School of Earth & Environmental Sciences

EESC905: Advanced Remote Sensing of the Environment

Subject Outline
Autumn, 2016
On-Campus
Wollongong

Subject Information
Credit Points: 12
Pre-requisite(s): Nil
Co-requisite(s): Nil
Restrictions: Nil
Contact Hours: 1 x 1.5 hr lecture and 1 x 3 hr practical

Subject Contacts
Subject Coordinator/Lecturer

| Name: | A/Prof Laurie Chisholm |
| Location: | Building 41, Room G25 |
| Telephone: | 61 2 4221 3765 |
| Email: | laurie_chisholm@uow.edu.au |
| Consultation mode and times: | Email for appointment |

Student Support and Advice
For general enquiries please contact StudentHub 41:

Location: 41.138B
Telephone: 61 2 4221 3492
Email: smah-students@uow.edu.au
Student Consultation and Communication

University staff receive many emails each day. In order to enable them to respond to your emails appropriately and in a timely fashion, students are asked to observe basic requirements of professional communication:

Please ensure that you include your full name and student number and identify your practical class or tutorial group in your email so that staff know who they are communicating with and can follow-up personally where appropriate.

Consider what the communication is about
- Is your question addressed elsewhere (e.g. in the subject outline or, on the eLearning site)?
- Is it something that is better discussed in person or by telephone? This may be the case if your query requires a lengthy response or a dialogue in order to address. If so, see consultation times above and/or schedule an appointment.
- Are you addressing your request to the most appropriate person?

Specific email subject title to enable easy identification of issue
- Identify the subject code of the subject you are enquiring about (as staff may be involved in more than one subject) put this in the email subject heading. Add a brief, specific query reference after the subject code where appropriate.

Professional courtesy
- Address the staff member appropriately by name (and formal title if you do not yet know them).
- Use full words (avoid ‘text-speak’ abbreviations), correct grammar and correct spelling.
- Be respectful and courteous.
- Allow 3 – 4 working days for a response before following up. If the matter is legitimately urgent, you may wish to try telephoning the staff member (and leaving a voicemail message if necessary) or inquiring at the School Office.
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Section A: General Information

Subject Learning Outcomes

<table>
<thead>
<tr>
<th>On completion of this subject, students should be able to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Demonstrate broad and coherent knowledge of remote sensing systems.</td>
</tr>
<tr>
<td>2. Apply knowledge of electromagnetic radiation theory to how sensors acquire spectral data of landscape features, including atmospheric effects.</td>
</tr>
<tr>
<td>3. Apply knowledge and appropriate techniques to interpret and analysis imagery.</td>
</tr>
<tr>
<td>4. Apply knowledge to evaluate possible remote sensing solutions to real world problems and defend choice of solution against alternatives.</td>
</tr>
<tr>
<td>5. Locate, synthesise and evaluate data, information, results and literature pertaining to remote sensing using appropriate methods, tools and technologies.</td>
</tr>
<tr>
<td>6. Communicate perspectives about remote sensing applications and knowledge effectively to a range of audiences using appropriate technologies and communication skills.</td>
</tr>
</tbody>
</table>

Subject Description

Remote sensing is a unique sub-discipline within the spatial sciences used to measure, monitor and model the condition and dynamics of biophysical elements within the terrestrial, aquatic and atmospheric sciences. Spectral data useful for these purposes may be acquired from a wide variety of sensors mounted on satellites or unmanned aerial vehicles (UAVs/drones). Biophysical information extracted from spectral images may be used directly as images or thematic maps, in decision making, as estimates of biophysical variables, or integrated within other spatial information for further analysis. Skill acquisition in digital image interpretation and processing is emphasised using a range of data from a variety of sensing systems (multispectral, hyperspectral, lidar), with subject content delivered as paired theory and computer practicals using a range of learning activities. Students complete the subject with the ability to effectively use remote sensing to address real-world environmental problems.

eLearning Space

This subject has materials and activities available via eLearning. To access eLearning you must have a UOW user account name and password, and be enrolled in the subject. eLearning is accessed via SOLS (student online services). Log on to SOLS and then click on the eLearning link in the menu column. For information regarding the eLearning spaces please use the following link: http://uowblogs.com/moodlelab/files/2013/05/Moodle_StudentGuide-1petpo7.pdf

Lecture, Tutorial, Laboratory Times

All timetable information is subject to variation. Check latest timetabling information on the ‘Current Student’ webpage on UOW website or log into SOLS to view your personal timetable prior to attending classes.


