

Course Title:	<b>Introduction to Sustainable Engineering</b>		
Course Code:	<b>BETC105D/205D</b>	CIE Marks	50
Course Type (Theory/Practical /Integrated )	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3-0-0-0	Exam Hours	03
Total Hours of Pedagogy	40 hours	Credits	03
<b>Course Learning Objectives:</b>			
<ul style="list-style-type: none"> <li>To familiarize the students to the area of sustainability and concepts of sustainability engineering</li> <li>To enable students with an understanding of principles and frame work of sustainable engineering</li> <li>To provide students with an understanding of Life Cycle Assessment tool in sustainable engineering</li> <li>To provide students with understanding of integration of sustainability with design.</li> </ul>			
<b>Teaching-Learning Process</b>			
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes and make Teaching –Learning more effective			
<ol style="list-style-type: none"> <li>Explanation via real life problem, deliberate on solution and inquiry type teaching</li> <li>Instructions with interactions in class room lectures (physical/hybrid)</li> <li>Use of ICT Tools including You Tube videos and related MOOCs, AR/VR/MR tools</li> <li>Flipped Classroom session (approx. 10% of classes)</li> <li>Guest talks and competitions for learning beyond the syllabus</li> <li>Students oral presentation of case studies</li> </ol>			
<b>Module-1 (8 Hours)</b>			
<b>Sustainable Development and Role of Engineers:</b> Introduction, Why and What is Sustainable Development, THE SDFs, Paris Agreement and Role of Engineering, Sustainable Development and the Engineering Profession, Key attributes of the Graduate Engineering			
<b>Sustainable Engineering Concepts:</b> Key concepts – Factor 4 and Factor 10: Goals of sustainability, System Thinking, Life Cycle Thinking and Circular Economy			
<b>Module-2 (8 Hours)</b>			
<b>Sustainable Engineering and Concepts, Principles and Frame Work:</b> Green Economy and Low Carbon Economy, Eco Efficiency, Triple bottom Line, Guiding principles of sustainable engineering, Frameworks for sustainable Engineering.			
<b>Tools for sustainability Assessment:</b> Environmental Management System, Environmental Auditing, Cleaner Production Assessment, Environmental Impact Assessment, Strategic Environmental			
<b>Module-3( 8 Hours)</b>			
<b>Fundamentals of Life Cycle Assessment</b>			
Why and What is LCA, LCA Goal and Scope, Life cycle inventory, Life Cycle Impact Assessment, Interpretation and presentation of Results, Iterative Nature of LCA, Methodological Choices, LCI Databases and LCA Softwares, Strength and Limitations of LCA.			
<b>Module-4(8 Hours)</b>			
<b>Environmental Life Cycle Costing, Social Life Cycle Assessment, and Life Cycle Sustainability Assessment:</b> Introduction, Environmental Life Cycle Costing, Social Life Cycle Assessment, Life Cycle Sustainability, LCA Applications in Engineering: Environmental Product Declarations and Product Category Rules, Carbon and Water Foot Printing, Energy systems, Buildings and the Built Environment, Chemical and Chemical Production Food and Agriculture			
<b>Introduction to Environmental Economics:</b> Introduction – What Is Environmental Economics?, Valuing the Environment, Market-based Incentives (or Economic Instruments) for Sustainability, Command-and-Control versus Economic Instruments, A Simple Model of Pollution Control			

**Module-5 (8 Hours)**

**Integrating Sustainability in Engineering Design:** Problems Solving in Engineering, conventional to Sustainable Engineering Design Process, Design for Life Guidelines and Strategies, Measuring Sustainability, Sustainable Design through sustainable procurement criteria, Case studies on sustainable Engineering Design Process – Sustainable Process Design, Sustainable Production Design Sustainable product design in Electronic Engineering,

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to:

CO1	Elucidate the basics of sustainable development, sustainable engineering and its role in engineering
CO2	Application of Sustainable Engineering Concepts and Principles in Engineering
CO3	Apply the Principle, and methodology of Life Cycle Assessment Tool to engineering systems
CO4	Understand integration methods of sustainability to Engineering Design
CO5	

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). The minimum passing mark for the SEE is 35% of the maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation(CIE):****Three Tests each of 20 Marks;**

- 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> tests shall be conducted after completion of the syllabus of 30-35%, 70-75%, and 90-100% of the course/s respectively.
- Assignments/Seminar/quiz/group discussion /field survey & report presentation/ course project/Skill development activities, suitably planned to attain the COs and POs for a total of 40 Marks.

If the nature of the courses requires assignments/Seminars/Quizzes/group discussion two evaluation components shall be conducted. If course project/field survey/skill development activities etc then the evaluation method shall be one.

**Total CIE marks (out of 100 marks) shall be scaled down to 50 marks**

**Semester End Examination(SEE):**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

- The question paper shall be set for 100 marks. The medium of the question paper shall be English). The duration of SEE is 03 hours.
- The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks. The students have to answer 5 full questions, selecting one full question from each module. The student has to answer for 100 marks and **marks scored out of 100 shall be proportionally reduced to 50 marks.**
- There will be 2 questions from each module. Each of the two questions under a module (with a

**Suggested Learning Resources:****Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)**

1. Introduction to Sustainability for Engineers, ToolseeramRamjeawon, CRC Press, 1<sup>st</sup>Edn., 2020
2. Sustainability Engineering: Concepts, Design and Case studies, Prentice Hall, 1<sup>st</sup>Edn, 2015
3. System Analysis for sustainable Engineering: Theory and applications, Ni bin Chang, McGraw Hill Publications, 1<sup>st</sup>Edn., 2010
4. Engineering for Sustainable development: Delivery a sustainable development goals, UNESCO, International Centre for Engineering Education, France, 1<sup>st</sup>Edn., 2021
5. Introduction to Sustainable Engineering, Rag. R.L. and Ramesh Lakshmi Dinachandran, PHI Learning Pvt. Ltd., 2<sup>nd</sup>Edn, 2016

**Web links and Video Lectures (e-Resources):**

- VTU/EDUSAT/SWAYAM/NPTEL/MOOC.
- <https://nptel.ac.in/courses/127105018>
- <https://nptel.ac.in/courses/107103081/www.macfound.org>
- <https://unesdoc.unesco.org/>
- <https://unesdoc.unesco.org/ark:/48223/pf0000375644.locale=en>
- <https://engineeringforoneplanet.org/>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Group Discussion of case studies.
- Solutions to real time case studies
- Seminar/Poster Presentation

**COs and POs Mapping (Individual course teacher has to fill up)**

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
C01												
C02												
C03												
C04												
C05												

Level 3- Highly Mapped. Level 2-Moderately Mapped. Level 1-Low Mapped. Level 0- Not Mapped