**MVJ** COLLEGE OF ENGINEERING
Since 1982
Engineering A Better Tomorrow

**An Autonomous Institute**
**Approved by AICTE, New Delhi**
**Affiliated to VTU, Belagavi**
**Recognized by UGC under 2(f) & 12(B)**
**Accredited by NBA & NAAC**

**FDP on Industrial Applications in Thermal Engineering**
**18.04.2023 – 20.04.2023**

## Faculty Development Program on
## "Industrial Applications in Thermal Engineering"
## 18th to 20th April 2023

The Faculty Development Program on "Industrial Applications in Thermal Engineering" was successfully conducted, in association with Department of Aeronautical and Aerospace Engineering, ISTE, IIEC and IQAC – MVJCE, from 18th April 2023 to 20th April 2023. This FDP was designed to impress upon Faculty, the importance of thermal engineering for industrial applications. Overall, 20 faculty members registered for event. 6th Semester ME students were also encouraged to sit in the sessions to impart knowledge for their career development.



**Invitation of the Event**

Dr. Sunil S W, Associate Professor, Department of Mechanical Engineering, inaugurated the event and highlighted the importance of thermal engineering, especially in the Automotive and Aerospace industries, He also stressed on the need for research in thermal engineering. Dr. Arunagiri P, Associate Professor, Department of Aeronautical Engineering Welcomed the guest.

The inaugural session of the FDP on 18th April 2023 was delivered by Dr. Babu Rao P, Advanced Engineering Division of Daimler Truck Innovation Center India.  In his talk, he gave an overview of the importance of industrial heat exchangers.

Industrial heat exchangers are used in various applications where heat needs to be transferred from one fluid to another. Some common applications of industrial heat exchangers include:

HVAC systems: Heat exchangers are used in HVAC systems to transfer heat between air and water or between two air streams. For example, a plate heat exchanger may be used to transfer heat from a warm air stream to a cooler air stream in an air handling unit.

Power generation: Heat exchangers are used in power plants to transfer heat from a high-temperature fluid, such as steam or gas, to a lower temperature fluid, such as water or air. This allows for the generation of electricity through turbines and other machinery.

Chemical processing: Heat exchangers are used in the chemical industry to heat or cool process fluids. For example, a shell and tube heat exchanger may be used to heat a liquid stream that is used in a chemical reaction.

Food and beverage processing: Heat exchangers are used in the food and beverage industry to pasteurize and sterilize liquids, such as milk and juice. Plate heat exchangers are commonly used for this purpose.

Oil and gas industry: Heat exchangers are used in the oil and gas industry to transfer heat between fluids in various processes, such as crude oil distillation and gas compression.

Automotive industry: Heat exchangers are used in automotive engines to cool the engine coolant and transmission fluid. Radiators and oil coolers are examples of heat exchangers commonly used in automobiles.

Overall, He emphasized the importance of industrial heat exchangers that are used in a wide range of applications where heat needs to be transferred from one fluid to another, making them an essential component in many industries.



**Inauguration of the Event**

**Dr. Babu Rao P gave an indetailed step by step procedure for the CFD analysis of cold plate heat exchange.**

**To simulate a cold plate heat exchanger, one needs to use computational fluid dynamics (CFD) software such as ANSYS Fluent, COMSOL Multiphysics, or OpenFOAM. The simulation process can be divided into the following steps:**

**Geometry creation - Create a 3D model of the cold plate heat exchanger geometry using a CAD software.**

- **Meshing - Create a mesh for the 3D model to divide it into small elements that the CFD software can analyze.**

- Boundary conditions - Define the inlet and outlet boundary conditions for the fluid flow, as well as the material properties of the cold plate and the fluid.

- Solver setup - Define the solver settings, such as the turbulence model, time step, and convergence criteria.

- Run the simulation - Run the simulation to obtain the temperature distribution, pressure drop, and other relevant parameters.

- Post-processing - Analyze the results of the simulation and visualize them using software such as ParaView or Tecplot.

- When simulating a cold plate heat exchanger, it is important to consider the following factors:

- Material properties - The material properties of the cold plate and the fluid need to be accurately defined to obtain accurate results.

- Flow rate and pressure drop - The flow rate and pressure drop across the heat exchanger need to be optimized to ensure efficient heat transfer.

