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PERSONNEL

Date of birth	:1st January 1983
Gender	: Male
Spouse	: Kowshalya
Known languages	: Kannada, English, and Hindi.
Hobbies	: Books reading and collection, sketching, playing flute, listening to classical music and travelling.

EDUCATION

Degree	Institute	Specialization/Branch
Ph.D.	Indian Institute of Science (IISc), Bengaluru Research advisor: Dr. S Saravanan, Indian Institute of Science, Bangalore. July 2015 – May 2020	Aerospace Engineering Dissertation Topic: *Experimental Investigation on Aerothermal Effects of Forward-Facing Cavity Accounting Geometry aspects and Combination techniques in Hypersonic Flow conditions.* Specialized in heat transfer, pressure and schlieren measurements in hypersonic flow conditions in conventional shock tunnel, Ludwig tube and free piston shock tunnel facilities.
Master of Engineering (M.E)	University of Visvesvaraya College of Engineering, Bengaluru, Karnataka, Aug 2005-Jan 2008 FCD with 81.75%. Advisor: Dr. C. K. Umesh, UVCE Dr. G Sivaramakrishna, GTRE-Bangalore	Thermal Science and Engineering Master's Thesis: *CFD Analysis of Film cooling in a Gas Turbine Combustor Liner.* Specialized in CFD analysis and thermal science.
Bachelor of Engineering (B.E)	Dr. Ambedkar Institute of Technology, Bengaluru, Karnataka, Aug 2002 – July 2005.	Mechanical Engineering

	FCD with 74.93%.	Project: *Design of Fixture for WS1 High Speed for Shaper & L200 Gear Hobber Machines*
Diploma	Government Polytechnic College, Bellary, Karnataka, June 1998- June 2001. FCD with 71. 90% (final year).	Mechanical Engineering **Project:** Design and fabrication of wind operated industrial clock
SSLC	Shri Chhatrapati Shivaji Vidya Mandira, Sandur, Karnataka, June 1988- March 1998 FCD with 79.68%.	---NA---

RESEARCH INTERESTS

Experimental Fluid Dynamics and Heat transfer, Hypersonic Flow and Shock Waves, Aerodynamics and Aerothermodynamics, Flow analysis using the wind tunnel (Subsonic, Supersonic, and hypersonic) and shock tunnel facilities, Drone and UAVs, Bio-inspired technologies, and Optical Diagnostics.

RESEARCH EXPERIENCE

1. **The hypersonic flow and heat transfer mitigation study for re-entry vehicles**: During ascent and re-entry conditions, the hypersonic vehicle experiences high-temperature effects strongly influencing the pressure and skin friction forces on the surface, and convective and the radiative energy fluxes. To counteract the critical aerothermal thermal challenges, the forward-facing cavity (FFC) mechanism is experimentally investigated in my Ph.D. research work considering the different cavity geometries, higher cavity lengths, FFC in combination with energy deposition and opposing jet.
   Dissertation title: ***Experimental Investigation on Aerothermal Effects of Forward-Facing Cavity accounting Geometry aspects and Combination techniques in Hypersonic Flow Conditions***
   Lab: Laboratory for Hypersonic and Shock Wave Research [LHSR]
   Department: Aerospace Engineering, Indian Institute of Science, Bengaluru, India.
   Advisors: Dr. S. Saravanan, Principal Research Scientist, July 2015 – Dec 2019

Outcomes:

- During the PhD research work, I had learnt the operation and technique of conventional shock tunnel, both straight through and reflected modes of operations, Ludwig tube, and free piston shock tunnel (FPST) which we were used extensively to perform the experiments. The experiments were conducted for the hypersonic flow free stream Mach number, M_∞ = 6 to 11 (i.e., 1.2 to 5.4 MJ/kg flow enthalpy respectively) are created using the simple and free piston shock tunnels. The operational experience of **sophisticated diagnostics such as pressure measurement by piezoelectric sensors, surface heat flux measurement by platinum thin film sensors and the flow visualization studies by a schlieren technique using high speed camera, and high-powered light source**, were obtained in the research works.
- The **novel technique of FFC with energy deposition inside the FFC** is achieved by the exothermic reaction of the chromium coating inside the cavity in a hypersonic high enthalpy flow of 3.2 and 5.4 MJ/kg. The catalytic reactions of the chromium coating, inside the cavity, is studied using the X-ray Photoelectron Spectroscopy (XPS) measurements along with the pressure and heat flux measurements.
- Interesting findings are presented in 6 conferences and published in **4 journal papers (ETFS, POF, Acta Astronautica).**

2. **Aerodynamic study on an airfoil with parabolic tubercles at the leading edge for wind turbine**

applications: Airflow over an airfoil separates from the surface and increases the performance losses at higher angles of attack conditions. In our work, experimentally aerodynamics effects of sinusoidal and parabolic shaped leading-edge tubercles are investigated by accommodating them in a NACA0020 symmetrical airfoil. Force measurements, pressure distribution, and surface flow visualization data are obtained using 6 component force balance, pressure scanner and photo-luminescent based technique respectively. Experiments were conducted for a Reynolds number of 200,000 by varying the angle of attack from 0° to 20° in a subsonic wind tunnel facility. It is observed that the parabolic tubercle geometry affects the flow and changes the pressure distribution significantly in the post-stall region, enhancing the lift coefficient by 40 - 92% compared to the baseline symmetrical airfoil. It also performs better than the sinusoidal tubercles in the post-stall region by increasing the lift coefficient by 10 - 18%. Results emphasize that the lift coefficient of tubercles geometries falls gradually at the trough, middle, and peak planes in the post-stall region as compared to the baseline airfoil.

Photoluminescent powder-based surface flow visualization is conducted to understand the flow features due to leading edge tubercles. It is observed that the increase in the tubercle amplitude influences counter rotating vortex pairs (CRVP's) formation. CRVPs flow structures are moved significantly towards the leading edge for low amplitude as compared to the higher amplitude geometry as the angle of attack is increased. Currently, experiments using PIV technique is in progress.

Outcomes:

- Based on our research experience, a ***project proposal titled as,*** '***Establishing the Infrastructure and Aerodynamic Investigation on an Airfoil with Novel Tubercles and Serrations Geometry for Wind Turbine Applications*** 'is accepted for funding 20 lakhs by the 'Vision Group for Science and Technology' Karnataka Govt. agency on January 2023 and the project is in progress.
- A consultancy on, ***'Design, Fabrication, and Testing of Wind Power assisted Duo Pack electronic module for electric vehicles propulsion' is in progress with a company Innovmon Pvt. Ltd. Bangalore,*** for the project cost of 5 lakhs.
- Results are presented in **ICTACEM 2021, IHTMC 2023** and **IAES 2024** conferences and communicated to journal of wind engineering and industrial applications.

