

## **CURRICULUM VITAE**

### **SUSHIL K. CHATURVEDI**

Department of Mechanical Engineering  
238 Kaufman Hall  
Old Dominion University  
Norfolk, VA 23528  
(757) 683-6363  
Email: schaturv@odu.edu

### **PROFESSIONAL EDUCATION**

Doctor of Philosophy, Case Western Reserve University, 1972-75, Field of Specialization – Fluid-Thermal Engineering.

Master of Science, Case Institute of Technology, 1969-72, Field of Specialization – Fluid-Thermal Engineering.

B. Tech (Honors), Indian Institute of Technology, Kharagpur, 1964-69, Field of Specialization – Mechanical Engineering.

### **PROFESSIONAL EXPERIENCE**

1991-Present, Professor of Mechanical Engineering, Old Dominion University, Norfolk, Virginia.

1997-2003, Chair, Dept. of Mechanical Engineering.

1993-1997, Graduate Program Director, Dept. of Mechanical Engineering.

1987-1990, Graduate Program Director, Dept. of Mechanical Engineering and Mechanics, Old Dominion University, Norfolk, Virginia.

1984-1991, Associate Professor of Mechanical Engineering and Mechanics, Old Dominion University, Norfolk, Virginia.

1978-1984, Assistant Professor of Mechanical Engineering and Mechanics, Old Dominion University, Norfolk, Virginia.

1975-1978, Post Doctorate Research and Teaching Associate, Dept. of Mechanics, Mechanical and Aerospace Engineering, Illinois Institute of Technology, Chicago, Illinois.

## **HONOR AND PROFESSIONAL SOCIETIES**

Elected in past to the following organizations:

Phi Kappa Phi

Tau-Beta Pi, Honorary Engineering Society

Sigma Xi, Honorary Scientific Society

American Society of Mechanical Engineers, Elected to “Fellow” grade in 2001

Pi Tau Sigma, Mechanical Engineering Honor Society

American Society of Engineering Education

## **U.S PATENTS AWARDED**

U.S. PATENT No. 5,374,400, “Two-Stage Gas Measurements Systems.” This invention facilitates the testing of the national aerospace plane in hypersonic wind-tunnels. Co-inventors: Sprinkle and Chen (doctoral student) 1995.

U.S. Patent No. 4,341,088, “Highway Vehicle Exhaust Gas Refrigeration system.” This invention uses exhaust gases to power the cooling system of a refrigerated truck. The invention has the potential of effecting significant savings in energy costs for truck refrigeration. Co-inventors: Mei and Lavan, 1980.

## **HONORS AND AWARDS**

Professor of the Year, awarded by Pi Tau Sigma, the Mechanical Engineering Honor Society, 2003.

Professor of the Month, awarded by the Office of Student Activities and Leadership (OSAL), 2003.

The Asian Pacific American Heritage Organization (APAHO) Award for Professional Achievement, 2002

Who’s Who among America’s Teachers’ Distinguished Educator Designation, 2002

State Council of Higher Education of Virginia (SCHEV) Outstanding Faculty Award, 2001, Virginia’s highest award for university and college professors, awarded in recognition of outstanding achievement in teaching, research and public service, \$5,000 cash award and citation from the Governor of Virginia

Fellow of American Society of Mechanical Engineers 2001, highest elected honor conferred by the national society, based on contributions as teacher, educator and researcher.

Pletta Award 2000, Virginia Outstanding Engineering Educator Award, awarded by the Virginia Society of Professional Engineers for outstanding teaching and service to the

Commonwealth of Virginia. The co-sponsors of the award are the Virginia Society of Professional Engineers, American Society of Civil Engineers/Central Virginia section, American Society of Mechanical Engineers/Central Virginia section, Consulting Engineers Council of Virginia and the Institution of Electrical and Electronics Engineers.

A Rufus Tonelson Distinguished Faculty Award for Outstanding Research, Teaching and Service, highest faculty award conferred by old Dominion University, \$2000 cash award.

NASA Certificate of Recognition for disclosure of an invention titled "Visual Detection of Thermal Contact Resistance with Liquid Crystals," \$350 cash award, 2000.

Listed in Marquis Who's Who in Science and Engineering, Millennium Edition, 2000.

University Finalist 1999, Council of Higher Education Outstanding Faculty Award Program, \$500 award.

Finalist, 1998, Council of Higher Education Outstanding Faculty Award, \$500 award.

Most Inspiring Faculty Award, 1998, as determined by the College's top honor undergraduate.

Professor of the Year Award, 1998, awarded by PI Tau Sigma, the Mechanical Engineering Honor Society.

Finalist, 1997, Council of Higher Education Outstanding Faculty Award, \$500 award.

NASA Certificate of Recognition, \$150 cash award, 1996.

NASA Certificate of Recognition, \$150 cash award, 1995.

NASA Certificate of Recognition, \$500 cash award, 1995.

NASA Technical Brief Award, certificate and \$150 cash award for technological innovation, 1995.

NASA Certificate of Recognition for Disclosure of Invention, Certificate and \$150 cash award, 1994.

Most Inspiring Faculty Award, 1993, received certificate from the Provost.

Certificate for services to the engineering profession as the ASME Faculty Advisor, awarded by the Board of Governors of ASME, 1993.

Certificate for Services to the Engineering Profession as the ASME Faculty Advisor, Awarded by the Board of Governors of ASME, 1992.

Most Inspiring Faculty Award, 1992, received certificate from the President.

Mechanical Engineering Outstanding Faculty Award, 1992, awarded by the ASME Student Chapter.

Mechanical Engineering Outstanding Faculty Award, 1987, awarded by the ASME Student Chapter.

Mechanical Engineering Outstanding Faculty Award, 1984, awarded by the American Society of Mechanical Engineering (ASME), Student Chapter.

Department of Energy, Summer Faculty Fellowship at Solar Energy Research Institute, 1980.

