



In addition to Part-I (General Handout for all courses appended to the timetable), this portion gives further specific details regarding the course.

Course Code : MF F485
Name of the Course : Sustainable Manufacturing
Instructor-In-Charge : KULDIP SINGH SANGWAN

I. Scope and Objective of the Course

Growing awareness and concerns about climate change, energy security and natural resource scarcity led by the rapid expansion of economic activity in the last two decades have put government and business under immense pressure to optimize the natural resources, to increase use of renewable energy and recycled material and to reduce the environmental effects involved in the production and consumption of goods and services. The primary objective of this course is to provide environmental, economical and social perspective of manufacturing processes, systems and tooling including material, energy and toxicity analysis during the various phases of product life cycle. A multidisciplinary approach will be undertaken. Collection and analysis of real world data from industry will be encouraged.

II. Textbook

1. K S Sangwan, A K Digalwar and Monica Sharma, 2011, Sustainable Manufacturing, EPH, New Delhi (soft copy)

III. Reference Papers

1. V K Mittal, 2013, Development and Validation of Drivers for, Barriers to and Stakeholders of Green Manufacturing, Phd Thesis, 2013, BITS Pilani <https://shodhganga.inflibnet.ac.in/handle/10603/25544?mode=full>
2. KS Sangwan, Development of a multi criteria decision model for justification of green manufacturing systems, International Journal of Green Economics 5 (3), 285-305
3. KS Sangwan, Performance value analysis for justification of green manufacturing systems Journal of Advanced Manufacturing Systems 5 (1), 59-73
4. KS Sangwan, Evaluation of manufacturing systems based on environmental aspects using a multi-criteria decision model, International Journal of Industrial and Systems Engineering 14 (1), 40-57.
5. Yovana M.B. Saavedra, Ana P.B. Barquet, Henrique Rozenfeld, Fernando A. Forcellinic, Aldo R. Ometto, Remanufacturing in Brazil: case studies on the automotive sector, Journal of Cleaner Production, 2013, 1-10
6. AM King, SC Burgess, W Ijomah and CA McMahon, Reducing waste: repair, recondition, remanufacture or recycle?, Sustainable Development, Vol 14, 2006, 257-267.
7. Christoph Herrmann; Marcus Mansour, Marc Mateika, Strategic and Operational Life Cycle Management – Model, Methods and Activities, Proceedings of the 12th International CIRP Seminar on LCE 2005, Laboratoire 3S, Grenoble, France, April 3-5, 2005
8. KS Sangwan, AK Digalwar, V Bhakar, Life Cycle Assessment and Comparison of CRT, LCD and LED Monitors, Procedia CIRP, 2015, Vol 29, pp. 433-438.





9. Kuldip Singh Sangwan, Vikrant Bhakar, Shilpa Naik and Sylvi Nazareth Andrat, Life cycle assessment of incandescent, fluorescent, compact fluorescent and light emitting diode lamps in an Indian scenario, Procedia CIRP, Vol 15, 2014, pp 467-472.
10. S. G. Lee, S. W. Lye and M. K. Khoo, A Multi-Objective Methodology for Evaluating Product End-of-Life Options and Disassembly, Int J Adv Manuf Technol (2001) 18:148–156
11. Nicola Morelli, Developing new product service systems (PSS): methodologies and operational tools, Journal of Cleaner Production 14 (2006)
12. Anil Jindal, Multi-objective Design and Optimization of a Closed-loop Supply Chain Network, and Assessment of Collection Methods, Product Recovery Methods and Network Configurations, PhD Thesis, 2015, BITS Pilani.
13. Vikrant Bhakar, development of a sustainability assessment framework for manufacturing industry, PhD Thesis, 2018, BITS Pilani.

IV. Course Contents

Topic	Learning Objectives	Learning Outcomes	Number of Lectures
1. Introduction	Overview, WEEE, triple bottom concept of environment, economy and society	To understand the effect of manufacturing on sustainable development in terms of environmental, economic and social impacts.	3
2. Sustainable manufacturing implementation factors	Drivers for, barriers to, and stakeholders of sustainable manufacturing	To find and analyze the drivers, barriers and stakeholders. To prioritize the drivers, barriers according to industry, government and expert perspectives. Classification of stakeholders.	6
3. Sustainable manufacturing design	Eco-innovation, design for environment, design for disposal, design for energy efficiency, design for material efficiency, sustainable materials, sustainable energy	To understand the importance of design for various sustainability elements.	4
4. Life cycle management and assessment	Strategic and operational evaluation of technologies using life cycle concept, MET analysis, environmental impact assessment, various impact assessment models,	To understand the concept and importance of life cycle management. To do life cycle assessment of products and processes based upon end-point and mid-point categories.	5
5. End of life (EOL) strategies	End-of-life strategies and product definition, reverse logistics	To understand the 3R concepts from design and operational perspectives.	4





Topic	Learning Objectives	Learning Outcomes	Number of Lectures
6. Sustainability assessment framework	Readiness assessment and sustainability assessment	To develop critical factors, resource perspective and assessment models	3
7. Circular economy and sustainable manufacturing	objectives, design and framework of a circular economy	To develop a framework and critical factors for design of a circular economy	2
8. Sustainable business models	Integrated product policy, sustainable product service systems, green factories	To develop PSS business models	2
9. Sustainable supply chains	Integration of pre-manufacturing, manufacturing and post-manufacturing activities for sustainability	To develop integrated supply chain mathematical models	2
10. Industry 4.0 and sustainable manufacturing	Role of industry 4.0 in sustainable manufacturing	To understand the sustainable manufacturing from Industry 4.0 perspective	2
11. Case studies	To practice life cycle assessment on LCA softwares	To develop life cycle assessment models using case studies.	4
12 Sustainability Games	Integrating sustainability at the strategy level using business game in teams	To understand the role of sustainability viz-a-viz other business strategies	5
Total			42

V. Evaluation Scheme and Schedule

EC No.	Component	Duration (minutes)	Weightage (%)	Date, time, venue	Nature
1	Mid Semester exam	90	25		OB
4	Project	--	40	Continuous evaluation	--
5	Comprehensive exam	120	35		CB/OB

VI. Chamber Consultation Hour: To be announced in the first class.

VII. Notices concerning the course: All notices concerning the course will be displayed on the Nalanda.

VIII. Make-up Policy: Make-up will be permitted only in genuine cases with prior permission.

IX. Grading: If a student gets less than the 20% of the toper marks then he/she is liable to get an NC grade

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