TSI NEWS LETTER

A PUBLICATION OF TRIBOLOGY SOCIETY OF INDIA DECEMBER 2011

From the desk of Secretary – TSI

Dear Colleagues,

I have pleasure in communicating with you through this second issue of our new-look Newsletter. Over the past year, our Society has been continuing its effort towards implementing various ambitious plans that we conceived during the tenure of our last Executive Committee. I am happy to say that TSI has now acquired a national identity in terms of visibility, activities and popular support – both from the academia and industry. It may be worthwhile to introspect on our efforts and achievements and also to remind ourselves about what we could do better.

The third TSI Summer School and our second joint Education Program in collaboration with the Society of Tribologists and Lubrication Engineers (STLE), USA have received enthusiastic response from the academia and industry in India. This year we have also received sponsorship support for our Summer School from the Department of Science & Technology, Government of India. This indicates that our events have now achieved a truly national status. We are in the advanced stage of renewing our fruitful association with STLE for another five years. This will enable us to implement several new initiatives like the STLE Certification Examinations, in addition to continuing the success story of our education courses. This year we are also launching our annual National Tribology Conference (NTC-2011), with the first event being organized at IIT Roorkee during 8 – 10 December 2011. Preparations have also started for our ICIT-2012 conference and the prestigious ASIATRIB-2014 mega event. We need the whole-hearted support from all our members through sponsorship, technical papers, exhibition stalls and participation, to turn these events into grand success. We have invested substantial efforts in creating a top-class website to present our Society to the external world and also to encourage effective networking among members. I urge all of you to utilize this resource to the fullest extent.

However, there is ample scope for improving the level of activities in our Local Chapters. While a few of the Chapters have managed to conduct some programs, most of these continue to remain dormant. In order to fulfill our Aims and Objectives, we need to make our local and regional efforts much more vibrant and effective. We also need to make concerted efforts in bringing within the TSI fold some of the key industry sectors (such as Railways, Automotive, Power, Nuclear and Space), which are currently unrepresented. Our interactions with the engineering student community also need to be reinforced and enlarged to a large extent. The disruption in regular publication of our Indian Journal of Tribology continues to be a major worry, though efforts are on to streamline the process. We have to work very hard to achieve our dream of making the IJT a world-class technical journal. But together we can do it.

I take this opportunity to convey my greetings to you and your family members on the occasion of the ensuing festive season.

With best wishes,

Dr. Barun Chakrabarti

Secretary - TSI

Director (R&D) Inaugurates Seminar on "Standardization in the Field of Tribology"

Dr. R K Malhotra, Director (R&D), Indian Oil Corporation and President, Tribology Society of India (TSI), inaugurated a one-day seminar on "Standardization in the Field of Tribology", held at the R&D Centre on March 22, 2011. The seminar was organized by Bureau of Indian Standards (BIS), in association with TSI. Encompassing an established Tribology department, the headquarters of TSI – Delhi Chapter is at the R&D Centre.

Dr. Malhotra inaugurating the seminar

Mr. K Gambhir, Scientist-G (Technical), BIS; Dr. KP Naithani, ED (R&D) and President, TSI, Delhi Chapter; Dr. B Basu, ED (Lube Technologies); Mr. V Martin, GM (Analytical Research), EC member, TSI and Chairman of Bearing Subcommittee, BIS; Dr. R.T Mookken, GM (Lube Technologies) and other senior members from the R&D Centre and BIS were present on the occasion.

Speaking on the occasion, Dr. Malhotra stressed the need for the standardization in testing, using tribological information and evaluation procedures. He suggested introducing Tribology as a subject at the graduate level so that engineers could take advantage of the knowledge while designing components with regard to their durability and efficiency. Dr. Malhotra expressed his happiness over the efforts put in by TSI and BIS for organizing the seminar, which was aimed at taking Tribology to the level of standardization of tribological components. In his address, Mr. Gambhir stressed the need of standardization in every product manufactured by the industry to meet the global standards. He said that it was acceptable in every respect in market and there were a lot of instances where lack of standardization posed as a technical barrier for entering into the international markets.

