Mechanical Department | M.Tech. | Thermal & Fluids Engineering Information Brochure 2020-2021

INDIAN

INSTITUTE OF

TECHNOLOGY BANARAS HINDU UNIVERSITY

भारतीय

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प्रौद्योगिकी

M.Tech. Programme in Thermal & Fluids Engineering



ABOUT US

We are a group of young, enthusiastic innovators pursuing our Master's in Thermal & Fluids Engineering-Mechanical Engineering. Mechanical Department is one of the oldest departments in the Institute. The objective of the M.Tech. programme is to transform bright students into research-oriented and technically-skilled individuals who work diligently towards development of technologies in various industries. Our exceptional faculty members take keen interest in undertaking collaborative projects on a National as well as International scale.

MEET OUR FACULTY









Associate Professor

Area of Interest: Computational Fluid Dynamics, Design & Innovation, Double Diffusive Convection, Renewable Energy

Dr Jeevan Vachan Tirkey (PhD)

Associate Professor

Area of Interest: Renewable Energy, Internnal Combustion Engine, Experimentation & Simulation, Alternate Fuels, Over Expanded Engine

Dr Rashmi Rekha Sahoo (PhD, IIT BHU)

Associate Professor

Area of Interest: Nanofluids, Internal Combustion Engine, CombustionTechnology, Alternate Fuels, Automotive Cooling Systems

Dr Laltu Chndra (PhD, KIT Germany)

Associate Professor

Area of Interest: Heat Transfer & Fluid Flow, Computation & Experimentation, Turbulent Flow Simulation & Modelling, Solar themal Sub-System Design, Nuclear Reactor Thermal Hydraulics

Dr Amitesh Kumar (PhD, IIT Kharagpur)

Assistant Professor

Area of Interest: Computaional Fluid Dynamics, Turbulence Modelling, High Mach number Flows, Cryosurgery, Heat Transfer & Fluid Flow

Dr Anubhav Sinha (PhD, IISc Bangalore)

Assistant Professor

Area of Interest: Combustion and Spray

Dr Binita Pathak (PhD, IISc Bangalore)

Assistant Professor Area of Interest: Multiphase Flows, Droplet Atomisation, Microfluidics, Biofluids **Dynamics**











MAJOR COURSES

The M.Tech. Program in Thermal & Fluids Engineering not only enhances one's expertise in the field of thermofluids but also develops one's competence in the use of state-of-the-art analytical methods, computational & experimental methods; and other advanced methods which are specifically designed for the analysis of heat transfer and fluid flow in both industrial and research applications.

Major courses that are being offered:

- Advance Fluids Mechanics
- Advance Thermodynamics
- Conduction & Radiation
 - 4 Convection
 - Gas Dynamics
- Numerical Methods In Thermal Engineering
 - 4 Advanced Computation Fluid Dynamics
 - HVAC Systems & Applications
 - Advanced Refrigeration System
 - Combustion Technology
 - 🖊 Advances In Internal Combustion Engine
 - 🖊 Design Of Thermal Systems
 - Alternative Fuels
 - Combustion Generated Pollution
 - Advanced Turbomachines
 - Energy Engineering
- 🜲 Experimental Methods In Thermal Science
 - Micro & Nano Scale Heat Transfer
- Wind Engineering & Industiral Applications

- 🖊 Experimental Methods In Thermal Science
 - Solar Energy Engineering
 - Solar Refirgeration & AC
 - Micro & Nano Scale Heat Transfer
- Wind Engineering & Industiral Applications

COMPUTER TOOLS

- ✓ ANSYS
- ✓ OpenFOAM

✓ COMSOL

✓ CFX

- ✓ MATLAB✓ AspenPlus
- ✓ TechPlot

✓ C, C++

✓ Fortran

✓ EES

- ✓ Python
- ✓ HyperWorks
- ✓ CATIA
- ✓ SolidWorks
- ✓ SolidThinkin

RESEARCH FACILITIES

Fluids Mechanics Lab Facility

Fluids Mechanics lab The is equipped with some of the latest technologies used in the field of fluid mechanics. It includes facilities like 2D Stereo Particle & Image Velocimetry (PIV), Planar laser Fluorescence Induced (PLIF), combined PIV & PLIF, Infrared Thermography, and Subsonic Wind Tunnel, etc. Besides these facilities, the lab also has various flow



measuring devices for research and educational purposes.



