ENGG650

Systems Design and Engineering

S1 Day 2018

Dept of Engineering

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General Information

Unit convenor and teaching staff
Unit Convenor
Professor Graham Town
graham.town@mq.edu.au
Contact via via iLearn
E6B 133
9-11am Tuesdays.

Unit Convenor
Dr Rex Di Bona
rex.dibona@mq.edu.au
Contact via via iLearn
E6B 155
Friday 2-3pm

Credit points
4

Prerequisites
Admission to MEng

Corequisites

Co-badged status
ENGG650, ENGG851

Unit description
This unit deals with the design of complex systems from a top-down integrated perspective, concentrating on methods for maximising system performance. The unit includes elements of system design covering the complete life cycle of engineering systems, including: needs identification; functional analysis, detailed design and development; system modelling and optimisation techniques; decision analysis and economic evaluation of alternatives; design for reliability and usability, system test and evaluation; and project management techniques.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

On successful completion of this unit, you will be able to:

Understand the reasons for, and be able to use, appropriate processes for designing engineering systems

Ability to use appropriate tools to perform critical analysis, decision making, and problem solving.

Demonstrated ability in project management and group work skills

Demonstrated ability in self-learning and information retrieval skills

Demonstrated ability in oral and written communication skills for system design and engineering

Demonstrated understanding of the role and impact of engineers in society

General Assessment Information

- Classes are co-taught, however for assessment purposes any groupwork must be completed with students enrolled in the same unit.
- Assessable tasks are to be completed by the due date - requests for extension must be submitted to the unit coordinator before the due date.
- Students are reminded of University policies on assessment, academic honesty and disruption to studies.

Assessment Tasks

Name	Weighting	Hurdle	Due
Participation	10%	No	see Unit Schedule on iLearn
Quizzes	10%	No	see Unit Schedule on iLearn
Projects/Assignments	40%	No	see Unit Schedule on iLearn
Final Exam	40%	No	to be advised

Participation

Due: **see Unit Schedule on iLearn**
Weighting: **10%**

Students are expected to actively participate in and contribute to class discussions, based on their experience and weekly readings. Marks will be awarded based on the quality and quantity of participation.

Please consult the Unit Schedule for details of the weekly readings and other learning activities.

Late arrival or lack of attendance or lack of participation in more than 3 out of 13 weekly classes will result in an incomplete mark for this component of the assessment.

On successful completion you will be able to:

- Understand the reasons for, and be able to use, appropriate processes for designing engineering systems
- Ability to use appropriate tools to perform critical analysis, decision making, and problem solving.
- Demonstrated ability in project management and group work skills
- Demonstrated ability in self-learning and information retrieval skills
- Demonstrated ability in oral and written communication skills for system design and engineering
- Demonstrated understanding of the role and impact of engineers in society

Quizzes

Due: **see Unit Schedule on iLearn**
Weighting: **10%**

Weekly multiple-choice quizzes on material for discussion the following week to be completed in iLearn before the end of the week.

Please consult the Unit Schedule for details.

On successful completion you will be able to:

- Understand the reasons for, and be able to use, appropriate processes for designing engineering systems
- Demonstrated ability in self-learning and information retrieval skills

Projects/Assignments

Due: **see Unit Schedule on iLearn**
Weighting: **40%**

Four major group projects and individual assignments (each 10 %) on (1) system analysis, (2) system design tools, (3) a presentation on a specific system design goal, and (4) a system design project. The projects/assignments are completed in succession during the semester. Deliverables associated with these projects and assignments are to be submitted via iLearn for assessment. Peer assessment may be applied in group projects. Please consult the Unit Schedule for details.

On successful completion you will be able to:

- Understand the reasons for, and be able to use, appropriate processes for designing engineering systems

- Ability to use appropriate tools to perform critical analysis, decision making, and problem solving.
- Demonstrated ability in project management and group work skills
- Demonstrated ability in self-learning and information retrieval skills
- Demonstrated ability in oral and written communication skills for system design and engineering
- Demonstrated understanding of the role and impact of engineers in society

Final Exam

Due: **to be advised**
Weighting: **40%**

Moderated 3 hour open-book examination at the end of semester. Any texts, notes or other aides (except communication devices) may be used.

