Umesh Madanan

Assistant Professor, Department of Mechanical Engineering
Indian Institute of Technology Kanpur, Uttar Pradesh-208016, India
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Research Interests

Buoyancy-driven convection at high Rayleigh numbers with and without porous media; heat and mass transfer analogies; pool boiling heat transfer enhancement; supercritical fluid thermofluidics

Education

2019 | **Ph.D. | Mechanical Engineering**
University of Minnesota Twin Cities, USA
- Areas of specialization: Heat Transfer, Fluid Mechanics
- Dissertation: High-Rayleigh-Number Thermal Convection of Compressed Gases in Inclined Rectangular Enclosures of Varied Aspect Ratios
- Advisor: Richard J. Goldstein

2012 | **M.Tech. | Mechanical Engineering**
Indian Institute of Technology Madras, India
- Area of specialization: Thermal Engineering
- Project: Experimental Investigation on Two-Phase Flow in a Set of Parallel Minichannels

2007 | **B.Tech. (Hons.) | Mechanical Engineering**
University of Calicut, India

Professional Experience

2020 - Present | **Assistant Professor | Department of Mechanical Engineering**
Indian Institute of Technology Kanpur, India
Kanpur, India

May - July 2024, May - July 2025, May 2026 - Present | **Guest Scientist | Fluid Physics, Pattern Formation and Biocomplexity**
Max Planck Institute for Dynamics and Self-Organization
Göttingen, Germany

2019 | **Post-doctoral Researcher | Heat Transfer Laboratory**
Department of Mechanical Engineering
University of Minnesota Twin Cities, USA

2012 - 2014 | **Edison Engineer | Advanced Technology Operations**
GE Power & Water, John F. Welch Technology Centre
Bengaluru, India

2007 - 2009 | **Assistant Manager | Product Development**
Mahindra & Mahindra Automotive Ltd
Nashik, India

Sponsored & Consultancy Projects

2026 - 27	Design and Development of an Advanced Furnace for Improved Black Salt Production (PI | Shubham Enterprises (Babanamak))
2025 - 26	Strategic Advisor (PI | Helium Smart Air Pvt Ltd.)
2024 - 27	Zeroe Aircraft Heat Transfer Loop Using Supercritical Fluid For Hydrogen Conditioning (PI | Airbus Ltd.)
2024 - 26	Thermal Management of Storage System With and Without Fans (PI | Seagate Technology, USA)
2024 - 25	Addressing The Suboptimal Energy Utilization Of The Stretching And Annealing Unit (PI | Lohia Corp. Ltd.)
2021 - 25	Thermosyphon Based Passive Interfacial Solar Steam Generation For High-Productivity Desalination (PI | DST-SERB CRG (post Prof. Sameer Khandekar's demise))
2024	Examining A Pre-Feasibility Study Conducted By M/S KPMG For Setting Up Of A Common Boiler Facility In Sector 25 And Sector 29 Of Panipat (PI | Haryana State Industrial & Infrastructure Development Corporation)
2021 - 23	Fine-grained Porous Media Convection at High Rayleigh Numbers (PI | DST-SERB SRG)
2021 - 23	Eco-friendly Techniques for Pool Boiling Enhancement in Water on Textured Surfaces (PI | Initiation Grant, IIT Kanpur)

Publications & Presentations

Guest Editorials

[2] Shadid, J. and **Madanan, U.**, 2024. Tracing the Academic Lineage of Richard J. Goldstein, *ASME Journal of Heat and Mass Transfer*, Vol. 146(5): 050302

[1] Manglik, R. M., Boetcher, S. K. S., Simon, T. W., and **Madanan, U.**, 2024. Special Issue: Richard J. Goldstein Memorial Issue—Transformative and Innovative Advancements in Heat and Mass Transfer: A Lifetime of Path-Breaking Scholarship That Spans Gas-Turbine Cooling to Transport Processes and Critical Diagnostic Tools for Convective Heat Transfer and More, *ASME Journal of Heat Mass Transfer*, Vol. 146(5): 050301

Invited Book Chapters

[3] Kattakkadan, S., Mandlik, N., Pol, N., and **Madanan, U.**, 2026. Passive thermal management of a hard-disk-drive-based storage system for edge appliances, *Advances in Heat Transfer – Volume 62* [in press]