IC Engine Lab Facility

The IC Engine laboratory of the department is equipped with various engines, i.e., variable speed four stroke diesel and petrol engines, VCR engines etc., as well as the Lab is equipped with the apparatus Bomb calorimeter (calorific value of fuels), Engine cooling system (radiator) and EGA analyze the exhaust qas to emissions etc., which enables us to understanding better of the practical aspects in this field. facilities, these Besides this laboratory is also equipped with a bio-diesel plant for the production

various alternate fuels, engine waste heat recovery systems i.e., TEG and PCM-TES systems for the advance research in this area.

Heat & Mass Transfer Lab Facility

The HMT Lab of the department is equipped with advanced and latest technologies which supports remarkably in the ongoing research in the Institute such as in the field of Nanotechnology, Natural circulation loop etc. as well as the Lab is equipped with Apparatus like Vapour compression and refrigeration system, Fin tube heat exchanger, Apparatus of pool boiling,



Computational Fluid Dynamics

The CFD Lab is well equiped in terms of softwares, with softwares such as ANSYS, OpenFOAM, COMSOL, CFX, HyperWorks,

MATLAB, etc. The lab has an abundance of high performing systems installed in order to cope up with research and educational

SolidThinking,

SolidWorks,

demands of the institute.

Apparatus for finding Boltzmann constant, Apparatus for determining heat transfer coefficient by natural and forced convection, Heat pipe Apparatus which enables us to have a better understanding of the practical aspects of the Heat and mass transfer mechanism.

Lab Facility

CATIA,



Centre for Energy & Resource Development (CERD)

CERD laboratory consists of different equipment from the multiple research area of renewable energy like solar energy, gasification technology, alternative fuels and wind energy. In the solar energy field, it has experimental setup like parabolic trough concentrator, flat plate collector, Data logger (to collect solar energy data at IIT (BHU), Varanasi), Thermal energy

storage setup to evaluate the performance of different Phase change materials, solar and solar water heating system. Apart from solar energy equipment there is a small wind tunnel to analyse the performance of wind turbine with the variation of wind speed.

Central Insrumentation Lab

Super-Computing Facility (Param Shivay Supercomputer)



Some of the ongoing research areas include but not limited to:

Heat Transfer & Fluid Flow Modelling of Solar Thermal Subsystem

- Heat transfer analysis of Open Volumetric Air Receiver (OVAR), Parabolic Trough Collector (PTC) using nanofluids, and hybrid nanofluids.
- Great potential as a source of process heat for metals processing operations makes Open Volumetric Air Receiver (OVAR) useful for operations such as soaking, heat treatment, high-temperature application, and solar electricity generation, milk chilling plants, etc.
- Turbulent flow modelling and simulation is being done using various software tools including ANSYS & Python.

Radiative & Evaporative Cooling

- Radiative cooling is a passive cooling technique which requires selective thermal emissive surface in the "atmospheric window" and reflective elsewhere. It is renewable & operates without any external operational energy, to produce a net cooling effect.
- Design of the required selective radiative surface based on material-radiation interaction. Emissivity measurement of the designed surface used to perform by the Integrating sphere in the combination of FTIR.
- Thermal performance based on the various governing parameters is evaluated.
- Simulation & Experimental studies on regenerative and dual-mode evaporative cooler and performance improvement.

Experimental as well as Numerical Analysis of Buoyancy Driven Flows (Natural Convection)

- Study of the natural convection phenomenon using Particle Image Velocimetry (PIV) and Planar Laser-Induced Fluorescence (PLIF).
- Experiments to capture velocity and temperature fields simultaneously using Combined PIV & PLIF Technique.
- The effect of various parameters on hydrodynamic & thermal boundary layers is being observed by modelling & simulation of the plumes which are formed by natural convection. Transient analysis of the phenomenon is also being done using computer tools.

Cryospray Ablation

- Cryospray is a process of destructing cancerous lesions occurring on the skin while spraying cryogen on the affected area.
- Ablation is achieved through the rapid freezing of the cell.
- Better aesthetics, low cost, and reduced pain are some of its advantages over other analogous techniques.

Heat Transfer & Flow Characteristics of Hybrid Nanofluids in Mini and Micro-channels

- Hybrid Nanofluids are used to increase the heat transfer coefficient and hence the cooling rate in mini-micro channels.
- Cooling of advanced electronic equipment where space is a major constraint.
- Nevertheless, the heat transfer characteristics were limited by the heat transfer fluids that were used i.e. why there is a need for hybrid nanofluids.