### **EXTERNALLY FUNDED RESEARCH PROJECTS AS PRINCIPAL INVESTIGATOR**

Dr. Chaturvedi has been the Principal Investigator on 27 research projects and Co-principal Investigator on two research projects for a sum totaling nearly 2.4 million dollars, funded by NASA, U.S. Department of Energy, National Science Foundation, and several industrial companies.

<b>Research Projects</b>	<b>Sponsor</b>	<b>Duration</b>	<b>Funding Level</b>
Simulation and Visualization Enhanced Engineering Education	NSF	2003-2008	\$1,175,000*
Visualization and Simulation Enhanced Engineering Education	NSF	2003-2005	\$119,000
Industrial Assessment Center	Rutgers/USDOE	2000	\$123,000
Modeling of Polymerization Reactors Using Computational Fluid Dynamic Softwares	Huntsman Chemical	1999	\$18,000
Modeling of Polymerization Reactors Using Computational Fluid Dynamics Softwares	Huntsman Chemical	1998-99	\$25,655
Parametric Study and CFD Modeling of Internal Flows (Co-PI)	Siemens	1998	\$25,908
Liquid Crystals for Aerodynamic flow Field Diagnostics	NASA	1993-94	\$73,888
Liquid Crystals for Aerodynamic Flow Field Diagnostics	NASA	1992-93	\$107,987
Liquid Crystals for Aerodynamic flow Diagnostics	NASA	1991-92	\$89,000
Near – IR Spectroscopic Technique for Monitoring and Controlling Oxygen Concentration (Co-Principal Investigator)	NASA	1992-93	\$50,000
Near-IR Specroscopy Technique or Monitoring and controlling Oxygen	NASA	1991-92	\$35,000

\* Includes \$170,000 matching from Old Dominion University

Concentration (Co-Principal Investigator)			
Zro2 -Based Oxygen Monitoring/Control System	NASA	1991-93	\$20,000
An Absorption Gaging System for Slush Hydrogen	NASA	1992-93	\$29,990
An Absorption Gaging System for Slush Hydrogen	NASA	1991-92	\$45,000
Eight-Ft. HTT Oxygen Monitoring System	NASA	1990-91	\$23,800
Analysis of Eight-Ft. HTT Combustor Using CFD Codes	NASA	1990-91	\$57,700
An Absorption Gaging System for Slush Hydrogen	NASA	1990-91	\$39,990
Eight-Ft. HTT Oxygen Monitoring System	NASA	1989-90	\$12,839
Analysis of Eight-Ft. HTT Combustor Using CFD Codes	NASA	1989-90	\$59,481
Oxygen Monitoring/Control System Development	NASA	1989	\$2,997
Eight Ft. High Temperature Tunnel Combustor Modeling	NASA	1988-89	\$44,908
Measurement of Seasonal and Geographical Variation of Aviation Fuel Characteristics	NASA	1988-89	\$24,288
On-Line Measurement of Heat of Combustion	NASA	1987-88	\$5,400
LOX Diffusion and Oxygen Monitoring and Control in the 8-Ft. High Temperature Tunnel	NASA	1987-88	\$54,496
A New Calorimetric Method for Determination of Heats of Combustion of Gaseous Hydrocarbons	NASA	1987	\$8,200
Design and Implementation of Oxygen Control System for Eight-Ft. HTT	NASA	1986-87	\$43,702
Energy Conservation and Economic Potential of Large Capacity, Solar-Assisted Heat Pumps for Low Temperature Industrial Process Heat Applications	TVA	1984-1987	\$34,000

Leading Edge Extension (LEE) for a Thick Delta Wing Model	NASA	1983-84	\$10,000
Investigation of Aerodynamics Characteristics of Wings having Vortex Flow Using Different Codes	NASA	1982-84	\$21,000

## TECHNICAL PUBLICATIONS

Dr. Chaturvedi has published over 100 technical papers and reports including 24 journal papers, listed below:

## REFEREED JOURNAL PAPERS/BOOK CHAPTERS

"Virtual Assembly" – A Web-Based Student Learning Tool for Thermodynamics Concepts Related to Multistaging in Compressors and Turbines, Innovations 2008: World Innovations in Engineering Education and Research, August 2008. in press, Chaturvedi, Abdel-Salam.

“Development of Building Blocks for Internet-Based Interactive Courses for Engineering Education,” International Journal of Internet Education (IJIE), Vol. 11, January 2007, pp 51-57, Chaturvedi, and Abdel Salam.

"Mapping of a Thermo-fluids Laboratory Experiment into a Web-based Virtual Experiment for Application as a Prelab Practice Tool", Innovations 2007: World Innovations in Engineering Education and Research, Chapter 28, ISSN 1553-9911, ISBN 978-0-9741252-6-8, August 2007, Chaturvedi, Abdel Salam, Muthoju, Shrinivas and Gagrani,

“A Web-based Module for Teaching Engineering Students About Environmental Effects of Fossil Fuel Combustion”, Computers in Education Journal, Vol. 17, No. 4, 2007, Chaturvedi, and Abdel Salam.

“A Web-Based Virtual Supersonic Nozzle Module as an Interactive Visualization Tool for Teaching Concepts Related to One-Dimensional Gas Dynamics”, Computer in Education Journal, Vol. 16 No. 2, April 2006, pp80-89, Chaturvedi, Abdel-Salam, Shrinivas, Khan and Chandorkar

“Two-Stage Direct Expansion Solar-Assisted Heat Pump for High Temperature Applications,” (in review) Energy Conversion and Management, Chaturvedi, Abdel-Salam, Kasinadhuni and Sreedharan.

“A Web-Based Interactive Student Learning Tool for Visualization, Simulation and Knowledge Integration in the Undergraduate Thermodynamics Course,” Book Chapter, Innovations 2006, World Innovations in Engineering Education and Research, ISBN 0-9741252-5-3, July 2006, Chaturvedi, Abdel-Salam and Sreedharan.

