Semester	JAN 2022
Open to semester	8,12,14,22
Course code	**CHM428/CH6414**
Course title	**Chemistry for Alternative Energy**
Credits	4 /4
Course Coordinator & participating faculty (if any)	Angshuman Nag* Muhammad Mustafa O.T
Nature of Course	Lectures
Pre-requisites	Students taking the course are expected to have basic knowledge of spectroscopy, electrochemistry and solid state chemistry.
Objectives (goals, type of students for whom useful, outcome etc)	The objective of the course is to discuss about different sources of sustainable energy and their consequences to environment and society. More specifically, the course will cover fundamental physical chemistry phenomena involved in light to electrical energy conversion (optoelectronics), chemical to electrical energy conversion (electrochemical), light to fuel conversion (photoelectrochemical), and energy storage. Students will be introduced to relevant research topics like solar cell, solar-to-hydrogen, fuel cell, and batteries.
Course contents (details of topics /sections with no. of lectures for each)	Introduction (5 hours): Energy-environment-economics, light to electrical energy (optoelectronics), chemical energy to electrical energy (electrochemical), light to chemical energy (photoelectrochemical), waste heat to electrical energy (thermoelectrics), nuclear energy, wind energy, solar thermal. Fundamentals of Optoelectronics (15 hours): Basics of semiconductor, solar light absorption, optical losses, charge excitation, charge separation, charge transport, carrier (electron and hole) mobility, lifetime and diffusion length, Si solar cell, open circuit voltage, fill factor, power conversion efficiency, GaAs solar cell, thin film solar cell, dye and quantum dot sensitized solar cell, perovskite solar cell, computational prediction of novel solar cell material, photodetector, light emitting diodes. Electrochemical Energy Storage (9 hours): Solar to fuel conversion, electrochemical and photoelectrochemical water

	splitting reaction, electrochemical and photoelectrochemical fuel production, the role of electrocatalysts and photocatalysts. Basics of batteries, primary and secondary batteries, elements and operation of electrochemical cells, theoretical cell voltage and capacity, losses in cells, factors effecting battery performance, batteries for PV system. ElectroChemical Energy Conversion (10 hours): Basics of polymer electrolyte membrane fuel cells, hydrogen oxygen cells and hydrogen air cell, hydrocarbon air cell, alkaline fuel cell, phosphoric acid fuel cell and solid oxide fuel cells. Super capacitor: basic components of supercapacitors, double layer and psuedocapacitors. Types of electrodes like high surface area activated carbons, metal oxide and conducting polymers, aqueous and organic electrolytes. The disadvantages and advantages of supercapacitors over battery systems and their applications in aspects of energy density and power density.
Evaluation /assessment	End-Sem Examination-40% Mid-Sem Examination-40% Others-Two quizzes: 20% %
Suggested readings (with full list of authors, publisher, year, edn etc.)	A. Jenny Nelson, The Physics of Solar Cells (Properties of Semiconductor Materials), Imperial College Press. B. E Conway. Electrochemical Supercapacitors. Fundamentals and Applications. Kluwer 1999. C. A Vincent and B. Scrosati. Modern Batteries. Butterworth-Heinemann, 1997. D. T. J. Crompton. Battery Reference Book, Elsevier. 2000. E. Sammes Nigel. Fuel Cell Technology, Springer 2006 We will also discuss recent research papers which will provided to students during the class.