Unit Outline

Unit summary

Unit Title: Applied Control Engineering
Unit Code: JEE344
Semester: 2 Year 2009
Pre-Requisites: JEE326 Instrumentation and Process Control
Prior knowledge &/or skills: JEE114 Electrical Fundamentals
JEE223 Thermal Engineering
Courses: Bachelor of Engineering (Marine and Offshore Systems)
Credit Points: 12.5
National Centre: Maritime Engineering and Hydrodynamics
Campus: Launceston

Teaching staff

<table>
<thead>
<tr>
<th>Title</th>
<th>Name</th>
<th>Office</th>
<th>Email</th>
<th>Phone</th>
<th>Consultation Days &amp; Times</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-ordinator</td>
<td>Hung Nguyen</td>
<td>G86</td>
<td><a href="mailto:H.Nguyen@amc.edu.au">H.Nguyen@amc.edu.au</a></td>
<td>6335 4350</td>
<td>Appointment</td>
</tr>
<tr>
<td>Lecturer 1</td>
<td>Hung Nguyen</td>
<td>G86</td>
<td><a href="mailto:H.Nguyen@amc.edu.au">H.Nguyen@amc.edu.au</a></td>
<td>6335 4350</td>
<td>Appointment</td>
</tr>
<tr>
<td>Lecturer 2</td>
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<td></td>
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<tr>
<td>Lecturer 3</td>
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</tbody>
</table>
Unit description
The unit is to provide students with knowledge of control engineering and help students to develop practical skills of design and analysis of control systems commonly used in maritime industries.

Learning outcomes
On successful completion of the unit, students should be able to:

1. Technical competence in BE(MOS) subject theory demonstrated by an ability to:
   1. Explain state variables of a dynamic system and state space representation
   2. Apply numerical methods in computer simulation of dynamic systems and design of control systems using LabVIEW and MATLAB/Simulink as required.
   3. Design and analyse PID control systems with hardware and software
   4. Explain modern control methods including pole placement control, optimal and robust control and intelligent control applications in marine and offshore systems
   5. Use LabVIEW MATLAB/Simulink (as required) as a tool for design and analysis of control systems
   6. Use computer, data acquisition devices for design and operation of control systems
   7. Use I/O interfaces, PLCs and CAN bus communication applied in marine and offshore systems.

2. An ability to integrate content studied with other subjects conceptually linking them to their degree discipline
   1. Explain how the unit relates to other units in the marine and offshore system engineering
   2. Complete programming control systems with I/O interface and CAN bus communication networks
   3. Explain how marine control systems play an important role in the marine and offshore industries and engineering

3. Project planning supervision and management skills to control work and meet deadlines under conflicting requirements and pressure of time and resource constraints.
   1. Complete a model scale control system design project

   1. Describe regulations, plans layout and equipment comprising the Safety Case for marine control systems
   2. Bus redundancy design

5. Concise and precise technical communication skills.
   1. Produce instrumentation and control schematics to standard format.
   2. Produce logic ladders.
   3. Produce concise practical reports

6. Objective, structured, goal oriented problem solving skills
   1. Solve problems within the control system design project
   2. Complete logic ladder exercises
   3. Complete programming exercises
Graduate attributes

All graduates from the NCMEH will be able to:

A. Demonstrate technical knowledge;
B. Design for the maritime environment;
C. Solve maritime engineering problems;
D. Manage, create, use and disseminate information;
E. Communicate effectively;
F. Work in teams;
G. Manage self and others;
H. Negotiate the business environment;
I. Behave as a professional; and
J. Consider wider context of engineering knowledge and work.

