Yaantrika Newsletter

Department of Mechanical Engineering

Volume 5 **Issue 2** **June - 2020**

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 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 Austrian Scientist and Mathematician
Richard Von Mises (1883-1953)
famous for the formulation of Distortion Energy Theory of Stress used in material strength calculations

What's inside……..!

Vidyayāmruthamashnuthe

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)
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EDITOR'S DESK

Dear Readers,

Welcome to the June 2020 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 efforts, share knowledge, concerns and special insights that have made this issue possible. Knowledge is a treasure that appreciates when we share and depreciate when accumulated. Never stop sharing knowledge and helping others.

Wishing the readers, a happy reading.

Editorial Team

'The Department of Mechanical Engineering has been accredited by the 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 during the session 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 equipment. The Department has a team of dedicated and well qualified faculty members, with a blend of rich industrial and academic experience. The Faculty members with Master's and Doctorate degree, having specialization in Machine Design, Thermal and Manufacturing Engineering are rendering their yeoman services to the students. The Department has an R&D Centre recognized by Visvesvaraya Technological University, Belagavi.

The Department has established a state-of-the-art Centre of Excellence in association with Toyota Kirloskar Motor, making the institute, first in the country to have the Toyota Kirloskar Centre of Excellence. The centre has cut sections of Innova and Fortuner car engine systems. The Center of Excellence also has facilities for students to experience hands-on assembly and dismantling of various engine parts.

The Department has MoUs with Toyota Kirloskar Motors Pvt. Ltd., Mahatma Gandhi Institute for Renewable Energy and Development (MGIRED) and Fenfe Metallurgicals for sustained activities in the area of automobile engineering, renewable energy and metallurgical engineering respectively.

The Department also offers 'Lathe Operator' course (Automotive Sector) under Pradhan Mantri Kaushal Vikas Yojana (PMKVY) an initiative by Automotive Skill Development Council, Ministry of Skill Development and Entrepreneurship, Government of India.

Approaching Zero-Emission Power Generation

Zero carbon emission is a challenging technology and might need an unforeseen technology breakthrough. The company Mitsubishi Heavy Industries Engg. Ltd (MHIENG) has achieved a large scale CO2 capture plants in coal fired power plants and is one of the major technology providers for this process. The company is also credited for building the largest CO2 capture plant in Petra Nova Project. The company along with Kansai Electric Power Co. has developed a unique solvent named KS-1 which provides superior performance and reliability for CO2 absorption. The company has delivered 14 commercial and demonstration plants with CO2 capacities ranging from 200-4700 tonnes/day worldwide. The Advanced KM CDR process has been lately developed by MHIENG and is a second generation process for CO2 capture. This process gives superior performance and significantly lower capital cost than any other conventional process used by MHIENG. The MHIENG has established many commercial CO2 recovery plants throughout Asia.