“Analysis of a Direct Expansion Solar-Assisted Heat Pump Using Different Refrigerants,” Energy Conversion and Management, Vol. 46, 2005, pp. 2614-2624, Chata, Chaturvedi, and Almogbel.

“Entropy Generation Method to Quantify Thermal Comfort,” Journal of Human Performance in Extreme Environmental,” Vol. Y, No. 1, 2002, Boregowda, Tiwari and Chaturvedi.

"Development of a Thermal System Around the Human Body," Abstract, Virginia Journal of Science, Vol. 50, No. 2, 1999, Al-Fahid and Chaturvedi.

"Thermodynamic Analysis of Two-Component, Two-Phase Flow in Solar Collectors with Application to A Direct-Expansion Solar-Assisted Heat Pump," Energy, 24, 247-259, 1999, Aziz, Chaturvedi and Kheireddine.

"Computation of Flame Base Height of a Turbulent Diffusion Flame Resulting from a Methane Jet," JSME International Journal, Series B, Vol. 42, No. 1, 1999, Kheireddine, Chaturvedi and Mohieldin.

"Thermal Performance of Variable Capacity Direct Expansion Solar-Assisted Heat Pump," Journal of Energy Conversion and Management, Chaturvedi, Chen and Kheireddine, 1997.

"Numerical Prediction of Pressure Loss Coefficient and Induced Mass Flux for Laminar Natural Convective Flow in a Vertical Channel," 1996, "Energy" The International Journal, Kheireddine, Houla-Sanda, Chaturvedi, and Mohieldin.

"Analysis and Quantification of Mental Stress and Fatigue Using Maxwell Relations from Thermodynamics," to appear, J. of Human Ergology," Tokyo, Japan, Boregowda, Tiwari, Chaturvedi and Redondo Vol.25, No.1, June 1996.

"Isolating Gas Sensor from Pressure and Temperature Effects," NASA Tech. Brief, The Digest of New Technology, Vol.6, 1994, Sprinkle, Chen and Chaturvedi.

"An Approximate Method for Calculating Laminar Natural Convective Motion in a Trombe-Wall Channel," Energy, Vol. 19, No. 2, pp. 259-296, 1994, Chen, Chaturvedi and Mohieldin.

"Heat and Mass Transfer from a Supercritical Lox Spray," International Communications Heat and Mass Transfer, Vol. 18, No. 6, pp. 767-778, 1991, Chegini, Chaturvedi and Kondic.

"Second Law Analysis of Solar-Assisted Heat Pumps," Energy, Vol. 16, No. 6, pp. 941-949, 1991, Chaturvedi, Mohieldin and Chen.

"Mixed Laminar Convection in Trombe Wall Channels," ASME J. of Solar Energy Engineering, Vol. 110, pp. 31--37, 1988, Chaturvedi, Mohieldin and Huang.

"Transient Simulation of a Capacity-Modulated Direct Expansion, Solar-Assisted Heat Pump," Solar Energy, Vol. 39, pp. 421-428, 1987, Chaturvedi and Abazeri.

"Energy Conservation Potential of Large Capacity Solar-Assisted Heat Pumps for Low Temperature IPH Applications," ASME J. of Solar Energy Engineering, Vol. 107, pp. 286-292, 1985, Chaturvedi and Murphy.

"An Experimental and Analytical Investigation of Friction Factors for Fully Developed Flow in Internally Finned Triangular Ducts," ASME J. of Heat Transfer, 1986, Chegini and Chaturvedi.

"Thermal Performance Aspects of Direct Expansion Solar Assisted Heat Pump," Solar Energy, Vol. 33, 2, 1984, Chaturvedi and Shen.

"Analysis of Two Phase Flow Collectors with Applications to Heat Pumps," ASME J. of Solar Energy Engineering, Vol. 104, 358-365, 1982, Chaturvedi, Chiang and Roberts.

"Unit Thermal Performance of Atmospheric Spray Cooling Systems," ASME J. of Heat Transfer, Vol. 102, 210-214, 1982, Jain, Porter and Chaturvedi.

"Truck Exhaust Gas Operated Absorption Refrigeration System," Japanese Translation of ASHRAE Paper, J. of Refrigeration, Vol.55, No.635, pp.58-62, Japan, Mei, Chaturvedi, and Lavan.

"Thermal Performance of Spray Canal Cooling Systems," ASME Journal of Engineering Power, Vol. 102, pp. 776-781, 1980, Chaturvedi, and Porter.

"Truck Exhaust Gas Operated Absorption Refrigeration System," Transactions of American Society of Heating, Refrigeration and Air-conditioning, Part 2, pp. 66-76, Oct. 1979, Mei, Chaturvedi and Lavan. Also appeared in J. Refrigeration, Vol.55, No.635, pp.58-62, Japan.

"Inviscid Rotational Flow Through Sprays," ASME J. of Applied Mechanics, Vol. 45, pp. 34-36, Chaturvedi and Jain.

Air Vapor Dynamics for Large Scale Open Spray Cooling Systems," J. Fluids Eng., 1978, Vol. 100, pp. 65-72, Chaturvedi and Porter.

"Stratified Flow Over a Flat Plate," J. Fluid Mech., No. 80, 1977, Chaturvedi and Janowitz.

#### **SPECIAL PUBLICATION (REFEREED)**

"On-Line Measurement of Heat of Combustion of Gaseous Hydrocarbon Fuel Mixtures," NASA Technical Paper 3572, 1996, Sprinkle, Chaturvedi and Kheireddine.

#### **REVIEWED PAPERS PUBLISHED IN BOOKS/PROCEEDINGS**

"Virtualization of Physical Experiments using Modeling,Simulation and Visualization", 6th Global Colloquium on Engineering Education, October 1-4, 2007 Istanbul, Turkey, Chaturvedi, Kasinadhuni and Muthoju.

