ENERGY CONSERVATION & GREEN BUILDING **Course Code : 315316**

Programme Name/s	**: Civil Engineering/ Civil & Rural Engineering/ Construction Technology/ Civil & Environmental Engineering/**
Programme Code	**: CE/ CR/ CS/ LE**
Semester	**: Fifth**
Course Title	**: ENERGY CONSERVATION & GREEN BUILDING**
Course Code	**: 315316**

I. RATIONALE

In current scenario various civil engineering construction practices in exploiting the natural resources which in turn contributes to global climate change and environmental degradation. The Energy Conservation and Green Building course is essential for addressing the pressing challenges of climate change and environmental degradation by reducing carbon footprints and promoting sustainable development. It equips students with the latest knowledge and skills in energy-efficient practices and sustainable building techniques, offering significant economic benefits through cost savings and compliance with regulatory standards. Additionally, it fosters healthier living environments, encourages innovation, and prepares individuals to meet the growing demand for sustainability professionals in the job market.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

To implement various strategies of green building to enhance sustainable environment and to address economic and social challenges of the modern world.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Justify the need of Energy Conservation and Green building
- CO2 - Implement the green principles in the green building construction
- CO3 - Suggest the relevant construction material and techniques for the green building construction.
- CO4 - Conduct the green and environment audit for a green building
- CO5 - Propose a relevant rating system for assessment of given type of green building.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
315316	ENERGY CONSERVATION & GREEN BUILDING	ECG	DSE	4	-	2	-	6	2	3	30	70	100	40	25	10	25#	10	-	-	150

Total IKS Hrs for Sem. : Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 10 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Justify the need of energy conservation in the given civil engineering project TLO 1.2 Adopt the legal provisions in the energy conservation and Green building in given situation. TLO 1.3 Explain the principles and importance of green building TLO 1.4 Implement the relevant principles in green building required for sustainable development	**Unit - I Fundamental of Green Building and Energy Conservation** 1.1 Introduction to Energy Conservation: Global energy consumption scenario, Energy conservation: Definition, objectives and Importance. 1.2 Salient features of Energy Conservation Act – 2001 1.3 Introduction to Green Building: Definition and Importance of green building concept, History and evolution of green building construction practices, Role of Green Building in sustainable development 1.4 Overview of Sustainable construction: Environmental, economic, and social development	Presentations Video Demonstrations Site/Industry Visit Case Study
2	TLO 2.1 Identify the principles of the given category of green building considering sustainability aspects TLO 2.2 Explain the Salient features of green building TLO 2.3 Illustrate the relevant benefits of green building for the given criteria TLO 2.4 Discuss the future trend in construction of green building TLO 2.5 Evaluate the economic impact of Green Building construction on Stakeholders.	**Unit - II Green Building Concepts And Sustainable Practices** 2.1 Green Building Principles: a. Sustainable Site Design b. Energy Efficiency and conservation c. Water Efficiency and conservation d. Materials selection and life cycle analysis e. Indoor environmental quality (IEQ) 2.2 Salient features of Green Building 2.3 Benefits of Green building: Environmental, economic and social benefits. 2.4 Future trends in green building 2.5 Economical Consideration of green buildings: Initial cost, long term Financial Benefits and Economic Impacts on Stakeholders.	Presentations Video Demonstrations Site/Industry Visit Case Study

