GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Subject Code: ME03000111

Course/Subject Name: Carbon Accounting for Sustainable Design

w. e. f. Academic Year:	2024 - 25
Semester:	3
Category of the Course:	MOPEC

Prerequisite:	Nil
Rationale:	The present course gives an overview of product life cycle technologies and Carbon Capture with storage. It is designed considering energy, sustainability and climate change. The objective is to identify carbon-negative solutions. Carbon capture and storage guarantees the security and feasibility of affordable and easily obtainable fossil fuels. The course includes emission of carbon dioxide into the atmosphere by firmly and permanently sequencing it beneath. A practical approach in designing, developing and running the DSS models in order to track, store and account the Carbon is presented.

PO

No	Program Outcomes
01	Engage in critical thinking and research to develop solutions to multifold real-world problems.
02	Communicate effectively with the engineering community at large level on complex design tasks & write and present technical reports.
03	Demonstrate a high level of professionalism in handling multidisciplinary and complex engineering problems.
04	Plan, assess, create, integrate, carry out, and oversee complex engineering projects in a sustainable local and global context.
05	Address societal issues by offering technologically advanced, reasonably priced solutions while upholding high standards of ethics and professionalism.

Course Outcome:

After Completion of the Course, Student will be able to:

No	Course Outcomes	RBT Level
01	Understand the principles of Carbon accounting for sustainable design	R, U
02	Apply the rules in carbon neutral product design	A
03	Analyze the carbon transformation process and traceability in PLM	N
04	Assess the carbon footprint of the sustainable design	E
05	Create the models considering carbon accounting for sustainability	C

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	0	3	70	30	-	-	100

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Introduction:** Introduction of Carbon accounting, Productivity vs sustainability, Transformation process and Sustainable development goals (SDGs), Carbon Accounting principles, Carbon Footprint Analysis, Direct Carbon emissions, Indirect Carbon emissions, Carbon Dioxide Utilization, Carbon Negative Technologies.	10	25
2.	**Carbon Sequestration:** Green Product Development, Connected Development Process, Carbon Sequestration technologies, Carbon Sinks, Carbon Sequestration examples, Carbon neutral processes, Carbon neutral product/process design	8	15
3.	**Product Lifecycle Management (PLM):** Introduction, Manufacturing Process, PLM components, Levels of PLM, Ecosystem in PLM, Meetings of PLM and SLM, Digitalization in PLM, PLM Data Analytics, Carbon Transformation Process, Traceability of Carbon, Carbon Traceability in PLM	10	25
4.	**Carbon Accounting:** ESG Frameworks, Carbon Footprint Assessment, Emission Reduction Strategies, Carbon Accounting Strategies, Capturing emissions data, Decisions on 6R – Reduce, Reuse, Recycle, Refuse, Repair, Re-innovate, Examples of 6R initiatives in SDG, Global Warming Potential (GWP),	10	25
5.	**Carbon Models:** Carbon Accounting and Databases, Auditorial database features, Creating Database, Models rendering, Energy System Modeling, Prototype Models, UI of Energy Modeling, Grid Model.	7	10
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
30	**20**	**20**	**20**	**10**	**--**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

(a) Books:

References/Suggested Learning Resources:

1. Product Lifecycle Management (PLM): A digital journey using Industrial Internet of Things (IIoT). Elangovan, 2020. CRC Press.
2. Carbon footprint analysis: concepts, methods, implementation, and case studies. Franchetti, M.J. and Apul, D., 2012. CRC press.
3. Framework for and the Role of Carbon Accounting in Corporate Carbon Management Systems: A Holistic Approach. Tang, Q., 2017.
4. Carbon Footprint Analysis, Franchetti Matthew John, Taylor & Francis publication, 2012
5. The Handbook of Carbon Accounting, Arnaud Brohé, A Greenleaf Publication Book, 2016
6. Accounting and Disclosure [Carbon Footprint & ESG for Sustainability], Dr. Abhineetkumar Jha, Insta Publishing, 2023
7. Product Lifecycle Management, John Stark, Springer London Ltd, 2005
8. Carbon Capture, Howard J Herzog, MIT Press, 2018

(b) List of Open-source software: (May not be open source but useful for the subject):

(c) List of MOOC Course link:

https://onlinecourses.nptel.ac.in/noc24_ge49/preview

(d) List of Experiments/Tutorials:

Minimum 20 problems from above topics.

Assignment work on

- Carbon footprint analysis
- Carbon negative technologies
- Carbon Sequestration technologies
- Product lifecycle management
- Examples of 6-R in SDGs
- Carbon models

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