SCHOOL OF ENGINEERING

DEPARTMENT OF COMPUTER SCIENCE & TECHNOLOGY

COURSE FILE

GREEN COMPUTING

(CSS325B)

Program(s) and semester: B Tech CSE7 & AIML7/CDFD7/CSTI7, B Tech R & AI5, B Tech ME-SMA5

NCrF Level of Program: Level 6 (for a Bachelors' engineering degree program of 4 years)

Course Coordinator: Dr. Sachin Lakra

Session: Jul-Dec, 2025

COURSE FILE CONTENTS

PROGRAM & SEMESTER: B Tech CSE7 & AIML7/CDFD7/CSTI7, B Tech R & AI5, B Tech ME-SMA5	
COURSE CODE: CSS325B	COURSE COORDINATOR: DR. SACHIN LAKRA
COURSE NAME: GREEN COMPUTING	THEORY FACULTY MEMBERS: DR. SACHIN LAKRA
LTPC: THEORY: 1-0-0-1 LAB: 0-0-2-1	LAB FACULTY MEMBERS: DR. SACHIN LAKRA

S. No.	Description	Y/N
1.	Vision and Mission of the University	
2.	Vision and Mission of the School	
3.	Vision and Mission of the Department, if applicable	
4.	GA's, PEOs, POs and PSOs of the Program	
5.	List of KSA Profiles of the Program	
6.	List of faculty members teaching the course	
7.	Academic Calendar	
8.	Time table of concerned faculty members teaching the course	
	OUTCOME BASED COURSE DESIGN	
9.	Course Design of Theory component including the following	
a.	KSA Profile Elements of the Theory component	
b.	List of SDGs/Ethics/Skill Levels & NSQF levels	
c.	Course Objective and List of Course Outcomes	
d.	Mapping to Skill/Employment/Entrepreneurship	
e.	Relevance of the Theory component	
f.	Syllabus with Text books, Reference books, Online Resources, MOOCs	
g.	Lesson Plan including innovative pedagogies and ICT Tools	
h.	CO-PO Mapping	
i.	CO-KSA Mapping, including Course KSA's, SDGs, Ethics, Skill Levels, NSQF Levels	
j.	Course Assessment Plan	
10.	Course Design of Lab component including the following	
a.	KSA Profile Elements of the Lab component	
b.	List of SDGs/Ethics/Skill Levels & NSQF levels	
c.	Course Objective and List of Course Outcomes	
d.	Mapping to Skill/Employment/Entrepreneurship	
e.	Relevance of the Lab Course	
f.	List of Experiments	
g.	Lab Text books, Reference books, Online Resources, MOOCs	
h.	Lesson Plan including innovative pedagogies and ICT Tools	
i.	CO-PO Mapping	
j.	CO-KSA Mapping, including Course KSA's, SDGs, Ethics, Skill Levels, NSQF Levels	
k.	Course Assessment Plan	
	OUTCOME BASED TEACHING, LEARNING & ASSESSMENT	
11.	Attendance Record for theory and labs	
12.	Lecture Notes and PowerPoint handouts (10% of entire content)	
13.	Tutorials/Assignments	
14.	Solution of Tutorials/Assignments (2 each)	
15.	Mid-Sem Question Paper	

S. No.	Description	Y/N
16.	End-Term Question Paper	
17.	Solution of Mid-Sem and End-Term Question Papers	
18.	Question Papers / Continuous Assessment Sheets (2 each) for all other assessment tools as per Course Assessment Plan	
19.	Rubrics for Lab assessments and miniprojects	
20.	Records of Rubrics based Evaluation of Lab Assessments	
21.	Note on how the course can contribute to the ePortfolio of Students	
22.	Records of Assessments based on Student ePortfolios	
23.	Continuous Evaluation for all Assessments as per Course Assessment Plan from ERP	
24.	Minutes of Course Coordinator Level Meetings with Feedback Analysis and Action Taken Report	
CO-PO ATTAINMENT		
25.	CO attainment analysis and action taken for the course, including direct and indirect assessments from Phase 1 to Phase 3.	
26.	List of slow (Slow Learners are those having an average Student CO attainment of less than 40% uptill Phase 1 of the semester (1 month into the semester) and the remaining are Advanced Learners).	
27.	The action taken to support slow and advanced learners and progress of slow learners to be discussed from Phase 1 to Phase 3. For advanced learners their progress to be discussed in terms of participation in projects, hackathons, competitions, publications in conferences and journals, etc.	
28.	Impact Analysis Report and Action Taken for Next Academic Cycle	
APPENDICES (attach hardcopies of samples)		
A	Sample hardcopies of Tutorials (4 samples: 2 for Slow and 2 for Advanced Learners) and Assignments (4 samples: 2 for Slow and 2 for Advanced Learners) submitted by students	
B	Sample hardcopies of answer sheets of Mid-Sem Exams (4 samples: 2 for Slow and 2 for Advanced Learners) and End-Term Exams (4 samples: 2 for Slow and 2 for Advanced Learners)	

1. Vision and Mission of Manav Rachna University (MRU)
   Vision of MRU
   <mark>To be finalized</mark>
   Mission of MRU
   <mark>To be finalized</mark>

2. Vision and Mission of School of Engineering (SoE)

   Vision of SoE
   To build a future where education and innovation, empowered by collaboration, create a sustainable global impact.

