ICFAI Foundation for Higher Education

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ATAL

Faculty Development Program

on

METAL ADDITIVE MANUFACTURING

25 - 30 December, 2023

Coordinator
Dr. K L Narayana

Co-Coordinator
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Organized by

COERAM Centre of Excellence in Robotics & Advanced Manufacturing

Department of Mechanical Engineering

IcfaiTech

Faculty of Science & Technology (FST)

Report on the Inaugural of the ATAL Faculty Development Programme on

Metal Additive Manufacturing

Date

25th to 30th December 2023

Location

Faculty of Science & Technology, ICFAI Foundation for Higher Education

Introduction

The much-anticipated ATAL Faculty Development Programme on Metal Additive Manufacturing commenced with an elaborate inauguration ceremony. This programme, a significant stride in advancing education in additive manufacturing technologies, was graced by the presence of esteemed dignitaries from the academic and research community.

Chief Guest: Dr. K P Karunakaran, IIT Bombay

The event was honored by Dr. K P Karunakaran from IIT Bombay, a renowned figure in the field of additive manufacturing. His presence as the chief guest added significant value to the proceedings, highlighting the programme's importance in the current technological landscape.

Presiding Dignitaries

The inauguration ceremony was presided over by Dr. G Suresh Kumar, Associate Dean Academics, along with Dr. Barla Madhavi, Head of the Department of Mechanical Engineering. Dr. A Manmadhachary, the Coordinator of the Faculty Development Programme, played a pivotal role in organizing this event.

Inaugural Session

The session commenced with a welcome address by Dr. A Manmadhachary, who outlined the objectives and the expected outcomes of the programme. This was followed by an enlightening speech by Dr. Barla Madhavi, emphasizing the importance of metal additive manufacturing in the contemporary industrial scenario.

Dr. G Suresh Kumar, in his address, highlighted the role of such development programmes in enhancing the skills and knowledge of faculty members across various institutions. He stressed the need for academia to stay abreast of evolving technologies to effectively educate the next generation of engineers.

Keynote Address by Dr. K P Karunakaran

The highlight of the event was the keynote address by Dr. K P Karunakaran. His speech provided deep insights into the latest trends and innovations in metal additive manufacturing. He discussed the challenges and opportunities in the field, inspiring the attendees to engage actively in this evolving domain.

Discussions and Interactions

The inaugural session also included a panel discussion and interactive session, allowing attendees to engage with the experts on various topics related to metal additive manufacturing. This interaction was invaluable for faculty members seeking to integrate advanced manufacturing concepts into their curriculum.

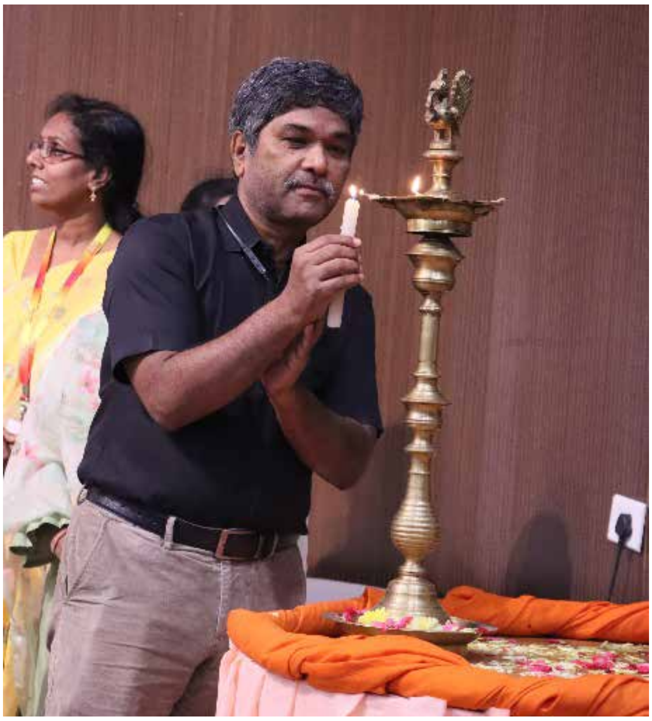
Conclusion and Vote of Thanks

The inaugural session concluded with a vote of thanks by Dr. Avinash Malladi, who expressed gratitude to the chief guest, dignitaries, and all participants for their valuable contributions. The ceremony set a positive tone for the upcoming sessions of the Faculty Development Programme, promising a rich learning experience for all attendees.

Anticipated Impact

This programme is expected to significantly impact the participating faculty members, equipping them with the latest knowledge and skills in metal additive manufacturing. It aims to foster an environment of innovation and research, contributing to the advancement of the manufacturing sector. The ATAL Faculty Development Programme on Metal Additive Manufacturing, through its successful inauguration, has set the stage for a transformative educational experience in the field of advanced manufacturing technologies.

Some Glimpses of Inaugural Function



Day1
25th December 2023

Morning Session: Lecture on Electron Beam Hybrid Manufacturing by Dr K P Karunakaran, Professor IIT Bombay

Introduction

In a significant session of the ATAL Faculty Development Programme, Dr. K P Karunakaran, a distinguished professor from IIT Bombay, delivered an insightful lecture on "Electron Beam Hybrid Manufacturing." This session was part of the broader series focused on Metal Additive Manufacturing and was attended by faculty members, researchers, and industry professionals.

Overview of the Lecture

Dr. Karunakaran commenced his lecture with an introduction to the fundamentals of Electron Beam (EB) technology and its integration into additive manufacturing. He elucidated the principles behind electron beam melting and its advantages in creating complex geometries and structures with high precision and reduced waste.

Key Highlights

1. **Hybrid Manufacturing Approach:** The central theme of Dr. Karunakaran's talk was the hybrid approach that combines additive and subtractive manufacturing. He detailed how electron beam technology can be effectively paired with traditional machining methods to enhance manufacturing capabilities.
2. **Material Considerations:** An in-depth discussion was presented on the types of materials suitable for EB hybrid manufacturing, emphasizing the flexibility and diversity of the process in accommodating various alloys and metals.
3. **Applications and Case Studies:** Dr. Karunakaran shared several case studies where EB hybrid manufacturing has been successfully applied. These included aerospace components, medical implants, and automotive parts, showcasing the wide applicability of this technology.
4. **Technological Innovations and Challenges:** The lecture also covered the latest advancements in EB technology, including increased beam control and efficiency. Challenges such as thermal stresses and material properties were discussed, along with potential solutions.
5. **Future Trends and Research Opportunities:** The future scope of EB hybrid manufacturing in various industrial sectors was highlighted, encouraging participants to explore research and development opportunities in this field.

Time: 12:00 pm to 01:00 pm

Article Discussion on Additive Manufacturing: Challenges, trends, and applications:

Introduction

A comprehensive article discussion session on "Additive Manufacturing: Challenges, Trends, and Applications" was conducted as a part of [Insert Event Name]. This session brought together experts, researchers, and practitioners in the field of additive manufacturing (AM) to delve into the current state and future directions of this rapidly evolving technology.

