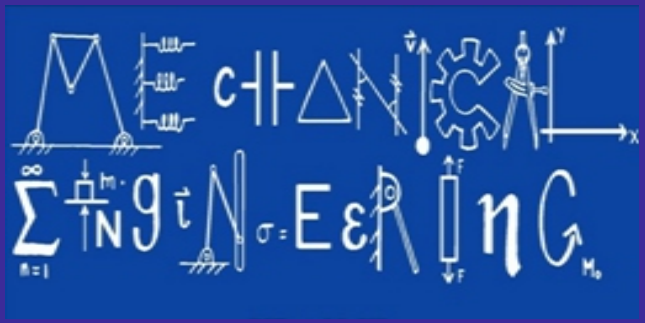
Yaantrika Newsletter

Department of Mechanical Engineering



Volume 5 | Issue 1 | December - 2019

Vision and Mission of the Institute

Vision

- To be one of the premier Institutes of Engineering and Management Education in the country

Mission

- To provide Engineering and Management Education that meets the needs of human resources in the country
- To develop leadership qualities, team spirit and concern for environment in students

Objectives

- To achieve educational goals as stated in the vision through the mission statements which depicts the distinctive characteristics of the Institution.
- To make teaching-learning process an enjoyable pursuit for the students and teachers.

Vision and Mission of the Department

Vision

- To be a premier department for education in Mechanical Engineering in the state of Karnataka, moulding students into Professional Engineers

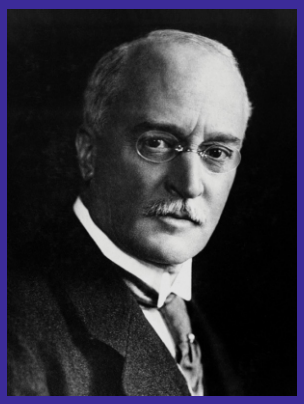
Mission

- To provide teaching - learning process that prepares engineers to meet the needs of industry and higher learning
- To provide environment for self-learning to meet the challenges of changing technology and inculcate team spirit and leadership qualities to succeed in professional career
- To instill professional ethics and concern for environment for the benefit of society

Program Educational Objectives (PEOs):

After 2/3 years of graduation, the students will have the ability to:

- Apply principles of Mathematics, Science and Mechanical engineering to design Mechanical Systems and Applications in Industry
- Apply knowledge of Mechanical Engineering to solve problems of social relevance with concern for environment
- Work with professional ethics as individuals and as team members in multi disciplinary projects demonstrating creativity and leadership
- Pursue higher education and research in advanced technology



This edition of Yaantrika from the Department of Mechanical Engineering is dedicated to the German Inventor and Mechanical Engineer Rudolf Christian Karl Diesel (1858 – 1913), famous for the invention of Diesel Engine.

What's inside……..!

B. N. M. Institute of Technology
(Approved by AICTE, Affiliated to VTU, Accredited as grade A Institution by NAAC
All UG branches - CSE, ECE, EEE, ISE & Mech.E Accredited by NBA for academic years 2018-19 to 2020-21 & valid upto 30.06.2021)
Post box No. 7087, 27th Cross, 12th Main, Banashankari II Stage, Bengaluru-560070, INDIA
Ph: 91-80- 26711780/81/82 Email: principal@bnmit.in, www. bnmit.org
Vidyayāmruthamashnuthe

EDITOR'S DESK

Dear Readers,

Welcome to the December 2019 issue of 'Yaantrika'

The team of Yaantrika, wishes to give our readers an intellectually stimulating news letter. Our endeavour is to reflect the values and the quality of our esteemed Institution.
The present edition of Newsletter focuses on the activities/achievements of the Department for the past six months along with some interesting articles from our students.

We would like to appreciate all the students who contributed the articles for the issue. It is the willingness to put effort, share knowledge, concerns and special insights that have made this issue possible.

Knowledge is a treasure which appreciates when we share and depreciates when accumulated. Never stop sharing knowledge and helping others. Wishing the readers a happy reading.

