



## **Prof. (Dr.) Harish Hirani**

**Director, CSIR-Central Mechanical Engineering Research Institute**  
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### **VISION**

In my vision, an integrated leadership is required to raise the level of organization so that its every employee feels proud to work tirelessly for sustainable development. This can only be achieved by adopting multi-pronged approach: innovations for poorest of poor, science for industrial economics, and inventions in cutting edge technologies to remain sustainable in India as well as in abroad.

As per my understanding, investment on human resource in the government institutions is huge and there is a need to find competitive advantage of this investment. Self-sustainability of government institutions, an ambitious target, is the foremost requirement to streamline the human resource. It is easier to change duties/tasks given to employees compared to changing employees, therefore the focus must be to identify rising stars and gauge their leadership. Apart from placing the best employees in strategic positions, there is need to place average performers in support positions and establish a rigorous disciplined but respectful process for dealing with low performing staff. All this is possible only by continuously interacting with human resources. In other words, my vision is to inspire, motivate, encourage and facilitate the scientific as well as administrative staff to become capable to plan, conceive, design and realize systems that fulfils the need of Indian society and thus serves this great nation and be an asset to the whole world and be revered for his/her innovativeness, intelligence and service to the mankind. To achieve this goal, on one hand choosing "right people in the right role" is required and on other hand "indigenization" and "overall economics" suited to Indian Societal conditions shall be emphasized so that innovative tailor made products as well as process for Indian masses can be provided. A mission to give impetus to develop technologies for societal benefit to help ease the daily lives of the common India is a must. I am sure that if young minds are appropriately guided and motivated, our India can be transferred into a prosperous, self-reliant and developed nation.

In my opinion, there is need to have continuous dialogue with important stakeholders and line ministries to market the science and technology invented at government intuitions. Often these technologies do not culminate into economic, user friendly, high-quality solutions, therefore a paradigm shift in attitude and action of scientists is the need of the hour to match with the dynamic highly competitive industry thriving on innovative solutions. There is a need to spread science awareness and use science of management economics to help farmers and small scale industries. In other words, there is exigency to build an incubator consisting of a network of laboratory facilities and resources spread across various institutions of the country so that enthusiast learner and innovator can participate. This could be used as a sanctuary by pro- social and altruistic job-seekers, temporarily employed learners in informal (agricultural and MSME) sectors that can easily access the required resources without the fear of failures, as analysis of failure is also a stepping stone to success. The incubator will facilitate the problem obviation for Indian masses and/or disadvantageous people and will go a long way in generating feasible solutions (that are indigenious and cost effective) to the societal, technological and environmental issues confronting the nation.

## RESEARCH INTEREST

Tribology, Inclusive Innovation, Rural Development

## DATE OF BIRTH

April 25, 1969

## EDUCATION

Sl.	Degree/ Certificate	Year of Passing	University/Institute	Subjects
1.	BOYSCAST Fellowship	2004 (Six Months)	Massachusetts Institute of Technology, Cambridge, USA	Innovative Tribo-Design (Innovation + Tribology + Axiomatic Design)
2.	Ph.D. (Doctor of Philosophy)	1999 (01/1994 to 04/1999)	Indian Institute of Technology Delhi, INDIA	Mechanical Design (Theoretical and Experimental Studies on Design of Dynamically Loaded Journal Bearing)
3.	M.E. (Master's Degree)	1994	Indian Institute of Technology, Roorkee (Formerly known as University of Roorkee), INDIA	Machine Design
4.	B. E. (Bachelor's Degree)	1992	Rajasthan Technical University (Formerly known as Government College of Engineering, Kota), INDIA	Mechanical Engineering

## PROFESSIONAL EXPERIENCE

Sl.	From	To	Name of Organization	Position held
1.	March 2016	Present	CSIR-Central Mechanical Engineering Research Institute	Director
2.	June 2014	Present	Indian Institute of Technology Delhi, India	Professor
3.	December 2008	May 2014	Indian Institute of Technology Delhi, India	Associate Professor
4.	April 2007	November 2008	Indian Institute of Technology Bombay, India	Associate Professor
5.	February 2001	March 2007	Indian Institute of Technology Bombay, India	Assistant Professor
6.	December 1999	January 2001	Indian Institute of Technology Bombay, India	Lecturer, Senior grade

## ACADEMIC/RESEARCH EXPERIENCE/EMPLOYMENT

Sl.	From	To	Name of Organization	Position held
1.	March 2016	Present	CSIR-Central Mechanical Engineering Research Institute	Director
2.	June 2014	Present	Indian Institute of Technology Delhi, India	Professor
3.	December 2008	May 2014	Indian Institute of Technology Delhi, India	Associate Professor
4.	April 2007	November 2008	Indian Institute of Technology Bombay, India	Associate Professor
5.	February 2001	March 2007	Indian Institute of Technology Bombay, India	Assistant Professor
6.	January 2004	June 2004	Massachusetts Institute of Technology, Cambridge, USA	Visiting Researcher
7.	December 1999	Jan 2001	Indian Institute of Technology Bombay, India	Lecturer, Senior Grade
8.	December 1998	November 1999	Indian Institute of Technology Delhi, India	Research Associate
9.	Jan 1994	November 1998	Indian Institute of Technology Delhi, India	Research Assistant

