MANF4611

PROCESS MODELING AND SIMULATION

CONTENTS

MANF4611

COURSE OUTLINE

you understand the lecture material, completing the set assignments, further reading about the course material, and revising and learning for the quizzes and final exam.

There is no parallel teaching in this course.

Summary of the course

Key factors for success in modern manufacturing and management include efficient and effective allocation of resources, infrastructure, capacity and capital investment. Depending on the characteristics of the 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 changing business landscape.

This course focuses on analytical techniques for decision making and solving complex process and resource allocation problems encountered in industry. It includes the major analytical techniques as part of Operations Research as well as the theory and use of discrete event simulation. Specific techniques discussed include linear programming, project management theory, network optimisation, decision theory and simulation using Rockwell Arena ® software.

MANF4611 operates in conjunction with MANF4100 Design and Analysis of Product-Process Systems by focusing more so on the quantitative techniques in analysing, designing, managing and improving systems and processes. 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.

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
> Network analysis and shortest route problems
> Inventory theory
> Transportation models
> Decision analysis and decision trees

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

Aims of the course

The course aims to develop you into a skilled and all-rounded design engineer and industrial analyst, able to carry out and manage the key design, managerial and decision-making processes. Management and design is inherently complex and a systematic, yet flexible, agile and interdisciplinary approach is required to manage and improve complex systems. The course teaches this approach, at the manufacturing system and factory level, 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

At the conclusion of the course it is expected that you will be able to:

1) Formulate a real world problem and select an appropriate analytical technique for modeling and ultimately solving this problem.
2) Characterise the behavior of a system in terms of the nature of its variables, interactions and state changes as a function of time.
3) Apply linear programming techniques to solve resource allocation problems and issues.
4) Apply simulation techniques to solve complex system issues and to select feasible, if not optimum, solutions and configurations amongst competing designs.
5) Solve large infrastructure issues involving location decisions, as well as resourcing decisions using transportation methods.
6) Apply decision analysis methods to make sound decisions under risk and uncertainty.

Graduate attributes

UNSW's graduate attributes are shown at:

   https://my.unsw.edu.au/student/atoz/GraduateAttributes.html

and are stated as:

4. able to apply their knowledge and skills to solving problems
5. ethical practitioners
6. capable of effective communication
7. information literate

Effective learning is supported when you are actively engaged in the learning process and by a climate of enquiry, and these are both an integral part of the lectures and practica.

You become more engaged in the learning process if you can see the relevance of your studies to professional, disciplinary and/or personal contexts, and the relevance is shown in the lectures and assignments by way of examples drawn from industrial situations as well as designs that are discussed in class.

Dialogue is encouraged between you, others in the class and the lecturers. Diversity of experiences is acknowledged, as some students in each class have prior experience. Your experiences are drawn on to illustrate various aspects, and this helps to increase your motivation and engagement.

Since you will work closely with your lecturers and colleagues, you will have almost instant feedback and discussion and this greatly enhances the learning experience.

4.   TEACHING STRATEGIES

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 from industry to show how the theory is applied in practice and the details of when, where and how it should be applied.

Teaching Strategies and their rationale

This course will be presented using PowerPoint presentations as well as case studies and real-life designs. The material will be presented in the lecture and the studen5.47 T.tervstue

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5.   ASSESSMENT

General

You are assessed by way of assignments, quizzes, and a final exam. Quizzes involve both calculations and descriptive material.

Assignment 1	10%	Due end-of-week 6 – Monday 13 April	(Graduate Attributes: 1, 2, 3 and 4)
Assignment 2	15%	Due end-of-week 9 – Monday 4 May	(Graduate Attributes: 1, 2, 3, 4, 7, 8 and 17)
Assignment 3	25%	Due end-of-week 12 – Monday 25 May	(Graduate Attributes: 1, 2, 3, 4, 7 and 8)
Final Exam	50%	To be advised	(Graduate Attributes: 1, 2, 3, 4, 6, 7,13,14,15 and 17)
TOTAL	100%		

The assessments are designed to bolster your understanding of the material being presented and focus on the key learning points. The quizzes will test the understanding of the sections being presented while the assignments will allow you to apply the concepts learnt in the course.