   Mission of SoE
   - **SM1 Quality Education:** Provide a rigorous, industry-aligned education that equips students with the foundational knowledge and technical expertise to excel in the academic and professional world.
   - **SM2 Skill Development:** Enhance skills by integrating hands-on learning experiences to promote critical thinking, problem-solving, and creativity.
   - **SM3 Research and Innovation:** Foster a culture of research and innovation that leads to new technologies and solutions to real-world problems.
   - **SM4 Industry Collaboration:** Build strong, strategic partnerships with industry leaders to bridge the gap between academic learning and real-world application.
   - **SM5 Ethics and Sustainability:** Nurture engineers to prioritize ethical decision-making for developing responsible solutions with a focus on a sustainable future.

3. Vision and Mission of Department of Computer Science of Technology

   Vision of DoCST
   <mark>As per Department</mark>
   Mission of DoCST
   <mark>As per Department</mark>

Graduate Attributes for an Engineer as per GAPC 4.0:

GA1-Engineering Knowledge: Breadth, depth and type of knowledge, both theoretical and practical

WA1: Apply knowledge of mathematics, natural science, computing and engineering fundamentals, and an engineering specialization as specified in WK1 to WK4 respectively to develop solutions to complex engineering problems.

GA2-Problem Analysis: Complexity of analysis

WA2: Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences with holistic considerations for sustainable development (WK1 to WK4).

GA3-Design/development of solutions: Breadth and uniqueness of engineering problems i.e., the extent to which problems are original and to which solutions have not previously been identified or codified

WA3: Design creative solutions for complex engineering problems and design systems, components or processes to meet identified needs with appropriate consideration for public health and safety, whole-life cost, net zero carbon as well as resource, cultural, societal, and environmental considerations as required (WK5).

GA4-Investigation: Breadth and depth of investigation and experimentation

WA4: Conduct investigations of complex engineering problems using research methods including research-based knowledge, design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions (WK8).

GA5-Tool Usage: Level of understanding of the appropriateness of technologies and tools

WA5: Create, select and apply, and recognize limitations of appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering problems (WK2 and WK6).

GA6-The Engineer and the World: Level of knowledge and responsibility for sustainable development

WA6: When solving complex engineering problems, analyze and evaluate sustainable development impacts to: society, the economy, sustainability, health and safety, legal frameworks, and the environment (WK1, WK5, and WK7).

GA7-Ethics: Understanding and level of practice

WA7: Apply ethical principles and commit to professional ethics and norms of engineering practice and adhere to relevant national and international laws. Demonstrate an understanding of the need for diversity and inclusion (WK9).

GA8-Individual and Collaborative Team work: Role in and diversity of team

WA8: Function effectively as an individual, and as a member or leader in diverse and inclusive teams and in multi-disciplinary, face-to-face, remote and distributed settings (WK9).

GA9-Communication: Level of communication according to type of activities performed

WA9: Communicate effectively and inclusively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, taking into account cultural, language, and learning differences.

GA10-Project Management and Finance: Level of management required for differing types of activity

WA10: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

GA11-Lifelong learning: Duration and manner

WA11: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change (WK8).

PEO's of B Tech CSE Program & specializations

PEO1: Core Competency

To inculcate analytical, design and implementation skills required to provide solutions to computing and interdisciplinary problems.

PEO2: Breadth

To groom graduates to innovate, design and develop products to provide sustainable solutions to contemporary societal, environmental and business problems.

PEO3: Professionalism

To instill the ability to work in teams, communicate effectively and lead as ethically and socially responsible professionals, researchers and entrepreneurs.

PEO4: Life Long Learning

To foster the ability of lifelong learning to constantly adapt to emerging technologies, to pursue higher education and instill life skills for a successful career.

Program Outcomes for an Engineering Program as per NBA

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.

4.   Common Program Specific Outcomes of the B Tech CSE (including all specializations)

PSO1-Emerging Technologies: Attain the ability to design and develop computer programs and possess acquaintance with emerging technologies and open-source platforms in the area of mobile app development, artificial intelligence, machine learning, web development, data analytics, cloud computing, networking, cyber security, gaming and animation to build effective computer-based systems.

PSO2-Career: Acquire technical competency to deliver computer based innovative and effective solutions to tackle business and societal challenges, for pursuing a successful career, entrepreneurship, research and higher studies.

Program Specific Outcomes of the BTech CSE specializations

PSO3 for AIML:
Apply artificial intelligence and machine learning technologies to build intelligent data-driven solutions.

PSO3 for CDFD:
Attain the ability to design application-based cloud computing solutions using full stack development technologies through latest industry software-development practices.

PSO3 for CSTI:
Build ethical security solutions using emerging cyber security and threat intelligence techniques and tools.

Knowledge, Skill and Attitude Profiles of Graduates of the Program
Knowledge Profile (WK) of an Engineering Graduate

WK1-Natural Sciences: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2-Mathematics: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3-Engineering Fundamentals: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4-Specialist Knowledge: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5-Engineering Design: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6-Engineering Practice: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7-Comprehension: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8-Research Literature: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9-Ethics, inclusive behavior and conduct: Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

Skill Profile (SK) of an Engineering Graduate

SK1-Problem Solving
Ability to identify, analyze, and solve complex engineering problems using logical reasoning and systematic methods.

SK2-Design and Innovation
Applying design thinking to develop creative, sustainable, and efficient engineering solutions.

SK3-Use of Modern Tools
Proficiency in tools such as CAD, simulation software, and data analytics to optimize engineering processes.

SK4-Project Management
Skills to manage projects effectively, including planning, execution, and monitoring of deliverables.

SK5-Communication
Clear and effective communication of ideas, designs, and reports to diverse audiences, including technical and non-technical stakeholders.

SK6-Collaboration and Teamwork
Working effectively in multidisciplinary teams to achieve shared objectives.

