MIHIR SEN

CURRICULUM VITAE

Notre Dame, Indiana
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Professor
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Educational Background

Undergraduate

1963–1968
Bachelor of Technology in Mechanical Engineering (First Class)
Indian Institute of Technology, Madras, India
Thesis project: Design of a four-stage radial compressor
Advisor: Dr.-Ing. W. Scheer

Graduate

1968–1970
Department of Mechanics
The Johns Hopkins University
Baltimore, Maryland
Thesis: Design, construction and experiments with a hot-wire anemometer vorticity meter
Advisor: Professor L.S.G. Kovásznay

1970–1974
Doctor of Science with specialization in Fluid Mechanics
Department of Aeronautics and Astronautics, Massachusetts Institute of Technology, Cambridge, Massachusetts
Thesis: Interaction between scales in the problem of wave generation by wind
Advisor: Professor E. Mollo-Christensen (Department of Meteorology)
Doctoral Committee: Professor D.J. Benney (Department of Mathematics), Professor M.T. Landahl (Department of Aeronautics and Astronautics), Professor S. Widnall (Department of Aeronautics and Astronautics)

Continuing Education Courses

1. Finite Element Analysis in Fluid Dynamics, one-week course organized by the Center for Continuing Education in Engineering, University of Texas, Austin, Texas, July 1979. Professors: J.T. Oden, Univ. of Texas, Austin; T.J. Chung, Univ. of Alabama, Huntsville; A.J. Baker, Univ. of Tennessee, Knoxville.
2. Non-Linear Partial Differential Equations, one-week course organized by the Faculty of Engineering, U.N.A.M., March 1980. Professor: W.F. Ames, Georgia Institute of Technology, Atlanta.
3. Fundamentals of Compressed Air Systems, June 1999, one-day course organized by the Department of Energy.

Scholarships and Fellowships

1. Merit Scholarship, Indian Institute of Technology, Madras, India, 1963–1968.
2. Whitehead Fellowship, The Johns Hopkins University, Baltimore, MD, academic year 1968–1969.
3. Du Pont Memorial Fellowship, Massachusetts Institute of Technology, Cambridge, MA, academic year 1970–1971.

Professional Experience

Predoctoral

1. Practical Training, Larsen & Toubro, Ltd., Bombay, India, two months 1967.
2. Research Assistant to Professor L.S.G. Kovásznay, The Johns Hopkins University, Baltimore, MD, 1969–1970.
3. Teaching Assistant to Professor W.S. Lewellen, Massachusetts Institute of Technology, Cambridge, MA, one semester 1971.
4. Research Assistant to Professor E. Mollo-Christensen, Massachusetts Institute of Technology, Cambridge, MA, 1971–1974.

Postdoctoral

1. Post-doctoral Fellow, Department of Meteorology, Massachusetts Institute of Technology, Cambridge, MA, Oct. 1974–Feb. 1975.
2. Professor Titular A[1], Faculty of Engineering, National University of Mexico (U.N.A.M.), Mexico City, 1975–1976.
3. Visiting Professor, Faculty of Engineering, National University of Mexico (U.N.A.M.), Mexico City, 1976–1978.
4. Professor Titular B[2], Faculty of Engineering, National University of Mexico (U.N.A.M.), Mexico City, 1978–1981.
5. Professor Titular C Definitivo[3], Faculty of Engineering, National University of Mexico (U.N.A.M.), Mexico City, 1981–1986.
6. Visiting Professor, Sibley School of Mechanical and Aerospace Engineering, Cornell University, Ithaca, NY, 1985–1986 (while on sabbatical from U.N.A.M.).
7. Associate Professor, Department of Aerospace and Mechanical Engineering, University of Notre Dame, Notre Dame, IN, Aug. 1986– (tenured1989).
8. Full Professor, Department of Aerospace and Mechanical Engineering, University of Notre Dame, Notre Dame, IN, Aug. 1994–.

Consulting and Other Activities

1. Research Consultant to the Department of Solar Energy, Institute of Materials Research, National University of Mexico (U.N.A.M.), Mexico City, 1981–1983.
2. Research Consultant to the Institute of Engineering, National University of Mexico (U.N.A.M.), Mexico City, 1984–1985.
3. Consultant to Sundstrand Heat Transfer, Inc., Dowagiac, Michigan, summer 1989.
4. Consultant to the Industrial Assessment Center, University of Notre Dame, 1996–2000.
5. University of Notre Dame London Program, Aug.–Dec. 2000, 2004.
6. Sabbatical at the Department of Thermo and Fluid Dynamics, Chalmers University of Technology, Göteborg, Sweden, Jan.–Aug. 2001.
7. Summer research, Department of Thermo and Fluid Dynamics, Chalmers University of Technology, Göteborg, Sweden, May–July 2002.

[1]Roughly corresponds to Assistant Professor.
[2]Roughly corresponds to Associate Professor.
[3]Roughly corresponds to Full Professor with tenure.