On successful completion you will be able to:

- Understand the reasons for, and be able to use, appropriate processes for designing engineering systems
- Ability to use appropriate tools to perform critical analysis, decision making, and problem solving.
- Demonstrated ability in oral and written communication skills for system design and engineering

Delivery and Resources

COMMUNICATIONS

- Students are reminded the University will communicate all official notices to you by email to your university email account. Please read your @student.mq.edu.au email regularly, or forward it to an account you do read regularly.
- All announcements and other communications regarding this unit will be via the unit iLearn website, https://ilearn.mq.edu.au/
- *Please do not email unit convenors and tutors directly, but instead use the "General Discussion" or "Dialogue" tabs on the unit website in iLearn.*

TEXTBOOK

- B. S. Blanchard & W. J. Fabrycky, Systems Engineering and Analysis, Pearson, 5th edition, 2014.
- It is expected that every student will have access to this textbook - weekly readings are

assigned (see the Unit Schedule on the unit's iLearn website) and must be completed before class.

OTHER RESOURCES

- The iLearn web page for this unit can be found at: https://ilearn.mq.edu.au/login/MQ/
- All unit resources and communications relating to this unit, including a week-by-week schedule of learning and assessment activities, will be provided via the iLearn unit website.

CLASS ARRANGEMENTS

- In most weeks classes are run as 3 hour small group tutorial/discussions. To ensure the small group numbers remain balanced, you must seek permission from the Unit Convenor if you wish to transfer between designated classes.
- On a small number of weeks all groups will meet together at one place and time, e.g. for guest lectures. These weeks will be Week 1, and other weeks as per the Unit Schedule, or as arranged by the Unit Convenor.
- Reading and assignments arre given instead of lecture/laboratory classes. Students are expected to spend at least 3 hours per week on these activities, i.e. in lieu of additional class time.

TEACHING AND LEARNING STRATEGY

- Classes in ENGG450/650 involve pre-reading of the text followed by class discussions of the material, and working through of example problems. In later weeks students take the role of lecturer, moderating the presentation and discussions. This mode of teaching and learning is used to develop self-learning and communication skills, which are particularly important when working as a professional engineer.
- Please refer to the Document “ENGG450/650 Timetable” for week-by-week details of class activities, due dates for assessment tasks, and other relevant information.

ASSESSMENT

- To complete this unit satisfactorily all assessable tasks must be completed.
- Assessable tasks are to be completed by the due date indicated in the unit schedule - requests for extension must be submitted to the unit coordinator before the due date.
- Assessable work should conform to accepted standards for professional communication (e.g. in formatting, presentation, spelling, clarity, etc.) A useful resource on Engineering Communications may be found at http://www.engineering.utoronto.ca/Directory/

students/ecp/handbook.htm

TECHNOLOGY USED

- The iLearn web page for this unit can be found at: https://ilearn.mq.edu.au/login/MQ/
- All unit resources and communications relating to this unit will be provided via the iLearn unit website.

RECOMMENDED REFERENCES

- B. S. Blanchard, System Engineering Management, John Wiley, New York, 3rd edn. 2003.
- G. Dandy, Planning and Design of Engineering Systems, Taylor & Francis, 2007.
- G. A. Hazelrigg, Systems Engineering: An Approach to Information-Based Design, Prentice-Hall 1996.
- B. Hyman, Fundamentals of Engineering Design, 2nd edn., Prentice Hall, 2003.
- **Haskins (ed.), INCOSE Systems Engineering Handbook, v3.0, 2006. http://sebokwiki.org/wiki/INCOSE_Systems_Engineering_Handbook**
- D. Long & Z. Scott, A Primer for Model Based Systems Engineering, Vitech, 2nd ed., 2011. http://www.vitechcorp.com/resources/mbse.shtml
- A. Kossiakoff, W. N. Sweet, Systems Engineering Principles and Practice, John Wiley, New Jersey, 2003.
- **NASA Systems Engineering Handbook, 2007. http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20080008301_2008008500.pdf**
- **D. W. Oliver, T. P. Kelliher & J. G. Keegan, Engineering Complex Systems, McGraw Hill, 1997. May be found online.**
- **D. Long, Z. Scott, A Primer for Model Based System Engineering, Vitech. http://www.vitechcorp.com/resources/mbse.shtml**
- C. Shamieh, Systems Engineering for Dummies, IBM, 2011. Free download from https://www.ibm.com/services/forms/signup.do?source=swg-rtl-sd-wp&S_PKG=500028066
- C. S. Wasson, System Analysis, Design, and Development: Concepts, Principles, and Practices, John Wiley, New Jersey, 2006.
- A. W. Wymore, Model-Based Systems Engineering, CRC Press, 1993.
- **DoD, Systems Engineering Fundamentals, 2001. http://www.acq.osd.mil/se/pg/guidance.html https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-885j-aircraft-systems-engineering-fall-2005/readings/sefguide_01_01.pdf**

