

Curriculum Vitae

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Fields of interest: Experimental **Nuclear Thermal Hydraulics, Phase Change in Multiphase Flow, Heat Transfer, and Computational Fluid Dynamics**



Academic qualifications

- **Ph. D.** – Mechanical Engineering – **Indian Institute of Technology Kanpur**, Uttar Pradesh, India 2014-2020 (**CGPA: 8.67**)

Thesis: *Containment Thermal Hydraulic Studies towards Understanding Post-Severe Nuclear Accident Scenarios*

- *Brief Summary:*

The containment is a large outer structure designed to isolate radioactivity associated with the nuclear reactor and other sensitive equipment from the surrounding environment. During a severe accident, several complex thermal-hydraulic processes, such as natural circulation, steam condensation on walls and in bulk, and hydrogen stratification, occur inside the containment. These processes are studied in a large-scale test facility called a THYCON facility, which was built as part of a PhD program. Additionally, a numerical modeling approach is used to simulate the thermal-hydraulics of the containment.

- **M. Tech.** – Thermal System Design – **Sardar Vallabhbhai National Institute of Technology, Surat**, India, 2012-2014 (**CGPA: 9.65**)

Thesis: *Analysis of Dispersion of Heated Effluent in Lake Scenario*

- *Brief Summary:*

Water is the most commonly used coolant in power plants and is required in large quantities. The water is taken from a source such as a lake or sea, used for cooling, and then discharged back into it along with excess heat. This can have a negative impact on aquatic life and the surrounding ecosystem. The spread of heated discharge plumes primarily depends on factors such as turbulence-induced heat convection, diffusion heat transfer, and environmental interactions (such as convection and evaporation on the surface). The effects of these factors were studied in a scaled-down

experimental facility. Additionally, analyses were also performed using analytical and numerical methods.

- **B. Tech.** – Mechanical Engineering – **Government College of Engineering Amravati**, Maharashtra, India, 2007-2011 (CGPA: **8.45**)

Project: *Optimization of number of turns of (CLPHP) Closed Loop Pulsating Heat Pipe.*

Academic achievements/fellowships

- Received “**Outstanding Ph. D. Thesis Award - 2020**” of IIT Kanpur on 53rd Convocation.
- “Student Best Poster Award” for 'Effect of surface inclination on film condensation heat transfer in the presence of non-condensable gases' at 27th International Conference on Nuclear Engineering (ICONE27), Ibaraki, Japan, May 19-24, 2019.
- Another paper entitled "Steam Condensation Heat Transfer inside Reactor Containment during the Initial Transient of a Severe Accident" presented at 27th International Conference on Nuclear Engineering (ICONE27), Ibaraki, Japan, May 19-24, 2019 is selected for publication in ASME Journal of Nuclear Engineering and Radiation Sciences.
- International travel grant from IIT Kanpur for attending the 27th International Conference on Nuclear Engineering (ICONE27), May 19-24, 2019 at Tsukuba International Congress Center, Tsukuba, Ibaraki, Japan.
- Received higher education scholarship from MHRD, Government of India to pursue Ph.D. at Indian Institute of Technology Kanpur, Kanpur (U. P.), India (2014-2019) and M.Tech. at Sardar Vallabhbhai National Institute of Technology, Surat (Gujarat), India (2012-2014).
- Awarded "Times of India Merit Scholarship" in M. Tech for academic year of 2012-13.
- Awarded Merit scholarship by Army Welfare Education Society (AWES), New Delhi, India in all four years of B. Tech from 2007-2011.

Research experience

Posdoctoral research

- Project1 : Reduction of Severe Accident Uncertainties (ROSAU) for Reactor Core-Debris Cooling in Shallow Containment Cavity
 - The objective of the work is to study the hydrodynamic and thermal interaction of corium, a highly radioactive material, during its horizontal spreading over a substrate in a shallow water pool in order to understand the phenomenology and develop numerical codes.
 - A new facility known as Co-rium Simulant Melt Underwater Spreading (CoSMUS) is developed with advanced measurement capabilities under the project.
 - Experiments are being conducted according to project objectives.

During Ph.D.

- Project 1: *Studies on heat transfer during condensation of steam-hydrogen mixtures inside closed containment*, funded by Bhabha Atomic Research Center (BARC), Mumbai, India with Prof. Sameer Khandekar (PI) and Prof. K. Muralidhar (Co-PI) for four and half years from October 2015 - March 2020 (Also the main work of PhD thesis).
 - Preparing initial drawings of large facility having 0.96 m diameter and 3.6 m height.
 - Design, fabrication, erection and instrumentation of the single-compartment large scale Thermal-HYdraulic test facility for CONtainment (THYCON).