"Simulation and Visualization Enhanced Engineering Education: The Stiffness Matrix Method Module for Structural Analysis 1 Course ", Modsim World 2007 Conference, Sep 11-13 2007, Norfolk, Virginia, Mohammed, Nguyen and Chaturvedi.

"Virtual Assembly: A Web-Based Student Learning Tool for Thermodynamics Concepts Related to Multistaging in Compressors and Turbines", Proceedings of the International Conference of Engineering Education, ICEE 2007, Coimbra, Portugal, September 2007, Chaturvedi, Abdel-Salam and Kasinadhuni.

"Development of Building Blocks for Internet-based Interactive Courses for Engineering Education", Accepted for presentation in, 6th International Internet Education Conference, Sep 2-4 2007, Cairo, Egypt, Chaturvedi and Abdel Salam,

"A Web-based Module for Teaching Engineering Students about Environmental Effects of Fossil Fuel Combustion ", Conference Proceedings of 5th Global Colloquium on Engineering Education, Oct 7-12 2006, Rio de Janeiro, Brazil, Chaturvedi, Abdel Salam and Kasinadhuni.

"Simulation and Visualization Enhanced Engineering Education", ASME International Conference on Engineering Education, Mar 2006, Beijing, China., Chaturvedi and Akan.

"Development of a Methodology to Visualize and conduct a Physical Experiment as a Web-based Virtual Experiment", Grindelwald, Switzerland, February 2005, Chaturvedi, Bawab, Akan, and Abdel-Salam.

"Mapping of a Thermo-Fluids Laboratory Experiment Into a Web-Based Experiment, Accepted for the 2004 ASEE Annual Conference, Chaturvedi, McKenzie, and Akan.

"A Web-Based Multi-Media Virtual Experiment," Proceedings of 33<sup>rd</sup> ASEE/IEEE Frontiers in Engineering Education Conference, 2003, Boulder, Colorado, Chaturvedi, Akan, Bawab, Abdel-Salam and Venkatramana.

"Performing a Virtual Experiment Interactively," Proceedings of the American Society of Engineering Education Annual Conference, 2003, Chaturvedi, Akan, Abdel-Salam and Priyadarshihi.

"Global Engineering in an Interconnected World: An Upper Division General Education Cluster at Old Dominion University," Proceedings of the 2001 American Society of Engineering Education Annual Conference, 2001, Chaturvedi, Crossman, Swart and Betit.

Computational Fluid Dynamic Study of a Three-Dimensional Human Body Model, "Proceedings of First Saudi Technical Conference and Exhibition, Vol. III, pp. 84-88, 2000, AlFaid and Chaturvedi.

"Numerical Study of Effects of Ramp Swept Angle in Supersonic Mixing and Combustion," Proceeding of 34<sup>th</sup> National Heat Transfer Conference, August 20-22, 2000, Pittsburgh, PA, Abdel-Salam, Tiwari, Mohieldin and Chaturvedi.

"Mixing and Combustion in SCRAMJET Combustor with Raised and Relieved Ramps," AIAA Paper 2000-3709, Abdel-Salam, Tiwari, Chaturvedi and Mohieldin, 2000.

"Thermodynamic Analysis of Two-Component, Two-Phase Flow in Solar Collectors with Application to a Direct-Expansion Solar-Assisted Heat Pump," Energy, Vol. 24, pp. 247-259, 1999, Aziz, Chaturvedi, and Kheireddine.

"Thermodynamic Analysis of an Unsteady 3D Human Thermal Model," AIAA Paper No.98-0840, Jan. 12-15, 1998, 36th AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV.

"Modeling and Simulation of Human Thermal Activity," 3rd ISHMT-ASME Conference, I.I.T. Kanpur, December 1997, Boregowda, Tiwari and Chaturvedi.

"Numerical Investigation of Stabilization Region of Turbulent Premixed Flames," 3rd ISHMT-ASME Conference, I.I.T. Kanpur, Dec.1997, Chaturvedi, and Kheireddine.

"An Innovative Approach to Measure and Monitor Human Stress Level in Man/Machine Interactions," Proceedings of 18th Annual American Society of Engineering Management (ASEM) National Conference, Virginia Beach, VA, October 23-26, 1997, pp.5-13.

"Modelling of Turbulent Diffusion Flame Stabilization Region," AIAA-97-2587, 32nd Thermophysics Conference, June 23-25, 1997, Atlanta, GA, Kheireddine and Chaturvedi.

"Heat Transfer, Mass Flow Rate and Pressure Characteristics of Laminar and Turbulent Convective Flows in Parallel Wall Channels," AIAA-97-2514, 32nd Thermophysics Conference, June 23-25, 1997, Atlanta, GA, Houla Sanda, Kheireddine and Chaturvedi.

"Novel Technique for Skin Friction Measurement in Wind-Tunnel Environment Utilizing Polymer Dispersed Liquid Crystals," AIAA-97-2218, 15th Applied Aerodynamic Conference, June 23-25, 1997, Atlanta, GA, Kheireddine, Chaturvedi and Parmar.

"Heat Transfer Modeling of Human Thermoregulation in Aerospace Environmental Control Systems," AIAA Paper No.97-2467, 32nd AIAA Thermophysics Conference, June 23-25, 1997, Atlanta, GA, Boregowda, Tiwari and Chaturvedi.

"Numerical Simulation of Human Thermoregulation in Different Environmental Conditions," AIAA Paper 970137, 1997, Boregowda, Tiwari, Chaturvedi, Hou and Morris.

"Investigation of Transient Human Thermoregulatory Response to Different Environment Conditions," AIAA Paper-96-1829, 1996, Boregowda, Tiwari and Chaturvedi.