SK7-Lifelong Learning
Self-directed learning to stay updated with technological advancements and global trends.

SK8-Research and Experimentation
Skills to design experiments, analyze data, and apply research findings to engineering problems.

SK9-Interdisciplinary Skills
Skills to work on finding solutions to problems spanning multiple disciplines.

Attitude Profile (AK) of an Engineering Graduate

AK1-Ethical Responsibility
Commitment to ethical decision-making, integrity, and professional conduct in engineering practice.

AK2-Equity, Diversity, and Inclusion
Respect for cultural, societal, and individual diversity, promoting inclusivity in engineering solutions.

AK3-Sustainability Awareness
Awareness of the need for sustainable development and the responsibility to minimize environmental impact.

AK4-Global Awareness
Understanding global challenges, such as climate change, and considering international perspectives in solutions.

AK5-Accountability
Taking responsibility for one's actions and decisions in professional practice.

AK6-Leadership

Inspiring and motivating teams to achieve shared goals with integrity and vision.
AK7-Adaptability
Embracing change, learning new tools, and adapting to evolving industry needs.
AK8-Social Responsibility
Commitment to contributing positively to society through engineering practices.

LIST OF FACULTY MEMBERS TEACHING THE COURSE

Theory: Dr. Sachin Lakra, PhD

Lab: Dr. Sachin Lakra, PhD

Dr. Sachin Lakra
Professor
Department of Computer Science & Technology
Manav Rachna University
sachin@mru.edu.in

MANAV RACHNA UNIVERSITY

ACADEMIC CALENDAR 2025-26 (ODD SEMESTER)

ALL SEMESTERS ALL PROGRAMMES

ACTIVITY	DATES	DAYS
Post 2nd 4th & 6th Semester Training of 2-6 weeks from 9th June to 18th July 2025		
Pre-Semester Preparation Work		
Submission of List of Mentors & Mentee to Dean Academics	9th June 2025	Monday
Uploading of Time Table & Teaching Plan on EMS	23rd June-27th June 2025	Monday-Friday
Perspective Plan & Activity Calendar of Department & other Centers/Sections of the University	23rd June 2025	Monday
Information to students about Next Session Commencement & Mentors allocation (senior semesters)	1st July 2025	Tuesday
Course wise result Analysis and action taken (Previous Semester)	14th July 2025	Monday
Course Registration on EMS by Students for Current Semester Courses (including MOOCs, VACs and Minor Specialization courses) (senior semesters)	7th to 11th July 2025	Monday-Friday
Three Weeks Orientation Programme (1st semester)	10th July to 30th July 2025	Thursday-Wednesday
Approval of Course Registration by Respective HoD (senior semesters)	21st to 23rd July 2025	Monday-Wednesday
Course Reflexion Series	21st to 25th July 2025	Monday-Friday
Commencement of Classes (senior semesters)	28th July 2025	Monday
Department Orientation (senior semesters)	28th July 2025	Monday
Commencement of Classes (1st semester)	31st July 2025	Thursday
Evaluation of Post-2nd Semester Social Internship	4th-8th August 2025	Monday-Friday
List of Interdisciplinary Projects with Mentors and Teams	4th August 2025	Monday
Information to students about Next Session Commencement, Course Registration & Mentors allocation (1st semester)	10th July 2025	Monday
Submission of Marks of Post-2nd Semester Social Internship to Exam Cell	13th August 2025	Wednesday
Formative Feedback (Turn 1)	18th-22nd August 2025	Monday-Friday
1st Attendance Review with ATR	29th August 2025	Friday
Interdisciplinary Projects First review	1st September 2025	Monday
Continuous Assessment Phase 1 Performance Review & Action Taken Report	1st-5th September 2025	Monday-Friday
Identification of Slow and Advanced Learner based on Phase I review. Schedule of activities planned and Remedial classes.	1st-5th September 2025	Monday-Friday
2nd Attendance Review with ATR	19th September 2025	Friday
Mid Sem Examination	20th-26th September 2025	Saturday-Friday
Interdisciplinary Projects Second Review	6th October 2025	Monday
Evaluation of Mid Sem / Continuous Assessment Phase 2 Performance review in case of PBL or any other assessment mode opted for and Uploading Awards on EMS	29th September-10th October 2025	Monday to Friday
Identification of Slow and Advanced Learner based on Mid Sem Exam. Schedule of activities to be made and Remedial classes to be held.	29th September-10th October 2025	Monday to Friday
Parent Teacher Interaction Day (short attendance cases + performance Continuous Assessment & Mid Sem Exam)	18th October 2025	Saturday
3rd Attendance Review with ATR	24th October 2025	Friday
Presentations on Electives and VAC courses for Next Semester	3rd-7th November 2025	Monday-Friday
Summative Feedback (Turn 2)	3rd-7th November 2025	Monday-Friday
Course Exit Feedback (Turn 3) by Students & Faculty Feedback	10th-14th November 2025	Monday-Friday
Pre Registration for Next Semester Minor Specialization, VACs and Electives	10th-14th November 2025	Monday-Friday
Review of Low Attendance Status of Students	14th November 2025	Friday
Interdisciplinary Projects Final Review	17th November 2025	Monday
Final Attendance Review	21st November 2025	Friday
Last Day of Classes		
Faculty Feedback for Odd Semester	24th Nov-26th November 2025	Monday-Wednesday
Preparatory Leave	24th Nov-26th November 2025	Monday-Wednesday
Announcement of Detention	24th November 2025	Monday
Issue of Admit Card	26th-27th November 2025	Wednesday-Thursday
Submission of Complete Internal Awards on EMS as per CAP Shared	1st December 2025	Monday
Submission of Action Taken on Faculty Feedback	1st December 2025	Monday
End Term theory & Practical Examinations	28th November-26th December 202	Friday-Friday
Submission of CO-PO attainment and Impact Analysis Report including End Term Assessments	2nd January 2026	Friday
Open House	2nd-3rd January 2026	Friday-Saturday
Result Declaration	7th January 2026	Wednesday