## EXECUTIVE EDUCATION COURSES

Sl.	Name of the Programme / Year	Duration of the Programme	Title / content of Session
1.	Organized for industry participants	September 05-08, 2000	Creative Design
2.	Organized for industry participants	June 19-21, 2001	Advanced Tribology
3.	Organized for industry participants	December 14-16, 2001	CAD/CAM/CAE Training
4.	Organized for engineering faculty	February 12-16, 2002	Innovation Through Computer Integrated Design
5.	Organized for engineering faculty	September 16-20, 2002	Innovative Tribo-Design
6.	Organized for industry participants	June 03-06, 2003	Creative Problem Solving
7.	Organized for industry participants	April 02-04, 2008	Gear Tribology
8.	Organized National Conference (60+ delegates)	December 11-12, 2009	Tribology of Automotive Systems
9.	Organized for Engineering Faculty	May 10-14, 2010	Tribology in Practice
10.	Organized for Engineering Faculty	December 13-17, 2010	Design Innovation
11.	Organized for Engineering Faculty	February 13-17, 2012	Advanced Tribology
12.	Training Programme for ONGC Maintenance Engineers, ONGC, Vadodara	February 14-16, 2012	Course on Lubricants for Maintenance Engineers
13.	Organised Short Course for Hero Motocorp Ltd.	June 23-24, 2012	Design of IC Engine Component
14.	Organised Short Course for Hero Motocorp Ltd.	June 30 - July 01, 2012	Design of IC Engine Component
15.	Training for ONGC Engineers, Vadodara	October 14-16, 2012	Course on Tribology

16.	Training Programme for ONGC Executive, ONGC, Dehradun	February 28 - March 01, 2013	Course on "standards and Measurement of Customer Satisfaction"
17.	Technical Services, School of Maintenance Practices	September 30 - October 03, 2013	Course on Tribology
18.	TEQIP + QIP course	December 07-11, 2015	Fundamentals of Engineering Tribology with Applications
19.	TEQIP + QIP course	December 14-18, 2015	Make in India: Innovative Product Design
20.	Training Programme on Tribology for ONGC Engineers, ONGC, Vadodara	February 29 - March 02, 2016	Course on Tribology

**NOTE:** The short term courses are convenient to attend. The course generates the curiosity, which sharpen the brain activity and may provide good solution for the Midlife crisis.

## AWARDS

1. 'Durgapur Sanman' in appreciation of excellent contribution of incomparable wisdom participation in combating Covid-19 and people care affected by pandemic Covid-19 from TV News 10, a unit of BBN
2. Recognition for Outstanding Vision, Leadership & Contribution in the Field of Engineering Innovation and R&D Management (2019), The Institute of Engineers (India)
3. Award for Distinguished Contribution to Tribo-Design field (2017), Chandigarh University
4. Reorganization as an Eminent Engineer for outstanding Talent, Vision and Leadership in the field of Engineering & Technology (2016), The Institute of Engineers (India)
5. Fellow of The Institute of Engineers (FIE), The Institute of Engineers (India)
6. Best paper award (2010), International Conference on Industrial Tribology
7. Best paper award (2006), International Conference on Industrial Tribology
8. Best paper award (2004), International Conference on Industrial Tribology
9. Best poster award (2004), International Conference on Industrial Tribology
10. Best Hostel Resident Award (1997-98), Shivalik Hostel, IIT Delhi
11. Roll of Honor (1997-98), Shivalik Hostel, IIT Delhi
12. Silver Medal, Squash (1994-95), IIT Delhi
13. Merit scholarship in II & III year B.E. (1989-1991)

## HONOURS

1. Chief Speaker of the Webinar on 'Advancements in Water-RO Purifications and Opportunities of Manufacturing in Rajasthan', jointly organised by MSME-DI, Jaipur, World Trade Centre, Jaipur and Water Trade Association of Rajasthan, September 29, 2020.
2. Chief Guest of the Webinar on 'Vishwa Bandhutya: Bharatiya Sankalpana', organised by Vivekananda Kendra Kanyakumari, Paschim Bang Prant, Shantiniketan Vibhag, September 19, 2020.
3. Speaker of the Webinar on Technological Innovators & Innovations to deal with the New Normal in COVID-19 pandemic, September 13, 2020.
4. Chief Speaker of the 'Samagra Shiksha', a webinar on "Scientific & Technological Interventions by CSIR-CMERI Combating COVID-19" for J&K Students, September 08, 2020.
5. Chief Speaker of the Webinar on Assessing R&D Needs & Development of Import Substitute in Farm Machineries for MSMEs, MSME-DI, Ludhiana, August 25, 2020.
6. Chief Guest of International Short term Course on Tribology & Sustainability on August 24, 2020.
7. Chief Speaker of the Webinar on New Technologies for various Products related to COVID 19 for MSMEs with focus of Water Purification Technologies, MSME-DI, Patna, August 07, 2020.