Editorial Team

"Department of Mechanical Engineering has been accredited by National Board of Accreditation (NBA) for the Academic Years 2018 - 19 to 2020 - 21 and valid upto 30.06.2021"

ABOUT MECHANICAL ENGINEERING DEPARTMENT

The Department of Mechanical Engineering started in the Year 2011-12 with an intake of sixty students. The department offers undergraduate program in Mechanical Engineering. All the laboratories have been established procuring state of the art equipments. The department has a team of talented and well qualified members of staff, with a blend of industrial and academic experience. Faculty members with Master's and Doctorate degree qualification having specialization in Machine Design, Thermal and Manufacturing Engineering are rendering their yeoman services to academics. The department has a R&D centre under VTU. Numerous research activities have been planned through the R&D centre.

BNMIT-Toyota Centre of Excellence was inaugurated on 14th May 2018. It is the state of the art lab equipped with cut section model of engine and transmission assembly along with clutch plate and differential gear box. The centre has been provided with separate engine and transmission systems which can be assembled and dismantled completely. From academic point of view, this type of exposure to the students of Mechanical Engineering plays vital role in their understanding of majority of core subjects by correlating the theoretical aspects of learning with hands-on sessions on the machines at the centre.

CAN FRICTION BE CONTROLLED BY CARBON-DI-OXIDE?

What? Controlling the friction by carbondioxide ? Yes. An interesting approach is discovered by the Swedish Research Council for Environment mainly by Prof. Ji, Ph.D candidate at Lulea University of Technology for the help in CO_2 absorption analysis and viscosity calculation.

Basic Stuff: Friction is the force resisting the relative motion of solid surfaces or fluid layers, sliding against each other. Often, we try to minimise friction but there are also many situations where high friction is desirable. While in some cases, something in between i.e., optimum friction is desirable. Nowadays, both ultrahigh and ultralow frictions have been studied extensively.

Some Examples: Ultra-high interlayer friction is observed in multilayer boron nitride nanotubes (BNNTs), caused by the structural reorganisation of the BNNTs layer. On the other hand, highly oriented pyrolytic graphite, diamond like carbon films and molybdenum disulphide can lead to ultra-low friction under special lubrication conditions.

What is this all about?

Firstly, viscosity is the most essential feature of lubricants, as it enables them, given the right conditions, to separate two solid bodies in relative motion. Here switchable ionic liquid 1-8-Diazabicyclo undec-7-ene (DBU) / glycerol mixture is used. Switchable ionic liquids/ CO_2 Binding Organic Liquids (CO_2BOLs) are the mixtures of alcohol and amidine or guanidine, based on Jessop's switchable solvent.

Now, how is CO_2 absorbed or how this work?

The mechanism of capturing CO_2 is that an amidinium or guanidinium alkyl carbonate salt is formed after absorbing CO_2 when passed through the liquid. When CO_2 amount is increased, the friction decreases and by releasing CO_2, the friction is partially increased. As CO_2 is absorbed by the liquid, the viscosity of the liquid increases which results in the increase in film thickness. At the same time, the pressure viscosity coefficient decreases with the addition of CO_2. By heating or bubbling the other gas, the CO_2 will be reversibly released and low viscosity of the liquid is obtained again and thus the friction decreases and it is thus possible to control friction by adding or removing CO_2.

Results Obtained: By the experiments done by researchers, the absorption loading of CO_2 in the studied mixtures was calculated, using the following equations:

$$n_{CO_2} = \frac{P_0(V_A - V_L)}{Z_1 RT} - \frac{P_t(V_A - V_L)}{Z_2 RT}$$

$$z = 1 + \frac{BP}{RT}$$

$$x = \frac{n_{CO_2}}{n_{DBU}}$$

P_0 and P_t are the initial and instantaneous pressures, respectively. Comparing the operating pressure, the saturated vapour pressure of the mixtures can be neglected. V_A and V_L represent the volumes of the absorption vessel and mixtures. Z_1 and Z_2 are the compressibility factors corresponding to the initial and instantaneous pressure, respectively. The generalized second virial coefficient correlation was used to get an approximation of compressibility factor Z. In equation (2), B is the correlation to critical properties of CO_2. nCO_2 is the number of moles of CO_2 absorbed by the switchable ionic liquids. nDBU is the molar amount of DBU, equal to the theoretical amount of absorbed CO_2 and, finally, x is the absorption loading

