B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VI

ALTERNATE BUILDING MATERIALS

Course Code	**18CV643**	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: This Course will enable students to:

1. understand environmental issues due to building materials and the energy consumption in manufacturing building materials
2. study the various masonry blocks, masonry mortar and structural behavior of masonry under compression.
3. Study the alternative building materials in the present context.
4. understand the alternative building technologies which are followed in present construction field.

Module -1

Introduction: Energy in building materials, Environmental issues concerned to building materials, Embodied energy and life-cycle energy, Global warming and construction industry, Green concepts in buildings, Green building ratings – IGBC and LEED manuals – mandatory requirements, Rainwater harvesting & solar passive architecture. Environmental friendly and cost effective building technologies, Requirements for buildings of different climatic regions.

Module -2

Elements of Structural Masonry : Elements of Structural Masonry, Masonry materials, requirements of masonry units' characteristics of bricks, stones, clay blocks, concrete blocks, stone boulders, laterite Blocks, Fal- G blocks and Stabilized mud block. Manufacture of stabilized blocks.

Structural Masonry Mortars: Mortars, cementations materials, sand, natural & manufactured, types of mortars, classification of mortars as per BIS, characteristics and requirements of mortar, selection of mortar.

Uses of masonry, masonry bonding, Compressive strength of masonry elements, Factors affecting compressive strength, Strength of Prisms/wallets and walls, Effect of brick bond on strength, Bond strength of masonry: Flexure and shear, Elastic properties of masonry materials and masonry, Design of masonry compression elements subjected to axial load.

Module -3

Alternate Building Materials: Lime, Pozzolana cements, Raw materials, Manufacturing process, Properties and uses. Fibers- metal and synthetic, Properties and applications. Fiber reinforced plastics, Matrix materials, Fibers organic and synthetic, Properties and applications. Building materials from agro and industrial wastes ,Types of agro wastes, Types of industrial and mine wastes, Properties and applications. Masonry blocks using industrial wastes. Construction and demolition wastes.

Module -4

Alternate Building Technologies: Use of arches in foundation, alternatives for wall constructions, composite masonry, confined masonry, cavity walls, rammed earth, Ferro cement and ferroconcrete building components, Materials and specifications, Properties, Construction methods, Applications.

Top down construction, Mivan Construction Technique.

Alternate Roofing Systems: Concepts, Filler slabs, Composite beam panel roofs, Masonry vaults and domes.

Module -5

Equipment for Production of Alternate Materials: Machines for manufacture of concrete, Equipments for production of stabilized blocks, Moulds and methods of production of precast elements, Cost concepts in buildings, Cost saving techniques in planning, design and construction, Cost analysis: Case studies using alternatives.

Course Outcomes: After studying this course, students will be able to:

1. Solve the problems of Environmental issues concerned to building materials and cost effective building technologies;
2. Select appropriate type of masonry unit and mortar for civil engineering constructions; also they are able to Design Structural Masonry Elements under Axial Compression.
3. Analyse different alternative building materials which will be suitable for specific climate and in an environmentally sustainable manner. Also capable of suggesting suitable agro and industrial wastes as a building material.
4. Recommend various types of alternative building materials and technologies and design a energy efficient building by considering local climatic condition and building material.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

1. KS Jagadish, B V Venkatarama Reddy and K S Nanjunda Rao, "Alternative Building Materials and Technologies", New Age International pub.
2. Arnold W Hendry, "Structural Masonry", Macmillan Publishers.

Reference Books:

1. RJS Spence and DJ Cook, "Building Materials in Developing Countries", Wiley pub.
2. LEED India, Green Building Rating System, IGBC pub.
3. IGBC Green Homes Rating System, CII pub.
4. Relevant IS Codes.

B. E. ELECTRICAL AND ELECTRONICS ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – VII

SOLAR AND WIND ENERGY (Professional Elective)

Course Code	**18EE731**	CIE Marks	40
Number of Lecture Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives:

- To discuss the importance of energy in human life, relationship among economy and environment with energy use.
- To discuss the increasing role of renewable energy, energy management, energy audit, energy efficiency, energy intensity.
- To discuss energy consumption status in India, energy saving potential and energy conservation efforts in India.
- To explain the concept of energy storage and the principles of energy storage devices.
- To discuss the characteristics and distribution of solar radiation, measurement of components of solar radiation and analysis of collected solar radiation data.
- To explain availability of solar radiation at a location and the effect of tilting the surface of collector with respect to horizontal surface.
- To describe the process of harnessing solar energy in the form of heat and working of solar collectors.
- To discuss applications of solar energy including heating and cooling.
- To discuss the operation of solar cell and the environmental effects on electrical characteristics of solar cell
- To discuss sizing and design of typical solar PV systems and their applications.
- To discuss basic Principles of Wind Energy Conversion and to compute the power available in the wind.
- To discuss forces on the Blades, Wind Energy Conversion, collection of Wind Data, energy estimation and site selection.
- To discuss classification of WEC Systems, its advantages and disadvantages of WECS, and Types of Wind Machines (Wind Energy Collectors).
- To evaluate the performance of Wind-machines, Generating Systems. ■