- Performed calibration and benchmarking of a complex online mass-spectrometry system (Hiden Analytical® make with 20 sampling ports) to estimate the mass fractions of steam-air-helium mixtures, where three gases involved in the mixtures have largely different properties.
- Implementing an inverse technique based high heat flux measurement system for adverse situations.
- Preparing project progress report/final report and mentoring undergraduate/graduate students.
- Published three articles (in section "List of Publications" #1, #4 and #5).
- Project 1: *Local heat transfer coefficient during film condensation of steam hydrogen mixtures*, funded by Board of Research in Nuclear Sciences (BRNS), Mumbai, India with Prof. Sameer Khandekar (PI) and Prof. K. Muralidhar (Co-PI) for three years from April 2015 - March 2018. The work carried out during this project includes:
 - Assistance in design, fabrication and instrumentations of the experimental set-up for generic condensation studies, including the severe accident scenario.
 - Experiments conducted on steam condensation heat transfer in the presence of only air and air-helium gases at all stages of a severe nuclear accident progression.
 - Published two articles (in section "List of Publications" #2 and #3).

List of publications

1. Punetha M., Yadav M. K., Jain S., Khandekar S., and Sharma P. K., Thermal-Hydraulic Test Facility for Nuclear Reactor Containment: Engineering Design Methodology and Benchmarking, Progress in Nuclear Energy, Vol. 138, pp. 1-20, August 2021. DOI: [10.1016/j.pnucene.2021.103837](https://doi.org/10.1016/j.pnucene.2021.103837) (**Web of Science: Q1**)
2. Yadav M. K., Punetha M., Bhanawat A., Khandekar S., and Sharma P. K., Steam Condensation Heat Transfer during Initial Blow-down Period of a Severe Nuclear Accident, ASME Journal of Nuclear Engineering and Radiation Science, Vol. 6 (4), pp. 1-9, October 2020. DOI: [10.1115/1.4046910](https://doi.org/10.1115/1.4046910) (**Web of Science: Q3**)
3. Bhanawat A., Yadav M. K., Punetha M., Khandekar S., and Sharma P. K., Effect of Surface Inclination on Filmwise Condensation Heat Transfer During Flow of Steam–Air Mixtures, ASME Journal of Thermal Science and Engineering Applications, Vol. 12 (4), pp. 1-12, August 2020. DOI: [10.1115/1.4046867](https://doi.org/10.1115/1.4046867) (**Web of Science: Q1**)
4. Punetha M., Yadav M. K., Khandekar S., Sharma P. K., and Ganju S., Intrinsic Transport and Combustion Issues of Steam-Air-Hydrogen Mixtures in Nuclear Containments, International Journal of Hydrogen Energy, Vol. 45 (4), pp. 3340-3371, 2020. DOI: [10.1016/j.ijhydene.2019.11.179](https://doi.org/10.1016/j.ijhydene.2019.11.179) (**Web of Science: Q1**)
5. Punetha M., Choudhary A., and Khandekar S., Stratification and Mixing Dynamics of Helium in an Air-Filled Confined Enclosure, International Journal of Hydrogen Energy, Vol. 43 (42), pp. 19792-19809, 2018. DOI: [10.1016/j.ijhydene.2018.08.168](https://doi.org/10.1016/j.ijhydene.2018.08.168) (**Web of Science: Q1**)
6. Punetha M., and Khandekar S., A CFD based Modeling Approach for Predicting Steam Condensation in the Presence of Non-condensable Gases, Nuclear Engineering and Design, Vol. 324, pp. 280-296, 2017. DOI: [10.1016/j.nucengdes.2017.09.007](https://doi.org/10.1016/j.nucengdes.2017.09.007). (**Web of Science: Q1**)

Book chapter

1. Yadav M.K., Punetha M., Bhanawat A., Khandekar S., and Muralidhar K., Measurement of Condensation Heat Transfer, in 'Drop Dynamics and Dropwise Condensation on

- Textured Surfaces', Mechanical Engineering Series, Springer, 2020. DOI: [10.1007/978-3-030-48461-3_13](https://doi.org/10.1007/978-3-030-48461-3_13)
2. Punetha M., Thermal Pollution: Mathematical Modelling and Analysis, in 'Environmental Contaminants', Energy, Environment and Sustainability, Springer, Singapore, 2018. DOI: [10.1007/978-981-10-7332-8_18](https://doi.org/10.1007/978-981-10-7332-8_18)

Peer reviewed conference proceedings (published/presented)