Session Overview

The discussion was structured around a pivotal article that provided an in-depth look into various aspects of additive manufacturing. Key focus areas included the current challenges faced in AM, emerging trends, and the diverse applications of this technology across different industries.

Discussion Highlights

Challenges in Additive Manufacturing:

1. **Material Limitations:** The discussion emphasized the need for a broader range of printable materials and the challenges in material properties and post-processing.
2. **Quality and Standardization:** Concerns were raised regarding the consistency in quality, lack of standardized procedures, and the need for comprehensive testing methods.
3. **Cost and Accessibility:** The high cost of AM equipment and materials, along with the need for skilled operators, were identified as significant barriers to wider adoption.

Emerging Trends:

1. **Advancements in 3D Printing Technologies:** Innovations in printing methods, such as increased printing speed, multi-material printing, and improvements in precision, were highlighted.
2. **Integration with Industry 4.0:** The integration of AM with other technologies like AI, IoT, and robotics was discussed as a key trend shaping the future of manufacturing.
3. **Sustainability:** The potential of AM in promoting sustainable manufacturing practices through waste reduction and energy efficiency was also a point of focus.

Applications Across Industries:

1. **Healthcare:** Customized implants, prosthetics, and bioprinting were discussed as revolutionary applications in the medical field.
2. **Aerospace and Automotive:** The use of AM for lightweight and complex components in aerospace and automotive sectors was highlighted.
3. **Construction and Architecture:** Innovative applications in creating complex structures and on-demand construction materials were discussed.

Afternoon Session

Lecture on Design Guidelines in Metal Additive Manufacturing by Dr Y Ravi Kumar

Professor NIT Warangal

Introduction

Dr. Y Ravi Kumar, a distinguished professor from NIT Warangal, delivered an enlightening lecture on "Design Guidelines in Metal Additive Manufacturing" as a part of [Event Name]. This session attracted a diverse audience, including academicians, industry professionals, and students interested in the nuances of additive manufacturing (AM).

Overview of the Lecture

Dr. Kumar's lecture focused on the unique design principles applicable to metal additive manufacturing. He emphasized that conventional design rules do not always apply to AM and that understanding the specificities of AM design is crucial for optimizing product functionality and manufacturability.

Key Highlights of the Lecture

1. **Design for Additive Manufacturing (DfAM):** Dr. Kumar explained the concept of Design for Additive Manufacturing, highlighting how it differs from traditional design methodologies. He stressed the importance of considering AM's capabilities and limitations during the design phase.
2. **Complex Geometries and Lightweight Structures:** A significant portion of the lecture was dedicated to the design of complex geometries and lightweight structures, which are key advantages of metal AM. Dr. Kumar provided examples of lattice structures and topology optimization.
3. **Material Considerations:** The selection of appropriate materials for AM was discussed. Dr. Kumar explained how material properties, such as melting point and thermal conductivity, impact the design process in metal AM.
4. **Design for Post-Processing:** The lecture also covered the importance of considering post-processing requirements, such as support removal and surface finishing, in the design stage.
5. **Design Rules and Guidelines:** Dr. Kumar presented a set of design rules specific to metal AM, including minimum feature sizes, overhang considerations, and thermal distortion management.
6. **Software Tools and Simulation:** The role of software tools in the design process was highlighted. Dr. Kumar discussed the use of simulation software to predict and mitigate potential issues in the printing process.

Day2

26th December 2023

Morning Session: Lecture by Mr. Yogendra Srivastav on Wire-Based Metal Additive Manufacturing: Applications and Future

Introduction

As part of the ongoing Faculty Development Program on Metal Additive Manufacturing, a noteworthy lecture was delivered by Mr. Yogendra Srivastav from Phillips Machine Tools. The session, focusing on "Wire-Based Metal Additive Manufacturing: Its Applications and Future," provided an in-depth understanding of this specific additive manufacturing (AM) technique.

Overview of the Lecture

Mr. Srivastav's lecture centered on the principles, applications, and future potential of wire-based metal additive manufacturing. He differentiated this method from more common powder-based AM processes and emphasized its unique benefits and challenges.

Key Highlights

1. Basics of Wire-Based AM: The session began with an overview of wire-based AM technology, including its working principle and process parameters. Mr. Srivastav explained how wire is fed through a nozzle and melted using a heat source to build parts layer by layer.
2. Advantages Over Powder-Based AM: The speaker highlighted several advantages of wire-based AM, such as higher deposition rates, reduced material waste, and improved safety due to the absence of powder handling.
3. Material Compatibility and Properties: A comprehensive discussion on compatible materials for wire-based AM was presented, along with insights into the resultant material properties like strength, durability, and finish.
4. Applications in Various Industries: Mr. Srivastav delved into the diverse applications of wire-based AM, citing examples from aerospace (for engine components), maritime (for shipbuilding), and automotive industries (for prototyping and parts manufacturing).
5. Challenges and Limitations: Despite its advantages, challenges such as limited resolution, the need for post-processing, and constraints in building complex geometries were discussed.
6. Innovations and Technological Advancements: The speaker covered recent technological advancements in wire-based AM, including improved precision, faster production times, and developments in multi-material printing.
7. Future Outlook: Mr. Srivastav shared his insights on the future trajectory of wire-based AM, predicting increased adoption in heavy industries and potential in large-scale manufacturing.

Article Discussion on Metal additive manufacturing simulations process:

Introduction:

The discussion on the recent article about metal additive manufacturing (AM) simulations provided an in-depth analysis of the current state, challenges, and future prospects in the field of metal AM. The article primarily focused on the simulation processes used in metal additive manufacturing, a critical aspect for improving efficiency, accuracy, and material properties in AM products.

Overview of Metal Additive Manufacturing:

Metal additive manufacturing is a revolutionary process in which digital 3D design data is used to build up a component in layers by depositing material. This technique is highly valued for its ability to create complex geometries, reduce waste, and shorten the production cycle in various industries, including aerospace, automotive, and healthcare.

Simulation Processes in Metal AM:

The article emphasized the importance of simulation in overcoming common challenges in metal AM, such as residual stresses, distortion, microstructural inconsistencies, and mechanical property variation. Simulations are crucial for predicting these issues and developing strategies to mitigate them.

