Course Name: Forest Photogrammetry & Introduction to Remote Sensing
Course Number: FE 209
Course Credits: 4 (3, 1-hr lectures and 1, 4-hr computer lab weekly)
Prerequisite: Trigonometry (MTH 112 or MTH 241 or MTH 251 or MTH 252)

Course Description
This course is intended to provide students interested in the management and conservation of natural resources with the fundamentals of spatial data acquisition from airborne and spaceborne sensors. It will provide an introduction into the theory of spectral reflectance properties of vegetation, the principles of photographic analysis and aerial photo-interpretation and new advances such as LIDAR. The course is also intended to prepare the forest engineering student for the next 2 courses in the sequence, Forest Route Surveying and Advanced Forest Surveying.

The Sequence of Surveying / Measurements Courses
This is the second course of an integrated sequence of four courses in Forest Surveying and Measurements (FE 208, FE 209, FE 310, and FE 311) and is an introduction to photogrammetry and remote sensing of forested ecosystems. Students will learn tools to gather spatial information about the Earth’s surface by remote sensing and how this information can be applied to map, monitor and manage forests and natural resources.

Measurable Learning Outcomes:

- Interpret the electromagnetic spectrum, identify and explain the spectral signature of vegetation.
- Place aerial or satellite images in a geographic coordinate system and transform between them using tools such as ArcGIS or Envi.
- Orient stereoscopic images under a stereoscope and delineate forest stands from it, and determine stand height from aerial photographs, and determine stand volume by applying height volume relationships and type timber from interpreting aerial photographs.
- Determine stand height, tree height and stand volume also from discrete LiDAR data by extracting ground returns, developing a digital elevation model from it and comparing this model to non-ground returns in a LiDAR dataset.
- Independently set up a sampling scheme for ground validation of remotely sensed data and validate measurements taken from both LiDAR and air photos.
- Load geospatial data into ArcGIS and do some basic operations; such as buffering/spatial querying.
- Explain the spatial and spectral properties of the most common satellite sensors (Landsat and MODIS) and when confronted with a specific remote sensing problem, be able to recommend either one of these technologies and explain why.
Instructor’s Course Policies

1. All assignments are due by 5:00 p.m. on the date assigned unless specifically stated as otherwise or previously arranged.

2. To receive credit, assignments must be turned in on time. Grades for late assignments will be reduced by 10% for each day late.

3. All work must be neat, legible, and complete. All steps should be shown. Repetitive calculations may be illustrated by sample calculations and a summary table. Use words to explain the computations where necessary. All assumptions should be stated and justified. Use sketches where required. Incomplete, undocumented work is unacceptable.

4. When work is completed as a group, each page of calculations should indicate who completed them and who checked them.

5. All figures, drawings, and tables should be titled.

6. Work which does not conform to the above requirements and the designated format may not be graded.

7. There will be no make-up exams or quizzes unless previously arranged.

8. Any requests for deviations in the course policies, schedule, or deadlines must be made in writing to the instructor (by email or otherwise).

Assignment Format:

All papers in this course, except where specifically noted, should adhere to the form illustrated below. The course number, assignment title, date submitted, student name, and sheet of sheets will be on the first sheet of every assignment. Sheets after the first will, as a minimum be identified by the students name and sheet of sheets. Except where otherwise required, all sheets shall be 8 1/2 inches x 11 inches with smooth edges. Assignments requiring computations will be completed on green engineering computation paper. All sheets will be fastened together by staple in the upper left corner. All papers, unless typed, will be printed with a soft lead pencil.

ABET Assignments:

There are two ABET assignments in this course. These must be completed with a grade of 70% or higher in order to pass the course. These will be explained in detail when they come up. The above assignment format must be followed for these assignments or they will not be accepted.
Assignment Format Example:

<table>
<thead>
<tr>
<th>Item</th>
<th>Total Points</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labs (9)</td>
<td>90</td>
<td>22.5</td>
</tr>
<tr>
<td>Homework (5)</td>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td>Quizzes (5)</td>
<td>30</td>
<td>7.5</td>
</tr>
<tr>
<td>Midterm Exam</td>
<td>100</td>
<td>25</td>
</tr>
<tr>
<td>Final Exam</td>
<td>100</td>
<td>25</td>
</tr>
<tr>
<td>Class Participation</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Totals</td>
<td>400</td>
<td>100</td>
</tr>
</tbody>
</table>

Grades:

Final grades for the course will be based on performance in the following areas: Note that the total points and assignments may be modified as the course progresses.

Statement Regarding Students with Disabilities
"Accommodations are collaborative efforts between students, faculty and Disability Access Services (DAS). Students with accommodations approved through DAS are responsible for contacting the faculty member in charge of the course prior to or during the first week of the term to discuss accommodations. Students who believe they are eligible for accommodations but who have not yet obtained approval through DAS should contact DAS immediately at 737-4098."

