KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS
DEPARTMENT OF PHYSICS
PHYS.301- Classical Mechanics I
TERM 211

Instructor : Prof. Hocine Bahlouli
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Lectures (UMTR) : 8:00–8:50 am
Office Hours : 4:00–5:40 pm (UT: Sunday & Wednesday) or by appointment.

Course Description:

Newton's laws of motion and conservation theorems, Forced damped Oscillations; Coupled Oscillations; Lagrangian Dynamics, Hamilton's equations of motion; Central-force motion; Dynamics of systems of particles, Motion in a non-inertial reference frame, Dynamics of Rigid bodies including properties of Inertia tensor.

Prerequisite:

PHYS 101, PHYS 210 or MATH 333 or MATH 302

Textbook:

Thornton, S. T and Marion, J. B. : *Classical Dynamics of Particles and Systems*, 5th edition, Brooks/Cole, Cengage Learning, 2008.

References:

K. R. Symon, *" Mechanics* " , Addison-Wesley, 3rd Edition

L.D. Landau and E.M. Lifshitz, Mechanics, Pergamon Press, second edition (1969).

Bargar, V., and Olsson, M.: *Classical Mechanics*, McGraw-Hill, 1995.

Fowles, G. R., and Cassiday, G. L.: *Analytical Mechanics*, 6th edition, Saunders College Publishing, 1999.

Zimmerman, R. L., and Olness, F. I.: *Mathematica for Physics*, Addison-Wesley Publishing Company, 1995.

Grading:

Quizzes : 15 %
Computational Assignments: 15 %
Two examinations: 40% (20 % each)
Final Examination: 30 %

Homework:

Every chapter you will be given up to 10 problems to be solved. These assignments will not be collected or graded but might be part of the quizzes.

Computational Assignments :

There will be few problems that you need to solve numerically using Mathematica, Maple, Mathcad, Matlab or Python, these assignments will have deadlines and will be graded.

Material to be covered:

The following material will be covered:

Chapter	*Title*
1	Matrices, Vectors, Vector Calculus, ODE and Dimensional Analysis.
2	Newtonian Mechanics – Single Particle motion.
3	Oscillations and Coupled Oscillations.
6	Brief summary on calculus of variation.
7	Hamilton's Variational Principle, Lagrangian and Hamiltonian Dynamics.
8	Central Force Motion.
9	Dynamics of a System of Particles.
10	Motion in a Non-Inertial Frame.
11	Dynamics of Rigid Bodies.

Examinations:

1st Exam: Chapters: 1, 2, 3.
2nd Exam: Chapters: 6, 7, 8.
Final Exam: Chapters: All.

Learning Strategy:

It is important to understand the basic principles. The key to success is hard work. It is vital to work out the problems in the homework and consult with the instructor during office hours in order to gain the necessary experience and understand the physical phenomena and mathematical techniques underlying this course.

SCHEDULE

Week	Topic	Book Sections
1	Dimensional Analysis, vectors; rotation matrices; vector & scalar products.	1.1 – 1.11
2	Derivatives & integrals; gradient; Ordinary Differential Equations.	1.12 – 1.17
3	Newton's laws; frictional forces; conservation laws	2.1 – 2.6
4	Simple harmonic oscillator, Phase diagrams	3.2 – 3.5
5	Driving force; resonance	3.6 – 3.7
6	Coupled oscillations	12.1– 12.3
EXAM I		
7	Gravitation	5.1 – 5.3
8	Calculus of variations	6.1 – 6.4
9	Lagrangian & Hamiltonian dynamics	7.1 – 7.4
10	Method of undetermined multipliers, Equivalence of Lagrangian dynamics	7.5 – 7.8
11	Hamiltonian dynamics; Conservation laws and Hamiltonian dynamics, Canonical equations, Conservation laws	7.9 – 7.12
EXAM II		
12	Central force motion Central force motion	8.1 – 8.7
13	Dynamics of a System of Particles	9.1 – 9.7
14	Motion in a non-inertial reference frame	10.1 – 10.4
15	Rigid Body Dynamics	11.1 – 11.9
FINAL EXAM		