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Suggest the relevant types of sustainable materials required for the green building construction TLO 3.2 Propose the relevant energy-efficient technologies based on the given climatic condition TLO 3.3 Implement the professional standards related to sustainability set by various professional organizations	**Unit - III Sustainable Building Materials and Technologies** 3.1 Sustainable building Materials: (Bamboo, Hempcrete, Recycled Plastic Lumber, Ferrock, Cross-Laminated Timber (CLT) etc) Uses, characteristic, advantages, benefits and limitations, Criteria for selecting sustainable materials. 3.2 Energy-Efficient Technologies: a. Building envelope improvement system: Insulation, windows and glazing, air sealing, Cool roofs and green roofs system. b. Building management system: energy management. c. Lighting: LED and daylighting strategies. d. HVAC unit in green Building: Concept and importance 3.3 Ethics and Professional Responsibility: Ethical considerations in sustainable design and construction, The role of professionals in promoting sustainability.	Presentations Video Demonstrations Site/Industry Visit Case Study
4	TLO 4.1 Justify the necessity of audit in the given green building construction. TLO 4.2 Create a comprehensive audit plan based on given criteria. TLO 4.3 Conduct an audit of the given Green building. TLO 4.4 Prepare the action plan based on the given audit report	**Unit - IV Green Building Audit** 4.1 Introduction to Green Building Audits: Definition, scope, Importance and benefits of green building audit. 4.2 Planning and Preparation for Green Building Audits: Setting audit objectives and scope, Developing an audit plan and checklist. 4.3 Conducting the Green Building Audits: On-site audit procedures and techniques, Data collection methods (e.g., interviews, observations, document reviews). 4.4 Reporting and Documentation: Audit reports and documentation, Communicating audit findings and recommendations, Corrective Actions and Continuous Improvement.	Presentations Video Demonstrations Site/Industry Visit Case Study
5	TLO 5.1 Explain the role of the relevant agency responsible for conducting an audit green building TLO 5.2 Conduct an energy audit as per the given type of green rating system.	**Unit - V Green Building Standards and Certification Systems** 5.1 Functions of government organization working for Energy conservation and Audit(ECA): Ministry of New and Renewable Energy (MNRE), Bureau of Energy efficiency (BEE) Maharashtra Energy Development Agency (MEDA). 5.2 Green building rating system: Leadership in Energy and Environmental Design (LEED) criteria, Indian Green Building council (IGBC) and Green Rating for Integrated Habitat Assessment. (GRIHA): Salient Features and Evaluation Criteria for assessment	Presentations Video Demonstrations Site/Industry Visit Case Study

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Analyze the collected energy data to identify trends, peak usage periods, and potential inefficiencies.	1	*Measurement of energy consumption of existing building.	2	CO1
LLO 2.1 Collect and document information on existing energy efficiency policies and methods implemented by the institution	2	Collection of the relevant documents on existing energy efficiency policies and methods.	2	CO1
LLO 3.1 Conduct a site assessment to evaluate the suitability of the building for solar installation.	3	*Estimation of solar plant capacity of a building on the basis of total electricity consumption.	2	CO2

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 4.1 Identify the benefits of green belts in improving building energy efficiency	4	Identify the impact of green belt on the energy level of the building. (By physical verification).	2	CO2
LLO 5.1 Identify the components of HVAC systems in the context of green building design.	5	Identify the components of HVAC unit with space calculation.	2	CO3
LLO 6.1 Prepare a report on properties and performance characteristics of sustainable building materials	6	*Collect the information of any five sustainable building materials for a proposed green building project.	2	CO3
LLO 7.1 Develop a set of ethical guidelines for green building construction.	7	Comparison of ethical guideline provided by various organization for green building construction.	2	CO3
LLO 8.1 Effectively plan and prepare for the energy audit thorough understanding of the chosen energy rating system.	8	*Prepare the action plan for converting conventional building into green building on the basis of energy audit.	2	CO4
LLO 9.1 Develop a comprehensive action plan for converting the conventional building into a green building.	9	*Preparation of action plan for upgrading existing green building to next level.	2	CO5
LLO 10.1 Determine the building's compliance with green building standards and the rating system.	10	*Comparative Study of IGBC and GRIHA Certification Processes in Buildings.	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Assignment

- •Visit to construction site to identify energy resources

•Prepare a report on silent provision made in energy conservation act – 2001
•Prepare a report on sustainable building material available in vicinity.
•Compare the working methodology of different Government organizations such as ECA,MNRE,MEDA & BEE
•Collect the sample Audit Report of any one rating Agency such as IGBC,GRIHA etc.
•Prepare a report on Local Construction Techniques and locally available material which will vary from city to city or from state to state.
•NOTE : These are the optional activities for extra learning of students.