Professional Recognition and Honors

1. Appointed National Researcher (Level II) by the National Research System (SNI) of the Government of Mexico, July 1984.
2. National Academy of Engineering (Mexico), Elected Coordinator for Mechanical Engineering (1980–1983).
3. Appointed Associate Ed for America, International Journal of Heat and Technology, published by CNR, Italy, 1986.
4. Listed in
   (a) Who's Who in Technology, 6th Edition, (Ed.) A.L. Unterburger, Gale Research, Detroit, 1988–1989.
   (b) Who's Who among Asian Americans, Gale Research, Detroit, MI, 1994.
   (c) American Men and Women of Science, R.R. Bowker, New Providence, N.J., 1995–1996.
   (d) The International Directory of Distinguished Leadership, American Biographical Institute, Raleigh, NC, 1994.
   (e) Who's Who in Science and Engineering, Third Edition, 1996–1997, Marquis Who's Who, New Providence, NJ, 1996.
   (f) Who's Who in the World, Seventeenth Edition, 2000, Marquis Who's Who, New Providence, NJ, 1996.
   (g) Lexington Who's Who Registry, 1999/2000 Edition, Garden City, NJ.
5. Elected Fellow of the ASME, 1999.
6. "Master Mentor," University of Notre Dame, 1999.
7. Fulbright Visiting Lecturer, Department of Mechanical Engineering, Indian Institute of Technology, Kanpur, India, April–May, 2000.
8. Kaneb Teaching Award, College of Engineering, University of Notre Dame, 2001.
9. Rev. Edmund P. Joyce, C.S.C., Award for Excellence in Undergraduate Teaching, 2009.

Professional Membership and Service

Membership

1. American Society for Mechanical Engineers (ASME), Student Member (1968–1970), Associate Member (1977–1979), Member (1979–1999), Fellow (1999–).
2. American Society for Engineering Education (ASEE), Member (1977–).
3. M.I.T. Chapter of the Society of the Sigma Xi (1973).
4. Institution of Engineers (India), Member (1978–).
5. National Academy of Engineering (Mexico), Life Member (1978–).
6. American Physical Society (APS), Member (1982–).
7. Combustion Institute (Mexican Section), Member (1982–1985).
8. Mexican Society of Heat Transfer (affliated to the International Society) Founder Member (1983–), Vice-President (1983–1985).
9. New York Academy of Science, Member (1985–1986).
10. American Association for the Advancement of Science (AAAS), Member (1986–).
11. Society for Industrial and Applied Mathematics (SIAM), Member (1986–).

Professional Activities

1. National Academy of Engineering (Mexico): Organizer of Mechanical Engineering sessions in Annual Congresses (1980–1983), President of Organizing Committee for VIII Annual Congress in Torreón, Mexico, 1982.
2. Second Mexican National Symposium on Thermal Sciences (1985): Member of Organizing Committee.
3. Mexican Society of Heat Transfer (affiliated to the International Society): Vice-President (1983–1985).
4. Selected by ASME to check ABET requirements in Mexican engineering schools.
5. Member of Steering Committee, Mid-West Fluid Mechanics Retreat, 1989–1990.

6. Chairman of session on Thermofluids, XVII Congress of the National Academy of Engineering (Mexico), Monterrey, Mexico, Sept. 1991.
7. Member of International Organizing Committee, First International Thermal Energy Congress, Marrakesh, Morocco, June 1993.
8. Chairman of sessions on (a) Hydraulic and Other Equipment, and (b) Heat and Mass Transfer, in II Latinamerican Conference on Turbomachinery, Cuernavaca, Mexico, Feb. 1993.
9. Member of International Committee, and Chairman of (a) Plenary and (b) Natural and Mixed Convection Sessions, in First International Thermal Energy Congress, Marrakesh, Morocco, June 1993.
10. Member of Latin American Committee on Heat and Mass Transfer (1996–).
11. Member of Scientific Committee, Seventh Latin American Congress on Heat and Mass Transfer, Salta, Argentina, Oct., 1998.
12. Member of Organizing Committee, 52nd Annual Meeting, American Physical Society Division of Fluid Dynamics, New Orleans, LA, 1999.
13. Co-organizer, Minisymposium on Turbulence as a Dynamical System, 2nd Annual Meeting, American Physical Society Division of Fluid Dynamics, New Orleans, LA, 1999.
14. Coordinating Scientist for USA, 5th ISHMT-ASME Heat and Mass Transfer Conference and 16th National Heat and Mass Transfer Conference, Calcutta, Jan. 2002.
15. Member of Scientific Committee, Eighth Latin American Congress on Heat and Mass Transfer, Veracruz, Mexico, 2001.
16. Member of Organizing Committee, Ninth Latin American Congress on Heat and Mass Transfer, San Juan, Puerto Rico, Oct. 2002.
17. Co-Organizer, Symposium on Flow Manipulation for Heat Transfer Enhancement, ASME 2nd Joint U.S.-European Fluids Engineering Summer Meeting, July 17–20, 2006, Miami, FL.
18. Co-Organizer, Symposium on Flow Manipulation and Active Control in the 5th Joint ASME/JSME Fluids Engineering Summer Conference, Jul. 30–Aug. 02, 2007, San Diego, CA.
19. Co-Organizer, Third Symposium on Flow Manipulation and Active Control in the ASME Fluids Engineering Division Summer Conference, Aug. 10–14, 2008, Jacksonville, FL.

Service at National University of Mexico

1. Appointed by the Council and Director of the Faculty of Engineering, National University of Mexico (U.N.A.M.), Mexico City, as Member of the Committee on Appointments and Promotions of the Division of Graduate Studies (1981–1984).
2. Appointed by the Head of the Division of Mechanical and Electrical Engineering, National University of Mexico (U.N.A.M.), Mexico City, as Coordinator of all Fluid Mechanics courses (1981–1985).
3. Commissioned by the Mexican Council of Science and Technology (CONACYT) to visit India and write a report on the state of Indian science and technology (1981).
4. Member of Examining Board for the students of the Faculty of Engineering, U.N.A.M., External Member for Anahuac University and Iberoamericana University, Mexico.
5. Member of Examining Board for promotion of professors of the Metropolitan University and the National School for Professional Studies, Mexico.

