Course Overview

Coal provides almost 40% of the world's energy needs. Conventional combustion using pulverized coal is still the most widely used conversion technology for coal. But despite improvements over several decades, achievable efficiency has been somewhat limited. Additionally, there is now increasing focus on the pollution from conventional conversion technologies. As a result, considerable R&D are being carried out worldwide on more efficient use of coal – from improving the efficiency of power generation to use of coals in fuel cells, for production of chemicals and liquid fuels, co-processing with minerals and to manufacture of other products such as carbon fibers. The short course will cover the past use, research and development in new coal conversion technologies, their potential applications and challenges to overcome. The course will also cover techno-economics of the different processes currently under development.

Objectives

This course will enable engineers and research specialists with knowledge of advanced coal utilization technologies, in particular advanced combustion and gasification, technologies for chemicals production, fuel cell use, and co-processing of coal and minerals.

Course Content

Module I – Conventional Coal Technologies

- **Introduction to combustion and gasification:** conventional *pf* and fluidized bed combustion, chemical kinetics
- **Large scale commercial technologies:** fluidized bed gasification, fixed bed gasification, entrained flow gasification, transport reactor gasification, dry feed vs. wet feed gasification
- **Effect of fuel quality on gasification:** effects of moisture, mineral matter content, fuel properties on gasification performance and emission
- **Gasifier selection based on coal quality:** design parameters and gasifier sizing
- **Review of ash viscosity for entrained flow gasification:** review of mathematical models, applicability of the models to different coal compositions

Module II – Advanced Coal Technologies

- **Strategies for fuel gas cleanup:** emissions and control strategies for SO_2, NOx, CO and PM, cyclone separator
- **Carbon capture and storage:** adsorption and absorption based techniques for CO_2 capture and sequestration
- **End products of gasification:** utilization of syngas in IGCC, synthesis of methanol and dimethyl ether, polygeneration
- Cost analysis of commercial gasification technologies
- **Chemical looping combustion and gasification:** fundamentals, effect of fuel quality and current status
- **Oxy-fuel combustion:** fundamentals of oxy-fuel *pf* and fluidized bed combustion, effect of fuel quality, current status
- **Direct carbon fuel cell:** principles, system efficiency and exergy analysis, mathematical modelling, effect of fuel quality, current status
- **Synthesis of other products from coal:** carbon fibre and graphene

GIAN
Global Initiative of Academic Networks

Ministry of Human Resource Development, **Government of India**

A short course on

Advanced Coal Utilization: Current Status and Future Prospects

(Lectures: 40 hours)

Jul 8-19, 2019

Course Instructor:
Prof. Sankar Bhattacharya
Department of Chemical Engineering,
Monash University, Australia

Course Coordinator:
Dr. Santanu De
Course Website: http://home.iitk.ac.in/~sde

Department of Mechanical Engineering
INDIAN INSTITUTE OF TECHNOLOGY KANPUR

Teaching Faculty

Prof. Sankar Bhattacharya is a Professor and the acting head at the department of Chemical Engineering, Monash University, Australia. Professor Bhattacharya came to academia in 2009 after having worked for twenty-one years in industry – at the International Energy Agency in France, Anglo Coal Australia and CRC for Lignite in Australia, and Development Consultants in India. He commissioned the first CFBC in Australia, led the first Oxygen-blown HTW and Transport Reactor trials of Victorian brown coal, and worked on commissioning of coal-fired plants in India.

In his current position, he has supervised 17 students to PhD completion and currently leads a group of 16 PhD students and researchers working on gasification of coal and biomass, petroleum coke and wastes, advanced combustion for CO_2 capture at lower energy penalty, biofuels production and platform chemicals from biomass. Professor Bhattacharya believes in the near to intermediate term application of engineering research. Most of his research projects are, therefore, affiliated with industries in Australia and overseas. He advises the Japanese Ministry of Economics, Trade and Industry (METI) on low-rank coal utilization and Clean Coal Victoria. He also advises and contributes to the International Energy Agency's flagship publications and Intergovernmental Panel on Climate Change (IPCC) as an expert reviewer.

Course Coordinator

Dr. Santanu De is an Assistant Professor at the Department of Mechanical Engineering, Indian Institute of Technology Kanpur, India. He received his PhD in the area of Computational Combustion from Aerospace Engineering, IISc Bangalore. Before joining IIT Kanpur in 2014, he worked as a postdoctoral researcher at the Michigan Technological University and the Universität Stuttgart. His current research includes modeling of turbulent reactive flows, spray atomization and combustion, coal and biomass gasification, optical diagnostics of combustion.

Who should attend?

- Executives, engineers and researchers from academia, government organizations including R&D laboratories with a background in aerospace, automotive, mechanical, and chemical engineering.
- Postgraduate students (MSc/MTech/PhD) and faculty from reputed academic institutions and technical institutions.
- Knowledge of thermodynamics, fluid mechanics and heat transfer at B.E. level is required.

How to Register?

- Register at the GIAN portal (http://www.gian.iitkgp.ac.in/) or send an e-mail to the coordinator (sde@iitk.ac.in) expressing your interest and wait for acceptance.
- If accepted, pay the relevant fee online and send the details to the course coordinator.

Registration Fee

UG & PG Students	Rs. 6,000*
Faculty members	Rs. 12,000*
Industry, R&D Organizations	Rs. 40,000*
Foreign participants	$1000

*GST extra. The above fee includes all instructional materials; Fee concession may be considered for individuals having limited financial support.

Accommodation

Accommodation will be arranged at the IITK visitors hostel and students' hostels based on single/twin sharing basis depending on availability. The candidates will have to bear the boarding, food and other miscellaneous expenses.

Important Dates and Venue

Last date for registration	Jul 1, 2019
Course schedule	Jul 8-19, 2019
Venue	IIT Kanpur

Contact Details

If you have any other queries, you may write to or call the course coordinator.

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