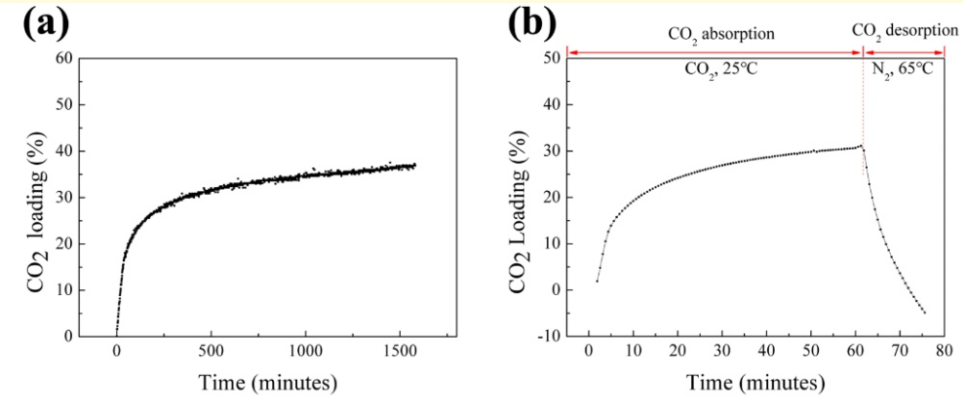


Figure 1. (a) CO_2 Absorption Kinetics of Mixture of DBU and Glycerol in 3:1 Molar Ratio at 25°C

Figure 1. (b) CO_2 Absorption and Desorption on the Mixture of DBU and Glycerol in 3:1 Molar Ratio by TGA (Absorption at 25°C for 60 min; Desorption by N2 at 65° C for 15 min)

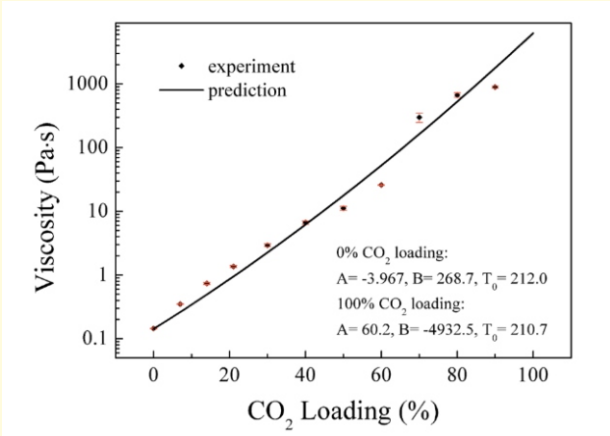


Figure 2. Viscosity as function of CO_2 loading at 25 °C.

