Fall 2021 Physics 531 Section 001 Classical Mechanics

This fall's Classical Mechanics (CM) course will use zoom. The course will be delivered from UTSI, actually my home in Manchester, TN. Please let me encourage your active participation in the zoom meetings.

I summarized the course contents and included guides of topics covered in typical sets of three (3) lectures each. Please see the course syllabus outlining planned course contents, class aims, goals and objectives. In addition, I already tallied up the dates for the take-home homework, mid-term and final exams.

Course description

Phys531 - 3 hours credit: Variational formulation, Lagrange's and Hamilton's equations, constraints, canonical transformations, Hamilton-Jacobi theory and action-angle variables.

Books (all readily available as pdf's from the UTK library)

The main course book will be "Classical Mechanics" by M. Chaichian et al. ISBN 978-3-642-16390-6;

However, reading material and exercises, and selected lecture notes will also include the two books "Classical Mechanics - Point Particles and Relativity" by W. Greiner ISBN 0-387-95586-0, and "Classical Mechanics - Point Particles and Hamiltonian Dynamics" by W. Greiner ISBN 0-387-95128-8 and for the second edition ISBN 978-3-642-03433-6. Additional reading material and extensions are from "Classical Mechanics - Hamiltonian and Lagrangian Formalism," by A. Deriglazov, 2nd ed. ISBN 978-3-319-44146-7.

Finally, selected mathematical background and reading material that is suggested includes "Mathematical Methods for Physicists" by Arfken and Weber, 5th ed **ISBN-13:** 978-0120598250 (preferred) or 7th ed. **ISBN :** 9780123846549 (Arken, Weber, and Harris) and mathematical reference material such as "Mathematical Handbook" by I.N. Bronshtein at al. 5th ed ISBN-13: 978-3540721215

General Information:

Recommendations regarding health from last summer: Syllabus-language-masks-and-social-distancing.pdf

For now, notes for class: Phys531_for_your_eyes_only(Links to an external site.)

Course Summary (zoom ID: 150 068 210)

Aug 18, 20, 23: First three lectures on the course contents and on Classical Mechanics and its importance, see "Discussions"

The syllabus and lecture schedule is largely along the lines of the main course book. There will be a few lectures on nonlinear dynamics and chaos. While using the main course book, it is expected that you read and study especially the examples of the Greiner books as part of this course, several exercises are taken from these two books. The Deriglazov book shows detailed theoretical treatments of selected mechanics topics. With this three-hour course, I recommend investing the order of two hours per day during a normal five-day work week.

Following Table of contents of Chaichian et al., grouped in bunches of three lectures.

Aug 25, 27, 30: Lectures 4,5,6 address selected aspects of "classical" Classical Mechanics, pages 1 to 74 up to and including Section 2.6 geodesics; HW1: Aug 30-Sep 8

Sep 1, 3, 8: Lectures 7,8,9 - Selected Math topics: Fourier transform, calculus of variation, differential equations, conic sections in polar coordinates.

Sep 10, 13, 15; Lectures 10,11,12 - Noether's theorem, Hamilton formulation, analogy of CM with wave mechanics, ray optics with physical optics. HW2: Sep 13-20

Sep 17, 20, 22; Lectures 13,14,15 - Commence with Chapter 3, Applications of Lagrangian Formalism for discrete particle systems: Central Force Fields, brief review of Hamilton dynamics and covariant derivative. HW3: Sep 20-27

Sep 24, 27, 29; Lectures 16,17, 18 - Kepler problem, Runge-Lenz vector. HW4: Sep 22 - Oct 4

Oct 4, 6, 8; Lectures 19,20,21 - Classical Theory of Collisions Between Particles; Midterm: Oct 11 - 18

Oct 11, 13, 15; Lectures 22,23,24 - Periodical Motion of a Particle Under the Influence of Gravity, Motion of a Particle Subject to an Elastic Force;

Oct 18, 20, 22; Lectures 25,26, 27 - Small Oscillations About a Position of Stable Equilibrium, Analogy Between Mechanical and Electric Systems; Chaos; HW5: Oct 25 - Nov 1

Oct 25, 27, 29; Lectures 28, 29, 30 - Commence with Chapter 4, General considerations, Inertial Forces, Motion of a Rigid Body About a Fixed Point, and Applications; HW6: Nov 1 - Nov 8

Nov 1, 3, 5; Lectures 31, 32, 33 - Commence with Chapter 5, Hamilton's Canonical Equations, Specific Hamiltonian Formulations of Classical Mechanics, Poisson Brackets; HW7: Nov 8 - 15

Nov 7, 10, 12, 15; Lectures 34,35,36 - Lagrange Brackets, Infinitesimal Canonical Transformations, Canonical Transformations, Integral Invariant Considerations; HW8: Nov 15 - 22

Nov 15, 17, 19; Lectures 37,38,39 - Liouville Theorem, Discussion of the Quantum Mechanical Harmonic Oscillator, Hamilton-Jacobi Formalism

Nov 22, 29, Dec 1; Lectures 40,41,42 - Noethers's Theorem for Continuous Systems, and Other Comments - Chapter 6 and Addenda; Finals: Nov 29 - Dec 6

Assignments: Homework & Exams

There are eight homework exercise sheets, four in the first half and four in the second half of this course, plus a mid-term and a final exam.

The distribution of weights is of the order of 67% for eight homework assignments, 11% for midterm and 22% for final exams. Homework exercise sheets and exams will have four questions each and four points per question.

Scaling for each question: 4 pts - outstanding, 3 pts - OK, 2 pts - about 50% OK, 1 pt - attempted but needs major work.