



KNOWLEDGE INCUBATION FOR TEQIP, IIT KANPUR

International workshop on Energy, Propulsion & Environment

March 08 - 11, 2017



Knowledge Incubation for TEQIP, IIT Kanpur in collaboration with University of Maryland, College Park, University of Illinois at Chicago, ACRI CFD, National Science Foundation and Office of Naval Research Global organized the **International Workshop on Energy, Propulsion and Environment**. This workshop was conducted at **Indian Institute of Technology Kanpur** from **March 8 to 11, 2017**. The primary focus of this workshop was on clean and sustainable energy, which is of fundamental importance in all applications of energy, power, mobility and propulsion. With this in mind, we invited experts available within IITK and other institutes in India and U.S.A to deliver talks which would enable participants to learn from the best domain experts in this field. We had a total of 25 talks along with laboratory scale demonstration on experimental methods and diagnostics. Moreover, a panel discussion and student poster sessions were also arranged.

Topics Discussed

- Combustion Diagnostics and Lab Scale Demonstration – 1
- Combustion Diagnostics and Lab Scale Demonstration - 2

- **Session-I: High Intensity GT**
 - On Lean Direct Injection Research
 - GE Aviation Low Emission Combustion Technologies
 - Study of Moten Flow Breakup Behavior in Solid Rocket Motor

- **Session-II: Fuels, Fuel Cell & Modeling**
 - Catalytic conversion of triglycerides and to green liquid biofuels
 - Thermochemical Conversion of Wastes to Fuels
 - A General Purpose Aerosol Transport Model including Nucleation, Growth, Coagulation and Deposition
 - Fuel Cell Systems in India: Opportunities and Challenges

- **Session-III: Emission, Modeling and Alternate Energy**
 - Effect of Fuel Unsaturation on Emissions in Diesel Engine Combustion
 - Numerical Study of the effect of the fine polydisperse water spray on Laminar flame speed of Hydrogen/Air premixed flames Stabilized in the stagnation flow field
 - Alternate Energy and Fuel Development for South India
 - Role of Analysis led design approach in diesel engine based after treatmentsystem

- **Session-IV: Combustion Modeling and High Speed Propulsion**
 - Synchronization transition in athermoacousticsystem: Temporal and spatiotemporal analysis
 - Design modifications & experimental validation of a liquid fueled single tube PDE for prolonged operation
 - A cloud-based, real-time emergency response system

- **Session-V: Fuels and Combustion Dynamics**
 - Boron Nanoparticles for Energy and Propulsion Applications
 - Sustainable Biofuels for Transportation
 - Dynamics of Ducted Inverse Diffusion Flames: A Dynamical Systems Approach
 - Innovative Bio-Char Briquetting from Corn Residue by Torrefaction Process

- **Session-VI: Diagnostics, Modeling, and Renewable Energy**
 - Quantitative Laser-based diagnostics and Modelling of Syngas- Air Counterflow Diffusion Flames
 - Turbulent Combustion Modeling Using Flamelet Generated Manifolds
 - How a spray interacts with swirling flow

- Design and Investigation on Modified Mechanism on Stirling Engine Powered by Renewable Energy
- **Session-VII: Advances in Combustion**
 - Low Damköhler number combustion in bespoke fractal grid turbulence
 - High pressure combustion research at KAUST
- **Lab Experiments on:**
 - Advanced Combustion and Acoustic Laboratory,
 - Aero Propulsion Lab,
- **Panel Discussion on Energy & Fuels for India – A path forward**
- **Poster Presentation**

List of Speakers

- HukamMongia, CSTI Associates, USA
- R. S. Amano, University of Wisconsin-Milwaukee, USA
- SutapatKwankaomeng, King Mongkut's Institute of Technology, Thailand
- Ram B. Gupta, Virginia Commonwealth University, USA
- Y. H. Taufiq-Yap, Universiti Putra Malaysia
- Darrell W. Pepper, University of Nevada, USA
- SomratKerdsuwan, King Mongkut's University of Technology, Thailand
- Suresh Aggarwal, University of Illinois at Chicago, USA
- Peter Lindstedt, Imperial College London, UK
- Gabriel D. Roy, CPnE Consultants, USA
- Ashwani K. Gupta, University of Maryland, USA
- AkshaiRunchal, Director, CFDVRI, USA
- William Roberts, CCRC, KAUST, Thuwal, KSA
- AchintyaMukhopadhyay, Jadavpur University, India
- SaptarshiBasu, Indian Institute of Science, Bangalore, India
- ArvindRao, GE Aviation, Bangalore, India
- AtulBhargav, Indian Institute of Technology Gandhinagar, India
- SrinibasKarmakar, Indian Institute of Technology Kharagpur, India
- SwarnenduSen, Jadavpur University, India
- Ambarish D Khot, Cummins Technologies India LTD, Pune, India
- AshishGoel, Terminal Ballistics Research Laboratory, Chandigarh, India
- R. V. Ravikrishna, Indian Institute of Science, Bangalore, India
- SudiptoMukhopadhyay, Indian Institute of Technology Jodhpur, India
- R. I. Sujith, Indian Institute of Technology Madras, India

