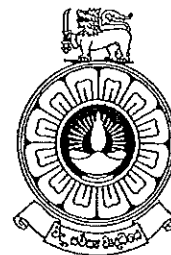


THE OPEN UNIVERSITY OF SRI LANKA

CENTRE FOR ENVIRONMENTAL STUDIES AND
SUSTAINABLE DEVELOPMENT

M.Sc. IN ENVIRONMENTAL SCIENCES- LEVEL 10 - 2017/18

PHPA309/NEP2222 – Cleaner Production
Final Examination



DATE: 2nd December 2018
TIME: 1.30 pm – 4.30 pm

DURATION: THREE HOURS

Index NO:

IMPORTANT INSTRUCTIONS TO CANDIDATES

- Write your INDEX NUMBER in the Answer Script
- This question paper consists of four (04) pages with nine (09) Essay type Questions.
Answer **06 questions only**.
- Write answers in separate papers.



(1) “Neat Wash” is a small washing soap manufacturing plant producing 80 gram cakes of soap and 400 gram soap bars. Their process for making 80 gram cakes is as follows.

Palm Oil (Low grade) and caustic soda flakes are stored in their raw material stores in bulk. For a day they use 4 barrels of Palm oil (each barrel is 200kgs), 400 kgs of caustic soda and 50 kgs of other chemicals. These are issued on a daily basis to the production floor.

First the oil is poured into buckets from the barrels and weighed. The oil weighed is poured into a large pivoted cooking vessel. The weight of oil per batch is 200 kgs. Then oil is heated using LP gas. When oil is 70 degrees C 100 kg of caustic soda is added and rapidly stirred. Once the caustic soda is dissolved the mixture 12.5 Kgs of chemical mixture is added and stirred continuously until it becomes thick. Once the mixture is uniform the vessel is turned horizontal level on the pivot to pour the soap mixture into prepared wooden moulds on which oil paper is laid. Each mould can have 20 kgs and they pour 15 moulds per batch. There will be remaining hardened soap in the vessel which they scrape off before the new batch begins. The scraped materials is stored separately and sold to outsiders at Rs 25/- per Kg. The oil spills, soda spills and chemical spills are washed away at the end of the day.

These moulded soap is allowed to cool for 4 hours and they are removed from the mould and cut into long strips by a band saw. The strips are then cut into pieces by a cutting machine. . These pieces are then stamped in hand presses. There are off cuts from the stripping, cutting operations and spills from the stamping operation. The oil paper from the moulds is also discarded after one use.

He stamped soaps are sent to the packing department. The soaps are sorted and wrapped in a oil paper and then in a final printed paper packing. These wrapped cakes are then packed in corrugated cartons and sent to the finished goods stores. Each carton will carry 48 cakes of soap. The total number of cartons of soap packed per batch is 70. The company operates 4 batches per day.

a) Draw a process flow diagram for the soap making process. (70 marks)

b) Identify the waste streams of the process and mark them on the process flow

diagram. (30 marks)



(2) The 'Neat Wash' soap making company (refer Q1) has decided to obtain ISO 14001 certification for their operation.

Explain in detail how they should organize themselves to obtain ISO 14001. (50 marks)

What steps do they have to take to establish the ISO system in the plant? Explain your answer using PDCA cycle. (50 marks)

(3) "A concrete sleeper is more environmentally friendly than a wooden sleeper."

a.) Do you agree to this statement? Explain your answer using the concept of life Cycle thinking (30 marks)

b.) Draw the life cycle of a concrete sleeper and describe in what stage of the life cycle it has the highest resource consumption.(50 marks)

c.) Suggest two ways to reduce resource consumption of a concrete sleeper during its life time.(20 marks)

(4) Answer all the questions

a) According to the standard Cleaner Production Methodology there are six phases in Conducting a comprehensive CP assessment. List out the six phases of the CP methodology and tasks under each phase briefly describing what these phases will achieve. (60 marks)

b) The first phase is called Getting started. What are the activities under this phase and how important are them to the successfully carrying out a CP assessment.(40 marks)

(5) a) When conducting a Cleaner Production Assessment, the second step of the methodology is Analysis the processing steps, which is considered to be very important. List out the 4 tasks involved in the analysis of processing steps and briefly explain the role and respective outcomes of each task. (60 marks)

b) It is said that calculating CP potential through costing of wastes is very important. Explain the 'CP Potential' by discussing its importance. (40 marks)



- (6) a.) Briefly explain how a product can be redesigned using eco design principles to make it environmentally friendly. (30 marks)
- b) What are the 8 strategies of eco design used in a redesign of a product? (50 marks)
- c) Briefly explain what are the benefits received from eco designing a product. (20 marks)
- (7) Waste Management Authority has requested you to visit a municipal council to study their solid waste management system and propose suitable measures to improve the situation. When you visited the field, you found that Municipal Council is collecting mixed waste from households and transport them in open tractors and deliver them to an open dumpsites, where workers dump all the wastes and cover the daily lot with soil.
- a) Using the conventional waste management hierarchy, you are required to prepare a short concept paper on problems with the waste management system by explaining the ways to improve the situation. (60 marks)
- b) Also write a short note to the Mayor on the drawbacks of the open dump and recommend the most suitable land fill type for the final disposal. (40 marks)
- (8) a.) Integrated Solid Waste management suggests a hierarchy of waste management. Draw a triangle showing each stage of hierarchy of waste management indicating order of preference. (30 marks)
- b.) Briefly describe the stages of life cycle of a solid waste from generation to disposal. (40 marks)
- c.) Give 3 methods to solve the problem of solid wastes through recovery of resources. (30marks)
- 9) Write short notes on 4 of the following. (Each carry equal marks)
- i) Use of Brain-storming technique for generation of CP options
 - ii) CP team is a necessary requirement to conduct a CP assessment
 - iii) Bio degradable solid waste can be converted to bio gas to be used as a fuel
 - iv.) Segregation of solid wastes increase the value of the resources in the bulk
 - v.) Greening of supply chain
 - vi.) Certification of products through green labels