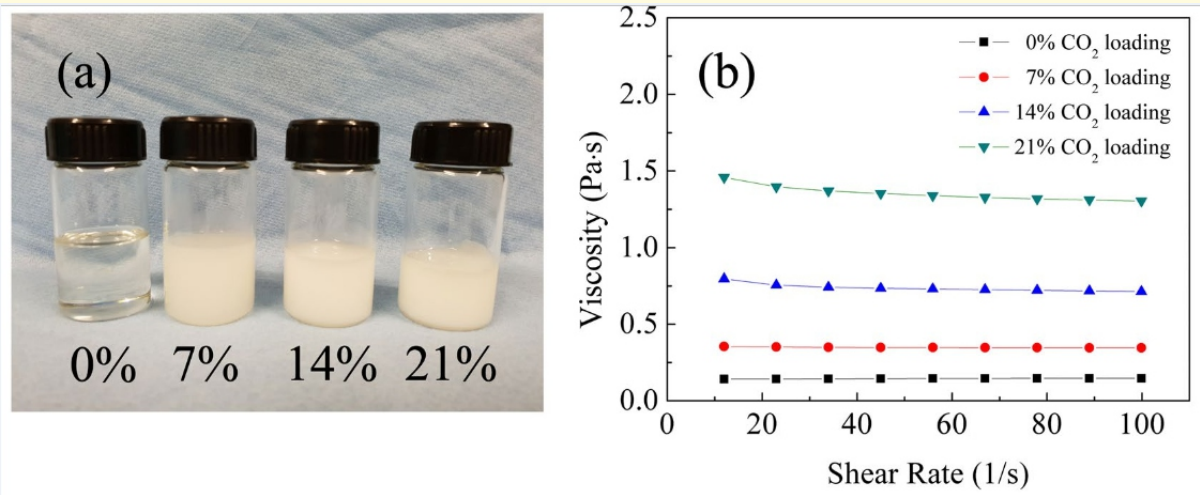


Figure 3. (a) Photos of DBU/ Glycerol Mixtures with different Loading of CO_2

Figure 3. (b) Viscosity at Different Shear Rates after CO_2 Absorption at different Levels in DBU /Glycerol Mixtures

As shown in Fig. 1(a), the CO_2 loading of DBU/glycerol mixture with 3:1 molar ratio increases as a function of time. The CO_2 loading increased rapidly when the loading was below 20%, then the absorption rate decreased gradually.

This is mainly because the viscosity of mixtures at high loading, is too large to be stirred magnetically, resulting in a mass-transfer limitation. This is the main reason we choose the low CO_2 loading for friction study in the coming part. Figure 1(b) shows the TGA curve for the mixture of DBU and glycerol in 3:1 molar ratio as a function of time. After absorption for an hour, the maximum CO_2 loading achieved 32% of theoretical loading and change of absorption rate appeared to be similar with that present in Fig. 1(a). The decomposition temperature of DBU/glycerol/CO_2 is 60 °C, and the desorption only took approximately 15 minute at 65 °C. The weight loss was even larger than the weight of CO_2 absorbed after 10 minutes' desorption, which indicated that part of the DBU evaporated during the TGA measurement.

Where is it implemented?

Currently, it is implemented on ball-on-disc test apparatus. CO_2 loading at different percentages are being tested so that they may be used in slightly larger machines, where friction is very crucial and critical.

VIGHNESH NANDAVAR
V Semester

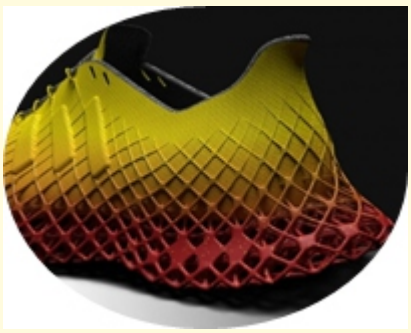
GENERATIVE DESIGN

ADDRESSING THE ROLE OF GENERATIVE DESIGN IN THE FUTURE SHAPE OF PRODUCT

What is generative design?

It is a fascinating technology that can re-shape the way we look at things. The easiest way to explain it, is that for the last 100 years, we've been manufacturing by taking material, and removing parts from it, whether it is wood, or steel, or whatever to create the product that we imagine. There's a human, drawing the lines, the shape, and then removing parts of it to create out end product. That's what we've been doing for decades, if you look at it, from stone or steel. With generative design, we have the potential for humans not to draw the lines and shapes anymore.

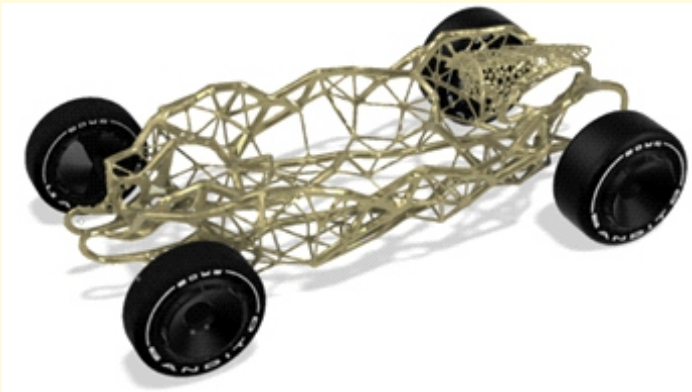
A computer will generate the optimized design or product or building for us, and it'll produce such optimized, organic shapes that we can no longer use subtractive manufacturing. We'll have to use things like additive manufacturing to print the product. And then the computer generates innumerable different designs that suit the criteria and the job as designers or engineers of tomorrow will be able to pick the design that fits the purpose the best.