Contents

1. Theory
   - Control systems applied within ships, boats and offshore platforms
   - Marine actuators and control elements, including their selection
   - Systems engineering approach to marine control design
   - An introduction to modern control engineering including pole placement, optimal control and intelligent control systems and distributed marine control systems
   - State space design of modern marine control systems
   - Theoretical and experimental modelling approaches: modelling mechanical, electric and electronic, hydraulic and pneumatic systems commonly used in marine control engineering
   - Data bus communication, marine (industrial) bus hardware, marine bus topography, bus redundancy and safety bus
   - Digital control systems: digital (computer-based) control systems
   - Design, simulation and analysis of computer-based PID control systems for marine and offshore systems
   - An introduction to PLCs.

2. Practical and Lab
   - **Lab 1**: I/O (NI 6036E) interfacing configuration and programming
   - **Lab 2**: Configuring and programming PLCs
   - **Lab 3**: Networked control systems using data communication buses
   - **Computer lab**: Students practice programming with MATLAB/Simulink and/or LabVIEW to design, simulate and analyse marine control systems in computer lab.

Learning resources required

**Requisite texts**

Nil
**Recommended reading**


**E- (electronic) resources**

**MyLO: Yes**

- Lecturer notes and handouts
- Tutorials, laboratories, and assessments
- Past examination papers
- Additional information


**Equipment & materials**

**Materials to be provided by the student**

Non-Programmable Scientific Calculator
Experimental work: lab coats or overalls, safety shoes

**Materials to be provided by AMC:**

Course notes purchased from Uni Print.
Extra costs:
Photocopying costs.

Computer hardware & software
MATLAB/Simulink, LabVIEW and Word processing and spreadsheet software.

Occupational health and safety (OH&S)
The University is committed to providing a safe and secure teaching and learning environment. In addition to specific requirements of AMC and this unit you should refer to the University’s policy at: http://www.admin.utas.edu.au/hr/ohs/pol_proc/ohs.pdf

All laboratory work requires students to follow OH&S requirements stipulated for the areas utilised. Students must wear lab coats or overalls and safety shoes for all laboratory sessions.

Other requirements
TBA

Details of teaching arrangements

Learning strategies
Lectures, Tutorials, Individual/Group laboratories, Assignments

Class times

<table>
<thead>
<tr>
<th>Class</th>
<th>Day</th>
<th>Time</th>
<th>Location</th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>Wed</td>
<td>09:00-11:00</td>
<td>G83</td>
<td>All</td>
</tr>
<tr>
<td>Tutorial</td>
<td>Friday</td>
<td>11:00-1:00</td>
<td>G38 (Adv Com Lab)</td>
<td>All</td>
</tr>
<tr>
<td>Labs</td>
<td>Thursday</td>
<td>03:00-05:00 (starts wk 5)</td>
<td>G51 (Control Lab)</td>
<td>All</td>
</tr>
</tbody>
</table>

Check tutorial groups and lab timetable/groups to identify your designated time and day.