Other References

- D. M. Buede, The Engineering Design of Systems, John Wiley, New York, 1999.
- W. L. Chapman, A. T. Bahill & A. W. Wymore, Engineering Modelling and Design – Better Results Through Operations Research Methods, CRC Press 1992. TA168 .C45/ 1992
- C. L. Dym & P. Little, Engineering Design: a project based introduction, Wiley 2004. TA174 .D958 2004
- R. L. Freeman, Telecommunication System Engineering, Wiley 1996. TK5103 .F68/1996
- C. J. Khisty & J. Mohammadi, Fundamentals of Systems Engineering, Prentice-Hall 2001.
- R. R. Levary (Ed.), Engineering Design, Elsevier 1988. TA174 .E5316/1988
- Gerhard Pahl, Wolfgang Beitz, Jörg Feldhusen, Karl-Heinrich Grote, (tr. Ken Wallace and Luciënne Blessing), Engineering Design A Systematic Approach, Springer, London, 2007. Electronic version TJ230 .P1613 2007eb
- S. T. Poage, Quantitative Management Methods for Practicing Engineers, Barnes & Noble 1970. TA190 .P6
- A. P. Sage, Systems Engineering, IEEE-Wiley 1992.
- A. P. Sage and W.B. Rouse, (Eds.), Handbook of Systems Engineering,Wiley & Sons, 1999.
- A. P. Sage, J.E. Armstrong, Jr., Introduction to Systems Engineering, Wiley 2000.
- D. G. Stevens, System Engineering – coping with complexity, Prentice Hall 1998.

Relevant standards

NB: IEEE Standards may be downloaded from the IEEE Xplore database, accessible through the library website.

- IEEE standard 1220-2005 (ISO/IEC26702), “Systems Engineering - Application and Management of the Systems Engineering Process”.
- IEEE standard 1233-1998, “IEEE Guide for Developing System Requirements Specifications”.
- IEEE Standard 15288-2004 (ISO/IEC 15288), “Systems Engineering – Systems Life Cycle Processes”.
- Electronics Industries Alliance (ANSI/EIA) Standard, “Processes for Engineering a System”, EIA 632.

- EIA SYSB-1, “System Engineering”.

Case Studies

- National Aeronautics and Space Administration, A Catalog of NASA-Related Case Studies, 2011. http://www.nasa.gov/centers/goddard/pdf/450420main_NASA_Case_Study_Catalog.pdf

Web-based Resources

- **Vitech website (CORE software and documentation) : http://www.vitechcorp.com**
    - Access to Student Edition of CORE 9.0
    - http://www.vitechcorp.com/downloads/index.shtml http://www.vitechcorp.com/university_activation/
- CORE documentation: http://www.vitechcorp.com/support/documentation.shtml#CORE_UE
- Systems Modelling Language (SML): http://www.sysml.org/
- Model-based systems engineering wiki: http://www.omgwiki.org/MBSE/doku.php
- Systems Engineering Body of Knowledge: http://www.bkcase.org/sebok/ http://sebokwiki.org/wiki/Guide_to_the_Systems_Engineering_Body_of_Knowledge_(SEBoK)
- IEEE Standards – IEEE Xplore via Macquarie Uni Library (online)
- “Introduction to System Design: Structural Approach”, course notes, Mark Levin, http://www.mslevin.iitp.ru/SYSD.HTM
- MIT OpenCourseware http://ocw.mit.edu/OcwWeb/Engineering-Systems-Division/index.htm
- Wikipedia http://en.wikipedia.org/wiki/Systems_engineering

