## ASEN6070 – Satellite Geodesy - Fall 2019
(crosslisted with EPP2 in GEOL/PHYS/ASTR 6620)

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Dr. R. Steven Nerem (Office: AERO 456, Ph. 492-6721, Email: <a href="mailto:nerem@colorado.edu">nerem@colorado.edu</a>)</th>
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<tbody>
<tr>
<td>Class Time</td>
<td>TTH 8:00 – 9:15 am</td>
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<tr>
<td>Class Location</td>
<td>ECCR 1B08</td>
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<td>Class Web Page</td>
<td><a href="http://canvas.colorado.edu">http://canvas.colorado.edu</a></td>
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<tr>
<td>Office Hours</td>
<td>9:30-10:30 TTH (after class), or anytime door is open, or by email</td>
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<td>Required Text</td>
<td><em>Geodesy and Gravity</em> by John Wahr</td>
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<td>Grading</td>
<td>Take Home Mid-Term (25%)</td>
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<td>Take Home Final Exam (25%)</td>
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<td></td>
<td>Homework (25%) (10 pts deducted for each day late!)</td>
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<td></td>
<td>Research Project (25%)</td>
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<td>90-100 = A, 80-89 = B, 70-79 = C, 60-69 = D, &lt; 60 = F</td>
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<td>Schedule</td>
<td>October 17 – Take-Home Mid-Term Exam Passed Out (due 10/22)</td>
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<td>December 12 – Take Home Final Exam Passed Out (due 12/17)</td>
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<td>Lecture Material</td>
<td>PDF files will be posted on the class website.</td>
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<td>Course Overview</td>
<td>This course provides an overview of how artificial satellites are used to study the Earth’s shape, rotation, and gravitational field, emphasizing Earth and space-based tracking of artificial satellites. Specific topics include satellite orbit perturbations due to the gravity field, satellite tracking systems (including SLR, GPS, DORIS, etc.), parameter estimation, Earth rotation and reference frames, time systems, ocean and solid Earth tides, and gravity field representations.</td>
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Syllabus – ASEN6070 – Satellite Geodesy
(reading assignments – Herring, Wahr)

I. Introduction to Geodesy (HCh1)

II. Introduction to Observational Techniques (HCh1, WCh2)
   1. Ground-based gravity measurements (HCh2, HCh3)
   2. Satellite Laser Ranging (SLR)
   3. DORIS
   4. The Global Navigation Satellite System (GNSS)
   5. Very Long Baseline Interferometry (VLBI)
   6. Satellite-to-Satellite Tracking / GRACE
   7. Accelerometer Measurements
   8. Gravity Gradiometer Measurements (GOCE)
   9. Satellite Altimetry (HCh5)
   10. Interferometric SAR (WCh12)

III. Potential Theory (WCh3, HCh2)
   1. MacCullagh’s Formula
   2. Laplace’s Equation
   3. Spherical Harmonic Representation
   4. Point Mass / Density Layer
   5. The Geoid
   6. Current Knowledge of the Earth’s Gravity Field

IV. Interpretation of Observed Gravity Anomalies (WCh6)

V. Satellite Equations of Motion, Reference Frames, Time Systems
   1. Coordinate Systems and Reference frames
   2. Time Systems
   3. Gravitational and non-gravitational forces
   4. Introduction to orbital mechanics

VI. Satellite Orbital Perturbations Due to the Gravity Field (Kaula Book)
   1. Kaula’s Solution
   2. Perturbation Spectrum

VII. Space-Based Geodetic Methods (HCh11)
   1. Lunar Laser Ranging (LLR)
   2. Satellite Laser Ranging (SLR)
   3. Very Long Baseline Interferometry (VLBI)
   4. GPS/GNSS
   5. Geophysical Applications of Positioning

VIII. Earth Rotation Variations (HCh10, WCh9)
1. Nutation and Precession
2. Polar Motion Variations
3. Rotation Variations

IX. Applications of Satellite Altimetry (HCh5)
   1. The Ocean Circulation
   2. Geostrophic Currents
   3. The Geoid and Dynamic Sea Surface Topography (DSST)
   4. Satellite Altimeter Measurements of DSST
   5. Sea Level change

X. Tidal Variations (HCh6, WCh8)
   1. Solid Earth Tides
   2. Ocean Tides
   3. Tidal Loading
   4. Tide Models Derived from Satellite Altimetry

XI. Non-Tidal Variations of the Gravity Field (HCh8)
   1. Post-Glacial Rebound (WCh7, HCh7)
   2. Melting/Accumulation of Polar/Glacial Ice
   3. Mass Redistribution in the Ocean
   4. Mass Redistribution in the Atmosphere
   5. Redistribution of Continental Water Mass
   6. Geocenter Variations

XII. Geodesy Using Interferometric SAR (HCh12)

XIII. Structure from Motion techniques.
References


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http://www.colorado.edu/osccr/
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