Module-1

Fundamentals of Energy Science and Technology: Introduction, Energy, Economy and Social Development, Classification of Energy Sources, Importance of Non -conventional Energy Sources, Salient features of Non-conventional Energy Sources, World Energy Status, Energy Status in India. **Energy Conservation and Efficiency:** Introduction, Important Terms and Definitions, Important Aspects of Energy Conservation, Global Efforts, Achievements and Future Planning, Energy Conservation/Efficiency Scenario in India, Energy Audit, Energy Conservation Opportunities.

Energy Storage: Introduction, Necessity of Energy Storage, Specifications of Energy Storage Devices. **Solar Energy-Basic Concepts:** Introduction, The Sun as Source of Energy, The Earth, Sun, Earth Radiation Spectrum, Extraterrestrial and Terrestrial Radiations, Spectral Power Distribution of Solar Radiation, Depletion of Solar Radiation. ■

Module-2

Solar Energy-Basic Concepts (continued): Measurement of Solar Radiation, Solar Radiation Data, Solar Time, Solar Radiation Geometry, Solar Day Length, Extraterrestrial Radiation on Horizontal Surface, Empirical Equations for Estimating Terrestrial Solar Radiation on Horizontal Surface, Solar Radiation on Inclined Plane Surface.

Solar Thermal Systems: Introduction, Solar Collectors, Solar Water Heater, Solar Passive Space Heating and Cooling Systems, Solar Industrial Heating Systems, Solar Refrigeration and Air Conditioning Systems, Solar Cookers. ■

Module-3

Solar Photovoltaic Systems: Introduction, Solar Cell Fundamentals, Solar Cell Characteristics, Solar Cell Classification, Solar Cell Technologies, Solar Cell, Module, and Array Construction, Maximizing the Solar PV Output and Load Matching. Maximum Power Point Tracker. Balance of System Components, Solar PV Systems, Solar PV Applications.

Module-4

Wind Energy: Introduction, Basic Principles of Wind Energy Conversion, History of Wind Energy, Wind Energy Scenario – World and India. The Nature of the Wind, The Power in the Wind, Forces on the Blades, Wind Energy Conversion, Wind Data and Energy Estimation, Site Selection Considerations
Wind energy systems: Environment and Economics Environmental benefits and problems of wind energy, Economics of wind energy, Factors influence the cost of energy generation, machine parameters, Life cycle cost analysis

Module-5

Basic Components of a Wind Energy Conversion(WEC) System: Classification of WEC systems, Advantages and Disadvantages of WECS, Types of Wind Machines (Wind Energy Collectors), Analysis of Aerodynamic Forces Acting on the Blade, Performance of Wind- machines, Generating Systems, Energy Storage, Applications of Wind Energy, Environmental Aspects.

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

- Discuss the importance of the role of renewable energy, the concept of energy storage and the principles of energy storage devices.
- Discuss the concept of solar radiation data and solar PV system fabrication, operation of solar cell, sizing and design of PV system.
- Describe the process of harnessing solar energy and its applications in heating and cooling.
- Explain basic Principles of Wind Energy Conversion, collection of wind data, energy estimation and site selection.
- Discuss the performance of Wind-machines, energy storage, applications of Wind Energy and environmental aspects.

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of three sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbook

1	Non-Conventional Energy Resources	B. H. Khan	McGraw Hill	2nd Edition 2017
2	Non-Conventional Sources of Energy	Rai G. D.	Khanna Publishers	4th Edition, 2009

Reference Books

1	Non-Conventional Energy Resources	ShobhNath Singh	Pearson	1st Edition, 2015
2	Solar Energy – Principles of Thermal Collections and Storage	S.P. Sukhatme J.K.Nayak	McGraw Hill	3rd Edition, 2008
3	Wind Turbine Technology	Ahmad Hemami	Cengage	1st Edition, 2012

B. E. MECHANICAL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – VII
Professional Elective 3

EMERGING SUSTAINABLE BUILDING COOLING TECHNOLOGIES

Course Code	**18ME742**	CIE Marks	40
Teaching Hours /Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives:

- To provide an overview of emerging delivery systems for high performance green buildings and the basis on which their sustainability can be evaluated
- To know the concepts of calculations of heating and cooling loads and the related economics.
- To learn the importance of green fuels and its impact on environment.
- To expose the students to sustainable cooling technologies.