Application of Generative Design

Under Armours are the shoe manufacturers. They are printing 3D for the bottom of the shoe. They're trying to work out how to make the lightest sports shoe and in that case, they took the information of what the shoe looks like currently, and put that into the generative design tool. It produced this organic, cool looking bottom of the shoe that could only be 3D printed.

La Bandita Research Analysis



La Bandita is a generatively designed racing car. It builts a chassis, and then puts sensors on to feed information back to the tool, generates an organic chassis that's 30 percent lighter than the one it had started with.

Getting manufactured in Australia and around the world will have access to this powerful technology. I don't think manufacturers have fully realized what it means. If we don't investigate and adopt this technology today, companies in Germany, America, China will adopt it, and implement at a much faster rate than what we're doing, and effectively they may make us redundant. That's how it is important for manufacturers. At this moment, they are the main beneficiaries. And with less material, the product will be lighter, but it'll also be cheaper to manufacture as well. A lot of material that goes into the products exist today may not be needed these. We do have a habit of over-designing and over-engineering our products.

Well, obviously today automotive and aerospace – companies like Airbus are already using this technology. We've been working with them over the last year to optimize one of the partitions in the Airbus 320. We were able to reduce it to 30 percent of the weight, and of course that makes a huge difference in efficiency and emissions, and ultimately helping the airlines to bring the manufacturing costs down.

VIGNESHWARAN
VII Semester

ROBOTIC SKINS

Whenever we think of robotics, a picture of something rigid, heavy and a purpose-built object flashes in our mind. In stark, contrast to these notions is the 'robotics skin' technology, recently developed by Yale researchers.

Developed in the lab of Rebecca Kramer-Bottiglio, Assistant Professor of Mechanical Engineering & Material science, robotic skins enable the users to customize their own robotic systems. The robotic skins have been designed with no specific task in mind, and can be used for applications ranging from search and rescue technologies to wearable technologies. The results of the team work have been published in the journal "Science Robotics".

The idea for the robotic skins was kindled a few years ago when NASA put out a call for 'soft robotic systems;'. Soft robotics is the specific subfield of robotics, dealing with constructing robots from highly compliant materials, similar to those found in living organisms. The technology was designed in partnership with NASA and its multifunctional and reusable nature would allow astronauts to accomplish an array of tasks with the same reconfigurable material.

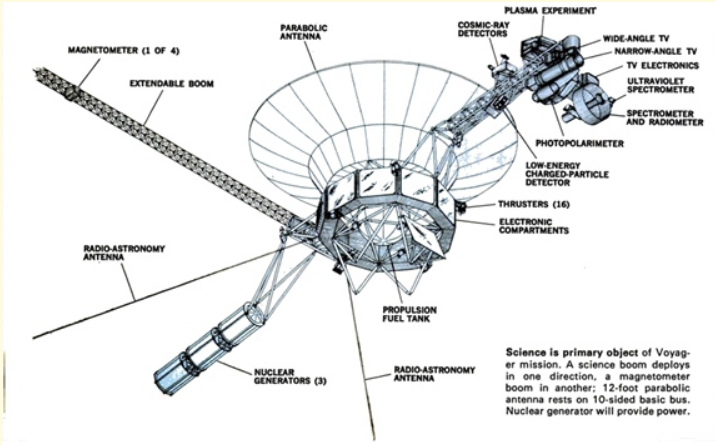
The robotic skins are made from elastic sheets, embedded with sensors and actuators developed in Kramer-Bottiglio's lab. Placed on a deformable object, a stuffed animal for instance, the skins animates are chosen. The makeshift robots can perform different tasks, depending on the soft objects and how the skins are applied.