In his welcome address, Dr. Naithani shared his views on lubrication aspects in automotive, industrial and metalworking applications and emphasized the role of Tribology in industries. During the seminar, various speakers from BIS apprised the delegates of its role in standardization, various certification schemes and the benefits that could be derived from implementing standardization. The tribological aspects from standardization point of view in Bearings, Gas Turbine Engines and Greases were also covered in detail by the speakers from Indian Oil, BHEL, NEI bearings and HAL. A presentation by a representative of FAG bearings on Quality control for bearings was also made during the seminar.

FROM THE DESK OF ORGANISING SECRETARY (NTC-2011)

With the advent of latest technological advancements, Tribology has seen tremendous increase in its applications in almost all spheres such as in micro and nanotechnology, bio-systems, aerospace, machine tool industries etc. New types of tribological materials, solid/liquid lubricants and films have been invented for specific applications. Tribologists all over the world form the backbone of industrial infrastructure of a country and therefore play a pivotal role in the growth and development of the country. Tribology is the key in design and maintenance of all such rotating machinery to have better productivity. This area has made tremendous strides in recent years. Thus, there is a need to disseminate the knowledge acquired and the progress made in this multi-faceted and multi-disciplinary area.

It is quite important that the awareness of tribology at a national level be made vigorously to bring the desired awareness on the advances in this field among the different researchers working in academia, R&D organizations and especially the industry. Keeping this objective Mechanical & Industrial Engineering Department, Indian Institute of Technology Roorkee, is organizing "National Tribology Conference (NTC – 2011), under the aegis of Tribology Society of India, during December 08 – 10, 2011. *The main theme of the symposium is the Mission Tribology for better Productivity*".

The highlight of NTC-2011 is ;

1. Expert talks by a galaxy of invited experts from the academia, research establishments and industries along with the presentation of peer-reviewed articles and posters on several important areas falling in the domain of Tribology.
2. The conference will provide a forum for exchange of ideas and identified new directions for future research on Tribology activities. It is planned to have about 5 international invited presentations of half an hour duration each and about 50 contributed papers including interactive poster sessions on various themes within the broad area of Tribology.
3. Souvenir of conference
4. Bussiness Presentation
5. Exhibition
6. Cultural programme by on 8th December, 2011
7. Visit to Hardwar, 9th December, 2011

Furthermore conference has been sponsored by DST, NBC, L&T, ISGEC etc. NTC-2011 is expecting sponsoring by INSA, CSIR, BRNS, IOCL etc and total number of delegates expected is around 200.

Please contact for further information:

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Professor & Head
Mechanical & Industrial Engineering Department, Indian Institute of Technology Roorkee ROORKEE – 247 667 (Uttarakhand);
Tel. No. +91-1332-285242/285603 (O); E-mail : NTC2011iitr@gmail.com

3rd Summer School in Tribology

After first two successful programmes on 'Summer School in Tribology' in 2009 and 2010, respectively, the "3rd Summer School in Tribology" was organized during 20-23 June 2011 at Indian Oil Institute of Petroleum Management, Gurgaon.

Highlights of the program:

There were total 55 participants (27 from academia and 28 from Industry). The program was sponsored by IOC (R&D), Faridabad; HPC, Mumbai; and Lubrizol India, Mumbai. In addition, the programme expenses for the academia and faculty travel etc were also partly supported by Department of Science and Technology (DST), Delhi.

In inaugural session Chief guest, Dr. D V Singh gave a talk on the topic **'Spreading Tribology Education & Research: why is it important ".**

This 4 day Technical programmme of summer school had 17 Technical Sessions and 2 Special guest lectures. There was half a day visit to IOC (R&D) Centre. The participants were also assigned a project on "Current Status of Under Graduate/Post Graduate Tribology Education and Future Plans".

