School of Civil and Environmental Engineering

Term 3, 2021

CVEN9612 Catchment and Water Resources Modelling

COURSE DETAILS

Units of Credit	**6**
Contact hours	• Four hours per week
Class/ Workshop	• Wednesday: 9:00 - 13:00 Online
Course Coordinator and Lecturer	Ashish Sharma (AS) email: a.sharma@unsw.edu.au office: School of Civil and Environmental Engineering, Kensington CE307 phone: 9385 5768
Lecturer	Fiona Johnson (FJ) email: f.johnson@unsw.edu.au office: School of Civil and Environmental Engineering, Kensington CE309 phone: 9385 9769
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INFORMATION ABOUT THE COURSE

An introduction to lumped and distributed catchment runoff models; an introduction on the rationale used for model verification and validation, model development and parameter estimation; Bayesian methods for estimating model parameters; reservoir and channel routing; reservoir operation and design; wetland design and conceptual processes; introduction to hydrologic time series characterization and stochastic modelling in the context of water resources management; Climate change: Bias correction and downscaling models.

HANDBOOK DESCRIPTION

See link to virtual handbook:

https://www.handbook.unsw.edu.au/undergraduate/courses/2021/CVEN9612

OBJECTIVES

Objective of the course is to impart advanced knowledge in Water Engineering with a focus on Hydrology and Water Resources Engineering methodologies. The course consists of two halves, both being taught as online courses. The first part focuses on catchment surface models, and the second part focuses on water resources management.

TEACHING STRATEGIES

The teaching strategies that will be used include:

- **Lectures** that will focus on the development and application of the development of rainfall-runoff models, catchment hydrological characteristics and processes and approaches to time series analysis, optimization approaches and other statistical techniques for hydrological investigation.
- **Workshop** classes will concentrate on strategies for solving such problems. You will be encouraged, from time to time, to work alone as well as in small groups to solve problems.
- **Computer-aided exercises** will also be used to assess operational application of analytical techniques and other concepts developed throughout the course.

Suggested approaches to learning in this course include:

- Regular participation in lectures and Workshops. Review lecture and Workshop material. Follow worked examples.
- Reflect on class problems and quizzes.
- Regular reading and reviewing of your learning.
- Appropriate preparation for Workshop activities.
- Planning your time to achieve all assessment requirements (see assessment)
- We encourage you to work with your peers. A good way to learn the material is in small study groups. Such groups work best if members have attempted the problems individually before meeting as a group.

Successful completion of this course will require active involvement by the student in:

Private Study	• Review lecture material • Do set problems and assignments • Reflect on class problems and assignments • Do internet and library searches on topics related to the course • Participate in class discussions on review questions at end of lecture notes
Lectures	• Find out what you must learn • Follow worked examples • Hear announcements on course changes
Workshops	• Be guided by demonstrators • Practice solving set problems • Ask questions
Assessments (exam, assignments)	• Demonstrate your knowledge and skills • Demonstrate higher understanding and problem solving

EXPECTED LEARNING OUTCOMES

It is expected that the student will have a clearer understanding of Water Engineering, its relevance in engineering design, and its application in water resources management. The student will be familiar with the development and operation of rainfall-runoff models, be familiar with the range of observation and modelling tools available to the water resource manager, understand the limits of models and the importance of

calibration/validation, and how to undertake data and modelling analysis using a range of statistical and other analytical approaches in a changed climate.

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

Learning Outcome		EA Stage 1 Competencies
1.	*Perform rainfall runoff modelling using conceptual models*	*PE1.1, PE1.5, PE2.2, PE2.3*
2.	*Perform semi-distributed hydrologic modelling.*	*PE1.2, PE2.2, PE2.3*
3.	*Understand differences between conceptual and distributed models*	*PE1.2, PE2.2, PE2.3*
4.	*Understand the basis for model calibration and validation*	*PE1.1, PE2.2, PE2.3, PE3.3*
5.	*Assess reservoir sizing and operation*	*PE1.1, PE2.2, PE2.3, PE3.3*
6.	*Perform simple time series analysis and use this to quantify uncertainty*	*PE1.2, PE2.2, PE2.3*
7.	*Assess implications of climate change on reservoir operation and learn how to correct systematic biases in climate model simulations*	*PE2.2, PE2.3, PE3.3*

For each hour of contact it is expected that a student will put in at least 1.5 hours of private study.

COURSE PROGRAM

The course schedule tabulated below shows the main topics and approximately how long will be spent on each topic in lectures. Please note that the lecture durations and sequence of topics is a guide only; there may be some variations. However, details on the associated assessment tasks should not be affected; if they are you will be informed.