The skins can be wrapped around one object to perform particular task- locomotion and then take them off to put them on a different task, such as grasping and moving an object.
Robots are typically built with a single purpose in mind. The robotic skins however allow users to create multifunctional robots on the fly which allows them to be used in settings they hadn't even been considered when they were designed.
In order to demonstrate the robotic skins in action, the researchers created a handful of prototypes. These include foam cylinders that move like an inchworm, a shirt like wearable device, designed to correct poor posture and a device with a gripper that can grasp and move object.
With the robotic skins on board , anything from balloons to balls of crumpled paper could potentially be made into a robot of purpose.

VISHAK M. ATHREYA
VII Semester

THE FARTHEST SATELLITE FROM THE EARTH – THE VOYAGER MISSIONS

The man made object to fly the longest distance ever is the spacecraft Voyager 1, in late February 2018 over 21 billion kilometres from Earth. Voyager 1 and it's twin, Voyager 2, were launched sixteen days apart in 1977. Both spacecrafts flew by Jupiter and Saturn. Voyager 2 also flew by Uranus and Neptune. Now, both the Voyagers are heading out of our solar system into the space between the stars. Voyager 1 officially became the first earthly craft to leave the solar system, crossing the heliopause, in 2012.Voyager 1 and Voyager 2 were launched in 1977, within a period of 3 years that occurs once every 176 year when a unique alignment of the Earth, Jupiter, Saturn, Uranus and Neptune presents the opportunity for a "Grand Tour."



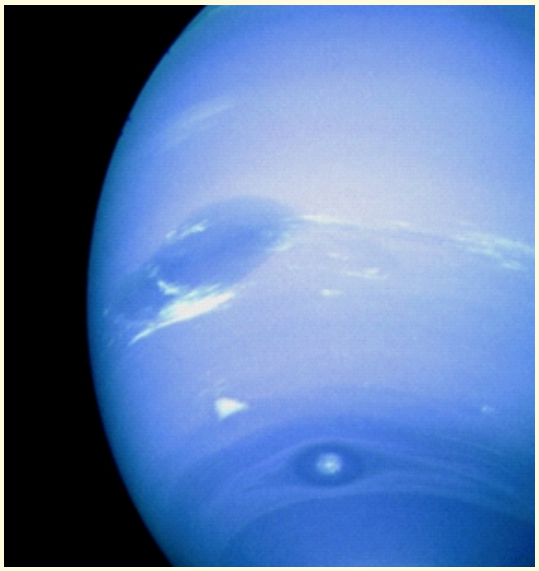
THE ENGINEERING PERSPECTIVE

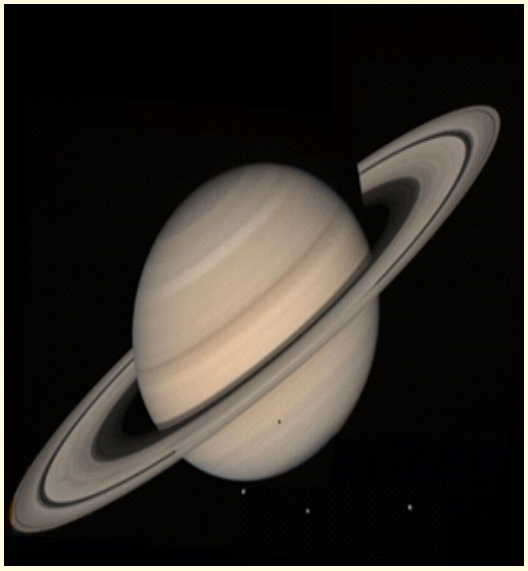
The primary purpose of satellites is to transmit data or communicate them back to the Earth and this also includes the power units that provide electricity for the instruments on board.
The main concern with long space travel is continuous power supply and lots of it! But this is taken care of by the electrical power, supplied by the three MHW-RTG Radio isotope Thermoelectric Generators (RTG). They are powered by plutonium -238 to get approximately 470 W (the decay heat is converted to electrical power) at 30 volts DC. Plutonium -238 decays with a half-life of 87.74 year so that the RTGs using PU-238 may lose a factor of 1-.5(1/87.74) =79% of their power output per year.
The uplink communications are executed via S-band (sound waves of frequencies of 2-4 Ghz). The downlink communications are carried out by an X band microwave transmitter (frequencies of 8.4Ghz to 11.5 Ghz). All long-range communications to and from the two voyagers have been carried out, using their 3.7 meter (12ft) high gain antennas. It can transmit data up to 1,000,000 bits per second, but because of the inverse square law in radio communications (i.e., farther the object, intensity decreases), the data transmission slowly reduces.

