	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Master of Technology**	Year of Regulation	**2018-19**
Department	**Civil Engineering**	Semester	**II**

Course Code	Course Name	Pre-requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE 544	**Advances in Sustainable Engineering**	**NIL**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	1. To introduce the concepts, principles, and need for sustainable development in engineering practices. 2. To explore advanced technologies and approaches promoting sustainability across energy, water, waste, and material systems. 3. To equip students with tools for sustainability assessment and life cycle thinking. 4. To integrate environmental, economic, and social dimensions into engineering solutions. 5. To develop problem-solving and system-design skills for sustainability-driven innovations.	Course Outcomes	CO1	Able to explain the fundamental principles of sustainable engineering and development.
			CO2	Be able to analyze the sustainability performance of engineering systems using appropriate tools and indicators.
			CO3	Be able to apply life cycle assessment (LCA), circular economy, and green design concepts.
			CO4	Be able to evaluate and integrate advanced sustainable technologies in environmental infrastructure.
			CO5	Be able to develop and propose holistic, sustainable solutions to real-world environmental problems.

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Sustainable Engineering:** Definition, goals, and pillars of sustainability; Sustainable development goals (SDGs) and global frameworks; Role of engineers in sustainable development; Sustainable thinking: system, design, and decision-making approaches	**5**	CO1, CO 2
II	**Sustainability Assessment Tools:** Life Cycle Assessment (LCA): stages, software tools; Environmental Impact Assessment (EIA); Carbon footprint, ecological footprint, and water footprint; Sustainability indicators and metrics.	**7**	CO2, CO3, CO4
III	**Sustainable Energy and Resource Management:** Renewable energy systems (solar, wind, biomass, micro-hydro); Smart grids and energy-efficient systems; Resource recovery from waste and wastewater; Sustainable water and sanitation solutions	**9**	CO2, CO3, CO4
IV	**Green and Circular Economy:** Green engineering and green chemistry principles; Eco-design, eco-labeling, and green buildings; Circular economy: principles, material flow, and case studies; Industrial symbiosis and zero-waste systems	**7**	CO4, CO5
V	**Sustainable Materials and Infrastructure:** Low-impact construction materials (fly ash bricks, geopolymer concrete); Life cycle design of infrastructure; Sustainable transportation systems; Nature-based solutions and climate-resilient design	**7**	CO4, CO5
VI	**Innovations and Case Studies in Sustainability:** Smart cities and sustainable urban planning; Technology for SDG; mplementation (AI, IoT, remote sensing); Community-based and indigenous practices; Case studies from India and global best practices	**7**	CO4, CO5
	Total Hours	**42**	

Essential Readings

1. A. K. Shukla, R. K. Thakur, and R. Kumar, Sustainable Engineering: Principles and Practices. Singapore: Springer, 2023.
2. M. Kumar, S. R. Devotta, and S. Sharma, Green and Sustainable Engineering: Concepts and Applications. Cham, Switzerland: Springer, 2022.
3. J. Sarkis, Handbook on the Sustainable Supply Chain. Cheltenham, U.K.: Edward Elgar Publishing, 2023.

Supplementary Readings

1. G. Habert and A. Schokker, Sustainable Construction Materials and Technologies, 2nd ed. Amsterdam, Netherlands: Elsevier, 2021.
2. D. P. Kothari, K. C. Singal, and R. Ranjan, Renewable Energy Sources and Emerging Technologies, 4th ed. New Delhi, India: PHI Learning, 2024
3. B. L. Reddy and S. M. Mahajan, Sustainable Infrastructure: Breakthroughs in Research and Practice. Hershey, PA, USA: IGI Global, 2020.