

CE 455

ADVANCED ENVIRONMENTAL ENGINEERING

(Elective-II)

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

UNIT-I

Industrial Waste Management - Types of industries, characteristics of industrial wastes, effects of industrial effluents on streams, land and human health. Environmental legislation related to industrial effluents and hazardous wastes. Self-purification of water bodies, Streeter phelps equation.

UNIT-II

Industrial Waste Water Treatment: Manufacturing process, waste water characteristics and effluent of the following industries - Leather tanning, dairy, pulp and paper, pharmaceutical, textiles, steel plants, thermal power plants, fertilizer, cement, sugar and distilleries.

UNIT-III

Air Pollution : Sources, classification and effects of air pollutants, Meteorology of air pollution, wind rose diagrams, lapse rates, atmospheric stability and dispersion of air pollutants, stack height calculation, ambient air quality monitoring, stack sampling, analysis of air pollutants.

UNIT-IV

Air Pollution Control : Air quality standards, methods of air pollution control- zoning, source correction, control of suspended particulate matter by equipment (gravitation, centrifugation, filtration, scrubbing, electrostatic precipitation), selection of proper equipment, gaseous pollutant control by absorption, condensation, combustion.

UNIT-V

Environmental Impact Assessment: Need for environmental impact assessment (EIA), objectives of EIA. EIA capabilities and limitations. Legal provisions of EIA. Methods of EIA, base line data collection required for EIA, evaluation of impacts, prediction of impacts. Preparation of Environmental Management Plan, preparation of EIAs of road project,

Industry, and dam. Issues related to rehabilitation of affected people, Preparation of Environment impact statement and Environment management plan.

Suggested Reading :

1. Rao M.N. and Dutt, *Waste Water Treatment*, Oxford and IBM Publications Ltd.,
2. Eckenfelder, W.W., *Industrial waste pollution control*. McGrawHill Book Co.
3. C.S. Rao, *Environmental Pollution Control Engineering*, WileyEastern Ltd., New Delhi.
4. M.N. Rao, H.V.N. Rao, *Air Pollution Control*, Tata McGraw Hill.
5. Peavy and Rowe, *Environmental Engineering*, McGraw Hill Publications.
6. Keiley, *Environmental Engineering*, McGraw Hill Publishers, 2003.
7. Sincero and Sincere, *Environmental Engineering*, Prentice Hall of India.

Course Code	Course Title					Core / Elective	
OE 601 CE	DISASTER MANAGEMENT					Elective	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	0	0	0	30	70	3
Course Objectives <ul style="list-style-type: none"> ➤ To provide students an exposure to disasters, their significance and types. ➤ To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction ➤ To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR) ➤ To enhance awareness of institutional processes in the country ➤ To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity Course Outcomes <ul style="list-style-type: none"> ➤ The students will be able to understand impact on Natural and manmade disasters. ➤ Able to classify disasters and destructions due to cyclones ➤ Able to understand disaster management applied in India 							

UNIT-I

Introduction to Disasters: Concepts and definitions of Disaster, Hazard, Vulnerability, Resilience, Risks. Natural and Manmade disasters, impact of drought, review of past disasters and drought in India, its classification and characteristics. Classification of drought, causes, Impacts (including social, economic, political, environmental, health, psychosocial, etc.).

UNIT-II

Disaster: Classifications, Causes, Impacts including social, economic, political, environmental, health, psychosocial etc. Differential Impacts, in terms of caste, class, gender, age, location, disability Global trends in disasters, urban disasters, pandemics, complex emergencies, climate change. Cyclones and Floods: Tropical cyclones & Local storms, Destruction by tropical cyclones and local storms, Cumulative atmospheric hazards/ disasters, Cold waves, Heat waves, Causes of floods, Flood hazards in India.

UNIT-III

Approaches to Disaster Risk Reduction: Disaster cycle, its analysis, Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural sources, roles and responsibilities of community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), states, Centre, and other stake-holders.

UNIT-IV

Inter-relationship between Disasters and Development: Factors affecting Vulnerabilities, differential impacts, impact of development projects such as dams, embankments, changes in Land-use etc. Climate Change, Adaptation, Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT-V

Disaster Risk Management in India: Hazard and Vulnerability profile of India

Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management Institutional arrangements (Mitigation, Response and Preparedness, OM Act and Policy, other related policies, plans, programmes and legislation)

Field Work and Case Studies: The field work is meant for students to understand vulnerabilities and to work on reducing disaster risks and to build a culture of safety. Projects must be conceived creatively based on the geographic location and hazard profile of the region where the college is located.

Suggested readings:

- 1) Sharma V. K., “**Disaster Management, National Centre for Disaster Management**”, IIPE, Delhi, 1999.
- 2) Gupta Anil K, and Sreeja S. Nair., “**Environmental Knowledge for Disaster Risk Management**”, NIDM, New Delhi, 2011.
- 3) Nick., “**Disaster Management: A Disaster Manager's Handbook**” Asian Development Bank, Manila Philippines, 1991.
- 4) Kapur, et al. , “**Disasters in India Studies of Grim Reality**”, Rawat Publishers, Jaipur, 2005.
- 5) Pelling Mark, “**The Vulnerability of Cities: Natural Disaster and Social Resilience**”, Earth scan publishers, London, 2003.

Course Code	Course Title				Core/Elective		
PE 841 ME	Energy Conservation and Management				Elective		
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

- To learn about energy conservation
- To understand sources of loss of power in energy conversion
- To understand Procedure for Comprehensive Energy Conservation Planning
- To understand Industrial energy conservation methods

Course Outcomes

On successful completion of this course, the student will be able to

1. Understand different forms of energy
2. Calculate the amount of heat energy available
3. Understand the industry energy conservation modelling
4. Understand methodology for forecasting industrial energy supply and demand.

UNIT-I

Definition, Principles of Energy Conservation - Maximum Thermodynamic efficiency. Maximum Cost - effectiveness in energy use. Various forms of energy - Heat Mechanical. Electrical energy and Chemical energy. Identification of potential sources of energy losses - Transportation, operation and conversion from one form to another.