Timetable information can be accessed from http://www.uow.edu.au/student/timetables/info/index.html

Key University Dates can be accessed from http://www.uow.edu.au/student/dates/index.html
Subject Delivery
The delivery of this subject includes traditional and non-traditional lectures (“flipped classroom”). The flipped classroom is a reversal of traditional teaching where students first gain exposure to new material outside of class, usually via reading or lecture videos, and then class time is used for activities which help students to assimilate that knowledge through a variety of strategies. In this approach, students take more responsibility for their own learning and study of core content and then apply knowledge and skills to activities in “lecture” time.

Given the “lecture” period becomes an opportunity to actively learn and apply content, attending this time is essential to gaining the most from the subject. While “lecture periods” are recorded by Echo360, this mechanism does not capture the activities that occur during class time.

Readings, References and Materials
The following text which covers essential theory and some practical concepts is highly recommended for students enrolled in this class. If it is not purchased, access to editions of this text, or an equivalent through the Library is essential.


The following text is highly recommended for the applied/practical content related to this subject and provides core background for all image processing functions used. Students are not expected to purchase this text, but should seek regular access through the Library.


Prescribed Readings (includes eReadings):
A variety of eReadings accessible from the Library will be made available for selected topics.

Materials:
It is essential that each student has a USB Flash drive for spatial data handling.

Recommended Readings:
The following references complement the prescribed readings and textbooks:


Recommended readings are not intended as an exhaustive list, students should use the Library catalogue and databases to locate additional resources.
**Recent Changes to this Subject**
Update to subject description and subject learning outcomes.

**Schedule of Learning***

<table>
<thead>
<tr>
<th>Week</th>
<th>Week Commencing</th>
<th>Lecture/Activity Period</th>
<th>Computer Practical</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>29/02/2016</td>
<td>Intro and Overview</td>
<td>none</td>
<td>Data Access Agreements</td>
</tr>
<tr>
<td>2</td>
<td>07/03/2016</td>
<td>EMR; Spectral Reflectance</td>
<td>Intro to ENVI and Image Display</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>14/03/2016</td>
<td>Sensors</td>
<td>Image Reflectance Spectra</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>21/03/2016</td>
<td>Digital Image Processing (DIP)– Pre-processing</td>
<td>Image Pre-Processing: radiometric, atmospheric, geometric</td>
<td>Quiz 1</td>
</tr>
<tr>
<td>5</td>
<td>28/03/2016</td>
<td>DIP: Enhancements</td>
<td>Image statistics; spatial enhancement</td>
<td>Research Assignment: Sensors and Applications</td>
</tr>
<tr>
<td>6</td>
<td>04/04/2016</td>
<td>DIP: Enhancements</td>
<td>Spectral enhancements</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>11/04/2016</td>
<td>Classification 1</td>
<td>Supervised Classification</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>18/04/2016</td>
<td>Classification 2</td>
<td>Accuracy Assessment</td>
<td>Practical Assignment: Spectral Feature Separability</td>
</tr>
</tbody>
</table>

**Mid-Session Recess 25th April-29th April**

<table>
<thead>
<tr>
<th>Week</th>
<th>Week Commencing</th>
<th>Lecture/Activity Period</th>
<th>Computer Practical</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>02/05/2016</td>
<td>Multi-temporal methods</td>
<td>Change Detection</td>
<td>Quiz 2, Essay</td>
</tr>
<tr>
<td>10</td>
<td>09/05/2016</td>
<td>Advanced Techniques</td>
<td>RS/GIS Integration</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>16/05/2016</td>
<td>Advanced Techniques</td>
<td>Project</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>23/05/2016</td>
<td>Advanced Techniques</td>
<td>Project</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>30/05/2016</td>
<td>Future of RS</td>
<td>none</td>
<td></td>
</tr>
</tbody>
</table>