Key Points Discussed:

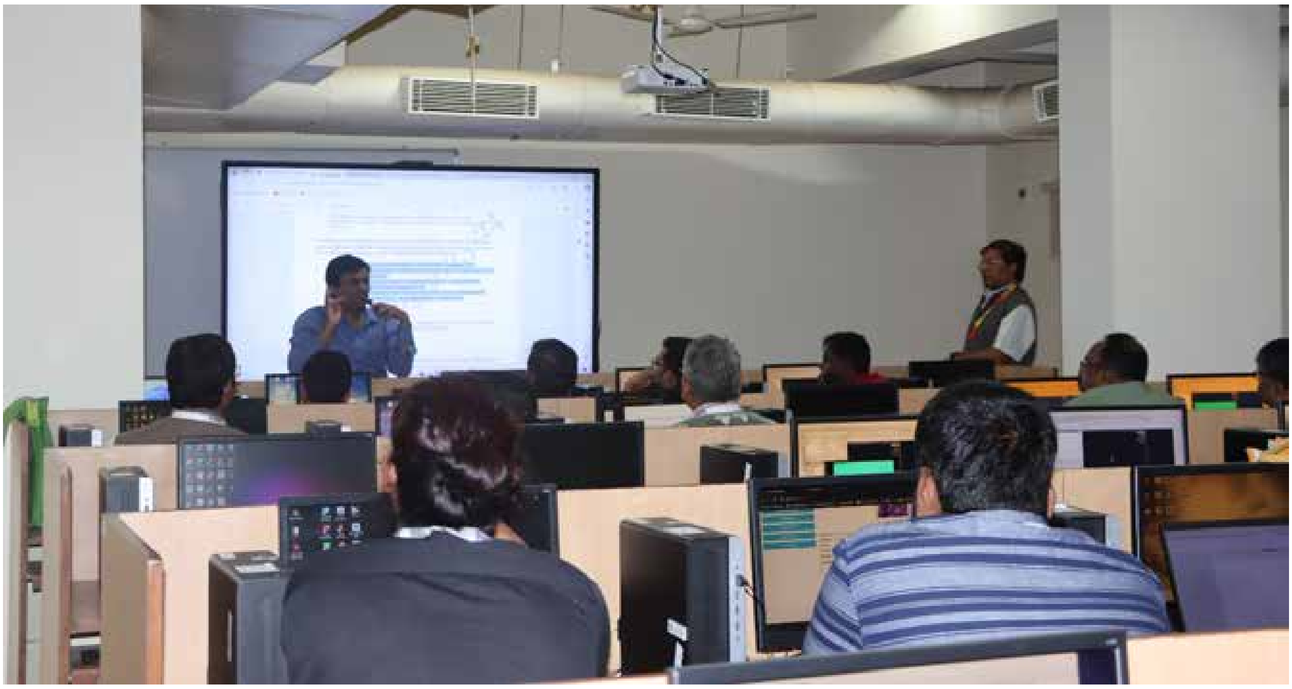
1. **Types of Simulations:** Thermal simulation: To predict and control the thermal behavior during the printing process.
2. **Mechanical simulation:** To understand and manage stresses and distortions.
3. **Microstructural simulation:** To predict grain structure and texture.
4. **Software and Tools:** Overview of various software tools used in AM simulations, such as finite element analysis (FEA) tools. Discussion on the integration of these tools with CAD and AM machine software.
5. **Accuracy and Validation:** Challenges in ensuring the accuracy of simulations. Methods for validating simulation results with experimental data.
6. **Case Studies:** Presentation of case studies where simulations have significantly improved the AM process. Discussions on the practical applications and outcomes of these simulations in industry settings.
7. **Future Trends:** Predictions about the integration of AI and machine learning in enhancing simulation processes. Potential for real-time simulations and adaptive control during the AM process.

Conclusion:

The article discussion concluded that while significant advancements have been made in the simulation of metal additive manufacturing processes, there are still considerable challenges to be addressed. The future of metal AM simulations looks promising with the integration of more advanced computational methods and real-time control systems. These advancements are expected to further enhance the reliability and efficiency of metal AM, leading to broader adoption across various industries.

Recommendations:

- Continued investment in research and development for more accurate and efficient simulation processes.
- Collaboration between software developers, AM machine manufacturers, and end-users to create more integrated and user-friendly solutions.
- Emphasis on training and skill development for professionals working in the field of metal additive manufacturing.
- The article discussion provided a comprehensive overview of the state of simulations in metal additive manufacturing, offering valuable insights into both the current capabilities and future directions of this transformative technology.



Afternoon Session

Title: Brief Report on "Innovative Applications of Additive Manufacturing" by Dr. L Siva Rama Krishna, Professor, Osmania University

Introduction:

Dr. L Siva Rama Krishna, a distinguished professor at Osmania University, delivered a compelling presentation on "Innovative Applications of Additive Manufacturing". The presentation highlighted the forefront of additive manufacturing (AM) technology and its innovative applications across various industries.

Objective:

The primary aim was to shed light on how additive manufacturing is revolutionizing traditional manufacturing processes and to explore its diverse and innovative applications.

Content Summary:

Introduction to Additive Manufacturing:

- Dr. Krishna began with an overview of additive manufacturing, outlining its evolution, fundamental principles, and various techniques like FDM, SLA, SLS, and EBM.
- He emphasized the uniqueness of AM in terms of customization, complexity, and material diversity.

Innovative Applications in Various Sectors:

- **Aerospace:** The use of AM for producing lightweight, complex aerospace components, and the impact on fuel efficiency and performance.
- **Medical Field:** Customized implants, prosthetics, and even bioprinting of tissues and organs, demonstrating the personalization capabilities of AM.
- **Automotive Industry:** Rapid prototyping, manufacturing of complex parts, and the development of new lightweight materials to improve efficiency.
- **Construction:** The emerging field of 3D printed buildings and structures, highlighting the potential for cost reduction and speed in construction.
- **Consumer Goods:** Customized consumer products like footwear, eyewear, and even personalized gadgets, showcasing the versatility of AM.

Technological Innovations in AM:

- Dr. Krishna discussed advancements in AM technology, including the development of new materials like advanced polymers, metal alloys, and composites.
- He also touched upon the integration of AM with other technologies such as AI, machine learning, and IoT, paving the way for smart manufacturing solutions.

Challenges and Future Prospects:

- The presentation addressed current challenges in additive manufacturing, including scalability, material limitations, and energy consumption.
- Dr. Krishna concluded with an optimistic outlook on the future of AM, predicting increased adoption across industries and continued technological advancements.

Day3

27th December 2023

Industrial Visit to ARCI

Introduction:

The industrial visit to the Advanced Research Centre for Industrial Innovation (ARCI) offered an invaluable opportunity for our team to gain firsthand insight into cutting-edge research and developments in the fields of nanomaterials, coatings, and metal additive manufacturing. This report summarizes our observations and learnings from the visit, focusing on the three main departments we explored.

1. Department of Nanomaterials:

Objective: To understand the advancements in nanomaterials and their applications in various industries.

Observations:

- **Research Focus:** The department is primarily engaged in developing innovative nanomaterials with enhanced properties for various applications, including energy storage, electronics, and healthcare.
- **Facilities and Equipment:** We observed state-of-the-art laboratories equipped with advanced tools for nanomaterial synthesis and characterization.
- **Innovations and Applications:** The team demonstrated several nanomaterial-based products, highlighting their improved performance characteristics. Notable among these were nano-coatings for corrosion resistance and nano-composites for high-strength materials.

2. Department of Coatings:

Objective: To gain insights into the latest developments in advanced coating technologies.

