



**Short Course Sponsored by GIAN MHRD, GOI**  
**On**  
**Course on ULTRA CLEAN AND LOW PULSATION**  
**GAS TURBINES**



**November 3<sup>rd</sup> to 7<sup>th</sup> 2019, at IIT Indore**

## Overview

Reduction of CO<sub>2</sub> emissions is of primary concern in power generation. This requires more efficient gas turbine cycles. Increase in efficiency can be achieved by higher pressure and higher turbine inlet temperatures or by completely new concepts. All of them need novel combustor technologies, allowing ultra-low emissions, fuel flexibility and stable operation over a wide operational range. The course will start with an overview of current gas turbine technology. Based on this knowledge we will discover additional highly efficient gas turbine cycles. An additional challenge of combustion-based systems are NO<sub>x</sub> emissions. Low NO<sub>x</sub> emissions are often associated with combustion instabilities with high pulsation amplitudes affecting the operational range of the gas turbine. First, methods to achieve ultra-low NO<sub>x</sub> emissions will be presented. Then we will discuss what leads to these instabilities, simple models to describe them and how to suppress their occurrence. We will present methods for fast and efficient mixing, combustors for ultra-wet cycles and constant volume combustors for gas turbines. The primary objectives of the course are as follows:

- i) Leading the participants to understanding the principles of clean gas turbine technology,
- ii) Sharpening the engineering background for more efficient power generation cycles,
- iii) Providing concepts for sustainable energy generation,
- iv) Building in capability amongst the participants in the design of ultra-low emission technologies,
- v) Providing exposure to combustion instabilities, their modeling and damping methods, enhancing the capability to model thermoacoustic problems and to develop mitigation measures.

<b>Modules</b>	<p><b>Day 1:</b> The clean power challenge, gas turbine processes, <i>lecture</i></p> <p><b>Day 2:</b> New gas turbine cycles, ultra-wet cycles, constant volume combustors, <i>lecture: 2 hrs</i> Basics of combustion dynamic with examples, <i>tutorial: 2 hrs</i></p> <p><b>Day 3:</b> Ultra clean combustors and the occurrence of combustion dynamics, <i>lecture: 2 hrs</i> Simulation of combustion instabilities session with examples, <i>tutorial: 2 hrs</i></p> <p><b>Day 4:</b> Combustor dynamics in gas turbines and how they were solved, <i>lecture: 2 hrs</i> Practical examples on how to characterize the burner behavior, <i>tutorial: 3 hrs</i></p> <p><b>Day 5:</b> Ultra-low emission and pulsation combustion systems, <i>lecture: 2 hrs</i> Suppression of combustion instabilities, <i>tutorial: 3 hrs</i></p>
<b>You Should Attend If...</b>	<ul style="list-style-type: none"> <li>Engineers, scientist and researchers from manufacturing, service and government organizations including R&amp;D laboratories.</li> <li>Undergraduates, M.E/ M.Tech. and Ph.D. Engineering students, Faculty in Mechanical, Manufacturing, Production and candidates with M.Sc. in Engineering</li> </ul>
<b>Fees</b>	<p>UG, PG students &amp; Research Scholars: INR 3000/-</p> <p>Faculty Members: INR 6000/-</p> <p>Foreigners: USD 300/-</p> <p>Industry and Others: INR 10000/-</p> <p>The above fees include all instructional materials, tutorials and assignments.</p>
<b>Accommodation</b>	<p>Paid accommodation will be provided to participants on first-come-first-serve basis.</p>

# The Faculty

## Foreign Expert: Professor Christian Oliver Paschereit



**Prof. Dr. Christian Oliver Paschereit** is heading the Chair of Fluid Dynamics, Hermann-Föttinger-Institut, TU Berlin since 2003. His research and teaching cover a broad spectrum of topics related to fluid mechanics and combustion technology: flow and combustion control, vessel aerodynamics, gas turbine technology, ultra-low NO<sub>x</sub> combustion, thermoacoustics, pressure gain combustion and wind turbine technology. Before moving to TU Berlin, Oliver Paschereit was holding an upper management position at ABB / ALSTOM in Switzerland which he joined in 1994. From 1992 – 1994 he worked on high-speed

train acoustics and helped to substantially reduce train noise. After his studies at TU Berlin and Ecole Centrale de Lyon he achieved his PhD from TU Berlin and the University of Arizona. His work in industry on clean, efficient and reliable gas turbines had major impact during the commissioning of several new gas turbine families. The developed methods and technologies paved the way for ultra-low emission gas turbine systems and are to a large extent state of the art of nowadays power generation technology. Future technologies like ultra-wet gas turbine cycles and the integration of constant volume combustion into gas turbines complete his profile. His research activities on fluid dynamics have impact on efficient trucks, cars and trains and were used even in the America's Cup. Innovative solutions are also applied to wind turbines. They range from smart flow visualization techniques, custom-made power boost devices helping to raise the power output of wind turbines and the development of smart blades for the wind turbines of the future.

His scientific and technology achievements are demonstrated by more than 500 Journal and conference publications. The research has not only academic interest but was also important for industrial applications documented in over 75 patent publications. A number of best paper awards, many research prizes and an ERC Advanced Grant underline his competence in combustion and fluid dynamics.

## Indian Expert: Dr Aditya Saurabh



**Dr. Aditya Saurabh** is a faculty at the Department of Mechanical Engineering, IIT Kanpur since 2019. Before joining IIT Kanpur he worked for eight years at the Chair of Fluid Dynamics, TU Berlin. He has previous research experience on several topics associated with gas turbine combustor technology: dynamic and static stability of combustors, thermoacoustic coupling (flame response and self-excited instability dynamics), active and passive damping of instabilities, diagnostics of reacting flows, and combustion

noise. He has contributed to research in these fields through highly cited results in high impact international journals (primarily from experiments) concerning fundamental and applied aspects of thermoacoustic instability and flame response, particularly in reference to state-of-the-art annular gas turbine combustors. At IIT Kanpur he is developing a program focused on fundamental research on combustion, acoustics, and aerodynamics within combustion systems, in particular gas turbine combustors; and novel combustion technologies that would address shortcomings (efficiency, pollutant emission, instabilities) and obstacles in the further development of present-day technology.

*For any information regarding eligibility, fee payment, travel information, accommodation, etc., please contact the course coordinator via e-mail or phone.*

## Course Co-Coordinator

*Dr. Devendra Deshmukh*

*Associate Professor  
Discipline of Mechanical Engineering  
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Interested candidate should send an email to the coordinator ([dldeshmukh@iiti.ac.in](mailto:dldeshmukh@iiti.ac.in)) and register on following link on acceptance.*

*Link of Registration:  
<http://gian.iiti.ac.in/register.php>*

*The payment can be made By Demand Draft: Demand Draft should be drawn in favor of “Registrar, IIT Indore”, payable at Indore Or By NEFT Transfer: Registration fee can be paid through NEFT. Transfer of the amount can be done to the A/c number given below:*

*Name of the Beneficiary : Registrar,  
Indian Institute of Technology Indore  
Name of Bank : Canara Bank  
Branch Code : IIT Indore Campus Branch  
Beneficiary Account No. : 1476101027440  
Bank MICR Code : 452015003  
Bank IFS Code : CNRB0006223*