2. **Design, fabrication and experimental analysis of vertical axis wind turbine for domestic power generation applications:** The Savonius and Darrieus kind of turbines are analyzed. For low velocity applications, a combination of Savonius and Darrieus with J-type of airfoil shape to achieve the low starting torque with higher wind energy conversion efficiency is designed and testing is progress.

Outcome: Based on the experience, a consultancy work on, ***'Design, Fabrication, and Testing of Wind Power assisted Duo Pack electronic module for electric vehicles propulsion' is in progress with a company Innovmon Pvt. Ltd. Bangalore,*** for the project cost of 5 lakhs. It is meant for hybrid vehicle powered with a combination switching mode to solar, wind, and battery system based on the energy availability.

3. **Shock wave impact effects on Chitosan Biopolymer and Multi wall Nano tubes (MWNT) for Biomedical applications:** In the direction of achieving low molecular weight and low viscosity chitosan (LMWC) a novel shock wave treatment technique is investigated. Shock tube is used to create the shock waves (shock Mach number (*Ms*) of 1.3 to 2.1) and the chitosan sample is exposed to 30 to 200 shock impulses. Different diagnostic tools such as, FT-IR spectroscopy, XRD, SEM, DSC, and Brook field viscometer were used to analyze the effects. Results indicated that the bond length reduced and the functionality of amide II increased by lowering the mass of the molecules. The degree of deacetylation (DDA) significantly changed about 75% to 90%. Crystallite size was improved considerably by 109%. The shear strain of the CS samples is raised, and the viscosity is reduced to about 88% percent as a result of the enhanced shock impulse. Altogether, the findings revealed that shockwave treatment considerably altered the physical characteristics of CS. Currently, experiments are in progress on Carrageenan, alginate and gelatin biomaterials.

Outcomes:

- Interesting results were **published in International Journal Polymer Analysis and Characterization in 2023 and ISSW34 conference proceedings.**
- Based on our research experience, a consultancy work on **'Shock treatment effect on Biomaterials' is in progress with a company Swakit-Biotech Pvt. Ltd. Bangalore,** for the project cost of 1 lakh.

The carbon nanotubes (CNTs) exhibit superior thermal, electrical and mechanical properties. Multi-wall carbon nanotube (MW-CNTs) subjected to shock wave loading of stagnation pressure conditions of 385 kPa, 807 kPa, and 897 kPa are experimentally investigated in a shock tube (*Ms* = 1.4, 1.7 and 2). The test samples are exposed to shock impulses of 10 to 60 and the surface morphological changes are studied SEM images. It is observed a decremental trend in average diameter of about 23% is noticed for up to 50 impulses at 385 kPa pressure condition. Whereas, for 847.9 kPa and 906.4 kPa conditions the average diameter decreased by about 43% till 40 impulses and later increased up to 15% for 60 impulses condition. Experiments subjected to high pressure conditions are in progress.

Outcomes: The results are published in **AIAA conference 2023** proceedings.

4. **Effect of like family oblique shock's interaction on the airframe in a hypersonic flow:** In supersonic, hypersonic flights and other aerodynamic bodies shock-shock interaction is in close proximity- such as engine inlet, adjacent missiles, launch vehicle separation and re-entry space shuttle. The shock interaction effect on the structure in a scramjet engine type of inlet is explored in this work. The inlet region with shock interaction condition is simulated by using opposing wedges and the opposite family of oblique shocks. The shock tunnel configuration is used to generate hypersonic flow with free-stream Mach numbers of 6.3, and the pressure fluctuations are studied using fast-reacting pressure transducers. The location of the shock interaction is determined in the inlet region by adjusting the offset distance and wedge angles. A sudden rise in pressure is noticed, in the region influenced by the shock interaction on the top wedge and low pressure in the bottom wedge due to its position.

Outcomes: Results are presented in **ICTACEM 2021** conference.

5. **Shock wave impact effects on gaseous fuels**: Considering the shock wave pressure and temperature jump, its effect on the LPG gas is investigated using the shock tube experiments. In the direction of achieving the different chemical compounds leading to enhance the calorific value of the fuel shock tube experiments are carried out. Currently, spectroscopic studies on the shock treated gas is in progress to quantify the effects.

6. **CFD analysis of flow in a duct with RO filters:** A consultancy work is in progress with Renalyx Pvt. Ltd., Bangalore, company for designing a home dialysis unit. A numerical model is developed to analyse the water flow in a duct with a RO filters and change in the flow characteristics involving the quantification of total dissolved solids (TDS) will be analyzed. An outcome of predicting the requirement of specific filter to achieve the required exit water TDS needs to be achieved. Considering the CFD results appropriate experimentation is also planned in the future.

7. **Design of a utensil for milk heating with no-spilling mechanism:** Studying the boiling curve for a milk pool heating a spill proof utensil designing work is in progress. Considering the spilling mechanism, surface motion and radiation appropriate circuit is designed and system will be fabricated.