8. Expert talk on 'Design Thinking to Rural Sustainable Development' in 'International Conference on Recent Advancements in Design and Manufacturing (ICRADM-2020)', July 16-17, 2020 at Sardar Vallabhbhai National Institute of Technology, Surat, Gujarat.
9. Chief speaker of the webinar on 'Technologies developed by CSIR-CMERI', organised by Indo Danish Tool Room, Jamshedpur, MoMSME, Gol and MSME-DI, Ranchi, MoMSME, Gol, July 11, 2020.
10. Chief Guest of National Conference on Modeling, Analysis and Simulation at Indian Institute of Technology (ISM), Dhanbad on December 17, 2019.
11. Key note address on 'Integrity – A way of life' as Guest of Honour at ISP, Burnpur on November 02, 2019.
12. Chief Guest of 'World Habitat Day' programme at the Institution of Engineers (India), Durgapur Centre on October 20, 2019.
13. Keynote speech in 'National Symposium on Waste Management and Resource Circulation (NSWMRC-2019)', August 09-10, 2019 at National Institute of Technology, Durgapur.
14. Chief Guest of Orientation workshop on Unnat Bharat Abhiyan at NIT, Durgapur on July 25, 2019.
15. Chief Guest of the Global Meet 2019 of Students Activity Centre, January 13, 2019, NIT Durgapur.
16. Plenary talk speaker in the international conference on Tribology 'TRIBOINDIA-2018', December 13-15, 2018 at Department of Mechanical Engineering, Veermata Jijabai Technological Institute, Mumbai.
17. Eminent Resource Persons of National Conference on Application of Optimization Techniques to Engineering and Management Sciences November 15-16, 2018 at NSHM Knowledge Campus, Durgapur.
18. Keynote speech on Engineers' Day observed at SAIL-DSP, September 15, 2018, Durgapur.
19. Chief Guest of Foundation Day Ceremony of Bengal College of Engineering & Technology, Durgapur on September 03, 2018.
20. Chief Guest at Nehru Yuva Kendra on August 29, 2018
21. Chief Guest at NSHM on August 11, 2018
22. Guest of Honour of all India seminar on 'Innovative Technical Education' organised by Durgapur Local Centre, April 20-21, 2018, Durgapur.
23. Keynote speaker in 'Recent Advances on Materials for Sustainable Energy-2018 (RAMSE-2018)', March 03-05, 2018 at Department of Applied Chemistry, Indian Institute of Technology (ISM), Dhanbad.
24. Chief Guest of 50<sup>th</sup> Engineers' Day celebration at Institution of Engineers, Kolkata on September 15, 2017
25. Guest of Honour of the Foundation Day Ceremony at Bengal College of Engineering & Technology on September 03, 2017.
26. Guest of Honour of the workshop on "Innovative Custom Hiring of Farm Machinery" at Kolkata held on May 26, 2017.
27. Chief Guest at DIATM, Rajbandh on April 03, 2017
28. Chief Guest at New Horizon on March 24, 2017
29. NIT, Durgapur Chief Guest on March 15, 2017
30. Guest of Honour at All India Seminar on Enabling Sustainable Development in Mechanical Engineering in the Context of Make in India organized at Durgapur Institute of Advanced Technology & Management, Durgapur on March 03, 2017.
31. Chief Guest at NSHM on February 16, 2017
32. Keynote lecture on 'Maintenance Free Flywheel Using Magnetic Bearing' in International Conference on Advances in Tribology (ICAT14), 2014, National Institute of Technology, Calicut, India.
33. Keynote address in Advances in Tribology, April 22-23, 2013, Manila, Philippines.
34. Keynote address in Advances in Tribology, September 03-04, 2013 at Novotel Accra City Centre, Ghana.
35. Keynote address on 'MR Fluids and its Applications', National Conference on 'Recent Advances in Mechanical Engineering (RAME-2013)', October 05, 2013, Roorkee, India.
36. Keynote address on 'Online Condition Monitoring of High Speed Gears using Vibration and Oil Analyses', in National Conference on Thermal, Fluid and Manufacturing Sciences (TFMS-2011), January 20-21, 2012, Surat, India

