AUSTRALIAN MARITIME COLLEGE

Unit Outline

Unit summary

Unit Title: Instrumentation and Process Control

Unit Code: JEE326

Semester: 2 **Year** 2009

Pre-Requisites: JEE104 Engineering Mathematics II

JEE114 Electrical Fundamentals

Prior knowledge &/or skills:

Courses: Bachelor of Engineering (Marine and Offshore Systems)

Credit Points: 12.5

National Centre: Maritime Engineering and Hydrodynamics

Campus: Launceston

Teaching staff

Title	Name	Office	Email	Phone	Consultation Days & Times
Co-ordinator	Hung Nguyen	G86	H.Nguyen@amc.edu.au	6335 4350	Appointment
Lecturer 1	Hung Nguyen	G86	H.Nguyen@amc.edu.au	6335 4350	Appointment
Lecturer 2					
Lecturer 3					

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Unit description

- To introduce students to fundamentals of instrumentation, methods of common measurements in marine and process industries, and Australian standard graphical symbols used in instrumentation and process control engineering.
- To provide students with basic control theory, knowledge and understanding of control systems and their components and performance.
- To introduce students to control applications in marine and offshore industries.

Learning outcomes

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

1. List variables measured and/or controlled in a typical measuring system or a control system.
2. Describe the methods of measuring temperature, pressure, velocity, vessel position and speed, acceleration, force, level, viscosity and density.
3. Explain Australian standard graphical symbols for instrumentation and process control engineering and apply them in understanding and drawing schematic diagrams of instrumentation and process control systems.
4. Describe methods used to represent a dynamic system.
5. Describe methods used in automatic control systems to reduce steady state error and deviation during a disturbance.
6. Describe linear first-order and second-order measuring and control systems, including PID control systems.
7. Explain the stability of control systems.
8. Describe automatic control systems, which are common in the marine and offshore industries.

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.

Content

1. Fundamentals of Instrumentation (26 Hours)

Concepts of systems with input(s) and output(s) (SISO, MIMO systems), open- and closed-loop control, examples of marine and offshore control systems. Needs and definitions for

instrumentation and measurements common to marine and process industries. Performance of measuring systems: static performance such as sensitivity, accuracy and precision, repeatability, resolution, linearity, and dynamic performance such as zero-order, first-order, and second-order responses, response time and bandwidth. Calibration and adjustment of sensors, transmitters and controllers. Standard drawing symbols used in instrumentation and control engineering. Measuring methods and instruments commonly used in marine and offshore industries such as measurement of temperature, level, marine vehicle position and speed, velocity, acceleration and viscosity and components of a measuring system such as sensors, transducers, signal conditioners (transmitters), and recorders and indicators.

2. Basic Control Engineering (26 Hours)

Mathematical representations of a control system and its components. Continuous-time model (differential equation). Transfer function, poles and zeros of a transfer function and block diagram. First and second-order systems, test signals and system responses, time delays, disturbances and means to reduce them, steady state error (SSE). Introduction to modern control laws, including PID (Proportional, Integral and Differential) control. Introduction to components of a control system, including: comparison elements, sensors, amplifiers, transmitters, and actuators. Control applications in marine and offshore systems and sub-sea systems.

INVESTIGATIVE STUDY

The investigative study will be designed to enhance the ability of students in applying the theory and to introduce practical measuring devices and control systems. These include:

- undertaking flow, level, and pressure measurements with different sensor types, including characterisation of their operating characteristics and calibration.

Learning resources required

Requisite texts

There are no prescribed textbooks. Students will be provided with an electronic copy of the lecturer-prepared lecture notes.

Recommended reading

Anderson, N.A., *Instrumentation for Processes Measurement and Control*, CRC Press, Boca Raton, Florida, USA, 1998.

Etter, D.M., Kuncicky, D.C., Introduction to MATLAB® 7, Prentice-Hall, Upper Saddle River, NJ, 2005.

Haslam, J.A., Summers, G.R., and Williams, D., *Engineering Instrumentation and Control*, Edward Arnold, UK, 1981.

Kou, B.C. and Golnaraghi, F., *Automatic Control Systems*, 8th Ed, John Willey and Sons Inc., New Jersey, 1990.

Taylor, D.A., *Marine Control Practice*, Butterworths, UK, 1987.

Tetley, L. and Calcutt, D., *Electronic Navigation Systems*, Butterworths-Heinemann, Oxford, UK, 2001.

Richards, R.J., *Solving Problems in Controls*, Longman Scientific and Technical, Essex, 1993.

Seborg, D., Edgar, T.F., and Mellichamp, D.A., *Process Dynamics and Control*, 2nd Ed., John Wiley and Sons Inc., New Jersey, 2004.

Ogata, K., *Modern Control Engineering*, 4th Ed., Prentice-Hall Inc., New Jersey, 2004.

E- (electronic) resources

MyLO: Yes

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

See *http://www.utas.edu.au/coursesonline/* for further information about accessing *MyLO*.

Lecturer's website at http://academic.amc.edu.au/~hnguyen

Equipment & materials

Materials to be provided by the student

Non programmable calculator (recommended Casio fx-82AU or Casio fx-100AU)

Materials to be provided by AMC:

MATLAB/Simulink software, LabVIEW (Classroom licence) in computer labs.
Lecture notes can also be downloaded from the lecturer's home page:
http://academic.amc.edu.au/~hnguyen.

Extra costs:

Photocopying costs.

