COURSE INFORMATION

Course Code	AAM 554	Course Name	Advanced Dynamics					
Type of Course	**Level of Course**	**Semester**	**Language**	**Theory**	**Application (Practice)**	**Laboratory**	**Local Credits**	**ECTS**
Elective	Graduate	-	English	3	0	0	3	6

Department	: Aerospace Engineering
Prerequisites/Requirements for Admission	: None
Mode of delivery	: Face to face
Course coordinator	: Assoc. Prof. Dr. Çetin ŞENTÜRK
Course lecturer(s)	: Assoc. Prof. Dr. Çetin ŞENTÜRK
Course assistant(s)	: None
Course description/aim	: The aim of this course is to present the dynamics of particles and rigid bodies in more detail by using vectorial and analytical methods.
Course contents	: Vector analysis, curvilinear coordinates, change of coordinates, relative motion analysis, inertial/noninertial frames of reference, moment of inertia tensor, principal axes, Euler's equations of motion, Euler angles, gyroscopic motion, generalized coordinates, degrees of freedom, holonomic/nonholonomic constraints, generalized forces, Hamilton's principle, Lagrange equations of motion, Hamilton's equations of motion.
Recommended optional program components	: -
Attendance	: 70%

Course Learning Outcomes

#	Learning outcome	Teaching Methods/Techniques	Assessment method(s)
At the end of this course; students will be able to:			
1	Apply vector calculus to analyzing the kinematics and kinetics of particles, system of particles, and rigid bodies.	Theoretical Lecture	Exams/Homeworks/Project
2	Analyze the dependent motion of constrained systems and the kinematics of relative motion.	Theoretical Lecture	Exams/Homeworks/Project
3	Draw free-body diagrams and write dynamic equations of motion using appropriate coordinate systems.	Theoretical Lecture	Exams/Homeworks/Project
4	Make use of the energy and momentum methods in solving dynamics problems.	Theoretical Lecture	Exams/Homeworks/Project
5	Explain the methods of analytical mechanics as represented by Lagrange's and Hamilton's equations.	Theoretical Lecture	Exams/Homeworks/Project

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Weekly Detailed Course Content

Week	Content	Recommended Resource(s)	Time (Hours)
1	General principles; Fundamental Concepts	Textbook and Lecture Notes	3
2	Review of Particle Kinematics: Vector Calculus; Curvilinear Coordinates; General Curvilinear Motion	Textbook and Lecture Notes	3
3	Review of Particle Kinematics: Time Derivatives of Moving Vectors; Relative Motion	Textbook and Lecture Notes	3
4	Review of Particle Kinetics: Newton's Laws of Motion; The Equation of Motion	Textbook and Lecture Notes	3
5	Review of Particle Kinetics: Energy & Momentum Methods	Textbook and Lecture Notes	3
6	Dynamics of a System of Particles: Center of Mass and Its Motion; Linear & Angular Momentum of a System of Particles; Conservation of Momentum for a System of Particles	Textbook and Lecture Notes	3
7	Rigid Body Dynamics: Coordinate Transformations; General Rotations; Euler Angles; Yaw, Pitch, and Roll Angles	Textbook and Lecture Notes	3
8	Rigid Body Dynamics: Moment of Inertia Tensor; Principal Axes; Euler's Equations of Motion / Midterm Exam	Textbook and Lecture Notes	6
9	Rigid Body Dynamics: Gyroscopic Motion; Torque-Free Motion	Textbook and Lecture Notes	3
10	Analytical Mechanics: Generalized Coordinates; Degrees of Freedom; Holonomic/Nonholonomic Constraints	Textbook and Lecture Notes	3
11	Analytical Mechanics: Virtual Displacement; Principle of Virtual Work; Generalized Forces	Textbook and Lecture Notes	3
12	Analytical Mechanics: D'Alembert's Principle; Hamilton's Principle; Lagrange's Equations of Motion	Textbook and Lecture Notes	3
13	Analytical Mechanics: Lagrange's Equations for Constrained Systems; Undetermined Multipliers	Textbook and Lecture Notes	3
14	Analytical Mechanics: Hamilton's Equations of Motion	Textbook and Lecture Notes	3
15	Final Exam		
16	Final Exam		

Sources

Course notes/textbooks	: Advanced Engineering Dynamics, J. H. Ginsberg, Cambridge University Press, 1998. Methods of Analytical Dynamics, L. Meirovitch, McGraw-Hill, 1986. Advanced Dynamics, D. T. Greenwood, Cambridge University Press, 2003.
Readings	: None
Supplemental readings	: None
References	: None

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Evaluation System

Work Placement	Number	Percentage of Grade (%)
Attendance		
Quizzes		
Homework	4	30
Laboratory/Practice		
Report(s)		
Graduate Thesis/Project		
Seminar		
Presentation		
Projects		
Midterm exam(s)	1	30
Others		
Final exam	1	40
	Total	100
	Percentage of semester work	60
	Percentage of final exam	40
	Total	100

Workload Calculation

Activity	Number	Time (hours)	Total Workload (hours)
Course Hours	14	3	42
On-line Activity Hours	0	0	0
Individual study	14	8	112
Lab practice	0	0	0
Midterm exam(s)	1	3	3
Final exam	1	3	3
Homework	4	6	24
Presentation	0	0	0
Project	0	0	0
		Total	184
		ECTS Credit *(Total/30)*	6

Contribution of Learning Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
LO1	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**
LO2	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**
LO3	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**
LO4	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**
LO5	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**
LO6	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**
LO7	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**

Contribution Level: 1 Very low, 2 Low, 3 Medium, 4 High, 5 Very High