NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

BENG HONORS DEGREE IN INDUSTRIAL AND MANUFACTURING ENGINEERING

ENVIRONMNETALLY CONSCIOUS MANUFACTURING

EIE/TIE5214

MARCH 2025

This examination paper consists of **5** printed pages

Time Allowed: **3 hours**

Total Marks: **100**

Examiner's Name: **PROF D ZIMWARA/MRS T.T. CHIGAVAZIRA-GWARA**

INSTRUCTIONS AND INFORMATION TO CANDIDATE

1. Answer Question 1 (COMPULSORY) and any other FOUR **(4)** Questions.
2. Each Question carries a total of 20 Marks.
3. Start the answer to each full question on a fresh page.
4. Ensure neatness and legibility of work.

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QUESTION 1 (COMPULSORY)

Read the Case study below and answer the following questions.

Case Study Green Manufacturing

Fritto Lay the multibillion-dollar snack food giant, requires vast amounts of water, electricity, natural gas and fuel to produce its 41 well know known brands. In keeping with growing environmental concerns, Frito Lay has initiated ambitious plans to produce environmentally friendly snacks. But even environmental impact the firm is an aggressive green manufacturer with major initiatives in resources reduction and sustainability.

For instance, the company's energy management program includes a variety of elements designated to engage employees in reducing energy consumption. These elements include scorecards and customised action plans that empower employees and recognise their achievements.

At Frito Lay factory in Casa Grande, Arizona, more than 500000 pounds of potatoes arrive every day to be washed, sliced, fried, seasoned and portioned into bags of Lays and Ruffles chips. The process consumes enormous amounts of energy and creates vast amounts of wastewater, starch and potato peeling. Frito Lay plans to take that plant off the power grid and run it almost entirely on renewable fuels and recycled water. The managers at the Casa Blanca plant have also installed skylights in the conference room, offices and a finished goods warehouse to reduce the need for artificial light. More fuel-efficient ovens recapture heat from the exhaust stacks. Vacuum hoses that pull moisture from the potato slices recapture the water and to reduce the amount of heat needed to cook the potato chips are also being used.

Frito lay also built over 50 acres of solar concentrators behind its Modesto, California plant to

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generate solar power. The solar power is being converted into heat to cook Sun Chips. A biomass boiler which will burn agricultural waste, is also planned to provide additional renewable fuel.

Frito Lay is installing high tech filters that recycle most of the water used to rinse and wash the potatoes. It also recycles byproducts to make Doritos and other snacks; starch is reclaimed and sold primarily as animal feed and leftover sludge is burnt to create methane gas to run the plant boiler.

There are benefits besides the potential energy savings. Like many other large corporations, Frito Lay is striving to establish its green credentials as consumers become more focused on environmental issues. There are marketing opportunities too. The company for example, advertises that its popular Sun Chips snacks are made using solar energy.

At Frito Lay Florida plant, only 3.5% of the waste goes to landfills, but that is still 1.5million pounds annually. The goal is zero waste to landfills. The snack food maker earned a post in the National Environmental Performance Track program by maintaining a sustained environmental compliance record and making new commitments to reduce reuse and recycle at this facility.

Substantial resource reductions have been made in the production process, with an energy reduction of 21% across Frito Lay's 34 US plants. But the continuing battle for resource reduction continues. The company is also moving toward biodegradable seasoning bags, and cans bottles. While these multilayer initiatives are expensive, they have the backing at the highest levels of Frito Lay as well as executives at PepsiCo, the parent company.

Answer the following questions

a) Using resources, regulations and reputation as a basis, what are the sources of pressure on a firm such as Frito Lay to reduce their environmental footprint? [5]

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b) Identify the specific techniques that Frito Lay is using to become a green manufacturer. [5]

c) How does green manufacturing differ from conventional ways of manufacturing? [5]

d) Compare Frito Lays green policies and the company you were attached to. [5]

QUESTION 2

a) What is enegy efficiency in relation to manufacturing? [2]

b) Discuss any 4 energy efficiency strategies. [8]

c) Describe the elements cleaner production? [4]

d) Do you think Cleaner Production is easy to adopt? Discuss. [6]

QUESTION 3

a) What are the benefits of ISO 14001? [10]

b) Explain with the aid of sketches how the following technologies work:

i. Electrostatic Precipitator. [5]

ii. Wet Air Scrubber. [5]

QUESTION 4

a) Briefly outline any 10 Sustainable Development Goals. [10]

b) Describe any 5 examples of sustainable development that can be adopted locally by your community. [10]

QUESTION 5

a) Describe the waste minimization methodology. [10]

b) How do manufacturing activities adversely affect the environment? Discuss. [10]

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QUESTION 6

a) Describe the stages of Life Cycle Assessment. [8]

b) What do you understand by the term Life Cycle Costing? [3]

c) Outline any 3 environment protection regulations in Zimbabwe. [9]

QUESTION 7

a) Discuss the different types of waste disposal you know. [5]

b) What would you recommend to your local authority in a bid to improve waste management in your city/town ? [10]

c) What is the role of Environment Managemnt Agency (EMA) in protecting the environment. [5]

END OF QUESTION PAPER-

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