Participating Institute

Institute	Number of Participants
MNNIT Allahabad	1
HBTU, Kanpur	1
MMMUT Gorakhpur	1
SATI, VIDISHA, M.P.	1
PES University, Bangalore	2
AMU, Aligarh	4
Jadavpur University, Kolkata	2
Rajasthan Technical University, Kota	1
S.V. National Institute of Technology, Surat	1
Total	14

Workshop Schedule

March 08, 2017

Time	Event
2:00 - 3:00 PM	Registration
3:00 - 4:00 PM	Workshop Inauguration
4:00 - 4:30 PM	Tea Break
4:30 - 5:00 PM	Combustion Diagnostics and Lab Scale Demonstration – 1 <i>AkshaiRunchal</i>
5:00 – 5:30 PM	Combustion Diagnostics and Lab Scale Demonstration – 1 <i>AbhijitKushari</i>
5:30 – 6:30 PM	Experiments in Lab: Advanced Combustion and Acoustic Laboratory,

March 09, 2017

Time	Event
9:00 – 10:00 AM	Combustion Diagnostics and Lab Scale Demonstration – 2 <i>HukamMongia</i>
10:00 – 10:30 AM	Combustion Diagnostics and Lab Scale Demonstration – 2 <i>Ashwani Gupta</i>
10:30 – 10:45 AM	Tea Break
11: 00 – 12:30 PM	Experiments in Lab:Aero Propulsion Lab, <i>Department of Aerospace Engineering</i>
12:30 – 2:00 PM	Lunch Break
Session-I: High Intensity GT (Session Chair: A. Runchal)	
2:00 – 2:30 PM	On Lean Direct Injection Research <i>Xiao Ren, Chih-Jen Sung and HukamMongia</i>
2:30 – 3:00 PM	GE Aviation Low Emission Combustion Technologies <i>ArvindRao</i>
3:00 – 3:30 PM	Study of Moten Flow Breakup Behavior in Solid Rocket Motor <i>R. S. Amano and Y. H. Yen</i>
3:30 – 4:00 PM	Tea Break
Session-II: Fuels, Fuel Cell & Modeling (Session Chair: HukamMongia)	
4:00 – 4:30 PM	Catalytic conversion of triglycerides and to green liquid biofuels <i>Y. H. Taufiq-Yap</i>
4:30 – 5:00 PM	Thermochemical Conversion of Wastes to Fuels <i>Ashwani K. Gupta</i>
5:00 – 5:30 PM	A General Purpose Aerosol Transport Model including Nucleation, Growth, Coagulation and Deposition <i>P. S. Rajagopal, AkshaiK.Runchal, JankiShinde, Madhukar M. Rao</i>
5:30 – 6:00 PM	Fuel Cell Systems in India: Opportunities and Challenges <i>AtulBhargav</i>
6:00 – 6:30 PM	Poster Presentation