Service at Notre Dame

1. Mechanical Engineering Undergraduate Curriculum Committee (1988–97).
2. Faculty advisor for Departmental Graduate Student Conference (1987–1989).
3. College of Engineering Computational Methods Advisory Committee (1988).
4. College of Engineering Fluid Mechanics and Transport Phenomena Advisory Committee (1988).
5. Elected to Department of Aerospace and Mechanical Engineering Committee on Appointments and Promotions (1989–1992, 1992–1995, 1995–1998, 1998–2001, 2007–2010).
6. Department of Aerospace and Mechanical Engineering Graduate Studies Committee (1989–1992, Director 1990–1992).
7. Graduate School Liaison for minority students (1993–1994).
8. Member of Search Committee for Associate Provost (1995).

9. Member of Search Committee for Chairman of Department of Aerospace and Mechanical Engineering (1996).
10. College of Engineering Undergraduate Studies Committee (1993–1996, 1999–2002).
11. Elected College of Engineering representative to University Committee on International Studies (1993–1998).
12. Elected member of the College of Engineering Council (1998–2001).
13. Elected member of the University Graduate Council (1998–2001).
14. Member of the Department Honesty Committee (2001–2002).
15. Elected member of the University Academic Council (2002–2005).
16. Member of University Committee on Libraries (2003–2004).
17. Member of University Council for Academic Technologies (2006–2007).

Short Courses Taught

Faculty of Engineering, National University of Mexico

1. Partial differential equations, intersemestral course for staff and students, 1976.
2. Introduction to measurement systems, intersemestral course for staff and students, 1979.
3. Dynamic measurement, part of a course on Stress Measurements in Continuum Mechanics organized by the Center for Continuing Education of the Faculty of Engineering, 1978.
4. Finite elements in thermofluids, part of a course on Finite Elements in Mechanical Engineering organized by the Center for Continuing Education of the Faculty of Engineering, April 1982, March 1983, March 1984 and Feb. 1985.
5. Numerical methods applied to thermofluids problems, intersemestral course for staff and students, Nov. 1983.
6. Thermal control, two-day course for graduate students, Oct. 2003.

Other Institutions

1. Mechanics of fluids, in the Technical Week of Electromechanical Engineering, Regional Technological Institute, Juchitán, Oaxaca, Mexico, March 1978.
2. Fluid mechanics, part of the course Fundamentals of Mechanical Engineering for the staff of the University of Zacatecas, Zacatecas, Mexico, April 1978.
3. Experimental methods, part of a course on Continuum Mechanics, Ninth Engineering Week, University of Querétaro, Querétaro, Mexico, Dec. 1980.
4. Heat transfer, course given to the staff of the Regional Technological Institute, Querétaro, Mexico, Dec. 1980.
5. Applied mathematics, part of a course on Nuclear Technology organized by the National Institute of Nuclear Research, Mexico City, Mexico, July 1980.
6. Hot-wire and hot-film anemometry, course organized by the University of Michoacán, Morelia, Mexico, Sept. 1981.
7. Boundary layer theory, course organized by the Faculty of Higher Studies, Cuautitlán (U.N.A.M.), Mexico, April 1982.
8. Hot-wire and laser Doppler anemometry, course organized by the Metropolitan University, Mexico City, Mexico, June 1982.
9. Experimental methods in fluid mechanics, course given to the staff of the Regional Technological Institute, Hermosillo, Sonora, Mexico, Aug. 1982.
10. Heat transfer, course organized by the Faculty of Higher Studies, Cuautitlán, U.N.A.M., Mexico, April 1983.
11. Numerical methods in fluid mechanics, part of a course in Fluid Mechanics given to the graduate students of the University of Guanajuato, Salamanca, Mexico, Aug. 1984.
12. Lectures on stability, Bifurcations and Chaos in Thermal Systems, Oct. 19–23, 1992, Universidad Simón Bolívar, Caracas, Venezuela.
13. Modeling by intelligent systems, June 7–11, 2007, 10 hours, Universidad Politécnica de Valencia in Alcoy, Spain.

Journal and Proposal Review

1. National Academy of Engineering (Mexico) Annual Congress: Occasional reviewer in Thermofluids area (1977–).
2. Applied Mechanics Review, published by the ASME: Reviewer (1983).
3. International Journal of Heat and Technology, published by Pitagora Editrice, Bologna, Italy, under the auspices of the National Research Council of Italy (CNR): Member of the Editorial Advisory Board (1983–), Associate Editor for America (1986–).
4. Revista de la Sociedad Mexicana de Ingeniería Mecánica, Member of Editorial Committee (2003–).
5. Occasional reviewer for the following journals: Geotermia, Mexican Federal Electricity Commission; Journal of the National Academy of Engineering (Mexico); Ingeniería Mecánica: Tecnología y Desarrollo, SOMIM; International Journal of Heat and Mass Transfer, Pergamon Press; Numerical Heat Transfer, Hemisphere Publishing Corporation; Experimental Thermal and Fluid Science, Elsevier; Advances in Water Resources, CML Publications; American Institute of Aeronautics and Astronautics Journal, AIAA; Journal of Thermophysics and Heat Transfer, AIAA; Journal of Fluid Mechanics, Cambridge University Press; Mechanics Research Communications, Pergamon Press; Journal of Fluids Engineering, ASME; Physics of Fluids, American Institute of Physics; Chemical Engineering Science, Elsevier; Chemical Engineering Communications, Gordon and Breach; Journal of Heat Transfer, ASME; American Institute of Chemical Engineers Journal, AIChE; Chaos, American Institute of Physics; Numerical Methods for Partial Differential Equations, Wiley; International Journal of Modelling and Simulation, IASTED; Aerosol Science and Technology, Taylor & Francis; International Journal for Numerical Methods in Engineering, Wiley; Experiments in Fluids, Springer; Heat Transfer Engineering, Taylor & Francis; Revista de la Sociedad Mexicana de Física, SMF; Journal of Enhanced Heat Transfer, Gordon and Breach; International Journal of Control and Intelligent Systems, ACTA Press; Acta Mechanica, Springer; Microscale Thermophysical Engineering, Taylor & Francis; Journal of Petroleum Science & Engineering, Elsevier; Applied Thermal Engineering, Elsevier; Experimental Heat Transfer, Taylor & Francis; Transactions on Components and Packaging Technologies, IEEE; International Journal of Vehicle System Modelling and Testing, Interscience Publishers; Lasers in Surgery and Medicine, Wiley.
6. Proposals reviewed for: National Science Foundation; Dutch Stichting voor Fundamental Onderzoek der Materie; Mexican National Council for Science and Technology (CONACYT); Idaho Board of Education Specific Research Grant Program; Department of Defense Experimental Program to Stimulate Competitive Research; University of Notre Dame Faculty Research Program; Petroleum Research Fund; Center for Indoor Air Research; Mexican Petroleum Institute (IMP); Council for International Exchanger of Scholars (Fulbright Scholars), National Sciences and Engineering Research Council of Canada, Los Alamos National Laboratory.

