Never Stand Still

Engineering

Mechanical and Manufacturing Engineering

MANF4611

Contents

Contact details and consultation times for course convenor

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Consultation concerning this course is available immediately after the classes. Direct consultation is preferred.

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Credit Points:

This is a 6 unit-of-credit (UoC) course, and involves three hours per week (h/w) of face-to-face contact.

The UNSW website states "The normal workload expectations of a student are approximately 25 hours per semester for each UoC, including class contact hours, other learning activities, preparation and time spent on all assessable work.

Summary of the Course

Key factors for success in modern engineering systems include efficient and effective allocation of resources, infrastructure, capacity and capital investment. Depending on the characteristics of the system, for example a product and its market, appropriate processes, resources, entity flows, layouts and systems need to be designed. The focus of this course is precisely that – the understanding, analysis, design and, to some extent, the optimisation of resourcing and processes in line with practical requirements and a constantly evolving set of task and operational requirements.

This course focuses on analytical techniques for decision making and solving complex process and resource allocation problems. It includes the major analytical techniques as part of Operations Research, statistical system characterisation as well as the theory and use of discrete event simulation. It covers the essential mathematical, statistical and computer simulation techniques for modelling and analysing complex systems involving multiple variables, internal, external and disturbances. Depending on the scope of the system to be analysed and the nature of its behaviour, different analytical techniques apply. Specific techniques discussed include linear programming, statistical analysis and simulation using Rockwell Arena ® software.

The course is focused on analysing, modelling and finally understanding and solving complex systems under multiple constraints. These may be manufacturing systems, but they can also be service systems, transportation systems, in fact any system involving multiple entities, processes, resources and constraints.

Topics include:

- Discrete event simulation and associated analysis techniques, using Rockwell Arena© simulation software.
- Linear programming and the simplex method
- Transportation models
- Regression analysis and Partial Least Squares

The course will combine lectures with practical case studies that require the theory taught to be applied to actual manufacturing and industrial systems.

Aims of the Course

The course aims to develop you into a skilled and all-rounded design engineer and operational analyst, able to carry out and manage the key design, operations and decision-making processes. Operations and design are inherently complex and a systematic, yet a flexible, agile and interdisciplinary approach is required to manage and improve complex systems. The course teaches this approach, at the system and managerial levels, based on global best-practice methodologies, industry lecturers, and incorporates case studies and projects, to apply these methodologies and become proficient at them.

Student learning outcomes

This course is designed to address the below learning outcomes and the corresponding Engineers Australia Stage 1 Competency Standards for Professional Engineers as shown. The full list of Stage 1 Competency Standards may be found in Appendix A.

After successfully completing this course, you should be able to:

Learning Outcome		EA Stage 1 Competencies
1.	Formulate a real world system or problem and select an appropriate analytical technique for modeling and ultimately solving or optimizing it.	PE1.2, PE2.1, PE3.2, PE3.4
2.	Characterize the behavior of a system in terms of the nature of its variables, interactions using regression methods.	PE1.3, PE1.4
3.	Apply linear programming techniques to solve resource allocation problems and issues.	PE1.2, PE2.3
4.	Apply simulation techniques to solve complex system issues and to select feasible, if not optimum, solutions and configurations amongst competing designs.	PE1.2, PE1.3, PE2.1, PE1.6

Lectures in the course are designed to cover the terminology and core concepts and theories in the area of manufacturing process design. They do not simply reiterate the texts, but build on the lecture topics using examples taken directly f.5(ec)-2(c4 Tj E)e3ory and2n5(m)-6toihow13.5

Date	Lecture Content (Colombo Theatre B) 12:00-13:30	Lab Content (Ainsworth 204) 13:30-15:00
Week 1 Thu 3/3/16	Introduction to Process and Operations Modeling Characteristics of Processes and Operations Flow Systems, Manufacturing Systems, Business Systems, Engineering Systems What are Models Stochastic Processes Dynamic Models Continuous – Discrete Time Models Input, Output and Disturbance Variables The Process of Modeling Introduction to Operations Research Introduction to Simulation and Arena	No labs in Week 1
Week 2 Thu 10/3/16	Random Variables and Probability Distributions Observing, Measuring and Analysing Random Behaviour Binomial, Poisson, Geometric, Exponential, Normal Distribution Fitting a Distribution and Goodness of Fit Random Number Generators Generating Random Observations Stationary – non-Stationary Processes Introduction to MINITAB	