1. Punetha, M., Komlev, A., Konlvalenko, A., and Bechta, S., Thermo-hydrodynamic of Corium Simulant Melt Spreading: A small scale model study. Accepted in '11th International Conference on Multiphase Flow (ICMF-2023)', Kobe, Japan. 2-7, April 2023
2. Punetha M., Kulkarni S., Yadav M.K., and Khandekar S., A CFD Study on Coupled Issues of Hydrogen Distribution and Steam Condensation Inside Thermal Hydraulic Test facility for Containment (THYCON), 25th National and 3rd International ISHMT-ASTFE Heat and Mass Transfer Conference, IIT Roorkee, Uttarakhand, India, December 28-31st, 2019.
3. Punetha M., Yadav M.K., Bhanawat A., and Khandekar, S., Steam Condensation Heat Transfer inside Reactor Containment during the Initial Transient of a Severe Accident, Proceedings of 27th International Conference on Nuclear Engineering (ICONE27), Tsukuba, Ibaraki, Japan, May 18-24, 2019. DOI: [10.1299/jsmeicone.2019.27.2166](https://doi.org/10.1299/jsmeicone.2019.27.2166)
4. Bhanawat A., Punetha M., Yadav M.K., and Khandekar, S., Effect of Surface Inclination on Film Condensation Heat Transfer in the Presence of Air, Proceedings of 27th International Conference on Nuclear Engineering, (ICONE27), Tsukuba, Ibaraki, Japan, May 18-24, 2019. DOI: [10.1299/jsmeicone.2019.27.2133](https://doi.org/10.1299/jsmeicone.2019.27.2133)
5. Kulkarni S., Punetha M., Choudhary A., and Khandekar S., Effect of Stratification and Natural Circulation on Steam Condensation in Presence of Non-Condensable Gases, Proceedings of 5th International Conference on Computational Methods for Thermal Problems (ThermaComp - 2018), IISc Bangalore, Karnataka, India, pp. 480-483, July 9-11, 2018. ISSN: [23055995](https://doi.org/10.1007/978-981-10-7332-8_18)
6. Punetha M., Choudhary A., Khandekar S. and Sharma P., Helium Stratification and Mixing Studies in a Fully Enclosed Chamber, 24th National Heat and Mass Transfer Conference and 2nd International ISHMT-ASTFE Heat and Mass Transfer Conference, BITS Hyderabad, Telangana, India, December 27-30, 2017.
7. Punetha M., and Khandekar S., Study of Film-wise Condensation inside Closed Containment using Wall Condensation Model (WCM), 6th International and 43th National Conference on Fluid Mechanics and Fluid Power (FMFP2016), Motilal Nehru National Institute of Technology, Allahabad, Uttar Pradesh, India, December 15-17, 2016.
8. Punetha M., Thaker, J. P., and Banerjee J., Experimental and Numerical Analysis of Dispersion of Heated Effluent from Power Plants, 5th International and 41th National Conference on Fluid Mechanics and Fluid Power (FMFP2014), Indian Institute of Technology Kanpur, Uttar Pradesh, India, December 12-17, 2014.
9. Punetha M., Roopchandani C., and Banerjee J., Analysis for dispersion of thermal effluent from Thermonuclear Power Plant, 40th National Conference on Fluid Mechanics and Fluid Power (FMFP2013), National Institute of Technology Hamirpur, Himachal Pradesh, India, December 12-14, 2013.

PhD Thesis Supervising

- Lu Zhao, Topic: Melt spreading under the water during ex-vessel phase of reactor severe accident (Role: Co-supervisor)

- Mohammad Monzur Hossain Khan, Topic: Analysing thermal-hydraulic response of Light Water Reactor Lower Head for In-Vessel Melt Retention during a core meltdown (Role: Co-supervisor)

Research experience

- June 2021-till now, as Postdoctoral Fellow, Division of Nuclear Power Safety, School of Engineering Sciences, KTH, Stockholm, Sweden (Supervisor: Prof. Sevostian Bechta)
- August 2020-June 2021 (10.5 months), as Senior Research Fellow, Department of Mechanical Engineering, IIT Kanpur, Kanpur India (Supervisor: Prof. Sameer Khandekar)

Teaching experience

- Nuclear Power Safety Engineering Project: Post graduate level course (9 credits) taken for 1 semester: Spring 2022.
- Applied Modern Physics Project: Undergraduate level course (3 credits) taken for 1 semester: Autumn 2021.
- Teaching Assistant (Undergraduate course: **Refrigeration and Air Conditioning** and Postgraduate course: **Liquid-Vapour Phase-Change Phenomena**) during the Ph.D. program at IIT Kanpur, India.

Industry experience

- 1 Year (July 2011-August 2012) as Assistant Manager (Health, Safety and Environment) in **Essar Steel India Limited, Hazira**, Gujarat; attained six sigma yellow belt certification.

Other experience

- Maintained website of Mechanical Engineering Department, IIT Kanpur from July 2015-December 2019.
- Volunteer in Indo-French Workshop on Phase Change Thermal Systems at Khajuraho, India, 29 November 2016 - 01 December 2016.
- Volunteer in TEQIP sponsored short term training program on "Conduction and Radiation" at Sardar Vallabhbhai National Institute of Technology Surat, Gujarat, India, 1-3 July 2013.
- Volunteer in 39th National Conference on Fluid Mechanics and Fluid Power (FMFP2013), Sardar Vallabhbhai National Institute of Technology, Surat, Gujarat, India, 13-15 December 2012.
- National Cadet Corps (NCC) 'C' certificate holder for serving 3 years in "3 Maharashtra Signals Company" Army Wing.
- Organized various technical functions (Convener for CAD competition) and sports events (Sports secretary for swimming) during the undergraduate program.

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