Observations:

- **Research and Development:** This department specializes in the development of high-performance coatings designed for wear resistance, thermal insulation, and environmental protection.
- **Technological Demonstrations:** We witnessed demonstrations of various coating processes, including thermal spraying and PVD (Physical Vapor Deposition).
- **Industry Applications:** The team discussed applications ranging from automotive to aerospace, emphasizing the role of coatings in enhancing the lifespan and performance of components.

3. Department of Metal Additive Manufacturing:

Objective: To understand the processes, challenges, and applications of metal additive manufacturing (AM).

Observations:

- **AM Processes:** The department showcased various metal AM processes, including Selective Laser Melting (SLM) and Electron Beam Melting (EBM).
- **Research Endeavors:** A significant focus was on optimizing AM processes for better precision, strength, and material properties.
- **Real-world Applications:** Discussions revolved around the use of metal AM in creating complex geometries for aerospace and medical implants, highlighting customization and efficiency advantages.

Conclusions and Learnings:

- **Interdisciplinary Collaboration:** The visit underscored the importance of interdisciplinary collaboration in driving innovation in materials science and manufacturing technologies.
- **Industry 4.0 Integration:** ARCI's work in advanced materials and manufacturing is pivotal in the context of Industry 4.0, offering potential transformations in manufacturing efficiency and product performance.
- **Future Potential:** The developments observed at ARCI have significant implications for future technological advancements, particularly in sectors like aerospace, automotive, and healthcare.

Overall Experience:

The visit to ARCI was an enlightening experience, providing us with a glimpse into the future of materials and manufacturing technologies. It was inspiring to see how research is being translated into practical solutions addressing real-world challenges.

Afternoon Session:

Title: Brief Report on "Selective Laser Melting Process and Engineering Applications" by Dr. Gururaj Telsang, Scientist, ARCI, Hyderabad

Introduction:

The insightful presentation titled "Selective Laser Melting Process and Engineering Applications" was delivered by Dr. Gururaj Telsang, a distinguished scientist at ARCI, Hyderabad. The lecture provided a comprehensive overview of Selective Laser Melting (SLM), an advanced additive manufacturing technique, and its diverse applications in the field of engineering.

Overview of Selective Laser Melting (SLM):

Objective: To educate the audience about the fundamentals, process intricacies, and the wide range of applications of Selective Laser Melting in modern engineering.

Content Summary:

1. **Fundamentals of SLM:**

- Dr. Telsang introduced SLM as a powder bed fusion process that uses a high-power laser to melt and fuse metallic powders layer by layer.
- He explained the unique capabilities of SLM in producing parts with complex geometries and internal structures, which are difficult to achieve with traditional manufacturing methods.

2. **Process Parameters and Control:**

- The presentation detailed the critical process parameters in SLM, such as laser power, scanning speed, layer thickness, and their impact on the quality of the final product.
- Dr. Telsang emphasized the importance of optimizing these parameters to achieve desired mechanical properties and minimize defects like porosity and residual stresses.

3. **Materials in SLM:**

- A variety of materials used in SLM, including stainless steel, titanium alloys, and nickel-based superalloys, were discussed.
- The adaptability of SLM to process different materials for specific application requirements was highlighted.

4. **Engineering Applications:**

Dr. Telsang showcased several real-world applications of SLM in various fields:

- **Aerospace:** Manufacturing of lightweight, high-strength components, and complex parts like turbine blades.
- **Medical:** Production of customized implants and prosthetics with intricate structures conducive to biological integration.
- **Automotive:** Fabrication of complex parts for performance optimization in racing and luxury vehicles.
- **Tooling:** Creation of tools with conformal cooling channels leading to improved productivity.

5. **Challenges and Future Prospects:**

- The challenges in SLM, including process stability, surface finish, and post-processing requirements, were discussed.
- Dr. Telsang concluded with an optimistic view of the future of SLM, highlighting ongoing research in process optimization, new material development, and hybrid manufacturing techniques.


Thank You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Department of Science & Technology, Govt. of India

Day4

28th December 2023

Title

"A Computational Framework to Simulate the Residual Stress and Distortion in Laser Metal Deposition" by

Dr. Mallikarjuna, *NIT Trichy*

Introduction:

Dr. Mallikarjuna from NIT Trichy delivered an insightful lecture on developing a computational framework for simulating residual stress and distortion in Laser Metal Deposition (LMD), a vital additive manufacturing process. This lecture highlighted the significance of predictive modeling in improving the efficiency and quality of LMD processes.

Objective:

The lecture aimed to provide a deep understanding of the challenges in LMD related to residual stress and distortion, and how computational simulations can effectively predict and mitigate these issues.

Content Overview:

Basics of Laser Metal Deposition:

Dr. Mallikarjuna began by explaining LMD, where a laser beam is used to fuse metallic powder or wire onto a substrate, layer by layer.

He emphasized the process's relevance in fabricating complex parts and repairing damaged components in aerospace, automotive, and tooling industries.

Challenges in LMD:

- The primary focus was on the residual stresses and distortions that occur due to rapid heating and cooling cycles in LMD.
- These challenges often lead to part failures, dimensional inaccuracies, and reduced mechanical properties.

Computational Framework:

- Dr. Mallikarjuna introduced the computational framework designed to simulate the LMD process.
- The framework integrates thermal modeling and structural analysis to predict residual stresses and distortions.
- He explained the use of finite element analysis (FEA) in the simulation process, detailing how it helps in understanding the thermal and mechanical behavior of the material during deposition.

Simulation Results and Validation:

- The lecture showcased various case studies where the computational model was used.
- Results from the simulation were compared with experimental data to validate the accuracy of the model.

Application and Benefits:

- Dr. Mallikarjuna discussed how this framework can assist in pre-process planning, parameter optimization, and design modification to minimize residual stresses and distortions.
- He highlighted the cost-effectiveness of using simulations to predict and prevent failures, rather than relying on trial and error in physical experiments.

Future Directions:

- The potential of integrating machine learning algorithms for predictive analytics was discussed.
- The importance of continual development of more sophisticated models for better accuracy was emphasized.

Conclusion:

The lecture by Dr. Mallikarjuna provided valuable insights into the complexities of Laser Metal Deposition and the importance of computational simulations in addressing its challenges. The developed framework marks a significant step towards enhancing the reliability and efficiency of LMD processes in various industrial applications. Attendees greatly appreciated the depth of knowledge shared by Dr. Mallikarjuna, particularly in bridging the gap between theoretical research and practical industrial applications. The lecture not only shed light on the technical intricacies of LMD but also demonstrated the practical benefits of computational modeling in advancing additive manufacturing technologies.

Article Discussion: "Residual Stresses in Metal Additive Manufacturing"

Overview:

The article discussion on "Residual Stresses in Metal Additive Manufacturing" provided a comprehensive analysis of one of the critical challenges in the field of additive manufacturing (AM) - residual stresses. The article delved into the causes, implications, and potential mitigation strategies for residual stresses in metal AM processes.

