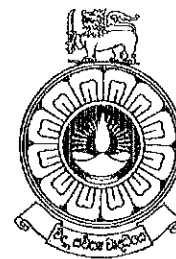


THE OPEN UNIVERSITY OF SRI LANKA
CENTRE FOR ENVIRONMENTAL STUDIES AND
SUSTAINABLE DEVELOPMENT



M.Sc. IN ENVIRONMENTAL SCIENCES- LEVEL 08 - 2016/17

Final Examination - NEP 2222 – Cleaner Production

DATE: 25th November 2017

TIME: 9.30 am – 12.30 pm

IMPORTANT INSTRUCTIONS TO CANDIDATES

- Write your Index Number in the Answer Script
- This question paper consists of five (05) pages with nine (09) Essay type Questions.
Answer **06 questions only**.
- Write answers in separate papers.



(1) Industries can improve their environmental performance while increasing their profits by the application of Cleaner Production

- a) Briefly explain what is Cleaner Production. *(25 marks)*
- b) Cleaner Production assessment methodology is an organized approach to identify wastes and generate solutions to eliminate or reduce wastes in an enterprise. List the phases in the CP assessment methodology with tasks in each phase. *(50 marks)*
- c) List five(5) benefits of successful implementation of Cleaner Production. *(25 marks)*

(2) Implementation of ISO 14001 Environmental Management System(EMS) in an enterprise requires a systematic approach.

- a) Using a diagram explain what is Deming's cycle which is the foundation of ISO 14001 EMS. *(30 marks)*
- b) What are the major activities in the implementation phase of an ISO 14001 EMS Program? *(30 marks)*
- c) Environmental policy is the core for an Environmental Management System (EMS). List the 8 main requirements to be addressed in developing an environmental policy to make it an effective policy. *(40 marks)*

(3) a) According to cleaner production(CP) approach, wastes are categorised into eight(8) different groups. Citing an example for each waste category, list the eight categories of wastes. *(40 marks)*

b) The solutions to prevent wastes are termed as CP techniques. In standard Cleaner Production approach the techniques are divided into eight groups. List the eight techniques in CP. *(40 marks)*

c) The options generated in a CP assessment are then screened by dividing them to three groups. What are the three groups of options used in screening ? *(20 marks)*



- (4) "A Glass Bottle is more Environmentally friendly than a Plastic Bottle."
- Explain why this is only a value statement and what decision tool you will use to explain this statement more scientifically. (25marks)
 - Glass Bottle is made using extraction of Silica sand, cleaning them and melting them using heat and pouring the glass in liquid form to moulds and cooling them. The cooled bottles are then distributed, used, recycled. Draw the life cycle of a glass bottle using the above information. (50 marks)
 - List the four stages of Life Cycle Analysis (25 marks)
- (5) During a training program conducted on addressing environmental factors in product design for wood based industries, a group of participants decided to study a revolving wooden chair to improve its performance and reduce environmental negative impacts.
- How will environmentally friendly product design differ from conventional product design? (25 marks)
 - What factors would you consider as relevant in redesigning the chair to make it more environmentally "friendly" and resource efficient? (50 Marks)
 - What economic, environmental and social benefits will a new design offer? (25 marks)
- (6) a) What are major differences between current waste management and integrated Waste Management? (20 marks)
- In Integrated Solid Waste management, Prevention is considered the most preferred strategy while final disposal as the least preferred strategy. Using the stages of hierarchy of waste management explain the strategies in integrated waste management in the order of preference? (50 marks)
 - Name the four types of final disposal landfills and indicate which types is the most beneficial for wastes disposal? (30 marks)
- (7) A paint factory producing a floor paint is using the following materials for the production of their special floor paint.

Given below are data on weekly inputs, weekly outputs and weekly wastes in a paint factory producing a special floor paint.



Weekly Inputs: Acrylic resin 12 barrels of 200 kgs (Price Rs 240/- per kg) ,TiO₂- 620kgs (Price Rs 300/- per kg) , Filler 480kgs (Rs 30/- per kg), Color- 64 kgs (Rs 360/- per kg),
Dryer 36 kgs (Rs 900/- per kg)

Weekly Wastes: Resin- 124kgs, TiO₂-76kgs, Filler- 42 kgs, color- 6 kgs, Dryer- 8 kgs,
Damaged paint- 36 cans of 4 kgs

Weekly Output; 750 cans of 4 kgs

- (a) Conduct a material Balance and find the unaccounted waste generated in the factory for one week. (50 marks)
- (b) Calculate the CP Potential of this factory. (CP potential is the cost of total wastes generated by the factory for one full year) (50 marks)
- (8) Answer all parts of the question.
- Greening the supply chain is a strategy used by large buyers to make their suppliers environmentally friendly. Explain how suppliers can become green in this approach. (40 marks)
 - What are the different tools a company can use to convert the suppliers to become green? (30 marks)
 - Briefly explain what is an Eco Label for a product? (30 marks)
- 9) A university intern studied the operations of a laundry to develop a process flow diagram for his Cleaner Production studies. He wrote down all the operation but not in the correct sequence. These operational steps are shown below. The laundry has one washing machine and one dryer.
- Load 25kgs of clothes into the washing machine.
 - Fill water
 - Inspect all the clothes to find any foreign matter
 - Do a preliminary wash without detergents to remove any debris
 - Sort all the clothes to different colours and categories
 - Rinse after the detergent wash
 - Add detergents and do a wash
 - Second rinse
 - Dry the clothes in the dryer
 - Third and final rinse after adding the softner (a chemical used for soft feeling)
 - Ironing using hand held irons
 - Spinning to remove water after the final rinse



- a) Write the process steps in the correct sequence to show the full laundry operation.(20marks)
- b) Draw a process flow diagram for the entire process. (50 marks)
- c) Show all resources used and waste streams on the process flow diagram. (30 marks)

(Use of correct symbols and neatness of the Process Flow diagram are important in the answer. Do not show waste streams separately.)

