



# PHYSICS OF RENEWABLE ENERGY SYSTEMS

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Department of Physics

IIT KGP

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 12 Weeks (26-Jul' 21 - 15-Oct' 21)

**EXAM DATE** : 24 Oct 2021

**PRE-REQUISITES** : Upto 3rd Year courses of the B.Tech. Degree.

**INTENDED AUDIENCE** : Integrated M.Sc. : Physics, material science, energy science ; B.Tech: Energy Science, Engineering Physics, Electrical, Mechanical Industry: Related to Power systems, Energy Storage; M.Tech.: Energy Sciences, Materials Science, Physics, Mechanical, Electrical

**INDUSTRIES APPLICABLE TO** : Su-Kam power systems Ltd, Luminous Power Technologies, Loom Solar, Suzlon Energy Limited, Orient Green Power Limited, Exide Batteries, Vikram Solar, Maxwell technologies, Hy-Cap Technologies

## **COURSE OUTLINE :**

For a country like India, renewable energy will play an important role in ensuring energy safety, security and sustainability. With the fast growing demand in off-grid applications in areas extending from villages to hills, newer technologies will have to be MADE IN INDIA. We will start with the basics of energy sources ranging from thermal, mechanical, and photovoltaic sources. The lectures will cover the topics on electricity generation using solar cells, use of solar heaters, solar based mobile chargers to use of solar cookers in India. Subsequently, we will shift our attention on wind, water, tidal and geothermal power. At the end, the need of efficient energy storage technologies will be discussed. These include Li batteries and supercapacitors. The additional required concepts such as free electron model, p-n junction, coriolis force, turbulence, standing waves, thermodynamics, capacitors, crystal structure, etc. will also be discussed. The basics of various characterization techniques useful for evaluating energy systems will also be explained. These include cyclic voltammetry, charge discharge, EIS, quantum efficiency, etc. will be explained.

## **ABOUT INSTRUCTOR :**

Prof. Amreesh Chandra is currently a Professor in the Department of Physics at Indian Institute of Technology Kharagpur. He has teaching experience of > 12 years, both at UG and PG level. His research activities focus on the development of smart functional materials, which are useful for energy systems. Prof. Chandra did his Ph.D. from IIT BHU and has post doctoral experience from Germany and United Kingdom. He joined IIT Kharagpur in 2009. He has > 70 research publications and has funded research projects from DST, DAE-BRNS, MHRD, MPG (Germany) and UKIERI (UK).

## **COURSE PLAN :**

**Week 1:** Basics of semiconductor, nanomaterials and nanotechnology

**Week 2:** Renewable energy sources and classifications

**Week 3:** Solar Power

**Week 4:** Wind power

**Week 5:** Hydro, Tidal and Geothermal Systems

**Week 6:** Energy storage Technology: Classification and principle

**Week 7:** Fuel cells: Principles, Classifications and Operations

**Week 8:** Supercapacitors and Battery

**Week 9:** Energy storage mechanism

**Week 10:** Effect of double layer in energy storage: Chemical approach

**Week 11:** Characterization techniques: I

**Week 12:** Characterization techniques II