Publications

CHAPTERS IN BOOKS (REFEREED)

1. The influence of developments in dynamical systems theory on experimental fluid mechanics, Sen, M., in *Frontiers in Experimental Fluid Mechanics,* (Ed.) M. Gad-el-Hak, Lecture Notes in Engineering, Springer-Verlag, Berlin, Germany, Vol. 46, pp. 1–23, 1989.
2. Chaotic mixing for heat transfer enhancement, H.-C. Chang and M. Sen, in *Applied Chaos,* (Eds.) J.H. Kim, J. Stringer, John Wiley & Sons, New York, Chap. 6, pp. 175–188, 1992.
3. One-dimensional modeling of thermosyphons with known heat flux, M. Sen, C. Treviño and E. Ramos, in *Trends in Heat, Mass and Momentum Transfer,* (Eds.) J. Menon, Council of Scientific Research Integration, Trivandrum, India, Vol. 2, pp. 161–172, 1992.
4. Capillary tube boiling, M. Sen, in *Experiments in Heat Transfer and Thermodynamics,* (Ed.) R.A. Granger, Cambridge University Press, Cambridge, U.K., pp. 127–134, 1994.
5. Chaotic particle paths and heat transfer in internal flows, M. Sen and H.-C. Chang, in *Towards the Harnessing of Chaos,* (Ed.) M. Yamaguti, Elsevier, Amsterdam, Holland, pp. 397–400, 1994.

6. Applications of artificial neural networks and genetic algorithms in thermal engineering, M. Sen and K.T. Yang, Section 4.24, pp. 620–661, in *The CRC Handbook of Thermal Engineering,* (Ed.) F. Kreith, CRC Press, Boca Raton, FL, 2000.
7. Soft computing in control, M. Sen and J.W. Goodwine, Chapter 14, pp. 1–37, in *The MEMS Handbook,* (Ed.) M. Gad-el-Hak, CRC Press, Boca Raton, FL, 2nd ed., 2006.
8. Dynamics of large rings of coupled Van der Pol oscillators, M.A. Barrón, M. Sen and E. Corona, in *Innovations and Advanced Techniques in Systems, Computing Sciences and Software Engineering,* (Ed.) K. Elleithy, Springer, pp. 346-349, 2008.

JOURNAL PUBLICATIONS (REFEREED)

