Course Outline – Winter 2014

**Course Objectives**
An introduction to theory and techniques used for processing and analysing digital images for autonomous machine interpretation.

**Prerequisites**
ECE 3780 Signal Processing 1

**Course Content**
The following topics will be covered:
- Digital image basics: pixels, colour spaces, logical operations, thresholding, gamma transform.
- Visualising pixel intensity distributions, contrast stretching, histogram matching.
- Linear filtering: convolution, noise, mean, median, rank order and normal distribution filtering.
- Mathematical morphology and image segmentation.
- Edge, line, corner detection: Laplacian, Gaussian, zero-cross, anisotropic filtering.
- 2D and 3D image shape and texture descriptors.
- Geometrical and topological properties of digital images.
- Image pattern discovery and image classification.

**Total Accreditation Units: 46.5**
Mathematics: 10 / 15%
Natural Science: 0
Complementary Studies: 0
Engineering Science: 23.25 / 50%
Engineering Design: 13.25 / 35%

**Web Page**
Course web page (to be announced during course).

**Textbook**

**Evaluation Details**
The final course grade will be determined from a student’s performance in laboratories (value 10%), and on 2 mid-terms (value 40%) and on final examinations (value 50%). Students must complete all the laboratories in order to be eligible to receive a passing grade.

**Mid-Term(s)**
1. Tuesday February 11, 2014 (in class)
2. Tuesday March 18, 2014 (in class)

**Instructor**
Prof. James Peters
Room: E1-530 EITC
Email: james.peters3@umanitoba.ca
Office Hours
By appointment.

Teaching Assistants
Urmila Samanta: umsamant@cc.umanitoba.ca
Dan Lockery: dlockery@ee.umanitoba.ca

Voluntary Withdrawal Date
Wednesday, March 19th, 2014

Requirements/Regulations
- Attendance at lectures and laboratories is essential for successful completion of this course. Students must satisfy each evaluation component in the course to receive a final grade.
- It is the responsibility of each student to contact the instructor in a timely manner if he or she is uncertain about his or her standing in the course and about his or her potential for receiving a failing grade. Students should also familiarize themselves with Sections 4 and 6 of the Regulations dealing with incomplete term work, deferred examinations, attendance and withdrawal.
- No programmable devices or systems (such as calculators, PDAs, iPods, iPads, cell phones, wireless communication or data storage devices) are allowed in examinations unless approved by the course instructor.

Academic Integrity
Students are expected to conduct themselves in accordance with the highest ethical standards of the Profession of Engineering and evince academic integrity in all their pursuits and activities at the university. As such, in accordance with the General Academic Regulations and Requirements of the University of Manitoba, Section 7.1, students are reminded that plagiarism or any other form of cheating in examinations, assignments, laboratory reports or term tests is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university). A student found guilty of contributing to cheating in examinations or term assignments is also subject to serious academic penalty.
Learning Outcomes

1. Learning digital image fundamentals: visual perception, digital image pixels, image features.
2. Applying knowledge of Matlab in digital image representation, colour spaces, histogram, quantisation of image features.
3. Learning and applying knowledge in analysing image filtering, DFT, enhancement, and registration methods.
4. Learning and applying knowledge in analysing image decomposition and reconstruction with wavelets, image morphology, WFT.
5. Learning and applying knowledge in analysing image segmentation, representation, description, and recognition techniques.

Expected Competency Level **

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<thead>
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<th>Learning Outcome</th>
<th>Attribute*</th>
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<tr>
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*Attributes:
A1 A knowledge base for engineering
A2 Problem analysis
A3 Investigation
A4 Design
A5 Use of engineering tools
A6 Individual and team work
A7 Communication skills
A8 Professionalism
A9 Impact of engineering on society/environment
A10 Ethics and equity
A11 Economics and project management
A12 Life-long learning

**Competency Levels:
1 - Knowledge (Able to recall information)
2 - Comprehension (Able to rephrase information)
3 - Application (Able to apply knowledge in a new situation)
4 - Analysis (Able to break problem into its components and establish relationships)
5 - Synthesis (Able to combine separate elements into whole)
6 - Evaluation (Able to judge of the worth of something)

Student Contact Time (Hrs)

Lectures: 3 hrs lecture/week × 13 weeks/term = 39 hrs
Laboratories: 3 hrs laboratory × 5 weeks = 15 hrs

Evaluation

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<tr>
<th>Component</th>
<th>Value (%)</th>
<th>Methods of Feedback *</th>
<th>Learning Outcomes Evaluated</th>
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<td>F, S</td>
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<td>S</td>
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* Methods of Feedback: F - formative (written comments and/or oral discussion), S - summative (number grades)