

UNIVERSITY OF SOUTH AUSTRALIA

DIVISION OF INFORMATION TECHNOLOGY
ENGINEERING AND THE ENVIRONMENT

SCHOOL OF NATURAL AND BUILT
ENVIRONMENTS

SEMESTER 1 EXAMINATIONS

27th JUNE 2006

Time: 9:00 am – 12:00 noon

WATER QUALITY PROCESSES
CIVE 4026

General Instructions to Candidates

- Open Book Examination: All class notes and completed assignments are allowed.
- Answer 6 questions in total. TWO questions from each section A, B and C.
- All questions are of equal value, 8 marks each.
- 2 marks are allocated for clarity of answers.
- Use 3 examination booklets that are provided and a separate booklet for EACH Section A, B, C. Label each booklet A or B or C. Put your Student ID on each booklet.
- Examination Duration: 3 hours.
- Calculators are allowed. Computers/Laptops are not allowed.

Section A : Water Sensitive Urban Design, Stormwater and Environmental flows

(Answer 2 questions from this section)

Question 1

- (a) Define the term “Water Sensitive Urban Design” and describe some of the objectives of this design. (3 marks)
- (b) Describe some of the technologies developed and/or are in development that improve water use in urban areas. (3 marks)
- (c) Give ONE example of implementation of Water Sensitive technologies as part of Urban Design, in South Australia. Briefly describe this example. (2 marks).

Question 2

- (a) Define the term “environmental flows”. (1 mark).
- (b) Discuss what aspects you need to consider in assessing environmental flows for a selected water course. (3 marks).
- (c) Discuss what are the general difficulties associated with the process of environmental flow assessments and the implementation of environmental flow provisions. Discuss possible strategies to overcome those issues (4 marks).

Question 3

Traditionally, stormwater management in urban areas has been based on minimisation of risks from floods. However, in recent times, management of stormwater has become more complex and challenging, in many instances.

- (a) Describe why stormwater management has become ‘more complex and challenging’ for urban areas. (2 marks).
- (b) Describe some of the ways of managing stormwater for urban, industrial, commercial and community uses. (2 marks).
- (c) Describe the threats to stormwater quality and how these might influence its treatment and use, and possible impacts on the receiving environment. (4 marks).

Section B: Water and Wastewater Treatment

(Answer 2 questions from this section)

Question 1

- (a) Describe the ways that water pollutants can be categorised. Detail and explain these categories and give examples of pollutants and possible causes of pollution in each category. (4 marks)
- (b) Explain natural water purification cycle – including but not limited to the role of the bacteria. (4 marks)

Question 2

- (a) Considering various water sources, discuss processes of water treatment for drinking water supply for each type of source. (3 marks)
- (b) Explain each process in a treatment train (processes) suitable for a water supply system for a town using surface water as its supply source. (5 marks)

(PTO)

Question 3

- (a) Choose a suitable wastewater treatment train (processes) for a town for achieving final effluent quality suitable for golf course irrigation. (2 marks)
- (b) Explain each process, its function / purpose and design consideration for it. (4 marks)
- (c) Explain the method of reclaimed water irrigation suitable for golf course irrigation and the measures need to be taken to prevent environmental harm and human exposure. (2 marks)

Section C: Guest Lecture Topics (Answer 2 questions from this section)

Question 1

- (a) Briefly discuss John Snow's pioneering epidemiological study of the cholera epidemic in 1850's London. [3 marks]
- (b) Is chlorination effective against all micro-organisms? For example, coliforms, *Cryptosporidium parvum* and protozoa? [2 marks]
- (c) Explain why multiple barriers are desirable in modern water treatment systems. [2 marks]

Question 2

Give a concise definition of the terms:-

- (a) osmosis (2 marks)
- (b) reverse osmosis (2 marks)
- (c) Determine how many 8" membrane elements (37 m²/element) are required to produce 1.0 ML/day of permeate at a permeate flux rate of 23.46 Lm⁻²h⁻¹. Show all calculations (4 marks)

Question 3

- (a) Describe how bubble-plume aerators work to reduce the growth of blue-green algae (cyanobacteria) in reservoirs, and compare their effectiveness against surface-mounted mechanical mixers. (4 marks)
- (b) What influences the effectiveness of the use copper sulphate for the control of (blue-green algae) cyanobacteria in reservoirs in South Australia? What is the most important factor that may reduce the effect of copper to kill the blue-green algae and why? (4 marks)

Question 4

You have the task of designing a processing wetland to treat the runoff from a new Greenfield urban development. You want to achieve the greatest removal of nutrients, heavy metals and suspended solids possible at reasonable cost. Space is not severely limited but the final design has to be visually pleasing and avoid problems of odours and insect pests.

List features you will incorporate in your design and explain the purpose or purposes of each feature. (8 marks)

(PTO)

Question 5 In relation to coagulation and flocculation processes:
Briefly describe each of the following terms: (you may use a diagram to further explain your descriptions)

- (a) Colloid (1 mark)
- (b) Diffuse layer (1 mark)
- (c) Stern Layer (1 mark)
- (d) Counter Ions and Co- Ions (1 mark)
- (e) Energy barrier and Energy trap (2 marks)
- (f) Charge neutralisation, (1 mark)
- (g) Sweep flocculation (1 mark).

End