In the valedictory Session Chief Guest, Dr. S K Biswas spoke on the topic **"Perspectives of Tribology Education in India".**

Chief Guest , Prof S K Biswas handing over 'participation certificate' during the 3rd SST -Valedictory Session to Prof C S Ramesh

Inaugural Session- Seated on the dais are Mr N K Bansal , ED IIPM, Dr D V Singh, Chief Guest, Dr KP Naithani , ED IOC (R&D) and Dr Har Prashad, V P TSI

"2nd TSI STLE Joint Education Course in Tribology, 21st to 23rd Feb 2011"

PROGRAM HIGH LIGHTS

1. The 2nd TSI STLE Joint Education Course in Tribology, was organised at Indian Oil Institute of Petroleum management. Following was the Participation in different courses of the 3 day program:

Course	Date	Participants
• Lubrication	21st Feb 2011	42
• Condition Monitoring	22nd Feb 2011	36
• Metal Working Fluids	23rd Feb 2011	33

2. **Program Faculty** : The faculty for the 3 programs included: Dr Robert M Gresham (Bob), Director of Professional Development (STLE); Mr Mike Johnson (Mike) , CLS, CMRP, MLT, Advanced Machine Reliability Resources; and Dr Fred Pass man (Fred) , President Bio deterioration Control Associates (BCA).

   While Dr. Robert M Gresham (Bob) and Mike Johnson (Mike) conducted the program face-to-face, Dr. Fred Pass man (Fred), conducted the program through Web Ex.

Dr Robert Gresham (Bob) and Mike Johnson (Mike) lighting the inaugural Lamp

Mr A K Mehta , ED TSI welcoming Dr Robert Gresham and Mike Johnson. Sh Ajay kumar, JS TSI was also present during the program.

3. The Web Ex program was the first experience of TSI and the program went very well with good Internet connectivity and good audio system at the venue. The participants were able to Raise their queries through audio as well as through text transfer to Dr. Fred by chat through a Second computer. Dr.Fred was kind enough to reply to the queries and send the Written answer to all the queries, which was later, sent to all participants.

2nd TSI - STLE JOINT EDUCATION COURSE IN TRIBOLOGY

(Lubrication - 21 February, 2011)

INDIANOIL INSTITUTE OF PETROLEUM MANAGEMENT , GURGAON , INDIA

Sitting Row (L to R) S/Shri : Dr.Pankaj Bhatnagar, Ramakant Pilani, B.S.Nagarkoti, Dr.T.C.S.M. Gupta, Cdr.Kuldeep Mathur, Sanjiv Wazir Dr.Robert M Gresham, Mike Johnson, Ajay Kumar Harinaraian, A.K.Mehta, Ramesh Kapoor, P.Pathak Neelam Aggarwal, Aradhana Tripathi, Kiran Chaudhari, Nitin Goel

Standing 1st Row (L to R) S/Shri : S.Krishna Kumar, A.G.Samy, Alagiri. B., Bibhu Ranjan Das, Shobh Nath Jha, Ajay V Khongal Narayan Adhikari, S.R.Kumar, P.K.Gandhi, L.Praveen, S.K.Murthy, Shiv Dutt Sharma, Dr.Atul S Jaywant Vijaya Baskar B., V.Vivek Raj, Ashutosh Pareek, P.Chandrasekhar

Standing 2nd Row (L to R) S/Shri : Shantanu Das, Ankit Dua, Nirmal Giri A., Kaushal Kishore, Cdr. Pallab Raha, Dr.Amit Pandey, R.Ganesh Pawan Tikkiwal, M.R.Satyanarayana, R.K.Pandey, Mohammad Akmal, Narendra Kumar, Shibu Mon Prasad A.Patne

Some Recent Research Papers Published in International Journals:

1. E. Rajasekhar Nicodemus, Satish C. Sharma, "Orifice Compensated Multirecess Hydrostatic/Hybrid Journal Bearing System of Various Geometric Shapes of Recess Operating with Micropolar Lubricant", Tribology International, Vol.44,No.3, pp.284-296,**2011**.
2. Satish C. Sharma, Vikas M. Phalle, S.C.Jain, "Performance Analysis of a Multirecess Capillary Compensated Conical Hydrostatic Journal Bearing", Tribology International, Vol.44, No.5, pp.617-626, **2011**.
3. Vikas M. Phalle, Satish C. Sharma, S.C.Jain, "Influence of Wear on the Performance of a 2-lobe Multirecess Hybrid Journal Bearing System Compensated with Membrane Restrictor", Tribology International, Vol.44,No.4, pp.380-395,**2011**.
4. E. Rajasekhar Nicodemus**,** Satish C. Sharma, "A Study of Worn Hybrid Journal Bearing System with Different Recess Shapes Under Turbulent Regimes", ASME Journal of Tribology**.** Vol 132 pp.41704-12, **2010**.
5. E. Rajasekhar Nicodemus**,** Satish C. Sharma, "Influence of Wear on the Performance of Multirecess Hydrostatic Journal Bearing Operating with Micropolar Lubricant", ASME Journal of Tribology 132, 021703-1 to 021703- 10, **2010**.

Recent Ph.D. Awarded:

"PERFORMANCE OF ELECTRORHEOLOGICAL (ER) FLUID LUBRICATED HYBRID JOURNAL BEARING SYSTEM"

Candidate Name:

SHARANA BASAVA RAJA J

Supervisors: **Dr. Satish C. Sharma**, Professor and Head,
and
Dr. S.C. Jain, Professor
Department of Mechanical and Industrial Engineering,
Indian Institute of Technology, Roorkee, Uttarakhand, INDIA

Year: Nov. 2010

Abstract: Turbomachinery plays a vital role in industries worldwide. Due to competitiveness and rapid technological advancements, turbomachines received considerable attention from the scientific and industrial community in order to extract better performance and higher reliability. The dynamic behavior of these machines is greatly dependent on the fluid film bearings. Despite the significant advancement in lubrication technology and advent of meticulous deign procedures, bearings do fail while in operation with serious consequences, particularly in large installations such as power plants, rolling mills etc. On-line control and in-situ remedy is essential in such real situations. Accordingly many tribologists and practicing lubrication experts around the world are now a days involved in design of the journal bearing system using an entirely new design approach based on electrorheological (ER) fluids to suit the requirement of high speed and heavy load operation. A very recent method for doing this is the creation of 'smart' journal bearings lubricated with electrorheological (ER) fluids. The ER Fluid in Bearing permits changes to rotor dynamic properties through relatively simple means, such as adjusting the lubricant supply pressure or viscosity (via electric field control). This bearing also allows independently adjustable damping and stiffness characteristics, providing more flexibility for machinery designers.

Organization of ASIATRIB-2014 Conference

- In the EC Meeting dated 27/01/2011, the EC had approved the formation of a Core Organizing Committee consisting of the following Members:
  - Prof. Satish Kailas, EC Member (TSI) *(IISc – Bangalore)*
  - Mr. Ajay Kumar, Joint Secretary (TSI) *(IOCL – R&D) - Convener*
  - Dr. B. Chakrabarti, Secretary (TSI) *(L&T – Mumbai)*
  - Dr. Pankaj Bhatnagar, Treasurer (TSI) *(IOCL – R&D)*
  - Dr. Har Prashad, Vice President (TSI (CETR – Hyderabad)
  - Mr. A. K. Mehta, ED (TSI) *(TSI HQ – Faridabad)*

Mr. Ajay Kumar at ASIAD at Australia

"Tribology Lab at BPC R&C Centre, Mumbai"

R&D Centre of Bharat Petroleum Corporation Limited, Mumbai is having state-of-the-art Tribology Lab. The important equipment/ tribology rigs in Tribology lab are given as under:

1. ***FZG TEST Rig - The FZG (*Forschungsstelle fur Zahnrader und Getriebebau - The Technical Institute for the Study of Gears and Drive Mechanisms.*)*** test rig is used to determine the scuffing load capacity of the lubricants required for gear lubrication. In the FZG test, the gears are loaded through a torsional coupling that is set to known load conditions, or stages. The gears are rotated by a variable speed electric motor. Fluid temperature is controlled by heating and/or cooling elements. It evaluates gear tooth face scuffing resistance of fluids using A profile gears. The rig is operated at 1450 rpm through up to 12 progressive load stages at 15 minute intervals. Gear teeth are inspected after each load stage for scuffing. In addition to a visual evaluation of gear tooth condition, gear weight loss is measured. **Pitting** test to determine the influence of different gear oils and additives on the pitting load capacity of the gear lubricants. Micro pitting test to determine the influence of different oils and additives on micro pitting. The ASTM test methods are **ASTM D5182 and ASTM D4998.**
2. **Timken test is** ideally suited for evaluation of **Extreme Pressure** and **Anti Wear** properties of lubricants and greases. Both lubricating fluids and greases can be evaluated to determine the load required for the onset of severe abrasive wear and scuffing. The Timken test consists in a bearing race mounted on a tapered arbour rotating at high speed. The race is brought into contact with a square steel test block under normal load. The contact area is flooded with the lubricant being tested. The width of wear scar is measured at several applied normal load and the **"OK load"** is defined by the load at which scoring, scuffing or seizure appears. The test method is **widely used for specification purposes** and to differentiate among lubricants having low, medium, or high levels of extreme pressure characteristics. The standard methods are:
    a. ASTM D2509; DIN 51434 P3; IP 326: EP Properties of Lubricating Greases
    b. ASTM D2782; DIN 51434 P2; IP 240 : EP Properties of lubricating Fluids
3. **Four Ball Test Rig:** It measures lubricant's extreme pressure properties under High Hertzian contact in pure sliding, or pure rolling, motion. The test is used to determine the load carrying properties of a lubricant at high test loads. Three determinations are made:
    a. Load-Wear Index (LWI)
    b. Last Non-Seizure Load (LNSL)
    c. Weld Point (WP).

    In this method a ½-inch diameter ball rotates in contact with three similar balls held stationary in the test cup. The contact surfaces are covered with test lubricant, a load is applied and a timed test is performed. The followings test methods are used:
    a. ASTM D 2596: Measurement of Extreme-Pressure Properties of Lubricating Grease
    b. ASTM D 2783 : Measurement of Extreme-Pressure Properties of Lubricating Fluids
    c. ASTM D2266 : Method for Wear Preventive Characteristics of Lubricating Grease
    d. ASTM D4172 : Method for Wear Preventive Characteristics of Lubricating Fluid
    e. CEC L-45-A-99 : Viscosity Shear Stability of Transmission Lubricants
    f. IP 239 : Determination of Extreme Pressure and Anti-wear Properties of Lubricants
4. **High Frequency Reciprocating Rig (HFRR):** It is used to test friction and wear test of fuels and lubricants. It is particularly suitable for wear testing relatively poor lubricants such as diesel fuels and for boundary friction measurements of engine oils, greases and other compounds. It has become the industry standard test for diesel fuel lubricity and conforms to ASTM D6079, CEC F-06-A, ISO 12156, EN 590, JPI-5S-50 and IP 450.
5. **Universal Material Tribo Tester:** For performing comprehensive range of tribological tests on lubricants and metals, like pin/ball on disk, ring on disk and vice versa with reciprocating and rotary set ups with a load range of 0.1 N to 1 kN.
6. **Tapping torque tester:** To determine the relative performance of metal removal fluids. It is used to evaluate cutting and forming

High Frequency Reciprocating Rig (HFRR)

Universal Material Tribo Tester

Tapping torque tester

Pin and Vee Block

Ferrography

efficiencies of metal working fluids. The machine uses a high precision tap and a wide range of reproducible nut blanks in cutting or forming operations. This machine provides data for the evaluation of cutting oils, tool life, tap design and machinability of metals. ASTM considered this method the only acceptable method (methods based on power consumption of the driving motor are not accurate). Method - ASTM D 5619: Comparing Metal Removal Fluids Using the Tapping Torque Test.