- Heat transfer coefficient - The heat transfer coefficient between the fluid and the cold plate needs to be accurately determined to calculate the heat transfer rate.

- Turbulence - Turbulent flow can affect the accuracy of the simulation, so an appropriate turbulence model needs to be selected.

In conclusion, simulating a cold plate heat exchanger requires a thorough understanding of fluid dynamics, heat transfer, and the use of CFD software. By

following the above steps and considering the key factors, you can obtain accurate and reliable results for your cold plate heat exchanger simulation.
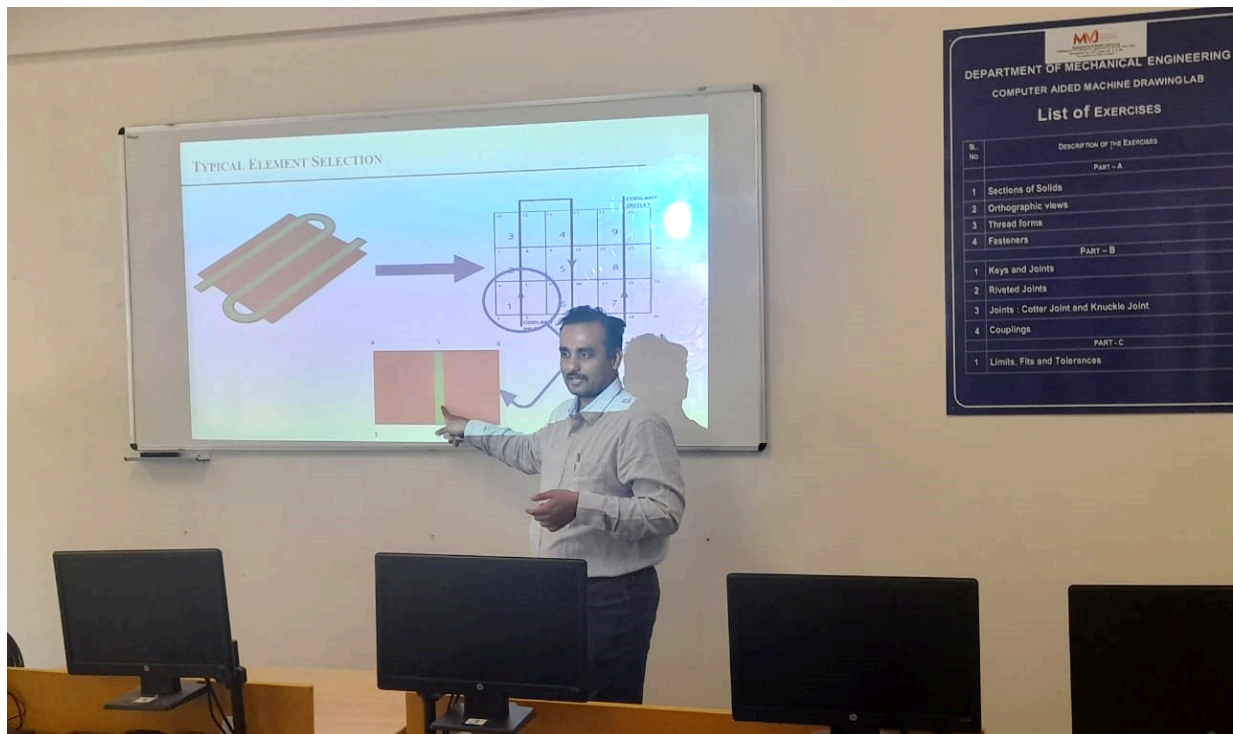


**Dr. Babu Rao P Explaining about typical element selection in cold plate heat exchanger**



**Participants keenly listening to the simulation aspects of CFD analysis of cold plate heat exchanger**

**On the second day 19<sup>th</sup> April 2023, Dr. M S Thakur, Former head, Bio-Engineering division CFTRI gave a session on the Bioenergy.**

**Dr. M S Thakur, Former Head, Bio-Engineering Division, CSIR – CFTRI, discussing with the faculty members on the importance of bio energy.**

Dr. M S Thakur delivered a session on the utilization of bioenergy for sustainable development. Bioenergy is a form of renewable energy derived from biomass, which is organic matter such as plants, trees, agricultural and forestry residues, animal waste, and algae. Bioenergy can be used for power generation, heating, and transportation fuels. Bioenergy research focuses on the development of new technologies and processes to improve the efficiency, sustainability, and cost-effectiveness of bioenergy production.