Micro project

- Prepare a report by taking case study to classify the terms and the construction methodologies between Traditional building and Green building.
- Conduct an energy audit of a small building to identify areas of energy wastage and propose energy-saving measures
- Collect the relevant information of recent technologies in green building construction and prepare a report on it.
- Prepare a questionnaire for environmental audit.
- Design a green roof for a small building or shed. Research suitable plants, materials, and construction methods that promote energy efficiency, improve air quality, and manage stormwater runoff.
- Design a rainwater harvesting system for a building or home. Calculate potential water savings, design storage solutions, and propose implementation steps.
- Explore ways to reuse or upcycle building materials (e.g., reclaimed wood, recycled glass) in construction or renovation projects. Calculate the environmental impact and cost savings.
- Research and analyze different green building certification programs (e.g., LEED, IGBC). Compare their criteria, costs, and benefits, and propose steps for a building to achieve certification.

- NOTE : These are the optional activities for extra learning of students.

Model/Prototype

- Develop a prototype for a smart home energy monitoring system. Use sensors to monitor energy usage and provide real-time feedback to homeowners on their consumption habits.
- Make a model of solar energy plant.
- NOTE : These are the optional activities for extra learning of students.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	All practical's are based on Field visits, survey, and report writing. No specific equipment's are required.	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Fundamental of Green Building and Energy Conservation	CO1	4	4	4	0	8
2	II	Green Building Concepts And Sustainable Practices	CO2	8	4	4	6	14
3	III	Sustainable Building Materials and Technologies	CO3	6	2	8	0	10
4	IV	Green Building Audit	CO4	10	0	8	10	18
5	V	Green Building Standards and Certification Systems	CO5	12	0	8	12	20
Grand Total				**40**	**10**	**32**	**28**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two-unit tests of 30 marks each will be conducted and average of two-unit tests shall be considered. For Formative assessment of laboratory learning 25 marks,each practical will be assessed considering appropriate % weightage to process and product and other instructions of assessment.

Summative Assessment (Assessment of Learning)

- Pen and Paper Test (Written Test), Term Work, Practical examination.

XI. SUGGESTED COS - POS MATRIX FORM

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Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	-	-	-	3	2	3			
CO2	3	1	2	2	3	2	3			
CO3	3	1	2	2	3	2	2			
CO4	3	2	2	2	3	2	2			
CO5	3	2	2	2	3	2	3			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Sam Kubba	Handbook of Green Building Design and Construction	Butterworth-Heinemann; 1st edition (30 July 2012); CBSPD - NEW DELHI -110092 , ISBN-13 :978-0123851284
2	Bureau of Energy Efficiency (BEE)	Energy Conservation Building Code - India	Bureau of Energy Efficiency (BEE)
3	Indian Green Building Council (IGBC)	Introduction to Green Buildings & Built Environment	BS Publications
4	K. V. Sharma, P. Venkataseshaiah	Energy management and conservation	I K International Publishing House Pvt. Ltd, ISBN-13:978-9381141298
5	Chetan singh, solanki	Renewable energy technologies: a practical guide for beginners	PHI Learning Pvt. Ltd., 2008 ISBN 8120334345, 9788120334342

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.mahaurja.com/	Official website of Maharashtra Energy Development Agency (MEDA)
2	https://mnre.gov.in/	official website of Ministry of New and Renewable Energy
3	https://beeindia.gov.in/en/about-bee	Official website of Ministry of New and Renewable Energy
4	https://www.youtube.com/watch?v=VE2tpwGCN0U	Green Building Ratings and Components

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students