7. **Pin and Vee Block:** To perform preliminary evaluation of wear properties of lubricating fluids by means of the pin and the Vee block tester. This apparatus consists of a rotating pin that is compressed between two vee-shaped blocks. The antiwear and extreme pressure characteristics of conventional fluid lubricants are evaluated as per ASTM D 2670 and ASTM D 3233 respectively.
8. **Ferrography :** To determine the wear particle concentration and wear particle analysis in lubricating oil which gives information about particle shape, composition, size distribution which in turn helps in predicting the imminent condition of machine.

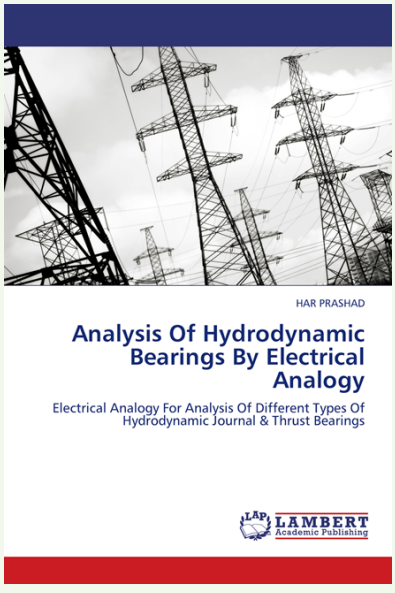
Visit of ED (TSI) to STLE Head Quarters at Chicago, USA

Mr AK Mehta ED (TSI) has visited STLE office at Chicago on 13th July, 2011. During his visit, following issues of mutual interest were discussed:

- 3rd TSI STLE Joint Education Course in Tribology;
- TLT Magazine for TSI members;
- TSI as hosting body for STLE's Certification Exams in India;
- STLE support of ICIT 2012 and ASIATRIB-2014;
- Cooperative publishing;
- Study on 'Potential on Saving through Correct / best practices of Tribology';
  and
- Sharing of Information on STLE Membership database.

LEFT TO RIGHT :
MS. MYRNA J. SCOTT,
MR. BRUCE MURGUEITIO,
MR. THOMAS T. ASTRENE,
MR. A K MEHTA,
MS. KARA LEMAR,
DR. ROBERT M. GRESHAM,
MS. ALICIA SHEARER,
MR. EDWARD P. SALEK, CAE

BOOK PUBLISHED



About the Book

This book basically covers static and dynamic analysis of different types of Hydrodynamic Journal and Thrust Bearings using Electrical Analogy in 7 Chapters including that of start/stop characteristics, electrical parameters of bearings, capacitive and inductive effects under the effect of shaft voltages. Theoretical procedure to establish, capacitance, resistance, capacitive reactance, impedance and charge accumulation on surfaces of bearings is given that originates the new methodology for the diagnosis of bearings under electrical analogy. Also, the decrease in life span of bearings under the influence of different levels of shaft voltages has been established theoretically, and the safe limit of the shaft voltage for a bearing has been identified. The dynamic coefficients of the bearings have been determined using an electrical analogy approach beside determination of minimum cycles before craters are formed on the active surface of bearings.

About the Author

Dr. Har Prashad is consultant of Centre for Tribology Incorporated, (CETR) USA. He is retired Senior Deputy General Manager from Bharat Heavy Electricals Limited, Research and Development Division, Hyderabad. He published more than 125 papers in both national and intern. journals. He is the author of four technical books & two non technical books.

LET US THINK—-WHAT IS MIND?

