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UNIVERSITY OF MUMBAI



Syllabus for Sem. V & VI

Program: B.Sc.

Course:

Non-Conventional Energy Sources & Waste Recycling

Applied Component

**(Credit Based Semester and Grading System with
effect from the academic year 2013–2014)**

T.Y.B.Sc.
**Applied Component : Non-Conventional Energy Sources &
Waste Recycling Syllabus**
Credit Based Semester and Grading System
To be implemented from the Academic year 2013-2014

SEMESTER V

USACNCE101: NON-CONVENTIONAL SOURCES OF ENERGY. (30 L)

Theory

USACN CE501	I	<p><u>NON-CONVENTIONAL SOURCES OF ENERGY. (30 L)</u></p> <p>1.1 Perspectives on Energy Sources and Utilization: 15L</p> <p>1.1.1: Definitions, units and concept.</p> <p>1.1.2: Energy needs for the domestic, industrial and agricultural and transport sector, energy utilization and sustainable development, patterns of energy use in different parts of the world, depletion of energy sources.</p> <p>1.1.3 Various types of energy sources, conventional/ non conventional, renewable / non renewable, fossil fuels: coal, oil, natural gas; thermal, hydroelectric and nuclear.</p> <p>1.1.4 Environmental implications of energy use, energy storage and conservation, Role of Government and non government organization, socio-economic aspects, Government policies.</p> <p>1.1.5 Entrepreneurship opportunities</p>	2	4
	II	<p>Unit –II Study of the following non conventional energy sources with respect to scope, present scenario, applications, limitations and future</p>		

	<p>prospects: 15L</p> <p>2.1 Solar Energy 7L</p> <p>2.1.1 Solar spectrum and its relevance as the energy source, solar radiation, conversion of solar energy into heat energy in solar collectors, Fresnel lenses, parabolic reflectors.</p> <p>2.1.2 Photovoltaic effect, semi-conductors as solar energy converters, different materials used, effect of different parameters on the photovoltaic efficiency, effect of temperature, solar cells.</p> <p>2.1.3 Photo-electrochemical process for the conversion of solar energy; applications of solar energy for different purposes.</p> <p>2.2 Wind Energy 3L</p> <p>2.2.1 Wind velocity and generation of wind energy</p> <p>2.2.2 Description of wind mills and its working, rotor with blades, gear generator, vertical and horizontal axis of rotation.</p> <p>2.3 Tidal Energy: 2L</p> <p>2.3.1:Tide height and its potential for power generation.</p> <p>.2.3.2:Construction of dam across sea basin, installation of the turbine, specification of the basin.</p> <p>2.4 Geothermal Energy: 3L</p> <p>2.4.1: Origin of geothermal heat, temperature gradient, geothermal steam and hot spring, geysers.</p> <p>2.4.2: Power production from geysers, mantle as</p>		
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		source,		
	III	<p><u>WASTE RECYCLING:</u></p> <p>3.1 Introduction to waste management : 12L 3.1.1</p> <p>Definition of waste, concept of waste management, end of the pipe treatment, in plant treatment, introduction to green chemistry.</p> <p>3.1.2 Recovery, reuse, recycle and disposal of waste, economic viability of each of the above, waste audit.</p> <p>3.1.3 Types of waste, domestic, industrial, agricultural and commercial waste; gaseous, solid and liquid waste.</p> <p>3.2 Particulate matter and its management: 3L</p> <p>3.2.1: Particulate matter, sources, characterization, effects.</p> <p>3.2.2 Disposal methods , cyclone separator, wet scrubber, electrostatic precipitator, fabric filter.</p>		
	IV	<p><u>Introduction to liquid waste and managements of gaseous waste</u> 15L</p> <p>4.1 Introduction to liquid waste 9L</p>		

	<p>4.1.1: Sources and generation of liquid waste, their characterization.</p> <p>4.1.2 Physical parameters; colour, odour, turbidity, TSS. TDS, TS</p> <p>4.1.3 Chemical parameters: pH, acidity, alkalinity, hardness, DO, COD, TOC, THOD and BOD. Chemical composition, classification.</p> <p>4.2 Management of gaseous waste: 6L</p> <p>4.2.1: Sources, types and effects; vehicular and chimney exhaust</p> <p>4.2.2 Treatment methods, adsorption, absorption, catalytic</p> <p>4.2.3 Minimization methods, economic viability of reuse.</p>		
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Practicals

USACNCE 5P1	<p><u>LIST OF PRACTICALS</u></p> <p>(a) The practicals to be carried out by each student 40 Marks</p> <ol style="list-style-type: none"> 1. Determination of COD of the waste water sample. 2. Construction of the breakthrough curve and hence determination of breakthrough capacity of the given ion exchanges resin. 3. Removal of hardness of the water sample by chemical addition- optimization study. 	2	4
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	<ol style="list-style-type: none"> 4. Removal of colouring matter from the waste water sample by adsorption – optimization study. 5. Determination of BOD of the waste water sample. 6. Determination of nitrite colorimetrically from the waste water sample. 7. Determination of Sulphate in the given water sample by benzidine sulphate method. 8. Determination of Cr (VI) spectrophotometrically in the given water sample. 		
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SEMESTER VI