9. Cooling of a thin flat plate of high conductivity exposed to a laminar convective flow (in Spanish), C. Treviño and M. Sen, *Journal of the Mexican Petroleum Institute,* Vol. XII, No. 2, pp. 73–79, 1980.
10. Effects of chemical recombination on the flow of a reactive mixture (in Spanish), C.Treviño and M. Sen, *Electromecánica,* Vol. 5, No. 2, pp. 4–7, 1980.
11. Effect of plate thermal resistance on boundary layer ignition, C. Treviño and M. Sen, *Combustion and Flame,* Vol. 43, pp. 121–129, 1981.
12. Dynamic analysis of a one-dimensional thermosyphon model, M. Sen and C. Treviño, *Journal of Thermal Engineering,* Vol. 3, No. 1, pp. 15–20, 1982.
13. Effect of Prandtl number on boundary layer ignition, C. Treviño and M. Sen, *Combustion and Flame,* Vol. 46, pp. 211–212, 1982.
14. Ignition criteria in boundary layer flows, C. Treviño and M. Sen, *Latin American Journal of Heat and Mass Transfer,* Vol. 6, No. 4, pp. 235–250, 1982.
15. Numerical solution of the stability equation of a one-dimensional conductive system with phase change, R. Avila, M. Sen and J. Cervantes, *American Journal of Heat and Mass Transfer,* Vol. 7, No. 2, pp. 173–185, 1983.
16. One-dimensional thermosyphon analysis, M. Sen and C. Treviño, *Latin American Journal of Heat and Mass Transfer,* Vol. 7, No. 2, pp. 135–150, 1983.
17. The toroidal thermosyphon with known heat flux, M. Sen, E. Ramos and C. Treviño, *International Journal of Heat and Mass Transfer,* Vol. 28, No. 1, pp. 219–233, 1985.
18. Catalytic combustion in stagnation-point flow, C. Treviño and M. Sen, *Wärme-und Stoffübertragung,* Vol. 19, pp. 159–166, 1985.
19. One-dimensional modeling of multiple loop thermosyphons, M. Sen and J. L. Fernández, *International Journal of Heat and Mass Transfer,* Vol. 28, No. 9, pp. 1788–1790, 1985.
20. A steady-state analysis for variable area one-and two-phase thermosyphons, E. Ramos, M. Sen and C. Treviño, *International Journal of Heat and Mass Transfer,* Vol. 28, No. 9, pp. 1711–1719, 1985.
21. On the steady-state velocity of the inclined toroidal thermosyphon, M. Sen, E. Ramos and C. Treviño, *ASME Journal of Heat Transfer,* Vol. 107, No. 4, pp. 974–977, 1985.
22. Catalytic combustion in monolith reactors, C. Treviño and M. Sen, *Chemical Engineering Science,* Vol. 41, No. 9, pp. 2253–2260, 1986.
23. Two-phase natural circulation in a toroidal loop, E. Manero, M. Sen and E. Ramos, *Wärme und Stoffübertragung,* Vol. 21, pp. 41–49, 1987.
24. Natural convection in a thin horizontal porous annulus, M. Sen and K.E. Torrance, *International Journal of Heat and Mass Transfer,* Vol. 30, No. 4, pp. 729–739, 1987.
25. Numerical study of natural convection in a tilted rectangular porous material, S.L. Moya, E. Ramos and M. Sen, *International Journal of Heat and Mass Transfer,* Vol. 30, No. 4, pp. 741–756, 1987.
26. Natural convection in a semi-elliptical cavity, E. Martin del Campo, M. Sen and E. Ramos, *Numerical Heat Transfer,* Vol. 12, No. 1, pp. 101–119, 1987.
27. Linear stability of a cylindrical falling film, F.J. Solorio and M. Sen, *Journal of Fluid Mechanics,* Vol. 183, pp. 365–377, Oct. 1987.
28. Single-phase natural circulation in a tilted square loop, R. Acosta, M. Sen and E. Ramos, *Wärme-und Stoffübertragung,* Vol. 21, No. 5, pp. 269–275, 1987.
29. A one-dimensional model of a thermosyphon with known wall temperature, M. Gordon, E. Ramos and M. Sen, International Journal of Heat and Fluid Flow, Vol. 8, No. 3, pp. 177–181, Sept. 1987.

30. Multiple steady-states for unicellular natural convection in an inclined porous layer, M. Sen, P. Vasseur and L. Robillard, *International Journal of Heat and Mass Transfer,* Vol. 30, No. 10, pp. 2097–2113, 1987.
31. Thermal degasification of ammonia in a porous generator, M. Sen, R. Best and I. Pilatowsky, *Applied Scientific Research,* Vol. 44, No. 3, pp. 341–359, 1987.
32. Turbulent convection in helicoidal tubes, M. Chávez, W. Zhixue and M. Sen, *Wärme-und Stoffübertragung,* Vol. 22, No. 1–2, pp. 55–60, 1988.
33. Simple modeling procedure for estimation of cyclonic wind speeds, J. Sánchez-Sesma, J. Aguirre and M. Sen, *ASCE Journal of Structural Engineering,* Vol. 114, No. 2, pp. 352–370, 1988.
34. Initial behavior of solutions to the Lorenz equations, W. Fiszdon and M. Sen, *International Journal of Non-Linear Mechanics,* Vol. 23, No. 1, pp. 53–66, 1988.
35. Analytical and experimental study of steady-state convection in a double loop thermosyphon, M. Sen, D. Pruzan and K.E. Torrance, *International Journal of Heat and Mass Transfer,* Vol. 31, No. 4, 709–722, 1988.
36. Analysis of laminar natural convection in a triangular enclosure, E. Martín del Campo, M. Sen and E. Ramos, *Numerical Heat Transfer,* Vol. 13, No. 3, pp. 353–372, 1988.
37. Flow in conjugate natural circulation loops, O. Salazar, M. Sen and E. Ramos, *AIAA Journal of Thermophysics and Heat Transfer,* Vol. 2, No. 2, pp. 180–183, 1988.
38. Parallel flow convection in a tilted two-dimensional porous layer heated from all sides, M. Sen, P. Vasseur and L. Robillard, *Physics of Fluids,* Vol. 31, No. 12, pp. 3480–3487, 1988.
39. An inflow-outflow characterization of inhomogeneous permeable beds, M. Sen and K.T. Yang, *Transport in Porous Media,* Vol. 4, pp. 97–104, 1989.
40. The effect of axial conduction on a thermosyphon with prescribed heat flux, M. Sen, E. Ramos, C. Treviño and O. Salazar, *European Journal of Mechanics, B/Fluids,* Vol. 8, No. 1, pp. 57–72, 1989.
41. The Brinkman model for natural convection in a shallow porous cavity with uniform heat flux, P. Vasseur, C.H. Wang and M. Sen, *Numerical Heat Transfer, Part A: Applications,* Vol. 15, No. 2, pp. 221–242, 1989.
42. Longitudinal and transverse dimensions of an incipient jet driven by a constant head, M. Sen, J. Hernández and J. Cervantes, *Experiments in Fluids,* Vol. 8, pp. 107–109, 1989.
43. Thermal instability and natural convection in a fluid layer over a porous substrate, P. Vasseur, C.H. Wang and M. Sen, *Wärme-und Stoffübertragung,* Vol. 24, pp. 337–347, 1989.
44. Natural convection in an inclined rectangular porous slot: the Brinkman extended Darcy model, P. Vasseur, C.H. Wang and M. Sen, *ASME Journal of Heat Transfer,* Vol. 112, No. 2, pp. 507–511, 1990.
45. Low-Reynolds number flow over a rotatable cylinder-splitter plate body, J.C. Xu, M. Sen and M. Gad-el-Hak, *Physics of Fluids A,* Vol. 2, No. 11, pp. 1925–1927, 1990.
46. Analytical investigation of Benard-Marangoni convection heat transfer in a shallow cavity filled with two immiscible fluids, C.H. Wang, M. Sen and P. Vasseur, *Applied Scientific Research,* Vol. 48, pp. 35–53, 1991.
47. Heat transfer enhancement due to slender recirculation and chaotic transport between counter-rotating eccentric cylinders, S. Ghosh, H.-C. Chang and M. Sen, *Journal of Fluid Mechanics,* Vol. 238, pp. 119–154, 1992.
48. The periodicity of droplets emanating from interconnected orifices, D.M. Weis, P.F. Dunn and M. Sen, *Experiments in Fluids,* Vol. 13, pp. 257–266, 1992.
49. Heat transfer enhancement in coiled tubes by chaotic mixing, N. Acharya, M. Sen and H.-C. Chang, *International Journal of Heat and Mass Transfer,* Vol. 35, No. 10, pp. 2475–2489, 1992.
50. Dynamic Analysis of a Hemispherical Dome Levitated by an Air Jet, M. Sen, *Applied Mathematical Modelling,* Vol. 17, No. 5, pp. 226–235, 1993.
51. Dynamics of a rotatable cylinder with splitter plate in uniform flow, J.C. Xu, M. Sen and M. Gad-el-Hak, *Journal of Fluids and Structures,* Vol. 7, No. 4, pp. 401–416, 1993.
52. Thermal entrance length and Nusselt numbers in coiled tubes, N. Acharya, M. Sen and H.-C. Chang, *International Journal of Heat and Mass Transfer,* Vol. 37, No. 2, pp. 336–340, 1994.
53. Analysis of natural convection in a rotating open loop, M.A. Stremler, D.R. Sawyers and M. Sen, *AIAA Journal of Thermophysics and Heat Transfer,* Vol. 8, No. 1, pp. 100–106, 1994.
54. Numerical and experimental investigation of flow past a freely rotatable square cylinder, T. Zaki, M. Sen and M. Gad-el-Hak, *Journal of Fluids and Structures,* Vol. 8, No. 6, pp. 555–582, 1994.

