THE OPEN UNIVERSITY OF SRI LANKA

CENTRE FOR ENVIRONMENTAL STUDIES AND SUSTAINABLE DEVELOPMENT

M.Sc. IN ENVIRONMENTAL SCIENCES- LEVEL 08 - 2015/16

NEP 2222 – Cleaner Production

Final Examination

DATE: 06th November 2016

DURATION: THREE HOURS
TIME: 1.30 pm – 4.30 pm

REGISTRATION NO: .....

IMPORTANT INSTRUCTIONS TO CANDIDATES

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

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NEP 2222 – Cleaner Production

(1) Cleaner Production is an approach to help industries to reduce their environmental performance through reduced resource wastage.

a) What are the six stages of cleaner Production assessment methodology? *(25 marks)*

b) Among the six stages analysis of the process is considered a crucial for successful CP assessment. Explain the activities involved in the process analysis stage stating the desired outcome of each activity? *(40 marks)*

c) Brain Storming is recommended as the most suitable approach for generating CP options during the option generation stage of the CP assessment. Briefly explain how to do a brain storming session highlighting Do's and Don'ts in conducting a brain storming session? *(35 marks)*

(2) You have been selected as the environmental manager of a large food manufacturing company. The first task assigned to you is to develop an environmental management system to obtain ISO 14001 for the company. For this assignment you are designated as the Environmental Management Representative of the company.

a) Explain in your own words what would be the methodology you would use to develop the Environmental Management System indicating key stages of the proposed methodology? *(25 marks)*

b) List out all the main tasks under each stage of the proposed environmental management system? *(40 marks)*

c) It is said that environmental policy is the main guidance document for an Environmental Management System (EMS). What are the main contents of an environmental policy?

(35 marks)

(3) Answer all questions

a) In cleaner production approach causes of generation of wastes are grouped into eight different categories. List these waste categories giving an example for each waste category? *(40 marks)*

b) There are three main strategies and eight CP techniques defined to find solutions for above waste causes. List out the three strategies and the eight CP techniques showing the relevant CP techniques under each strategy? *(40 marks)*

c) In the implementation of the above CP strategies and techniques indicate the order of implementation? *(20 marks)*

(4) "A Cloth Handkerchief is more environmentally friendly than a Paper Facial Tissue."

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 cloth handkerchief and describe in what stage of the life cycle it has the highest resource consumption? *(45 marks)*

c) Suggest two ways to reduce resource consumption of a cloth handkerchief during its life time? *(25 marks)*

(5) During a meeting held at the Department of Agriculture to improve productivity of Tomato cultivators, the farmers complained about the wooden crates, used by them for carrying and transporting tomatoes. The crates were too heavy to carry and pose a safety threat, have a short life span of three cycles and sometimes break while carrying the load, thus damaging the product.

The transporters also complained that the crates break frequently and therefore they also loose the income from the tomatoes transported. Besides they were reluctant to transport these empty crates back as these were bulky.

The Department has requested you to examine the above problem and suggest a suitable solution.

a) What factors would you consider as relevant in redesigning a crate that is "friendly" to both the farmers and the transporters and the environment? *(30 Marks)*

b) Briefly explain the approach you would take to redesign the tomato crate according to eco design principles and strategies? *(50 marks)*

c) What economic, environmental and social benefits will a new design offer? *(20 marks)*

(6) Answer all parts of the question.

a) What is Integrated Waste Management and what benefits it will bring to an industry? *(30 marks)*

b) 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)*

c) Briefly describe the stages of life cycle of a solid waste from generation to disposal? *(40 marks)*

(7) a) Following quantities of raw material inputs and waste streams are generated by a process for a day (All are in kilograms)

Main Raw material- M	Main Output- P
Auxiliary raw material A- m1	Waste stream 1-w1
Auxiliary raw material B- m2	Waste Stream 2-w2
Auxiliary raw material C- m3	Waste Stream 3-w3
	Waste stream 4-w4

Write an equation for to show the material balance of the process *(20 marks)*

b) For the process indicated in Figure Q7 in page 5, conduct a material balance for a batch with following quantities. *(40 marks)*

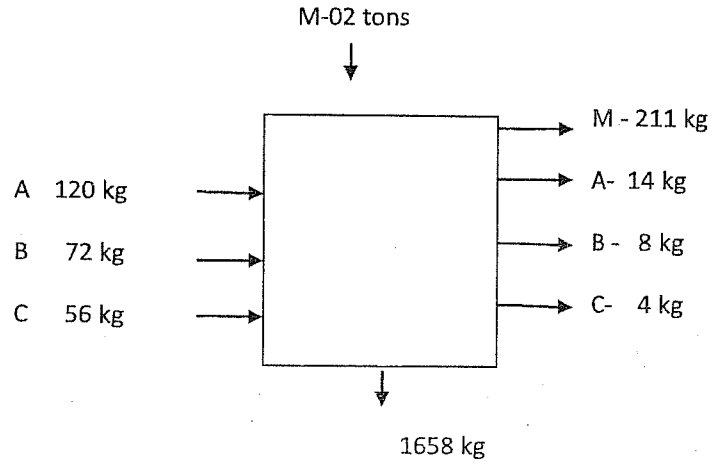


Figure Q7- Sample process

c) If the prices of raw materials M, A, B and C are Rs 40/-, Rs 200/_, Rs 360/- and Rs. 600/- per kilogram, respectively and for a year they do 300 such batches calculate the Cleaner Production Potential of this process *(40 marks)*

(8) a) You are hired by a company as sustainability consultant. They want to ensure that their suppliers are environmentally more responsible. Explain what strategies and actions you will use to make them green. *(30 marks)*

b) What criteria you will use to verify that the suppliers are green? *(40 marks)*

c) Briefly explain what is an Eco Label for a product? *(30 marks)*

(9) A factory producing activated carbon receives 100,000 coconut shell pairs per day. The weight of a pair of coconut shells is 110 grams. The coconut shells are then cleaned in a rotary sieve driven by an electric motor. The amount of debris removed during this process is 200 kg. The remaining shells are then loaded into a kiln and are fired. The coconut shells are then partially burned to charcoal without adding any fuel and the exhaust gases are trapped to run the boiler. The remaining weight of the coconut shells after partial burning is 4320 kg. The charcoal is again sieved to remove the dust and small pieces. The dust removed is 140 kg and small pieces are 180 kg. The remaining large charcoal pieces are then packed into barrels. Each barrel can contain 200 kg. The barrels are then transported to activation section. The charcoal is then automatically unloaded to two chambers. The capacity of each chamber is 2000 kg. The

chambers are then supplied with steam 10 bar. The steaming process takes 30 minutes. After steaming the charcoal in the chamber is converted into activated carbon. The activated carbon is then dried using hot air at 80 degrees. The drying process takes about 2 hours. The remaining dried charcoal weighs 3800 kg. The charcoal is then send to the packing department by a conveyor and the charcoal is packed into 25 kg bags. The bags are then stored in the finished goods stores until loaded into a container every 5 days. The factory works only 240 days per year.

a) Prepare a process flow diagram for activated carbon making process. *(40 marks)*

b) Do a material balance and quantify the total losses to the company per day *(40 Marks)*

c) If coconut shells are purchased at Rs0.20 per pair, calculate annual loss to the company through wastages. *(20 marks)*