37. Keynote address in conference on 'Frontline of Tribology' organized by JAST, May 23-25, 2011 Tokyo, Japan.
38. Keynote address on 'Recent Developments and Applications of Eco-Friendly Lubricants', Conference on 'Recent Advances in Eco-Friendly Lubricants (RAIEFL-2010)', at Indian Institute of Science Bangalore, India.
39. Invited lecture on 'FLUID FILM LUBRICATION' in TRIBOLOGY: Friction, Wear and Lubrication, A Summer Professional Program, June 14-18, 2004, Massachusetts Institute of Technology, Cambridge, USA
40. Invited lecture on 'TRIBO-DESIGN' in TRIBOLOGY: Friction, Wear and Lubrication, A Summer Professional Program, June 14-18, 2004, Massachusetts Institute of Technology, Cambridge, USA

## **PROFESSIONAL MEMBERSHIP**

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1. Fellow of The Institute of Engineers (FIE) (Membership No.: F-1214884)
2. Life Member of Tribology Society of India (Membership No.: LM 3657)
3. Association of Machines and Mechanisms (Membership No.: LM 119)

## **MEMBER OF THE BOARD/COMMITTEE**

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1. Member of the Subject Expert Committee (Engineering Sciences) of Department of Science and Technology, Govt. of India for 'Fund for Improvement of S&T Infrastructure in Universities and other Higher Educational Institutions (2020-2024)
2. Member of the Research Council of CSIR-CLRI, Chennai (2020-2023)
3. Member of the National Advisory Committee of International Tribology Research Symposium on Impact of Tribology on Society (ITRS-2020)
4. Member of the Governing Body for the SATHI Centre, IIT Kharagpur
5. Member of the Apex committee to review the nomination for Institute Chair Professorship-2020 & A K Singh Chair Professorship-2020
6. Member of the Programme Advisory Committees (PAC) on 'Mechanical, Manufacturing, Aerospace Engineering & Robotics', Science and Engineering Research Board (SERB)
7. Advisory Board for LAB ANALYTIX WORLD EXPO 2021
8. Member of the National Advisory Committee of the International Conference on Synthesis, Characterization and Application of Nanomaterials (SCAN) organised by The Institution of Engineers (India), 2019
9. Member of the National Advisory Committee of the 10<sup>th</sup> International Conference on Advances in Metrology, AdMet-2019
10. Member of the Management Council of CSIR-CFTRI, Mysore, 2015-16
11. Member of the Research Council of CSIR-NAL, Bengaluru
12. Member of the Management Council of CSIR-NAL, Bengaluru
13. Member of the Research Council of CSIR-CSIO, Chandigarh
14. Board Member of Dr. B.C. Roy Engineering College, Durgapur
15. Member of the Advisory Committee Tribology of Materials and Manufacturing (TMM -2018)
16. Member of the National Advisory Committee of International Conference on Nanotechnology: Ideas, Innovations & Initiatives-2017
17. Expert of the evaluation committee for Gandhian Young Technological Innovation (GYTI) Awards 2016
18. Member of the Board of Studies of the Mechanical Engineering Department, BVB College of Engineering & Technology, Hubli

## PROFESSIONAL OUTPUTS / OUTCOMES

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### VIDEO LECTURES ON TRIBOLOGY

<http://web.iitd.ac.in/~hirani/> (total 42 lectures. Average number of views is 7000)

#### Top five lectures:

1. Lecture # 1, Introduction (50,343 views)
2. Lecture # 33, Bearing Clearance (38,367 views)
3. Lecture # 39, Journal Bearings (26,394 views)
4. Lecture # 31, Selection of Rolling Element Bearings (22,515 views)
5. Lecture # 41, Hydrodynamic Journal Bearings (18,420 views)

### WEB COURSES IN TRIBOLOGY

<http://www.nptel.ac.in/courses/112102015/>

### ORGANIZATION OF AICTE SPONSORED SHORT TERM COURSES (STC) UNDER QUALITY IMPROVEMENT PROGRAMME

Successfully organized 12 short term courses on topics like: Advanced Tribology, Advanced Machine Design, Innovative Tribo-design, Innovation in Maintenance Management, etc. A consistently active participation of Faculty members from various engineering institutes was witnessed from all over India. The course contents were designed to cover the basic concepts along with the case studies showcasing the current state of the art. Each course, of one or two-week duration created a platform for like-minded people together and was helpful in upgrading and enriching the knowledge of participants. Two fold benefits were evident: firstly, providing opportunities to spread knowledge to community and secondly, enriching the organizational capabilities.