Even Semester Commencement	12th January 2026	Monday
Total Semester Duration (senior semesters) = 28th July to 21st Nov, 2025	Total days:77, Teaching Days: 71; Mid Sem Working Days: 6;	
Total Semester Duration (1st semester) = 10th July to 21st Nov, 2025	Total days:86, Orientation: 3 weeks, Teaching Days: 71; Mid Sem Working Days: 6; End Term Working Days:21 ; Preparatory Leaves: 5	
For all semesters: On Working Saturdays special time table for remedial classes and extra classes for slow learners & advanced learners will be followed.		
2025 : RESURRECTION 2025;Convocation 2025		

LIST OF HOLIDAYS

Holiday	Date	Day
Raksha Bandhan	9-Aug-25	Saturday
Independence Day	15-Aug-25	Friday
Janmashtami	16-Aug-25	Saturday
Maha Navami	1-Oct-25	Wednesday
Gandhi Jayanti	2-Oct-25	Thursday
Dussehra	2-Oct-25	Thursday
Karwachauth	9-Oct-25	Thursday
Diwali	21-Oct-25	Tuesday
Vishwakarma Day	22-Oct-25	Wednesday
Bhai Dooj	23-Oct-25	Thursday
Guru Nanak Dev Jayanti	5-Nov-25	Wednesday
Christmas Day	25-Dec-25	Thursday

Prof. (Dr.) Shruti Vashist Dean Academics, MRU

7/4/25

2/2

TIME TABLE OF FACULTY MEMBERS TEACHING THE COURSE

SACHIN LAKRA

Day	1	2	3	4	5	6	7	8	9
TIME	8:10-9:00	9:00-9:50	9:50-10:40	10:40:11:30 AM	11:30-12:20	12:20-1:10	1:10-2:00	2:00-2:50	2:50-3:40
Mo	GC(L) R&AI 5TH SEM HT10		CST7_GC(LAB) 7B,CSE 7C,AIML 7,CDI G1 HF03 ME-GC (LAB) M.E-5 S.M.A HF03	CST7_GC(LAB) 7B,CSE 7C,AIML 7,CDI G1 HF03 ME-GC (LAB) M.E-5 S.M.A HF03	LUNCH	CST7_GC(LAB) R&AI 5TH SEM Lab IG10	CST7_GC(LAB) R&AI 5TH SEM Lab IG10		
Tu					LUNCH			CST 1_PS(LAB) CSTI 1 LAB01	CST 1_PS(LAB) CSTI 1 LAB01
We					LUNCH				
Th		CST 1_PS(L) CSTI 1,B.Tech. GenAI 1 LT03	GC(L) 7B,CSE 7C,AIML 7,CDI G1 HS02 ME-GC (L) M.E-5 S.M.A HS02		LUNCH	CST 1_PS(LAB) CSTI 1 LAB02	CST 1_PS(LAB) CSTI 1 LAB02		
Fr					LUNCH		CST 1_PS(L) CSTI 1,B.Tech. GenAI 1 LS03		

OUTCOME-BASED COURSE DESIGN

Course Title	GREEN COMPUTING
Course Code	CSS325B

LTPC	1-0-0-1
Course type:	Professional Elective Course (PEC): for B Tech CSE7 & AIML7/CDFD7/CSTI7, B Tech ME-SMA5 Program Core Course: for, B Tech R & AI5
Course Nature (NEP)	Elective: for B Tech CSE7 & AIML7/CDFD7/CSTI7, B Tech ME-SMA5 Core: for, B Tech R & AI5
Relationship to other courses	**Course Prerequisites** NA
	Assumed Knowledge Awareness of issues causing harmful impact on the environment.
	Following Courses Environmental, Social and Governance (ESG) Courses
Course KSA Profile Elements	WK5-Engineering Design WK7-Comprehension WK9-Ethics, inclusive behavior and conduct SK1-Problem Solving SK9-Interdisciplinary Skills AK1-Ethical Responsibility AK3-Sustainabilty Awareness AK4-Global Awareness
Course SDGs/Ethics/Skill Levels & NSQF levels	SDG11-Sustainable Cities & Communities SDG13-Climate Action Ethics-Yes Skill Levels – Basic (1), Applied (2) NSQF Levels – Supervisory (5)
Course Objective	Students will be able to comprehend sustainability (AK3, AK4) issues (WK7) and apply (SK1) green computing concepts (WK5) for ethically (AK1, WK9) solving environmental problems (SK9) being caused by computing devices.
Course Outcomes (COs)	Students would be able to **CSS325BT.1.** Describe the basic concepts of green computing and e-waste management (WK5). **CSS325BT.2.** Describe environmental problems being caused by electronic devices (WK7) and their ethical (AK1, WK9) and sustainable solutions (SK1, AK3, AK4). **CSS325BT.3.** Apply (SK1) power management techniques in computers and datacenters (WK5). **CSS325BT.4.** Apply (SK1) techniques of how to follow an environment-friendly lifestyle at work (AK3). **CSS325BT.5.** Analyze (SK1, SK9) how to make information systems green (WK5).

