



UNIVERSITY OF
KWAZULU-NATAL
INYUVESI
YAKWAZULU-NATALI

SCHOOL OF ENGINEERING

EXAMINATIONS: NOVEMBER 2025

COURSE AND CODE: PROJECTS AND THE ENVIRONMENT

ENCH4PE

DURATION: 2 HOURS

TOTAL MARKS: 100

INTERNAL EXAMINER(S): DR N BRIJMOHAN

INTERNAL MODERATOR(S): PROF D LOKHAT

EXTERNAL MODERATOR: DR L MAHARAJ

INSTRUCTIONS:

1. **ALL** questions should be attempted.
2. Any programmable or non-programmable calculator may be used provided it has been cleared of any information that would subvert the purpose of the examination.
3. Calculations must be shown in sufficient detail to illustrate your understanding of the procedure.
4. This examination question paper, together with all associated diagrams **MUST BE HANDED IN TOGETHER WITH YOUR SCRIPT.**

Student Number:

QUESTION 1

A project for a new chemical plant is represented in Activity-on-Arrow form with the following activities (i → j) and durations (days). Copy the table in your answer booklet and determine the earliest start time (ES), earliest finish time (EF), latest start time (LS), latest finish time (LF), and slack. Thereafter, determine the critical path and project duration.

Activity	Duration (days)	ES	EF	LS	LF	Slack
1-2	4					
1-3	6					
2-4	5					
3-4	2					
2-5	4					
4-6	7					
5-6	3					
5-7	6					
6-7	2					
6-8	4					
7-8	3					

TOTAL /30/**QUESTION 2**

In terms of environmental compliance, which aspects of a production process in a chemical factory need to be taken into account? Please present your substantiated answers in point form. Each point is worth two marks (20)

TOTAL /20/**QUESTION 3**

Answer the following questions based on wastewater treatment:

- Explain why monitoring the Food-to-Microorganism (F/M) ratio is important in an activated sludge system. (5)
- A municipal wastewater flow of 5 ML/day with a BOD concentration of 300 mg/L is treated in an activated sludge plant. The aeration system consists of three tanks, each 20 m long × 8 m wide × 5 m deep. The MLSS concentration = 3 000 mg/L. Determine the detention time, volumetric organic loading, and food-to microorganism ratio. (15)

Important formulae:

$$t = V/Q$$

$$\text{Volumetric organic loading} = \text{Mass of BOD/Aeration volume}$$

$$F/M = \text{Mass of BOD/Mass of MLSS in tanks}$$

TOTAL /20/

QUESTION 4

Decision-making is a critical part of implementing projects. Answer the questions that follow:

- a) Outline and briefly explain the decision-making process followed in project management. Present your answer in point form. Each point is worth two marks. (14)

- b) An entrepreneur is considering launching an e-sports venue. He/She has three mutually exclusive options:

A: Pop-up lounge (low capital)

B: Standard venue

C: Flagship venue (high capital)

Market research suggests three demand states for the first year with probabilities:

Low demand: 0.25

Medium demand: 0.45

High demand: 0.30

Estimated net profits (already net of setup costs) under each option and demand state are:

Option	Low	Medium	High
A: Pop-up lounge	20	35	45
B: Standard venue	5	50	80
C: Flagship venue	-20	40	120

Draw the decision tree with a decision node and chance nodes, and thereafter compute the EMV for each option. Finally, recommend the option with the highest EMV and justify briefly.

(16)

TOTAL /30/