Computer hardware & software

LabVIEW, MATLAB/Simulink 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, Group laboratories, Assignments

Class times

Class	Day	Time	Location	Group
Lecture	Mon	3:10-5:00	G47	All
Lecture	Wed	12:00-1:00	G80	All
Tutorial	Wed	1:00-2:00	G80	All
Labs	Thu	9:00-11:00 (starts wk 5)	G51 (Control Lab)	TBA

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

Syllabus and Learning Schedule

Week	Date	Topic	Readings / Problems	Assessment
1	13/7 (Mon) 2 hours	Introduction (Unit specs) Introduction to Instrumentation and process control	Lecture Notes Chapter 1	
	15/7 (Wed) 2 hours	Basic theory of measurement Introduction to standard drawing symbols (P & ID) used in instrumentation & process control engineering	Chapter 2 Chapter 3 No tutorial	
2	19/7 (Mon) 2 hours	Principles of transducers	Chapter 4	
	22/7 (Wed) 2 hours	Signal conditioning Data acquisition systems	Chapter 5 Tutorial 1	
3	27/7 (Mon) 2 hours	Temperature measurement Pressure measurement	Chapter 6 Chapter 7	
	29/7 (Wed) 2 hours	Flow measurement Level measurement	Chapter 8 Chapter 9 Tutorial 2	
4	3/8 (Mon) 2 hours	Density measurement Viscosity measurement	Chapter 10 Chapter 11	
	5/8 (Wed) 2 hours	Displacement, velocity and acceleration measurements	Handout Tutorial 3	
5	10/8 (Mon) 2 hours	Displacement, velocity and acceleration measurements (cont) Actuators and final control elements	Handout Chapter 12	

	12/8 (Wed) 2 hours	Actuators and final control elements (cont.)	Chapter 12 Tutorial 4	
	TBA	*Labs (instrumentation) G51*		
6	17/8 (Mon) 2 hours	Actuators and final control elements (cont.)	Chapter 12	
	19/8 (Wed) 2 hours	Revision 1	Tutorial 5	
	TBA	*Labs (instrumentation) G51*		
7	24/8 (Mon) 2 hours	Math foundation	Chapter 15	***Class Test 1***
	26/8 (Wed) 2 hours	Math foundation	Chapter 15 Tutorial 6	
	TBA	*Labs (instrumentation)*		
Mid-term break (from 31/8-4/9)				
8	7/9 (Mon) 2 hours	Basic control theory	Chapter 13	
	9/9 (Wed) 2 hours	Basic control theory (cont.)	Chapter 13 Tutorial 7	
	TBA	*Labs (instrumentation)*		
9	14/9 (Mon) 2 hours	Basic control theory (cont.)	Chapter 13	
	16/9 (Wed) 2 hours	Basic control theory (cont.)	Chapter 13 Tutorial 8	
	TBA	*Labs (process control)*		
10	21/9 (Mon) 2 hours	Revision 2 for Class Test 2 Controllers	Chapter 14	
	23/9 (Wed) 2 hours	Controllers	Chapter 14 Tutorial 9	
	TBA	*Labs (process control)*		
11	28/9 (Mon) 2 hours	Controllers	Chapter 14	***Class Test 2***
	31/9 (Wed) 2 hours	Control applications	Chapter 14 Tutorial 10	
	TBA	*Labs (process control)*		
12	5/10 (Mon) 2 hours	Control applications	Chapter 14	
	7/10 (Wed) 2 hours	Control applications (cont)	Chapter 14 Tutorial 11	

13	12/10 (Mon) 2 hours	Control applications (cont.)	Chapter 14	
	8/ (Wed) 2 hours	Revision 3 for Final Exam	Tutorial 12	
14	TBA	*Self-study and exam*		
15	TBA	*Self-study and exam*		

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

Assessment Task	Due Date / Details	%
Class Test 1	Week 7	15
Class Test 2	Week 11	15
Tutes	Ongoing	5
Practical/Labs	TBA	15
Exam	TBA	50

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 final exam. Detail of each assessment is given below.

Class test 1 (15%): An hour class test will cover all aspects of mathematic foundation for instrumentation and process control engineering. The primary emphasis will be (i) problem identification, formulation and solution and (ii) demonstration of basic fundamentals.

Due Date for Class Test 1: Week 7

Class Test 2 (15%): An hour class test will cover all aspects of instrumentation. The primary emphasis will be (i) problem identification, formulation and solution and (ii) demonstration of basic fundamentals.

Due Date for Class Test 2: Week 11 (28/9/09)

Practical/Labs (**15%**): The practicals in Control Engineering Lab require preparation, participation and group reporting. Individual or group reports are scheduled in two weeks

after commencement of the lab experiments (Timetable for labs will be advised). 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 Each Lab Report: two weeks after commencing experiments

Tutorials (5%): 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 and support class tests and exam. Students have to keep their own personal tutorial notebooks and submit at the end of semester.

Final exam (50%): Students are responsible for material from lecture, tutorial, practical, and text. A 3-hour exam in October will cover all aspects of the unit. The primary emphasis will be (i) problem identification, formulation and solution and (ii) demonstration of basic fundamentals. ***The exam schedule will be finalised several weeks before the examination period. Do not make travel plans until the exam schedule is finalised.***

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 lab 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

Course rules

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

http://www.amc.edu.au/maritime.engineering/be.course.content.rules

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:

http://www.utas.edu.au/library/assist/gpoa/gpoa.html

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/