

## **Industrial & Vehicle Aerodynamics: A New Frontier for India's Economic Prosperity, Energy Security and Sustainable Environment**

### **Overview**

India is world's fourth largest motor vehicle manufacturer with over 30 million vehicles in 2018. Out of which, 4 million are passenger vehicles, 1 million three-wheelers, 0.66 million commercial vehicles, 0.58 million tractors, 23 million motorcycles and other off-road vehicles. The worth of India's automotive industry is nearly US\$ 150 billion and plays vital role in country's GDP. A road vehicle travelling at 80 km/h or over consumes 80-85% of the total fuel to overcome the aerodynamic resistance and the remaining 20% for rolling resistance and frictional losses. Most vehicles manufactured by Indian local companies are notably aerodynamically inefficient hence their fuel efficiency is significantly lower and less competitive than their counterparts in Europe, North Asia and North America. Vehicle's performance, handling, safety and comfort are significantly affected by its aerodynamic properties. Low drag vehicle is not only important for good fuel economy but also low (greenhouse gas) emission. The knowledge of vehicle aerodynamics is vital for vehicle quality such as directional stability, wind noise, soiling of the lights, windows and body, cooling of engine, transmission/gearbox, exhaust and brakes; and heating, ventilating and air conditioning of passenger compartment. Hence the industrial and vehicle aerodynamics knowledge is fundamental for engineers and designers in developing aerodynamically efficient, fuel smart, thermally efficient, safe and comfortable vehicles. The vehicle aerodynamics knowledge is also essential for academics, researchers, students, motor enthusiasts, and government regulatory bodies in their professional practices.

The course will be delivered by Prof. Firoz Alam, a Professor in the School of Aerospace, Mechanical and Manufacturing Engineering at RMIT University, Melbourne (Australia), who is an internationally acclaimed academic and researcher with proven knowledge, experience, and demonstrable ability in teaching, consultancy, research, and training in the field of industrial and vehicle aerodynamics. Indian expert and host faculty members will be associated with the foreign expert to ensure smooth delivery of the course. The course is planned and offered as per the norms set by GIAN and Motilal Nehru National Institute of Technology Allahabad, India.

### **Course Objectives**

This short course will provide participants opportunities to familiarize with the core concepts, understand latest developments (recent advances and future trends), industry applications (linking theory and real-world), and decision making and trade-off analysis in wider industrial and vehicle aerodynamics. After successful completion of this short course, participants will be able to:

- Understand principal concept of industrial and vehicle aerodynamics and its implication on energy conservation, economy and aesthetics.
- Learn passenger car aerodynamics and car development processes (from concept to production vehicle) using wind tunnel, on-road experimentation and Computational Fluid Dynamics (CFD) simulation.
- Interpret CFD simulation data with Design parameters.
- Comprehend aerodynamic drag, directional stability, safety and comfort of vehicles (passenger car, bus, truck & delivery vans).
- Analyse vehicle engine and underbody (exhaust & brakes) cooling and in-cabin thermal performance and development strategy.
- Comprehend motorcycle and helmet aerodynamics and aero-acoustics.
- Apply industrial and vehicle aerodynamics knowledge to retrofit locally manufactured commercial vehicles for reducing aerodynamic drag, enhancing comfort and safety.