"Experimental and Numerical Investigation of Lift-Off and Blow-Off Limits of Subsonic Methane Flame," 1st South African Conference on Applied Mechanics, Midrand, South Africa, July 1996, Comer, Kheireddine, Tiwari, Chaturvedi and Mohieldin.

"Experimental and Numerical Investigation of Lift-Off and Blow-Off Limits of Subsonic Methane Flame," AIAA Paper-96-1842, 1996, Tiwari, Mohieldin, Comer, Kheireddine and Chaturvedi.

"Calculation of Vent Losses in a Parallel Wall Channel Undergoing Natural Convective Motion," ASME Paper, 95 HTC-004, 1995, Kheireddine, Sanda, Chaturvedi.

"Numerical Prediction of Flame Base Height of a Diffusion Flame Produced by a Cylindrical Tube Methane Injector," Numerical Methods in Thermal Problems, Vol.IX, Part 1, pp.240-251, 1995, Kheireddine, Chaturvedi and Mohieldin.

"A Real Time System for Measuring Oxygen in Hypersonic Wind Tunnels," Proceedings of the 40th International Instrumentation Symposium, Paper No.94-3027, pp.661-671, 1994, Sprinkle and Chaturvedi.

"Wavelength Modulation Spectroscopy of Oxygen a Band Transitions for Non-Intrusive Concentration Measurements," Laser Application to Chemical Analysis Technical Digest, Vol. 5, pp. 43-46, Optical Society of America, 1994, Jackson, Dharamsi and Chaturvedi.

"Non-Intrusive Measurements of Gaseous Concentrations and Temperatures," Proceedings of International Congress on Instrumentation in Aerospace Facilities, Saint-Louis, France, 1993, Dharamsi, Jackson and Chaturvedi.

"Flame Lift-Off and Thermal Load Characteristics of a Cylindrical Injector," Proceedings of the English International Conference on Numerical Methods in Thermal Problems , Vol. 3, pp. 1346-1357, 1993, Mohieldin and Chaturvedi.

"Numerical Simulation of Thermal Performance of a Solar Heat Pump Water Heater," Accepted for Proceedings of National Conference of ASES, Florida, 1992, Ericson and Chaturvedi.

"Prediction of Refrigerant Properties and Heat Pump Cycle Thermal Performance Using Several Equations of State," Recent Research in Heat Pump Design, Analysis, and Application, ASME, AES-Vol.28, Edited by Herold and Mei, pp.53-60, Ericson, Chaturvedi and Boregowda.

"Ventilation Characteristics of a Trombe Wall Thermosyphon Loop," Accepted for publication in the Proceedings of the International Symposium on Room Air Convection and Ventilation Effectiveness, ISRACVE, Tokyo, Japan, 1992, Chaturvedi, Chen and Mohieldin.

"Calculation of Thermal Loads on a Methane Fuel Injector with Complex Geometry," Proceedings of the 28th National Heat Transfer Conference and Exhibition, ASME HTD-Vol. 199, pp. 73-80, 1992, Mohieldin and Chaturvedi.

"Numerical Modeling of Flame Lift-Off Phenomenon in A Combuster Chamber with Three Cylinders Methane Fuel Injector," Proceedings of the ASME Computers in Engineering Conference, Vol. 1, pp. 655-660, 1992, Mohieldin and Chaturvedi.

The 8-Ft High Temperature Tunnel Combuster Analysis Using CFD Codes," Creare.x.Inc. User Group Meeting Proceedings, pp. 135-176, 1991, Mohieldin and Chaturvedi.

"Langley 8-Foot High-Temperature Tunnel Oxygen Measurement System," International Symposium on Instrumentation, San Diego, 1991, Paper No.91-073, pp. 313-330, Sprinkle, Chen and Chaturvedi.

"Mixing of a Supercritical Jet of Oxygen Injected in a High Pressure Air Stream," The 2nd PACAM-II Conference Proceedings in Chile, 1990, abstract published in the proceedings, Chaturvedi and Wei.

"A Computer Program for Calculation of Thermodynamic Properties of Non-Ideal Gas Mixtures," Symposium on "Education in Thermodynamics and Energy Systems", ASME Winter Annual Meeting, Vol. AES-20, Chaturvedi, Chen and Mohieldin.

"Modeling of a Hypersonic Wind Tunnel Combustor," Proceedings of CSM Mechanical Engineering Forum 1990, Mohieldin, Chaturvedi and Puster, pp. 361-365.

"Turbulent Natural Convection in Trombe Wall Solar Collector," Proceedings of International Solar Energy Society Japan Conference, 1989, Chaturvedi, Mohieldin and Chen.

"Temperature, Size and Position Histories of Evaporating Drops Injected Into a Gas, with Finite Transfer Resistance," Proceedings of National Heat Transfer Conference, Published by ANS, pp. 79-89, 1989, Chaturvedi, Chegini and Kondic.

"Numerical Computation of Liquid Oxygen Droplet Evaporation and Diffusion in a Supercritical Air Stream," Proceedings of International Conference on Mechanics of Two-Phase Flows, Taipei, Taiwan, pp. 402-409, June 1989, Chaturvedi and Chegini.

"A CFD Analysis of Effects of Vent Location on Pollutant Concentration in Rooms," Room Air and Contamination Distribution Symposium, ASHRAE Proceedings, pp. 158-160, 1989, Chaturvedi and Mohieldin.

"Lox Injection, Evaporation and Diffusion in High Pressure Stream," Fundamentals of Convection Symposium Volume, Published by ASME, 1988, Chaturvedi, Chegini and Puster.

"Continuous Capacity Modulation of a Solar-Assisted Heat Pump," Heat Pump Technology and Application Symposium Volume, Published by ASME, pp. 110-116, 1988, Chaturvedi and Chen.

"Thermodynamic Analysis of a Direct Expansion Solar-Assisted Heat Pump," Physics and Technology of Solar Energy, Vol. 1, pp. 561-582, 1987, Chaturvedi.