UNIT-II

Heat energy and storage - Media of transport of heat energy - steam, oil and flue gases. Calculation of steam quality. Calculation of amount of heat energy available. Recuperators. Constructional details, Selection of materials to store heat energy. Concept of power. Modes of mechanical energy transport - Gears, pulleys, belts, shafts etc., Calculation of power. Sources of loss of power in energy conversion into electricity, potential energy (i.e., pumps).

UNIT-III

Chemical energy - combustion of fuels - petrol, diesel and coal. Loss due to quality of fuel, conversion into other form of energy - boilers, I.C. engines. Calculation related to losses. Electrical energy - Working principle of motors and generators. Calculation of efficiency of generators. Losses during transmission and energy conversion - into mechanical energy, thermal energy. Calculation of effecting parameters.

UNIT-IV

Procedure for Comprehensive Energy Conservation Planning (CECP) -Specifying targets, identifying energy in-efficient facilities. Synthesize evaluation and optimization of alternative conservation measures in view of organization costs. Flow chart of organization's functions. Collection of accountable data. Application of CECP method. An example.

UNIT-V

Industrial energy conservation modeling - Methodology - Definition of production system - A primary copper production system, Model construction - Mathematical Programming. Market penetration, Structure of energy conservation model. Data preparation - coefficients needed in a model, Unit production cost and unit energy requirements. Model exercise, verification and validation. Methodology for forecasting Industrial Energy Supply and Demand.

Suggested Readings:

1. Gottschalk C.M., "Industrial Energy Conservation", John Wiley & Sons, 1996.
2. Chaturvedi P., and Joshi S., "Strategy for Energy Conservation in India", Concept PublishingCo., New Delhi, 1997.

Course Code	Course Title					Core / Elective	
PC 506 CE	ENVIRONMENTAL ENGINEERING					Core	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	0	0	0	30	70	3
Course Objectives <ul style="list-style-type: none"> ➤ Fill the gap between general introductory environmental science and the more advanced environmental engineering ➤ Explain the different sequential unit operations of water and wastewater treatment Processes ➤ Provide necessary engineering principles for analyzing the environmental issues ➤ Motivate the present Course Outcomes <ul style="list-style-type: none"> ➤ Students will understand the impact of engineering solutions in a global, economic, environmental and societal context. ➤ Students will have an ability to design environmental engineering systems that include considerations such as risk, uncertainty, sustainability and environmental impacts. ➤ Students will have the ability to speak before a group, effectively convey information to technical and non-technical audiences. 							

UNIT-I

Introduction: Necessity of protected water supply and sanitation, Water demand and per capita consumption, factors affecting population forecasts.

Water Supply: Sources of water and quality parameters, standards of potable water, infiltration pipes & galleries, intake structures pipes, joints, valves & pumps. Water distribution systems and solution of a simple network using Hardy Cross method.

UNIT-II

Treatment of Water: Clarification sedimentation – Principles. Design of sedimentation tanks, coagulation and flocculation, design of a clariflocculator. Filtration – Types of filters and filter media. Design principles of slow and rapid sand filters. Backwash mechanisms. Pressure filters. Disinfections – Necessity and methods, Chlorination of water supplied, action of chlorine, break point chlorination. Ozone and U-V radiations, Removal of hardness, tastes & odor control.

UNIT-III

Domestic Sewage: Quantity estimation, quality parameters – BOD, COD and TOC. Sewerage systems, ultimate disposal of sewage, Land and water bodies, Sewage conveyance – Sewer types and appurtenances, Velocity in sewers, Design of a simple sewerage system. Storm water sewers – Storm water estimation by rational method.

UNIT-IV

Waste Water Treatment: Preliminary treatment, screens, grit chambers. Primary treatment – Sedimentation – rectangular and circular sedimentation tanks, Secondary treatment – sewage filtration – trickling design. Activated sludge process – design parameters, secondary clarifier. Design aspects of a sewage treatment facility.

UNIT-V

Sludge: Sludge digestion and disposal methods – septic tanks – design parameters and working principles. Low cost waste treatment – oxidation ponds, RBC.

Solid Waste: Types, source and composition of solid waste, Methods of collection, transportation and disposal

Suggested readings:

- 1) Fair. G. M. and Geyer. J. C. “*Water and Wastewater Engineering* “, Vol. I & II. John Wiley & Sons Inc., New York, 2010.
- 2) White. J.B., “*Wastewater Engineering*”, 2nd Edition, Edward Arnold. London, 1978
- 3) Hammer. M. J. and Hammer. M. J. Jr., “*Water and Wastewater Technology*”, Prentice-Hall of India Pvt. Ltd., New Delhi, 1998
- 4) Metcalf & Eddy. ‘*Wastewater Engg; Treatment, Disposal Reuse*’, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1995
- 5) Sasi Kumar, K. and Sanoop Gopi Krishna., ‘*Solid waste Management*’, Prentice-Hall of India Pvt. Ltd., New Delhi, 2009
- 6) Gilbert, M. Masters , ‘*Introduction to Environmental Engineering and Science*’, Prentice-Hall of India Pvt. Ltd., New Delhi, 1995

Course Code	Course Title					Core / Elective	
MC 916 CE	ENVIRONMENTAL SCIENCES					Core	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	-	-	-	30	70	3
<p>Course Objectives</p> <ul style="list-style-type: none"> ➤ To study the basic concepts, sources of water, floods and their impact on environment ➤ To know the ecosystems and energy resource systems ➤ To understand the Biodiversity concepts and their advantages ➤ To study the different pollutions and their impact on environment ➤ To know the social and environment related issues and their preventive measures <p>Course Outcomes</p> <ul style="list-style-type: none"> ➤ Awareness of effects of hazardous environment. ➤ Idea about optimum utilization of natural resources. ➤ Be a catalyst in moving towards Green technologies ➤ Information about rules and regulations of pollution control 							

UNIT-I

Environmental studies: Definition, scope and importance, need for public awareness. Natural resources: Water resources; use and over utilization of surface and ground water, Floods, drought, conflicts over water, dams-benefits and problems. Effects of modern Agriculture, Fertilizer-pesticide problems, water logging and salinity.