55. Application of chaotic advection to heat transfer, H.-C. Chang and M. Sen, *Chaos, Solitons and Fractals,* Vol. 4, No. 6, pp. 955–975,1994 (also in *Chaos Applied to Fluid Mixing,* Eds. H. Aref, M.S. El Naschie, pp. 211–231, Pergamon Press, 1995).
56. Analysis of a square natural convective loop, C. Treviño and M. Sen, *European Journal of Mechanics, B/Fluids,* Vol. 13, No. 5, pp. 591–611, 1994.
57. A multilevel wavelet collocation method for solving partial differential equations in a finite domain, O.V. Vasilyev, S. Paolucci and M. Sen, *Journal of Computational Physics,* Vol. 120, pp. 33–47, 1995.
58. Statistics of boiling in a capillary U-tube, D.R. Kabele, M. Sen and P.F. Dunn, *International Communications in Heat and Mass Transfer,* Vol. 23, No. 1, pp. 34–44, 1996.
59. A novel pump for MEMS applications, M. Sen, D. Wajerski and M. Gad-el-Hak, *ASME Journal of Fluids Engineering,* Vol. 118, No. 3, pp. 624–627, 1996.
60. Effect of chaotic interfacial stretching on bimolecular chemical reaction in helical-coil reactors, D.R. Sawyers, M. Sen and H.-C. Chang, *The Chemical Engineering Journal,* Vol. 64, No. 1, pp. 129–139, 1996.
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62. Effect of tube-to-tube conduction on plate-fin and tube heat exchanger performance, R. Romero-Méndez, M. Sen, K.T. Yang and R.L. McClain, *International Journal of Heat and Mass Transfer,* Vol. 40, No. 16, pp. 3909–3916, 1997.
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37. Effect of delay in heating and cooling systems, G. Díaz, S. Basu, M. Sen, K.T. Yang and R.L. McClain, Proceedings of the Eurotherm No. 53, Advanced Concepts and Techniques in Thermal Modelling, pp. 41–42, 1997.
38. The use of MEMS-based sensors for measuring wall-shear stress, P. Johansson, L. Löfdahl, M. Sen and M. Gad-el-Hak, American Physical Society Fluid Dynamics Meeting, 1998.
39. The use of MEMS-based sensors for measuring wall-shear stress, P. Johansson, L. Löfdahl, M. Sen and M. Gad-el-Hak, Proceedings of the Annual Swedish Days of Mechanics (Svenska Mekanikdagar) 1999 (SMD-99), eds. H. Alfredsson, Paper No. 4.5.b, Swedish National Committee for Mechanics, 7–9 June, KTH Högskoletryckeriet, Stockholm, Sweden, 1999.
40. Artificial intelligence in heat transfer, K.T. Yang and M. Sen, Journal of Heat Transfer, Millennium Edition, 2000.
41. Modeling of thermal sensors for wall-shear stress, P. Johansson, A. Bakchinov, L. Löfdahl, M. Sen and M. Gad-el-Hak, American Physical Society Fluid Dynamics Meeting, Vol. 44, No. 8, p. 181, 1999.

