Name of the Programme: UG General Education Programmes
Course Code: VAC-112
Title of the Course: Green Energy Systems
Number of Credits: 02
Effective from AY: 2023-24

Pre-requisites for the Course	Nil	
Course Objectives:	1. To demonstrate the importance of solar energy collection and storage. 2. To understand the principles of wind energy and biomass energy. 3. To gain knowledge on geothermal and ocean energy. 4. To gain knowledge on geothermal and ocean energy. 5. To understand the concepts of green manufacturing systems.	
Content:	**Unit I Solar, Wind and Biomass Energy** Solar (10 hours) **SOLAR RADIATION**: Role and potential of new and renewable sources, the solar energy option, Environmental impact of solar power, structure of the sun, the solar constant, sun-earth relationships, coordinate systems and coordinates of the sun, extra-terrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data, numerical problems. Photo voltaic energy conversion – types of PV cells. **SOLAR ENERGY COLLECTION:** Flat plate and concentrating collectors, classification of concentrating collectors, orientation. SOLAR ENERGY STORAGE AND APPLICATIONS: Different methods, sensible, latent heat and stratified storage, solar ponds, solar applications- solar heating/cooling technique, solar distillation and drying, solar cookers, central power tower concept and solar chimney. Wind and Biomas (5 hours) **WIND ENERGY**: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, betz criteria, types of winds, wind data measurement. **BIO-MASS**: Principles of bio-conversion, anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, utilization for cooking, bio fuels, I.C. engine operation and economic aspects.	**15 hours**
	Unit II **Geothermal And Ocean Energy, Energy Efecient Systems, And Green Manufacturing Systems** GEOTHERMAL ENERGY: Resources, types of wells, methods of harnessing the energy. OCEAN ENERGY: OTEC, Principles of utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques. (A) ELECTRICAL SYSTEMS: Energy efficient motors, energy efficient lighting and control, selection of luminaire, variable voltage variable frequency drives (adjustable speed drives), controls for HVAC (heating, ventilation, and air conditioning), demand site management. (B) MECHANICAL SYSTEMS: Fuel cells- principle, thermodynamic	**15 Hours**

	aspects, selection of fuels & working of various types of fuel cells, environmentally friendly and Energy efficient compressors and pumps. Environmental impact of the current manufacturing practices and systems, benefits of green manufacturing systems, selection of recyclable and environment friendly materials in manufacturing, design and implementation of efficient and sustainable green production systems with examples like environmentally friendly machining, vegetable based cutting fluids, alternate casting and joining techniques, zero waste manufacturing.	
Pedagogy:	Lectures/Experiential Learning	
References/ Readings:	1. Sukhatme S.P. and Nayak J.K. *Solar Energy – Principles of Thermal Collection and Storage*, Tata McGraw Hill,1984. 2. Khan B.H ,*Non-Conventional Energy Resources*, Tata McGraw Hill, New Delhi, 2006. 3. Paulo Davim J. , *Green Manufacturing Processes and Systems*, Springer 2013. 4. K.S Jagadeesh, B.V Venkata Rama Reddy and K.S Nanjunda Rao *Alternative Building Materials and Technologies* 2nd edition,New Age International,2017. 5. D.Yogi Goswami, Frank Krieth & John F Kreider *Principles of Solar Engineering*,4th edition,Taylor & Francis, 2022.	
Course Outcomes	Students will, 1. Explain the importance of solar energy collection and storage 2. Apply the principles of wind energy and biomass energy. 3. Analyse knowledge on geothermal and ocean energy. 4. Learn about energy efficient systems. 5. Discuss the concepts of green manufacturing systems	