Term 3 2021

Week	Date	Lecturer	Topic	Assessments
1	15/09/2021	FJ	• Introduction to the course • Watershed concepts and characteristics - Catchment processes: rainfall, evaporation, infiltration, and runoff - Understanding the hydrograph - Flood routing approaches	Asst#1 Part1: Rainfall runoff modelling (due 4/10/2021)
2	22/09/2021	FJ	• Rainfall-runoff modelling: - The role of modelling - Objectives and concepts - Types of models - Model components and conceptualizations	
3	29/09/2021	FJ	• Rainfall-runoff modelling continued: - Sensitivity analysis - Uncertainty	
4	06/10/2021	AS	• Semi-distributed modelling (SMART) • Application of SMART, data requirements, realities and limitations	
5	13/10/2021	AS	• Application of SMART, data requirements, realities and limitations (continued) (09:00-11:00)	Asst#1 Part2: SMART (due 28/10/2021)
		SK	• **Workshop**: SMART (11:00-13:00)	

6	***No lectures***			
7	27/10/2021	AS	• Introduction, reservoir design and operation • Reservoir simulation methods, definition of storage capacity	
8	03/11/2021	AS	• Storage capacity (continued) • Class workshop: reservoir design and storage	
			• Introduction to simple time series models • Class workshop: time series models	
9	10/11/2021	AS	• Climate change and bias correction (09:00-11:00)	Asst#2: Reservoir modelling application (due 23/11/2021)
		RM	• **Workshop**: climate change, bias correction, downscaling (11:00-13:00)	
10	17/11/2021	AS	• Advanced time series simulation methods, seasonal models, downscaling models • Class workshop: time series models (continued)	

ASSESSMENT

The final grade for this course will normally be based on the sum of the scores from each of the assessment tasks. If you apply for and receive special consideration for any of the assignments, a scaling of your final exam marks will be carried out. It is recommended that students who perform poorly in the assignments and workshops discuss progress with the lecturer during the trimester. The formal exam scripts will not be returned. The lecturer reserves the right to adjust the final scores by scaling if agreed by the Head of School.

Supplementary Examinations for Term 3 2021 will be held on Monday 10th January – Friday 14th January 2022 (inclusive) should you be required to sit one. You are required to be available during these dates. Please do not to make any personal or travel arrangements during this period.

PENALTIES

Late submissions of the assignments will result in penalties dependent on the number of days of delay. Late work will be penalised at the rate of 10% per day after the due time and date have expired.

ASSESSMENT OVERVIEW

The course learning outcomes include a significant level of technical learning, calculations, and engineering understanding of problems. These outcomes can be effectively and ideally assessed in an exam environment that can reflect the students' understanding of concepts, and the students' abilities to make decisions and solve problems within limited time. The final exam will be held under open book conditions. You need to score at least 40% in the final exam to be able to pass the course.

The assessment is separate for the two halves of the course, but there is related course material.

- Catchment Modelling (Weeks 1–5): 50% (assignment#1 25%, exam: 25%)
- Water Resources Modelling (Weeks 7–10): 50% (assignment#2 30%, exam: 20%)

Details for the assignments and the final exam are as follows.

- Assignments (55%)
  - ❖ #1: Rainfall-Runoff Modelling and Computation (25%)
    - o Part 1: Runoff routing and model calibration (15%, due on: 4 Oct, marks returned: 9 Oct)
    - o Part 2: SMART (10%, due on: 28 Oct, marks returned: 11 Nov)
  - ❖ #2: Reservoir Modelling Application (30%, due on: 23 Nov, marks returned: 25 Nov)

  * Note that an absolute failure for an assignment automatically occurs when the penalty for a late submission excesses the mark limit (i.e., your mark - penalty ≤ 0)

- Final Exam (45%): online, 2-hour duration during the T3 examination period (26 Nov – 9 Dec)

RELEVANT RESOURCES

There is no subject textbook but a number of recommended reference books for this course are as follows:

- Handbook of Hydrology (1992), by D.R. Maidment (Editor in Chief); published by McGraw-Hill, Inc.
- Water Resources Engineering (2001), by L. W. Mays; published by John Wiley & Sons Inc.
- Applied Hydrology (1988), by Chow, Maidment and Mays; published by McGraw-Hill Inc.
- Hydrology, An Australian Introduction (2008), by Anthony Ladson; Oxford University Press.

DATES TO NOTE

Refer to MyUNSW for Important Dates available at:

https://student.unsw.edu.au/dates

PLAGIARISM

Beware! An assignment that includes plagiarised material will receive a 0% Fail, and students who plagiarise may fail the course. Students who plagiarise are also liable to disciplinary action, including exclusion from enrolment.

Plagiarism is the use of another person's work or ideas as if they were your own. When it is necessary or desirable to use other people's material you should adequately acknowledge whose words or ideas they are and where you found them (giving the complete reference details, including page number(s)). The Learning Centre provides further information on what constitutes Plagiarism at:

https://student.unsw.edu.au/plagiarism

ACADEMIC ADVICE

For information about:

- Notes on assessments and plagiarism;
- Special Considerations: student.unsw.edu.au/special-consideration;
- General and Program-specific questions: The Nucleus: Student Hub
- Year Managers and Grievance Officer of Teaching and Learning Committee, and
- CEVSOC/SURVSOC/CEPCA

Refer to Academic Advice on the School website available at:

https://intranet.civeng.unsw.edu.au/key-staff-to-contact-during-your-studies-at-unsw

Appendix A: Engineers Australia (EA) Competencies

Stage 1 Competencies for Professional Engineers

	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
PE3: Professional and Personal Attributes	PE3.1 Ethical conduct and professional accountability
	PE3.2 Effective oral and written communication (professional and lay domains)
	PE3.3 Creative, innovative and pro-active demeanour
	PE3.4 Professional use and management of information
	PE3.5 Orderly management of self, and professional conduct
	PE3.6 Effective team membership and team leadership