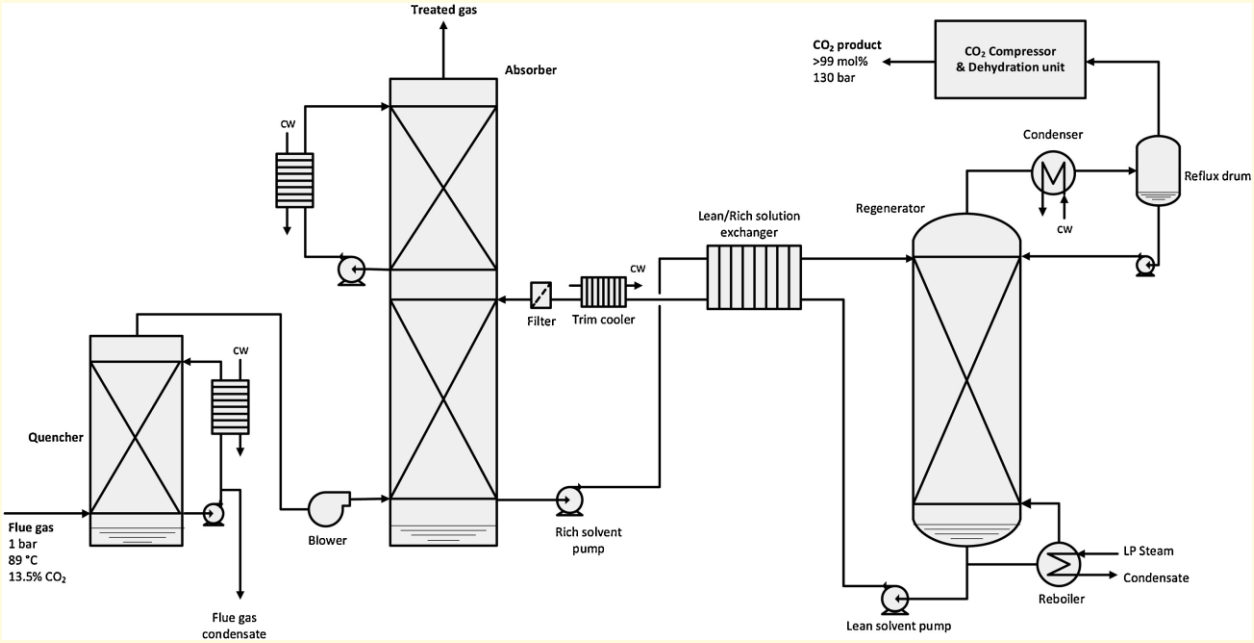


Image: Process Flow Diagram of Advanced KM CDR Process™

So, how does this entire process actually work? In order to achieve this, the flue gas passes through many filtration sections like flue gas quencher, CO2 absorption section, solvent regeneration section and CO2 compression and dehydration section. Firstly, CO2 is pre-treated before entering the flue gas quencher. In the quencher, the flue gas gets cooled before entering the CO2 absorber. In the CO2 absorbing section, the flue gas is mixed with the KS-1 solvent which absorbs the CO2 present in the flue gas. The flue gas is now treated and CO2 rich solvent is passed into solvent regeneration chamber. Here, the CO2 rich solvent is heated up to strip out CO2 and thus regenerating the solvent. The CO2 obtained here is then compressed and dehydrated in the chamber. At last, CO2 is obtained as a product by being compressed to 130bar after removing residual water.

A group of industrial experts from Japan have studied the Economics of the process. It is realized that total operational expenditure (OPEX) decreases significantly at CO2 capture ratio of 99.5% when compared to the base case at 90%. Whereas, annualized capital expenditure (CAPEX) increases by over 6% compared to the base case at 90%. While calculating the overall expenditure, it is found that the increased CAPEX is paid-off significantly due to the decrease in OPEX. Finally, the overall annualized expenditure is increased to over 3% when compared with the base case at 90%.

Therefore, it is found that near zero emission using the advanced KM CDR process is technically feasible but it increases the cost of CO2 captured by 3%. The obtained CO2 at 130 bar pressure is then delivered for geological storage and utilization.

Datla Dilip Varma
IV Semester

SODAR and LIDAR for Wind Speed Measurement

Remote Sensing System has become more and more popular in the wind industry as a supplement to the traditional met mast. It can be applied to complement a wind site assessment campaign or for wind farm monitoring. Detailed knowledge of the wind resource is necessary in the developmental and operational stages of a wind farm site. As wind turbines continue to grow in size, masts for mounting cup anemometers—the accepted standard for resource assessment—has necessarily become much taller, and much more expensive. This limitation has driven the commercialization of two remote sensing (RS) tools for the wind energy industry: The LIDAR (Light Detection and Ranging) and the SODAR (Sonic Detection and Ranging) are Doppler Effect Instruments using light and sound, respectively. Remote Sensing devices not only measure the wind speed directly at the respective measurement height, but also from the ground. This technique does not require a met mast, but higher uncertainties have to be considered, especially in complex terrain.

SODAR Background

A SODAR is a ground-based Remote Sensing Instrument that transmits (via speakers), a short acoustic sinusoidal pulse (typically 50 ms) into the ABL (Atmospheric Boundary Layer), then listens for return signals for a short period of time, measuring the sound waves that are scattered back by turbulence caused by the thermodynamic structure of the atmosphere. Both, the intensity and the Doppler shift of the returns can be used to determine wind speed and direction and the turbulent structure of the lower atmosphere, up to about 2 km, depending upon the power output of the system, sonic frequency, atmospheric stability, turbulence and the existing noise environment). SODARs consisting of 3 or more beams at different angles to the vertical allow a three-dimensional vertical wind profile to be obtained. The most typical topology is that of the 'mono-static' SODAR, where the transmitter and receivers are all co-located in a relatively compact unit.

