PHYS 301
Classical Mechanics I
Spring 2005/2006 (051)

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Course Description

The course is an introduction to modern classical mechanics. The topics covered include Newton's laws of motion and conservation theorems, nonlinear oscillations and chaos, computational study of forced oscillatory motion and nonlinear motion, gravitation, Hamilton's variational principle, Lagrangian and Hamiltonian dynamics, and central-force motion in a non-inertial frame.

Pre-requisite

Phys 101 and Math 202

Textbook

"Classical Dynamics of Particles and Systems" by J.B. Marion & S.T. Thornton (4th Edition, Saunders College Publishing, 1995).

Supplementary References:

- K.R. Symon, "Mechanics", Addison-Wesley, 3rd edition. Call #: QC 125.S98
- G.R. Fowles, "Analytical Mechanics", Holt-Rinehart and Winston, 6th edition. Call #: QA807 .F65
- S. Wolfram, "Mathematica, a System for doing Mathematics by Computer". Call #: QA76.95 .W65 1991
- R. Zimmerman and F. Olness, "Mathematica for Physics". Call #: QC20 .Z56 1995

Grading

Homeworks and Quizzes	20%
1st Major Exam	20%
2nd Major Exam	20%
Final Exam	40%

General Remarks

- You are expected to use **calculus** as a tool for understanding the material and solving problems. Techniques involving differential equations and vector calculus will be used. I expect you to be familiar with the material of the prerequisite courses (esp. math 201, 202, 260 and 280).
- You will be requested to use Mathematica and (possibly) Microsoft Excel at an elementary level for plotting various complicated functions.
- You should read the appropriate sections (see syllabus) from the textbook *prior* to class.
- There will be approximately 6 homework problem sets. I do not mind students "discussing" the homework problems with each other. However, cheating (e.g. copying) **will not be tolerated**.
- Be sure to take good notes and do not delay time between the lecture and your review of the notes.
- Please ask questions and stop me whenever I go too fast.

Week	Date	Topics	Chapter	Sections	Homework
1	10 Sept. 12	Coordinate Transformation and Rotation, Propertied of Rotation Matrices, and Matrix Operations Definitions of Scalars and Vectors in terms of transformation matrices, Scalar Product and Vector Operations, Unit Vectors	01 01	1-5 6-11	4, 9, 15, 20, 25, 30, 31
2	17 19	Vector Product of Two Vectors, Differentiation of Vectors, Velocity and Acceleration, The gradient Operator	01 01	12-14 15, 16	
Tuesday – 20 Sept. 2005 - Last day for dropping courses without permanent record					
3	24 26	*National Holiday (No classes)* Integration of Vectors	- 01	- 17	 9, 23, 31, 38, 43, 52
4	01 Oct. 03	Newton's Law and Reference Frames, The Equation of Motion of a Particle Conservation Theorems	02 02	1-4 5	
5	08 10	Energy Rocket Motion	02 02	6 7	
6	15 17	Limitation of Newtonian Mechanics Review	02	7,8	
Saturday – 22 Oct. 2005 – First Major Exam (Chapters 1, 2)					
7	22 24	Simple Harmonic Oscillator, Harmonic Oscillations in 2 D Phase Diagrams, Damped Oscillations	03 03	1- 3 4, 5	2, 4, 10, 15, 21, 22, 27
Tuesday 25 Oct. 2005- Last day for dropping courses with grade of "W"					
Eid Al-Fitr vacation (27 Oct. – 11 Nov. 2005)					
8	12 Nov. 14	Sinusoidal Driving Forces Physical Systems, Electric Oscillations	03 03	6 7, 8	
9	19 21	Non-Linear Oscillations, Phase Diagram for Non-Linear systems Plane Pendulum, Jumps, Hysterisis	04 04	1, 2 3-5	2, 6
10	26 28	The Gravitational Potential Lines of Force, Equipotential Surfaces	05 05	1, 2 3	 4, 9, 13
Wednesday 30 Nov. 2005– Last day for withdrawal from all courses with grade of "WP/WF"					
11	03 Dec. 05	Ocean Tides Calculus of Variations, Euler's Equation	05 06	4, 5 1-3	 5, 10
12	10 12	The Second Form of Euler's Equation Constraints, The Delta Notation	06 06	4, 5 6, 7	
Wednesday – 14 Dec. 2005 – Second Major Exam (Chapters 3 –5)					
13	17 19	Hamilton's Principle, Lagrange'e Equations of Motion Lagrange's Equations with Undetermined Multipliers, The	07 07	1-4 5, 6	4, 7, 12, 15, 25, 28
14	24 26	Equivalence of Lagrange's and Newton's Equations, Conservation Theorems Revisited Hamilton's Dynamics, The Virial Theorem	07 07	7, 8 9, 10, 13	
15	31 02 Jan. 2006	First Integral of Motion Potential Equations of Motion for Central , The Effective Potential	08 08	1-3 4-6	3, 6, 13, 14
Eid Al-Adha vacation (05 – 20 Jan. 2006)					
	21 Jan.	General Review	-	-	
Final Exam (Chapters 1 – 8)					

Wish you a successful semester. Dr. A. Mekki