### RESEARCH PAPER PUBLISHED

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Total Number of Publications: 155 (Details in Annexure-I)

#### LIST OF SELECTED PAPERS IN LAST 5 YEARS

1. Kunal Ghosh, Subhrojyoti Mazumder, Harish Hirani, Poulomi Roy and Nilrudra Mandal, **2021**, "Enhancement of dry sliding tribological characteristics of perforated ZTA ceramic composite filled with nano MoS<sub>2</sub> in high vacuum", *Journal of Tribology*, 143 (6), article no. 061401 (9 pages). <https://doi.org/10.1115/1.4048497>
2. S Paul, R Das, M Seth, H Hirani, N C Murmu and P Banerjee, **2020**, "A urea functionalized chemoreceptor for expeditious chromogenic recognition of toxic industrial pollutants Cu<sup>2+</sup> and CN<sup>-</sup> from real water sources and bio-fluids: Diagnosis of Wilson's disease from human urine", *Industrial & Engineering Chemistry Research*, <https://doi.org/10.1021/acs.iecr.0c02695>.
3. Paras Kumar and Harish Hirani, **2020**, "Misalignment effect on gearbox failure: An Experimental study", *Measurement*, <https://doi.org/10.1016/j.measurement.2020.108492>.
4. M Murmu, S K Saha, P Bhaumick, N C Murmu, H Hirani and P Banerjee, **2020**, "Corrosion inhibition property of azomethine functionalized triazole derivatives in 1 mol L<sup>-1</sup> HCl medium for mild steel: Experimental and theoretical exploration", *Journal of Molecular Liquids*, 313, article no. 113508.
5. K Ghosh, S Mazumder, B K Singh, H Hirani, P Roy and N Mandal, **2020**, "Tribological Property Investigation of Self-Lubricating Molybdenum-Based Zirconia Ceramic Composite Operational at Elevated Temperature", *Journal of Tribology*, 142(2), article no. 021704.

6. G Paul, H Hirani, T Kuila and N C Murmu, **2019**, "Nanolubricants Dispersed with Graphene and its Derivatives: An Assessment and Review of the Tribological Performance", *Nanoscale*, 11, pp. 3458-3483.
7. P Mahato, S K Mishra, M Murmu, N C Murmu, H Hirani and P Banerjee, **2019**, "A prolonged exposure of Ti-Si-BC nanocomposite coating in 3.5 wt% NaCl solution: Electrochemical and morphological analysis", *Surface and Coatings Technology*, pp. 0257-8972.
8. G Paul, S Shit, H Hirani, T Kuila and N C Murmu, **2019**, "Tribological behavior of dodecylamine functionalized graphene nanosheets dispersed engine oil nanolubricants", *Tribology International*, 131, pp. 605-619.
9. P Kumar, H Hirani and A K Agrawal, **2019**, "Effect of gear misalignment on contact area: Theoretical and experimental studies", *Measurement*, 132, pp. 359-368.
10. P Kumar, H Hirani and A K Agrawal, **2019**, "Modeling and simulation of mild wear of spur gear considering radial misalignment", *Iranian Journal of Science and Technology, Transactions of Mechanical Engineering*, 43 (Supplement 1), pp. 107-116.
11. S Bej, R Das, H Hirani, S Ghosh and P Banerjee, **2019**, "Naked eye detection of CN- from aqueous phase and other extracellular matrices: An experimental and theoretical approach mimicking logic gate concept", *New Journal of Chemistry*, 43(46), pp. 18098-18109.
12. P Kumar, H Hirani and A K Agrawal, **2018**, "Online condition monitoring of misaligned meshing gears using wear debris and oil quality sensors", *Industrial Lubrication and Tribology*, 70(4), pp. 645-655.
13. K P Lijesh, D Kumar and H Hirani, **2017**, "Synthesis and field dependent shear stress evaluation of stable MR fluid for brake application", *Industrial Lubrication and Tribology*, 69(5), pp. 655-665.
14. K P Lijesh and H Hirani, **2017**, "Design and Development of Permanent Magneto-Hydrodynamic Hybrid Journal Bearing", *Journal of Tribology*, 139(4), article no. 044501.
15. K P Lijesh, D Kumar and H Hirani\*, **2017**, "Effect of disc hardness on MR brake performance", *Engineering Failure Analysis*, 74, pp. 228-238.
16. C Sarkar and H Hirani\*, **2017**, "Experimental studies on magnetorheological brake containing plane, holed and slotted discs", *Industrial Lubrication and Tribology*, 69(2), pp. 116-122.
17. K P Lijesh, S M Muzakkir, H Hirani\* and GD Thakre, **2016**, "Control on wear of journal bearing operating in mixed lubrication regime using grooving arrangements", *Industrial Lubrication and Tribology*, 68, pp. 458-465.
18. K P Lijesh, S M Muzakkir and H Hirani\*, **2016**, "Failure mode and effect analysis of passive magnetic bearing", *Engineering Failure Analysis*, 62, pp. 1-20.