The monostatic SODAR equation is given by :

$P(R) = P_o AL\sigma(R) \exp(-2\alpha R)/R^2$

where:

$P(R)$ is the power received from distance R, P_o is the effective transmitted power,

A is the effective area of the receiver,

L is the length of the acoustic pulse in space and

σ is the acoustic reflectivity (backscattering cross-section) at distance R.

SODAR is useful in studying special meteorological phenomena such as atmospheric dispersion of pollutants, sound transmission and vortex generation (for aircraft warning).

LIDAR

LIDAR is an active optical remote sensing instrument that transmits a laser beam (either as a continuous wave, or as a pulse) into the ABL and measures the scattered radiation received back at the instrument. It can be deployed both at ground level and airborne, for different applications. The technique has been in use for decades and descriptions can be found in numerous texts. LIDARs can use radiation in the ultraviolet, visible and infrared regions of the electromagnetic spectrum, and each of these will interact differently with the various physical processes within the atmosphere. Thus, the choice of differing process of scattering allows an array of information about the ABL to be inferred, such as temperature, atmospheric composition and wind. The small divergence of the laser beam results in a very low beam width (and hence volume) up to a few hundred metres for a continuous wave (cw) LIDAR (such as used in this study), and up to tens of kilometers for pulsed LIDARs, allowing high resolution even at these heights. The former systems rely on detector, focusing to resolve vertical distance, while the latter uses signal timing.

In simple terms, the backscattered LIDAR signal can be described as :

$P(R) = K\, G(R)\, \beta(R)\, T(R)$

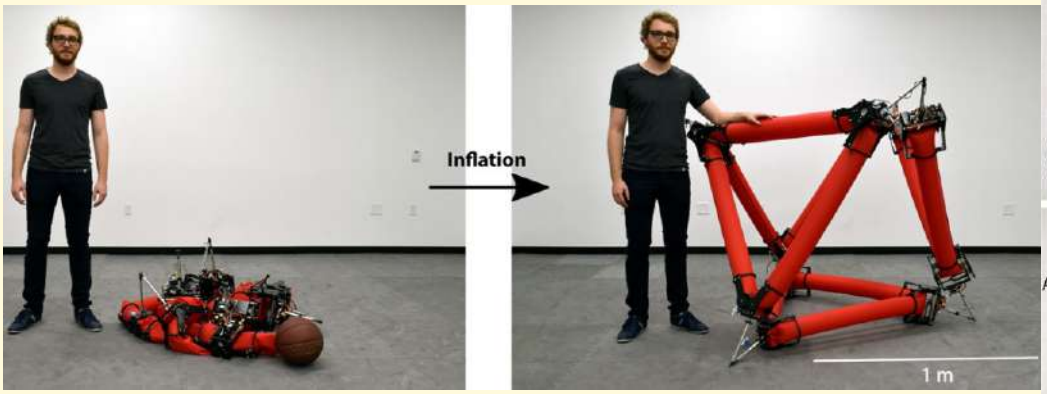
where:

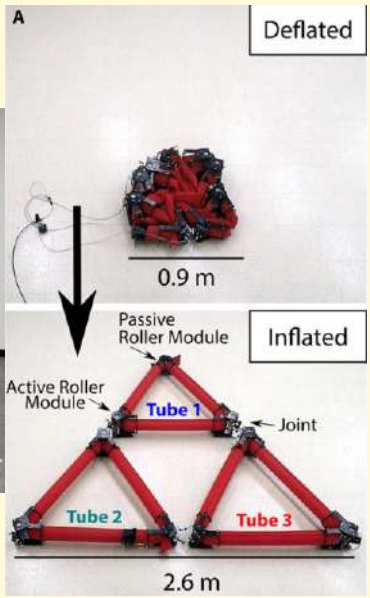
K is the performance of the system, G(R) is the range-dependent geometric factor, β(R) is the backscatter coefficient at distance R and T(R) is the transmission factor, which describes how much light is lost from the LIDAR to distance R and back.