UNIT-II

Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in ecosystem, food chains, ecological pyramids, aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries) Energy resources: Growing energy needs renewable and non-renewable energy sources. Land Resources, land as a resource, land degradation, soil erosion and desertification.

UNIT-III

Biodiversity: Genetic species and ecosystem diversity, bio-geographical classification of India. Value of biodiversity, threats to biodiversity, endangered and endemic species of India, conservation of biodiversity.

UNIT-IV

Environmental Pollution: Cause, effects and control measures of air pollution, water pollution, soil pollution, noise pollution, thermal pollution and solid waste management. Environmental protection act: Air, water, forest and wild life Acts, enforcement of Environmental legislation.

UNIT-V

Social issues and the Environment: Water conservation, watershed management, and environmental ethics. Climate change, global warming, acid rain, ozone layer depletion.
Disaster management: Types of disasters, impact of disasters on environment, infrastructure, and development. Basic principles of disaster mitigation, disaster management, and methodology, disaster management cycle, and disaster management in India.

Suggested Reading:

1. De A.K., “**Environmental Chemistry**”, Wiley Eastern Ltd.,
2. Odum E.P., “**Fundamentals of Ecology**”, W.B. Saunders Co., USA.
3. Rao M.N and Datta A.K., “**Waste Water Treatment**”, Oxford and IBK Publications.
4. Benny Joseph, “**Environmental studies**”, Tata McGraw Hill, 2005
5. Sharma V.K., “**Disaster Management**”, National Centre for Disaster management, IPE, Delhi, 1999

Course Code	Course Title				Core / Elective		
OE 771 CE	Green Building Technologies				Open Elective-II		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

- To impart knowledge of the principles behind the green building technologies.
- To know the importance of sustainable use of natural resources and energy.
- To understand the principles of effective energy and resources management in buildings.
- To bring awareness of the basic criteria in the green building rating systems.
- To understand the methodologies to reduce, recycle and reuse towards sustainability.

Course Outcomes

After completing this course, the student will be able to

1. Define a green building, along with its features, benefits and rating systems.
2. Describe the criteria used for site selection and water efficiency methods.
3. Explain the energy efficiency terms and methods used in green building practices.
4. Select materials for sustainable built environment & adopt waste management methods.
5. Describe the methods used to maintain indoor environmental quality.

UNIT-I

Introduction to Green Buildings: Definition of green buildings and sustainable development, typical features of green buildings, benefits of green buildings towards sustainable development. Green building rating systems – GRIHA, IGBC and LEED, overview of the criteria as per these rating systems.

UNIT- II

Site selection and planning: Criteria for site selection, preservation of landscape, soil erosion control, minimizing urban heat island effect, maximize comfort by proper orientation of building facades, day lighting, ventilation, etc.

Water conservation and efficiency: Rainwater harvesting methods for roof & non-roof, reducing landscape water demand by proper irrigation systems, water efficient plumbing systems, water metering, waste water treatment, recycle and reuse systems.

UNIT-III

Energy Efficiency: Environmental impact of building constructions, Concepts of embodied energy, operational energy and life cycle energy. Methods to reduce operational energy: Energy efficient building envelopes, efficient lighting technologies, energy efficient appliances for heating and air-conditioning systems in buildings, zero ozone depleting potential (ODP) materials, wind and solar energy harvesting, energy metering and monitoring, concept of net zero buildings.

UNIT-IV

Building materials: Methods to reduce embodied energy in building materials: (a) Use of local building materials (b) Use of natural and renewable materials like bamboo, timber, rammed earth, stabilized mud blocks, (c) use of materials with recycled content such as blended cements, pozzolana cements, fly ash bricks, vitrified tiles, materials from agro and industrial waste. (d) reuse of waste and salvaged materials

Waste Management: Handling of construction waste materials, separation of household waste, on-site and off-site organic waste management

UNIT-V

Indoor Environmental Quality for Occupant Comfort and Wellbeing: Daylighting, air ventilation, exhaust systems, low VOC paints, materials & adhesives, building acoustics. Codes related to green buildings: NBC, ECBC, ASHRAE, UPC etc.

Suggested Readings:

1. IGBC Green Homes Rating System, Version 2.0., Abridged reference guide, 2013, Indian Green Building Council Publishers.
2. GRIHA version 2015, GRIHA rating system, Green Rating for Integrated Habitat Assessment.
3. *Alternative building materials and technologies* by K.S. Jagadish, B.V. Venkatarama Reddy and K.S. Nanjunda Rao.
4. *Non-Conventional Energy Resources* by G. D. Rai, Khanna Publishers.
5. *Sustainable Building Design Manual*, Vol.1 and 2, TERI, New Delhi 2004.
6. Mike Montoya, *Green Building Fundamentals*, Pearson, USA, 2010.
7. Charles J. Kibert, *Sustainable Construction - Green Building Design and Delivery*, John Wiley & Sons, New York, 2008.
8. Regina Leffers, *Sustainable Construction and Design*, Pearson / Prentice Hall, USA, 2009.

Course Code	Course Title				Core / Elective		
PE 833 CE	Groundwater Management				Elective		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Water Resources Engineering-I	3	-	-	-	30	70	3
<p>Course Objectives To make the student familiar with the concepts of</p> <ul style="list-style-type: none"> ➤ The importance of hydrologic cycle in improving groundwater. ➤ The characteristics of groundwater flow, storage parameters and geophysical methods in groundwater exploration. ➤ The socio-economic aspects of groundwater hydrology. ➤ Developing numerical solutions for groundwater flow models. <p>Course Outcomes After completing this course, the student will be able to</p> <ol style="list-style-type: none"> 1. Describe the socio-economic aspects of groundwater hydrology. 2. Perform geophysical methods for groundwater exploration. 3. Compute flow from a groundwater aquifer. 4. Identify groundwater contamination sources. 5. Analyse various models in ground water. 							

