Renewable Energy Sources 3 (2+1)

Objective

To make the students acquainted with the different renewable energy sources and to enable them to analyse and select the appropriate technology to meet the energy demand in different types of agricultural operations

Theory

Different sources of renewable energy: Concepts and limitations of different renewable energy sources (RES) as solar, wind, geothermal, biomass, ocean energy sources; Criteria for assessing the potential of RES; Comparison of renewable energy sources with non-renewable sources.

Solar energy: Energy available from sun, solar radiation data, solar energy conversion into heat through flat plate and concentrating collectors, different solar thermal devices, principle of natural and forced convection solar drying system; Solar photo voltaics- basics and applications, p-n junctions; Solar cells, PV systems, stand alone, grid connected solar power station; Calculation of energy through photovoltaic power generation and cost economics.

Wind energy: Energy availability, general formula, lift and drag; Basics of wind energy conversion, effect of density, frequency variances, angle of attack, wind speed, types of windmill rotors, determination of torque coefficient, induction type generators; Working principle of wind power plant; Wind farms, aero-generators, wind power generation system.

Biogas: Basics of anaerobic digestion, types and constructional details of biogas plants, biogas generation and its properties, factors affecting biogas generation and usages, design considerations, advantages and disadvantages of biogas spent slurry; Generation of power from biogas; Design and use of different commercial biogas plants.

Power generation from urban, municipal and industrial waste; Ocean thermal and electric power generation, wave and tidal power; Power generation from biomass (gasification and Dendro-thermal); Mini and micro hydel plants; Fuel cells and its associated parameters.

Practical

Study of solar thermal devices like solar cookers; Study of solar water heating system; Study of natural convection solar dryer; Study of forced convection solar dryer; Study of solar desalination unit; Study of solar greenhouse for agriculture production; Study of cost economics of solar thermal devices including solar panels; Study of solar photovoltaic system and study of characteristics of solar photovoltaic panel; Study of evaluation of solar air heater/dryer; Study of biogas plants and its components; Performance evaluation of a fixed dome type biogas plant; Performance evaluation of floating drum type biogas plant; Study of biomass gasifiers; Study of cost economics of biogas system; Visit to a windmill plant.

Suggested Readings

1. Basu, P. 2018. *Biomass Gasification and Pyrolysis Practical Design and Theory*. Academic Press.
2. Deublein, D. and Steinhauser, A. 2008. *Biogas from Waste and Renewable Resources*. WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim.

3. Duffie, J. A. and Beckman, W. A. 2013. *Solar Engineering of Thermal Process*. John Wiley and Sons.
4. Julian Chen, C. 2011. *Physics of Solar Energy*. John Wiley & Sons, Inc.
5. Khan, B. H. 2006. *Non-Conventional Energy Resources*. The McGraw Hill Publishers.
6. Knothe, G., Gerpen, J. V. and Krahl, J. (Eds). 2010. *The Biodiesel Handbook*. AOCS Press.
7. Patel, M. R. 2005. *Wind and Solar Power Systems*. CRC Press, Bota Racon.
8. Rai, G. D. 2013. *Non-Conventional Energy Sources*. Khanna Publishers, New Delhi.
9. Rai, G. D. 2020. *Solar Energy Utilization*. Khanna Publishers, New Delhi.
10. Reed, T. B. and Das, A. 1988. *Handbook of Biomass Downdraft Gassifier Engine Systems*. SERI, USA.
11. Ryszard, Petela. 2010. *Engineering Thermodynamics of Thermal Radiation for Solar Power Utilization*. The McGraw-Hill Companies.
12. Stefan, C. W. and Krauter. 2008. *Solar Electric Power Generation – Photovoltaic Energy Systems*. Springer.

Post-Harvest Engineering of Cereals, Pulses and Oilseeds 3 (2+1)

Objective

To make the students acquainted with the different unit operations in processing of major cereals, pulses and oilseeds, and the different equipment for the operations

Theory

General unit operations in agricultural process engineering and importance of these unit operations in grain processing; Structure and composition of cereals, pulses and oil seeds.

Cleaning and grading: Principles of cleaning, scalping, sorting and grading; screens, different types of screen separators, fixed and variable aperture screens, capacity and effectiveness of screens, sieve analysis; various types of separators as specific gravity, magnetic, disc, spiral, pneumatic, inclined belt draper, velvet roll separator, colour sorter, cyclone separator.

Drying: Moisture content and water activity, free moisture, bound moisture and equilibrium moisture content, isotherm, hysteresis effect, EMC determination; Psychrometric chart and its use in drying; Drying principles and theory, thin layer and deep bed drying analysis, falling rate and constant rate drying periods, maximum and decreasing drying rate periods, drying equations, mass and energy balance, Shedd's equation; Drying methods (conduction, convection, radiation, batch, continuous); Different types of grain dryers (bin, flat bed, LSU, columnar, RPEC, fluidized, rotary and tray), tempering during drying; dryer performance.

Principles of grain storage; different types of grain storage structures; deep bin and shallow bin; design of a silo, structural and functional requirements of a grain storage go-down.

Size reduction: Principle; Bond's law, Kick's law, Rittinger's law; Sieve analysis; Different classifications of size reduction machines; description of jaw crusher, hammer mill, attrition mill, and ball mill; Material handling: Basic parts of different types of conveyors and elevators, viz. belt, roller, chain, screw, and bucket elevator, cranes and hoists, pneumatic conveying, power requirement for conveying and elevating.