III Year I Semester: **L T P C**

Code: 20EE5316 **3 0 0 3**

WIND & BIOMASS ENERGY SYSTEMS

Preamble : This course intends the students to learn the basics and modern techniques in Wind and Biomass Energy Systems

Course Objectives

1. Study the basics of Wind Energy Conversion Systems (WECS)
2. Study and analyse the types and classifications of WECS
3. Study and analyse the Biomass Energy Systems

Course Outcomes

1. Describe Wind Energy and how it has been used historically
2. Consider and evaluate the environmental factors that affect harnessing wind energy and its advantages
3. Describe the and outline the advantages and dis-advantages of Biomass Energy

CO – PO & CO – PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			3			2	3					1	3	2	
CO2			3			2	3					1	3	2	
CO3			3			2	3					1	3	2	
CO4			3			2	3					1	3	2	
CO5			3			2	3					1	3	2	

1 – Weak, 2 – Moderate and 3 – Strong

Unit – I: Wind energy conversion **10 Hours**

Wind energy conversion principles; General introduction; Types and classification of WECS; Power, torque and speed characteristics.

Unit – II: Wind energy application **10 Hours**

Wind pumps: Performance analysis, design concept and testing; Principle of WEG; Stand alone, grid connected and hybrid applications of WECS; Economics of wind energy. Utilization; Wind energy in India; Case studies.

Unit – III: Characteristics of Electrical Systems in WECS **10 Hours**

Basic characteristics of Electric generators, variable and constant speed machines, Mechanical considerations and speed coupling, WECS applications, MPP of WECS, Stand alone, grid

connected and wind farms, WECS systems –Grid interconnection and associated instrumentation.

Unit – IV: Energy Generation From Waste Types **12 Hours**

Biochemical Conversion: Sources of energy generation, Industrial waste, agro residues; Anaerobic Digestion: Biogas production; Determination of BOD, DO, COD, TOC, & Organic loading, Aerobic & Anaerobic treatments – types of digester – factors affecting biodigestion - Activated sludge process. Methods of treatment and recovery from the in industrial waste water – Case Studies in municipality and medical.

Unit – V: Application of Biomass **12 Hours**

Rural applications of biomass –Combustion - Chulas - improved Chulas- Biomass – Physical - Chemical composition – properties of biomass – TGA – DSC characterization – Ash Characterization -Preparation of biomass – Size reduction – Briquetting of loose biomass- Briequtting machine

Text Books:

1. Parker, Colin, & Roberts, Energy from Waste - An Evaluation of Conversion Technologies, Elsevier Applied Science, London, 1985
2. Brendan Fox et. al.: Wind Power Integration connection and system operational aspects, IET Power and Energy Series 50 (2007).

Reference Books:

1. Rich, Gerald et.al., Hazardous Waste Management Technology, Podvan Publishers, 1987
2. Nick Jenkin, Janaka Ekavayake: Wind Energy Generation Modeling and Control (Wiley and Sons).