Theory

USACNCE 601	I	<p><u>USACCNE601: NON-CONVENTIONAL SOURCES OF ENERGY. (30 L)</u></p> <p>1.1Study of the following non conventional energy sources with respect to scope, present scenario, applications, limitations and future prospects:</p>	2	4
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		<p style="text-align: center;">1.1.1 Ocean Thermal Energy Conversion 3L</p> <p>1.1.1.1:Surface and deep water temperature of oceans, temperature difference as a driving source for power generation.</p> <p>1.1.1. 2: Requirements for a practical OTEC plant, different working fluids.</p> <p>1.2 Study of the following energy sources</p> <p>1.2.1Fuel Cells: 12L</p> <p>1.2.1.1 Electrochemical energy conversion, basic principle of fuel cells, distinction between fuel cell and battery.</p> <p>1.2.1.2 Thermodynamic and kinetic effects of the fuel cell.</p> <p>1.2.1.3 Hydrogen – oxygen fuel cell, organic oxygen fuel cell</p> <p>1.2.1.4 Applications of fuel cells.</p> <p>1.3 Hydrogen as a potential fuel:</p> <p>1.3.1 Advantages</p> <p>1.3.2 Economically viable production of hydrogen, photolysis of water</p>		
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	II	<p style="text-align: center;">2.1 Biomass:</p> <p style="text-align: center;">15L</p> <p>2.1.1 Solar energy flow and its contribution to biomass production energy from plants.</p> <p>2.1.2 Feasible biomass conversion technologies, thermo chemical combustion, pyrolysis, gasification.</p> <p>2.1.3. Alcohol from fermentation of sugars, enzyme reactor for continuous production of alcohol. Biodiesel.</p> <p>2.1.4 Fuels from farm and animal waste: fermentation and production of methane in the biogas plant, domestic and industrial use of bio gas.</p> <p>2.1.5 Municipal and industrial solid waste, as heat source.</p>		
	III	<p><u>WASTE RECYCLING:</u></p> <p>3.1 Solid Waste Management:</p> <p style="text-align: center;">15L 1.1.1</p> <p>Sources and generation of solid waste, their characterization,</p>		

		<p>chemical composition and classification.</p> <p>3.1.2 Recycling of metal, paper, plastic rubber and glass.</p> <p>3.1.3: Methods of disposal of solid waste, dumping of garbage, sanitary landfills, composting, soil conditioning, incineration; vermin- composting.</p> <p>3.1.4 Hazardous waste, definition, classification, methods of minimization; toxic waste, disaster management and risk analysis, restriction of hazardous substances.</p> <p>3.1.5 Radioactive waste, sources, effects on plants, animal and man, level of activity and management, minimization and treatment.</p> <p>3.1.6: e-waste , types, hospital waste, disposal and preventive measures.</p>		
	<p>IV</p>	<p>Liquid Waste Management</p> <p>15L</p> <p>4.1 Use of COD, BOD and TOC for deciding the process with respect to treatment.</p> <p>4.2:Pre-primary treatment: neutralization, equalization screening, sedimentation, coagulation, and filtration</p>		

		<p>4.3 Primary treatment: screening, sedimentation, coagulation, filtration</p> <p>4.4 Secondary treatment: principles of the biological treatment of liquid waste,</p> <p>4.5 Various processes used for, aerobic and anaerobic process.- mechanism and different methods.</p> <p>4.6 Aerobic process, oxidation ponds, oxidation ditch, lagoons, activated sludge process and trickling filter process.</p> <p>4.7 Anaerobic processes, anaerobic contact process</p> <p>4.8 Tertiary treatment, reverse osmosis, ultra filtration electrodilysis, ion exchange, ozone treatment, Fenton's reagent</p> <p>4.9 Characterization of effluent from i) pharmaceutical ii) food and beverage iii) Fertilizer</p>		
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Practicals

USACNCE 6P1	<p>(A) Experiments to be conducted by a group of students (Project Work) :</p> <p>20 Marks</p> <ol style="list-style-type: none"> 1. Visit to any one of the sites or units where non-conventional sources of energy are being harnessed. Write a detailed report of the visit and the any 	2	4
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	<p>studies undertaken.</p> <p>2. Given characteristics of waste water released from an industry, prescribe suitable methods for its treatment. Describe various steps required to optimize the process. Submit as the project report.</p> <p>3. The candidate shall submit the project work report to the laboratory supervisor, on the day of inspection, who in turn will make it available to the examiners.</p>		
	<p>(B) Journal</p> <p style="text-align: right;">: 5 Marks</p>	S	
	<p>(C) Viva-voce examination</p> <p style="text-align: right;">: 5 Marks</p>		
	<p>(D) Presentation</p> <p style="text-align: right;">: 10 Marks</p>		

REFERENCE BOOK

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– S.P. Sukhatme, Tata Mcgraw Hill, New Delhi 1990
- 2 Fuel Cell Will Mitchell, Academic Press 1963
- 3 Photo electrochemical Cells: Studies in Physical and theoretical Chemistry,
Vol.50 K.V.S.Santham & M.Sharma, Elsevier Publishing Company, Amsterdam,
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New Delhi 1990
- 5 Pollution Control in Process Industries: S.P.Mahajan, Tata Mcgraw Hill, New
Delhi 1990
- 6 Waste Water Treatment: M.N. Rao and A.K. Datta, Oxford and IBH Publishing
1978
- 7 Nonconventional energy sources: G.D. Rai: 4th edition, Khanna Publishers, New
Delhi 1996
- 8 Waste Recycling and Pollution control Handbook, A.V. Bridge Water &
Mumford
- 9 Basic Photovoltaic Principles & Methods, Solar Energy Research Institute.
- 10 Industrial Water Pollution control, Eckenfelder, 2nd edition Mcgraw Hill Book
Company, 1989
- 11 Nonconventional Energy Systems, Principles, Progress and Processes, K.M.
Mittal, 1st edition, Wheeler Publishers, New Delhi.
- 12 Solar Energy Utilization, G. D. Rai, 5th edition, Khanna Publishers, New Delhi
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