PH3110 Theoretical Mechanics I ... (3-0-0) f ... 3 Cr

An intermediate study of mechanics including the study of relativistic mechanics, kinematics, Newtonian mechanics of a single particle, oscillations, motion in non-inertial reference frames, and gravitation and central-force motion.

Prerequisites: PH2400 and MA3530 Intro. Diff. Equations.

This course is a prerequisite for PH3111 and PH4210.

Text (Fall, 2003):


Typical Texts:

- *Basic Concepts in Relativity and Early Quantum Theory*, Resnick and Halliday
- *Classical Dynamics of Particles and Systems, 3rd edition*, Marion and Thornton

Typical Topics (# of Lectures)

1. Relativistic Mechanics (6)
   - The Galilean Transformation
   - Einstein's Postulates
   - The Lorentz Transformation and Relativistic Kinematics
   - Relativistic Dynamics

2. Mathematical Preliminaries and Kinematics (5)
   - Vectors
     - Vector Calculus: Derivatives of Vectors, Derivatives of Products, Vector Integration
   - Kinematics
     - Position, Velocity and Acceleration: Cartesian Coordinates
     - Tangential and Normal Components of Acceleration
     - Velocity and Acceleration in Some Orthogonal Curvilinear Coordinate Systems

3. Newtonian Mechanics: Rectilinear Motion of a Single Particle (5)
   - Newton's Laws of Motion
   - Constant Forces
   - Time-Dependent Forces
   - Velocity-Dependent Forces
   - Position-Dependent Forces: Kinetic and Potential Energies

4. Oscillations (5)
5. Particle Motion in Three Dimensions (6)

- Auxiliary Principles of Newtonian Dynamics
  - Torque and Angular Momentum
  - Work and Kinetic Energy
- Conservative Forces and Potential Energy
- Separable Forces: Projectile Motion
- The Harmonic Oscillator in Two and Three Dimensions
- The Simple Pendulum

6. Non-inertial Reference Frames (6)

- Translation of the Coordinate System and Inertial Frames
- Rotating Coordinate Systems
- Dynamics in an Accelerating Reference Frame
- Motion Relative to the Earth
  - Static Effects
  - Dynamic Effects: Projectile Motion
  - Foucault's Pendulum

7. Central Forces and Celestial Mechanics (8)

- Newton's Universal Law of Gravitation
- Gravitational Field and Gravitational Potential
- Motion under a Central Force
  - Kepler's Second Law
  - Energy and the Equation of Motion
- Inverse Square Force Law
  - Orbital Energies and Classification of Orbits
  - Kepler's First Law
  - Kepler's Third Law

Total Number of Lectures: 41

Course Rationale:
The first course of two at the intermediate level in mechanics, one of the well-established core areas of Physics. It provides an in-depth study of mechanics at a higher level of mathematical skill than in the introductory course and covers material considered essential for an undergraduate physics major and closely related majors. It is a required course for all SPH and SAP majors.
PH3110 - Intermediate Mechanics I

Fall 2003

Instructor: B. H. Suits
Phone: 487-2093
e-mail: suits@mtu.edu

Texts:

(PH3110 covers chapters 1-6, with some additional material added)
Mathematical Handbook of Formulas and Tables, 2nd Ed., Spiegel and Liu, (Schaum's Outlines series, McGraw-Hill)

Also, you may find it helpful to have access to another decent integral/math table.

Class Meets: Tu, Th at 12:30, room 129, Fisher Hall.

Syllabus and Homework Assignments
Handouts in pdf format
Final Exam: Take-home, due 18 Dec.

To PH3111
MTU Physics Dept
PH3110 - Fall 2003

Homework problem solutions are due the first day of the following week unless otherwise notified.

Instructor: B H Suits, Fisher 105.

Syllabus is subject to change.

<table>
<thead>
<tr>
<th>Week</th>
<th>Dates</th>
<th>Chap, Sections, Add'l Topics</th>
<th>Homwork</th>
<th>Due on</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aug 26,28</td>
<td>1</td>
<td>Handout - <a href="#">Vector Exercises</a></td>
<td>Sep 2</td>
<td></td>
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<tr>
<td>2</td>
<td>Sep 2,4</td>
<td>1, small arg. expansions</td>
<td>Sm. Arg. Handout, 1.12, 1.18, 1.19, 1.20, 1.24, 1.25</td>
<td>Sep 9</td>
<td>Vector Quiz Thurs</td>
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<tr>
<td>3</td>
<td>Sep 9,11</td>
<td>2.1-2.3</td>
<td>2.1, 2.2, 2.3, 2.8, 2.14</td>
<td>Sep 16</td>
<td>Galileo Video</td>
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<tr>
<td>4</td>
<td>Sep 16,18</td>
<td>2.4</td>
<td>2.11, 2.15, 2.16, 2.18, 2.19</td>
<td>Sep 23</td>
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<td>5</td>
<td>Sep 23,25</td>
<td>3.1-3.4</td>
<td>3.2, 3.3, 3.5, 3.7</td>
<td>Sep 30</td>
<td>Exam Sep 25: Chaps 1,2 &amp; small args.</td>
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<td>6</td>
<td>Sep 30-Oct 2</td>
<td>3.5-3.9</td>
<td>3.11, 3.13, 3.16, 3.19a, 3.23, 3.24 b&amp;c</td>
<td>Oct 7</td>
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<td>7</td>
<td>Oct 7,9</td>
<td>4.1-4.3</td>
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<td>Oct 14</td>
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<td>8</td>
<td>Oct 14,16</td>
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<td>4.12, 4.13, 4.14, 4.17, 4.18</td>
<td>Oct 21</td>
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<td>9</td>
<td>Oct 21,23</td>
<td>5.1-5.3</td>
<td>5.1, 5.3, 5.5, 5.7</td>
<td>Oct 28</td>
<td>Fred Astaire &amp; Dr. Hume</td>
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<td>10</td>
<td>Oct 28,30</td>
<td>5.4-5.6</td>
<td>5.10, 5.11, 5.16, 5.19</td>
<td>Nov 4</td>
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<td>11</td>
<td>Nov 4,6</td>
<td>sp. rel.</td>
<td>Handout - <a href="#">sp. rel. 1</a></td>
<td>Nov 11</td>
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<tr>
<td>12</td>
<td>Nov 11,13</td>
<td>sp. rel.</td>
<td>Handout - <a href="#">sp. rel. 2</a></td>
<td>Nov 18</td>
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<td>13</td>
<td>Nov 18,20</td>
<td>review, 6</td>
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<td>Exam Nov 20: Chap. 3-5 &amp; sp. rel.</td>
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<td>Nov 25,27</td>
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<td>Thanksgiving Break</td>
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<td>14</td>
<td>Dec 2,4</td>
<td>6</td>
<td>Handout - <a href="#">Orbit Problems</a></td>
<td>Dec 11</td>
<td>Preliminary Grade info avail</td>
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<td>Dec 15-19</td>
<td>Finals Week</td>
<td>Final exam</td>
<td>Comprehensive</td>
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