The Voyager spacecraft each weigh 773 kilograms and shoot through space at a velocity of 62,140kmph.They have 4 TCM (Trajectory Course Manoeuvring) thrusters to alter its position . The identical Voyager spacecraft use three-axis-stabilized guidance systems that use gyroscopic and accelerometer inputs to their attitude control computers to point their high-gain antennas towards the Earth and their scientific instruments towards their targets, sometimes with the help of a movable instrument platform for the smaller instruments and the electronic photography system.

The Command Computer Subsystem (CCS) provides sequencing and control functions The CCS contains fixed routine such as command decoding, fault detection, corrective routines, antenna pointing information and spacecraft sequencing information. The Attitude and Articulation Control Subsystem (AACS) controls spacecraft orientation, maintains the pointing of the high gain antenna towards Earth, controls attitude maneuvers and thus positions the scan platform. The objectives of the mission was to study the planets Jupiter, Saturn and Neptune and others. Here are some of the achievements it can boast.

In the summer of 1989, NASA's Voyager 2 became the first spacecraft to observe the planet Neptune, its final planetary target.





Voyager 1 is leaving the solar system. Voyager 2 completed its encounter with Uranus in January 1986 and with Neptune in August 1989. It is now also en route out of the solar system. The Saturn encounters increasing our knowledge to alter our understanding of Saturn.

Conclusion

Hence, the 1990's were a great year for planetary missions and has contributed a lot to the space age. But it doesn't end here. The space organizations of USA's NASA, India's ISRO, China's CNSA, Europes ES, Russia's Roscosmos, Space X from USA and many more have always striven to achieve higher goals. Here, we are standing as the fourth country in the world to touch the surface of the moon and many more missions to come. These ideas and motives give inspiration to the youth so that they may venture forth far more than we have ever imagined.

Bibliography,
-Jet Propulsion Laboratory; NASA
-National Geographic
- Wikipedia.com
- Edition ; CNN .com

ACHYUTH BHARADWAJ
V Semester

DEPARTMENTAL ACTIVITIES

Dignitaries Inaugurating the International Conference on "Thermo-fluids and Energy systems" on Dec 27 & 28, 2019.
L to R: Participating Delegates, Dr. Krishnamurthy G. N., Principal, Padmashri A. S. Kiran Kumar, Former Chairman, ISRO, Chief Guest, Dr. C. Naganna, Chairman, Prof. T. J. Rama Murthy, Director, Dr. Mukesh Patil, HoD, Mechanical Department, Prof. C. R. Panduranga Gupta, Vice-Principal

Padmashri A. S. Kiran Kumar, Former Secretary, Department of Space and Chairman, ISRO, Addressing the Audience during the Inauguration of International Conference on "Thermo-fluids and Energy Systems"

Dr. Stephane Zaleski, Professor, Mechanics, Sorbonne University, Paris, France Delivering a Lecture during the International Conference on on Dec 27, 2019

A Group Photo of Participanting Delegates along with Dignitaries attending the International Conference

Prof. B. A. Patil, Director - R&D, Think and Ink Education Research Foundation Bengaluru Delivering a Lecture on 'Success Mantras for Mechanical Engineers' on November 5, 2019, organised under ISTE Student Chapter

Dr. K Badari Narayana, Subject Expert from the Aerospace & Defence, Centre of Excellence, VTU, R.O, Bengaluru Delivering a Lecture on 'Aircraft and Aerospace Engineering' on November 14, 2019, organised under the Banner of BNMIT Association of Mechanical Engineers (BAME)