March 10, 2017

Time	Event
Session-III: Emission, Modeling and Alternate Energy (Session Chair: Darrell Pepper)	
9:00 – 9:30 AM	Effect of Fuel Unsaturation on Emissions in Diesel Engine Combustion <i>Suresh Aggarwal</i>
9:30 – 10:00 AM	Numerical Study of the effect of the fine polydisperse water spray on Laminar flame speed of Hydrogen/Air premixed flames Stabilized in the stagnation flow field <i>Swarnendu Sen</i>
10:00 – 10:30 AM	Alternate Energy and Fuel Development for South India Gabriel D. Roy
10:30 – 11:00 AM	Role of Analysis led design approach in diesel engine based after treatment system <i>Ambarish D Khot</i>
11:00 – 11:15 AM	Tea Break
Session-IV: Combustion Modeling and High Speed Propulsion (Session Chair: Gabriel D. Roy)	
11:15 – 11:45 AM	Synchronization transition in a thermoacoustic system: Temporal and spatiotemporal analysis <i>R. I. Sujith</i>
11:45 – 12:15 PM	Design modifications & experimental validation of a liquid fueled single tube PDE for prolonged operation <i>Aashish Goel</i>
12:15 – 12:45 PM	A cloud-based, real-time emergency response system <i>Darrell W. Pepper</i>
12:45 – 1:30 PM	Lunch Break
Session-V: Fuels and Combustion Dynamics (Session Chair: S. Aggarwal)	
1:30 – 2:00 PM	Boron Nanoparticles for Energy and Propulsion Applications <i>Srinibas Karmarkar</i>
2:00 – 2:30 PM	Sustainable Biofuels for Transportation <i>Ram B. Gupta</i>
2:30 – 3:00 PM	Dynamics of Ducted Inverse Diffusion Flames: A Dynamical Systems Approach <i>Achintya Mukhopadhyay</i>
3:00 – 3:30 PM	Innovative Bio-Char Briquetting from Corn Residue by Torrefaction Process <i>Somrat Kerdsuwan</i>
3:30 – 4:00 PM	Tea Break
Session-VI: Diagnostics, Modeling, and Renewable Energy (Session Chair: Ashwani Gupta)	
4:00 – 4:30 PM	Quantitative Laser-based diagnostics and Modelling of Syngas-Air Counterflow Diffusion Flames <i>R. V. Ravikrishna</i>
4:30 – 5:00 PM	Turbulent Combustion Modeling Using Flamelet Generated Manifolds

	<i>SudiptoMukhopadhyay</i>
5:00 – 5:30 PM	How a spray interacts with swirling flow <i>SaptarshiBasu</i>
5:30 – 6:00 PM	Design and Investigation on Modified Mechanism on StirlingEngine Powered by Renewable Energy <i>SutapatKwankaomeng</i>
6:00 – 6:30 PM	Poster Presentation

March 11, 2017

Time	Event
Session-VII:Advances in Combustion(Session Chair: R. S. Amano)	
9:00 – 9:30 AM	Low Damköhler number combustion in bespoke fractal gridturbulence <i>Peter Lindstedt</i>
9:30 – 10:00 AM	High pressure combustion research at KAUST <i>William Roberts</i>
10:00 – 10:15 AM	Tea Break
10:15 – 11:30 AM	Panel Discussion: Energy & Fuels for India – A path forward
11:30 – 1:00 PM	Lunch Break

Faculty Feedback

Workshop

Questions	Excellent	Good	Ordinary
Clarity of communication about workshop	8	2	00
Organization of the sessions	4	6	00
Quality of lectures	5	5	00
Quality of posters	2	7	00
Effectiveness of discussions	3	7	00
Effectiveness of learning experience	3	7	00
	Appropriate	Short	long
Duration of workshop	7	2	00
	Definitely	Maybe	No
Would you like to have more such	5	4	1
Would you like e-lectures by experts on special	10	00	00
Suggest specific topic that you would like additional expert lectures on	<ul style="list-style-type: none"> • Supersonic flows combustion • Use & scope & future of renewable energy • Waste management • High temperature fuel cells. • Topic related with propulsion. • Pulse detonation engine. • Super critical diesel combustion system. CRDI systems, various diesel combination systems etc. • More fundamental topics like droplet combustion, implementation in spray analysis etc. • Engine emission reduction technologies. • High speed flow/supersonic combustion. 		

Additional Suggestions	<ul style="list-style-type: none"> • Hard copy of slides or lectures should be provided, so that extra information could be written. • Organize conference on propulsion. • Some handsome sessions on commercial combustion software. • Renewable energy based lectures like solar, wind etc. • Introduction & use of commercial software like ansys, open foam
------------------------	--

