

**Course code: JNC 206**

**Credits: 3:0**

**Course Name: Energy and Environment**

**Instructor: Kanishka Biswas, Premkumar Senguttuvan & Sebastian C Peter**

Energy scenario in World and India (demand and consumption), Alternative (Renewable energies).

Fuel cells: Basic principle, history of fuel Cell, different types of fuels and sources, electrochemical cell, different components of fuel cell, cell potential, thermodynamics and kinetics of fuel cell reactions; different types of fuel cells, various approaches in designing materials as electrodes, applications.

Batteries: History and principles of batteries, Primary and Secondary Batteries, Zn-carbon, alkaline Batteries, Pb-acid, Ni-MH and Li-, Na- and Mg-ion Batteries, Redox flow batteries.

Capacitors and Supercapacitors: history, working principle, different types of capacitors, applications.

CO<sub>2</sub> reduction: Chemistry of CO<sub>2</sub>, advantages and disadvantages, greenhouse effect, sources of CO<sub>2</sub>, carbon recycling, global warming, photosynthesis, CO<sub>2</sub> capture, CO<sub>2</sub> sequestration, CO<sub>2</sub> reduction using different pathways, chemicals and fuels from CO<sub>2</sub>, reaction mechanisms, carbon footprint, zero carbon policy, industrial development.

Solar cell: What is solar cell? Definition and history of solar cell, Photovoltaic effect, working principle, construction of solar cell, mechanism, basic physics of solar cell, materials for solar cell, solar cell properties, applications.

Water splitting and photocatalysis; electronic structure of semiconductors, hetero-structures, charge separation, band gap evolution, Z-scheme, thermo-chemical water splitting, artificial photo synthesis

Hydrogen generation and storage; chemical processes, hydrogen storage in porous materials

Thermoelectrics; electronic structure modulation, resonance state, band convergence, low thermal conductivity, point defect phonon scattering, nano-structuring, intrinsic factors- bonding asymmetry, soft chemical bonding, effect of lone pair and rattling

Piezoelectronics; ferroelectric, dielectrics, piezoforce microscopy

Nuclear energy: Radioactive materials, radioactivity, radioactive decay and half life, Alpha, beta and gamma emission, Nuclear reactions (fission and fusion), Nuclear reactors and their operation principles, Nuclear safety information and radiation protection.