Course Outcome	Mapping to Skill/Employment
CSS325BT.1. Describe the basic concepts of green computing and e-waste management (WK5).	-
CSS325BT.2. Describe environmental problems being caused by electronic devices (WK7) and their ethical (AK1, WK9) and sustainable solutions (SK1, AK3,AK 4).	Skill Development
CSS325BT.3. Apply (SK1) power management techniques in computers and datacenters (WK5).	Employment and Skill Development
CSS325BT.4. Apply (SK1) techniques of how to follow an environment-friendly lifestyle at work (AK3).	Employment and Skill Development
CSS325BT.5. Analyze (SK1, SK9) how to make information systems green (WK5).	Employment and Skill Development

Relevance of the course

The environment is nature's gift to humanity and it is our responsibility as well as ethical duty to preserve it since we are also a part of it. The survival of future generations of human beings as well as other organisms depends upon how sustainably we consume resources and for what purpose. Awareness related to climatic and environmental issues has already spread and the next fast-rising concerns are excessive waste heat from electronic devices and appliances, and the accumulation of e-waste. This course is focussed on these two concerns and how they can be mitigated. The need of this course in the industry is increasing with the introduction of concepts such as circular economy, recycling and reuse of throwable devices.

Syllabus

	Sections	Weightage
	A	25%
	B	25%
Syllabus	C	25%
	D	25%
	TOTAL	**100%**

Section-A

Overview and Issues: Problems: Toxins, Power Consumption, Equipment Disposal; Company's Carbon Footprint: Measuring; Carbon Footprint Calculator(online); Plan for the Future; Cost Savings: Hardware, Power, Ethics of Green Computing. **Initiatives and Standards:** Global Initiatives: United Nations, Basel Action Network, Basel Convention; WEEE Directive, Restriction on Hazardous Substances Directive, the Paris Climate Agreement.

Section-B

Minimizing Power Usage: Power Problems, Monitoring Power Usage, Servers, Low-Cost Options, Reducing Power Use, Data De-Duplication, Virtualization, Management, Low Power Computers, PCs, Linux, Components, Servers, Computer Settings, Storage, Monitors, Power Supplies, Wireless Devices, Software. **Green Data Centers:** The benefits of a green data center, developing a strategy, Energy optimization with IT equipment.

Section-C

Changing the Way of Work: Old Behaviours, starting at the Top, Process Reengineering with Green in Mind, Analysing the Global Impact of Local Actions, Recycling, Energy, Pollutants, Teleworkers, Telecommuting, Outsourcing, how to Outsource, Green Computing in Daily Life. **Recycling:** Problems: China, Africa; Materials, Means of Disposal, Recycling, Refurbishing, Recycling Life Cycle, Life of a Product, Cost, Green Design, Recycling Companies, Certifications, Hard Drive Recycling, Consequences, cleaning a Hard Drive, Pros and cons of each method, CDs and DVDs, good and bad about CDs and DVDs disposal, Change the mind-set.

Section-D

Greening Your Information Systems: Initial Improvement Calculations, Change Business Processes, Customer Interaction, Paper Reduction, Green Supply Chain, Improve Technology Infrastructure, Reduce PCs and Servers, Shared Services, Hardware Costs, Cooling. **Green Computing in Ancient India:** Balance of life in Indian villages with nature: Use of biomass as fuel, no electricity; devices made of natural materials, absence of e-waste. **Applications of Green Computing:** Energy Efficiency of algorithms, Green Networks, Green Cloud Computing, Green Internet of Things, Green Artificial Intelligence, Relevance to Industry 4.0.

Text Books:
1. Green IT, Toby Velte, Anthony Velte, Robert Elsenpeter, McGraw Hill, 2008.
2. Green Data Center: Steps for the Journey Alvin Galea, Michael Schaefer, Mike Ebbers, Shroff Publishers and Distributers, 2011.

Reference Books:
Green Computing and Green IT Best Practice, Jason Harris, Emereo.

Online Content for Additional Reading:
1. www.footprintcalculator.com
2. Living in Balance with Nature, Sachin Lakra, Kindle Desktop Publishing (online e-book only available at www.amazon.com).

MOOCs for Self-Learning (Optional):
NPTEL:

1. Sustainable Energy Technology: https://onlinecourses.nptel.ac.in/noc25_me178/preview

LinkedIn (Mandatory except for 1st year courses):

1. Climate Change: A top ESG concern: https://www.linkedin.com/learning/climate-change-a-top-esg-concern/climate-change-is-a-critical-esg-factor?u=109705204
2. Corporate Finance: Environmental, Social and Governance(ESG): https://www.linkedin.com/learning/corporate-finance-environmental-social-and-governance-esg
3. Learning Design for Sustainability: https://www.linkedin.com/learning/learning-design-for-sustainability
4. Employee Engagement-Making Sustainability PArt of Everybody's Job: https://www.linkedin.com/learning/employee-engagement-making-sustainability-part-of-everybody-s-job
5. Sustainability for Design, Construction and Manufacturing: https://www.linkedin.com/learning/sustainability-for-design-construction-and-manufacturing

Topic/Unit/Chapter Layout

Section	Topics	L	T	P
A	Overview and Issues; Initiatives and Standards	4	0	8
B	Minimizing Power Usage and Green Datacenters	4	0	8
C	Changing the way of work and Recycling	3	0	6
D	Greening your Information Systems	3	0	6
	TOTAL	**14**	**0**	**28**