## BOOKS/BOOK CHAPTERS AUTHORED/EDITED

1. Harish Hirani, **2016**, "Fundamentals of Engineering Tribology with Applications", published by Cambridge University Press, Online ISBN: 9781107479975
2. Updated version of the article on "Failure of Sliding Bearings", by Harish Hirani as a part of an overall effort to update ASM Handbook Volume 11, Failure Analysis and Prevention is under process and expected to be published in 2021
3. Harish Hirani, **2017**, Chapter on "Friction and Wear of Sliding Bearings" in ASM Handbook, Volume 18: Friction, Lubrication, and Wear Technology, published by ASM International, ISBN: 978-1-62708-141-2
4. H Hirani\* and S S Goilkar, **2010**, Chapter on "Rotordynamic Analysis of Carbon Graphite Seals of a Steam Rotary Joint" in Book on IUTAM Symposium on Emerging Trends in Rotor Dynamics, pp. 253-262, published by Springer Netherlands, ISBN 978-94-007-0020-8

(Details in Annexure-II)



## NUMBER OF IPR GRANTED / APPLIED FOR & HIGHLIGHTS OF TRANSLATIONAL RESEARCH CONTRIBUTIONS

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- A. Number of Patent: 01 (granted) + 28 (applied for)
- B. Number of Copyright: 16 (granted) + 14 (applied for)
- C. Number of Design Registration: 04 (granted) + 14 (applied for)

(Details in Annexure-III)

## DISSERTATION SUPERVISED

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- 1. Ph.D. thesis supervised: 08
- 2. M.Tech. Thesis supervised: 30

(Details in Annexure-IV)



## Annexure-I

### RESEARCH PAPER PUBLISHED

#### SCI JOURNALS PUBLICATIONS

1. Kunal Ghosh, Subhrojyoti Mazumder, Harish Hirani, Poulomi Roy and Nilrudra Mandal, **2021**, "Enhancement of dry sliding tribological characteristics of perforated ZTA ceramic composite filled with nano MoS<sub>2</sub> in high vacuum", *Journal of Tribology*, 143 (6), article no. 061401 (9 pages). <https://doi.org/10.1115/1.4048497>
2. S Paul, R Das, M Seth, H Hirani, N C Murmu and P Banerjee, **2020**, "A urea functionalized chemoreceptor for expeditious chromogenic recognition of toxic industrial pollutants Cu<sup>2+</sup> and CN<sup>-</sup> from real water sources and bio-fluids: Diagnosis of Wilson's disease from human urine", *Industrial & Engineering Chemistry Research*, <https://doi.org/10.1021/acs.iecr.0c02695>.
3. Paras Kumar and Harish Hirani, **2020**, "Misalignment effect on gearbox failure: An Experimental study", *Measurement*, <https://doi.org/10.1016/j.measurement.2020.108492>.
4. M Murmu, S K Saha, P Bhaumick, N C Murmu, H Hirani and P Banerjee, **2020**, "Corrosion inhibition property of azomethine functionalized triazole derivatives in 1 mol L<sup>-1</sup> HCl medium for mild steel: Experimental and theoretical exploration", *Journal of Molecular Liquids*, 313, article no. 113508.
5. K Ghosh, S Mazumder, B K Singh, H Hirani, P Roy and N Mandal, **2020**, "Tribological Property Investigation of Self-Lubricating Molybdenum-Based Zirconia Ceramic Composite Operational at Elevated Temperature", *Journal of Tribology*, 142(2), article no. 021704.
6. G Paul, H Hirani, T Kuila and N C Murmu, **2019**, "Nanolubricants Dispersed with Graphene and its Derivatives: An Assessment and Review of the Tribological Performance", *Nanoscale*, 11, pp. 3458-3483.
7. P Mahato, S K Mishra, M Murmu, N C Murmu, H Hirani and P Banerjee, **2019**, "A prolonged exposure of Ti-Si-BC nanocomposite coating in 3.5 wt% NaCl solution: Electrochemical and morphological analysis", *Surface and Coatings Technology*, pp. 0257-8972.
8. G Paul, S Shit, H Hirani, T Kuila and N C Murmu, **2019**, "Tribological behavior of dodecylamine functionalized graphene nanosheets dispersed engine oil nanolubricants", *Tribology International*, 131, pp. 605-619.
9. P Kumar, H Hirani and A K Agrawal, **2019**, "Effect of gear misalignment on contact area: Theoretical and experimental studies", *Measurement*, 132, pp. 359-368.
10. P Kumar, H Hirani and A K Agrawal, **2019**, "Modeling and simulation of mild wear of spur gear considering radial misalignment", *Iranian Journal of Science and Technology, Transactions of Mechanical Engineering*, 43 (Supplement 1), pp. 107-116.
11. S Bej, R Das, H Hirani, S Ghosh and P Banerjee, **2019**, "Naked eye detection of CN<sup>-</sup> from aqueous phase and other extracellular matrices: An experimental and theoretical approach mimicking logic gate concept", *New Journal of Chemistry*, 43(46), pp. 18098-18109.
12. P Kumar, H Hirani and A K Agrawal, **2018**, "Online condition monitoring of misaligned meshing gears using wear debris and oil quality sensors", *Industrial Lubrication and Tribology*, 70(4), pp. 645-655.
13. K P Lijesh, D Kumar and H Hirani, **2017**, "Synthesis and field dependent shear stress evaluation of stable MR fluid for brake application", *Industrial Lubrication and Tribology*, 69(5), pp. 655-665.
14. K P Lijesh and H Hirani, **2017**, "Design and Development of Permanent Magneto-Hydrodynamic Hybrid Journal Bearing", *Journal of Tribology*, 139(4), article no. 044501.
15. K P Lijesh, D Kumar and H Hirani\*, **2017**, "Effect of disc hardness on MR brake performance", *Engineering Failure Analysis*, 74, pp. 228-238.
16. C Sarkar and H Hirani\*, **2017**, "Experimental studies on magnetorheological brake containing plane, holed and slotted discs", *Industrial Lubrication and Tribology*, 69(2), pp. 116-122.