<b>Dates</b>	<b>28 August – 2 September 2023</b>	
<b>Location</b>	<b>The course will be conducted via offline mode at the Motilal Nehru National Institute of Technology (MNNIT) Allahabad, Prayagraj-211004, U.P. (India).</b>	
<b>Course Schedule</b>	28 <sup>th</sup> Aug. 2023 (Monday)	<p><b>Inauguration:9.00 AM to 9.30 AM</b>  <b>Lecture Module 1: 10:00 AM to 11:00 AM (1 hr)</b>  Topic: An Overview of Industrial and Vehicle Aerodynamics.  <b>Lecture Module 2: 11:15 AM to 12:15 PM (1 hr)</b>  Topic: Some Fundamentals of Fluid Mechanics &amp; Performance of Cars and Light Vehicles.  <b>Lecture Module 3: 12:30 PM to 1.30 PM (1 hr)</b>  Topic: Aerodynamic Drag of Passenger Cars.  <b>Hands-on Session/Interactive Tutorial 1 : 3.00 PM to 4.00 PM (1 hr)</b>  Topic: Evaluation of Passenger Car Aerodynamic Drag.</p>
	29 <sup>th</sup> Aug. 2023 (Tuesday)	<p><b>Lecture Module 4: 9:30 AM to 10:30 AM (1hr)</b>  <b>Topic:</b> Vehicles Directional Stability, Safety, Comfort and Crosswind Effect.  <b>Lecture Module 5: 10:45 AM to 11:45 AM (1hr)</b>  <b>Topic:</b> Vehicle Aerodynamic Noise and Aeroacoustics.  <b>Lecture Module 6:12.00 Noon to 1.00 PM (1 hr)</b>  <b>Topic:</b> Racing Car (High Performance Vehicle) Aerodynamics.  <b>Hands-on Session/Interactive Tutorial 2:3.00 PM to 4.00 PM (1hr)</b>  <b>Topic:</b> Evaluation of Vehicle's Wind Average Drag (WAD).</p>
	30 <sup>th</sup> Aug. 2023 (Wednesday)	<p><b>Lecture Module 7:9:30 AM to 10:30 AM (1 hr)</b>  <b>Topic:</b> Aerodynamics of Commercial Vehicles (Trucks).  <b>Lecture Module 8: 10:45 AM to 11:45PM (1 hr)</b>  <b>Topic:</b> Aerodynamics of Commercial Vehicles (Buses, Delivery Vans/Utility Vehicles).  <b>Lecture Module 9:12.00 Noon to 1.00 PM (1 hr)</b>  <b>Topic:</b> Suppression of Spray, Splashes and Soiling and their Reduction Strategy.  <b>Lecture Module 10: 3.00 PM to 4.00 PM (1 hr)</b>  <b>Topic:</b> Wind Engineering: Buildings, Structures, Bridges and Wind Turbines.</p>
	31 <sup>st</sup> Aug. 2023 (Thursday)	<p><b>Lecture Module 10: 9:30 AM to 10:30 AM (1 hr)</b>  <b>Topic:</b> Motorcycle and Helmet Aerodynamics and Aeroacoustics.  <b>Lecture Module 11: 10:45 AM to 11:45 AM (1 hr)</b>  <b>Topic:</b> Aerodynamics Effect on Vehicle Engine and Underbody Cooling.  <b>Lecture Module 12:12:00 Noon to 1.00 PM (1hr)</b>  <b>Topic:</b> Aerodynamic Effect on Vehicle's Heating, Ventilating and Air Conditioning.  <b>Hands-on Session/Interactive Tutorial 3: 3.00 PM to 4.00 PM (1 hr)</b>  <b>Topic:</b> Application of Computational Fluid Dynamics (CFD) in Vehicle Aerodynamic Evaluation.</p>
	1 <sup>st</sup> Sept. 2023 (Friday)	<p><b>Lecture Module 13:9:30 to 10:30 AM (1 hr)</b>  <b>Topic:</b> Vehicle Aerodynamic Measurement and Test Techniques.  <b>Lecture Module 14:10:45 to 11:45 AM (1 hr)</b>  <b>Topic:</b> Low Speed Wind Tunnels for Vehicle Aerodynamic Testing.  <b>Lecture Module 15: 12.00 Noon to 1.00 PM (1 hr)</b>  <b>Topic:</b> Vehicle On-Road Testing, Evaluation and Comparison with Wind Tunnel Testing.  <b>Hands-on Session/Interactive Tutorial 4:3.00 PM to 4.00 PM (1 hr)</b>  <b>Topic:</b> Panel Discussion on Vehicle Aerodynamics Implication on Indian Motor Vehicles Industry and Consumers.</p>
	2 <sup>nd</sup> Sept. 2023 (Saturday)	<p>Evaluation of Learning Outcomes (Examination/Test, Feedback) &amp; Certificate distribution.  9.30 AM-12.00 PM.</p>