UNIT – I

Introduction: Ground water in hydrologic cycle, Distribution of subsurface water, ground water potential in India and A.P, occurrence of Ground water in hydrogeologic formations, components of groundwater studies, Darcy's law and its validity. Geophysical methods in groundwater Exploration: surface geophysical methods; Electrical resistivity method, seismic method, magnetic method, determination of aquifer thickness.

UNIT – II

Governing Equations of Groundwater Flow in Aquifers: 3-D Ground water flow equations in Cartesian and polar coordinates. Equations for steady radial flow into a well in case of confined and unconfined aquifers, Equations for effect of uniform recharge in a fully penetrating unconfined aquifer, well flow near aquifer boundaries. Equations for unsteady radial flow into a well in case of confined aquifer, determination of S and T by Thei's graphical method, Cooper- Jacob's and Chow's method.

UNIT – III

Sources and Types of Groundwater Contamination: Introduction underground storage tanks, landfills, surface impoundments, waste disposal of injection wells, radioactive contaminants, classification of organic compounds, inorganic compounds in ground water. Mechanism of salt water intrusion, Ghyben-Herzberg relation, slope and shape of the interface, prevention and control of seawater intrusion, case studies involving sea water intrusion.

UNIT – IV

Contaminant Transport: Introduction, advection process, diffusion and dispersion process, mass transport equation governing flow and transport equations, analytical methods, tests for dispersivity.

Non-Aqueous Phase Liquids (NAPL'S): Types general processes, transport; fate of NAPL'S in subsurface.

UNIT – V

Models in Groundwater Analysis: Major applications of ground water models, sand models, viscous fluid models, membrane models, thermal models, Electric-Analog models, numerical modelling of ground water systems.

Suggested Readings:

1. Rastogi, A.K. (2007). *Numerical Groundwater Hydrology*. Penram International Publishing (India) Pvt Ltd.
2. Ven-Te-Chow. (1964). *Hand Book of Applied Hydrology*. McGraw Hill Company, New York.
3. Todd, D.K. (1980). *Groundwater Hydrology*. John Wiley and Sons, New York.
4. Karanth, K. R. (1987). *Groundwater Assessment, Development and Management*. Tata McGraw-Hill publishing company New Delhi.
5. Raghunath H.M (1982). *Ground Water*. Wiley Eastern Ltd, New Delhi.

Course Code	Course Title				Core / Elective		
OE 774 EE	Non-Conventional Energy Sources				Open Elective-II		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

To impart the knowledge of basics of different non-conventional types of power generation & power plants in detail so that it helps them in understanding the need and role of Non-Conventional Energy sources particularly when the conventional sources are scarce in nature

Course Outcomes

On completion of course the student will be able to:

1. Understand the different nonconventional sources and the power generation techniques to generate electrical power.
2. Understand the Solar energy power development and different applications.
3. Understand different wind energy power generation techniques and applications.
4. Design a prescribed engineering sub-system
5. Recognize the need and ability to engage in lifelong learning for further developments in this field.

UNIT-I

Review of Conventional and Non-Conventional energy sources - Need for non-conventional energy sources
Types of Non- conventional energy sources - Fuel Cells - Principle of operation with special reference to H₂ O₂ Cell - Classification and Block diagram of fuel cell systems - Ion exchange membrane cell - Molten carbonate cells - Solid oxide electrolyte cells - Regenerative system- Regenerative Fuel Cell - Advantages and disadvantages of Fuel Cells-Polarization - Conversion efficiency and Applications of Fuel Cells.

UNIT-II

Solar energy - Solar radiation and its measurements - Solar Energy collectors -Solar Energy storage systems - Solar Pond - Application of Solar Pond - Applications of solar energy.

UNIT-III

Wind energy- Principles of wind energy conversion systems - Nature of wind - Power in the Wind-Basic components of WECS -Classification of WECS -Site selection considerations -Advantages and disadvantages of WECS -Wind energy collectors -Wind electric generating and control systems - Applications of Wind energy -Environmental aspects.

UNIT- IV

Energy from the Oceans - Ocean Thermal Electric Conversion (OTEC) methods - Principles of tidal power generation -Advantages and limitations of tidal power generation -Ocean waves - Wave energy conversion devices -Advantages and disadvantages of wave energy - Geo-Thermal Energy - Types of Geo-Thermal Energy Systems - Applications of Geo-Thermal Energy.

UNIT-V

Energy from Biomass - Biomass conversion technologies / processes - Photosynthesis - Photosynthetic efficiency - Biogas generation - Selection of site for Biogas plant - Classification of Biogas plants - Details of commonly used Biogas plants in India - Advantages and disadvantages of Biogas generation -Thermal gasification of biomass -Biomass gasifiers.

Suggested Readings:

1. Rai G.D, *Non-Conventional Sources of Energy*, Khandala Publishers, New Delhi, 1999.
2. M.M. El-Wakil, *Power Plant Technology*. McGraw Hill, 1984.

Course Code	Course Title				Core / Elective		
PE 842 CE	Principles of Green Building Practices				Elective		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	L			
-	3	-	-	-	30	70	3

Course Objectives

- To impart knowledge of the principles and practices of the green buildings.
- To know the importance of sustainable use of natural resources and energy.
- To understand the principles of effective energy and resources management in buildings.
- To bring awareness of the basic criteria in the green building rating systems.
- To understand the methodologies to reduce, recycle and reuse towards sustainability.

Course Outcomes

After completing this course, the student will be able to

1. Define sustainability and a green building, along with its features and benefits.
2. Describe the criteria used for site selection and water efficiency methods.
3. Explain the energy efficiency terms and methods used in green building practices.
4. Select materials for sustainable built environment & adopt waste management methods.
5. Describe the methods used to maintain indoor environmental quality.