Syllabus and Learning Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic</th>
<th>Readings / Problems</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15/7 (Wed) 2 hours</td>
<td>Unit information Introduction to control systems applied in maritime industries and system engineering approach</td>
<td>Handout</td>
<td></td>
</tr>
<tr>
<td></td>
<td>17/7 (Fri) 2 hours</td>
<td>LabVIEW Basics: Level measurement</td>
<td>Tutorial 1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>22/7 (Wed) 2 hours</td>
<td>Review of dynamic systems – control systems</td>
<td>Handout</td>
<td>Assignment tasks (out)</td>
</tr>
<tr>
<td></td>
<td>24/7 (Fri) 2 hours</td>
<td>LabVIEW Basics: Complete level measurement</td>
<td>Tutorial 2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>29/7 (Wed) 2 hours</td>
<td>Modelling, simulation and design of computer-based control systems - Tank level system</td>
<td>Handout</td>
<td></td>
</tr>
<tr>
<td></td>
<td>31/7 (Fri)</td>
<td>LabVIEW Basics: Saving data into files</td>
<td>Tutorial 3</td>
<td></td>
</tr>
<tr>
<td>Unit</td>
<td>Date</td>
<td>Duration</td>
<td>Session</td>
<td>Material</td>
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<tr>
<td>4</td>
<td>5/8 (Wed)</td>
<td>2 hours</td>
<td>Modelling, simulation and design of PC-based control systems (continued)</td>
<td>Handout</td>
</tr>
<tr>
<td></td>
<td>7/8 (Fri)</td>
<td>2 hours</td>
<td>LabVIEW Simulation: Tank level system</td>
<td>Tutorial 4</td>
</tr>
<tr>
<td>5</td>
<td>12/8 (Wed)</td>
<td>2 hours</td>
<td>Introduction to digital control systems</td>
<td>Handout</td>
</tr>
<tr>
<td></td>
<td>14/8 (Fri)</td>
<td>2 hours</td>
<td>LabVIEW Simulation: Tank level control system (On/Off Control)</td>
<td>Tutorial 5</td>
</tr>
<tr>
<td></td>
<td>TBA</td>
<td></td>
<td>Lab 1 Exp 1 (LabVIEW data acquisition)</td>
<td>Level meas.</td>
</tr>
<tr>
<td>6</td>
<td>19/8 (Wed)</td>
<td>2 hours</td>
<td>Digital control systems</td>
<td>Handout</td>
</tr>
<tr>
<td></td>
<td>21/8 (Fri)</td>
<td>2 hours</td>
<td>LabVIEW Simulation: Tank level control system (PID)</td>
<td>Tutorial 6</td>
</tr>
<tr>
<td></td>
<td>TBA</td>
<td></td>
<td>Lab 1 Exp 2 (LabVIEW data acquisition)</td>
<td>Flow/temp. meas.</td>
</tr>
<tr>
<td>7</td>
<td>26/8 (Wed)</td>
<td>2 hours</td>
<td>Introduction to modern control systems and actuators and final control elements</td>
<td>Handout</td>
</tr>
<tr>
<td></td>
<td>28/8 (Fri)</td>
<td>2 hours</td>
<td>LabVIEW Simulation: Tank level control system (PID control)</td>
<td>Tutorial 7</td>
</tr>
<tr>
<td></td>
<td>TBA</td>
<td></td>
<td>Lab 1 Exp 3 (LabVIEW On/Off control)</td>
<td>On/Off level con</td>
</tr>
</tbody>
</table>

**Mid-term Break (31/8 to 4/9)**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Date</th>
<th>Duration</th>
<th>Session</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>9/9 (Wed)</td>
<td>2 hours</td>
<td>Introduction to I/O interfacing and data communication buses and networked control systems</td>
<td>Handout</td>
</tr>
<tr>
<td></td>
<td>11/9 (Fri)</td>
<td>2 hours</td>
<td>LabVIEW Simulation: second-order systems (mechanical system)</td>
<td>Tutorial 8</td>
</tr>
<tr>
<td></td>
<td>TBA</td>
<td></td>
<td>Lab 1 Exp 4 (LabVIEW PID control)</td>
<td>PID level con</td>
</tr>
<tr>
<td>9</td>
<td>16/9 (Wed)</td>
<td>2 hours</td>
<td>Introduction to PLCs</td>
<td>Handout</td>
</tr>
<tr>
<td></td>
<td>18/9 (Fri)</td>
<td>2 hours</td>
<td>LabVIEW Simulation: second-order system (electrical system)</td>
<td>Tutorial 9</td>
</tr>
<tr>
<td></td>
<td>TBA</td>
<td></td>
<td>Lab 1 Exp 5 (system identification)</td>
<td>Submission of Assignment Part A</td>
</tr>
<tr>
<td>10</td>
<td>23/9 (Wed)</td>
<td>2 hours</td>
<td>Ladder programming for PLCs</td>
<td>Handout</td>
</tr>
<tr>
<td></td>
<td>25/9 (Fri)</td>
<td>2 hours</td>
<td>LabVIEW: advanced topics</td>
<td>Tutorial 10</td>
</tr>
<tr>
<td></td>
<td>TBA</td>
<td></td>
<td>Lab 2 Exp 1 (PLCs)</td>
<td>Hydraulic</td>
</tr>
<tr>
<td>11</td>
<td>30/9 (Wed)</td>
<td>2 hours</td>
<td>Ladder programming for PLCs</td>
<td>Handout</td>
</tr>
<tr>
<td></td>
<td>2/10 (Fri)</td>
<td>2 hours</td>
<td>LabVIEW: advanced topics</td>
<td>Tutorial 11</td>
</tr>
<tr>
<td></td>
<td>TBA</td>
<td></td>
<td>Lab 2 Exp 2 (PLCs)</td>
<td>Pneumatic</td>
</tr>
<tr>
<td>12</td>
<td>7/10 (Wed)</td>
<td>2 hours</td>
<td>Introduction to CAN bus and Modbus</td>
<td>Handout</td>
</tr>
<tr>
<td></td>
<td>9/10 (Fri)</td>
<td>2 hours</td>
<td>Self-study (Computer lab and/or in Control Lab)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TBA</td>
<td></td>
<td>Lab 3 (Demo: CANbus, Modbus)</td>
<td>Networked con</td>
</tr>
<tr>
<td>13</td>
<td>14/10 (Wed)</td>
<td>2 hours</td>
<td>Revision</td>
<td>Handout</td>
</tr>
<tr>
<td></td>
<td>16/10 (Fri)</td>
<td>2 hours</td>
<td>Self-study in Control Lab</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TBA</td>
<td></td>
<td>Self-study</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>TBA</td>
<td></td>
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</tr>
</tbody>
</table>