INDUSTRIAL VISITS

Students of V Semester and Faculty Members Visited M/s. Marvel Technology and Tools Pvt. Ltd., Nelmangala, Bengaluru on August 26, 2019

Students of III Semester and Faculty Members Visited M/s. Spectrum Tool Engineers Pvt. Ltd., Magadi Road, Bengaluru on September 04, 2019

Students of VI Semester and Faculty Members Visited M/s. ForgePro India Pvt.Ltd., Harohalli Industrial Area Kanakapura Road, Bengaluru on October 25, 2019

Students of V Semester and Faculty Members Visited M/s. Sakthi Accumulators Pvt. Ltd., Harohalli Industrial Area Kanakapura Road, Bengaluru on November 08, 2019

FACULTY ACHIEVEMENTS

- Dr. Anil Kumar B S presented a paper titled 'Computational Investigation of Flow Separation Over NACA 23024 Airfoil at 3 Million Free Stream Reynolds Number Using K-Omega SST Turbulence Model' in the International Conference on Recent Trends in Science, Engineering and Mathematics held from September 21-22, 2019 at Radisson Goa Candolim, Goa, India

- Dr. Shivalingappa D published a paper titled 'Development of Particulate Metal Matrix Composites', in ETMCM, ISBN: 978-81-941281-8-2, November 2019

- Dr. Raghavendra N published a paper titled 'Development of Particulate Metal Matrix Composites', in ETMCM, ISBN: 978-81-941281-8-2, November 2019

- Mr. Kumarswamy H S published a paper titled 'Design & Development of Smart Waste Segregation', https://doi.org/10-1007/978-98/32-9931-3-6, December, 2019

- Mr. Kumarswamy H S presented a paper titled 'Microstructure & Mechanical Properties of Al-2024 hybrid MMCS' in the International Conference on Recent Trends in Science, Engineering and Mathematics held from September 21-22, 2019 at Radisson Goa Candolim, Goa, India

- Mr. Karthik S R presented a paper titled 'Performance Analysis of Plate-Fin Heat Exchanger for case Drain Oil Cooling Application in Variable Displacement Pumps' in the International Conference on ThermoFluids and Energy Systems held on 27 and 28 December, 2019 at BNMIT, Bengaluru

- Mr. Hemanth Kumar C published a paper on 'Experimental Study on Mechanical Characteristics of Graphite and Silicon Carbide Reinforced ZA-27 Metal Matrix Composite', IJIRSET, Volume 8, June 2019, 2319-8753

STUDENTS' ACHIEVEMENTS

- Prajwal Sharath of 3rd Sem represented Indian Ice-skating team and won Belarus-2019 cup held in Minsk Belarus from September 6-23, 2019

- Prajwal Sharath of 3rd Sem qualified for the 'Junior World Ice Skating Championship 2020' which is going to be held in Italy

- Prajwal Sharath of 3rd Sem participated and won 3 silver and 1 gold in the 20th District Roller Skating Championship 2019 held in Bangalore from October 24-27, 2019
- Prajwal Sharath of 3rd Sem participated and won 1 silver and 1 bronze in the 35th State Championship 2019 held in Mysore from November 13-17, 2019

- Prashanth. M. of 3rd Sem participated in the event 'FURY ROAD' and secured Second place during National Level Annual Tech Symposium, Phase Shift 2019 at B.M.S. College of Engineering, Bengaluru from September 14-15, 2019

- Agnesh Rao K., Nesar V. Shetty, Chetan Prasad, Thejas M. and Mohitesh C. S. of 5th Sem won the Best Project Award for 'Rotating Solar Panel' at Department level IPL Summer Competition 2019

EDITORIAL TEAM

FACULTY

Manu A. S
Asst. Professor

R. N. Tiwari
Asst. Professor - English
Training and Placement

LAYOUT & DESIGN

Sri. Meiyappa B
Graphic Designer

STUDENTS

Vighnesh Nandavar	V Sem
Achyuth Bharadwaj	V Sem
Vigneshwaran	VII Sem
Vishak M. Athreya	VII Sem