



ENERGY CONVERSION TECHNOLOGIES (BIOMASS AND COAL)

PROF. VAIBHAV VASANT GOUD

Department of Chemical engineering
IIT Guwahati

INTENDED AUDIENCE : The target audience for this course is

1. BTech/MTech/PhD students or faculties from reputed academic and technical institutions interested in acquiring knowledge of solar, wind and biomass renewable energy systems
 2. Those who are pursuing a career as a Chemical engineer/Mechanical engineer or Biosciences and Bioengineer designing renewable energy systems such as solar, wind and biomass systems
- Executives, engineers and researchers from manufacturing, service and government organizations including R&D laboratories working in the area of energy engineering.

INDUSTRY SUPPORT : All Energy Industries and Energy Equipment Manufacturing Industries.

COURSE OUTLINE :

Energy conversion technology is concerned with the transformations of energy from forms provided by nature to convenient or useful forms of energy. Harnessing the energy through these sources using efficient technologies is expected to play an important role in serving as clean energy source for mankind. This course covers fundamentals of such energy conversion systems with a broad perspective that encompasses technical and environmental aspects. The topic covers analysis of energy conversion in thermochemical, biochemical, and chemical processes using range of traditional and alternative energy sources and presents assessments of their availability, sustainability, and evaluation of their potential role in solving the global energy crisis. This course aims at providing the recent advancement and technological developments (carbonization, torrefaction, sub and supercritical water gasification, thermochemical conversion to ethanol, green diesel) in the field of conventional (coal) and non-conventional energy sources (biomass) with emphasis on engineering and design aspects and concept of integration of energy system. This course has been especially prepared for researchers, academicians, professionals from industries and students to learn the important aspects of environmental friendly energy conversion technologies to produce fuels and chemicals.

ABOUT INSTRUCTOR :

Prof. Vaibhav V. Goud is Professor in the Department of Chemical Engineering, Indian Institute of Technology Guwahati, India since 2018. Principal research interests of Dr. Goud are in the fields of reaction engineering, renewable energy, supercritical fluids, bio lubricants. He has published more than 120 papers in international peer reviewed journals and made presentations of his research in several national/international conferences. He has also written 14 book chapters in the area of renewable energy. He has taught energy resources as an elective course to UG, PG and Ph.D. students at IIT Guwahati for six consecutive years (2014, 2015, 2016, 2017, 2018 and 2019).

COURSE PLAN :

Week 1: Introduction :

Introduction, major sources of energy: primary and secondary energy sources, energy scenario, prospects/need of alternate energy sources, common forms of energy, conventional and non-conventional energy sources; energy from biomass/coal; environmental aspects of energy utilisation-conventional energy resources and their importance.

Week 2: Basics of feedstock:

Concept of solid and liquid fuels, basic understanding of various properties of fuels solid fuels: heating value, ultimate analysis, proximate analysis, Liquid fuels: heating value, density, specific gravity, viscosity, flash point, ignition temp, pour point, ash composition.

Week 3: Energy from bio-based feedstock:

Availability of the feedstock, compositional analysis and properties of feedstock, preparation of fuel pellets using bio-additives, carbonization, torrefaction (practice example)

Week 4: Thermochemical conversion:

Simultaneous bio-char and bio-oil production and their application, hydrothermal liquefaction of bio-based feedstocks, comparison of biomass with conventional fuels Gasification (practice example), upstream and downstream processing, comparison of conventional gasification with sub-supercritical water gasification process, plasma gasification

Week 5: Biochemical conversion process:

Anaerobic digestion in landfills, landfill gas and biogas, bioconversion into biogas, single/two-stage anaerobic digestion, wet and dry fermentation, integrated centralized co-digestion plant concept, comparison of biochemical and thermochemical routes, competitive production of alcohol, bioethanol production from edible sources and non-edible sources, process description, distillation, combined biogas and bioethanol production.

Week 6: Chemical conversion processes:

Biodiesel production, different types of feedstock, extraction process, mechanism of trans-esterification, fuel characteristics of biodiesel, green diesel synthesis from bio-based feedstocks and their applications

Week 7: Energy from coal:

Origin and composition solid fuels; properties of coal; coal classification; properties and storage of coal; coal carbonization, gasification and liquefaction. Combustion process (biomass/coal): Combustion stoichiometry and combustion chemistry (practice example).

Week 8: Integrated energy system:

Concept of integration of conventional and non-conventional energy resources and systems.