Kothari Ayush Surendrakumar
VI Semester

Isoperimetric Robots

Robots have become ubiquitous. Their flexibility and adaptable nature have allowed them to be used in a wide range of applications which keep on growing. Soft robotics is a specified field of robotics which deals with the construction of robots made from highly compliant materials. Most of the soft robots have a bulky air compressor, attached to them or are plugged to a wall that limits their movement.





Recently, research students at Stanford University have developed a human scale soft robot that can change its shape, grab and handle objects and roll in controllable directions. The simplest version of this robot is an inflated tube that runs through three small machines that pinch it into a triangular shape similar to a truss. The researchers call it an 'Isoperimetric Robot' although the shape changes dramatically, the total length of the edges, that is the perimeter and the amount of air inside remains the same.

The key feature is that, for a large, yet soft pneumatic robot, compressed air need not be pumped in and out regularly. The isoperimetric robot uses the air already present in the tube only, requiring it to be moved around with simple motors. This provides a more efficient and a quicker robot.

The iso-perimetric robot is a descendant of three types of robots: soft robots, truss robots and collective robots. Soft robots are lightweight and compliant, truss robots have geometric forms that can change shape and collective robots are small robots that work together, making them particularly strong in the face of single part failures. This has enabled the researchers to realize a unique set of traits while by-passing the limitations of the above-mentioned robots.

The outer layer of the inflatable tubes used in the demonstration at the university was constructed out of Nylon fabric. The inner bladder was made from a low-density polyethylene tube. The robots take less than 50 seconds for transition among a few basic shapes like a triangle, hexagon, square and a pincer for grasping an object. The truss beams can buckle under excessive loads but can be straightened again using the roller modules. The robot is also capable of a punctuating rolling gait.

These robots are appealing as tools for disaster response. Another important area of application for this robot is in the area of space exploration as it can be transported in a small package and then can operate unmetered after inflation, using its shape changing ability to traverse complicated environments.

Vishak M Athreya
VIII Semester

Electromagnetic Compatibility: A Mechanical Engineer's Perspective

Electromagnetic compatibility means a device compatible with its electromagnetic environment and it does not emit levels of electromagnetic energy that cause electromagnetic interference (EMI) in other devices in the vicinity. Further, Electromagnetic Compatibility (EMC) is the ability of electrical equipment and systems to function effectively in their electromagnetic environment, by limiting and also ensuring the unintentional generation, propagation and reception of electromagnetic energy that doesn't negatively affect the equipment in their proximity and cause unwanted effects such as Electromagnetic Interference (EMI) or even physical damage in operational equipment. EMC can be reduced by limiting the unintentional generation, propagation, and reception of EM energy, which can lead to EMI.

Important terms

EMI: EMI stands for Electromagnetic Interference. It is a disturbance generated by an external source which affects an electrical circuit by electromagnetic induction, electrostatic coupling or conduction.

Electromagnetic Shielding: Electromagnetic Shielding (Shielding) is the practice of reducing the electromagnetic field in a space by blocking the field by surrounding electronics and cables with barriers of conductive and/or magnetic materials.

Electrostatic Discharge: Electrostatic Discharge (ESD) is the sudden flow of electricity between two electrically charged objects caused by contact, an electrical short or dielectric breakdown.

Emissions: The EMI emissions refer to the generation of unwanted electromagnetic energy.

Systems Level Considerations

The acceptable thresholds depend on EMI considerations for which we are designing. Mainly the IEC-61000 family of standards are used but a careful review of regulations for a given region is merited before design. Pre-scanning methods can help engineers get closer to EMC before expensive external testing.

Mechanical Design Considerations

In order to reduce emissions and immunity Electromagnetic Interference can be addressed by electrical engineers in their designs by using component-level strategies. This includes PCBA (Printed Circuit Board Assembly) integrated solutions such as grounding planes and cages in order to shield the sensitive components. Electromagnetic Interference is the electrical noise that is induced in cabling in the presence of nearby electrical

Image: Electromagnetic shielded enclosure

equipment such as motors, air conditioners, fluorescent lights, and power lines. For cabling, this includes annular shielding layers and clip-on ferrites. The mechanical engineer perspective comes in picture when the system requires shielding to protect it from external sources. The mechanical engineer can work towards sealing for EMC, by deriving the requirements from electrical engineer for shielding.

Hence, the basic requirements include:

1) Tolerable gap width, within or between the parts.