<b>Who should attend?</b>	<ul style="list-style-type: none"> <li>• Anyone with a degree in Mechanical, Aerospace/Aeronautical, Civil, Chemical, Energy or relevant branches of Engineering and Science.</li> <li>• Student at all levels (B.Tech./B.Eng./B.Sc./M.Sc./MTech./Ph.D.) and faculty members/academic staff from universities and institutions.</li> <li>• Engineers, Scientists and Professionals working in companies, industries and R&amp;D institutions.</li> </ul>								
<b>Course Fee</b>	<p><b>One-Time GIAN Registration:</b> Please visit <a href="http://www.gian.iitkgp.ac.in/GREGN/">http://www.gian.iitkgp.ac.in/GREGN/</a> and register by paying Rs. 500/- (who have already been paid, need not pay again). The participation fees for attending the course is as follows:</p> <table border="1"> <tr> <td><b>Participants from abroad:</b></td> <td>US\$ 200 + 18% GST</td> </tr> <tr> <td><b>Industry/ Research Organizations:</b></td> <td>Rs. 5000 + 18% GST</td> </tr> <tr> <td><b>Academic Institutions (Faculty members):</b></td> <td>Rs. 3000 + 18% GST</td> </tr> <tr> <td><b>Academic Institutions (Students/Research scholars):</b></td> <td>Rs. 1000 + 18% GST</td> </tr> </table> <ul style="list-style-type: none"> <li>• The course will be offered via OFFLINE mode.</li> <li>• No hardcopy of the learning materials would be provided to the participants.</li> <li>• Minimum 90% attendance necessary to be eligible for certificate of participation/attendance.</li> <li>• Appearing for evaluations/examinations during the course is necessary for certificate of grades in the course.</li> </ul>	<b>Participants from abroad:</b>	US\$ 200 + 18% GST	<b>Industry/ Research Organizations:</b>	Rs. 5000 + 18% GST	<b>Academic Institutions (Faculty members):</b>	Rs. 3000 + 18% GST	<b>Academic Institutions (Students/Research scholars):</b>	Rs. 1000 + 18% GST
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<b>Bank Details</b>	<p><b>Account Name:</b> SNFCE MNNIT Allahabad.  <b>Account No.:</b> 10424975574.  <b>Bank Name:</b> State Bank of India (SBI).  <b>Branch:</b> MNNIT Allahabad, Prayagraj-211004, Uttar Pradesh, India.  <b>IFSC Code:</b> SBIN0002580.  <b>Last Date of Registration:</b> 14<sup>th</sup> August 2023.</p>								

## International Expert



### **Professor Firoz Alam, RMIT University, Melbourne (Australia)**

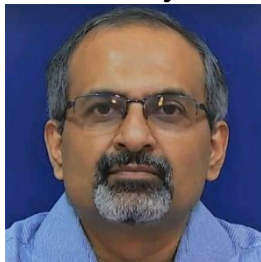
Professor Firoz Alam completed his Ph.D. in Road vehicle aerodynamics and Aero-acoustics from RMIT University, Melbourne, Australia in 2001. He completed M.Sc. (combined with Bachelor's degree) in Aeronautical Engineering with 1st class Honours (First Class First) from Riga Civil Aviation Engineers Institute, Latvia in 1991. Dr. Alam joined the School of Aerospace, Mechanical and Manufacturing Engineering at RMIT University as Lecturer in January 2002. He was promoted to Senior Lecturer in 2006, Associated Professor in 2011 and full Professor in 2015. In addition to teaching and research responsibilities, Prof. Alam has been serving as Program Director for Mechanical Engineering at RMIT University over 15 years. He has been heavily involved in teaching, research and administration. His research specialization includes thermal engineering, energy and energy policy, aerodynamics of aircraft, road vehicles, trains, buildings and wind turbines, sports aerodynamics and engineering education. His thermal engineering research includes building energy performance, heating, ventilation and air conditioning, renewable and conventional energy. Prof. Alam has supervised over 15 PhD students as principal supervisor. He has undertaken over 10 energy and aerodynamics related commercial projects with General Motors-Holden (GMH), Ford Motor Company, Queensland Rail, Breeze Air, Freight Link, Neopurple, SCT Logistics, National Pacific Rail, ACI logistics, Ministry of Power, Energy and Mineral Resources Bangladesh, Ministry of Mines and Petroleum Afghanistan, Department of Foreign Affairs and Trade (DFAT) Australia. Prof. Alam has successfully completed a large research project (over 1.2 million dollar) on energy conservation funded by the Australian Federal Government and Ministry of Power, Energy and Mineral Resources Bangladesh. Currently Prof. Alam is leading a skills enhancement project for Afghan Ministry of Mines and Petroleum funded by the Australian Federal Government with the support of Indian Central Government. Professor Alam has been awarded numerous awards including RMIT University Teaching Award, Emerging Researcher Award, Visiting Research Fellowship at Princeton University and NASA (USA). Currently he is serving as a member of the Editorial Board for Sports Engineering, published by Springer, assessor of Australian Research Council (ARC) and European Research Council (ERC). He is also serving as external invited referee for many reputed Journals such as Nature, National