**Specific attendance/performance requirements**

Attendance at all assigned class times is expected. You are responsible for all information (both academic and administrative) presented during class times. Should you miss a class for
whatever reason it is your responsibility to obtain information and content that was missed. Attendance at all laboratory and practical sessions is compulsory.

Assessment

Assessment schedule

<table>
<thead>
<tr>
<th>Assessment Task</th>
<th>Due Date / Details</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class Test</td>
<td>Week 8 (8/9/09)</td>
<td>10</td>
</tr>
<tr>
<td>Design Assignment</td>
<td>Part A: 18/9/09</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Part B: 19/10/09</td>
<td>30</td>
</tr>
<tr>
<td>Tutes</td>
<td>Continuous</td>
<td>10</td>
</tr>
<tr>
<td>Practical/Lab 1</td>
<td>TBA</td>
<td>10</td>
</tr>
<tr>
<td>Practical/Lab 2</td>
<td>TBA</td>
<td>10</td>
</tr>
<tr>
<td>Practical/Lab 3</td>
<td>TBA</td>
<td>10</td>
</tr>
<tr>
<td>Exam</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Assessment details

Types and Weighting of Assessment:

To pass the unit student must achieve at least 50% of the total coursework and 50% of the design assignment. Detail of each assessment is given below.

Class Test (10%): An hour class test will cover theoretical design of control systems applied in maritime industries. Students are responsible for material from lecture, tutorials and text.

Due Date for Class Test: Week 8 (Wed 8/9/2009)

Practical/Labs (30%): The practicals in control engineering lab require preparation, participation, and individual or group reporting. Reports are scheduled in two weeks after the commencement of experiments. The format for the reports will be discussed prior to the submission of the lab report. Practical reports, teamwork and written and graphical communication skills will be emphasised and assessed.

Due Date for Lab Report (if required) is two weeks after commencing experiments

Tutorials (10%): Participation in tutorials is assessable so attendance is mandatory. Problems lay out and written communication skills are very important in engineering problem solving. The tutorials involve in solving control problems, programming and support class tests and design assignments. Attendance, solving problems and programming in tutorials will be assessed continuously. Complete programs are submitted at the end of semester.

Design Assignment (50%, Part A 20% and Part B 30%): Design assignment is a project-based design assessment and requires preparation, practice of programming and individual reporting. Design assignment will cover all aspects of the unit. Students are expected to start the design assignment in the beginning of semester 2, submit into two parts (Part A and Part B).