In the word “mind”, “m” stands for “Maya”—the illusion; “i” stands for “indulgence”; “n” stands for ‘noise’; and “d” stands for “diversion” and ‘distress”. So the literally meaning of the mind can be expressed as:

“That sensitive instrument in a human system, which indulges in “Maya”— the illusion; through the senses; a small time bound activities; creating a noise in the process; and ultimately disturbances even on accomplishment. The diversion and distribution of disturbances in the human system finally results in distresses in due course”.

From the Book “Solution of Problems and Remedies of Human Life——A Path of peace and Enlightenment” www.Lppindia.com

TSI Karnataka Chapter News

Two technical programs were organised by TSI Karnataka Chapter, during the period Jan- Sep 2011.

The first program was under the title , **“Fundamentals of Tribology, Testing and Surface Characterization of MMCs”,** and was held at Anjuman Engineering College, Bhatkal on May 7, 2011.

During this program Dr. C S Ramesh, Prof Deptt of Mech.Engg.,PESIT College, Bangalore and Chairman TSI Karnataka chapter, gave following two lectures :

1. **Fundamentals of Tribology & Testing**
2. **Surface Characterization of MMCs**

The second program under the title, **‘Trends in Lubrication Engineering’** was held at PESIT College, Bangalore **on August 6, 2011**.

Prof Ramesh interacting with participants during the program at Anjuman Engineering College, Bhatkal

Dr. S. K. Biswas, (Professor, Mechanical Engineering, IISc)&**Dr. K. N. B. Murthy**, Principal, PESIT, Bangalore, were the chief guests during the program . Besides the presidential lecture by Prof Biswas and Key note lecture by Dr KNB Murthy , following 4 technical presentations were made during the one day program :

- “Fundamentals of Tribology” by Prof C S Ramesh,
- “Vegetable Oils in Metal Working” by Dr S R Jayaraman,
- “Fundamentals of Space Tribology” by DR Savio Sebastian, and
- “Carriers in Tribology” by Mr Anshuman,Secy TSI Karnataka chapter of TSI.

“Inaugural Function” of the program shows (R to L), Dr S K Biswas , DR KNB Murthy and Mr Anshuman

Group Photo taken during the Program “ Trends in Lubrication Engineering” held at PESIT , Bangalore