Assessment Overview

Assessment	Length	Weight	Learning outcomes assessed	Assessment criteria	Due date and submission requirements	Marks returned
Group assignment – Part 1	3000 words	10%	1 and 4	Problem formulation, system representation, flowcharts, data structures	End of Week 6 – Fri 15 April	Two weeks after submission
Group Assignment – Part 2	3000 words	15%	1 and 4	Model design and documentation, verification (& limited validation)	End of Week 10 – Fri 13 May	Two weeks after submission
Group assignment – Part 3	3000 words	25%	1 and 4	System analysis and design using the simulation model, statistical analysis, final documentation	End of Week 13 – Fri Week 3 June	Upon release of final results
Final exam	3 hours	50%	2 and 3	All content except simulation	Exam period, date TBC	Upon release of final results
TOTAL		100%				

The assessments are designed to bolster your understanding of the material being presented and focus on the key learning points. The assignments will allow you to apply the concepts learnt in the course in a professional context whereas the final exam will test your understanding of the basic theory.

Assignments

Each of you will undertake a major assignment consisting of three parts, each building on the previous. You will undertake this in a team of three. The assignments will cover important areas of manufacturing system design.

Each part of the assignment requires a write-up and these are due in week 6, 10 and 13.

You need to ensure that you use both an appropriate writing style as well as professional formatting and editing of style and content in your report.

The assignments will be posted on Moodle and discussed in class (as shown in the teaching schedule) and the due dates shown are firm. Completed assignments will be handed in hard copy by the end of the week the assignment is due. The assignments support the learning outcomes by incorporating an appropriate mix of analytical techniques, enabling software, data analysis that supports achievement of appropriate solutions.

Criteria for Marking

The following criteria will be used to grade assignments:

- Analysis and evaluation of requirements by integrating knowledge and methods learned in lectures and demonstratons.
- Sentences in clear and plain English—this includes correct grammar, spelling and punctuation
- Correct referencing in accordance with the prescribed citation and style guide
- Appropriateness of engineering techniques and methodologies used
- Accuracy of numerical answers and comprehensiveness of methods and techniques employed.
- Evidence of quality data and analysis-based decision making
- All working shown
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Provisional Examination timetables are generally published on myUNSW in May for Semester 1 and September for Semester 2

For further information on exams, please see the Exams section on the intranet.

Calculators

You will need to provide your own calculator, of a make and model approved by UNSW, for the examinations. The list of approved calculators is shown at student.unsw.edu.au/exam-approved-calculators-and-computers

It is your responsibility to ensure that your calculator is of an approved make and model, and to obtain an “Approved” sticker for it from the School Office or the Engineering Student Centre prior to the examination. Calculators not bearing an “Approved” sticker will not be allowed into the examination room.

Special Consideration and Supplementary Assessment

For details of applying for special consideration and conditions for the award of supplementary assessment, see the School intranet, and the information on UNSW’s Special Consideration page.

Lecture notes for all topics will be posted on Moodle. For all e-Books and reference books please visit the UNSW Library website on:

http://info.library.unsw.edu.au/web/services/services.html

Textbooks:

Simulation modeling and analysis with Arena, Tayfur. Altiok Benjamin Melamed, Warren, N.J. : Cyber Research and Enterprise Technology Solutions, 2001. UNSW Library – High Use Collection.

Griva, I., Nash, S., Sofer, A., & Books24x7, Inc. (2009).Linear and nonlinear optimization, second edition (2nd ed.). Philadelphia: Society for Industrial and Applied Mathematics. e-Book available through UNSW Library.

Vanderbei, R., & Ebooks Corporation. (2008). Linear Programming Foundations and Extensions. (International Series in Operations Research & Management Science, v. 114). Dordrecht: Springer. e-Book available through UNSW Library.

	Program Intended Learning Outcomes
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals
	PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing
	PE1.3 In-depth understanding of specialist bodies of knowledge
	PE1.4 Discernment of knowledge development and research directions
	PE1.5 Knowledge of engineering design practice
	PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice
PE2: Engineering Application Ability	PE2.1 Application of established engineering methods to complex problem solving
	PE2.2 Fluent application of engineering techniques, tools and resources
	PE2.3 Application of systematic engineering synthesis and design processes
	PE2.4 Application of systematic approaches to the conduct and management of engineering projects