"Second Law Analysis of a Solar-Assisted Heat Pump," Proceedings of 2nd ASME-JSME Thermal Energy Conference, Vol. 1, pp. 519-526, 1987, Chaturvedi and Mohieldin.

"Long-Term System Performance of Direct Expansion Solar-Assisted Heat Pump for Water Heating Applications," Proceedings of Intersol 85 Meeting of International Solar Energy Society, Montreal, June 1985, Chaturvedi and Abazeri.

"Mixed Convection in Trombe Wall Channel," Published in Symposium Volume of 23rd ASME/AICHE National Heat Transfer Conference, Denver, 1985, Huang and Chaturvedi.

"Analysis of Two-Phase Flow Solar Collectors with Application to Heat Pumps," ASME Paper 80-WA/SOL-32, 1980, Chaturvedi, Chiang and Roberts, Jr.

"Heat and Mass Transfer to Atmosphere from Spray Cooling Systems," Sixth International Conference on Heat Transfer, Toronto, pp. 55-60, August 1978, Published in Proceedings, Porter, Weinstein and Chaturvedi.

"Collector as Heat Pump Evaporator," Proceedings of 13th Intersociety Energy Conversion Conference, pp. 99-104, August 1979, Chaturvedi, Roberts and Mei.

"Thermal Performance of SAHP System with Combined Collector/Evaporator, AIAA Paper, 79-0976, pp. 1-6, 1979, Chaturvedi and Mei.\*

"Development of Solar Desiccant Dehumidifier," Proceedings of International Solar Energy Conference, Cairo, Published in book title "Solar Energy International Progress," Pergamon Press, Edited by Veziroglu; 1979, Lavan, Gidaspow, Onischalk, Chaturvedi, Perkari and Mathiprakasam.

"Dispersion of Heat and Humidity from Atmospheric Spray Canal Cooling Systems," published in the book titled Waste Heat Utilization, Editor Sengupta, Vol. 2, pp. 243-283, 1979, Porter, Weinstein and Chaturvedi.

"Atmospheric Spray Cooling for Large Electric Power Plant," published in the book titled Waste Heat Utilization, Editor Sengupta, Vol. 2, pp. 121-161, 1979, Porter, and Chaturvedi.

"Environmental Effects of Heat and Moisture Released from Open Spray Cooling Systems," ASME Symposium on Environmental Effects of Heat and Moisture Release, Published in the bound volume of Symposium Proceedings, pp. 65-73, 1978, Chaturvedi and Porter.

"Air-Vapor Dynamics of Large Scale Open Spray Cooling Systems," ASME Paper 77-WA/FE-11, 1977, Chaturvedi and Porter.

---

\*Based on review of extended abstract.

## **RESEARCH TOPICAL AREAS**

Dr. Chaturvedi has performed research in six distinct areas described below. His research has resulted in publication of over 100 technical papers and reports, and 2 U.S. patent.

### **1. Modeling of Atmospheric Sprays**

The primary goal of this research has been to develop thermal and fluid-dynamic models to enhance understanding of basic physical mechanisms governing heat and mass transfer from open sprays of a power plant cooling system. Novel contributions of the work are:

- Development of a convective-diffusion equation for non-dimensional wet-bulb temperature, first of its kind reported and solved in the literature. This work was published in the ASME Journal of Fluids Engineering.
- Development of a comprehensive model for calculation of thermal performance and design of spray cooling systems for power plants. This work was published in the ASME Journal of Engineering Power.
- Development of an experimental methodology for measurement of interference factor between adjacent sprays. This work was published in the ASME Journal of Heat Transfer.
- The efforts resulted in 4 journal and 5 conference proceedings papers.
- Research supported by National Science Foundation and carried out in collaboration with industry partner, Commonwealth Edison Company of Chicago (PI: Dr. Porter).

### **2. Solar-Energy Research and Energy Conservation Research**

Dr. Chaturvedi has conducted extensive research in solar energy including topical areas such as solar-assisted heat pump, solar collector analysis and Trombe wall solar collectors. The details are as follows:

- Research supported by TVA, Solar Energy Research Institute, Rutgers/U.S. DOE and ODU (summer faculty fellowship).
- Developed a thermodynamic model for phase change in solar collectors. This is one of the first papers in the literature that extends the single-phase collector theory to the two-phase domain. It was published in the ASME Journal of Solar Energy Engineering (see publication list).
- Developed a high efficiency capacity modulated solar-assisted heat pump. The system, one of the first of its kind to be reported in literature, has significant potential for energy conservation. This was published in the Journal of Energy Conversion and Management in 1997.
- Developed a transient simulation model for the long-term averaged thermal performance of a solar-assisted heat pump. This work was published in Solar Energy Journal.

- Analyzed the energy conservation potential of large capacity SAHP systems. This work was reported in the ASME Journal of Solar Energy Engineering.
- Developed a model for analysis of multi-component two-phase solar collectors. This extends the solar collector theory to multi-phase and multi-component domains. This work was published in the “Energy” International Journal.
- Developed computational and analytical models for analyzing laminar and turbulent flows in Trombe wall solar collectors. The model permits calculation of pressure drop and energy collected. The work was reported in the ASME Journal of Solar Energy Engineering and also other journals.
- Proposed a scheme to use truck exhaust gases to power absorption refrigeration system. This work was published in two journal papers and resulted in one U.S. patent
- Resulted in 13 refereed journal papers, conference proceedings papers, and 8 technical reports.
- Resulted in nine master’s theses and 1 doctoral dissertation.
- Solar heat pump research was used by a Japanese corporation to design products.
- Resulted in one U.S. patent.

### **3. Combustion Modelling Using CFD Codes**

- Funded by NASA.
- One and two step kinetic models for fuel gas mixtures are used to predict the diffusion flame lift-off and phenomenon using CFD codes.
- Modeling of high pressure combustor and calculation of thermal loads on fuel injector surfaces. This resulted in design of safer combustor for the high speed wind-tunnel.
- Resulted in 3 journal papers and 9 conference papers
- Resulted in 2 doctoral dissertations.