Geographic, Computers & Fluids, Energy and Buildings, Building and Environment, Applied Thermal Engineering, Wind Engineering and Industrial Aerodynamics, Sports Engineering, Sports Technology, Sports, Medicine and Science, Sports Science, Applied Biomechanics, Fuel, Powder Technology, European Journal of Engineering Education, Experimental Thermal Fluid Science, etc. Prof. Alam is a Fellow of Engineers Australia (IEAust) and Chartered Professional Engineer. He has delivered invited keynote papers at numerous international conferences and seminars on energy and power and allied areas. He has published over 200 scientific publications as book, book chapters, journal articles and conference papers. His research in applied aerodynamics and thermodynamics has notable impact and has been widely reported by the print and electronic media worldwide. Prof. Alam has chaired and organized major international conferences and Scientific Committees. He was the organizing Chair of 19th Australasian Fluid Mechanics Conference (AFMC2014) and founding chair of International Conferences on Energy and Power (ICEP2016, ICEP2018)- a popular conference series. He was also Co-Chair of the 4th APCST2009, held in Honolulu, USA in 2009 and 5th APCST2011 held in Melbourne in 2011. He has chaired aerodynamics, thermodynamics, and heat transfer sessions of a range of international conferences. He is also an active member of the International Advisory Committee for ICME, ICMIEE, ICTE, ICMERE, ICESD2020 and WEES2020.

### Indian Expert

#### Prof. Arnab Roy, Indian Institute of Technology Kharagpur



Prof. Arnab Roy is a Professor in the Department of Aerospace Engineering at Indian Institute of Technology (IIT) Kharagpur. He did B.E. from Jadavpur University, M.Tech. from IIT Madras and Ph.D. from IIT Kharagpur. Dr. Roy's research spreads across computational and experimental fluid dynamics and aerospace propulsion. His current research interests are bluff body flows, fixed and flapping wing unsteady aerodynamics, modal analysis of flows, data driven models, multiphase flow simulations for semi-cryogenic rocket engines, jet in supersonic cross flow, energetic solid fuels, droplet breakup, interacting cavitation bubbles, shock wave boundary layer interaction. Dr. Roy is the visiting researcher of various reputed international universities including Shock Waves Laboratory (SWL) at RWTH Aachen, Institute of Aerospace Thermodynamics (ITLR) at TU Stuttgart, Institute of Aerodynamics and Gas Dynamics (IAG) at TU Stuttgart, and Institute for Computational Modeling in Civil Engineering (IrMB) at TU Braunschweig. Prof. Roy is the recipient of Air India Award (1997), DAAD Faculty Exchange Award (2008, 2013, 2019) and Milton Van Dyke Award Video Winner (2021).

### Host Faculty:



**Dr. Abhishek Kundu** is an Assistant Professor in the Department of Applied Mechanics, Motilal Nehru National Institute of Technology Allahabad (India). Dr. Kundu has over 3 years of combined teaching and research experience and is actively involved in research in the areas of fluid mechanics, especially compressible computational fluid dynamics, high speed flow, high resolution CFD solver. He obtained his Ph.D. from AcSIR (CSIR-Central Mechanical Engineering Research Institute, Durgapur) in 2017. He has published 12 papers in refereed international journals. Dr. Kundu has received Junior Research Fellowship award from CSIR in the year 2013. As a principal investigator, he is presently working on the funded project with SERB, AR & DB. He has also working experience in the DST-funded Indo-Russian project during his PhD.



**Dr. Akshoy Ranjan Paul** is an Associate Professor in the Department of Applied Mechanics, Motilal Nehru National Institute of Technology Allahabad (India). Dr. Paul has over 20 years of teaching and research experience and is actively involved in research in the areas of fluid mechanics, aerodynamics, CFD and green energy. He obtained his Ph.D. from MNNIT Allahabad in 2013. Dr. Paul has published over 200 research papers, 4 textbooks and delivered several invited talks in India and abroad on a variety of technical and motivational topics. Dr. Paul is presently working in several research projects sponsored by various government agencies as an investigator.



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Contact:



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Principal Course Coordinator	Course Coordinator	Local Coordinator, GIAN
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