The University of Melbourne
Semester 2 Assessment 2004

School of Agriculture and Food Systems
208-116
Environmental Engineering

Student Number
Reading Time: 10 minutes
Writing Time: 3 hours

This paper has 6 pages.

Authorised Materials:

Students may use any calculators

Instructions to Invigilators:
Students will require examination booklets in which to answer questions.

Instructions to Students:

Answer all questions
Answer all questions in the examination booklets provided
Read all questions carefully
No part of the examination material may be removed from the examination room

Paper to be held by Library: Yes

Useful Information:

The head loss due to friction can be calculated using:

$$h_L = \frac{kLQ^2}{\rho g C^2 D^5} \qquad \text{.....(1)}$$

where k = 10 when all the parameters are in metric units, L is the length of pipe (m), Q is the fluid flow (m^3/s), D is the pipe diameter (m), ρ is the density of the fluid (kg/m^3), g is the acceleration due to gravity and C is the coefficient of friction for the pipe. Typical values of C are 1.0 for steel pipes, 1.5 for concrete and 0.8 for plastic pipes (Wrigley, 1991).

Questions:

1. UPVC pressure pipe is to be used in a pressure irrigation system. The system requires 1500 m of Class 6 pipe.

   a) If a pump, which can deliver 10 litres/second is to be used, what would the head loss due to friction be in the pipe if 80 mm internal diameter pipe is used?
   b) What is the velocity of the water in the pipe?
   c) What difference in head loss due to friction would it make if 100 mm internal diameter pipe was used instead?

   (6 + 3 + 6 = 15 Marks)

2. A reinforced concrete boxed shape sump of dimensions 3 m x 3 m x 3 m is to be installed in the ground with the top at natural surface as part of a grain silo development. If the mass of the sump is 13.5 tonnes and the water table can potentially rise to the natural surface:

   a) At what water table elevation is there likely to be problems with the structure?
   b) What measures can be taken to avoid this problem?

   (6 + 4 = 10 Marks)

3. A rectangular section earthen channel, full with water, is 0.5 m deep and 5 m wide conveying water with a velocity of 1 m/sec.

   a) What is the flow rate of the channel in ML/day?
   b) If the depth is increased to 0.75 m what is the impact on the flow rate?

   (3 + 2 = 5 Marks)

4. A cylindrical water tank is 3 m high and 2.5 m in diameter. If the tank is full and sits on top of a 10 m high stand find:

   a) The pressure of water at the base of the tank.
   b) The pressure of water on a hose connected to the tank, which is at the base of the stand.
   c) The velocity of discharge from the hose (assuming zero hose friction) using $v = \sqrt{2gh}$, where g = 9.81 m/sec^2, h = head and v = velocity.

(2 + 2 + 1 = 5 Marks)

5. Demonstrate by mathematical example that the pressure in an incompressible fluid, such as water, must be proportional to the height of the fluid above the point where the pressure is being measured.

(10 Marks)

6. Answer the following:

   a) Describe what is meant by a system, indicating the steps involved in the process of system analysis.
   b) What is a state variable? Illustrate your answer by identifying some state variables for two systems.

(7 + 3 = 10 Marks)

7. Calculate the percentage advantage in drawbar power by using FWA compared with 2WD

   Test results: FWA mode = 40 kW @ 10% wheel slip
   2WD mode = 35 kW @ 10% wheel slip

(5 Marks)

8. Describe the Doppler effect and how it can be used to calculate the speed of a moving object using either Radar or "active sonar".

(10 Marks)

9. Complete the following survey results table:

BS	IS	FS	Rise	Fall	RL	Remark
0.30						Bench Mark
	3.90					
	1.05					
0.80		2.70				Instrument Change
	1.80					
	1.30					
	3.00					
	3.50					
	2.98					
		3.10				
						Totals
						Error =

(15 Marks)

10. With the aid of appropriate diagrams explain the operation of a 4 stroke, spark ignition engine.

(16 Marks)

11. Identify 5 strategies, which are used to improve the performance of engines.

(5 Marks)

12. Explain what a Geo-synchronous satellite orbit is and why it can be useful for remote sensing purposes.

(5 Marks)

13. Given the following information.

Task	Must Follow	Expected Time (in Days)
P	None	9
Q	P	12
R	Q	3
S	R and Z	7
T	P	11
X	None	8
Y	X	14
Z	T and Y	5

a) Draw a Gantt chart for the project
b) Draw a PERT chart for the project
c) How long should the project take from start to finish?

(6 + 6 + 2 = 14 Marks)

14. Knowing that $A = vwt\eta$, where v is the velocity (m/sec), A is the area (m^2), w is the implement width (m), t is the time taken to cover the desired area (seconds) and η is the field efficiency, determine:

a) The field efficiency of a 12 m wide cultivator being pulled by a tractor at 6 km/hr, which takes 2 hours to plough 10 ha of ground.
b) What speed will the tractor need to travel at if the farmer wishes to plough a 27 ha paddock in 4 hours.

(5 + 5 = 10 Marks)

15. Starting electric motors is a serious problem on some systems. Explain what the problem is and some strategies that are used to overcome it.

(5 Marks)

16. Write a few sentences to demonstrate your understanding of the following terms or expressions.

a) Heat capacity
b) Freezing Injury
c) Controlled atmosphere storage
d) Vapour pressure deficit
e) Relative Humidity

(10 Marks)

17. Cooling of fruit and vegetables after harvest is important in managing the rate of post-harvest changes. Several factors influence the rate at which produce can be cooled. For the factors listed below describe how they affect cooling rate.

a) Type of cooling medium - compare air with water
b) temperature difference between produce and cooling medium
c) Surface area to volume ratio

(5 + 5 + 5 = 15 Marks)

18. For a tractor:

a) Describe how you would increase the drawbar pull of a tractor on a cultivated soil.
b) Define "Stabilising Torque" and explain its importance in tractor safety. As part of your answer identify methods of improving stability.

(10 Marks)

End of Examination