### **4. Numerical simulation of Human Thermoregulatory Response to Different Environment Conditions**

- Modeling of human thermoregulation.
- Quantification of human stress.
- Resulted in 1 journal paper and 6 conference proceedings papers.
- Resulted in one doctoral dissertation

### **5. Development of Techniques for Measurement of Heat of Combustion for Fuels Oxygen Concentration in High Speed Wind-Tunnels, and Thermal Contact Resistance Using Liquid Crystals.**

- Funded by NASA Langley.

- Developed in collaboration with NASA researchers a new on-line method for measurement of fuel gas mixtures. This method has potential for applications for the natural gas transmission industry where knowledge of heat of combustion is important.
- A fast response oxygen monitoring system has been developed in collaboration with NASA researchers to monitor oxygen concentration in the test section of the eight-foot high temperature tunnel at NASA Langley Center.
- Developed a technique for measuring thermal contact resistance by employing liquid crystals.
- Developed a novel technique for skin friction measurement in wind tunnel environment utilizing polymer dispersed liquid crystals.
- Development of a model for analyzing evaporation, and diffusion of super critical liquid oxygen (LOX) injected into a high pressure stream. A CFD model, accounting for droplet phase, turbulence, non-ideal gas behavior and super critical nature of LOX was developed to solve the problem numerically.
- Resulted in two journal papers, one NASA technical paper, six proceeding papers.
- Resulted in one doctoral dissertation and one Masters thesis.
- Resulted in one U.S. Patent.
- Resulted in five NASA Certificate of Recognition and cash awards.

## **SUPERVISION OF GRADUATE STUDENTS**

Dr. Chaturvedi, has mentored many graduate students. He has supervised to completion doctoral dissertations of five Ph.D. students and theses of several master's students in topics related to fluid, thermal and energy engineering. Three of his doctoral students are employed as faculty in universities across Virginia.

### **PH.D. DISSERTATIONS SUPERVISED**

A. Almogbel, "Modeling of Human Thermal Regulation in Controlled Environments," May 2004 (holds faculty position in Saudia Arabia).

A. Alfahaid, "Computational Analysis of Vent Flow and Thermal Comfort Conditions in Rooms," Dec. 2000. (Currently Director General in Ministry of Education, Saudi Arabia)

A. Kheireddine, "Numerical Prediction of Turbulent Diffusion Flame formed by Cylindrical Tube Injector, Sept. 1996. (Currently Vice-President, AM Telecom)

D. T. Chen, "Numerical Modeling of Buoyancy "Driven Flows in Enclosures," Completed, 1993. (Currently Associate Professor at James Madison University)

T. O. Mohieldin, "Numerical Modeling of a Cylindrical Fuel Injector," 1992. (Currently Full-Professor at Old Dominion University)

H. Chegini, "Injection, Evaporation and Diffusion of Supercritical LOX in a High Pressure Air Stream," May 1989. (Currently Associate Professor at Hampton University).

### **M.S. THESES/M.E. PROJECTS SUPERVISED**

V. Gagani, "Simulation and Thermo-Economic Solar-Assisted Heat Pump System for Domestic Analysis of Water Heating Application," December 2007.

S. Sreedharan, "A Study Correlating Entropy Generation to Parameters Characterizing Thermal Comfort in a Conditioned Space," December 2006.

D. Andreyka, "A Holistic Analysis of Residential Solar Hot Water Heating Systems," December 2006.

K. Kadempalli, "Cost Estimation Software for Injection Molding," May 2006.

A. Chandorkar, "Design of Single Valve Test Fixture for Visualization of Atomization Across the Valve Surface," August. 2005.

R. Kothamasa, "Modal Analysis and Validation of a Gasoline Fuel Injector Using Ansys and Laser Vibrometer," December 2004.

S. Hariharan, "Spray Simulation Inside the Intake Port of a Port Injected Gasoline Engine," December 2004.

C. F. Gorozabel, "Numerical Calculation of Cooling Loads," May 2002.

W. Aziz, "A Study of the Thermodynamic and Heat Transfer Characteristics of Two-Phase Two-Component Flow with Application to A Solar-Assisted Heat Pump," 1994.

S. Ericsson, "Prediction of Refrigerant Properties and Heat Pump Cycle Thermal Performance Using Several Equations of State," 1992.

Wen Wei, "Mixing Characteristics of An Oxygen Injector Operating Under Non-Ideal Conditions," 1990.

T. O. Mohieldin, "Numerical Computation of Natural Convection Motion in Two-and Three-Dimensional Cavities," 1987.

S. Fouladi-Semnani, "Solar-Assisted Heat Pumps for Low Temperature Industrial Process heat Application," 1985.

G. C. Huang, "Combined Forced and Free Convection in the Trombe Wall Channel," February 1985.

M. Abazeri, “Long-Term system performance of a Direct Expansion Solar-Assisted Heat Pump,” 1985.

H. Chegini, “An Experimental and Analytical Investigation of Friction Factors for Fully Developed Flow in Internally Finned Triangular Ducts,” June 1984.

F. Ghaffari, “An Analytical Design Procedure for the Determination of Effective Leading Edge Extensions for Thick Delta Wings,” March 1984.