**Study Recess 6th June-10th June**

**UOW Exam Period 11th June-23 June**

*The above timetable should be used as a guide only, as it is subject to change. Students will be advised of any changes as they become known.*
### Section B: Assessment

#### Assessment Summary

<table>
<thead>
<tr>
<th>Assessment Item</th>
<th>Form of Assessment</th>
<th>Due Date</th>
<th>Return/Feedback Due Dates</th>
<th>Weighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment 1</td>
<td>Quiz 1</td>
<td>21-25 March</td>
<td>25 March</td>
<td>15%</td>
</tr>
<tr>
<td>Assessment 2</td>
<td>Research Assignment: Sensors and Applications</td>
<td>1 April</td>
<td>18 April</td>
<td>25%</td>
</tr>
<tr>
<td>Assessment 3</td>
<td>Practical Assignment: Spectral Feature Separability</td>
<td>22 April</td>
<td>9 May</td>
<td>10%</td>
</tr>
<tr>
<td>Assessment 4</td>
<td>Quiz 2</td>
<td>2 – 6 May</td>
<td>6 May</td>
<td>15%</td>
</tr>
<tr>
<td>Assessment 5</td>
<td>Essay</td>
<td>20 May</td>
<td>10 June</td>
<td>10%</td>
</tr>
<tr>
<td>Assessment 6</td>
<td>Practical Project Report</td>
<td>27 May</td>
<td>17 June</td>
<td>25%</td>
</tr>
</tbody>
</table>

**Total Marks 100%**

#### Details of Assessment Tasks

Assessment tasks will be marked using explicit criteria that are provided below to students prior to submission.

**Assessment 1**
- **Quiz 1**
  - **Due date**: 21-25 March (Week 4)
  - **Weighting**: 15%
  - **Submission**: Complete the quiz online in Moodle.
  - **Type of Collaboration**: Individual Assessment
  - **Length**: 1 hour 25 Questions
  - **Details**: Compulsory quiz, one attempt, content covers weeks 1 – 3.
  - **Subject Learning Outcomes**: 2, 3, 4
  - **Marking Criteria**: The marking criteria will be made available on your eLearning site by week 1 of session.

**Assessment 2**
- **Research Assignment: Sensors and Applications**
  - **Due date**: 1 April
  - **Weighting**: #25%
  - **Submission**: Submit an electronic copy of your assessment via upload to elearning
  - **Type of Collaboration**: Group and Individual Research Assessment
  - **Length**: Completed template and 200 word summary
  - **Details**: Determine four resolution elements related to applied mapping problems in order to match the most appropriate sensor to the application.
  - **Style and format**: Powerpoint template, written submission
  - **Subject Learning Outcomes**: 1, 2, 3, 4, 5, 6
  - **Marking Criteria**: The marking criteria will be made available on your eLearning site by week 1 of session.
**Assessment 3**