New TSI Life Members- Jan to September 2011

LM # NO	NAME	ORGANISATION	CITY/ STATE
4191	MR. PRABHAKAR AGRAWAL	MINIMAC	RANCHI
4192	MR. ANIRUDH R NARAYAN	LARSEN & TOUBRO LTD.	MUMBAI
4193	MR. SANDEEP KOGGE	LARSEN & TOUBRO LTD.	PUNE
4194	MR. SAURABH VERMA	LARSEN & TOUBRO LTD.	MUMBAI
4195	DR. PUNIT KUMAR	NIT KURUKSHETRA	HARYANA
4196	DR. P K SAINI	NIT KURUKSHETRA	KURUKSHETRA
4197	MR. MILIND R KULKARNI	D/O SCIENCE & TECHNOLOGY	NEW DELHI
4198	MR. DEEPAK KUMAR KOTNALA	LUBRITECH TECHNOLOGIST	GURGAON
4199	MR. SHANTANU DAS	BHARAT OIL STORES	LUDHIANA
4200	DR. A K GUPTA	GANESH BENZOPLAST LTD.	DEHRADUN
4201	DR. UMASHANKAR	SIDDAGANGA INSTITUTE OF TECHNOLOGY	TUMKUR
4202	DR. BILSON SHUKLA	PALL INDIA PVT. LTD.	MUMBAI
4203	MR. SURENDRA KHURANA	ORBIT RESEARCH ASSOCIATES PVT. LTD.	DELHI
4204	MR. SANJIV WAZIR	SHAGUN ENTERPRISES	MUMBAI
4205	MR. VIVEK YADAV	TATA CONSULTANCY SERVICES LTD.	LUCKNOW
4206	DR. J N PANDEY	INDIAN OIL CORPORATION LTD, R&D CENTRE	GURGAON
4207	MR. N SIVASURIAN	INDIAN OIL CORPORATION LTD, R&D CENTRE	FARIDABAD
4208	MR. BHUPINDAR SINGH	UNIVERSAL OIL CORPORATION	JAMSHEDPUR
4209	MRS. NEELAM AGGARWAL	INDIAN OIL CORPORATION LTD, R&D CENTRE	FARIDABAD
4210	DR. MUKESH KUMAR	ROYAL INSTITUTE OF TECH. SWEDEN	NEW DELHI
4211	MRS. K SHUNMUGAPRIYA	CEMILAC	BANGALORE
4212	MR. R SHANMUGAVEL	CEMILAC	BANGALORE
4213	MR. L M PANDEY	INDIAN OIL CORPORATION LTD, R&D CENTRE	FARIDABAD
4214	MR. R SURESH	INDIAN OIL CORPORATION LTD, MUMBAI	MUMBAI
4215	DR. B BASU	INDIAN OIL CORPORATION LTD, R&D CENTRE	FARIDABAD
4216	MR. A K SEHGAL	INDIAN OIL CORPORATION LTD, R&D CENTRE	FARIDABAD
4217	MR. MOHIT SHARMA	IIT DELHI	NEW DELHI
4218	MS. SINI N K	IIT DELHI	NEW DELHI
4219	MR. AJAY KUMAR KADIYALA	IIT DELHI	MYSORE
4220	MR. ARANGANATHAN N	IIT DELHI	NEW DELHI
4221	DR. VEENA BANSAL	INDIAN OIL CORPORATION LTD, R&D CENTRE	FARIDABAD
4222	DR. D ELANGOVAN	KARPAGAM COLLEGE OF ENGINEERING	COIMBATORE
4223	MR. RISHIKESH KUMAR	LARSEN & TOUBRO LTD.	SAMA VADODARA
4224	MR. UJJAL DUTTA	PRACTISING AS ENGINEERING & MGMT. CONSULTANT	NEW DELHI
4225	DR. HARPREET SINGH	IIT ROPAR	RUPNAGAR
4226	MR. M ANANTH KUMAR		NAGERCOIL
4227	MR. UDEY DHIR	EASTERN COATINGS & SERVICES PVT. LTD.	JAMSHEDPUR
4228	MR. MAHENDRA BOOPATHI. M	KARPAGAM COLLEGE OF ENGINEERING	NAMAKKAL (DT)
4229	MR. MANIVANNAN. R	KARPAGAM COLLEGE OF ENGINEERING	COIMBATORE
4230	MR. L . FRANCIS XAVIER	KARPAGAM COLLEGE OF ENGINEERING	COIMBATORE
4231	MR. V. KAVIN RAJ	KARPAGAM COLLEGE OF ENGINEERING	COIMBATORE
4232	MR. RAKESH KUMAR YADAV	AL-FALAH SCHOOL OF ENGG & TECH.	FARIDABAD
4233	MR. BHUPAL CHANDRA PATEL	SUNDARGARH ENGG. COLLEGE	SUNDARGARH
4234	MR. ARVINDKUMAR S. MISHRA	GANESH BENZOPLAST LTD.	ANDHERI
4235	MR. PRABHAT RANJAN MISHRA	KIRODIMAL INST. OF TECH.	RAIGARH
4236	MR. SWARUP PAUL	NIT AGARTALA	AGARTALA
4237	MR. PRAKASH KUMAR SEN	KIRODIMAL INST. OF TECH.	RAIGARH
4238	MR. SURENDRA KUMAR DWIWEDI	O.P. JINDAL INSTITUTE OF TECH.	RAIGARH
4239	MR. AMIT SUHANE	MAULANA AZAD N.I.T, BHOPAL	BHOPAL
4240	BASKAR. S	SRI CHANDRA SEKHARENDRA SARASWATHI VISWA MAHA VIDYALAYA	KANCHIPURAM
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