Key Points from the Article:

Understanding Residual Stresses:

The article began by defining residual stresses as stresses retained in a solid material after the original cause of the stress has been removed. In the context of metal AM, these stresses are primarily attributed to the rapid heating and cooling cycles during the layer-by-layer fabrication process.

Causes and Effects:

- It identified the primary causes of residual stresses in metal AM, including thermal gradients during the printing process and the material's constraints against thermal expansion and contraction.
- The article highlighted the effects of residual stresses, such as warping, distortion, reduced mechanical properties, and potential failure of the printed parts.

Measurement Techniques:

Various techniques for measuring residual stresses were discussed, such as X-ray diffraction, neutron diffraction, and hole-drilling methods. The article stressed the importance of accurately measuring these stresses to ensure the structural integrity and reliability of AM components.

Mitigation Strategies:

Several strategies for reducing residual stresses were presented. These included optimizing process parameters (like laser power, scan speed, and layer thickness), post-processing treatments (such as heat treatment and hot isostatic pressing), and adopting novel approaches like process simulation for predictive corrections.

Case Studies and Applications:

The article provided real-world examples and case studies where controlling residual stresses was crucial, especially in industries such as aerospace, automotive, and biomedical, where the performance and safety of components are paramount.

Future Research Directions:

Finally, it discussed the ongoing research aimed at better understanding and controlling residual stresses, including the development of new materials and advanced computational models for more accurate predictions.

Conclusion:

The discussion on this article underscored the significance of understanding and managing residual stresses in metal additive manufacturing. As the article illustrated, addressing these stresses is vital for the advancement and wider adoption of AM technologies, particularly in applications where precision and structural integrity are critical.

Overall Impression:

The article provided a thorough and insightful exploration of the challenges posed by residual stresses in metal AM. It not only highlighted the technical aspects but also offered practical solutions, making it a valuable resource for professionals and researchers in the field of additive manufacturing.

Afternoon Session:

Title: "National Education Policy (NEP) 2020 Implementation" by Dr. A Chandrashekhar, Associate professor, IFHE Hyderabad

Overview:

Dr. A Chandrashekhar from IFHE Hyderabad presented an enlightening talk on the implementation of the National Education Policy (NEP) 2020. His discussion focused on the key aspects of NEP 2020 and its transformative impact on the Indian education system.

Key Highlights of the Talk:

Introduction to NEP 2020:

Dr. Chandrashekhar commenced by providing an overview of the NEP 2020, highlighting its objective to revamp and reinvigorate the Indian education system. He mentioned that this policy replaces the previous policy formulated in 1986 and is aimed at making education more holistic, flexible, and aligned with the 21st-century needs.

Major Reforms in School Education:

- The NEP 2020's significant shift from the 10+2 structure to a 5+3+3+4 curricular framework was discussed. This framework focuses on early childhood care and education (ECCE) and integrates play-based and activity-based learning for foundational stages.
- Dr. Chandrashekhar stressed the importance of multilingualism and the promotion of local languages in primary education.

Changes in Higher Education:

- The talk highlighted the policy's aim to increase the Gross Enrolment Ratio in higher education to 50% by 2035.
- The introduction of multidisciplinary education with flexible curriculums, multiple entry and exit points, and the credit transfer system were discussed.

Focus on Skill Development:

Emphasis was placed on the policy's focus on skill development and vocational training from a young age. Integration of vocational education with mainstream education was highlighted as a key strategy to enhance employability.

Assessment Reforms:

The NEP 2020's approach to transforming the assessment methods to promote learning and critical thinking was discussed. Dr. Chandrashekhar pointed out the shift from rote learning to a more competency-based system.

Research, Innovation, and Technology Integration:

The policy's focus on research and innovation, setting up of the National Research Foundation (NRF), and integrating technology in education through the National Educational Technology Forum (NETF) were notable points.

Implementation Challenges:

Dr. Chandrashekhar addressed the potential challenges in implementing such a comprehensive policy, including the need for extensive teacher training, infrastructure development, and significant financial investment.

Day 5

29th December 2023

Title

"Metal Additive Manufacturing for Space Applications" by

Dr. V Anil Kumar

Scientist, Vikram Sarabhai Space Center, ISRO, Trivandrum

Introduction:

In an insightful lecture, Dr. V Anil Kumar, a prominent scientist at Vikram Sarabhai Space Center (VSSC), ISRO, Trivandrum, shared his expertise on the use of metal additive manufacturing (AM) in space applications. The talk focused on the innovative ways in which metal AM is being leveraged to enhance the efficiency and functionality of space components.

Objective:

The main objective of the lecture was to elucidate the role and potential of metal additive manufacturing in the context of space technology and its significant contributions to advancing space missions.

Key Points Discussed:

Overview of Metal Additive Manufacturing:

- Dr. Kumar began with a comprehensive introduction to metal AM, explaining its basic principles and processes such as Selective Laser Melting (SLM) and Electron Beam Melting (EBM).
- He emphasized the advantages of AM over traditional manufacturing, including design freedom, material efficiency, and the ability to create complex geometries.

Applications in Space Technology:

- The core of the presentation was dedicated to exploring various applications of metal AM in space technology. These included the manufacturing of lightweight structural components, intricate cooling channels in rocket engines, and parts for satellite systems.
- Dr. Kumar showcased specific examples from ISRO's projects where AM had been successfully implemented.

Material Considerations:

- A significant portion of the talk addressed the materials used in metal AM for space applications. The focus was on high-strength alloys, titanium alloys, and nickel-based superalloys, known for their high-performance under extreme space conditions.
- Dr. Kumar discussed the challenges in material selection, including the need for high precision and reliability in space-grade materials.

Challenges and Solutions:

- The lecture also covered the unique challenges faced in using AM for space applications, such as ensuring the structural integrity of printed components and dealing with the high thermal stresses during launches.
- Dr. Kumar discussed various strategies to overcome these challenges, including post-processing treatments and rigorous testing protocols.

Future Prospects:

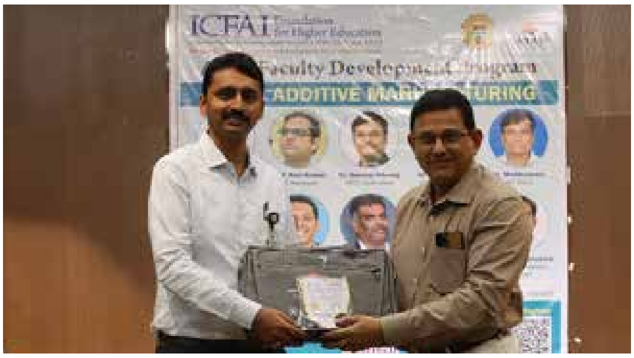
- The future of metal AM in space technology was a key point of discussion. Dr. Kumar expressed optimism about the potential for AM in creating more efficient, cost-effective, and high-performance components for future space missions.
- He also hinted at ongoing research and development in this area, including the use of AM for in-situ resource utilization in space missions.

