ANALYTICAL DYNAMICS

Instructors: **Assoc. Prof. Yannis Kominis**
gkomin@central.ntua.gr

Class: Wednesdays 15:00-16:00
Office Hours: Fridays 11:00-13:00

Textbook: NO Textbook
Recommended Reading:
1. Goldstein, H., Poole, C.P., Safko, J.L., 2001. Classical Mechanics (3rd ed.), Addison-Wesley.
2. José, J.V., Saletan, J., 2013. Classical Dynamics: A Contemporary Approach, Cambridge University Press.
3. Lichtenberg, A.J., Lieberman, M.A., 1991. Regular and Chaotic Dynamics (2nd ed.), Springer-Verlag.
4. Bountis, T., Skokos, H., 2012. Complex Hamiltonian Dynamics, Springer.

CONTENTS

1   Variational Principles and Lagrange's Equations
1.1 D'Alembert Principle and Lagrange's Equations
1.2 Hamilton's Principle
1.3 Calculus of Variations
1.4 Conservation Theorems and Symmetry Properties
1.5 Energy Function and Conservation of Energy

2   The Hamilton Equations of Motion
2.1 Legendre transformations and the Hamilton Equations of Motion
2.2 Cyclic Coordinates and Conservation Theorems
2.3 Derivation of Hamilton's Equations from a Variational Principle

3   Canonical Transformations
3.1 The Equations of Canonical Transformation
3.2 Symplectic Approach
3.3 Poisson Brackets and Other Canonical Invariants
3.4 Liouville's Theorem

4   Hamilton-Jacobi Theory and Action-Angle Variables
4.1 The Hamilton-Jacobi Equation for Hamilton's Principal and Characteristic Functions
4.2 Separation of Variables and Ignorable Coordinates
4.3 Action-Angle Variables in Systems of One and Many Degrees of Freedom

5   Canonical Perturbation Theory
5.1 Asymptotic Series, Small Denominators, and the Effect of Resonances
5.2 Canonical Perturbation Theory for Systems of One and Many Degrees of Freedom
5.3 Adiabatic Invariance and Canonical Adiabatic Theory
5.4 Secular Perturbation Theory

6   Hamiltonian Chaos
6.1 Hamiltonian Systems as Canonical Mappings
6.2 Generic Behavior of Canonical Mappings

6.3 Separatrices and Chaotic Motion
6.4 Resonance Overlap and Transition to Global Chaos