PUBLICATIONS

- **JOURNAL PAPERS:**

Published

1. **B. Sudarshan,** H.A. Pranav, A.V. Sanjay, Hypersonic flow study in a pneumatically operated academic shock tunnel, Review of Scientific Instruments, Vol 94, 055104 (2023). https://doi.org/10.1063/5.0142147. Jl. Impact factor:1.84. *(Citations: 2)*
2. H. A Pranav, **B Sudarshan,** Shashikant N Joshi, Effect of shock wave impact on natural chitosan biopolymer, International Journal of Polymer Analysis and Characterization, Vol. 28, Issue 1, 2023, pp, 59-72. doi: 10.1080/1023666X.2022.2146917. Jl**.** Impact factor:2.83. *(Citations:1)*
3. **Sudarshan B,** Jagadeesh G., and S. Saravanan. "Experimental investigation on Aerothermal Effects of Forward-Facing Cylindrical and Parabolic Cavity in Hypersonic Flow," Acta Astronautica, Vol. 185 (2021) 226-235, 2021, doi: https://doi.org/10.1016/j.actaastro.2021.04.036
   Jl**.** Impact factor:2.83. *(Citations: 11)*
4. **Sudarshan B,** Srisha M.V. Rao, G. Jagadeesh, S. Saravanan. Effect of the axial cavity with an opposing high-pressure jet combination in a Mach 6 flow condition, Acta Astronautica 178 (2021) 335-348, 2020. Doi: https://doi.org/10.1016/j.actaastro.2020.09.021.
   Jl. Impact factor: 2.83. (*Citations: 9)*
5. **Sudarshan B,** Sneh Deep, Jayaram, V., Jagadeesh, G., and S. Saravanan. "Experimental Study of Forward-Facing Cavity with Energy Deposition in Hypersonic Flow Conditions," *Physics of Fluids 31, 10610 (2019);* https://doi.org/10.1063/1.5118751.
   Jl. Impact factor: 3.38. (*Citations:25)*
6. **Sudarshan B,** and S. Saravanan. "Heat Flux Characteristics within and Outside a Forward-Facing Cavity in a Hypersonic Flow." *Experimental Thermal and Fluid Science*, vol. 97, 2018, pp. 59 – 69. doi: 10.1016/j.expthermflusci.2018.03.023.
   Jl. Impact factor: 4.04. (*Citations: 40)*
7. **Sudarshan B**, Vishwesh Prasad, Prashanth M, Mohammed Ismail Zabi, **"***Experimental Analysis of Temperature Variation in an Air Medium Radiation Field,"* International Journal of Innovative Science and Modern Engineering (IJISME) ISSN: 2319-6386, Volume-3 Issue-3, February 2015. Jl. Impact factor: 0.48
8. **Sudarshan B**, Narayan U Rathod, and Victor Seram, "*Experimental Investigation on Characteristics of Non-Newtonian Fluids*," International Journal of Engineering Development and Research (IJEDR), ISSN: 2321-9939, Volume 2, Issue 4, 2014. **Jl.** Impact factor:0.54.

Accepted/in-press

1. Venkatesh Lamani, **Sudarshan B**, Ramesh M. Chalkapure, Bheemsha Arya, B Kotresha, Numerical Investigation of Combustion, performance and emission studies of HCCI engine operated with carbon free fuels (Ammonia - Hydrogen blends), ID-348, Proceedings of the International Conference on Advances in Aerospace and Energy Systems (IAES2024) April 04-06, 2024, Liquid Propulsion Systems Centre (ISRO), Thiruvananthapuram-695547, Kerala, India. Accepted for publishing in Engineering Research Express, IOP.

Submitted/in-preparation

1. **B. Sudarshan**, V S V Viswanath, Mukund S, Suhas S, Sujan J V, Aerodynamic study on an airfoil with novel U shape tubercle geometry, Journal of European Journal of Mechanics / B Fluids, June 2023. Jl. Impact factor: 2.86
2. **Sudarshan B**, Deepak Y, Shashikant N Joshi, Physical Characteristics of Chitosan Biopolymer subjected to Shock Wave Impact, Journal of Polymer Science, Feb 2024. Jl. Impact factor: 3.4

PUBLISHED BOOK CHAPTER:

1. Dr. Venkatesh T. Lamani, Mr. Hari Babu D, **Dr. Sudarshan B**, Dr. Ramesha D K, State-of-the-art technologies in hydrodynamic cavitation (HC), Theme: Futuristic Trends in Mechanical Engineering, e-ISBN: 978-93-5747-545-7 IIP Series, Volume 3, Book 5, Part 1, Chapter 3, 2022.
2. The work on '***Photo luminescence-based surface flow visualization study of an airfoil with leading edge sinusoidal tubercles*** ', selected for **Springer Lecture Notes in Mechanical Engineering series, 2024.**

❖ CONFERENCE PAPERS

INTERNATIONAL CONFERENCES:

Published

1. Shreejeet P Tarale, **B. Sudarshan**, Surface Morphological Investigation of Multi-wall Carbon Nanotubes for Aviation Vehicle Structure Suitability in flight regimes, 25th AIAA International Space Planes and Hypersonic Systems and Technologies Conference, Indian Institute of Science, May 28 - June 1, 2023. https://doi.org/10.2514/6.2023-3109.
2. **Sudarshan, B**., Jagadeesh, G., and S. Saravanan. "Effect of Forward-Facing Cavity Geometry in High Enthalpy Flows", Proceedings of the 32nd International Symposium on Shock Waves (ISSW32 2019), Research publishing Singapore, pp 295-301, July 2019. doi: 10.3850/978-981-11-2730-4_0457-cd. ***(selected for UGC travel grant, 2019).***
3. **Sudarshan, B.,** Sneh Deep, Jayaram, V., Jagadeesh, G., and S. Saravanan. "Effect of Energy Deposition Inside the Forward-Facing Cavity in a Hypersonic Flow." Proceedings of the 32nd International Symposium on Shock Waves (ISSW32 2019), Research publishing Singapore, pp 1419-1425, July 2019. doi: 10.3850/978-981-11-2730-4_0216-cd
4. **Sudarshan, B.,** and S. Saravanan. "Numerical Analysis of Surface Heat Flux in a Forward-Facing Cavity." *31st International Symposium on Shock Waves 2*, Nagoya, Japan, pp. 795–806, July 2017. doi:10.1007/978-3-319-91017-8_99. *(Citations:3)*
5. **Sudarshan, B.,** and S. Saravanan. "Shock Interaction Effect due to Axial Cavity in a Blunt Nosed Geometry Flying at Hypersonic Speeds." No. 121, 24th *International Shock Interaction Symposium (SIS 2022)*, Indian Institute of Technology, Madras, October 17-20, 2022.
6. Sanjay A V, **Sudarshan B,** Effect of oblique shocks interaction on the inlet structure in a hypersonic flow, Aerospace and Associated Technology **-** Proceedings of the Joint Conference of ICTACEM 2021, APCATS 2021, AJSAE 2021 and AeSI 2021, pp 522-527, September 2022 (conference dates: December 20-22, 2021) https://doi.org/10.1201/9781003324539-96
7. Praful K and **Sudarshan B,** Experimental study on two octave Indian flute acoustics, Aerospace and Associated Technology **-** Proceedings of the Joint Conference of ICTACEM 2021, APCATS 2021, AJSAE 2021 and AeSI 2021, pp 87-94, September 2022. https://doi.org/10.1201/9781003324539-16. (*Citations: 1)*
8. **Sudarshan B,** V Viswanath, S Mukund, J V Sujan and S Suhas, Aerodynamic Study on Airfoil U- shape Tubercles Geometry, Aerospace and Associated Technology **-** Proceedings of the Joint Conference of ICTACEM 2021, APCATS 2021, AJSAE 2021 and AeSI 2021, pp 186-191, September 2022. https://doi.org/10.1201/9781003324539-33
9. Pranav K, **Sudarshan B,** Shock wave effects on Chitosan biopolymer for drug delivery applications, Aerospace and Associated Technology **-** Proceedings of the Joint Conference of ICTACEM 2021, APCATS 2021, AJSAE 2021 and AeSI 2021, pp 493-498, September 2022. https://doi.org/10.1201/9781003324539-91
10. Dheeraj R and **B Sudarshan,** Rohith J, Shashank H K, Akshay S Prasad, Design of Propulsion System for Propeller-less UAV, Aerospace and Associated Technology **-** Proceedings of the Joint Conference of ICTACEM 2021, APCATS 2021, AJSAE 2021 and AeSI 2021, pp 217-221, September 2022. https://doi.org/10.1201/9781003324539-39.