Conclusion:

Dr. V Anil Kumar's lecture provided a comprehensive understanding of the significant role that metal additive manufacturing plays in the realm of space technology. His insights into the current applications and future potential of AM in space exploration were particularly enlightening.

Overall Experience:

The session was extremely informative and engaging, particularly for those interested in the intersection of advanced manufacturing technologies and space exploration. Dr. Kumar's expertise and practical examples from ISRO's projects greatly enhanced the understanding of the subject matter.



Title: "Modeling Approaches for Metal Additive Manufacturing Process" - Article Discussion

Introduction:

A comprehensive discussion was held on the article titled "Modeling Approaches for Metal Additive Manufacturing Process," which delved into various modeling strategies employed to enhance the efficiency and accuracy of metal additive manufacturing (AM). The article provided an in-depth analysis of different modeling techniques and their applications in optimizing metal AM processes.

Objective:

The primary objective of this discussion was to explore and understand the diverse modeling approaches used in metal additive manufacturing, highlighting their significance in addressing the challenges and improving the overall process.

Key Points from the Article:

Overview of Metal Additive Manufacturing:

- The article began by outlining the basics of metal AM processes, including popular techniques like Selective Laser Melting (SLM), Direct Metal Laser Sintering (DMLS), and Electron Beam Melting (EBM).
- It emphasized the growing importance of metal AM in various industries due to its ability to create complex geometries and customized parts.

1. Need for Modeling in AM:

The discussion highlighted why modeling is crucial in AM, particularly for predicting and controlling the thermal behavior, residual stresses, microstructure evolution, and mechanical properties of the printed parts.

2. Thermal Modeling Approaches:

Thermal models, which predict the temperature distribution during the printing process, were discussed extensively. The article presented various approaches, including finite element analysis (FEA) and computational fluid dynamics (CFD), used to simulate the thermal behavior and cooling rates.

3. Structural and Mechanical Modeling:

The article also covered structural modeling techniques that help predict residual stresses and distortions. It discussed the use of FEA to simulate the mechanical behavior of materials under the rapid heating and cooling conditions of AM.

4. Microstructural Modeling:

Microstructural modeling was another focal point, essential for predicting the grain structure and texture of the printed metals. Phase-field models and cellular automaton methods were among the techniques mentioned for this purpose.

5. Process Optimization and Control:

The discussion underscored how these modeling approaches aid in process optimization, allowing for parameter tuning to achieve desired qualities in the final product. It also touched on the role of models in real-time process monitoring and control.

Challenges and Future Directions:

- The article acknowledged the challenges in modeling, such as the need for high computational resources and the development of more accurate and comprehensive models.
- Future directions include integrating machine learning and AI with traditional modeling approaches to enhance predictive accuracy and efficiency.

Afternoon Session:

Title: "Design and Manufacturing of Patient-Specific Implants Using Metal Additive Manufacturing" by Dr. A Manmadhachary, Associate Professor, IFHE Hyderabad

Introduction: Dr. A Manmadhachary, an Associate Professor at IFHE Hyderabad, delivered an insightful lecture on the cutting-edge topic of designing and manufacturing patient-specific implants using metal additive manufacturing (AM). The session was particularly focused on the integration of AM technology in the medical field, specifically in the creation of custom implants tailored to individual patients' needs.

Objective: The primary aim of the lecture was to shed light on the process, advantages, and challenges of using metal AM for developing patient-specific implants, and to explore the future potential of this technology in personalized medicine.

Key Points Discussed:

Introduction to Metal Additive Manufacturing:
Dr. Manmadhachary began with an overview of metal AM technologies, including Selective Laser Melting (SLM) and Electron Beam Melting (EBM), which are commonly used for medical implant manufacturing.

Advantages of AM in Implant Manufacturing:
He highlighted the advantages of AM, such as the ability to create complex geometries, the optimization of implant design for better osseointegration, and the potential for weight reduction without compromising strength.

1. **Design Process for Patient-Specific Implants:**
   - The lecture delved into the design process, emphasizing the importance of accurate imaging techniques like CT and MRI scans to model implants that precisely match the patient's anatomy.
   - The role of computer-aided design (CAD) and finite element analysis (FEA) in optimizing the design for biomechanical compatibility was discussed.
2. **Material Considerations:**

Dr. Manmadhachary touched upon the selection of materials for implants, focusing on biocompatible metals like titanium and cobalt-chromium alloys. He discussed their properties, such as corrosion resistance and strength, which make them suitable for orthopedic and dental implants.

3. **Case Studies and Applications:**

The session included case studies where metal AM had been successfully utilized to create patient-specific implants, such as hip joints and dental prostheses. These examples illustrated the practical applications and benefits of this technology.

4. **Challenges and Limitations:**
   - The challenges in this field were also addressed, including the high cost of AM, the need for stringent quality control, and the challenges in regulatory approvals for medical devices.
   - The professor also discussed the limitations in current technology, such as size constraints and surface finish considerations.
5. **Future Trends and Research:**

The future potential of metal AM in the medical field was a key point of discussion. Dr. Manmadhachary predicted advancements in material science, machine technology, and process control that could further enhance the effectiveness and accessibility of patient-specific implants.

Day6

30th December 2023

Title

Brief Report on "Materials for Additive Manufacturing" by

Mr. K Rakesh Kumar
Technical Officer, National Center for Additive Manufacturing, Hyderabad

Introduction:

Mr. K Rakesh Kumar, Technical Officer at the National Center for Additive Manufacturing in Hyderabad, delivered an informative lecture on the topic of materials used in additive manufacturing (AM). The talk was aimed at providing an overview of the various types of materials that are compatible with AM techniques and their specific applications in different industries.

Objective:

The main objective of this lecture was to educate attendees on the range of materials available for additive manufacturing, including their properties, applications, and the challenges associated with their use.

Key Points Discussed:

Overview of Additive Manufacturing:

Mr. Kumar started the session with a brief introduction to materials to additive manufacturing, highlighting its evolution and its growing importance in modern manufacturing processes.

Types of Materials Used in AM:

- A significant portion of the lecture was dedicated to discussing the different types of materials used in AM, including polymers, metals, ceramics, and composites.
- Each material type was discussed in detail, focusing on their properties, strengths, and limitations.

Metal Materials in AM:

Special emphasis was placed on metal materials, which are extensively used in industries like aerospace, automotive, and healthcare.

Mr. Kumar discussed various metal powders used in AM, such as titanium, stainless steel, nickel alloys, and aluminum alloys, explaining their applications and processing challenges.

Polymer Materials:

The discussion also covered polymer materials used in AM, such as PLA, ABS, and Nylon. The lecture touched upon their usage in consumer goods, automotive components, and prototyping.