Teaching

Which subjects do you teach?	<ul style="list-style-type: none"> • Applied thermodynamics: power plant engineering • Heat and mass transfer. • Ref & air cond, energy storage systems. • Basic thermal science, IC engines. • Thermodynamics, IC engines, heat transfer, propulsion(electives) 		
What is average student to teacher ratio in your institute?	<ul style="list-style-type: none"> • 25:01 • 15:01 • 13:01 • 25:01 		
Questions	YES	NO	
Do you have additional support for teaching (tutors, graders, teaching Assistants, etc)?	3	2	
Do you give class projects for UG classes?	3	2	
Do you give class projects for PG classes?	3	2	
Do you have sufficient resources for laboratory courses?	3	2	
	Sufficient	Inadequate	
Is the library/journal/e-connection support adequate?	4	1	
	Definitely	May be	No
Would you like to have common (TEQIP) repository of course material?	5	0	0

Would you like to visit IITK to participate in and develop course material (existing or new)	3	2	0
Would you like to participate in creation of the repository material (course files/lab. Manuals/question bank/etc)	3	2	0
	e-courses	Workshops	Content
How can IITK effectively help you prepare for teaching?	3	4	1
How can TEQIP help improve your teaching?	<ul style="list-style-type: none"> • Organizing workshop and conference • Find more workshop and conferences in TEQIP-II and TEQIP-III 		

Research

Questions	Definitely	Maybe	No
Would you like to visit an IIT for a visiting-faculty/post-doctoral fellow ,if offered(viaTEQIP)?	4	1	0
Would you like to share/use research infra-structure at IITK, if made available?	5	0	0
Would you like to conduct collaborativeresearch with IITK?	5	0	0
Would you like lectures by experts (Indianand international) on niche researchareas/topics?	4	1	0
Do you want special-topic conferences?	4	0	0
How can TEQIP help improve your research?	<ul style="list-style-type: none"> • Development set up in laboratory. • By organizing & participating in workshops and conferences. • By enhancing equipment grant. • Workshops on propulsion; supersonic combustion; new advancements. 		

Student Feedback

Workshop

Questions	Excellent	Good	Ordinary
Clarity of communication about workshop	4	1	1
Organization of the sessions	3	1	0
Quality of lectures	3	1	0
Quality of posters	2	2	0
Effectiveness of discussions	3	0	0
Effectiveness of learning experience	4	0	0
	Appropriate	Short	long
Duration of workshop	2	2	0
	Definitely	Maybe	No
Would you like to have more such sessions?	4	0	0
Would you like e-lectures by experts on special topics?	3	1	0
Suggest specific topic that you would like additional expert lectures on	<ul style="list-style-type: none"> • Laser diagnostics • Atomization • spray modelling 		
Additional Suggestions	<ul style="list-style-type: none"> • CFD • Few invited expert speakers with sufficient time to discussion and interaction. 		

Learning

Questions	Yes	No	
Do you get enough class projects?	1	0	
Is the learning adequate?	1	0	
Do you have sufficient resources for laboratory courses?	1	0	
What is your area of specialization	<ul style="list-style-type: none"> Combustion algorithm 		
	Sufficient	inadequate	
Is the library/journal support/e-connection adequate?	1	0	
	Definitely	Maybe	No
Would you like to have common (TEQIP) repository of course material?	1	0	0
Would you like to visit IITK to attend specialized courses?	1	0	0
Would you like MOOCS/e-resources based courses?	0	0	0
How can TEQIP help improve your learning?	<ul style="list-style-type: none"> By giving us presentations of speakers 		

Research

Questions	Definitely	Maybe	No
Would you like to visit an IIT for a short visit/internship/post-doctoral stint, if offered (via TEQIP)?	1	0	0
Would you like to share/use research infrastructure at IITK, if made available?	1	0	0
Would you like to conduct collaborative research with IITK faculty?	1	0	0
Would you like lectures by experts (Indian and international) on niche research areas/topics?	0	1	0
Do you want special-topic conferences?	0	1	0
How can TEQIP help improve your research?	<ul style="list-style-type: none"> By knowing state of art 		

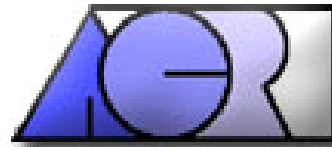
Outcome

- This workshop brought together renowned experts from across the country and USA to share the latest fundamental and applied research innovations on clean energy utilization.
- Poster Presentation held during the workshop was very helpful to participants to gain confidence and obtain a better understanding of the topics.
- Participants gained knowledge about fundamental aspects of clean energy and combustion.
- Diagnostics techniques in combustion were discussed in detail and participants got a chance to closely grasp these techniques so that they can use them for their research.
- This workshop gave fundamental knowledge of energy, power, mobility and propulsion.