Accepted/in-press

1. Amit Kaniyattu Roy, **Sudarshan B**, Manish M S, Mohammad Fahad, and Meenakshi Basavaraj Aili, Photo luminescence-based surface flow visualization study of an airfoil with leading edge sinusoidal tubercles, ID-656, Proceedings of the International Conference on Advances in Aerospace and Energy Systems (IAES-2024), April 04-06, 2024, Liquid Propulsion Systems Centre (ISRO), Thiruvananthapuram, Kerala, India.
2. Udaya Karthik B S, **B Sudarshan**, Sanat J Kumar, and Pratik Agarwal, Flow Visualization study on a NACA0020 airfoil with sinusoidal tubercles using photo luminescence particles, Proceedings of the

27th National and 5th International ISHMT-ASTFE Heat and Mass Transfer Conference December 14-17, 2023, IIT Patna, Patna-801106, Bihar, India.

3. Deepak Y, **Sudarshan B,** Chintoo S Kumar, Depolymerization study on Chitosan Biopolymer subjected to Shock Wave Impact, 34th International Symposium on Shock Waves, Daegu, Korea, 16-21 July 2023 ***(selected for SERB travel grant, 2023).***

Submitted/in-preparation

1. **Sudarshan B**, Likith Gowda. N. R, Pannag Bhaskar Kini, Niranjan S Hegde, Mohammad Azeez Chikkabbar, Experimental Aerodynamic Study on Modified Airfoil with different leading and trailing edge Geometries, ID-368, Proceedings of the International Conference on Advances in Aerospace and Energy Systems (IAES-2024), April 04-06, 2024, Liquid Propulsion Systems Centre (ISRO), Thiruvananthapuram, Kerala, India.
2. Sohan C S, **Sudarshan B**, Jayanth V T, Vikram S, Vignesh P, An aeroacoustics study on modified airfoils, ID-675, Proceedings of the International Conference on Advances in Aerospace and Energy Systems (IAES-2024), April 04-06, 2024, Liquid Propulsion Systems Centre (ISRO), Thiruvananthapuram, Kerala, India.
3. Venkatesh T Lamani, Swapnil K Singh, **Sudarshan B**, Ramesh M. Chalkapure, Bheemsha Arya, Influence of NH3/H2 doping ratio (carbon free fuels) on laminar flame speed and NO emission, ID-628, Proceedings of the International Conference on Advances in Aerospace and Energy Systems (IAES2024) April 04-06, 2024, Liquid Propulsion Systems Centre (ISRO), Thiruvananthapuram-695547, Kerala, India.
4. Deepak Y, **Sudarshan B**, Shashikant N Joshi, Surface Morphology and Viscosity variations of Chitosan biopolymer subjected to shock waves impact, ISAMPE National Conference on Composites (INCCOM-18) on 9th of February 2024, National Aerospace Laboratories (NAL), Bangalore.
5. Amit Kaniyattu Roy, **Sudarshan B**, Manish M S, Meenakshi B. Aili, Mohammed Fahad, CFD analysis of drone impeller blades with a leading-edge serration, 15th International Symposium on Experimental and Computational Aerothermodynamics of Internal Flows, 24-27 October 2023, IIT Madras, India.
6. **Sudarshan B**, Shreejeet P Tarale, Anil Chandra A R, Surface Morphological Study of Multi-walled Carbon Nanotubes subjected to Shock Wave Impact, 34th International Symposium on Shock Waves, Daegu, Korea, 16-21 July 2023.

Papers/poster presented in conferences/symposiums but not published

1. **Sudarshan B**, Likith Gowda. N. R, Pannag Bhaskar Kini, Niranjan S Hegde, Mohammad Azeez Chikkabbar, Experimental Aerodynamic Study on Modified Airfoil with different leading and trailing edge Geometries, ID-368, Proceedings of the International Conference on Advances in Aerospace and Energy Systems (IAES-2024), April 04-06, 2024, Liquid Propulsion Systems Centre (ISRO), Thiruvananthapuram, Kerala, India.
2. Sohan C S, **Sudarshan B**, Jayanth V T, Vikram S, Vignesh P, An aeroacoustics study on modified airfoils, ID-675, Proceedings of the International Conference on Advances in Aerospace and Energy Systems (IAES-2024), April 04-06, 2024, Liquid Propulsion Systems Centre (ISRO), Thiruvananthapuram, Kerala, India.
3. Venkatesh T Lamani, Swapnil K Singh, **Sudarshan B**, Ramesh M. Chalkapure, Bheemsha Arya, Influence of NH3/H2 doping ratio (carbon free fuels) on laminar flame speed and NO emission, ID-628, Proceedings of the International Conference on Advances in Aerospace and Energy Systems (IAES2024) April 04-06, 2024, Liquid Propulsion Systems Centre (ISRO), Thiruvananthapuram-695547, Kerala, India.
4. **Sudarshan B**, Shreejeet P Tarale, Anil Chandra A R, Surface Morphological Study of Multi-walled Carbon Nanotubes subjected to Shock Wave Impact, 34th International Symposium on Shock Waves, Daegu, Korea, 16-21 July 2023.
5. **Sudarshan B**., Srisha Rao, M. V., Jagadeesh, G., and S. Saravanan, "Study on combined effects of forward facing cylindrical and parabolic cavities with a high-pressure opposing jet (PR ≈ 18) at Mach 6 conditions", National Symposium on Shock Waves (NSSW 2020), Indian Institute of Technology, Madras, February 2020. (Won 'Best Paper' award).
6. **Sudarshan B**., S. Saravanan. "Surface Heat Flux Variations by Forward Facing Cavity in a Hypersonic Flow," Aerospace Research Scholars Symposium (AERES 2018), Indian Institute of Science, October 2018 (Won 'Best Presentation' award).
7. **Sudarshan B**., S. Saravanan. "Surface Heat Flux Variations by Forward Facing Cavity in a Hypersonic Flow," National Symposium on Shock Waves (NSSW 2018), TBRL, Chandigarh, February 2018.