2) Ground interface point for earth or ground reference within system.

3) Whether the shielding can be scratched and defeated or not i.e. reliability.

4) To seal/ enclosure the conductivity levels.

5) Serviceability, for getting into internal components and reconstructing the shielding when it is damaged.

6) Thermal considerations.

Most electromagnetic shields are made of sheet metals. The potential for enclosures to be carried through to the late stage and product level device is generally high. When used in external environment, sheet metal enclosures also come with the added benefit of being robust to external physical forces and wear over time. Common sheet metals for shielding are copper, brass, nickel, silver, steel, and tin. These are used in preventing mechanical damage, such as being knocked and to reduce the electromagnetic interference, where cases are made from powder-coated mild steels and aluminium. PCB and system level shielding may reduce the system-level EMI between wireless PCB board and the outside environment, but rarely prevent the intra-system EMI within the shielding enclosure.

By spraying a conductive material on the sides of the package, a very thin metal layer is constructed around the top and four sides of a package. This very thin sprayed metal layer adds zero penalties to the package size and works similar to a solid metal shielding with very good shielding effectiveness. Hence, it is suitable for wireless infrastructure, telecommunications, and high-speed digital applications.

There are several ways to support the plastic case so as to meet the EMC requirements, if the device is enclosed within plastic casing. By adding a conductive coating to the plastics after fabrication, the effect can be an EMI opaque shield. Various methods are used to do the above process: vacuum metallization, arc and flame spraying, conductive film application, or plating.

Conclusion

The perspective of Electrical engineers' concentrates on EMC first and addresses concerns at the PCB. Mechanical Engineers get involved when enclosing the PCB or device. This is collective effort by both specialties and should work through planning and execution. Engineers make choices to meet EMC requirements by choosing the materials and components for electromagnetic enclosures. Engineers can make EM, an integral part of the design approach.

Yeleswarapu Raghava
IV Semester

STUDENTS' ACHIEVEMENTS

- **Chetan Prasad S**. of 6th Semester successfully completed the NPTEL courses on *'Manufacturing Automation*' and *'Introduction to Machining and Machining Fluids*' with Elite grade. He has also successfully completed the NPTEL course on *'Bio MEMS and Microsystems*'.
- **Omkar N. Kashyap** of 6th Semester successfully completed the NPTEL course on '*Design of Fixed Wing Unmanned Aerial Vehicles*'.
- **Vishak M. Athreya** of 8th Semester successfully completed the NPTEL course on '*Basics of Finite Element Analysis-1*' with Elite Grade.
- **Vishal Nayyar** of 8th Semester successfully completed the NPTEL course on '*Inspection and Quality Control in Manufacturing*' with Elite grade.
- **Vigneshwaran P**. of 8th Semester been certified as *Autodesk Certified User* by Autodesk.
- **Aditya Narayan Mahto** of 8th Semester completed a project based online course on '*Gear Train Design'* organised by Skyfi Labs.
- **Venkatesh Mohan Sharma** of 8th Semester successfully completed courses on '*Neural Networks and Deep Learning*', '*Structuring Machine learning Projects'* and *'Convolutional Neural Networks*'
- **Omkar N. Kashyap** and **Vighnesh Nandavar** of 6th Semester participated in the events REboat Challenge, Oral Competition, Biomimicry Challenge of the *2020 ASME E-Fest Asia Pacific* held at Marwadi University, Rajkot.
- **Prateek Mohan** of 4th Semester participated in the 08 day Internship programme on '*Robotics and Automation*' held at AMC Engineering College, Bengaluru.
- **Harsha R.** of 4th Semester successfully completed the workshop on '*My captain Crypto currency and Block chain with Captain Rinkesh Gorasia*'
- **Nihal Sheikh, Udit Bagdai** and **Sumukh Shenoy** of 4th Semester have been actively participating in the COVID-19 Relief Response.

FACULTY ACHIEVEMENTS

- **Mr. Kumarswamy H. S.** submitted his Ph.D. thesis on '*Development and Characterization of Aluminum- Boron Fiber Graphite Hybrid Metal Matrix Composite*' to VTU Belagavi.
- **Dr. B. S. Anil Kumar** was the Chief-coordinator for One Week Online Faculty Development Programme titled '*Continuity in I-3 (Industry Institute Interaction)*' organized by the Department of Mechanical Engineering from 20th to 24th July 2020.
- **Dr. N. Raghavendra**, authored a book chapter titled '*Artificial Neural Network Application for Tribological Studies of Composites Materials*' in Contemporary Research in Engineering and Technology.

