Universidad Carlos III de Madrid

COURSE TITLE: MECHANICS AND RELATIVITY		
BACHELOR IN ENINEERING PHYSICS	YEAR: 2nd	SEMESTER: 1ST

COURSE SCHEDULE

WEEK	SESSION	DESCRIPTION OF THE CONTENTS	GROUP (Tick X)		Indicate if a space different from the classroom is required (laboratory, computer classroom, etc)	Indicate YES/NO if It is a session with two teachers (*)	STUDENT'S WEEKLY SCHEDULE		
			Lecture Class	Practical Class			DESCRIPTION	CLASS HOURS	HOMEWORK HOURS Máximum 7 H
1	1	**1. Introduction to Analytical Mechanics** - Introduction - Generalized Coordinates - Systems with Constraints - Kinetic Energy and Generalized Momenta * Generalized Velocity * Kinetic Energy * Generalized Momenta - Virtual and Real Displacements - Virtual Work. Generalized Forces * Virtual work * Generalized Forcs * Virtual Work and Forces of Constraint	X				- Reading of proposed topics - Work on the subject, including bibliographic research	1,66	5
1	2			X			- Solution of proposed exercises - Presentation of short proposed works - Participation in discussions and debates	1,66	
2	3	**1 (cont.)**	X				- Reading of proposed topics	1,66	5

							- Work on the subject, including bibliographic research		
2	4			X			- Solution of proposed exercises - Presentation of short proposed works - Participation in discussions and debates	1,66	
3	5	**2. The Lagrange's Equations** - Introduction - Derivation of the Lagrange's Equations - Lagrange's Equations for Conservative Forces. The Lagrangian of a Mechanical System - Lagrange's Equations for Conservative and Non-Conservative Forces - Lagrangian Mechanics and Newtonian Mechanics - Cyclic Coordinates and Conservation Theorems * Constants of Motion * Definition of Cyclic (or Ignorable) Coordinates. Conservation Theorem for Cyclic Coordinates	X				- Reading of proposed topics - Work on the subject, including bibliographic research	1,66	5
3	6	- Written test exam (*)		X			- Written test exam - Solution of proposed exercises - Presentation of short proposed works - Participation in discussions and debates	1,66	
4	7	**3. The Hamilton's Equations. The Hamilton's Principle** - Introduction - Derivation of the Hamilton's Equations. The Hamiltonian of a Mechanical System - General Procedure to Determine the Hamiltonian and Obtain the Hamilton's Equations - Other Expressions for the Hamiltonian. Physical Meaning - Cyclic Coordinates and Conservation Theorems in the Hamiltonian Mechanics - Comparison between the Hamiltonian and Lagrangian Formulation of Mechanics	X				- Reading of proposed topics - Work on the subject, including bibliographic research	1,66	5

		- Fields of Application of the Hamiltonian Mechanics - The Hamilton's Principle. Principle of Least Action							
4	8			X			- Solution of proposed exercises - Presentation of short proposed works - Participation in discussions and debates	1,66	
5	9	**4 Analytical Statics** - The Principle of Virtual Work - D'Alembert's Principle	X				- Reading of proposed topics - Work on the subject, including bibliographic research	1,66	5
5	10			X			- Solution of proposed exercises - Presentation of short proposed works - Participation in discussions and debates	1,66	
6	11	**5 Introduction to the Rigid Body** - Definition of the Rigid Body. Degrees of Freedom - General Motion of a Rigid Body in Space. Chasles Theorem - Angular Velocity of Rotation of a Rigid Body - Kinetic Energy. Köning's Theorem	X				- Reading of proposed topics - Work on the subject, including bibliographic research	1,66	5
6	12	- Written test exam (*)		X			- Written test exam - Solution of proposed exercises - Presentation of short proposed works - Participation in discussions and debates	1,66	
7	13	**6. The Inertia Tensor** - Rotational Kinetic Energy. Definition of the Inertia Tensor - Angular Momentum with respect to a Point * Angular Momentum * Relation between the Angular Momentum and the Rotational Kinetic Energy - Planar Motion - Properties of the Inertia Tensor - Principal Axes of Inertia * Principal Axes and Principal Moments of Inertia * Procedure to determine the Principal Axes and Moments	X				- Reading of proposed topics - Work on the subject, including bibliographic research	1,66	5