Advancements in Composite Materials:

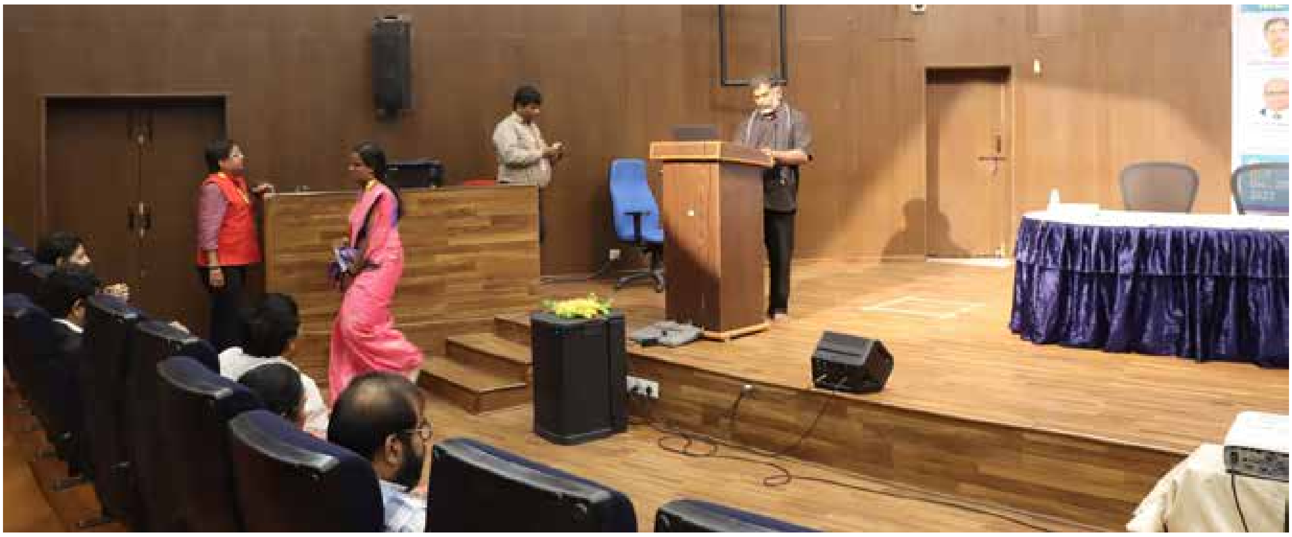
The lecture highlighted the advancements in composite materials for AM, focusing on their enhanced properties like increased strength-to-weight ratio and improved thermal resistance.

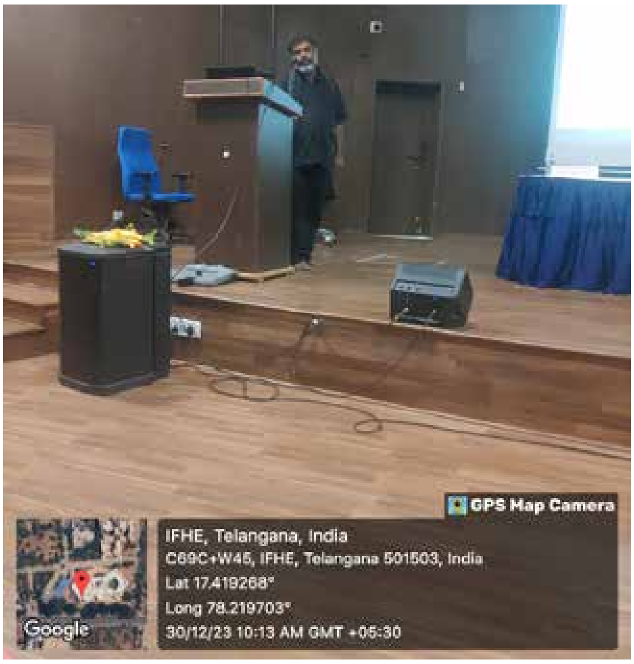
Material Selection Criteria:

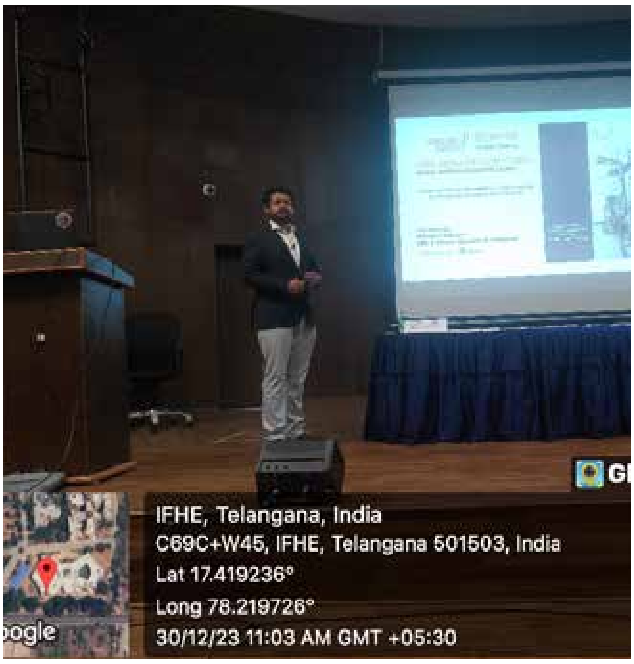
Mr. Kumar discussed the criteria for selecting materials for specific applications in AM, considering factors like mechanical properties, thermal stability, and cost-effectiveness.

Challenges and Future Trends:

- The challenges associated with AM materials, such as powder manageability, consistency in quality, and post-processing requirements, were addressed.
- Mr. Kumar shared insights into future trends in AM materials, including the development of new alloys and the exploration of sustainable and bio-based materials.