Professional Organisations and Resources

- Systems Engineering Society of Australia, http://www.sesa.org.au/ ? International Council on Systems Engineering (INCOSE), http://www.incose.org/
- Systems Engineering Advancement Research Initiative: http://seari.mit.edu/

Engineering Communications

- An excellent reference on engineering communication (presentations, writing, documentation, etc.) may be found at: http://ecp.engineering.utoronto.ca/online-handbook/

Unit Schedule

Classes in this unit involve pre-reading of prescribed sections of the text before class, then discussion of the material and concepts in class, followed by working through of example problems. In the second half of semester students take the role of the lecturer, moderating the presentation and discussions. This mode of teaching and learning is used to develop self-learning and communication skills, which are particularly important when working as a professional engineer.

Please refer to the Unit Schedule in the iLearn unit webpage for week-by-week details of class learning and assessment activities, and other relevant information.

Learning and Teaching Activities

Weekly classes

Tutorial/discussion of course material.

Guest lectures

Guest lectures on how system design and engineering is used in specific industries (e.g. telecommunications, medical devices, etc).

Group projects and individual assignments

Three major system analysis or system design tasks or problems to be completed during semester.

Student presentations

Student presentations of course material to class.

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- Academic Appeals Policy
- Academic Integrity Policy
- Academic Progression Policy

- Assessment Policy
- Fitness to Practice Procedure
- Grade Appeal Policy
- Complaint Management Procedure for Students and Members of the Public
- Special Consideration Policy *(**Note:** The Special Consideration Policy is effective from 4 December 2017 and replaces the Disruption to Studies Policy.)*

Undergraduate students seeking more policy resources can visit the Student Policy Gateway (https://students.mq.edu.au/support/study/student-policy-gateway). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

If you would like to see all the policies relevant to Learning and Teaching visit Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central).

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/study/getting-started/student-conduct

Results

Results shown in *iLearn*, or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit ask.mq.edu.au.

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to improve your marks and take control of your study.

- Workshops
- StudyWise
- Academic Integrity Module for Students
- Ask a Learning Adviser

Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the Acceptable Use of IT Resources Policy. The policy applies to all who connect to the MQ network including students.

Graduate Capabilities

Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

Learning outcomes

- Understand the reasons for, and be able to use, appropriate processes for designing engineering systems
- Ability to use appropriate tools to perform critical analysis, decision making, and problem solving.
- Demonstrated ability in self-learning and information retrieval skills
- Demonstrated understanding of the role and impact of engineers in society

Assessment tasks

- Participation
- Projects/Assignments

Learning and teaching activities

- Three major system analysis or system design tasks or problems to be completed during semester.

Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

Learning outcomes

- Understand the reasons for, and be able to use, appropriate processes for designing engineering systems
- Ability to use appropriate tools to perform critical analysis, decision making, and problem solving.
- Demonstrated ability in project management and group work skills
- Demonstrated ability in self-learning and information retrieval skills
- Demonstrated ability in oral and written communication skills for system design and engineering
- Demonstrated understanding of the role and impact of engineers in society

Assessment tasks

- Participation
- Projects/Assignments
- Final Exam

Learning and teaching activities

- Tutorial/discussion of course material.
- Guest lectures on how system design and engineering is used in specific industries (e.g. telecommunications, medical devices, etc).
- Three major system analysis or system design tasks or problems to be completed during semester.
- Student presentations of course material to class.

Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

Learning outcomes

- Understand the reasons for, and be able to use, appropriate processes for designing engineering systems
- Ability to use appropriate tools to perform critical analysis, decision making, and problem solving.

- Demonstrated ability in self-learning and information retrieval skills
- Demonstrated ability in oral and written communication skills for system design and engineering

Assessment tasks

- Participation
- Quizzes
- Projects/Assignments

Learning and teaching activities

- Tutorial/discussion of course material.
- Guest lectures on how system design and engineering is used in specific industries (e.g. telecommunications, medical devices, etc).
- Three major system analysis or system design tasks or problems to be completed during semester.
- Student presentations of course material to class.

Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

Learning outcomes

- Understand the reasons for, and be able to use, appropriate processes for designing engineering systems
- Ability to use appropriate tools to perform critical analysis, decision making, and problem solving.
- Demonstrated ability in project management and group work skills
- Demonstrated ability in self-learning and information retrieval skills
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Assessment tasks

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- Final Exam

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- Tutorial/discussion of course material.
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- Three major system analysis or system design tasks or problems to be completed during semester.
- Student presentations of course material to class.

Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

Learning outcomes

- Understand the reasons for, and be able to use, appropriate processes for designing engineering systems
- Ability to use appropriate tools to perform critical analysis, decision making, and problem solving.
- Demonstrated ability in self-learning and information retrieval skills
- Demonstrated ability in oral and written communication skills for system design and engineering
- Demonstrated understanding of the role and impact of engineers in society

Assessment tasks

- Participation
- Projects/Assignments
- Final Exam

Learning and teaching activities

- Tutorial/discussion of course material.
- Three major system analysis or system design tasks or problems to be completed during semester.

Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

Learning outcomes

- Understand the reasons for, and be able to use, appropriate processes for designing engineering systems
- Ability to use appropriate tools to perform critical analysis, decision making, and problem solving.
- Demonstrated ability in project management and group work skills
- Demonstrated ability in self-learning and information retrieval skills

Assessment tasks

- Participation
- Quizzes
- Projects/Assignments
- Final Exam

Learning and teaching activities

- Tutorial/discussion of course material.
- Three major system analysis or system design tasks or problems to be completed during semester.

Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

Learning outcomes

- Understand the reasons for, and be able to use, appropriate processes for designing engineering systems
- Demonstrated ability in project management and group work skills
- Demonstrated ability in self-learning and information retrieval skills
- Demonstrated ability in oral and written communication skills for system design and engineering

Assessment tasks

- Participation
- Projects/Assignments
- Final Exam

Learning and teaching activities

- Tutorial/discussion of course material.
- Three major system analysis or system design tasks or problems to be completed during semester.
- Student presentations of course material to class.

Engaged and Ethical Local and Global citizens

As local citizens our graduates will be aware of indigenous perspectives and of the nation's historical context. They will be engaged with the challenges of contemporary society and with knowledge and ideas. We want our graduates to have respect for diversity, to be open-minded, sensitive to others and inclusive, and to be open to other cultures and perspectives: they should have a level of cultural literacy. Our graduates should be aware of disadvantage and social justice, and be willing to participate to help create a wiser and better society.

This graduate capability is supported by:

Learning outcomes

- Understand the reasons for, and be able to use, appropriate processes for designing engineering systems
- Ability to use appropriate tools to perform critical analysis, decision making, and problem solving.
- Demonstrated ability in self-learning and information retrieval skills
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Assessment tasks

- Participation
- Projects/Assignments

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- Tutorial/discussion of course material.
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- Three major system analysis or system design tasks or problems to be completed during semester.

Socially and Environmentally Active and Responsible

We want our graduates to be aware of and have respect for self and others; to be able to work with others as a leader and a team player; to have a sense of connectedness with others and country; and to have a sense of mutual obligation. Our graduates should be informed and active participants in moving society towards sustainability.

This graduate capability is supported by:

Learning outcomes

- Understand the reasons for, and be able to use, appropriate processes for designing engineering systems
- Ability to use appropriate tools to perform critical analysis, decision making, and problem solving.
- Demonstrated ability in self-learning and information retrieval skills
- Demonstrated ability in oral and written communication skills for system design and engineering
- Demonstrated understanding of the role and impact of engineers in society

Assessment tasks

- Participation
- Projects/Assignments

Learning and teaching activities

- Tutorial/discussion of course material.
- Guest lectures on how system design and engineering is used in specific industries (e.g. telecommunications, medical devices, etc).
- Three major system analysis or system design tasks or problems to be completed during semester.

Changes from Previous Offering

Specific assessment tasks have been changed.

Changes in Response to Student Feedback

N/A