There are several areas of bioenergy research, including:

☐ Biomass feedstock - Researchers are exploring new biomass feedstocks, such as fast-growing grasses and trees, to increase the supply of biomass and reduce the competition with food crops. They are also developing methods to improve the sustainability of biomass production, such as reducing the use of fertilizers and pesticides.

☐ Biomass conversion technologies - There are several technologies available to convert biomass into bioenergy, including combustion, gasification, pyrolysis, and fermentation.

Researchers are working to improve the efficiency and reliability of these technologies, as well as develop new ones.

☐ Biorefinery - A biorefinery is a facility that converts biomass into a range of products, such as biofuels, chemicals, and materials. Researchers are developing new processes and technologies to optimize the use of biomass in biorefineries and increase the value of the products.

☐ Biofuels - Biofuels are liquid or gaseous fuels produced from biomass, such as ethanol, biodiesel, and biogas. Researchers are developing new biofuel production processes, such as consolidated bioprocessing and lignocellulosic biofuels, to increase the yield and reduce the cost of biofuels.

☐ Biogas - Biogas is a renewable energy source produced by the anaerobic digestion of organic matter, such as animal waste and food waste. Researchers are working to improve the efficiency and sustainability of biogas production, as well as develop new applications for biogas, such as transportation fuel and electricity generation.

☐ Algae bioenergy - Algae are a promising biomass feedstock for bioenergy production, as they can grow rapidly and contain high levels of lipids and carbohydrates. Researchers are developing new algae cultivation and harvesting technologies, as well as improving the efficiency of algae biomass conversion to biofuels and other products.

☐ Overall, bioenergy research is a diverse and rapidly evolving field that is essential for the transition to a sustainable and low-carbon energy system. The development of new bioenergy technologies and processes has the potential to provide significant environmental, economic, and social benefits, such as reducing greenhouse gas emissions, creating jobs, and improving energy security.

**Participants keenly listening to the session on bio energy delivered by Dr. M S Thakur**

Finite element analysis (FEA) is a powerful tool for designing and optimizing industrial thermal applications. FEA can be used to simulate and analyze complex thermal processes and predict the behavior of systems under different operating conditions. In this regard, Mr. Deepak from Xitadel gave a session on the importance of FEA for industrial thermal applications on 20th April 2023.

'

Here are some of the key benefits and applications of FEA for industrial thermal applications elucidated by him.

☐ Optimization of thermal performance: FEA can be used to optimize the thermal performance of industrial systems by simulating different design configurations and operating conditions. By analyzing the temperature distribution and heat transfer rates within a system, FEA can identify areas of high thermal stress or inefficiencies, and suggest improvements to optimize the system's performance.

☐ Predictive analysis: FEA can predict the behavior of industrial thermal systems under a range of operating conditions, such as temperature changes, pressure fluctuations, and flow rates. This allows engineers to evaluate the performance of the system and identify potential problems before they occur, reducing the risk of failure and improving safety.

☐ Reduced development costs: FEA can reduce development costs by providing insights into system performance without the need for physical prototypes or testing. This reduces the time and cost required to develop and test new products, as well as the risk of failure or product recalls.

☐ Design optimization: FEA can be used to optimize the design of industrial thermal systems, such as heat exchangers and heat sinks. By simulating different design configurations and analyzing the thermal performance of each, FEA can help engineers identify the most efficient and cost-effective design for a given application.

☐ Improved efficiency: FEA can help to improve the efficiency of industrial thermal systems by optimizing heat transfer rates, reducing thermal losses, and identifying areas of thermal inefficiency. This can lead to significant energy savings and reduced operating costs over the life of the system.

☐ Reduced environmental impact: By optimizing the thermal efficiency of industrial systems, FEA can reduce energy consumption and greenhouse gas emissions, improving the environmental sustainability of industrial operations.

In summary, FEA is a valuable tool for designing and optimizing industrial thermal applications. By simulating thermal processes and predicting system behavior, FEA can help engineers to optimize system performance, reduce development costs, improve efficiency, and reduce environmental impact.

Overall, the FDP was very well coordinated, with the main impetus on Industrial focus, and the faculty and students benefitted from the program in terms of industrial applications in thermal engineering.