[2] Kumar, G. and **Madanan, U.**, 2023. Factors influencing heat transfer mechanism in nucleate pool boiling: a comprehensive review with state of the art and future prospects. *Advances in Heat Transfer - Volume 56* (pp.435-582)

[1] Goldstein, R. J. and **Madanan, U.**, 2022. Thermal convection studies at the University of Minnesota. *Advances in Heat Transfer - Volume 54* (pp.89-133)

International Journal Articles

[26] Kumar, G. and **Madanan, U.**, 2027. Non-nonotonic critical heat flux and orientation-dependent roughness effects in pool boiling, *International Journal of Thermal Sciences*, Vol. 233(1) (111434)

[25] Yik, H., Schettler, C., Bodenschatz, E., **Madanan, U.**, Weiss, S., 2026. A multipurpose thermal convection setup to study turbulent super structures, *Review of Scientific Instruments* [in press]

[24] Alam, P. and **Madanan, U.**, 2026. Effect of aspect ratio and grain size in classical Darcy–Bénard systems: onset of convection and beyond, *International Journal of Heat and Mass Transfer*, Vol. 271(2) (129394)

[23] Alam, P. and **Madanan, U.**, 2026. Boundaries matter: Impact of sidewall conductance on porous-media thermal convection, *International Communications in Heat and Mass Transfer*, Vol. 173 (p.110773)

[22] Chatterjee, D., Kumar, P., Goel, S., Muralidhar, K. and **Madanan, U.**, 2025. *Enhanced vapor generation and salt mitigation in a solar evaporator using a Janus-type hybrid wick*. Applied Thermal Engineering, Vol. 284 (p.129175)

[21] Alam, P. and **Madanan, U.**, 2026. Thermal Transport in Porous Media: Effect of Grain Size in Darcy-Bénard Convection at High Rayleigh Numbers, International Journal of Thermal Sciences, Vol. 220 (p.110409)

[20] Bhadwal, A., Alam, P., Kumar, G., and **Madanan, U.**, 2025. A semi-analytical approach to estimate sidewall thermal conductance for turbulent Rayleigh-Bénard convection with uninsulated sidewalls, *International Communications in Heat and Mass Transfer*, Vol. 165 (p.108993)

[19] Alam, P. and **Madanan, U.**, 2025. Addressing the Nusselt number divergence across varied fluid–solid combinations in Darcy–Bénard convection, *International Communications in Heat and Mass Transfer*, Vol. 161 (p.108403)

[18] Alam, P. and **Madanan, U.**, 2024. Effect of Finite Thermal Conductivity Bounding Walls on Darcy-Bénard Convection, *ASME Journal of Heat and Mass Transfer*, Vol. 146(5) (p.052701)

[17] Sen, N. and **Madanan, U.**, 2023. A set of generic correlations for high-Rayleigh-number thermal convection in inclined rectangular enclosures, *Progress in Nuclear Energy*, Vol. 166 (p.104975)

[16] Pandey, R. and **Madanan, U.**, 2023. Heat Transfer Enhancement through Pitch Ratio Optimization of Butterfly Inserts in Minichannel Heat Sinks, *Thermal Science and Engineering Progress*, Vol. 46 (p.102262)

[15] Sudheer A. P. and **Madanan, U.**, 2022. Numerical investigation into heat transfer augmentation in a square minichannel heat sink using butterfly inserts. *Thermal Science and Engineering Progress*, Vol. 36 (p.101522)

[14] Srinivasan, V., **Madanan, U.** and Goldstein, R. J., 2022. Turbulent Rayleigh-Bénard convection of compressed gas: effect of sidewall conductance. *International Journal of Heat and Mass Transfer*, Vol. 182 (p.121965)

[13] Kulkarni, K. S., **Madanan, U.** and Goldstein, R. J., 2020. Effect of freestream turbulence on recovery factor of a thermocouple probe and its consequences. *International Journal of Heat and Mass Transfer*, Vol. 152 (p.119498)

[12] **Madanan, U.** and Goldstein and R. J., 2020. High-Rayleigh-number thermal convection of compressed gases in inclined rectangular enclosures. *Physics of Fluids*, Vol. 32(1) (p.017103)