**Practical Assignment: Spectral Feature Separability**

**Due date**
22 April

**Weighting**
10%

**Submission**
Submit an electronic copy of your assessment via upload to elearning

**Type of Collaboration**
Group and Individual Assessment

**Length**
Time Allocation/ Word Limit/Number of Questions

**Details**
evaluation of the spectral separability of the land cover class samples.

**Style and format**
Spectral plots accompanied by written summary (approximately one page).

**Subject Learning Outcomes**
2,3,4,5,6

**Marking Criteria**
The marking criteria will be made available on your eLearning site by week 1 of session.

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**Assessment 4**

**Quiz 2**

**Due date**
2 – 6 May (Week 9)

**Weighting**
15%

**Submission**
Complete the quiz online in Moodle.

**Type of Collaboration**
Individual Assessment

**Length**
1 hour, 25 Questions

**Details**
Compulsory quiz, one attempt, content covers weeks 4 - 8

**Style and format**
Multiple choice

**Subject Learning Outcomes**
2, 3, 4

**Marking Criteria**
The marking criteria will be made available on your eLearning site by week 1 of session.

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**Assessment 5**

**Essay**

**Due date**
20 May

**Weighting**
10%

**Submission**
Submit to Turnitin dropbox on Moodle.

**Type of Collaboration**
Individual Assessment

**Length**
2000 words plus references

**Details**
Research on selected remote sensing application topic.

**Style and format**
Essay

**Subject Learning Outcomes**
1,2, 4,5,6

**Marking Criteria**
The marking criteria will be made available on your eLearning site by week 1 of session.

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**Assessment 6**

**Practical Project Report**

**Due date**
27 May

**Weighting**
25%

**Submission**
Submit an electronic copy of your assessment via upload to elearning

**Type of Collaboration**
Individual Assessment

**Length**
Time Allocation/ Word Limit/Number of Questions

**Details**
Scenario-based project of land cover analysis

**Style and format**
Series of guided practicals, culminating in a practical report

**Subject Learning Outcomes**
2,3,4,5,6

**Marking Criteria**
The marking criteria will be made available on your eLearning site by week 1 of session.
Minimum Requirements for a Pass in this Subject

To receive a clear pass in this subject a total mark of 50% or more must be achieved. In addition, failure to meet any of the minimum performance requirements is grounds for awarding a Technical Fail (TF) in the subject, even where total marks accumulated are greater than 50%.

The minimum performance requirements for this subject are:

- attempt all assessment tasks

Minimum Student Attendance and Participation

It is expected that students will allocate 2 hrs per credit point per week to this subject, including any required class attendance, completion of prescribed readings and assessment tasks.

Student attendance at practicals is compulsory. The Subject Coordinator must be advised of any absence to a practical, but an academic consideration is not required unless extreme circumstances occur. Any missed practicals must be completed during the student’s own time.

Scaling

Scaling may occur in this subject at the end of session by the Unit Assessment Committee and/or Faculty Assessment Committee (FAC). Marks will only be scaled to ensure fairness/parity of marking across groups of students. Scaling will not affect any individual student’s rank order within their cohort. For more information refer to Assessment Guidelines – Scaling: http://www.uow.edu.au/about/policy/UOW058609.html

Late Submission

Late submission of an assessment task without an approved extension of the deadline is not acceptable. If you are unable to submit an assessment due to extenuating circumstances (e.g. medical grounds or compassionate grounds), you can make an application of academic consideration. Not all circumstances qualify for academic consideration. For further details about applying for academic consideration visit the Student Central webpage: http://www.uow.edu.au/student/central/academicconsideration/index.html

Late Submission Penalty

Late submission of an assessment task without an approved extension of the deadline is not acceptable. Marks will be deducted for late submission at the rate of 10% of the total possible marks for that particular assessment task per day. This means that if a piece of work is marked out of 100, then the late penalty will be 10 marks per day (10% of 100 possible marks per day). The formula for calculating the late penalty is the total possible marks x 0.10 x number of days late. For the purposes of this policy a weekend (Saturday and Sunday) will be regarded as two days.

For example:

- Student A submits an assessment which is marked out of 100. The assessment is submitted 4 days late. This means that a late penalty of 40 marks will apply (100 x 0.10 x 4). The assessment is marked as per normal out of 100 and is given a mark of 85/100, and then the late penalty is applied. The result is that the student receives a final mark of 45/100 for the assessment (85 (original mark) – 40 marks (late penalty) = 45/100 (final mark)).

- Student B submits a report which is marked out of 20. The report is submitted three days late. This means that a late penalty of 6 marks will apply ((20 x 0.10 x 3). The report is marked as per normal out of 20 and is given a mark of 15/20, and then the late penalty is applied. The result is that the student receives a final mark of 9/20 for the report (15 (original mark) – 6 marks (late penalty) = 9/20 (final mark)).