Assignments

The assignments will be posted on Moodle 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.

The School guidelines recommend that late submissions incur a penalty of 10% of the total marks awarded for each calendar day the assignment is late. For example, if you received a mark of 40 out of 50 for an assignment that you handed in 2 days late you would receive a penalty of 8 marks and your mark would be reduced to 32. If the same assignment were handed in 4 days late the mark would be reduced to achievementie32aebnm

some cases late work may not be assessed. Please carefully check course outlines for more detailed information regarding late penalties.

It is always worth submitting late assessment tasks when possible. Completion of the work, even late, may be taken into account in cases of special consideration.

Submission of Assignments

Each of you will undertake two assignments. You can undertake this by yourself or in a team of two. 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 8 and week 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.

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 practica.
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
Use of diagrams, where appropriate, to support or illustrate the calculations
Use of graphs, were appropriate, to support or illustrate the calculations
Use of tables, where appropriate, to support or shorten the calculations
Neatness

6.   ACADEMIC HONESTY AND PLAGIARISM

Plagiarism is using the words or ideas of others and presenting them as your own. Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a booklet which provides essential information for avoiding plagiarism: https://my.unsw.edu.au/student/academiclife/Plagiarism.pdf

There is a range of resources to support students to avoid plagiarism. The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one. Information is available on the dedicated website Plagiarism and Academic Integrity website: http://www.lc.unsw.edu.au/plagiarism/index.html

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students

7.   COURSE SCHEDULE

Week	Topic	Lecturer
1	**Introduction to Process and Operations Modeling** Characteristics of Processes and Operations Flow Systems, Economic Systems, Business Systems What are Models Stochastic Processes Dynamic Models Continuous – Discrete Time Models Input, Output and Disturbance Variables The Process of Modeling (lower level) The Process of Using Modeling to Make Decisions (higher level) Introduction to Operations Research Introduction to Simulation and Arena Key Arena Constructs: Process, Entity, Create, Dispose, Resource, Queues, Schedule, Set, TNOW Seize – Delay – Release One-Shot	EVV
2	**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	RC

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5	**Analysing Simulation Output** Within – Across Replication Statistics Types of Statistical Variables Confidence Intervals and Determining the Number of Replications Sequential Sampling Interpreting Arena Output Files Finite – Infinite Horizon Simulations Effect of Initial Conditions, Warming-up Period Comparison of Different System Configurations and Designs ANOVA Process Analyser Sensitivity Analysis		JB
6	**Advanced Arena Concepts** Transportation Materials Handling Model Animation Sub-Models Variable Tables Interfacing to Excel		JB
7	**Inventory Theory and Queueing** Forecasting Time Horizons Types of Forecasts The Forecasting Process Time Series Forecasting Moving Average Exponential Smoothing Measuring Forecasting Error Trend Adjustment Seasonal Variation Regression Analysis in Forecasting Goodness of Fit		RC
8	**Resource Allocation Problems: Linear Programming 1** Simplex Method Geometry of the Simplex Method Duality Theory		RC
9	**Applications of Linear Programming** Multi-goal Programming Sensitivity Analysis Applications		RC
10	**Transportation Models** Northwest Corner Method Stepping Stone Method Intuitive Method		EVV
11	**Network Analysis** Deterministic Networks: Process sequencing, aggregate production planning Stochastic Networks: Probabilistic Networks with certain outcomes, Markov Networks with uncertain outcomes		EVV

12	**Decision Analysis**
	    Overcoming risk and uncertainty
	    Decision Trees
	    Decision tables
	    Decision methods: Maximax, Maximin, Equally Likely
	    Expected monetary value
	    Value of information
		EVV

13	**Summary of course**	RC/JB/EVV

Please note that the some of the topics may run over the indicated period if there are questions and the discussions are long.

10   USE OF CALCULATORS

You will need to provide your own calculator, of a make and model approved by UNSW. The list of approved calculators is shown at:
https://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.

11.   ADMINISTRATIVE MATTERS

You are expected to have read and be familiar with Administrative Matters, available on the School website. This document contains important information on student responsibilities and support, including special consideration, assessment, health and safety, and student equity and diversity.

Erik van Voorthuysen
February 2015