[11] **Madanan, U.** and Goldstein, R. J., 2019. Effect of sidewall conductance on Nusselt number for Rayleigh-Bénard convection: a semi-analytical and experimental correction. *ASME Journal of Heat Transfer*, Vol. 141(12) (p.122504)

[10] Goldstein, R. J., **Madanan, U.** and Kuehn, T. H., 2019. Simplified correlations for free convection from a horizontal isothermal cylinder. *Applied Thermal Engineering*, Vol. 161 (p.113832)

[9] **Madanan, U.** and Goldstein, R. J., 2019. Experimental investigation on very-high-Rayleigh-number thermal convection in tilted rectangular enclosures. *International Journal of Heat and Mass Transfer*, Vol. 139 (pp.121-129)

[8] **Madanan, U.** and Goldstein, R. J., 2019. Thermal convection in horizontal rectangular enclosures at moderate Rayleigh numbers: effect of sidewall conductance and aspect ratio. *International Journal of Heat and Mass Transfer*, Vol. 136 (pp.178-185)

[7] **Madanan, U.**, Chatterjee, D. and Das, S. K., 2018. A note on adiabatic two-phase flow maldistribution in a set of horizontal parallel minichannels with I-type and Z-type configurations. *Chemical Engineering and Processing: Process Intensification*, Vol. 132 (pp.34-41)

[6] **Madanan, U.**, Nayak, R., Chatterjee, D. and Das, S. K., 2018. Experimental investigation on two-phase flow maldistribution in parallel minichannels with U-type configuration. *The Canadian Journal of Chemical Engineering*, Vol. 96(8) (pp.1820-1828)

[5] Kulkarni, K. S., **Madanan, U.**, Simon, T. W. and Goldstein, R. J., 2018. Experimental validation of a boundary layer convective heat flux measurement technique. *ASME Journal of Heat Transfer*, Vol. 140(7) (p.074501)

[4] **Madanan, U.**, 2017. Prediction of two-phase mass split in mini tubes. *Chemical Engineering and Processing: Process Intensification*, Vol. 120 (pp.216-219)

[3] Mittal, R., **Madanan, U.** and Goldstein, R. J., 2017. The heat/mass transfer analogy for a backward facing step. *International Journal of Heat and Mass Transfer*, Vol. 113 (pp.411-422)

[2] Kulkarni, K. S., **Madanan, U.**, Mittal, R. and Goldstein, R. J., 2017. Experimental validation of heat/mass transfer analogy for two-dimensional laminar and turbulent boundary layers. *International Journal of Heat and Mass Transfer*, Vol. 113 (pp.84-95)

[1] Papa, F., **Madanan, U.** and Goldstein, R. J., 2017. Modeling and measurements of heat/mass transfer in a linear turbine cascade. *ASME Journal of Turbomachinery*, Vol. 139(9) (p.091002)

Other Peer-Reviewed Articles

Madanan, U., 2021. A step-by-step guide for precision thermocouple calibration. *Resonance - Journal of Science Education: Indian Academy of Sciences*, Vol. 26 (10) (pp.1451-1463)

Conference Proceedings & Presentations

[18] Kumar, G., Malik, W., Badwe, N. and **Madanan, U.** (Jan 2027). Experimental investigation of pool boiling heat transfer on electrodeposited nickel-copper microporous surfaces at atmospheric conditions, Proceedings of the *8th Micro/Nanoscale Heat & Mass Transfer International Conference*, Napoli, Italy [paper accepted]

[17] Chaudhary, A., Pathak, M., Muralidhar, K., and **Madanan, U.** (December 2025). Numerical investigations into thermofluidics of supercritical nitrogen in a straight circular tube, Proceedings of the *28th National and 6th International ISHMT-ASTFE Heat and Mass Transfer Conference*, IIT Jodhpur, Rajasthan, India

[16] Kumar, G., Mallick, R., Badwe, N., and **Madanan, U.** (December 2025). Heat transfer performance and durability of electrodeposited bi-conductive microporous coatings in saturated pool boiling, Proceedings of the *28th National and 6th International ISHMT-ASTFE Heat and Mass Transfer Conference*, IIT Jodhpur, Rajasthan, India