42. Thermal sensors for wall-shear stress: Reality and Myth, L. Löfdahl, P. Johansson, A. Bakchinov, M. Sen and M.Gad-el-Hak, American Physical Society Fluid Dynamics Meeting, Bulletin of the APS, Vol. 44, No. 8, p. 181, 1999.
43. Simulation of heat exchanger performance by artificial neural networks, G. Díaz, M. Sen, K.T. Yang and R.L. McClain, ASHRAE Winter Meeting, Dallas, TX, Feb. 2000.
44. An analytical solution to the conjugate heat transfer problem of a thermal wall-shear-stress sensor, C.-F. Stein, Peter Johansson, J. Bergh, L. Löfdahl, M. Sen, M. Gad-el-Hak, American Physical Society Fluid Dynamics Meeting, 2000.
45. Reducibility, emergence and the mathematical modeling of complex systems, M. Sen, PanIIT Research Symposium, Chennai, India, !Dec. 19–20, 2008.
46. A two-dimensional model of particle motion in ureteral peristaltic flow, J. Jiménez-Lozano, M. Sen, P.F. Dunn, ASME 2009 Summer Bioengineering Conference, Lake Tahoe, CA, June 2009.

Invited Lectures and Seminars

1. Numerical methods in fluid mechanics, Regional Technological Institute, Merida, Mexico, 1979.
2. Chaotic behavior in convective flows, Second School of Statistical Physics, Oaxtepec, Mexico, 1983.
3. One-dimensional analysis of thermosyphons, Mechanical Engineering Department, Indian Institute of Technology, New Delhi, India, July 1985.
4. One-dimensional modeling of natural convection loops, Seminar in Mechanics Series, Department of Civil Engineering, McGill University, Montreal, Canada, April 9, 1986.
5. Natural convection in a thin horizontal porous snnulus, Hydrodynamics Laboratory, Ecole Polytechnique, Montreal, Canada, April 10, 1986.
6. One-dimensional modeling of natural convection loops, Department of Mechanical Engineering, State University of New York, Stony Brook, NY, March 1986.
7. Some characteristics of unicellular convection, Department of Mechanical Engineering and Applied Mechanics, University of Pennsylvania, Philadelphia, PA, Dec. 2, 1987.
8. Periodicity and bifurcation in boiling, Aug. 16, 1989, Solar Energy Laboratory, Temixco, Mexico.
9. Natural convection in rectangular cavities with the parallel flow approximation, Aug. 23, 1989, Solar Energy Laboratory, Temixco, Mexico.
10. Chaotic mixing for heat transfer enhancement and other applications, H.-C. Chang and M. Sen, Workshop on Applications of Chaos, EPRI Office of Exploratory Research, San Francisco, Dec. 1990.
11. Relation between theory and experimentation in Research, Oct. 23, 1992, Universidad Simon Bolivar, Caracas, Venezuela.
12. Chaotic advection and heat transfer, Dec. 3, 1992, Solar Energy Laboratory, Temixco, Mexico.
13. Stability of flow in a rotating open loop thermosyphon, Feb. 18, 1993, II Latin American Conference on Turbomachinery, Cuernavaca, Mexico.
14. Chaotic advection with heat transfer, invited keynote presentation, June 9, 1993, First International Thermal Energy Congress, Marrakesh, Morocco.
15. Chaotic particle paths and heat transfer in coiled tubes, June 11, 1993, Ecole Nationale d'Industrie Minerale, Rabat, Morocco.
16. Chaotic particle paths and heat transfer in internal flows, Seventh Toyota Conference 1/2 Towards the Harnessing of Chaos, Lake Hamana, Shizuoka, Japan, Toyota Motor Corporation, Nov. 3, 1993.
17. Thermoacoustic machines, invited keynote presentation, 5th Latin American Congress of Heat and Mass Transfer, Caracas, Venezuela, Oct. 24–27, 1994.
18. Chaos and heat transfer, participation by invitation, American Society of Mechanical Engineers, Winter Annual Meeting, Chicago, Nov. 6–11, 1994.
19. Effect of chaotic advection on heat transfer, Faculty of Mechanical, Electrical and Electronic Engineering, University of Guanajuato, Salamanca, Mexico, Aug. 22, 1994.
20. Application of chaos theory in heat transfer, as part of New Frontiers in Mechanical Engineering, Division of Graduate Studies, Faculty of Engineering, National University of Engineering, Mexico City, Mexico, Aug. 22–26, 1994.
21. Chaotic advection and heat transfer, invited panelist in Panel on Chaotic Heat Transfer, ASME International ME Congress and Exposition, Chicago, Nov. 7, 1994.

22. Application of artificial intelligence to thermal engineering, Institute Lecture, Indian Institute of Technology, Kanpur, May 10, 2000.
23. Transport processes in heat exchangers, Department of Mechanical Engineering, Indian Institute of Technology, Kanpur, May 24, 2000.
24. Chaos and complexity in convective heat transfer, Department of Thermo and Fluid Dynamics, Chalmers University of Technology, Göteborg, Sweden, 2001.
25. Thermal control, Department of Mechanical Engineering, Purdue University, Nov. 7, 2002.
26. The fractional derivative and some thermofluid applications, Center for Energy Research, Temixco, Mexico, Oct. 22, 2003.
27. The fractional derivative and some thermofluid applications, Universidad Autónoma de San Luis Potosí, San Luis Potosí, Mexico, Oct. 24, 2003.
28. Control of HVAC systems, March 13, 2007, Kuwait University, Kuwait.
29. Analysis and control of complex thermo-mechanical systems, March 18, 2007, Kuwait University, Kuwait.
30. Analysis of simple and complex systems, Universidad Autónoma de San Luis Potosí, San Luis Potosí, March 30, Mexico, 2007.
31. From the simple to the complex: An engineer's perspective, Distinguished Lecture Series, Virginia Commonwealth University, Richmond, VA, April 23, 2007.
32. (a) Mathematical modeling of simple and complex systems, (b) Intelligent systems in engineering, March 5, 2008, Universidad Autónoma de Querétaro, Querétaro, Mexico.