Lesson Plan

Week/ Lect No.	Lecture Topics	Course outcome	Blooms Taxonomy	Innovative Pedagogy used	ICT Tools used
1	**Overview and Issues:** Problems: Toxins, Power Consumption, Equipment Disposal; Company's Carbon Footprint: Measuring; Carbon Footprint Calculator (online)	CSS325BT.1	BT3	Blended Learning	LCD Projector
2	Plan for the Future; Cost Savings: Hardware, Power.	CSS325BT.1	BT3	Blended Learning	LCD Projector
3	**Initiatives and Standards:** Global Initiatives: United Nations, Basel Action Network, Basel Convention;	CSS325BT.2	BT2	Blended Learning	LCD Projector
4	WEEE Directive, Restriction on Hazardous Substances Directive, the Paris Climate Agreement	CSS325BT.2	BT2	Blended Learning	LCD Projector
5	**Minimizing Power Usage:** Power Problems, Monitoring Power Usage, Servers, Low-Cost Options, Reducing Power Use, Data De-Duplication, Virtualization, Management, Low Power Computers, PCs, Linux,	CSS325BT.3	BT3	Blended Learning	LCD Projector
6	Components, Servers, Computer Settings, Storage, Monitors, Power Supplies, Wireless Devices, Software.	CSS325BT.3	BT3	Blended Learning	LCD Projector
7	**Green Data Centers:**The benefits of a green data center, developing a strategy, Energy optimization with IT equipment.	CSS325BT.3	BT2	Blended Learning	LCD Projector
8	**Changing the Way of Work:** Old Behaviours, starting at the Top, Process Reengineering with Green in Mind, Analysing the Global Impact of	CSS325BT.4	BT3	Flipped Classroom	LCD Projector

Week/Lect No.	Lecture Topics	Course outcome	Blooms Taxonomy	Innovative Pedagogy used	ICT Tools used
	Local Actions, Recycling, Energy, Pollutants, Teleworkers, Telecommuting, Outsourcing, how to Outsource, Ethics of Green Computing in Daily Life				
9	**Recycling:** Problems: China, Africa; Materials, Means of Disposal, Recycling, Refurbishing, Recycling Life Cycle, Life of a Product, Cost, Green Design	CSS325BT.2	BT2	Blended Learning	LCD Projector
10	Recycling Companies, Certifications, Hard Drive Recycling, Consequences, cleaning a Hard Drive, Pros and cons of each method, CDs and DVDs, good and bad about CDs and DVDs disposal, Change the mind-set.	CSS325BT.2	BT3	Flipped Classroom	LCD Projector
11	**Greening Your Information Systems:** Initial Improvement Calculations, Change Business Processes,	CSS325BT.5	BT3	Blended Learning	LCD Projector
12	Customer Interaction, Paper Reduction, Green Supply Chain, Improve Technology Infrastructure, Reduce PCs and Servers, Shared Services, Hardware Costs, Cooling.	CSS325BT.5	BT3	Blended Learning	LCD Projector
13	**Applications of Green Computing:** Energy Efficiency of algorithms, Green Networks, Green Cloud Computing, Green Internet of Things, Green Artificial Intelligence, Relevance to Industry 4.0.	CSS325BT.5	BT3	Blended Learning	LCD Projector
14	**Green Computing in Ancient India:** Balance of life in Indian villages with nature: Use of biomass as fuel, no electricity; devices made of natural materials, absence of e-waste.	CSS325BT.2	BT3	Blended Learning	LCD Projector

CO-PO Mapping

CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3 (AIML)	PSO3 (CDFD)	PSO3 (CSTI)
CSS325BT.1.	3					2										
CSS325BT.2.		2				3	2						2			
CSS325BT.3.		3				3									2	
CSS325BT.4.						3										
CSS325BT.5.		3	2			2						2	2	2		2

CO-KSA Mapping

CO/PO-PSO	WKs	SKs	AKs	SDGs	Ethics	Skill Level	NSQF Level
CSS325BT.1.	WK5	-	-	SDG11	-	-	-
CSS325BT.2.	WK7 WK9	SK1	AK1 AK3 AK4	SDG13	Y	1	-
CSS325BT.3.	WK5	SK1	-	SDG13	-	2	5
CSS325BT.4.	-	SK1	AK3	SDG11	-	2	5
CSS325BT.5.	WK5	SK1 SK9	-	SDG11	-	2	5