[15] Chatterjee, D., Goswami, S., Muralidhar, K., and **Madanan, U.** (December 2025). Evaporative mass flux resolved using IR thermography from thin bi-porous surfaces, Proceedings of the *28th National and 6th International ISHMT-ASTFE Heat and Mass Transfer Conference*, IIT Jodhpur, Rajasthan, India

[14] Kumar, G. and **Madanan, U.** (July 2025). Combined influence of surface orientation and roughness on pool boiling heat transfer performance, *11th International Symposium on Turbulence Heat and Mass Transfer*, Tokyo, Japan

[13] Alam, P. and **Madanan, U.** (November 2024). Thermal convection in Darcy-Bénard system: effect of sidewall thermal conductance, *International Conference on Heat and Mass Transfer in Porous Media: Fundamentals and Applications*, Xi'an, China

[12] Chatterjee, D., **Madanan, U.** and Muralidhar, K. (August 2024). Effect of Characteristic Length on Natural-convection-driven Evaporation-based Solar Evaporators for Desalination Applications, Proceedings of the *10th World Conference on Experimental Heat Transfer, Fluid Mechanics and Thermodynamics (ExHFT-10)*, Rhodes Island, Greece

[11] Barik, R., Alam, P., Kumar, G. and **Madanan, U.** (December 2023). Enhancement of free convective heat transfer inside an enclosure with discrete heat sources, Proceedings of the *27th National and 5th International ISHMT-ASTFE Heat and Mass Transfer Conference*, IIT Patna, Bihar, India

[10] Halder, A., Pandey, R. and **Madanan, U.** (December 2023). Computer simulations on heat transfer enhancement in a minichannel heat sink using modified butterfly inserts, Proceedings of the *27th National and 5th International ISHMT-ASTFE Heat and Mass Transfer Conference*, IIT Patna, Bihar, India

[9] Pandey, R. and **Madanan, U.** (December 2023). Numerical investigations into the effect of pitch of butterfly inserts on heat transfer enhancement in a minichannel heat sink, Proceedings of the *27th National and 5th International ISHMT-ASTFE Heat and Mass Transfer Conference*, IIT Patna, Bihar, India

[8] Alam, P., Kumar, G. and **Madanan, U.** (August 2023). Sidewall thermal conductance in turbulent Rayleigh-Bénard convection: effect of uninsulated sidewalls, Proceedings of the *17th International Heat Transfer Conference*, Cape Town, South Africa

[7] Alam, P. and **Madanan, U.** (June 2022). Numerical investigation into effect of sidewall thermal conductance in Darcy-Bénard convection, Proceedings of the *1st International Conference in Fluid Thermal and Energy Systems*, NIT Calicut, India

[6] Sudheer, A. P. and **Madanan, U.** (June 2022). Numerical study on heat transfer augmentation in a square minichannel heat sink using butterfly inserts, Proceedings of the *1st International Conference in Fluid Thermal and Energy Systems*, NIT Calicut, India [Best Paper of the Session]

[5] Sen, N., Pisharody, A. S. and **Madanan, U.** (June 2022). Empirical and machine learning approaches for turbulent thermal convection in rectangular enclosures tilted at acute angles, Proceedings of the *1st International Conference in Fluid Thermal and Energy Systems*, NIT Calicut, India

[4] **Madanan, U.** and Prajapati, S. (December 2021). Computational study on jet breakup behavior of a high-density liquid jet entering a quiescent immiscible liquid pool, Proceedings of the *26th National and 4th International ISHMT-ASTFE Heat and Mass Transfer Conference*, Chennai, Tamil Nadu, India

[3] **Madanan, U.** and Goldstein, R. J. (July 2019). Effect of sidewall conductance on Nusselt number for Rayleigh-Bénard convection: a fin model and experimental correction. *2019 ASME Summer Heat Transfer Conference*, Seattle, USA

[2] **Madanan, U.** and Goldstein, R. J. (August 2018). Prediction and correction of sidewall conductance for natural convection in horizontal enclosures. Poster session at the *16th International Heat Transfer Conference*, Beijing, China