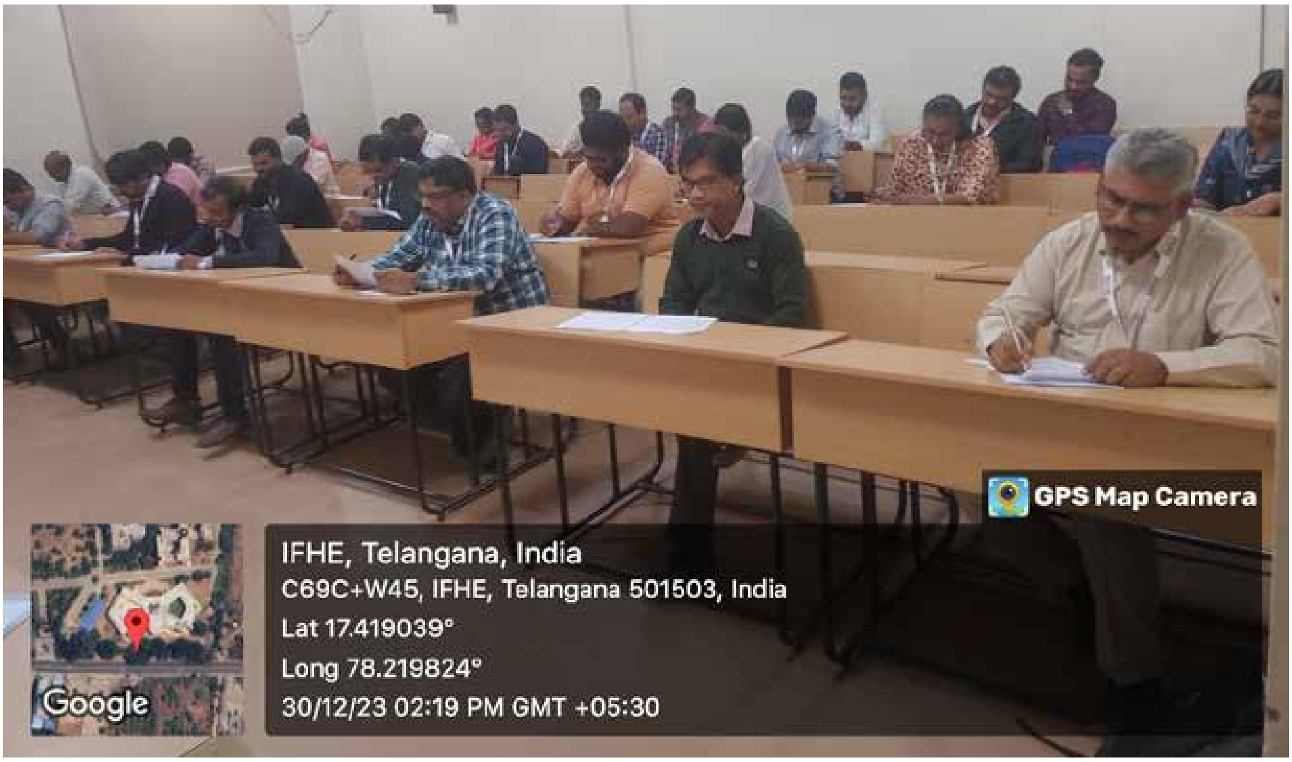


Highlights of the Events:

In addition to lectures from various resource persons, participants engaged in daily hands-on sessions to deepen their understanding:

- Day 1: Dr. A Manmadha Chary from IcfaiTech, IFHE Hyderabad, led a session on CAD Modelling, 3D Slicing, and G-code development.
- Day 2: The focus was on Medical CAD Modelling, conducted by Dr. A Manmadha Chary.
- Day 3: Dr. Gururaj, a Scientist at ARCI, Hyderabad, provided insights into Plastic and Metal AM machines at ARCI.
- Day 4: Dr. Avinash Malladi from IcfaiTech, IFHE Hyderabad, introduced Metal AM software including Altair, Digimat, and Autodesk NetFabb.

Participants also took part in an MCQ exam based on the lectures. The program concluded with a vote of thanks from Dr. B Madhavi and a valedictory function chaired by Dr. K L Narayana, Director of IcfaiTech.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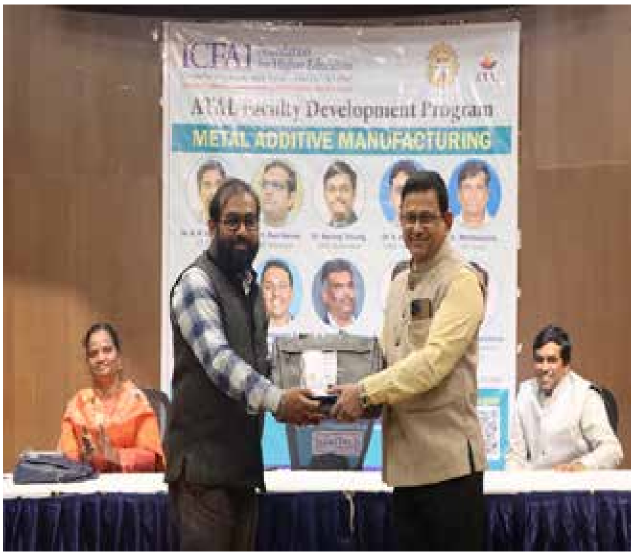
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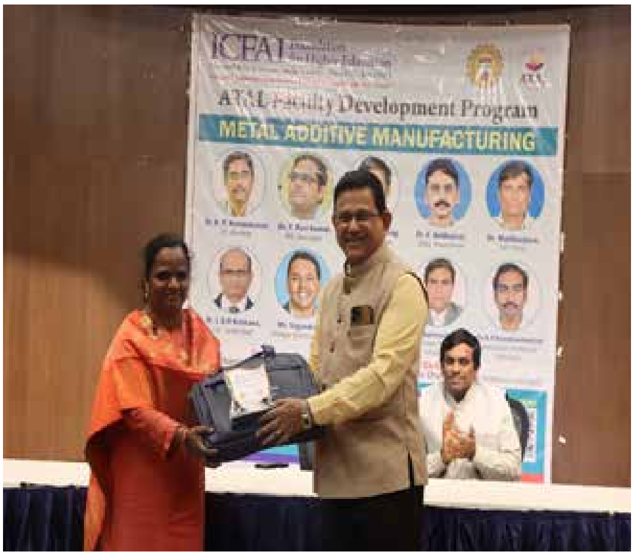
METAL ADDITIVE MANUFACTURING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ATAL Faculty Development Program
METAL ADDITIVE MANUFACTURING


ATAL Faculty Development Program
METAL ADDITIVE MANUFACTURING

Summery of the FDP Programme

The Faculty Development Program (FDP) on Metal Additive Manufacturing was sponsored by All India Council for Technical Education (AICTE) through the AICTE Training and Learning (ATAL) scheme. This year a total of 3285 proposals were received for evaluation and out of which 395 were approved. We are one among 395 approved list. In mechanical engineering a total of 370 proposals were received and approved 25 only. We are part of those 25 Mechanical engineering approved list. An amount of Rs 3.5 Lakhs was sanctioned for this program. The workshop was organized by the Centre for Excellence in Robotics & Advanced Manufacturing, Department of Mechanical Engineering. The FDP was conducted in offline mode. Sessions were conducted from 9:30 A.M to 5:30 P.M during 25th Dec, 2023 to 30th Dec 2023.

The resource persons identified are experts in the field from eminent institutions, R&D centers and industries like IIT, NIT, ISRO, ARCI(DST), Osmania University and Phillips machine tools.

The participants registered for the FDP in the ATAL portal. 60 participants from 76 enrolled were shortlisted and approved to attend the FDP. The FDP was successfully completed by 56 participants who attended at least 80 % of the sessions and scored more than 70 % marks in the continuous comprehensive assessment conducted as per AICTE guideline. E-certificates were issued for these participants through AICTE-ATAL portal.

The major learnings of the participants are various types of 3D printing, printing materials, and machines, metal additive manufacturing, Industrial approach for 3D printing, impact of 3D printing in the industry and startup ecosystem, development of new materials for 3D printing, fabricating their own FDM machines. Application of 3D printing in various fields including human implants. They got hands-on training in developing CAD models, configuration of models in slicing software MIMICS, Magics, 3-matic. Altair Inspire 3D, Ansys Additive Manufacturing setting up the FDM 3D printing machine and printing of components. Herewith attached a few photographs of FDP.

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