The participants learnt that the thermal engineering plays a vital role in several industrial applications, from flow simulation to energy production. The efficient management of thermal energy is essential for reducing energy consumption, increasing efficiency, and improving the sustainability of industrial operations.
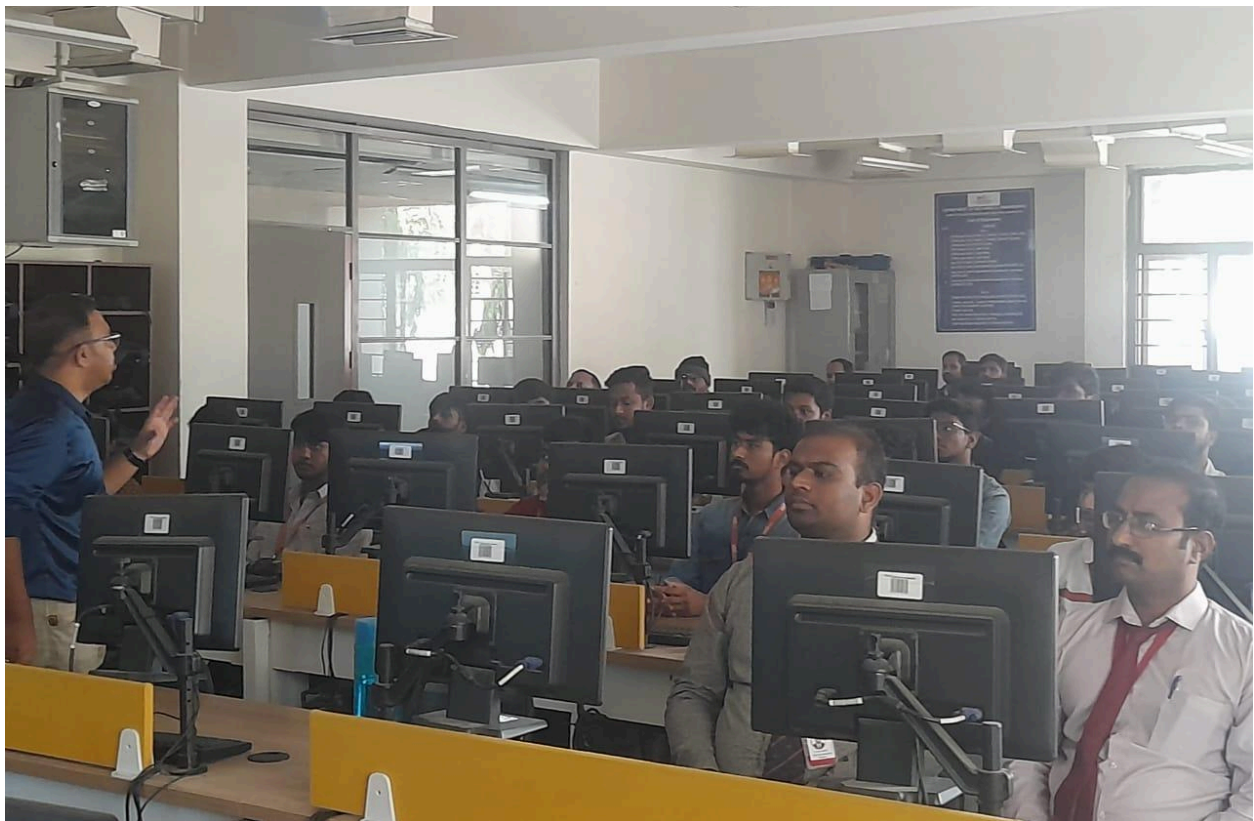
**Participants keenly understanding and appreciating the importance of FEA in Industrial Thermal Engineering.**

# Summary of the FDP

---

| Date of the Event | 18th to 20th April 2023 |
|---|---|
| Title of the Event | FDP on Industrial Applications in Thermal Engineering |
| Organized by | **Department of Mechanical Engineering, MVJCE, in association with Department of Aeronautical and Aerospace Engineering, ISTE, IIEC and IQAC – MVJCE** |
| Venue | **CAMD Lab (043)** |

**Outcome of the FDP**

1. The faculty members were encouraged to carry out research activities in bioenergy, applications of FEA and FVA for thermal simulations.

2. They experienced and understood the concepts of thermal analysis and simulations.

3. They were prompted to apply for fundings in the domain of bioenergy to MNRE and other central government agencies.