8. **Sudarshan B**., S. Saravanan. "Aerothermal issues on the Nose surface due to the Axial Cavity in High Enthalpy Flow, 3rd National Aerospace propulsion Conference, BMS College of Engineering, Bengaluru, Dec 17-19, 2020.
9. **Sudarshan B**, H A Pranav A V Sanjay. Hypersonic flow study in a pneumatically operated academic shock tunnel, at 7th National Symposium on Shock Waves (NSSW2023), organized at Physical Research Laboratory, Ahmedabad, from February 15-17 2023.
10. Praveen, Mythri, **Sudarshan B**, and S. Saravanan, Aerodynamic analysis on hypervelocity ballistic HB-2 model for a Mach number 5.7 flow conditions, at 7th National Symposium on Shock Waves (NSSW2023), organized at Physical Research Laboratory, Ahmedabad, from February 15-17 2023.

RESEARCH AND CONSULTANCY PROJECTS DETAILS

Sl No	Role (PI/Co-PI	Project Title	Sponsoring/ Funding agency	Year of sanction	Duration	Amount (in Lakhs)
1	PI: **Dr. B Sudarshan**	Establishing the Infrastructure and Aerodynamic Investigation on an Airfoil with Novel Tubercles and Serrations Geometry for Wind Turbine Applications	Vision Group on Science and Technology (VGST, Govt. of Karnataka)	January 2023	2	20
2	PI: **Dr. B Sudarshan**	Flow visualization and Aerodynamic study on parabolic shaped tubercles airfoil geometry	FRPS, BMS College of Engineering	September 2022	2	2
3	Mentor: **Dr. B Sudarshan** PI: Dr. Ram Rohith V	Studying the Effects of Rotor Tilt by Building a Prototype Model on Hybrid Vertical Take-off and Landing (VTOL) UAV for Geographical Mapping Applications	FRPS, BMS College of Engineering	September 2022	2	2
4	**PI: Dr. Sudarshan B**	Design, Fabrication, and Testing of Wind Power assisted Duo Pack electronic module for electric vehicles propulsion	INNVMON TECHNOLOGIES, Bangalore	Nov 2023	1	5
5	**PI: Dr. Sudarshan B**	CFD simulation and parametric analysis of a duct flow with a RO membrane	Renalyx Pvt. Ltd., Bangalore	Submitted on August 2024 (in review)	1	2
6	**PI: Dr. Sudarshan B**	Shock wave treatment of biomaterial & its characterization.	Swakit-Biotech. Pvt. Ltd., Bangalore	Submitted on May 2024 (in review)	1	1
7	PI: **Dr. B Sudarshan** Co-PI: Dr. Anish S, NITK	Experimental and Numerical Investigation on Shock Interaction and Heat Transfer Effects on an RLV test model with Double Wedge Wing'	ISRO under 'Research areas in space' category	Submitted on August 2022 (in review)	2	30
8	PI: **Dr. B Sudarshan**	Shock impact studies on Chitosan and Gaurgum Biopolymers	TEQUIP-III, B.M.S. College of Engineering	Nov 2020-June 2021	1	0.25
9	PI: **Dr. B Sudarshan**	Effect of like family oblique shock's interaction on the airframe in a hypersonic flow	TEQUIP-III, B.M.S. College of Engineering	Nov 2020-June 2021 (Completed)	1	0.25

	Co-PI: Dr. Sangamesh Godi					
10	PI: **Dr. B Sudarshan** Co-PI: Dr. Bhimsha Arya	A wind tunnel study on Boundary Layer Transition Characteristics on a Flat plate with hydrophobic and rough surfaces	TEQUIP-III, B.M.S. College of Engineering	Nov 2020-June 2021 (Completed)	1	0.24
11	PI: **Dr. B Sudarshan**	Acoustical Investigation on transforming the conventional bamboo flute into the 3-octave condition	TEQUIP-III, B.M.S. College of Engineering	Nov 2020-June 2021 (Completed)	1	0.25
12	PI: **Dr. B Sudarshan**	Upgradation of shock tunnel to pneumatically operated mode	B.M.S. College of Engineering	Nov 2019-June 2020 (Completed)	1	0.20

RESEARCH GUIDANCE

I have guided UG and PG student projects and guiding few Ph.D. research scholars. The following table depicts the current status.

Program	No. of students guided	No. of Students presently guiding
Ph.D.	---	01
MTech.	07	---
B.E.	20	06

PARTICIPATION IN PROFESSIONAL TECHNICAL COMMITTEES/BOARDS

1. Editorial committee member of American Journal of Aerospace Engineering from July 2024-July2027.
2. Chapter advisor of ASHRAE at BMSCE, 2024.
3. Life member of Indian Society of Heat and Mass Transfer (ISHMT) from 2023
4. Life member of Society of Shock wave research (SSWR) at IISc, from 2020.
5. Life member of Aeronautical Society of India (AeSI) from 2022.
6. Reviewer in Physics of Fluids journal
7. Reviewer in Journal of Biomaterials and Applications
8. Reviewer in International Journal of Mechanical Engineering Sciences
9. Reviewer in Aeronautical Journal
10. Reviewer in Review on Scientific Instruments journal
11. Reviewer in Journal of Propulsion and Power Research

❖ PAPERS REVIEWED

1. DSMC investigation on flow characteristics of rarefied hypersonic flow over a cavity with different geometric shapes, Guangming Guo and Qin Luo, International Journal of Mechanical Sciences, Volume 148, pp 496-509, November 2018.
2. Cavitation dynamics and flow aggressiveness in ultrasonic cavitation erosion, Jianhua Du and Fengjun Chen, International Journal of Mechanical Sciences, 106545, May 2021.Doi: https://doi.org/10.1016/j.ijmecsci.2021.106545.
3. The feedback loops of discrete tones in under-expanded impinging jets, Luhan Liu, Xiangru Li, Nianhua Liu, Pengfei Hao, Xiwen Zhang, and Feng He, Physics of Fluids 33, 106112 (2021); https://doi.org/10.1063/5.0068431.
4. On the three-dimensional flow and aerodynamic characteristics of a cylindrical cavity in rarefied hypersonic flows, Guangming Guo, Qin Luo, International Journal of Mechanical Sciences, May 2022.
5. Study on the mechanism of shock wave/boundary layer interaction control using high frequency pulsed arc discharge plasma, Xiaogang Maa, JianFanb,YunkaiWua, Xiaowei Liuc, Rui Xuea, Physics of Fluids, June 2022.