Link to Statement of Expectations for Student Conduct, i.e., cheating policies http://oregonstate.edu/studentconduct/code/index.php#acdis
### FE 209 Proposed Course Schedule
#### Winter 2013

<table>
<thead>
<tr>
<th>Week 1</th>
<th>Lecture:</th>
<th>Lab:</th>
<th>Reading:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Course Introduction – learning objectives and overview</td>
<td>Lab checkout, ABET paperwork. Introduction into image processing (10 pts)</td>
<td>Lillesand and Kiefer 1.1-1.4</td>
</tr>
<tr>
<td></td>
<td>• The electromagnetic spectrum</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Energy interactions with surface and atmosphere</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Lab:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Reading:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Week 2</strong></td>
<td><strong>Lecture:</strong></td>
<td><strong>Quiz:</strong></td>
<td><strong>Lab:</strong></td>
</tr>
<tr>
<td></td>
<td>• Understanding Map Projections, Datum, and Coordinate Systems</td>
<td><strong>Lab:</strong></td>
<td>Stereoscopy, Photo geometry (10 pts)</td>
</tr>
<tr>
<td></td>
<td>• Introduction into Photogrammetry → Image rectification/Geometry → Photo scale</td>
<td><strong>Reading:</strong></td>
<td>Lillesand and Kiefer 2.1-2.5, 3.1-3.5</td>
</tr>
<tr>
<td></td>
<td><strong>Homework:</strong></td>
<td><strong>Quiz:</strong></td>
<td><strong>Lab:</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Reading:</strong></td>
<td><strong>Quiz:</strong></td>
<td>Stereoscopy, Photo geometry (10 pts)</td>
</tr>
<tr>
<td><strong>Week 3</strong></td>
<td><strong>Lecture:</strong></td>
<td><strong>Lab:</strong></td>
<td>Maps and GPS measurements (10 pts)</td>
</tr>
<tr>
<td></td>
<td>• Public holiday / no class</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Horizontal Photo Measurements</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Parallax / Vertical Measure</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Lab:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Reading:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Week 4</strong></td>
<td><strong>Lecture:</strong></td>
<td><strong>Quiz:</strong></td>
<td><strong>Lab:</strong></td>
</tr>
<tr>
<td></td>
<td>• Maps and Map delineation</td>
<td><strong>Lab:</strong></td>
<td>Height and volume estimates from air photos</td>
</tr>
<tr>
<td></td>
<td>• Stand volume estimates from air photos</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Double Sampling / fixed and variable plots</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Quiz:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Lab:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Reading:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Homework:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Exercise for inventory from air photos (ABET) (16 pts)</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Week 5 | Lecture: | • Timber typing  
• Mission planning  
• Photogrammetry recap  
Lab: | Timber typing (10 pts)  
Reading: | Paine/Kiser – chap 21, chap 22 456-459 |
|---|---|---|---|---|
| Week 6 | Lecture: | • Introduction into LiDAR remote sensing  
• Digital Elevation and Canopy surface models  
Exam: | Midterm Monday (100 pts)  
Lab: | Basic LiDAR data processing (10 pts)  
Reading: | Baltsavias et al, 1999. ISPRS 54, 83-94  
Lillesand and Kiefer 725-732  
Homework: | Assignment on LiDAR models (16 pts) |
| Week 7 | Lecture: | • Public holiday/no class  
• Height estimates from LiDAR  
• Volume and structure estimates from LiDAR  
Quiz: | Q3 Wednesday (6 pts)  
Lab: | Height and volume estimates from LiDAR (10 pts)  
Reading: | |
| Week 8 | Lecture: | • Volume and Height estimates from LiDAR  
• Maps and Mapping with LiDAR  
Quiz: | Q4 Wednesday (6 pts)  
Lab: | Field measurements (10 pts)  
Reading: | Lim et al LiDAR Remote sensing of forest structure (Progress in Physical Geography 27,1 (2003)  
Homework: | Field data exercise (16pts) |
**Week 9**

| Lecture: | GIS  
| Lab: | Passive Optical Remote Sensing  
| Reading: | Image classification  
| Homework: | Image classification (10 pts)  
| | Lillesand and Kiefer 397-438  
| | Lillesand and Kiefer 476-486  
| | Exercise with field data (16 pts)  

**Week 10**

| Lecture: | Errors and uncertainties in remote sensing  
| Quiz: | Review for final  
| Lab: | Quiz 5 Wednesday (6 pts)  
| Reading: | Open lab TBA  
| Homework: | Paine/Kiser – chap 22 438-444  
| | None  

**Week 11**

| **FINAL EXAM** (100 pts) |  

---

**Required Texts:**

2. Aerial Photography & Image Interpretation 2nd ed. (Paine & Kiser)

**Materials:**

*Provided*

Pocket Stereoscope

*Bookstore*

Aerial photos – COOP-06 13-40-26, 27, 28  
Aerial photo interpretation template  
Blue & red photo pencils or sharpies (ultra-fine)  
Photo eraser

*Other Required Tools*

Handheld scientific calculator  
Engineer’s scale  
Protractor