UNIT-I

Introduction to Green Buildings: Definition of green buildings, definition of sustainability, typical features of green buildings, benefits of green buildings towards sustainable development. Green building rating systems – GRIHA, IGBC and LEED, overview of the criteria as per these rating systems.

UNIT- II

Site selection and planning: Criteria for site selection, preservation of landscape, soil erosion control, minimizing urban heat island effect, maximize comfort by proper orientation of building facades, day lighting, ventilation, and so on.

Water conservation and efficiency: Rainwater harvesting methods for roof & non-roof, reducing landscape water demand by proper irrigation systems, water efficient plumbing systems, water metering, waste water treatment, recycle and reuse systems.

UNIT-III

Energy Efficiency: Environmental impact of building constructions, Concepts of embodied energy, operational energy and life cycle energy.

Methods to reduce operational energy: Energy efficient building envelopes, Solar Heat Gain Coefficient, U-Values for facade materials, efficient lighting technologies, energy efficient and BEE rated appliances for heating and air-conditioning systems in buildings, zero ozone depleting potential (ODP) materials, wind and solar energy harvesting, energy metering and monitoring, concept of NET ZERO buildings.

UNIT-IV

Building materials: Methods to reduce embodied energy in building materials: (a) Local building materials. (b) Natural and renewable materials like bamboo, timber, rammed earth, stabilized mud blocks. (c) Materials with recycled content such as blended cements, pozzolana cements, fly ash bricks, vitrified tiles, materials from agro and industrial waste. (d) Reuse of waste and salvaged materials.

Waste Management: Handling of construction & demolition waste materials, separation of household waste, handling e-waste, on-site and off-site organic waste management.

UNIT-V

Indoor Environmental Quality: Day lighting, air ventilation, exhaust systems, low VOC paints, materials & adhesives, building acoustics.

Codes related to green buildings: NBC, ECBC, ASHRAE, UPC etc.

Suggested Readings:

1. IGBC Green Homes Rating System, Version 2.0., Abridged reference guide, 2013, Indian Green Building Council Publishers.
2. GRIHA version 2015, GRIHA rating system, Green Rating for Integrated Habitat Assessment.
3. *Alternative building materials and technologies* by K.S. Jagadish, B.V. Venkatarama Reddy and K.S. Nanjunda Rao.
4. *Non-Conventional Energy Resource* by G. D. Rai, Khanna Publishers.
5. Sustainable Building Design Manual, Vol.1 and 2, TERI, New Delhi, 2004.
6. Mike Montoya, *Green Building Fundamentals*, Pearson, USA, 2010.
7. Charles J. Kibert, *Sustainable Construction - Green Building Design and Delivery*, John Wiley & Sons, New York, 2008.
8. Regina Leffers, *Sustainable Construction and Design*, Pearson / Prentice Hall, USA, 2009.

Course Code	Course Title				Core/Elective		
PE 843 ME	Waste Heat Recovery and Co-Generation				Elective		
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3
Course Objectives <ul style="list-style-type: none"> ➤ To learn concepts of waste heat recovery ➤ To learn the applications of heat exchangers & recuperators in heat recovery ➤ To understand cogeneration methods Course Outcomes Student will be <ol style="list-style-type: none"> 1. Understand the concept of waste heat recovery 2. Distinguish heat exchangers and recuperators 3. Acquire knowledge about various cogeneration methods 							

UNIT-I

Definition, Sources, Quantity and quality of waste heat. Technologies for waste heat recovery and utilization. Need of storage systems for waste heat.

Utilization of Waste Heat - Continuous and Intermittent. Energy requirements of industry. Various forms of waste heat available.

UNIT-II

Overview of heat exchangers. Gas to gas. Gas to liquid and liquid to liquid heat exchangers. Calculation of effectiveness and design of heat exchanger for number of tubes. Pressure drop considerations LMTD and effectiveness -NTU methods.

UNIT-III

First and Second law of thermodynamics, and its effect on design of recuperators. Recuperators-Ceramic, metallic and reradiant recuperators, high temperature recuperators. Concept of porosity, Peclet number superficial velocity, pressure drop, and selection of material for heat storage and recovery.

UNIT-IV

Cogeneration - Definition, Two basic cogeneration concepts, thermodynamic advantage, Cogeneration efficiency, potential benefits and costs of cogeneration. Cogeneration-Over view, Industrial application of cogeneration.

UNIT-V

Source of waste heat and methods of utilization. Application of Cogeneration to a steam power plant. Identifying the possibilities of extracting energy to run a gas turbine. Integration of Steam turbine and Gas turbine - Power calculations, various types and their applications towards power generation. Quality of steam and its effect on performance. Legislation - Power plant and Industrial fuel use act (FUA) Potential nationwide benefits of Cogeneration, Impact of Cogeneration on fuel use patterns. Legislative, Environment and Institutional Constraints for use of waste heat.

Suggested Readings:

1. Donald Q. Kern, "Process Heat Transfer", McGraw Hill International Editions, Chemical Engineering Series, 1965.
2. Wylen V. and Sonntag, "Fundamentals of Classical Thermodynamics" - SI Version, Wiley Eastern Ltd., 1993.
3. David Hu S., "Handbook of Industrial Energy Conservation", Van Nostrand Reinhold Co., 1983.

Course Code	Course Title					Core/Elective	
MC 952 SP	NATIONAL SERVICE SCHEME (NSS)					Elective	
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	25	50	3U
<p>Course Objectives:</p> <ul style="list-style-type: none"> ➤ To help in Character Molding of students for the benefit of society ➤ To create awareness among students on various career options in different fields ➤ To remold the students behavior with assertive skills and positive attitudes ➤ To aid students in developing skills like communication, personality, writing and soft skills ➤ To educate students towards importance of national integration, participating in electoral process etc. by making them to participate in observing important days. <p>Course Outcomes: Student will be able to:</p> <ul style="list-style-type: none"> ➤ Students will become more focused towards becoming excellent citizens with more and more discipline in their day-to-day life. ➤ An all-round development-physical, mental and spiritual health-takes place. ➤ Self-discipline and discipline with respect society enormously increases. ➤ University environment becomes more peaceful and harmonious. 							