The due dates for Design Assignment: Part A (18.9.09) and Part B (19.10.09)
Submission of assignments and reports

All assignments, reports, etc. must be completed using the template provided on the web, (http://www.amc.edu.au/maritime.engineering/beng.templates/), unless otherwise specified by the lecturer. The accompanying cover sheet must be completed. **All descriptive components of the assignments and reports should be typed.** Group reports must be signed by all participants.

Assignments and reports must be placed in the lecturer’s assignment box by the due dates (ground floor in the Swanson Building).

Electronic submissions are not acceptable (unless otherwise instructed by lecturer). The assessed work will be returned during lecture or as agreed between the students and the lecturer.

How your final result is determined

The grade that you receive for this unit will be determined by a committee of examiners. The raw marks that you receive from each piece of assessable material will be combined in order to determine a letter grade for the unit (see Assessment Schedule for percent weighting). The raw marks may undergo a scaling process.

Penalties

Except in cases where medical documentation can prove a student’s illness during the appropriate period or under certain exceptional circumstances, assignments and reports will be deducted 10% of the maximum possible mark for each working day.

Problems with your assessment

If you have questions or problems with your assessment, you should discuss this with the following people:

(1) The person who marked the assessment.

(2) Unit Coordinator.

(3) Head, Maritime Engineering.

(4) Director, National Centre for Maritime Engineering and Hydrodynamics.

If this does not resolve the issue, you may a file formal appeal. The procedure is given at: [http://www.studentcentre.utas.edu.au/examinations_and_results/results/result_review_results.htm](http://www.studentcentre.utas.edu.au/examinations_and_results/results/result_review_results.htm)

Course rules

More information with regard to content, assessments, grading, etc. is found in the Course Rules Document at:

Academic referencing

In your written work you will need to support your ideas by referring to scholarly literature, works of art and/or inventions. It is important that you understand how to correctly refer to the work of others and maintain academic integrity.

Failure to appropriately acknowledge the ideas of others constitutes academic dishonesty (plagiarism), a matter considered by the University of Tasmania as a serious offence.

For information on presentation of assignments, including referencing styles:


Please read the following statement on plagiarism. Should you require clarification please see your unit coordinator or lecturer.

Plagiarism

Plagiarism is a form of cheating. It is taking and using someone else's thoughts, writings or inventions and representing them as your own; for example, using an author's words without putting them in quotation marks and citing the source, using an author's ideas without proper acknowledgment and citation, copying another student's work.

If you have any doubts about how to refer to the work of others in your assignments, please consult your lecturer or tutor for relevant referencing guidelines, and the academic integrity resources on the web at: http://www.academicintegrity.utas.edu.au/

The intentional copying of someone else's work as one's own is a serious offence punishable by penalties that may range from a fine or deduction/cancellation of marks and, in the most serious of cases, to exclusion from a unit, a course or the University. Details of penalties that can be imposed are available in the Ordinance of Student Discipline – Part 3 Academic Misconduct, see: http://www.utas.edu.au/universitycouncil/legislation/

The University and any persons authorised by the University may submit your assessable works to a plagiarism checking service, to obtain a report on possible instances of plagiarism. Assessable works may also be included in a reference database. It is a condition of this arrangement that the original author’s permission is required before a work within the database can be viewed.

For further information on this statement and general referencing guidelines, see: http://www.utas.edu.au/plagiarism/ or follow the link under ‘Policy, Procedures and Feedback’ on the Current Students homepage.
Further information and assistance

If you are experiencing difficulties with your studies or assignments, have personal or life planning issues, disability or illness which may affect your course of study, you are advised to raise these with your lecturer in the first instance.

There is a range of University-wide support services available to you including Teaching & Learning, Student Services, and International Services. Please refer to the Current Students homepage at: http://www.utas.edu.au/students/

Should you require assistance in accessing the Library visit their website for more information at: http://www.utas.edu.au/library/