bilgi birikimi; Adequate knowledge in mathematics, science and subjects specific to the relevant engineering discipline;
1.2.	Bu alanlardaki kuramsal ve uygulamalı bilgileri, karmaşık mühendislik problemlerinin çözümünde kullanabilme becerisi. Ability to use theoretical and applied knowledge in these areas to solve complex engineering problems.
2.1.	Karmaşık mühendislik problemlerini tanımlama, formüle etme ve çözme becerisi; Ability to identify, formulate and solve complex engineering problems;
2.2.	Bu amaçla uygun analiz ve modelleme yöntemlerini seçme ve uygulama becerisi. Ability to select and apply appropriate analysis and modeling methods for this purpose.
3.1.	Karmaşık bir sistemi, süreci, cihazı veya ürünü gerçekçi kısıtlar ve koşullar altında, belirli gereksinimleri karşılayacak şekilde tasarlama becerisi; The ability to design a complex system, process, device or product under realistic constraints and conditions to meet specific requirements;
3.2.	Bu amaçla modern tasarım yöntemlerini uygulama becerisi. Ability to apply modern design methods for this purpose.



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4.1.	Mühendislik uygulamalarında karşılaşılan karmaşık problemlerin analizi ve çözümü için gerekli olan modern teknik ve araçları seçme ve kullanma becerisi; Ability to select and use modern techniques and tools necessary for the analysis and solution of complex problems encountered in engineering practice;
4.2.	Bilişim teknolojilerini etkin bir şekilde kullanma becerisi. Ability to use information technologies effectively.
5.1.	Karmaşık mühendislik problemlerinin veya disipline özgü araştırma konularının incelenmesi için deney tasarlama, Design experiments to investigate complex engineering problems or discipline-specific research topics,
5.2.	Deney yapma, Experimentation
5.3.	Veri toplama, sonuçları analiz etme ve yorumlama becerisi. Ability to collect data, analyze and interpret results.
6.1.	Disiplin içi takımlarda etkin biçimde çalışabilme becerisi; Ability to work effectively in disciplinary teams;
6.2.	Çok disiplinli takımlarda etkin biçimde çalışabilme becerisi; Ability to work effectively in multidisciplinary teams;
6.3.	Bireysel çalışma becerisi. Ability to work individually.
7.1.	Sözlü ve yazılı etkin iletişim kurma becerisi; Ability to communicate effectively both orally and in writing;
7.2.	En az bir yabancı dil bilgisi; Knowledge of at least one foreign language;
7.3.	Etkin rapor yazma ve yazılı raporları anlama becerisi, Ability to write effective reports and understand written reports,
7.4.	Tasarım ve üretim raporları hazırlayabilme becerisi, Ability to prepare design and production reports,
7.5.	Etkin sunum yapabilme becerisi, Ability to make effective presentations,
7.6.	Açık ve anlaşılır talimat verme ve alma becerisi. Ability to give and receive clear and understandable instructions.
8.1.	Yaşam boyu öğrenmenin gerekliliği konusunda farkındalık; Awareness of the necessity of lifelong learning;
8.2.	Bilgiye erişebilme, bilim ve teknolojiadaki gelişmeleri izleme ve kendini sürekli yenileme becerisi. Ability to access information, to follow developments in science and technology and to continuously renew oneself.
9.1.	Etik ilkelerine uygun davranma, mesleki ve etik sorumluluk ve Acting in accordance with ethical principles, professional and ethical responsibility and
9.2.	Mühendislik uygulamalarında kullanılan standartlar hakkında bilgi. Information about standards used in engineering applications.



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10.1.	Proje yönetimi, risk yönetimi ve değişiklik yönetimi gibi, iş hayatındaki uygulamalar hakkında bilgi; Knowledge of business practices such as project management, risk management and change management;
10.2.	Girişimcilik, yenilikçilik hakkında farkındalık; Awareness about entrepreneurship and innovation;
10.3.	Sürdürülebilir kalkınma hakkında bilgi. Knowledge about sustainable development.
11.1.	Mühendislik uygulamalarının evrensel ve toplumsal boyutlarda sağlık, çevre ve güvenlik üzerindeki etkileri ve çağın mühendislik alanına yansıyan sorunları hakkında bilgi; Knowledge about the effects of engineering applications on health, environment and safety in universal and social dimensions and the problems of the era reflected in the field of engineering;
11.2.	Mühendislik çözümlerinin hukuksal sonuçları konusunda farkındalık. Awareness of the legal implications of engineering solutions.