No marks will be awarded for work submitted after the assessment has been returned to the students (except where a particular assessment task is undertaken by students at different times throughout the session, but where the assessment is based on experiments or case studies specific to a student). Notwithstanding this, students must complete all assessment tasks to a satisfactory standard and submit them, regardless of lateness or loss of marks, where submission is a condition of satisfactorily completing the subject.
System of Referencing Used for Written Work

The Author-Date (Harvard) referencing system should, unless otherwise specified for a particular assessment (check Details of Assessment Tasks), be utilised. A summary of the Harvard system can be accessed on the Library website at: http://public01.library.uow.edu.au/refcite/style-guides/html/

Use of Internet Sources

Students are able to use the Internet to access the most current information on relevant topics and information. Internet sources should only be used after careful critical analysis of the currency of the information, the role and standing of the sponsoring institution, reputation and credentials of the author, the clarity of the information and the extent to which the information can be supported or ratified by other authoritative sources.

Plagiarism

The full policy on Academic Integrity and Plagiarism is found in the Policy Directory on the UOW website.

"The University's Academic Integrity and Plagiarism Policy, Faculty Handbooks and subject guides clearly set out the University's expectation that students submit only their own original work for assessment and avoid plagiarising the work of others or cheating. Re-using any of your own work (either in part or in full) which you have submitted previously for assessment is not permitted without appropriate acknowledgement. Plagiarism can be detected and has led to students being expelled from the University.

The use by students of any website that provides access to essays or other assessment items (sometimes marketed as ‘resources’), is extremely unwise. Students who provide an assessment item (or provide access to an assessment item) to others, either directly or indirectly (for example by uploading an assessment item to a website) are considered by the university to be intentionally or recklessly helping other students to cheat. This is considered academic misconduct and students place themselves at risk of being expelled from the University."

Submission of Assessments

Refer to the submission requirements under the details of the individual assessments. Students should ensure that they receive a receipt acknowledging submission. Students will be required to produce this in the event that an assessment task is considered to be lost. Students are also expected to keep a copy of all their submitted assessments in the event that re-submission is required.

Assessment Return

Students will be notified when they can collect or view their marked assessment. In accordance with University Policy marked assessments will usually only be held for 21 days after the declaration of marks for that assessment.
Section C: General Advice

Students should refer to the Faculty of Science, Medicine and Health website for information on policies, learning and support services and other general advice.

University Policies

Students should be familiar with the following University policies:

a. Code of Practice – Teaching and Assessment

b. Student Charter

c. Academic Integrity and Plagiarism Policy

d. Student Academic Consideration Policy

e. Course Progress Policy

f. Graduate Qualities Policy

g. Academic Complaints Policy (Coursework and Honours Students)

h. Policy and Guidelines on Non-Discriminatory Language Practice and Presentation

i. Workplace Health and Safety, where relevant

j. Intellectual Property Policy

Student Support Services and Facilities

Students can access information on student support services and facilities at the following link. This includes information on “Academic Support”, “Starting at University,” “Help at University” as well as information and support on “Career’s and Jobs”. http://www.uow.edu.au/student/services/index.html

Student Etiquette

Guidelines on the use of email to contact teaching staff, mobile phone use in class and information on the university guide to eLearning ‘Netiquette’ can be found at http://www.uow.edu.au/student/elearning/netiquette/index.html

Version Control Table

<table>
<thead>
<tr>
<th>Version Control</th>
<th>Release Date</th>
<th>Author/Reviewer</th>
<th>Approved By</th>
<th>Amendment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20160115</td>
<td>A/Prof Laurie Chisolm – Subject Coordinator</td>
<td>Sonia Losinno – ADE Nominee</td>
<td>FINAL EESC905 Autumn 2016 Subject Outline</td>
</tr>
</tbody>
</table>