J. Shen, “Experimental Investigation of a Direct Expansion Solar-Assisted Heat Pump,” May 1982.

Y. F. Chiang, “Analysis of Two Phase Flow Solar Collectors with Applications to Heat Pump,” June 1980.

## **KEY CONTRIBUTIONS/INNOVATIONS IN TEACHING AND CURRICULUM DEVELOPMENT**

### **Video-Help Sessions**

One of Dr. Chaturvedi’s key contributions to undergraduate teaching at Old Dominion University is the development of video help sessions for two undergraduate courses, namely Thermodynamics I (ME 311) and Thermodynamics II (ME 312). These Video-Assisted Learning and Understanding Enhancement (VALUE) tapes, used frequently by students as a supplementary tool, provide opportunities for students to achieve a deeper understanding of many difficult concepts in thermodynamics. Using two faculty development grants from the Office of Academic Affairs at ODU (\$2700 in 1997 and \$3000 in 1994), he developed six one-hour video-taped help sessions each for thermodynamics I and II courses. The instructional network at ODU, TELETECHNET, provided technical assistance for taping of the sessions.

### **Development of Virtual Engineering Laboratories**

Dr. Chaturvedi, along with his colleagues from two other engineering departments, has taken the lead role in developing virtual engineering laboratories for undergraduate mechanical engineering program. This cutting edge technology, once developed, will facilitate offering of web-based undergraduate engineering programs.

### **Global Engineering Minor**

Dr. Chaturvedi chaired the College Global Engineering Taskforce from 1998 to 2000. A proposal for a new minor titled “Global Engineering in an Interconnected World” was developed and implemented. The minor is geared towards engineering undergraduate students who would like to pursue careers with multi-national companies. Courses in this multi-disciplinary minor emphasize challenges and opportunities faced by project teams working in a global and culturally diverse environment.

## **UNIVERSITY, COLLEGE AND DEPARTMENT SERVICE**

Dr. Chaturvedi has served on nearly 70 department, college and university committees, many as the chair of committees.

### **Chairmanship of Department Committees**

Chairperson, Department Graduate Committee/Graduate Program Director, 1987-90, 1993-97.

- During the period, the department graduate enrollment, as well as quality of students, improved considerably due to vigorous recruitment activities.
- During 1994, he initiated the Masters program in Design and Manufacturing. This program has become very successful, and currently it has enrollment of about 30 graduate students.

Senator, University Faculty Senate, 1986-87.

Chairperson, Dept. Graduate Committee, 1987-90, 1993-97.

Chairperson, four Ph.D. dissertation Committee, 1987-90.

Chairperson, four Ph.D. Guidance Committees, 1986-90.

Chairperson, 12 M.S. Thesis Committees, 1982-90.

Chairperson of MEM Fluid-Thermal Subcommittee for Revision of Undergraduate Courses, (1984-85). After an exhaustive review of undergraduate courses, recommendations were made to the chairperson regarding prerequisites, elimination of overlapping materials and introduction of new subject material in courses.

Chairperson, MEM Dept. Tenure and Promotion Committee, 1992-93. The Committee was responsible for evaluating annual performance of tenure track faculty members. Served as mentor to junior faculty members.

### **Membership of Dept. Committees**

Dept. Tenure and Promotion Committee (four years)

Dept. Resource Committee (1984-1986)

Dept. Undergraduate Committee (1979-1986), Five times, (1994-96)

Dept. Executive Committee (Spring, 1988)

Fifteen M.S. Thesis Committees of students of other faculty members (1983-96)

Ten Ph.D. Dissertation Committees of students of other faculty members (1983-2000)

Coordinator for preparing undergraduate courses for ABET visit (1985). As a one-person committee, he was responsible for collecting and displaying materials for four different courses for the ABET visit.

Advisor – University Minority Engineering Program (1989-90)

MEM 394 Laboratory Committee (1984)

Ad Hoc Planning Committee

Dept. Graduate Committee (1990-91, 1994-97)

Dept. Overhead Research Committee (1991-93)

Advisor, ASME Student Chapter (1992-94)

Dept. Presidential Fellowship Committee (1995-97)

## **College Service**

Chair, College Global Engineering Taskforce (1998-2000)  
Member, College Graduate/Research Committee (1987-1990)  
Member, College Graduate Committee (1993-96)  
Chair, College Graduate Committee (1995-96)  
Member, College Tenure and Promotion Committee (1994-97)  
Chair, College Faculty Load Committee (1992-93). The Committee did an exhaustive faculty load analysis, and made recommendations to the Dean concerning faculty teaching loads.

## **University Service**

Coordinator, Asian/Asian-American Advisory Council, 2001-Present  
Member, Provost Search Committee, 2001-2003  
Member, Outstanding Faculty Award Committee, 2001-2003  
President, Asian-Asian American Faculty Caucus (1996-98).  
University Tenure and Promotion Committee, 1996-97  
Presidential Asian/Asian-American Advisory Council, 1995-2000  
University Suspension and appeals Committee, 1994-96  
Presidential Advisory Committee on Equal Opportunity and Affirmative Action (1992-93)  
University Library Collection Management Committee (1988-89). As a member of the sub-committee, he participated in development of guidelines for resource allocations amongst various university departments.  
University Library Collection Management Committee (1987-88)  
University Library Committee (1986-88)  
University Graduate Committee (1984-85)  
University Recognition committee (1983-84)  
University Resource Committee (1981-82)  
University Interdisciplinary Committee (1979-81)

## **SERVICE TO THE PROFESSION**

1. Member, ASME "Heat Pump" Technical Committee, 1990-92.
2. Member, ASME "Multi-Phase" Committee, 1990-92.
3. Co-chaired Technical Session in the Gas-Liquid Symposium during the 1990 joint ASME-JSME Conference at Portland, Oregon.
4. Faculty Advisor, ASME Student Chapter at Old Dominion University, 1990-92. During that period the chapter grew in membership to 80, a fairly large number for a small department.
5. Served as reviewer of technical papers to the following journals or professional society divisions:

AIAA Journal of Thermophysics and Heat Transfer  
Solar Energy Journal  
ASHRAE Proceedings  
ASME Solar Energy Division

ASME Advanced Energy Division  
ASME Heat Transfer Division  
ASME Journal of Heat Transfer  
ASME Journal of Energy Resource Technology