17. K P Lijesh, S M Muzakkir, H Hirani\* and GD Thakre, **2016**, "Control on wear of journal bearing operating in mixed lubrication regime using grooving arrangements", *Industrial Lubrication and Tribology*, 68, pp. 458-465.
18. K P Lijesh, S M Muzakkir and H Hirani\*, **2016**, "Failure mode and effect analysis of passive magnetic bearing", *Engineering Failure Analysis*, 62, pp. 1-20.
19. K P Lijesh and H Hirani\*, **2015**, "Optimization of Eight Pole Radial Active Magnetic Bearing", *ASME Journal of Tribology*, 137(2), article no. 024502 (7 pages).
20. K P Lijesh and H Hirani\*, **2015**, "Magnetic Bearing Using Rotation Magnetized Direction Configuration", *ASME Journal of Tribology*, 137(4), article no. 042201 (11 pages).
21. K P Lijesh and H Hirani\*, **2015**, "Development of Analytical Equations for Design and Optimization of Axially Polarized Radial Passive Magnetic Bearing", *ASME Journal of Tribology*, 137(1), article no. 011103 (9 pages).
22. S M Muzakkir, K P Lijesh, H Hirani\* and G D Thakre, **2015**, "Effect of Cylindricity on the Tribological Performance of Heavily-Loaded Slow Speed Journal Bearing", *Proceedings of the Institution of Mechanical Engineers, Part J, Journal of Engineering Tribology*, 229(2), pp.178-195.
23. C Sarkar and H Hirani\*, **2015**, "Synthesis and Characterisation of Nano Silver Particle-based Magnetorheological Fluids for Brakes", *Defence Science Journal*, 65(3), pp. 252-258.
24. C Sarkar and H Hirani\*, **2015**, "Development of magnetorheological brake with slotted disc", *Proceedings of the Institution of Mechanical Engineers, Part D: Journal of Automobile Engineering*, 229(14), pp. 1907-1924.
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## Annexure-II

### **BOOKS/BOOK CHAPTERS AUTHORED/EDITED**

#### **BOOK ON TRIBOLOGY**

I have been successful in completing my Book on "**Fundamentals of Engineering Tribology with Applications**". Just completing this book has taught me a lot such as looking into minutest details and being my own worst critic by answering FAQs and generating multiple choice questions. Revisiting fundamentals and amalgamating it with my experience gained through the various consultancies and sponsored projects have left me with a deeper understanding and appreciation of the subject. I have realized that a Book is a medium to communicate with like-minded people who are viewing my perspective on a particular subject and it is most effective when it becomes user friendly and application based so I have included program coding at end of every section of my book.

The book is on "Tribology", which is related to friction, wear and lubrication of machine elements. Tribology not only deals with the design of fluid containment systems like seals and gasket but also with the lubrication of surfaces in relative motion. It helps in better understanding of design and maintenance of machine elements such as bearings, gears, cam-followers, hard disk drives, seals, pumps, compressors, etc. To calculate the load support by bearings, there is a need to study their structure and the nature of fluid flow.

The book presents detailed explanation on theories and applications of hydrodynamic thrust bearing, gas (air) lubricated bearing and elasto-hydrodynamic lubrication. It elucidates the concepts related to friction including coefficient of friction, friction instability and stick-slip motion. It clarifies the delusion that harder and cleaner surfaces produce better results in wear. Recent developments including Online Condition Monitoring (an integration of moisture sensor, wear debris and oil quality sensors) and Multigrid Technique are discussed in detail. It also provides design problems and their real life applications for cams, followers, gears and bearings. MATLAB programs, frequently asked and multiple choice questions are interspersed throughout the book for easy understanding of the topics.