Organizer's Report



International Workshop on Energy, Propulsion and Environment



SPONSORED BY:



Report on “International Workshop on Energy, Propulsion and Environment” held between 08th to 11th March 2017 at Outreach Auditorium, IITKanpur

Organizing Committee

Patron

Prof. Indranil Manna (Director, IIT Kanpur)

Chairman

Prof. S. Ganesh (Dean R & D, IIT Kanpur)

Coordinators

Dr. Ashwani K. Gupta (University of Maryland, USA)

Dr. Suresh K Aggarwal (University of Illinois at Chicago, USA)

Dr. Akshai Runchal (Director, CFDVRI, USA)

Dr. Abhijit Kushari (IIT Kanpur)

Dr. Ashoke De (IIT Kanpur)

Dr. Vaibhav Arghode (IIT Kanpur)

Local Organizing Committee

Dr. Abhijit Kushari (Department of Aerospace Engineering, IIT Kanpur)

Dr. Ashoke De (Department of Aerospace Engineering, IIT Kanpur)

Dr. Vaibhav Arghode (Department of Aerospace Engineering, IIT Kanpur)

Overview

The **International Workshop on Energy, Propulsion and Environment** is a jointly organised workshop by University of Maryland, College Park, University of Illinois at Chicago, ACRI CFD and Indian Institute of Technology Kanpur, and conducted at **Indian Institute of Technology Kanpur** from **March 8 to 11, 2017**.

It is the 7th workshop in a Series on Status of Combustion in India.

The event is supported by:

1. TEQIP
2. NSF
3. ONR Global

Highlights

- 1) Invited lectures by renowned experts in the field of energy and combustion from across the globe.
- 2) Pre-workshop tutorials on experimental combustion diagnostics.
- 3) Poster presentation competition for students.

Objectives

This workshop will enable engineers and researchers with knowledge of fluid mechanics and thermodynamics to move to an integrated understanding of fundamental aspects of energy, combustion, and environment especially in the field of multi-scale multi-physics problems.

More Information

Availability of clean and sustainable energy is of fundamental importance in all applications of energy, power, mobility and propulsion. This workshop has brought together renowned experts from around the globe to share the latest fundamental and applied research innovations on clean energy utilization for a wide range of devices extending from micro scale energy conversion to hypersonic propulsion using fossil and biofuels. The specific applications included the research areas of: hypersonic propulsion, combustion of fossil and biofuels, clean energy and power for various stationary applications, gas turbines, biofuels and value added products, thermal management, emission control and environmental issues from energy conversion. A round-table discussion was also held to identify key areas of common interest and to develop a strategy to promote collaborative research on those focussed areas. The international collaborations

helped to identify key novel technologies that show promise for viable options for improved, efficient and sustainable energy conversion for power and propulsion applications.

Through international partnership the workshop has also brought together experts in selected fields spanning from fuels, biofuels, and their cleaner utilization in current and future platforms of power, mobility and propulsion. It will bring the awareness to young scientists so that they know the topics of significant importance to work on in their professional careers. The workshop has also created the networking opportunities in common areas of interest.

The planned workshop had several tailored technical tracks with presentations from world renowned technical experts in the field on current and future activities. Since hydrocarbons fuel use is expected to be the major source of energy in all sectors of power, transportation and propulsion for the foreseeable future, focussed research and development efforts are needed to develop and deploy energy conversion technologies. The energy and environment sustainability would require a multi-pronged approach involving development and utilization of new and renewable fuels, design of fuel-flexible combustion systems that can be easily operated with the new fuels, and develop novel and environmentally friendly technologies for improved utilization of fuels.

It is expected that this workshop would result in several international collaborations in the near term as the topic of energy and environment is of pinnacle importance to all invited at the workshop as well as the international community. In addition, it would provide educational benefits to students and faculty in India on the recent advances in specific topical areas as well as the style and teaching methods.

Contribution

This primary theme of the workshop was on clean and sustainable energy, which is of fundamental importance in all applications of energy, power, mobility and propulsion. With this in mind, we invited experts available within IITK, India and the U.S.A to deliver talks which would enable participants to learn from the best domain experts in their fields. We had a total of 25 talks along with the talks and laboratory scale demonstration on experimental methods and diagnostics. Moreover, a panel discussion along with student poster sessions was also arranged.