Course Assessment Plan – Theory

<table>
<tr><td colspan="7">DEPARTMENT OF CST
ODD SEMESTER (JUL-DEC 2025)
COURSE ASSESSMENT PLAN</td></tr>
<tr><td colspan="2">FACULTY MEMBER NAME: DR. SACHIN LAKRA</td><td colspan="5">COURSE COORDINATOR NAME: DR. SACHIN LAKRA</td></tr>
<tr><td>COURSE NAME:Green Computing</td><td>COURSE CODE:CSS325-T</td><td>CREDITS: 1</td><td colspan="4">ASSESSMENT METHOD</td></tr>
<tr><td>SECTION AS PER SYLLABUS</td><td>COURSE OUTCOME:</td><td>WEIGHTAGE IN % OF ASSESSMENT</td><td>QUIZ (2*10=20)</td><td>ASSIGNMENT (20)</td><td>SEMINAR (10)</td><td>END SEM THEORY EXAM (50)</td></tr>
<tr><td>SECTION:A</td><td>CSS325BT.1.
CSS325BT.2.</td><td>25%</td><td>√</td><td>√</td><td></td><td>√</td></tr>
<tr><td>SECTION:B</td><td>CSS325BT.3.</td><td>25%</td><td></td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>SECTION:C</td><td>CSS325BT.4.</td><td>25%</td><td>√</td><td></td><td>√</td><td>√</td></tr>
<tr><td>SECTION:D</td><td>CSS325BT.5.
CSS325BT.2.</td><td>25%</td><td></td><td>√</td><td>√</td><td>√</td></tr>
<tr><td colspan="3">TOTAL WEIGHTAGE</td><td>20%</td><td>20%</td><td>10%</td><td>50%</td></tr>
<tr><td rowspan="7">WK5-Engineering Design
WK7-Comprehension
WK9-Ethics, inclusive behavior and conduct
SK1-Problem Solving
SK9-Interdisciplinary Skills
AK1-Ethical Responsibility
AK3-Sustainabilty Awareness
AK4-Global Awareness
SDG11-Sustainable Cities & Communities
SDG13-Climate Action
Ethics-Yes
Skill Levels – Basic (1), Applied (2)
NSQF Levels – Supervisory (5)</td><td>WKs</td><td>5, 7, 9</td><td>5, 7, 9</td><td>5, 7, 9</td><td>5, 7, 9</td></tr>
<tr><td>SKs</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>AKs</td><td>1, 3, 4</td><td>1, 3, 4</td><td>1, 3, 4</td><td>1, 3, 4</td></tr>
<tr><td>SDGs</td><td>11, 13</td><td>11, 13</td><td>11, 13</td><td>11, 13</td></tr>
<tr><td>Ethics</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td></tr>
<tr><td>Skill Level</td><td>1, 2</td><td>1, 2</td><td>1, 2</td><td>1, 2</td></tr>
<tr><td>NSQF Level</td><td>5</td><td>5</td><td>5</td><td>5</td></tr>
</table>

Course Title	GREEN COMPUTING LAB	
Course Code	CSS325B	
LTPC	0-0-1-1	
Course type:	Professional Elective Course (PEC): for B Tech CSE7 & AIML7/CDFD7/CSTI7, B Tech ME-SMA5 Program Core Course: for, B Tech R & AI5	
Course Nature (NEP)	Elective: for B Tech CSE7 & AIML7/CDFD7/CSTI7, B Tech ME-SMA5 Core: for B Tech R & AI5	
Relationship to other courses	Course Prerequisites	NA
	Assumed Knowledge	Awareness of issues causing harmful impact on the environment.
	Following Courses	Environmental, Social and Governance (ESG) Courses
Course KSA Profile Elements	WK5-Engineering Design WK7-Comprehension WK9-Ethics, inclusive behavior and conduct SK1-Problem Solving	SK9-Interdisciplinary Skills AK1-Ethical Responsibility AK3-Sustainabilty Awareness AK4-Global Awareness
Course SDGs/Ethics/Skill Levels & NSQF levels	SDG11-Sustainable Cities & Communities SDG13-Climate Action Ethics-Yes Skill Levels – Basic (1), Applied (2) NSQF Levels – Supervisory (5)	
Course Objective	Students will be able to comprehend sustainability (AK3, AK4) issues (WK7) and apply (SK1) green computing concepts (WK5) for ethically (AK1, WK9) solving environmental problems (SK9) being caused by computing devices.	
Course Outcomes (COs)	Students would be able to **CSS325BP.1** Analyze the impact of using computing devices (WK7) on the environment (SK9) thereby finding ethical solutions (AK1, WK9) for real world problems. **CSS325BP.2** Solve (SK1, SK9) case-based problems on relevant and emerging areas of environmental sustainability (AK3, AK4, WK5).	

Course Outcome	Mapping to Skill/Employment
CSS325BP.1 Analyze the impact of using computing devices (WK7) on the environment (SK9) thereby finding ethical solutions (AK1, WK9) for real world problems.	Skill Development and Employment
CSS325BP.2 Solve (SK1, SK9) case-based problems on relevant and emerging areas of environmental sustainability (AK3, AK4, WK5).	Skill Development and Employment

Relevance of the course

Comprehending that an observed phenomenon is actually an environmental problem looming at the horizon and understanding the reasons for it to bring focus on the real issue is an ability which is essential for any green computing student. This identification can have far-reaching consequences in saving Nature from potential calamities, some of which may be unknowingly borne by humanity. Not only this, finding solutions to these problems becomes even more essential to help maintain Natural Balance. The focus of this course is to help students learn these abilities with the help of case-based problems from diverse disciplines.

List of Assignments and Case-based Problems

- Assignment 1 on basics concepts of Green Computing
- Case-based problem 1 on Carbon Footprints
- Assignment 2 on Carbon Footprints
- Case-based problem 2 on Robots, Humanity and Society
- Assignment 3 on Robots, Humanity and Society
- Case-based problem 3 on Robots and Nature
- Assignment 4 on Robots and Nature

- Case-based problem 4 on Power Consumption Management
- Assignment 5 on Power Consumption Management
- Case-based problem 5 on Data Centers of Google
- Assignment 6 on Data Centers of Google
- Case-based problem 6 on Recycling Hard Drives
- Assignment 7 on Recycling Hard Drives
- Case-based problem Development and Presentation

Text Books:
1. Green IT, Toby Velte, Anthony Velte, Robert Elsenpeter, McGraw Hill, 2008.
2. Green Data Center: Steps for the Journey Alvin Galea, Michael Schaefer, Mike Ebbers, Shroff Publishers and Distributers, 2011.

Reference Books:
Green Computing and Green IT Best Practice, Jason Harris, Emereo.

Online Content for Additional Reading:
1. www.footprintcalculator.com
2. Living in Balance with Nature, Sachin Lakra, Kindle Desktop Publishing (online e-book only available at www.amazon.com).