- **Mr. Mahendra Kumar C.** published a journal titled '*Effect of Carbon Nanotube in Aluminium Metal Matrix Composites on Mechanical Properties*' in Journal of Engineering Science and Technology, Vol. 15, No. 2 (2020) 919-930.
- **Dr. D. Shivalingappa** and **Mr. Kumarswamy H. S.** have co-authored a research paper titled '*Development and Fabrication of Smart Waste Segregator*' in Springer Lecture Notes in Mechanical Engineering. https://doi.org/10.1007/978-981-32-9931-3_6
- **Mr. Kumarswamy H. S.** published a research paper titled '*Microstructure and Mechanical Properties of Sintered Al 2024 Hybrid MMCs*' Journal of Physics: Conf. Series, https://doi:10.1088/1742-6596/1455/1/012024
- **Mr. Vishnu P.** co-authored a research paper titled '*Development of Vertical Axis Wind Turbine by Maglev Suspension – An innovative approach*' in Journal of Physics: Conf. Series, https://doi:10.1088/1742-6596/1473/1/012020
- **Mr. Hemanth Kumar C.** published a paper titled '*Development and Wear Characterization of Graphite and Silicon Carbide Reinforced ZA -27 MMCs*' in International Journal of Advance Science and Technology, Vol. 29, No. 4, ISSN 2005-4238.
- **Mr. Manu A. S.** presented a research paper titled '*Experimental Investigation on Effect of Terrazyme on Index Properties of Lime Treated Black Cotton Soil*' in the 13th International Conference on Recent Development in Engineering ,Science, Humanities and Management(ESHM-2020), organized by Gurukul Institute of Engineering and Technology, Kota, Rajasthan, held online on 25th July, 2020.
- **Mr. Manu A. S.** presented a research paper titled '*Influence of Terrazyme on Consistency Limits of Lime Treated Black Cotton Soil*' in the International Conference on Advanced Materials Behaviour and Characterization organized by Mattest Research Academy, Chennai during 18th to 23rd July 2020.
- **Mr. Mahendra Kumar C.** successfully completed an eight week online NPTEL Course on '*Nature and Properties of Materials*' coordinated by IIT Kanpur.
- **Mr. Vishnu P.** successfully completed the online training course on '*High Voltage Vehicle Safety System for Electric Vehicles and Heavy Electric Vehicles*' offered by Haritha Techlogix, Bengaluru.
- **Mr. Vishnu P.** successfully completed an eight week NPTEL online certification course on '*Fundamentals of Welding Science and Technology*' coordinated by Indian Institute of Technology, Guwahati.
- **Mr. Hemanth Kumar C.** successfully completed the Coursera Online Certification Course titled '*Material Behaviour*' offered by Georgia Institute of Technology.
- **Mr. Manu A. S.** successfully completed an eight week NPTEL Online Course titled '*Digital Land Surveying and Mapping*' offered by IIT Roorkee.
- **Mr. Madhu P.** completed One Week Live Online Certificate Course on '*Composite Materials and its Characterizations*' by Coursera.
- **Mr. Karthik S. R.** developed e-content of 10-hour (Video lectures + Study material) in "*Heat Transfer (17ME63)*" course for VTU e-shikshana programme (Feb-June 2020).

DEPARTMENTAL ACTIVITIES

Resource persons *who delivered lectures during the One Week Online Faculty Development Programme on* ***'Continuity in I-3(Industry Institute Interaction)'*** *organized between 20th and 24th July 2020*

Group photo of 4th ***Semester*** *students during their Industrial Visit to* ***Accutech Enterprises, Peenya, Bengaluru*** *on Feb 27, 2020*

EDITORIAL TEAM

Faculty

Dr. B. S. Anil Kumar, Professor

Prof. R. N. Tiwari, Assistant Professor
Department of Training and Placement

Students

Byregowda S.	VIII Sem.
Vishak M. Athreya	VIII Sem
Amrutha D.	VI Sem
Harsha R.	IV Sem