List of Activities:

1. Orientation programme about the role of NSS in societal development
2. Swachh Bharath Programme
3. Guest lecture's from eminent personalities on personality development
4. Plantation of saplings/Haritha Haram Programme 5.BloodDonation / Blood Grouping Camp
5. Imparting computer education to schoolchildren
6. Creating Awareness among students on the importance of Digital transactions
7. Stress management techniques
8. Health Checkup Activities
9. Observation of Important days like voters day, World Water Day etc.
10. Road Safety Awareness Programs
11. Energy Conservation Activities
12. Conducting Programme' son effective communication skills
13. Awareness programme's on national integration
14. Orientation on Improving Entrepreneurial Skills
15. Developing Effective Leadership skills
16. Job opportunity awareness programs in various defence, public sector undertakings
17. Skill Development Programmes
18. Creating awareness among students on the Importance of Yoga and other physical activities
19. Creating awareness among students on various governmentsponsored social welfare schemes for the people

Note: At least Ten Activities should be conducted in the Semester. Each event conducted under Swachh Barath, Plantation and important days like voters day, world water day may be treated as a separate activity.

Course Code	Course Title				Core / Elective		
OE 781 CE	Road Safety Engineering				Open Elective-III		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	0	0	0	30	70	3

Course Objectives

- Introduction to various factors considered for road safety and management
- Explain the road safety appurtenances and design elements
- Discuss the various traffic management techniques

Course Outcomes

At the end of the course, the students will be able to

1. Prepare accident investigation reports and database
2. Apply design principles for roadway geometrics improvement with various types of traffic safety appurtenances/tools
3. Manage traffic including incident management

UNIT – I

Road Accidents: Causes, scientific investigations and data collection, Analysis of individual accidents to arrive at real causes, statistical methods of analysis of accident data, Basic concepts of Road accident statistics, Safety performance function: The empirical Bayes method Identification of Hazards road location. Application of computer analysis of accident data.

UNIT – II

Safety in Road Design: Operating the road network for safety, highway operation and counter measures, road safety audit, principles-procedures and practice, code of good practice and checklists, vehicle design factors & Driver characteristics influencing road safety.

UNIT – III

Road Signs and Traffic Signals: Classification, Location of Signs, measures of sign effectiveness, Types of visual perception, sign regulations, sign visibility, sign variables, Text versus symbols. Road Marking: Role of Road markings, Classification, visibility. Traffic Signals: Need, Signal face. Illumination and location of Signals, Factors affecting signal design, pedestrians' safety, fixed and vehicle actuated signals. Design of signals, Area Traffic control. Delineators, Traffic Impact Attenuators, Road side rest areas, Safety Barriers, Traffic Aid Posts.

UNIT – IV

Traffic Management Techniques: Integrated safety improvement and Traffic Calming Schemes, Speed and load limit, Traffic lights, Safety cameras, Tests on driver and vehicles, pedestrian safety issues, Parking, Parking enforcement and its influence on Accidents. Travel Demand Management; Methods of Traffic management measures: Restriction of Turning Movements, One-way streets, Tidal Flow Operation Methods, Exclusive Bus Lanes and Closing Side-streets; Latest tools and techniques used for Road safety and traffic management. Road safety issues and various measures for road safety; Legislation, Enforcement, Education and Propaganda, Air quality, Noise and Energy Impacts; Cost of Road Accidents.

UNIT – V

Incident Management: Introduction, Characteristics of Traffic Incidents, Types of Incidents, Impacts, Incident management process, Incident traffic management; Applications of ITS: Motorist information, Equipment used; Planning effective Incident management program, Best practice in Incident management

programs. National importance of survival of Transportation systems during and after all natural disasters especially cyclones, earthquakes, floods etc. and manmade disasters like sabotage, terrorism etc.

Suggested Readings:

1. Guidelines on Design and Installation of Road Traffic Signals, IRC:93.
2. Specification for Road Traffic Signals, IS: 7537-1974.
3. Principles and Practice of Highway Engineering by L.R. Kadiyali and N.B. Lal.
4. Hand Book of T.E. Myer Kutz, Editor McGraw Hill, 2004.

Course Code	Course Title					Core/Elective	
MC453HS	SOCIETY OUTREACH PROGRAM					Core	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	-	-	-	2	50	---	2 Units
<p>Course Objectives:</p> <ul style="list-style-type: none"> ➤ To prepare the students to sensitize the society on social issues, particularly on environment, health and literacy. ➤ To prepare the students to learn the concept PAY BACK TO SOCIETY . ➤ To change the attitude of the society. <p>Course Outcome:</p> <ul style="list-style-type: none"> ➤ Able to find the scientific solutions for a specific problem in the society. ➤ Able to demonstrate the leadership qualities. ➤ Able to bring out their talent. ➤ Able to develop interpersonal skills and team-spirit. 							

The Society Outreach Program gives students the opportunity to understand and involve in community service. Projects are student-led and may encompass the activities related to the following:

Environmental issues,
 Health education for the community and sanitation,
 Communal harmony and peace education,
 Legal Awareness/Rights,
 Human rights and rights of vulnerable groups;
 Panchayats and development issues;
 Women's Empowerment and
 Social issues and gender issues.
 Awareness on Solid waste management and any possible solutions;
 Awareness on natural resources, solar energy and wind energy;
 Awareness of work culture, punctuality, discipline, cleanliness in house and surroundings, and Intake of quality food;

Note:

The students are required to make a study and/or participate in society outreach programmes and submit a report.

The department will appoint a project coordinator who will be incharge of the following:

- Grouping of students (a maximum of three in group)
- Allotment of project guides
- Project monitoring at regular intervals

The students shall give a presentation for about 30 minutes they have worked/ studied. The work carried out, the report and the presentation carry 50 marks.