Patent

1. Process and apparatus for enhancing in-tube heat transfer by chaotic mixing, M. Sen and H.-C. Chang, U.S. Patent No. 5,311,932, May 17, 1994.

Courses Taught at the University of Notre Dame

Undergraduate

1. Differential Equations and Applied Mathematics
2. Thermal Systems
3. Fluid Mechanics
4. ME Senior Design Project
5. Compressible Flow
6. Heat Transfer
7. Food Processing Engineering
8. Fluid Mechanics Laboratory
9. Measurements Laboratory
10. Introduction to Engineering Systems I and II
11. Engineering Analysis
12. Energy Systems

Graduate

1. Mathematical Methods I
2. Introduction to Chaotic Dynamics
3. Intermediate Fluid Mechanics
4. Intermediate Heat Transfer
5. Intelligent Systems
6. Thermal Convection

Courses Taught at Other Universities

Faculty of Engineering, National University of Mexico

Undergraduate:

1. Mechanics of Fluids I
2. Mechanics of Fluids II
3. Mechanics of Fluids III
4. Elements of Fluid Mechanics
5. Dynamics of Fluids
6. Heat Transfer
7. Thermodynamics
8. Applied Thermodynamics

Graduate:

1. Mechanics of Ideal Fluids
2. Mechanics of Viscous Fluids
3. Experimental Methods
4. Random Phenomena in Fluid Mechanics
5. Hydrodynamic Instability and Turbulence
6. Fundamentals of Fluid Mechanics
7. Advanced Topics in Fluid Mechanics
8. Geophysical Flows
9. Experimental Methods in Fluid Mechanics
10. Numerical and Approximate Methods in Fluid Mechanics
11. Advanced Topics in Heat Transfer
12. Two-Phase Heat Transfer

Cornell University

Undergraduate

1. Senior Mechanical Engineering Laboratory

Master's Theses Supervised

1. Non-Linear Interaction between Shallow Water Waves, J.L. Samaniego, 1978.
2. Analysis of the Transient Behavior of a Thermosyphon, J.A. Rojas, 1980.
3. Characteristics of Circular Jets, E. Rincón, 1981.
4. Approximate Stability Analysis for a Cylindrical Falling Film, F.J. Solorio, 1982.
5. Numerical Solution of Natural Convection in Cavities, S.L. Moya, 1983.
6. Natural Convection in Semi-Elliptical Cavity, E. Martín del Campo, 1984.
7. Flow in Conjugate Thermosyphon Loops, O. Salazar, 1984.
8. Maximum Cyclonic Wind Speeds, J. Sánchez-Sesma, 1985.
9. Starting Characteristics of Round Jets, J. Hernández, 1987.
10. Natural Convection in a Tilted Trapezoidal Enclosure, V. Kumar, 1987.
11. Deterministic Chaos in Nucleate Boiling, N. Acharya, 1989.
12. Analysis of Flow over Fixed and Rotatable Cylinder-Splitter Plate Body (Co-Director), J.C. Xu, 1990.
13. Experimental and Numerical Investigation of Flow Past a Freely Rotatable Square Cylinder (Co-Director), T.G. Zaki, 1991.
14. A Two-Dimensional Model for an Evaporative Falling Film with Deposition (Co-Director), M. Núñez, 1994.
15. Analytical and Numerical Study of Solidification by Convective Cooling with Void Formation, Z. Yang, 1994.

16. Performance of a Single-Row Heat Exchanger at Low In-Tube Flow Rates (Co-Director), X. Zhao, 1995.
17. Development of Computational Algorithms for Forced and Mixed Convection in Coiled Tubes in a Fin-Tube Heat Exchanger (Co-Director), Q. Shi,1997.
18. Dynamic Modeling and Thermal Control of Multi-Room Cooling, Z. Xiao, 1999.

Doctoral Dissertations Supervised

1. Ignition Processes of Premixed Gases in Boundary Layer Flows, César Treviño, 1980.
2. Linear Stability of a Cylindrical Falling Film of Liquid: Theoretical and Experimental Study, Francisco J. Solorio, 1989.
3. Experimental and Numerical Investigation of Heat Transfer Enhancement by Chaotic Mixing, Narasimha Acharya, 1992.
4. Mathematical Modeling of Thermocompressive and Thermoacoustic Machines (Co-Director), Driss Omari, 1996.
5. Heat Transfer Enhancement by Regular and Chaotic Mixing in Laminar Channel Flow, David R. Sawyers, 1997.
6. Study of External Heat Transfer Mechanisms in Single-Row Fin and Tube Heat Exchangers, Ricardo Romero-Méndez, 1998.
7. Simulation and Control of Heat Exchangers using Artificial Neural Networks, Gerardo Díaz, 2000.
8. Simulation of Compact Heat Exchangers using Global Regression and Soft Computing, Arturo Pacheco-Vega, 2002.
9. Temperature Controllability in Cross-Flow Heat Exchangers and Long Ducts, Sorour Alotaibi, 2003.
10. Hydrodynamics and Control in Thermal-Fluid Networks, Walfre Franco, 2003.
11. Nonlinear Dynamics of Thermal-Hydraulic Networks, Weihua Cai, 2006.
12. Linear Stability of Electron-Flow Hydrodynamics in Ungated Semiconductors, Williams Calderón Muñoz, 2009.
13. Peristaltic Flow with Application to Ureteral Biomechanics, Joel Jiménez Lozano, 2009.