Module-1

Social and Environmental Issues related to conventional Refrigeration and Air conditioning: Climate Change and energy poverty implications of energy consumption and refrigerants use by conventional Vapor-Compression based RAC technologies, Global and Indian environmental, energy efficiency and green building policies, laws and rules warranting a trajectory shift in the RAC economy, Introduction to Thermal comfort as an 'ends' and cooling systems as a 'means', Socio-economic and environmental benefits of a Negawatt approach to energy conservation vs. a Megawatt approach towards power generation.

Module-2

Thermal Comfort, Climate Analysis and Psychrometry: The 'human thermal comfort' lens and its implications for cooling system design, Progressive models for addressing human thermal comfort needs, Thermodynamics of human body, Factors affecting human comfort, Introduction to the ASHRAE Std. 55, Adaptive Comfort Model and the Indian Model for Adaptive Comfort (IMAC) and its implications for mitigating climate change and energy consumption from cooling technologies, Tools for predicting thermal comfort in buildings, Principles and tools for climate analysis, Composition of Psychrometric Charts, Psychrometric processes of conventional and sustainable cooling technologies and representation on psychrometric chart, Application of psychrometry to design conventional and sustainable cooling technologies.

Indoor Air Quality and Building Cooling Load Modelling:

Addressing trade-offs between indoor air quality requirements, daylighting needs, and solar heat gain reduction in artificially cooled buildings. Factors affecting building cooling loads. Building cooling load

Module-3

Refrigeration Systems and Refrigerants:

Thermodynamics of Vapor Compression Refrigeration (VCR) and Vapor Absorption Machine (VAM) Cycles, Equipment used in commercial and residential VCR and VAM systems, Physical, Chemical, Thermodynamic and Environmental properties of Refrigerants and Refrigerant mixtures **(**zeotropic and azeotropic mixtures) used in conventional VCR system, Absorbent **–** Refrigerant combinations (Water-Ammonia and Lithium-Bromide) used in VAM systems, Physical, Chemical, Thermodynamic and Environmental properties of emerging Natural Refrigerants for VCR systems.

Module-4

Air conditioning:

Air conditioning demand scenarios for India and associated health, social justice, energy access, and environmental Implications for its peoples and communities, Potential sustainable air conditioning scenarios for India, Heat transfer and psychrometric principles of air conditioning cycles, Engineering principles of air conditioning components, Air conditioning coefficient-of-performance calculation, Energy efficient air conditioning system, Energy and greenhouse gas emissions-based performance comparison of natural

refrigerant and f-gas based air conditioners.

Module-5

Sustainable Cooling Technologies:

Radical social justice fostering, energy conservation, and climate change mitigation potential of natural cooling, Design principles of natural and sustainable cooling systems, Science and engineering design principles of a) Direct, Indirect, and Hybrid (Direct-Indirect and DX) Evaporative Cooling technology, b) Structure Cooling, c) Radiant Cooling Systems, and d) Solar VAM technology, Basic equipment sizing calculations, System performance assessment methods, Comparative energy consumption, greenhouse gas emissions and life-cycle cost case studies for residential and commercial applications of conventional and sustainable cooling technologies.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Empathize with sustainable cooling as a means of enhancing social justice in India and mitigating climate change through their intellectual capabilities and ethical orientation

CO2: Compute and Interpret cooling and heating loads in a building and how they could be efficiently managed by using building energy modelling software

CO3: Estimate the performance of airconditioning systems using the principles of thermodynamics, heat transfer, and psychometry

CO4: Calculate and interpret the energy, cost, and greenhouse gas emissions performance of conventional and sustainable cooling technologies.

Co6: Conduct building and sustainable cooling modelling projects on a sophisticated building energy modelling software.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Refrigeration and Airconditioning	C P Arora	Tata McGraw Hill	3rd Edition
2	Heating, Ventilating and Airconditioning	Faye C McQuiston, Jerald D. Parker, Jeffrey D. Spitler	Wiley Indian Private Ltd.	
Reference Books				
1	Radiant Heating and Cooling Handbook	Richard D. Watson	McGraw-Hill Publication	2002
Link: https://www.accessengineeringlibrary.com/browse/radiant-heating-and-cooling-handbook#p2000a97e9970iii001				
2	Evaporative Cooling		CAREL	
Link: http://www.carel.com/-evaporative-cooling-book				