6. Study on the mechanism of shock wave/boundary layer interaction control using high frequency pulsed arc discharge plasma, Xiaogang Maa, JianFanb,YunkaiWua, Xiaowei Liuc, Rui Xuea, Physics of Fluids, August 2022.
7. Evaluation of water vapor condensation using the thermoelectric cooling technique by experimental and theoretical observations," by Dinesh Kumar, Akhilesh Tiwari, and Jean-Pierre Fontaine, Physics of Fluids, September 2022.
8. Numerical study of three-dimensional flow and aerodynamic characteristics of a cylindrical cavity in rarefied hypersonic flows, Ms. No. SUBMIT2IJMS-D-22-02297R2, August 2022.
9. Temperature dependent performance of Schmidt-Boelter heat flux sensors, Ruth A. Miller,and Hannah S. Alpert, Review of Scientific Instruments, November 2022
10. Investigation of drag reduction mechanism for blunt bodies with plasma spikes, Weilin Zhang, Baozheng Ding, Zhiwei Shi, Yanlin Shu, and Fengtao Sun, Physics of Fluids, July 2023.
11. Design-oriented dynamic model of deployable fin under time-varying elevated temperature environment, Haoyuan Ren, Yi Wang *, Liang Wang, Jianbo Zhou, Hanjiang Chang, Yipeng Cai, Bao Lei, Aeronautical Journal, April 2023.
12. Polymeric system based on chitosan/ ethanolic extract propolis: biocompatibility and expression of transcription factors, Journal of Biomaterials Applications, June 2023.
13. Cell interaction, cytotoxicity and inflammatory gene expression of chitosan-propolis films, Journal of Biomaterials Applications, May 2023.
14. Investigation of drag reduction mechanism for blunt bodies with plasma spikes, Weilin Zhang, Baozheng Ding Zhiwei Shi, Yanlin Shu, and Fengtao Sun, Physics of Fluids, July 2023.
15. Study of Aerothermal and Aerodynamic Characteristics of Reusable Hypersonic Vehicles with Heat Transfer Minimized Sweepback, Shripad P Mahulikar, A, Aeronautical Journal, Oct 2023.
16. Design and construction of an exploding wire pulsed plasma system to create a shock wave for industrial applications, Maryam Akbari N a saji, Morteza Habibi , Reza Amrollahi, Physics of Fluids, Jan 2024.
17. Design and construction of an exploding wire pulsed plasma system to create a shock wave for industrial applications, Maryam Akbari Nasaji, Morteza Habibi, Reza Amrollahi, Journal of Radiation Physics and Chemistry, April 2024.

TEACHING EXPERIENCE

I have overall 16 years of teaching experience working in engineering institutions. Specialized in Thermal science stream, I have handled most of the thermal stream subjects offered to the UG and PG students. Thrust areas based specialized elective subjects, value added courses, and training programs floated to the student's community. The comprehensive details of my overall experience and the handled subjects are captured in the following table.

Sl No	Institute	Year	Regular subjects	Electives subjects/ value added programs
1	B.M.S. College of Engineering, Bengaluru	Oct. 2008 – Till present	**UG:** Thermal and Fluid Engineering, Fundamentals of Heat Transfer, Turbomachines, Basic and Applied Thermodynamics, Engineering Drawing, Engineering Vibrations **PG:** Advanced Fluid Dynamics, Steam and Gas Turbines, Advanced Heat Transfer	**UG:** Gas Dynamics, CFD, Incompressible Fluid Dynamics, Experimental techniques in Incompressible Flows, Advanced Thermodynamics, High-Speed Flow and Experimental Techniques (proposed), Mechanical Engineering in Nano Satellites (proposed) **PG:** Gas Dynamics, Aerothermodynamics (proposed) ***Value added courses****:* Basic Math in Fluid Mechanics and Python Programming, Fundamentals to challenges in aerodynamics at different application regimes, ***Training*****:** PIV and its applications

2	J.S.S. Technology, of Technical Education, Bengaluru	Aug. 2007- Oct. 2008	**UG:** Fluid Mechanics, Basic and Applied Thermodynamics, Heat and mass transfer, Elements of Mechanical Engineering	**UG:** Power plant Engineering
3	Basava Academy of Engineering, Bengaluru	Sept. 2004 - May 2005	**UG:** Elements of Mechanical Engineering, Heat transfer, Theory of Machines, Dynamics of Machines, Operation Research	--

- **Setting up of new labs, courses and lab in charge activities:**
  1. Established the CFD lab (2021), wind tunnel lab (2014-15) with the required latest diagnostic tools.
  2. Contributed in starting the post graduate course on Thermal Engineering in the Dept of Mechanical Engineering and handled specialized subject and coordinated the course as a coordinator from the department during 2021-24.
  3. Contributed to developing the Heat transfer (2009-11) and Turbo Machines lab (2011-15) with newer experimental testing rigs.
- **New technique in the subject delivery:**
  1. In the subject's delivery, **a topic-based presentation** assessment tool, **value-added courses** and **specialized training programs** are introduced to expose the students to the industrial perspectives and the applications.
  2. Conducting the seminars on cutting-edge topics, organizing the conferences/symposiums, and organizing the industrial visits.
  3. Participated in many knowledge enhancing programs such as faculty development programs (FDP), workshops (WS), seminars(S), conferences, and symposiums etc. as listed below.

Participated FDP/WS/S

Program duration	2 weeks	1 week	4 days	3 days	2 days	1 day
No. of programs	5	10	2	2	6	6

Attended number of conferences/symposiums.