#### **CHAPTER ON FRICTION AND WEAR OF SLIDING BEARINGS IN ASM HANDBOOK, VOLUME 18: FRICTION, LUBRICATION, AND WEAR TECHNOLOGY**

Bearings are usually provided where a specific spatial relationship (alignment) must be maintained between the parts or where a force is to be transmitted from one part to the other. This article introduces the general types and configuration of sliding bearings, bearing materials, and the practical aspects and solutions in the friction, lubrication, and wear mitigation of sliding bearings. The lubrication of bearings includes thick-film lubrication, thin-film lubrication, and boundary lubrication. The article concludes with a discussion on the effects of material elasticity on the lubrication of bearings.

## Annexure-III

### **IPR GRANTED / APPLIED FOR**

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## Annexure-IV

### DISSERTATION SUPERVISED

Teamwork, coordination and meeting deadlines has always been the strength of my research team especially my PhD scholars. To measure the effectiveness of my work, I am happy to see that I have more than 2150 citations on Google scholar. I do hope that my work is coming of use to other passionate researchers as me. I am also exploring newer horizons of knowledge with two of my students working in other departments.

#### PH.D. THESIS SUPERVISED

No. of PhD theses supervised Singly: 5 (\* marked)

No. of PhD theses supervised jointly: 3

Sl.	Title of the Thesis	Name	Year
*1	Hybrid (Permanent+Hydrodynamic) Bearing: Theoretical and Experimental Study	P Samanta	2007
*2	Synthesis and Application of Low Cost Magnetorheological (MR) Suspensions	V K Sukhwani	2007
3	Design of an Economical Mechanical Face Seal	S S Goilkar	2010
*4	Studies on Magnetorheological brake operating under compression and shear modes	C Sarkar	2014
*5	Studies on Heavily Loaded Slow Speed Journal Bearing	S M Muzakkir	2015
*6	Design and Development of Magnetic-Hydrodynamic Hybrid Journal Bearing	K P Lijesh	2016
7	Vibration and Wear Debris based Condition Monitoring of Spur Gearbox	Paras Kumar	2018
8	An MDM Framework for Modeling Changes in Construction Projects	S P Sreenivas Padala	2020

#### M.TECH. THESIS SUPERVISED

Sl.	Title of the Thesis	Name	Year
1	Wear resistance of textile machinery components	Somnath Basu	2000
2	Development of software for torsional vibration analysis of a tractor driveline	Ravi Kumar	2000
3	Design optimization of automobile chassis	Gowtham Goli	2000
4	Improvements in jute spinning machine flyer performance	Sadiq Basha Sahib	2001
5	Engine Journal Bearing	Kedar Kanse	2001
6	Optimal Placement of Actuators for Shape Control	Anurag Ganguli	2001
7	Analysis of piston ring friction	Prakash Kumar Jha	2001
8	Structural Optimization of Automotive Chassis	Roopesh Shroff	2001
9	Studies on corrosive wear mechanisms and models, design and fabrication of an experimental set-up and studies on an austenitic stainless steel	Suresh Babu	2002
10	Optimization of Journal Bearing Design Using Genetic Algorithms	S K Talluri	2002
11	Computer Simulation of Active Magnetic Bearing	Srajan Jain	2002
12	Design and development of Engine valve test rig	Dadaso Chavan	2003

13	Design and development of active magnetic bearing setup	Santosh Shankar	2003
14	Modified design of Jute Flyer	Sarang Satish Dani	2006
15	Analysis of thermal thinning and Shear thinning behavior of MR Fluid	Lt. Vijaya Lakshmi	2006
16	Implementation & performance evaluation of MR fluid variable valve mechanism on a real engine	Lt. Manjunatha C S	2006
17	Tribological study of elastomeric bearings of marine shaft system	Manish Verma	2007
18	Design of Tilting pad thrust bearing for marine application	Kaustubh K. Tamhankar	2007
19	Engine Mount Using MR Fluid	Abhijit Ganpat Sasane	2008
20	Design of Valve Operating System For Internal Combustion Engines	Maltesh G. Patil	2008
21	Oil Condition Monitoring of Spur Gear	Neeraj Verma	2010
22	Life Estimation of Hip Joint Prosthesis	Changadev kumar Desai	2010
23	Design and Development of the Gearbox Test Setup and Online Defect Detection of Gears	Lokesh Kumar Reddy	2010
24	Design and Development of Magnetorheological Brakes	Ashioue Ellahi	2011
25	Electromagnetic Simulation of Magnetorheological Brake using ANSYS Software	Chiranjit Sarkar	2011
26	Experimental Comparative Study of "Conventional Volve Brake" and "Magnetorheological Fluid Brake"	Sanjay Kumar Singh	2011
27	Online Condition Monitoring of Spur Gears	Hiral Shah	2012
28	Online Condition Monitoring of Spur Gears	Dheer Singh	2013
29	Studies on Magnetorheological Fluid and Magnetorheological Brake operating under Shear mode	Deepak Kumar	2015
30	Online Condition Monitoring of Spur gear box	Abhinav Yadav	2016