Natural Circulation Loop

- A natural circulation system operates based on natural laws like gravity and buoyancy.
- Its has numerous advantages like elimination of hazards related to pumps, better flow distribution, cost reduction, etc.
- A rectangular single-phase natural circulation loop, which consists of two horizontal copper tubes (heat transfer sections) and two vertical copper tubes (legs) connected using four bends. The lower section consists a heater that heats the fluid while the upper section consists of a cooler which creates density difference and hence buoyancy effect.

Nanofuel & Nanofluid Application To Engines

- Experiments to analyse the energetic, exergetic, and emission parameters with WiDE-based emulsion fuels incorporating and nano additive for DICI engine.
- Effect of various shape-based hybrid nano additives in biodiesel-based emulsion fuel for exergetic, and sustainability analysis of diesel engine. Also, optimal engine performance evaluation with the application of Taguchi, Grey, and ANOVA optimization techniques.
- Impact of novel dissimilar shape nanoparticles-based hybrid nanofluids, ternary hybrid nanofluid on the heat transfer, and second law analysis for an automotive cooling system.

Engine Waste Heat Recovery

- Experiments to evaluate the performance of engine exhaust WHR through TEG by using nano coolants. Also, the performance assessment evaluation for a new twisted tape automotive heat exchanger for WHR.
- Experiments for the optimum thermal performance and thermophysical parameters evaluation of MWCNT-based capric acid PCM by using the T-history method. Effect of nano-enhanced PCM on the energy and exergy performance of a designed cylindrical TES system integrated with engine WHR.
- Cooling system heat recovery by engine air/fuel preheating through hybrid/ternary hybrid nanofluid radiator coolants.



Research Grants/Projects



YEAR	PROJECT TITLE	SPONSORING AGENCY
2020	Behaviour of Partially Miscible Fluid in Microgravity.	China Space Station
2020	Performance analysis of Artiulated Concrete Blocks using CFD.	Floodkon Consultants LLP
2020	Effect of Nanofluids on Double Diffusion Finger Convection.	Seed Grant, IIT BHU
2020	Experimental Study of Turbulent Jet.	Seed Grant, IIT BHU
2019	Characterization & validation of Schlieren Imaging Technique for Capturing Shock Wave.	DRDO
2019	Design & Development of Cooling & Power Generation Systems.	CST, UP
2019	Development of ORC Technology for Waste Heat Utilization for the generation of electricity.	BRNS
2018	Investigation on Solar Power-Driven Electric Boat.	Project Varanasi
2018	Development of Eco-Friendly Heat Pump Dryer for Bio Applications.	DIC, IIT BHU & BHU
2018	Heat Transfer & Flow Characterization of Hybrid Nanofluids in Mini & Micro-Channels.	IIT BHU
2018	Quenching Behavior of Dry Heated Rod in Nanofluids.	BRNS, DAE
2018	Design & Development of WHRS through TEG and PCM	DIC
2017	Design of High Temperature Facility for Graphite dust Formation & Transport.	BRNS
2016	Effective Tumor Necrosis using Cryosurgery.	DST
2 years	Study of Wind Climatology on Slender Structures using Weibull & Generalized Extreme Value Distribution.	BRNS, Department of Atomic Energy
2 years	Harvesting of Renewable Energy through Gasification of Biomass.	CERD, IIT BHU

Message from Professor In-charge:

It gives me immense pleasure to extend you a most cordial invitation to participate in the Campus Recruitment Programme of the Indian Institute of Technology (BHU), Varanasi. With an increasing thrust being placed on Institute-Industry Interaction, it is my sincere belief that your esteemed organization and IIT (BHU) Varanasi will stand to gain immensely from this symbiotic relationship.

Our Institute holds the pride of place being a pioneer in the field of engineering and technical education in this country and has a glorious heritage. We have been continuously ranked amongst the elite by all peers and stakeholders. Our constant pursuit of excellence has made our institute a focal point in technical education for students and faculty members alike. Admissions to the institute take place through the reputed Joint Entrance Examination (JEE) and Graduate Aptitude Test in Engineering (GATE).

At this institute, we take the utmost care to groom our students according to the needs of the industry. We seek to open frontiers of knowledge and reveal new horizons of change to broaden mindset and to create a positive attitude in our students. Our students receive industrial exposure by their frequent industrial visits. Besides, our undergraduate students undergo an eight-week training during summer vacation in reputed industries/institutions/organizations (in India as well as abroad) as part of their academic requirements.

We would be most delighted to host you for campus recruitment and beyond. I am looking forward to a mutually beneficial relationship.



Dr Anil Kumar Agrawal Training & Placement Officer IIT (BHU) Varanasi

































OYO

Placement Team



Dr Anil Kumar Agrawal

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