Type of program	Int. Symposium/conference	National conference/ Symposium
No. of programs	8	6

AWARDS/ RECOGNITIONS/ ACHIEVEMENTS

1. Selected for **SERB International travel grant 2023** for presenting the research paper '*Depolymerization study on Chitosan Biopolymer subjected to Shock Wave Impact*' in 34th International Symposium on Shockwave (ISSW34), organized by International Symposia on Shock Waves (ISSW), at Daegu, South Korea, 16-21 July 2023.
2. Won the **Best Project Work award** for the undergraduate project work on '*Flow visualization for the flow over airfoil with leading edge tubercles using photo luminescent particles*' for the academic year of 2022-23 in Department of Mechanical Engineering, B.M.S. College of Engineering at September 2023.
3. The project work conceptualized and guided by me on '*Building a Prototype Model on Hybrid Vertical Take-off and Landing (VTOL) UAV for Geographical Mapping Applications*' have won the **2nd best project award** in 3rd South Indian Project Exhibition held on April 2022
4. Won the ***2nd best project award*** for the project work on *'Building a Prototype Model on Hybrid Vertical Take-off and Landing (VTOL) UAV for Geographical Mapping Applications'* in 3rd South Indian Project Exhibition held on April 2022.
5. Won the **Best Project Work award** for the undergraduate project work on '*Aerodynamic Study on Airfoil with Tubercle Geometries*' for the academic year of 2020-21 in Department of Mechanical Engineering, B.M.S. College of Engineering at September 2021.

6. Recognized as a **Research Supervisor** for Visvesvaraya Technological University (VTU) from March 2021.
7. Won the **Best Paper award** in 6th National Symposium on Shock waves (NSSW2020)' organized by the Society of Shock Wave Research at Indian Institute of Technology in February 2020.
8. Got selected for **UGC travel grant** in 2019 for presenting the research paper in 32nd International Symposium on Shockwave (ISSW32), organized by International Symposia on Shock Waves (ISSW), at NUS – Singapore.
9. Won the **Best Presentation award** in Aerospace Research Scholars Symposium (AERES2018), organized by the department of aerospace engineering at IISc. in October 2018.
10. Won the **Certificate of Excellence** for organizing the 2-week ISTE workshop on 'Engineering Thermodynamics conducted by Indian Institute of Technology, Bombay from 11th to 21st December 2012.

ACADEMIC AND ADMINISTRATIVE RESPONSIBILITIES

I have delivered many departmental responsibilities and many roles during my teaching experience in B.M.S. College of Engineering. The noticeable responsibilities are listed below.

1. Department final year students project coordinator from 2020; Dept. BOE member from 2019.
2. Institutional Anti Ragging squad- faculty from 2022.
3. Post Graduate coordinator for the PG course Thermal Engineering in Dept of Mechanical Engineering, B.M.S. College of Engineering during 2021-24.
4. In charge of the newly installed *CFD lab* from 2021.
5. Worked as a *nodal officer* in *COVID task force* in N.R. Colony, BBMP office (ward no 154), from July 2020 to Feb 2021.
6. Department core faculty member of '*BMS - Upagraha'* project from 2019.
7. Wind tunnel lab in-charge from 2019.
8. ASHRAE – BMSCE chapter convener from 2013 -15 and adviser from 2019.
9. Turbomachinery lab in-charge during 2011-2015.
10. Department Phase shift (technical event) coordinator and Placement coordinator during 2013-2014.
11. Department BOS (board of studies) member, BOE (board of examinations) member during 2012-2014.
12. Coordinator for Mechanical Engineering Association - student body, BMSCE, 2012-14.
13. Department Phase shift (technical event) coordinator and Placement coordinator during 2013-2014.
14. Heat and mass transfer lab in-charge from 2009-11.

FDP's/CONFERECES/WORKSHOPS ORGANIZED:

1. Organizing member for XVI International Conference on Vibration Engineering & Technology of Machinery (VETOMAC 2021), December 16-18, 2021, organized at B.M.S. College of Engineering in collaboration with IIT Guwahati and IIT Patna.
2. Organizing member for 1-week faculty development program (online) on the title, *'Recent advances in CFD and its application'* from 27th September to 1st October 2021.
3. Co-organizer for 3rd National Aerospace Propulsion Conference (NAPC 2020) on the theme of *'Research, Development and Product Realization'* organized by the NCABE and BMSCE from 17th - 19th December 2020.
4. Organizer for the 1-week faculty development program (online) on the title, *'Recent advances in heat transfer and its application'* from 13th to 17th July 2020.
5. Organized a 2-day Experts sessions-FDP on '*Thrust areas and research approaches in mechanical sciences*' in January 2020.
6. Main coordinator of 3 days' workshop on '*Gas Turbine Technology and Challenges'* in April 2014.
7. Workshop coordinator for Two-week ISTE workshop on '*Engineering Thermodynamics'* from 11th-21st, December 2012, sponsored by MHRD.

DELIVERED TALKS AND SEMINARS

1. Delivered a talk on '**Interesting exploration in PIV'** on 7th Nov 2023 in a 3 days training program on 'A training on Particle Image Velocimetry (PIV) Flow Visualization Technique and Its Applications',

organized at department of mechanical engineering, B.M.S. College of Engineering, during 6-8 November 2023.

2. On 11th July 2023, delivered a research seminar on," **Aero thermal mitigation by a forward-facing cavity with novel combinational techniques, and shock wave impact studies on chitosan and multi wall carbon nanotube materials** "at Indian Institute of Technology Kanpur.
3. On 16th February 2023, delivered an invited speaker talk on, "**Studies on the shock wave effects on biopolymers and nano tubes using the modified Reddy shock tunnel"** at 7th National Symposium on Shock Waves (NSSW2023), organized at Physical Research Laboratory, Ahmedabad, from February 15-17 2023.
4. On December 02, 2021, delivered an invited speaker talk on, "**A study on aerothermal effects mitigation by forward facing cavity in a hypersonic flow**" at Aerospace and Aeronautics World Forum organized at Frankfurt, Germany, from December 02-04, 2021.
5. On 11th December 2020, delivered a talk on **'Shock wave: significance and applications'** in a AICTE sponsored Short Term Training Program (STTP) on "Noise, Vibration and Shock – Measurement and Analysis". This program is organized by the Dept. of Mechanical Engineering, R.V. College of Engineering, Bengaluru, from 07/12/2020 to 12/12/2020 through online mode.
6. On 15th December 2020, delivered a talk on **'Research perspectives in shock wave technology'** in an AICTE sponsored Short Term Training Program (STTP) on "Noise, Vibration and Shock – Measurement and Analysis". This program is organized by the Dept. of Mechanical Engineering, R.V. College of Engineering, Bengaluru, from 14/12/2020 to 19/12/2020 through online mode.
7. On 31st December 2020, delivered a talk on **'Heat transfer analysis using MATLAB'** in an online workshop on MATLAB in Interdisciplinary Engineering Research. This program is organized by the Dept. of Mechanical Engineering from Vimal Jyothi Engineering College, Kerala, and B.M.S. College of Engineering, Karnataka, from 14/12/2020 to 31/12/2020 through online mode.
8. On 15th July 2020, delivered a talk on '**Challenges and advances in heat transfer studies for hypersonic vehicles'**, in a 1-week faculty development program (online) organized on the theme 'Recent advances in heat transfer and its application'. This program is organized by the Dept of Mechanical Engineering, B.M.S. College of Engineering from 13th to 17th July 2020.
9. Delivered a talk on '**2018 Noble scientists and their contributions'** at Govt. Higher Primary School, Yeshwanth Nagar (Sandur (T), Bellary (D)), August 2018.
10. Delivered **expert lectures** for technical personnel of Scania Commercial Vehicles Pvt. Ltd. between 10th June – 2nd August 2013 at B.M.S. College of Engineering, Bengaluru.