MOOCs for Self-Learning (Optional):

NPTEL:
1. Sustainable Energy Technology:
   https://onlinecourses.nptel.ac.in/noc25_me178/preview

LinkedIn (Mandatory except for 1ˢᵗ year courses):
1. Climate Change: A top ESG concern: https://www.linkedin.com/learning/climate-change-a-top-esg-concern/climate-change-is-a-critical-esg-factor?u=109705204
2. Corporate Finance: Environmental, Social and Governance(ESG): https://www.linkedin.com/learning/corporate-finance-environmental-social-and-governance-esg
3. Learning Design for Sustainability: https://www.linkedin.com/learning/learning-design-for-sustainability
4. Employee Engagement-Making Sustainability PArt of Everybody's Job: https://www.linkedin.com/learning/employee-engagement-making-sustainability-part-of-everybody-s-job
5. Sustainability for Design, Construction and Manufacturing: https://www.linkedin.com/learning/sustainability-for-design-construction-and-manufacturing

Lesson Plan

Week	Laboratory	Course outcome	Blooms Taxonomy	Innovative Pedagogy Used	ICT Tools used
1	Assignment 1 on basics concepts of Green Computing	CSS325BP.1	BT3	Active Learning	Laptops
2	Case-based Problem on Carbon Footprints	CSS325BP.1	BT3	Case based Learning	LCD Projector
3	Assignment 2 on Carbon Footprints	CSS325BP.1	BT2	Active Learning	Laptops
4	Case-based Problem 2 on	CSS325BP.1	BT2	Case based	LCD

Week	Laboratory	Course outcome	Blooms Taxonomy	Innovative Pedagogy Used	ICT Tools used
	Robots, Humanity and Society			Learning	Projector
5	Assignment 3 on Robots, Humanity and Society	CSS325BP.1	BT3	Active Learning	Laptops
6	Case-based Problem 3 on Robots and Nature	CSS325BP.1	BT3	Case based Learning	LCD Projector
7	Assignment 4 on Robots and Nature	CSS325BP.1	BT2	Active Learning	Laptops
8	Case-based Problem 4 on Power Consumption Management	CSS325BP.1	BT3	Case based Learning	LCD Projector
9	Assignment 5 on Power Consumption Management	CSS325BP.1	BT2	Active Learning	Laptops
10	Case-based Problem 5 on Data Centers of Google	CSS325BP.1	BT3	Case based Learning	LCD Projector
11	Assignment 6 on Data Centers of Google	CSS325BP.1	BT3	Active Learning	Laptops
12	Case-based Problem 6 on Recycling Hard Drives	CSS325BP.1	BT3	Case based Learning	LCD Projector
13	Assignment 7 on Recycling Hard Drives	CSS325BP.1	BT3	Active Learning	Laptops
14	Case-based Problem Development and Presentation	CSS325BP.2	BT3	Case based Learning	LCD Projector

CO-PO Mapping

CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3 (AIML)	PSO3 (CDFD)	PSO3 (CSTI)
CSS325B.1		2				2								2	2	2
CSS325B.2		3	2			3	2						2	3		

CO-KSA Mapping

CO/PO-PSO	WKs	SKs	AKs	SDGs	Ethics	Skill Level	NSQF Level
CSS325BT.1.	WK7,9	SK9	AK1	SDG11	-	2	5
CSS325BT.2.	WK5	SK1 SK9	AK3 AK4	SDG13	Y	2	5

Course Assessment Plan – Lab

			DEPARTMENT OF CST ODD SEMESTER (JUL-DEC 2025) COURSE ASSESSMENT PLAN				
FACULTY MEMBER NAME: DR. SACHIN LAKRA			COURSE COORDINATOR NAME: DR. SACHIN LAKRA				
COURSE NAME:Green Computing	COURSE CODE:CSS325-T		CREDITS: 1	ASSESSMENT METHOD			
SECTION AS PER SYLLABUS	COURSE OUTCOME:	WEIGHTAGE IN % OF ASSESSMENT	Lab Performance (5)	Mid-term Prac Exam (10)	Case Study Dev, Presentation + ePortfolio (15)	End Sem Prac Exam (20)	
SECTION:A	CSS325B.1. CSS325B.2.	25%	√	√		√	
SECTION:B	CSS325B.1 CSS325B.2	25%	√	√		√	
SECTION:C	CSS325B.2	25%			√	√	
SECTION:D	CSS325B.2	25%			√	√	
TOTAL WEIGHTAGE			20%	20%	10%	50%	

		Lab Performance	Mid-term Prac Exam	Case Study Dev, Presentation + ePortfolio	End Sem Prac Exam
WK5-Engineering Design WK7-Comprehension WK9-Ethics, inclusive behavior and conduct	WKs	5, 7, 9	5, 7, 9	5	5, 7, 9
SK1-Problem Solving SK9-Interdisciplinary Skills	SKs	1	1	1, 9	1
AK1-Ethical Responsibility AK3-Sustainabilty Awareness	AKs	1, 3, 4	1, 3, 4	3, 4	1, 3, 4
AK4-Global Awareness	SDGs	11, 13	11, 13	11, 13	11, 13
SDG11-Sustainable Cities & Communities SDG13-Climate Action	Ethics	Y	Y	Y	Y
Ethics-Yes Skill Levels – Basic (1), Applied (2)	Skill Level	1, 2	1, 2	1, 2	1, 2
NSQF Levels – Supervisory (5)	NSQF Level	5	5	5	5

OUTCOME-BASED TEACHING, LEARNING & ASSESSMENT

Please include the following also for the 1st Academic Audit:

12. Lecture Notes and PowerPoint handouts (10% of entire content)
13. Tutorials/Assignments
14. Solution of Tutorials/Assignments (2 each)