FUEL CELLS: FUNDAMENTAL CONCEPTS, MATERIALS CHEMISTRY AND APPLICATIONS

Course Dates : 17th to 21st January, 2022

भारत सरकार

INFORMATION :

REGISTRATION / CLOSING DATE	THROUGH ONLINE MODE ONLY
12 January 2022	From 02:00 PM To 05:00 PM (IST)
(300 Participants Only)	

The course will be suitable for undergraduate, postgraduate and research students, postdoctoral researchers, academic faculty members, industrial scientists and engineers of any discipline.

All applicants must register themselves on GIAN portal - https://www.gian.iitkgp.ac.in/GREGN/index

Registration to the portal is one time affair and will be valid for lifetime. Once registered in the portal, an applicant will be able to apply for any number of GIAN courses. One time Non-refundable fee of Rs. 500/- is to be charged for this service. Registered Candidates will recieve the Course Link through email.

NOTE: There is no additional course registration fee.

OVERVIEW :

Today there is great alarm at the negative consequences of humanity's reliance on the combustion of fossil fuels for its energy needs. Our dependence upon this shrinking resource will inevitably have serious globo-political and economic consequences. In addition, the combustion of these hydrocarbons in such large quantities has serious effects on the health of living beings both directly and indirectly, through climate change. New technologies are required that will allow us to move away from this dependence and an array of renewable energy concepts are presently under development. It is expected that fuel cells will help enable our move to a greener and more sustainable future energy landscape, finding applications in stationary electricity generation, emergency backup, electric vehicles and military requirements.

In this GIAN course, energy conversion devices known as fuel cells will be explained in detail. The course will first focus on the underlying electrochemical processes occurring in fuel cells and then address operating principles, materials requirements and the advantages and disadvantages of different fuel cell designs, materials sets and feedstocks. Environmental impact and systems efficiency will be considered, and prototype and commercial fuel cell systems will be reviewed. Course participants will study these topics through lectures and experimental demonstrations.

University of St Andrews

Dr. RICHARD BAKER
Main Speaker

Dr. Richard Baker is a member of faculty at the University of St. Andrews, where he has worked since 2005. He holds a PhD in Chemical Engineering and Chemical Technology from Imperial College, London. He has published over 80 research articles, reviewed for a dozen international journals and made over 25 keynote or invited presentations. He was Editor, Secretary/Treasurer and then Chair of the Electron Microscopy and Analysis Group of the Institute of Physics. He has very considerable experience, over 25 years, of teaching and research in fuel cell science and technology. His research has focused on Solid Oxide Fuel Cells (SOFCs) which are completely solid state devices based on ceramic electrolytes which are good conductors of O^{2-} ions. SOFCs are able to use a wide range of fuels, including biofuels, and, if the excess heat from the SOFC is utilised, efficiencies of up to 80% can be attained (cf. internal combustion engine: 25%). Recent projects have improved conductivity of ceria-based electrolytes, developed new anode materials for use with challenging biofuels and studied proton-conducting ceramics in a novel electrochemical reactor for combined chemicals synthesis and electrical power generation.

Dr. ALOK MITTAL
Course Coordinator

Dr. Alok Mittal is working as Professor of Chemistry at Maulana Azad National Institute of Technology, Bhopal and possesses a long academic, research and administrative experience. He received distinction to become 'Clarivate Analytics Highly Cited Researchers of the Year 2018' and he is amongst only 10 Indian Researchers out of top 4000 most influential Scientists of the World. He has published more than 100 research papers in the journals of high impact and authored several books. His papers have been cited more than 14500 times and his present H - index is 55. Dr. Mittal earned the highest academic degree, Doctor of Science (D.Sc.), the thesis being related to environmental issues, from Jiwaji Unviersity Gwalior. He is an aluminus of the University of Roorkee (Presently IIT Roorkee) and obtained M.Sc. (Physical Chesitry) and Ph.D. (Thesis related to Electro-Chemistry) degrees from there. He also contributes his expertise as reviewer for many international journals of environmental field and has guided several Ph.D.s on the topics related to environmental problems. His research field focuses on the removal of various inorganic and organic pollutants, like metal ions, dyes etc. from wastewater through adsorption and photocatalytic degradation.

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TIME TABLE:

DATE	DAY	TIMING		
		02:00 - 03:00 PM	03:00 - 04:00 PM	04:00 - 05:00 PM
17-01-2022	*MONDAY*	*INTRODUCTION + LECTURE - 1*	*LECTURE - 2*	*LECTURE - 3*
18-01-2022	*TUESDAY*	*LECTURE - 4*	*LECTURE - 5*	*LECTURE - 6*
19-01-2022	*WEDNESDAY*	*LECTURE - 7*	*LECTURE - 8*	—
20-01-2022	*THURSDAY*	*LECTURE - 9*	*LECTURE - 10*	*LECTURE - 11*
21-01-2022	*FRIDAY*	*LECTURE - 12*	*CLOSING CEREMONY*	*FACULTY INTERACTION*

NOTE: The Interaction will provide opportunity to interested faculty members to explore collaborative opportunities with University of St. Andrews.

LECTURE OVERVIEW:

LECTURE - 1	*Introduction. Present and future electricity generation landscapes. Introduction to electrochemical and battery concepts.*
LECTURE - 2	*History and concept of fuel cells. Review of different types of fuel cell. Nernst equation.*
LECTURE - 3	*The Polymer Electrolyte Fuel Cell (PEMFC). Ionic conductivity in the polymer electrolyte.*
LECTURE - 4	*Materials choice and requirements for anode, electrolyte and cathode materials for PEMFCs. Sources of overpotential in fuel cell devices.*
LECTURE - 5	*Sources of overpotential in fuel cell devices.*
LECTURE - 6	*Fundamentals of oxygen ion conduction in electroceramics. Allovalent doping to promote ionic conductivity.*
LECTURE - 7	*Review of composition and performance of the present range of electrolyte materials for Solid Oxide Fuel Cells (SOFCs). Effects of changing dopant concentration.*
LECTURE - 8	*Laboratory Exposure: Demonstration of working fuel cell device and determination by students of its characteristic current-voltage curve and its Faradaic and energy efficiencies.*
LECTURE - 9	*Materials sets and compositional, nanostructural and performance requirements of Cathode Materials for SOFCs.*
LECTURE - 10	*Materials sets and compositional, nanostructural and performance requirements of Anode Materials for SOFCs.*
LECTURE - 11	*Utilisation of challenging fuels, e.g. hydrocarbons and alcohols.*
LECTURE - 12	*Systems considerations. Review of prototype and commercial applications of fuel cell systems, including in stationary, portable, military and transport sectors.*