



# HYDROGEN ENERGY: PRODUCTION, STORAGE, TRANSPORTATION AND SAFETY

## PROF. PRATIBHA SHARMA

Department of Energy Science and Engineering  
IIT Bombay

**PRE-REQUISITES :** BSc or BTech or BE

**INTENDED AUDIENCE :** Chemical Engineering, Mechanical Engineering, Energy Science, Energy Engineering, Energy Systems Engineering Masters and PhD students

**INDUSTRY SUPPORT :** Oil and Gas PSUs, Energy Systems related industries

### COURSE OUTLINE :

The course will broadly cover all the aspects of hydrogen energy including the production, storage, transportation, utilization of hydrogen as an energy carrier. Hydrogen sensing methods and safety associated with the use of hydrogen at all the places whether at the point of production, storage, transport, refueling etc will be discussed. Global and Indian status on all the technologies, policies and developments will be discussed.

### ABOUT INSTRUCTOR :

Prof. Pratibha Sharma is a Professor in the department of Energy Science and Engineering (DESE) at IIT Bombay. Her research interest lies in the field of hydrogen energy specifically solid state hydrogen storage materials, storage systems development for various applications. She is leading several multi-institutional projects on hydrogen and have several international collaborations. At IIT Bombay she has established four different research laboratories: (i) Hydrogen Storage Lab, (ii) DST- IIT Bombay Energy Storage Platform on Hydrogen (ESPHy), (iii) Alloy Synthesis Lab and (iv) Hydrogen Systems and Application Lab (HySAL). She has been teaching the course on Hydrogen Energy (EN 610) since 2010.

### COURSE PLAN :

**Week 1:** Physical and chemical properties of hydrogen, fuel properties, Global and Indian status on hydrogen, Different ways of Hydrogen Production

**Week 2:** Steam Reforming, Sorption Enhanced Reforming and Hydrogen Membrane Reforming; Partial Oxidation – Catalytic and non-catalytic partial oxidation processes, Autothermal Reforming

**Week 3:** Combined Reforming, Carbon di oxide Reforming, Plasma Reforming, Steam Iron Process

**Week 4:** Non-oxidative methods of hydrogen production – Thermal decomposition, Catalytic methane decomposition, plasma assisted decomposition and others

**Week 5:** Hydrogen production from coal and biomass

**Week 6:** Electrolysis fundamentals and various types of Electrolyzers, Hydrogen production from renewables

**Week 7:** Hydrogen Separation and Purification – different methods, Hydrogen storage fundamentals

**Week 8:** Compressed and liquid state storage of hydrogen- thermodynamics, equipment and processes; storage tanks requirements and current state of art

**Week 9:** Solid state hydrogen storage, materials for storage, requirements for storage materials, thermodynamics and kinetics of materials, measurement methods of hydrogen storage in different materials, hydrogen storage systems

**Week 10:** Hydrogen Transport - different ways of transporting and distributing hydrogen to the point of utilization, current status of existing methods globally, hydrogen refueling stations-concepts and components

**Week 11:** Hydrogen Utilization for various applications including sectors like transportation, energy storage, industrial and space applications; various energy conversion devices, current state of art of each of these technologies

**Week 12:** Hydrogen sensing and safety, Economics of different processes and technologies involved in various aspects of hydrogen