



**SCHOOL OF COMPUTING AND ENGINEERING SCIENCES
MASTER OF SCIENCE IN SUSTAINABLE ENERGY TRANSITIONS
END OF SEMESTER EXAMINATION**

MSSET 8302: ENERGY PRACTICUM DESIGN

DATE: 15th August, 2023

Time: 2½ Hours

Instructions

1. This examination consists of **FOUR** questions.
2. Answer **Question ONE (COMPULSORY)** and any other **TWO** questions.

QUESTION ONE

(Total: 20 Marks)

Case Study 1

Study this case study and answer the following questions

Whilst refurbishing a large crankshaft prior to recoating in a given factory, a grinding wheel failed catastrophically. Part of the wheel struck the operator's head, fatally injuring him. The crankshaft was set up in conventional lathe (*a machine tool that rotates a workpiece about an axis of rotation to perform various operations such as cutting, sanding, knurling, drilling, deformation, facing, and turning*), and the bearings were to be reground using an attachment mounted on the lathe saddle. The maximum safe operating speed was marked on wheel but there was no indication of speed of grinding attachment and no means of adjusting the attachments to a safe speed. The wheel burst because it was used at over twice its safe operating speed. No guard was fitted to grinding attachment (to contain a wheel burst or to protect operators from contact with the wheel) and the lathe controls required the operator to be close to wheel.

- a. Identify and discuss any **two** unsafe conditions and acts in this case each that are;
 - i. of technical nature (2 Marks)
 - ii. related to human behaviour or management (2 Marks)
- b. Highlight four measures that can be taken to rectify the noted safety concerns. (2 Marks)
- c. There are three fundamental reasons for managing workplace health and safety. Discuss and contextualize them in case study 1. (4½ Marks)
- d. Prevention or control of a hazard can be illustrated using hierarchy of controls. Draw the hierarch and for each level, indicate the most ideal control measure to take. (3 Marks)
- e. Following an extensive analysis of the cause of the accident in case study 1, it was suggested that lathe machine be replaced with a safer one. You are tasked as a project manager to advice on which machine to purchase between the two whose specifications are shown in table 1 below. *Show all the steps to justify your decision* (5 Marks)

Table 1

No.	Specifications	Machine 1	Machine 2
1	Cost of acquisition (Ksh)	100 000	120 000
2	Duration of service (years)	8	10

3	Reselling price (Ksh)	10 000	12 000
4	Production per year	15 000	15 000
5	Calculatory interest rate (%)	7	7
6	Other fixed costs (\Ksh/year)	1 000	1 100
7	Labour costs (Ksh/year)	6 000	4 800
8	Material costs (Ksh/year)	1 500	1 500
9	Variable operational costs (Ksh/year)	1 850	1 600

- f. Highlight three project constraints (*with reasons*) to be considered in Q1(e) above. (1½ Marks)

QUESTION TWO

(Total: 15 Marks)

Case Study 2

Study this case study and answer the following questions

Juno Industries, a sugar factory located in the Western region of Kenya, has a capacity of crushing 3000 metric tonnes of cane per day. The factory has, directly and indirectly, employed over 300 workers on contract and casual basis. The factory has heavy machinery and boilers that use bagasse, coal, and biomass as fuel for heat in various stages of production, such as crystallization process. Over the last few years, there have been few reported incidences that has led to the death or injury of a number of workers or tractor drivers delivering sugar cane to the factory. Preliminary investigation put the blame on victims for not taking proper caution when working within the factory (e.g. walking on non-designated walking path/area, not wearing helmets and other protective clothing within the factory, tractor drivers not observing safety when the crane is offloading the cane delivered onto the conveyor belt system, etc.). However, a private investigator has put the blame squarely on the low sensitive and probably non-sensitive sensors that control the conveyer belt ferrying offloaded sugar cane to the crashing machine. Also, the crane offloading the cane is a bit old and there has been an incident (not formally reported) of the crane malfunction in the middle of offloading cane that led to the crane dropping the lifted cane injuring the tractor driver. Other identified issues include lack of proper heat isolation as the pathway near the boiler section is always hot and can harm the workers.

- a. Briefly discuss the problem solving steps in relation to case study 2 and show then in a diagram (5 Marks)
- b. One of the suggested solutions is replacement of the conveyor belt system with a new efficient unit. However, the new unit is slightly larger in size and may need restructuring of that section in the factory to accommodate the new unit.
 - i. Using design thinking methodology, discuss your strategy on how to successfully implement a feasible solution. (6 Marks)
 - ii. Identify and explain any four project constrains in this scenario? (2 Marks)
 - iii. Show how you can manage project constraints identified in Q2b(ii). (2 Marks)

QUESTION THREE

(Total: 15 Marks)

Case Study 3

Study this case study and answer question 3a below

John is an engineer in a large construction firm. He has been assigned the task of being the sole person to recommend rivets for the construction of a large apartment building. After some research and testing, he decides to recommend xyz company for the job, which he determines are of the lowest cost and highest quality. On the day after John's decision was made, an xyz company representative visits him and gives him a voucher for an all-expense-paid trip to the

annual xyz company Technical Forum, which meets in Canada. The trip will have considerable educational value, but will also provide day trips to the beach and other points of interest.

- a. Resolving moral/ethical dilemmas by using line-drawing is one of the best techniques of addressing this ambiguity. Analyze the ethical dilemmas in case study 3 using line drawing technique. (*analyze six dilemma features using the format shown in table 2*) (6 Marks)

Table 2

No.	Feature	Paradigm (Ethical)	Test Case	Paradigm (Non-Ethical)
1				
2				
3				

- b. Sometimes, you may be faced with an ethical dilemma which can be referred to as on-the-Job Ethical Dilemma as it relates to the common business ethical challenge. This type of the dilemma can be categorized into 4 distinct categories. Describe these four categories. (4 Marks)
- c. Discuss the difference between portfolio management and project management in terms of the purpose, focus, planning emphasis and responsibility (2 Marks)
- d. Elaborate three important aspects of skills matrix in project management. (3 Marks)

QUESTION FOUR

(Total: 15 Marks)

Case Study 4

Study this case study and answer the following questions

Spillage of titanium tetrachloride occurred when a heat treatment furnace of a fertilizer manufacturing factory was being serviced by the manufacturer's engineer. The engineer who was servicing the furnace spoke little English, was not wearing appropriate PPE and seemed unaware of correct emergency procedures. When he noticed the spillage, he applied water to it to try to decontaminate and mitigate the effects of the spillage. Unfortunately, applying water to the spillage increased the amount of hydrogen chloride generated. The extractor fan was turned on, exhausting the fume into in the yard of a neighbouring firm during a break time resulting in sixty-six people being taken to hospital.

- a. Identify and discuss all the parties who should be held liable for the harm caused. (3 Marks)
- b. How can we use economic tools to deal with environmental problems and reduce possibility of occurrence on incidences witnessed in case study 4? Discuss three approaches. (3 Marks)
- c. Describe the environmental impact assessment (EIA) process. For each step/process, discuss the key activities that must be carried out to realize successful EIA. *Answer this question with reference to case study 4* (6 Marks)
- d. Argue your case on whether there is a possibility that EIA was or was not carried out during the establishment of the factory in case study 4. (3 Marks)