[1] Papa, F., **Madanan, U.** and Goldstein, R. J. (April 2017). Numerical and experimental investigation of heat/mass transfer in a linear turbine cascade. *2nd Thermal and Fluids Engineering Conference*, Las Vegas, USA

Teaching Experience

2020 - Present	**Instructor | Department of Mechanical Engineering** Indian Institute of Technology Kanpur, India ME 334 - Experiments in Mechanical Engineering - II (2025-26-II) ME301 - Energy Systems I (2025-26-I, 2026-27-I) ME742 - Boiling and Condensation (2024-25-II | 2025-26-II) ME613A - Thermal Environmental Control (2024-25-I | 2022-23-II) ME341A - Heat and Mass Transfer (2023-24-II) ME341A - Heat and Mass Transfer Laboratory (2023-24-II | 2022-23-II) ME340A - Introduction to Refrigeration and Air Conditioning (2022-23-I | 2021-22-I) ME642A - Convective Heat and Mass Transfer (2021-22-II | 2020-21-II)
2020 - Present	**Tutor | Department of Mechanical Engineering** Indian Institute of Technology Kanpur, India ESO201A - Thermodynamics (2023-24-I) ESO204A - Fluid Mechanics and Rate Processes (2021-22-I) ESO204A - Fluid Mechanics and Rate Processes (2020-21-I)
2019	**Teaching Fellow | Department of Mechanical Engineering** University of Minnesota Twin Cities, USA Heat Transfer (Spring 2019)
2015 - 2018	**Teaching Assistant | Department of Mechanical Engineering** University of Minnesota Twin Cities, USA

Ongoing Student Supervision

No. of Graduated Students = 9 (M.Tech.) and 1 (Ph.D.)

Ph.D.	Parvez Alam (Joined April 2021; FARE Fellow) Gyanesh Kumar (Joined April 2021) Priyanka Rajeev (Joined August 2022)
M.Tech.	Kartik Navalgund (Joined October 2025) Sumanth Pentapalli (Joined October 2025) Ayush Bhupendra Ninave (Joined October 2025) Pramod H. M. (Joined November 2024) Prapti P. Salaskar (Joined in October 2026) Meghaj N. Barhate(Joined in October 2026)

Awards and Honors

2026-29	**P. K. Kelkar Fellowship**, Indian Institute of Technology Kanpur, India
2026	**Associate Editor**, Journal of the Brazilian Society of Mechanical Sciences and Engineering, Springer Nature
2025-27	**Member, Early Career Editorial Board**, Applied Thermal Engineering, Elsevier
2024-25-I	**Outstanding Instructor (ME613 | Thermal Environmental Control)**, Indian Institute of Technology Kanpur, India
2023-24-II	**Outstanding Instructor (ME341A | Heat and Mass Transfer)**, Indian Institute of Technology Kanpur, India
2024	**Invitation to deliver a Keynote Lecture** on "Addressing the Nusselt number divergence across varied fluid-solid combinations in Darcy-Bénard convection", International Conference on Heat and Mass Transfer in Porous Media: Fundamentals and Applications (HMT-PM 2024), Xi'an, China, November 7-10, 2024

2023-24-I	**Outstanding Instructor (ESO201A | Thermodynamics)**, Indian Institute of Technology Kanpur, India
2023	**International Travel Support**, Science and Engineering Research Board, Department of Science and Technology, Government of India
2023	**Max Planck-India Mobility Grants**, Max Planck Gesellschaft (MPG), Germany
2022	**Scientific High Level Visiting Fellowship**, Institut français India - Embassy of France in India
2021-22-II 2020-21-II	**Outstanding Instructor (ME642A | Convective Heat and Mass Transfer)**, Indian Institute of Technology Kanpur, India
2018-19	**Graduate Teaching Fellowship**, Department of Mechanical Engineering, University of Minnesota Twin Cities, USA
2017-18 2016-17	**Outstanding Teaching Assistant Mention**, Department of Mechanical Engineering, University of Minnesota Twin Cities, USA
2014-15	**Graduate Student Fellowship**, Department of Mechanical Engineering, University of Minnesota Twin Cities, USA
2014	**Winner of ENG@GE Robotics Competition**, GE Global Learning Technology, Bengaluru, India
2012	**Prof. B. Sengupto Prize and Institute Medal**, 1st rank in the Department of Mechanical Engineering, Indian Institute of Technology Madras, India
2011	**Prof. N. Venkatarayulu Memorial Prize and Institute Medal**, 1st rank in the Thermal Engineering Stream, Indian Institute of Technology Madras, India
2011	**Ramanan Ramamurthy Memorial Prize and Institute Medal**, 1st rank in the Department of Mechanical Engineering, Indian Institute of Technology Madras, India