ATTENDED WORKSHOPS/CONFERENCES/FDP DURING LAST 5 YEARS

Sl. No.	Month & Year	Title	Organizer and no. of days	Venue
1.	May 5, 2024	Industry Institute Conclave 2024	FSID, BeST, IISc, Bangalore 1 day	IISc,
2.	January 10-11, 2024	Thermal Management Techniques: Innovations and Insights	Indian Society for Heat and Mass transfer (ISHMT) 2 days' workshop	Dept of Mechanical Engineering, IIT Madras
3.	April 4-6, 2024	International Conference on Advances in Aerospace and Energy Systems (IAES-2024), April 04-06, 2024	Liquid Propulsion Systems Centre (ISRO) 3 days	Liquid Propulsion Systems Centre (LPSC), Thiruvananthapuram
4.	July, 16-21, 2023	34th International Symposium on Shock Waves, Daegu, Korea	International Society of Shock waves (ISSW 34)	Daegu, Korea
5.	May 28-June1, 2023	25th AIAA International Space Planes and Hypersonic Systems and Technologies Conference	American Institute of Aeronautics and Astronautics (AIAA)	Indian institute of Science

6.	Feb 15-17, 2023	7th National Symposium on Shock Waves (NSSW2023)	SSWR, IISc 3 days	Physical Research Laboratory, Ahmedabad
7.	10th March, 2023	Natural Refrigerants: Applications and Policies	IISc jointly with IITM, ISHRAE, SADHANA, INDEE+ and NTNU (Norway),1 day	IISc, Bangalore
8.	6-10 March, 2023	Applications of shock waves in science, engineering, and medicine	Dayanand Sagar University, 5 days	Dayanand Sagar University
9.	Oct 17-20, 2022	24th International Shock Interaction Symposium (SIS 2022)	Indian Institute of Technology, Madras	Indian Institute of Technology, Madras
10.	3-14, October 2022	Schlieren and Background Schlieren visualization Techniques for High Speed Flows	National Aerospace Laboratories (NAL) 2 weeks	National Aerospace Laboratories (NAL), Bangalore
11.	29th April-3rd May 2022	Modelling and Simulation of Turbulence	GIAN, Dept of Mechanical Engineering and Dept of Mathematics, BMS College of Engineering, 1 week	Online
12.	6-10, Dec 2021	International Colloquium on Shock Waves	The University of Queensland 1 week	Online
13.	27th September -1st October 2021	Recent Advances in CFD and its application	Dept of Mechanical Engineering, BMS College of Engineering, 1 week	Online
14.	20-23, September 2021	High-Performance Computing for Astronomy and Astrophysics	NCRA-TIFR and IIT Kharagpur 4 Days	Online
15.	26th March 2021	Hypersonic Air-Breathing Vehicle	National Centre for Combustion Research and Development, IIT-Madras, 1 day	Online (Webinar)
16.	July 2019	32nd International Symposium on Shock Waves (ISSW32)	ISSW32, 1 week	National University of Singapore (NUS)
17.	February 2018	5th National Symposium on Shock Waves	NSSW2018, 3 days	TBRL, Chandigarh
18.	10-12, September, 2018	Symposium on classical to computational aero elasticity	Dept. of Aerospace Engg., IISc, Bengaluru, 3 days	IISc, **B**engaluru
19.	July 2017	31nd International Symposium on Shock Waves (ISSW31)	ISSW31, 1 week	Nagoya University, Japan

20.	July 2017	Pulse Detonation Engine and Air Breathing Propulsion Technologies	Society for shock wave research, IISc, 2 days	Department of Aerospace Engineering, IISc., Bangalore
21.	25-26, February 2016	4th National Symposium on Shock Waves	NSSW2016, 2 days	Karunya Institute of Technology and Sciences, Coimbatore
22.	June 5-6, June 2015	Curriculum Design and Development of Mechanical Engineering'	BMS College of Engineering (BMSCE), 2 days	BMSCE, Bengaluru
23.	August 2-7, 2013	Latex and Excel for Research-Hands on sessions	BMSCE, 1 week	BMSCE, Bengaluru
24.	August 19-24, 2013	MEMS & Nano Technology	BMSCE, 1 week	BMSCE, Bengaluru
25.	May 27-31, 2013	Theoretical and Computational Aspects of Nonlinear Waves (TCANW-2013)	National program on differential equations: Theory, computation & applications (NPDE-TCA), 1 week	IIT Bombay
26.	November 20-24, 2012	Engineering Thermodynamics	Coordinator's workshop, 1 week	IIT Bombay
27.	June 12-22, 2012	Computational Fluid Dynamics	MHRD, 2 weeks	IIT Bombay
28.	March 23-24, 2012	Advanced Topics pm Modelling of Turbulent Flows	AICTE, 2 days	IIT-Madras
29.	28th February-3rd March 2012	Computational Combustion	QIP-STC, 1 week	IIT-Kanpur
30.	November 22-27 2010	Recent Advances in Computational Sciences with Application	QIP-STC, 1 week	IIT-Kharagpur
31.	May 31-June 4, 2010	Satellite Orbits: Applied Perturbations, Maintenance, and Launch	QIP-STC, 1 week	IIT Bombay
32.	February 16-21, 2009	Instructional Design & Delivery Systems - pedagogy training Programme	BMSCE, 1 week	BMSCE, Bengaluru

REFERENCES

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