Course Code	Course Title				Core/Elective		
PE 831 ME	Intellectual Property Rights				Elective		
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

Students will understand

- Fundamental aspects of IP
- Aspects of IPR acts.
- Awareness of multi-disciplinary audience
- Awareness for innovation and its importance
- The changes in IPR culture
- About techno-business aspects of IPR

Course Outcomes

At the end of the course, the students will be able to

1. Will respect intellectual property of others
2. Learn the art of understanding IPR
3. Develop the capability of searching the stage of innovations.
4. Capable of filing a patent document independently.
5. Completely understand the techno-legal business angle of IP.
6. Capable of converting creativity into IP and effectively protect it.

UNIT-I

Overview of Intellectual Property: Introduction and the need for intellectual property right(IPR), IPR in India – Genesis and Development, IPR abroad, Some important examples of IPR. Importance of WTO, TRIPS agreement, International Conventions and PCT

Patents: Macro economic impact of the patent system, Patent and kind of inventions protected by a patent, Patent document, how to protect your inventions. Granting of patent, Rights of patent, how extensive is patent protection. Why protect inventions by patents. Searching a patent, Drafting of a patent, Filing of a patent, the different layers of the international patent system, (national, regional and international options), compulsory licensing and licensors of right & revocation, Utility models, Differences between a utility model and a patent. Trade secrets and know-how agreements

UNIT-II

Industrial Designs: What is an industrial design. How can industrial designs be protected? What kind of protection is provided by industrial designs? How long does the protection last? Why protect industrial designs?

UNIT-III

Trademarks: What is a trademark, Rights of trademark? What kind of signs can be used as trademarks? Types of trademark, function does a trademark perform, how is a trademark protected? How is a trademark registered? How long is a registered trademark protected for? How extensive is trademark protection? What are well-known marks and how are they protected? Domain name and how does it relate to trademarks? Trademark infringement and passing off.

UNIT-IV

Copyright: What is copyright. What is covered by copyright. How long does copyright last? Why protect copyright? Related Rights: what are related rights. Distinction between related rights and copyright. Rights covered by copyright? Copy rights in computer programming.

UNIT-V

Enforcement of Intellectual Property Rights: Infringement of intellectual property rights Enforcement Measures Emerging issues in Intellectual property protection. Case studies of patents and IP Protection.

Unfair Competition: What is unfair competition. Relationship between unfair competition and intellectual property laws.

Suggested Readings:

1. Ajit Parulekar and Sarita D' Souza, *Indian Patents Law – Legal & Business Implications*; Macmillan India ltd, 2006
2. B. L. Wadehra; *Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications*; Universal law Publishing Pvt. Ltd., India 2000
3. P. Narayanan; *Law of Copyright and Industrial Designs*; Eastern law House, Delhi 2010
4. Cronish W. R1 *Intellectual Property; Patents, copyright, Trad and Allied rights*, Sweet & Maxwell, 1993.
5. P. Narayanan, *Intellectual Property Law*, Eastern Law Edn., 1997.
6. Robin Jacob and Daniel Alexander, *A Guide Book to Intellectual Property Patents, Trademarks, Copy rights and designs*, Sweet, Maxwell 4th Edition.

Course Code	Course Title					Core/Elective	
MC 953 SP	SPORTS					Elective	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	20	30	3U
<p>Course Objectives:</p> <ul style="list-style-type: none"> ➤ To develop an understanding of the importance of sport in the pursuit of a healthy and active lifestyle at the College and beyond. ➤ To develop an appreciation of the concepts of fair play, honest competition and good sportsmanship. ➤ To develop leadership skills and foster qualities of co-operation, tolerance, consideration, trust and responsibility when faced with group and team problem-solving tasks. ➤ To develop the capacity to maintain interest in a sport or sports and to persevere in order to achieve success. ➤ To prepare each student to be able to participate fully in the competitive, recreational and leisure opportunities offered outside the school environment. <p>Course Outcomes: Student will be able to:</p> <ul style="list-style-type: none"> ➤ Students' sports activities are an essential aspect of university education, one of the most efficient means to develop one's character and personal qualities, promote the fair game principles, and form an active life position. ➤ Over the past year, sports have become much more popular among our students. Let us remember the most memorable events related to sports and physical training. ➤ Special attention was paid to team sports. Our male and female games and sports have achieved remarkable progress at a number of competitions. ➤ Our teams in the main sports took part in regional and national competitions. Special thanks to our team in track and field athletics, which has been revitalized this year at ICT and which has won Javelin competition. ➤ Staff of our faculties and students of Sports, Physical Development, & Healthy Lifestyle of Faculty congratulates everyone on the upcoming New Year and wishes you robust health and new victories in whatever you conceive. 							

I. Requirements:

- i) Track Pant (students should bring)
- ii) Shoes
- iii) Volley Ball, Foot Ball and Badminton (Shuttle)
- iv) Ground, Court, indoor stadium and swimming pool

II. Evaluation Process:

Total Marks 50

- i) 20marks for internal exam (continuous evaluation) a) 8 marks for viva
b) 12marks for sports & fitness
- ii) 30marksforendexam a) 10marks for viva
b) 20marks for sports & fitness

Course Code	Course Title				Core/Elective		
MC 951 SP	YOGA PRACTICE				Elective		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	20	30	3U
<p>Course Objectives:</p> <ul style="list-style-type: none"> ➤ Enhances body flexibility ➤ Achieves mental balance ➤ Elevates Mind and Body co-ordination ➤ Precise time management ➤ Improves positive thinking at the expense of negative thinking <p>Course Outcomes:</p> <p>Student will be able to:</p> <ul style="list-style-type: none"> ➤ Students will become more focused towards becoming excellent citizens with more and more discipline in their day-to-day life. ➤ An all-round development-physical, mental and spiritual health-takes place. ➤ Self-discipline and discipline with respect society enormously increases. ➤ University environment becomes more peaceful and harmonious. 							