		* Principal Axes and Properties of Symmetry - The Ellipsoid of Inertia							
7	14			X			- Solution of proposed exercises - Presentation of short proposed works - Participation in discussions and debates	1,66	
8	15	**7 Equations of Motion of a Rigid Body. Applications** - Eulerian Angles * Translational and Rotational Coordinates. Eulerian Angles * Angular Velocity of Rotation as a function of the Eulerian Angles - Equations of Motion - Euler's Equations - Gyroscopic Motion	X				- Reading of proposed topics - Work on the subject, including bibliographic research	1.66	5
8	16			X			- Solution of proposed exercises - Presentation of short proposed works - Participation in discussions and debates	1.66	
9	17	**8 Oscillations** - Introduction - Formulation of the Problem - The Eigenvalue Equation. Normal Modes and Frequencies - Normal Coordinates - Summary of the Method	X				- Reading of proposed topics - Work on the subject, including bibliographic research	1,66	5
9	18	- Written test exam (*)		X			- Written test exam - Solution of proposed exercises - Presentation of short proposed works - Participation in discussions and debates	1,66	
10	19	**8 (cont.)**	X				- Reading of proposed topics - Work on the subject, including bibliographic research	1,66	5
10	20			X			- Solution of proposed exercises - Presentation of short proposed works - Participation in discussions and Debates	1,66	

11	21	**9 Postulates of the Special Theory of Relativity** - Introduction - The Classical Relativity * The Galilean Principle of Relativity * The Galilean Transformation and Classical Mechanics - The Principle of Relativity and the Electromagnetic Theory - Einstein's Postulates **10 Relativistic Kinematics** - Lorentz Transformation * Lorentz Transformation of Coordinates * Lorentz Velocity Transformation - Consequences of the Lorentz Transformation * Time Dilation * Contraction of Length * Relativity of Simultaneity	X				- Reading of proposed topics - Work on the subject, including bibliographic research	1,66	5
11	22			X			- Solution of proposed exercises - Presentation of short proposed works - Participation in discussions and debates	1,66	
12	23	**10 (cont.)** **11 Relativistic Dynamics** - Introduction - Relativistic Linear Momentum - Relativistic Expression of the Force - Relativistic Energy * Kinetic Energy * Definition of the Total Energy * Mass-Energy Equivalence * Energy-Momentum Relation	X				- Reading of proposed topics - Work on the subject, including bibliographic research	1,66	5
12	24			X			- Solution of proposed exercises - Presentation of short proposed works - Participation in discussions and Debates	1,66	
13	25	**11 (cont.)** - Written test exam (*)	X				- Reading of proposed topics - Work on the subject, including bibliographic research - Written test exam	1,66	6.5

13	26	- **Laboratory session:** Seminar of Numerical Methods in Mechanics		X			- Reading of the guideline document - Carrying out the laboratory session - Analysis of results - Preparation of the report	1,66	
14	27	- **Laboratory session:** Rigid Body		X			- Reading of the guideline document - Data acquisition - Analysis of results - Preparation of the report	1.66	4.5
14	28	- **Laboratory session:** Rigid Body		X			- Reading of the guideline document - Data acquisition - Analysis of results - Preparation of the report	1.66	4.5
15	29	- **Laboratory session:** Seminar of Relativity		X			- Reading of the guideline document - Carrying out the laboratory session - Analysis of results - Preparation of the report	1.66	4.5
SUBTOTAL								**48 + 80 = 128**	
15		Support classes, delivery of proposed homework assignments, etc						2	2
16-18		Preparation for the final written exam and exam						3	15
TOTAL								**150**	

(*) Test dates are tentative.
(**) Laboratory session dates are tentative.