LIST OF INTERNATIONAL SPEAKERS

Speakers	Title
Hukam Mongia CSTI Associates, USA	On Lean Direct Injection Research
R. S. Amano University of Wisconsin-Milwaukee, USA	Study of Moten Flow Breakup Behavior in Solid Rocket Motor
Sutapat Kwankaomeng King Mongkut's Institute of Technology, Thailand	Design and Investigation on Modified Mechanism on Stirling Engine Powered by Renewable Energy
Ram B. Gupta Virginia Commonwealth University, USA	Sustainable Biofuels for Transportation
Y. H. Taufiq-Yap Universiti Putra Malaysia	Catalytic conversion of triglycerides and to green liquid biofuels
Darrell W. Pepper University of Nevada, USA	A cloud-based, real-time emergency response system
Somrat Kerdsuwan King Mongkut's University of Technology, Thailand	Innovative Bio-Char Briquetting from Corn Residue by Torrefaction Process
Suresh Aggarwal University of Illinois at Chicago, USA	Effect of Fuel Unsaturation on Emissions in Diesel Engine Combustion
Peter Lindstedt Imperial College London, UK	Low Damköhler number combustion in bespoke fractal grid turbulence
Gabriel D. Roy CPnE Consultants, USA	Alternate Energy and Fuel Development for South India
Ashwani K. Gupta University of Maryland, USA	Thermochemical Conversion of Wastes to Fuels
Akshai Runchal Director, CFDVRI, USA	A General Purpose Aerosol Transport Model including Nucleation, Growth, Coagulation and Deposition
William Roberts CCRC, KAUST, Thuwal, KSA	High pressure combustion research at KAUST

LIST OF INDIAN SPEAKERS

Speakers	Title
Achintya Mukhopadhyay Jadavpur University	Dynamics of Ducted Inverse Diffusion Flames: A Dynamical Systems Approach
Saptarshi Basu Indian Institute of Science	How a spray interacts with swirling flow
Arvind Rao GE Aviation, Bangalore	GE Aviation Low Emissions Combustion Technologies
Atul Bhargav Indian Institute of Technology Gandhinagar	Fuel Cell Systems in India: Opportunities and Challenges
Srinibas Karmakar Indian Institute of Technology Kharagpur	Boron Nanoparticles for Energy and Propulsion Applications
Swarnendu Sen Jadavpur University	Numerical Study of the effect of the fine polydisperse water spray on Laminar flame speed of Hydrogen/Air premixed flames Stabilized in the stagnation flow field
Ambarish D Khot Cummins Technologies India LTD, Pune	Role of Analysis led design approach in diesel engine based after treatment system
Ashish Goel Terminal Ballistics Research Laboratory, Chandigarh	Design modifications & experimental validation of a liquid fueled single tube PDE for prolonged operation
R. V. Ravikrishna Indian Institute of Science	Quantitative Laser-based diagnostics and Modelling of Syngas-Air Counterflow Diffusion Flames
Sudipto Mukhopadhyay Indian Institute of Technology Jodhpur	Turbulent Combustion Modeling Using Flamelet Generated Manifolds
R. I. Sujith Indian Institute of Technology Madras	Synchronization transition in a thermoacoustic system: Temporal and spatiotemporal analysis

Feedback from the participants

Out of the 38 participants who registered, 37 of them were present for the workshop. We had a mix of faculty from private and government aided colleges, faculty from other sister IITs, students (Ph.D/M.Tech) from all over the country, and some participants from the Govt. Research Organizations and Private Industry.

The workshop was very well received and all sessions were very interactive. The participants were highly appreciative of how the workshop was structured from start to finish and of how the learnings in classroom teachings translated to hands-on experimental sessions. Many of the participants had never before done any such experiments as they did during the workshop.

Overall, we believe that this was a very successful workshop. It was the first course of its kind in India (fundamentals in nature), and we hope that this motivated interest in the field of combustion which can translate to renewed interest and focus on fundamental research and activity to strengthen the manufacturing enterprise in the country.

Key take-away from the workshop for the participants

Participating in the course, we hope has enabled participants to:

- Gain knowledge about fundamental aspects of clean energy and combustion
- Understand diagnostics techniques in combustion

Acknowledgements

In the end, we sincerely thank all the funding agencies such as TEQIP (India), NSF (USA) and ONR-Global. Their in-kind support was immensely helpful in order to have smooth organization of the workshop. This workshop would not have been successful without their constant support.