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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

September / October 2023 Semester End Main Examinations

Programme: B.E. **Semester: I / II**
Branch: Common to all Branches **Duration: 3 hrs.**
Course Code: 22ME1ETISE / 22ME2ETISE **Max Marks: 100**
Course: Introduction to Sustainable Engineering

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may suitably be assumed.

MODULE - I

1	a)	Discuss the key attributes of graduate engineer.	**05**
	b)	Explain the following; systems thinking, and life cycle thinking.	**05**
	c)	Discuss the need of a circular economy and its relevance with neat sketches and examples for sustainable development of India.	**10**

OR

2	a)	Discuss the Factor 4 and Factor 10 with reference to the implementation of sustainability engineering.	**08**
	b)	List all the sustainable development goals as defined by the United Nations Department of Economic and Social Affairs (UNDESA) and explain any four goals.	**12**

MODULE - II

3	a)	Define the following terms: (i) Energy sustainability, (ii) Sustainable engineering, (iii) Green economy, (iv) Low carbon economy, (v) Triple bottom Line.	**10**
	b)	Why do you think Environmental Management Systems and Environmental Impact Assessment procedural tools provide solutions for sustainable development? Explain.	**10**

MODULE - III

4	a)	Consider the commonly used household appliance (refrigerator), and describe its environmental concerns at each stage of its life cycle (cradle-to-grave).	**10**
	b)	Discuss the need, goal and scope for life cycle assessment (LCA).	**05**
	c)	List the strengths and limitations of LCA	**05**

MODULE - IV

5	a)	What is carbon foot printing? List out the direct and indirect greenhouse gas emissions (GHG). Why do you think it is necessary to reduce GHG gases and	**06**

what measuring steps are taken by the world leaders?

b) Discuss any four LCA applications in the field of engineering. **10**

c) List out five economic instruments and discuss any one instrument how it can used for protection of environment. **04**

MODULE - V

6 a) What are the conventional Design process followed and what changes has to be made to make it a sustainable one. **10**

b) Draw a neat sketch showing the sustainability design strategy wheel and briefly explain all seven strategies. **10**

OR

7 a) To enable innovation for sustainability engineers have to develop key individual Principles list the same and explain briefly. **08**

b) Read the following case study on a product redesign regarding a trailer for rural transport of crops in Ghana (Source: Crul and Diehl, 2006) and identify the design for sustainability strategies which have been used: **12**

The company REAL ("Rural Enterprise for Agro Logistics") is an enterprise working for, and partly owned, by farmers and agro-managers in Ghana. The project was carried out in 2003 and had the aim to design a means of rural transport for crops that would reduce post-harvest loss, thus increasing crop market value and improving labor conditions for farmers (men and women) in Ghana. This sustainable transport system was designed with locally available materials and production methods suitable for Ghana. The design took into consideration the influences of local culture and social habits. The concept development phase began with the generation of concepts from a functional point of view. The concepts were made out of combinations of the several functions and were clustered into three design directions. After identifying the available materials, further constraints were encountered and considerations were made. Three design directions resulted in three concepts, the Plain trailer, the Combi trailer, and the Crate trailer. The Plain trailer concept consisted of one loading space, created with wire mesh. The Combi trailer could carry almost any kind of container and had the possibility to create one space, from wire mesh as well. The Crate trailer could only fit plastic crates from an industrial containers producer in Tema. After taking several steps in development a fourth concept, the Multi trailer was generated out of the Combi and Crate trailers. The Multi trailer concept offered the opportunity to use almost any kind of container to transport the crops. It was especially designed for current use as well as future use anticipating the introduction of a complete logistic system based on crates by REAL. After comparing the four concepts on design guidelines, the Crate trailer and the Multi trailer proved to be the two most feasible concepts. Both concepts were constructed in a Ghanaian workshop. Before going into production, models were constructed. This required locating a workshop, a welder, buying the materials, and finding specific components for the construction of details of the trailers. As soon as

the models were finished, they were tested in the two regions in the south. After observation and evaluation of the models in use, small changes were made to improve performance. The last test in the north was performed and evaluated as well. It appeared that at least twice the amount of head load could be transported in the same time or even faster. The users of the trailer appreciated the ease of use and maneuvering, the increased amount of products that could be loaded and the width of the total trailer which could be used on small paths. After testing both the Crate trailer and the Multi trailer on the design guidelines, it was evident that the Multi trailer needed to be further defined. The dimensions of the Multi trailer were further optimized in Solidworks, a 3D modeler, in the Netherlands. This model contains the basic construction and some details. The Multi trailer potential results include:

• Transportability was improved: The trailer was suitable for single path roads, double track grass roads, feeder roads and asphalt roads, except for Abor where it is only suitable for single and double track roads.

• Efficiency was increased: Twice the amount of crops could be transported in the same time or faster.

• Ergonomics of handling crops was improved: The burden on the farmers (men and women) was lightened.

• The trailer could be produced locally: It could be produced with production methods available in Ghana and made from locally available materials. The construction of the trailer could be optimized for weight and weld type and production could be simplified. Promote the use of trailers amongst women, as well as in the transport of the crops. In summary, the Multi trailer reduced the post-harvest losses thereby increasing the farmers' income. Labor conditions have improved due to the lighter burden

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