COURSE INFORMATION					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
MATHEMATICAL METHODS AND CLASSICAL MECHANICS	PHYS 561	1	3 + 1	3	10

Prerequisites	-

Language of Instruction	English
Course Level	Graduate
Course Type	Compulsory (Theory Option)
Course Coordinator	Prof. Dr. Avadis Hacinliyan
Instructors	Prof. Dr. Avadis Hacinliyan
Assistants	
Goals	Introducing mathematical methods of physics such as vector and tensor analysis, linear algebra, Laplace and Poisson Equations. Introducing the physical and mathematical basis of classical mechanics, analytical mechanics, symmetry and invariance principles. Studying Lagrangian and Hamiltonian formulations, canonical transformations, Poisson brackets, Hamilton Jacobi theory, perturbation theory. Investigating problems that can be exactly or approximately solved.
Content	Scalars, vectors and tensors, generalized coordinates, Linear algebra review. Lagrange’s Equations. Divergence, curl, Gauss's and Stokes's theorems. Particles and systems of particles. Symmetries and conservation laws Hamilton’s principle and Lagrange’s equations. Constrained systems. Small oscillations. Two body central force problem. Classical scattering theory. Rotating coordinate systems. Centrifugal and Coriolis forces. Solvable problems in rigid body mechanics. Legendre transformations. Hamilton’s canonical equations. Canonical Transformations. Poisson Brackets. Hamilton Jacobi Theory. Action Angle Variables.

Learning Outcomes	Teaching Methods	Assessment Methods
1) Create the physical and mathematical background that the student will need in the graduate level.	1,2,3	A,B,C
2) Lay the mathematical and mechanical foundation for problems that the student will encounter in graduate studies.	1,2,3	A,B,C
3) Skill to apply knowledge in physics and mathematics Motivation And Behavior	1,2,3	A,B
4) Teach basic mathematical methods and variational principles and the Lagrange, Hamilton, Hamilton Jacobi and Poisson formulations.	1,2,3	A,B
5) Exact and approximate computation methods	1,2,3	A,B,C
6) Skill to define, formulate and solve physical problems.	1,2,3	A,B,C
7) Skill to use the techniques and means necessary for physics applications.	1,2,3	A,B,C

Teaching Methods:	1: Lecture, 2: Problem Sets, 3: Presentations
Assessment Methods:	A: Examination, B: Homework C: Presentation

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Vector and scalar fields	Math Methods.
2	Orthogonal and generalized coordinate systems. Lagrange equations.	Math. Meth. İn Physics
3	Permutation symbols. Tensors. Flux, divergence and Gauss' theorem.	Math Meth. in Phys.
4	Curl and Stokes' Theorem. Classical gravitational theory.	Math. Meth. in Phys..
5	Laplace and Poisson Equations. Potential Theory.	Electromagnetic Theory.
6	Systems of particles, Principles of mechanics and conservation laws.	Classical Mechanics
7	Midterm Exam	
8	Hamilton's principle, Calculus of variations and Lagrange's Equations. Symmetry and conservation principles. First Integrals.	Classical Mechanics.
9	Eigenvalues and Eigenvectors. Small oscillations. Normal frequencies and coordinates	Linear algebra. Math. Methods
10	Two body central force problem. Classical scattering theory.	

11	Orthogonal transformations, Rotating coordinate systems. Centrifugal and Coriolis forces.	Classical Mechanics.
12	Solvable problems in rigid body mechanics. Top problem.	Classical Mechanics.
13	Legendre Transformations, Hamilton's canonical equations, Canonical transformations	Math. Meth. Phys.
14	Poisson Brackets, Hamilton Jacobi Theory	Classical Mechanics
15	General Revision and Midterm Exam	

RECOMMENDED SOURCES	
Textbook	H. Goldstein, C. P. Poole Jr., J. L. Safko, Classical Mechanics (3. Baskı), Addison Wesley ve Pearson Education (2002). ; Hans J. Weber, Frank Harris, George B. Arfken] Essential Mathematical Methods for Physicists, Academic Press. G. Stephenson and P. M. Radmore "Advanced Mathematical Methods for Engineering and Science Students, Cambridge University Press
Additional Resources	C. Lanczos, The Variational Principles of Mechanics (2. Edition) Dover (1970) F. Scheck: Mechanics from Newton's Laws to Deterministic Chaos 5. Edition, Springer (2010)

MATERIAL SHARING	
Documents	Ahmed Yüksel Özemre, "(Math. Meth. Phys.) Fizikte Matematiksel Metotlar" and "(Classical Theoretical Mechanics) Klasik Teorik Mekanik" İstanbul University Publication (1998)
Assignments	From Textbook
Exams	

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution				
		1	2	3	4	5
1	Gets a sound base for the main fields of physics such as Classical Mechanics, Quantum Mechanics and Electromagnetism,					X
2	Gets the ability of interpreting, analysing, forming a synthesis and relationships between the main fields of physics and/or other sciences,					X
3	Obtains the education required for the measurements in scientific and technological areas and the contribution of physics in the industrial applications and on the macroscopic scale such as the society,				X	
4	Follows the up-to-date scientific developments, makes the analysis/synthesis for the new ideas and evaluates them,				X	
5	Uses the academic sources, the computer technology and the related devices,		X			

6	Joins the working and research groups, also the scientific meetings, communicates well at the national and international level,		X			
7	Gets the ability of creative and critical thinking, problem solving, researching, producing a new and original work, improving himself/herself in his/her own fields of interest,					X
8	Gains the concepts of ethics and responsibility. Undertakes the responsibility for the solutions to the problems related with his/her field as required for having an intellectual identity.		X			

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-terms	2	80
Quizzes	4	10
Assignment	8	10
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		40
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		60
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 16x Total course hours)	16	4	64
Hours for off-the-classroom study (Pre-study, practice)	16	5	80
Mid-terms	2	10	20
Quizzes	4	1	4
Homework	8	3	24
Problem Hour and Presentation (Preparation included)	5	8	40
Final examination (Reparation Exam included)	2	10	20
Total Work Load			252

Total Work Load / 25 (h)			10
ECTS Credit of the Course			10