Service

2025-27	**Stream Convenor**, Fluid and Thermal Sciences, (Department of Mechanical Engineering), Indian Institute of Technology Kanpur
2025	**Member**, National Advisory Committee, The 3rd Biennial International Symposium on Fluids and Thermal Engineering, Amity University, Noida, August 2025
2025	**Member**, National Advisory Committee, First International Conference on Thermofluids Engineering, IIT (ISM) Dhanbad, October 2025
2024	**Editor**, International Colloquium on Advances in Engineering and Technology (IC@MACE 2023), AIP Conference Proceedings, Volume 3134(1)
2024	**Member of the Organizing Committee**, International Conference on Heat and Mass Transfer in Porous Media: Fundamentals and Applications (HMT-PM 2024), Xi'an, China, November 7-10, 2024
2024	**Institute Representative**, IIT GATE
2024	**Member of the Organizing Committee**, Symposium in Memory of Professor Richard J. Goldstein at the 2024 ASME Summer Heat Transfer Conference, Anaheim, CA, USA
2023	**Interview Committee - Mechanical Engineering**, Uttar Pradesh Power Corporation Limited Assistant Engineers Recruitment
2023	**Guest Editor**, Special Issue on Transformative Advancements in Heat and Mass Transfer, ASME Journal of Heat and Mass Transfer

2023	**Member**, Advisory Board, International Colloquium on Advances in Engineering and Technology (IC@MACE 2023), Mar Athanasius College of Engineering, Kothamangalam, Kerala, India
2023	**Third-Party Evaluator**, Department of Chemical and Biological Engineering, Seoul National University, South Korea
2023	**Member**, Scientific Council, International Centre for Heat and Mass Transfer
2022 - 23	**Member**, Departmental Undergraduate Committee (Department of Mechanical Engineering), Indian Institute of Technology Kanpur
2022 - Present	**Review Editor**, Frontiers in Thermal Engineering (Heat Transfer and Thermal Power)
2021 - Present	**Faculty Coordinator**, Undergraduate Heat Transfer Laboratory (Department of Mechanical Engineering), Indian Institute of Technology Kanpur
2017	**Reviewer**, OPUS 14: General Grants, National Science Center, Government of Poland
2017	**Session Chair**, 2nd Thermal and Fluids Engineering Conference, Las Vegas
2017 - Present	**Peer Reviewer**: International Journal for Heat and Fluid Flow, International Communications in Heat and Mass Transfer, Heat and Mass Transfer, International Journal of Thermal Sciences

Certifications

2014	**Edison Engineering B-Course Practicum and Gas Turbine Teardown School**, Energy Technical Training, General Electric, Schenectady, USA
2013	**Foundations of Leadership**, Crotonville Leadership, General Electric, Hyderabad, India
2013	**Power Plant Engineering Fundamentals**, John F. Welch Technology Centre, General Electric, Bengaluru, India
2013	**Advanced Courses in Engineering**, John F. Welch Technology Centre, General Electric, Bengaluru, India

Skills

Experimental Techniques	Naphthalene sublimation mass transfer technique, hot-wire anemometry, flow visualization techniques (Schlieren, Shadowgraphy, Interferometry), precision temperature calibration
Analysis and Modeling Tools	ANSYS (Structural Analysis, CFX, and Workbench), FLUENT (GAMBIT), Unigraphics NX, HyperMesh, SolidWorks, CATIA, Pro/ENGINEER
Programming Languages	LabVIEW, MATLAB, C/C++

Professional Affiliations

Member, The American Society of Mechanical Engineers

Life Member, Indian Society for Heat and Mass Transfer

Member, The Institution of Engineers (India)

Life Member, National Society for Fluid Mechanics and Fluid Power