UNIT-I

Introduction: Yoga definition – Health definition from WHO-Yoga versus Health-Basis of Yoga-yoga is beyond science-Zist of 18 chapters of Bhagavadgita- 4 types of yoga: Karma, Bhakti, Gnyana and Raja yoga–Internal and External yoga-Elements of Ashtanga yoga (Yama, Niyama, Asana, Pranayama, Prathyahara, Dharana, Dhyana and Samadhi)-Panchakoshas and their purification through Asana, Pranayama and Dhyana.

UNIT-II

Surya Namaskaras (Sun Salutations): Definition of sun salutations-7 chakras (Mooladhaar, Swadhishtaan, Manipura, Anahata, Vishuddhi, Agnya and Sahasrar)- Various manthras (Om Mitraya, Om Ravaye, Om Suryaya, Om Bhanave, Om Marichaye, Om Khagaye, Om Pushne, Om Hiranya Garbhaye, Om Adhityaya, Om Savitre, Om Arkhaya and Om Bhaskaraya) and their meaning while performing sun salutations-Physiology-7systems of human anatomy-Significance of performing sun salutations.

UNIT-III

Asan as (Postures): Pathanjali's definition of asana-Sthiram Sukham Asanam-3rdlimbofAshtangayoga-Looseningorwarmingupexercises- Sequence of perform in as an as (Standing, Sitting, Prone, Supine and Inverted)-Nomenclature of as an as (animals, trees, rishis etc)-As an as versus Chakras-As an as versus systems-As an as versus physical health-Activation of Annamaya kosha

UNIT-IV

Pranayama (Breathing Techniques): Definition of Pranayama as per Shankaracharya-4th limb of Ashtanga yoga-Varioustechniques of breathing-Pranayama techniques versus seasons-Band has and their significance in Pranayama-Mudras and their significance in Pranayama-Restrictions of applying band has with reference to health disorders-Pranayama versus concentration-Pranayama is the bridge between mind and body-Pranayam versus mental health-Activation of Pranamaya kosha through Pranayama.

UNIT-V

Dhyana (Meditation): Definition of meditation-7th limb of Ashtanga yoga- Types of mind (Conscious and Sub-Conscious)-various types of dhyana. Meditation versus spiritual health-Dharana and Dhyana- Extention of Dhyana to Samadhi-Dhyana and mental stress-Activation of Mano mayakosha through dhyana- Silencing the mind

Suggested Reading:

1. Light on Yoga by BKS Iyengar
2. Yoga education for children Vol-1 by Swami Satyananda Saraswati
3. Light on Pranayama by BKS Iyengar
4. Asana Pranayama Mudra and Bandha by Swami Satyananda Saraswati
5. Hatha Yoga Pradipika by Swami Mukhtibodhananda
6. Yoga education for children Vol-11 by Swami Niranjan an and a Saraswati
7. Dynamics of yoga by Swami Satyananda Saraswati

Course Code	Course Title					Core/Elective	
Mandatory Course	GENDER SENSITIZATION					Core	
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
-	3	--	--	--	30	70	0

Course Objectives:

- To develop students' sensibility with regard to issues of gender in contemporary India.
- To provide a critical perspective on the socialization of men and women.
- To introduce students to information about some key biological aspects of genders.
- To expose the students to debates on the politics and economics of work.
- To help students reflect critically on gender violence.
- To expose students to more egalitarian interactions between men and women.

Course Outcomes:

- Students will have developed a better understanding of important issues related to gender in contemporary India.
- Students will be sensitized to basic dimensions of the biological, sociological, psychological and legal aspects of gender. This will be achieved through discussion of materials derived from research, facts, everyday life, literature and film.
- Students will attain a finer grasp of how gender discrimination works in our society and how to counter it.
- Students will acquire insight into the gendered division of labour and its relation to politics and economics.
- Men and women students and professionals will be better equipped to work and live together as equals.
- Students will develop a sense of appreciation of women in all walks of life.
- Through providing accounts of studies and movements as well as the new laws that provide protection and relief to women, the textbook will empower students to understand and respond to gender violence.

UNIT I**Understanding Gender**

Gender: Why Should We Study It? Socialization: Making Women, Making Men

Introduction Preparing for Womanhood Growing up Male First lessons in Caste. Different Masculinities

Just Relationships: Being Together as Equals, Mary Kom and Onler Love and Acid just do not Mix. Love Letters Mothers and Fathers Rosa Parks-The Brave Heart

UNIT – II**Gender and Biology**

Missing Women: Sex Selection and Its Consequences Declining Sex Ratio. Demographic Consequences.

Gender Spectrum: Beyond the Binary Two or Many? Struggles with Discrimination Our Bodies Our Health

UNIT – III**Gender and Labour**

Housework: The Invisible Labour “My Mother doesn’t Work.” “Share the Load.”

Women's Work: Its Politics and Economics Fact and Fiction. Unrecognized and Unaccounted work. Wages and Conditions of Work

UNIT – IV

Issues of Violence

Sexual Harassment: Say No! Sexual Harassment, not Eve-teasing- Coping with Everyday Harassment “Chupulu”

Domestic Violence

Speaking Out: Is Home a Safe Place? -When Women Unite [Film]. Rebuilding Lives New Forums for Justice

Thinking about Sexual Violence Blaming the Victim-“I Fought for my Life”The Caste Face of Violence

UNIT – V

Gender Studies

Knowledge through Lens of Gender: Point of View – Gender and the structure of knowledge – Unacknowledged women artists of Telangana; Whose History? **Questions for Historians and Others:** Reclaiming a past – Writing other histories – Missing Pages from modern Telangana History

Suggested Reading

1. A.Suneetha, Uma Bhrugubanda, Duggirala Vasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu “ *Towards a World of Equals*” A Bilingual Textbook on Gender by Telugu Akademi, Hyderabad, Telangana., 1ST Edition,2015.