



**Two-week online AICTE Sponsored Faculty Development Program on
Frontier of 3D Printing Technology and Its Industrial Applications
(Phase-I) From 7th to 19th DEC – 2020**



Detailed Report of FDP

Phase-I - From 07.12.2020 to 19.12.2020

Phase-II - From 25.01.2021 to 06.02.2021

Phase-I		Phase-II	
Registered	440	Registered	433
Shortlisted Candidates	220	Shortlisted Candidates	220
Attended	139	Attended	159
Awarded with e-Certificate	121	Awarded with e-Certificate	128

Phase-I Brochure (From 07.12.2020 to 19.12.2020):



Who can Attend

- Faculty members/ research scholars/ Scientists/ Engineers working in Private/ Public/ Govt. organizations/ industries etc.

Registration and Fee Particulars

- There is no registration fee

Registration Link

<https://tinyurl.com/AICTE-3D-PRINTING>

Important Dates

- Submission of Application on or before 04/12/2020
- Confirmation of Acceptance on 05/12/2020
- The selected candidates will be intimated through email only.

Important to participants

- All the sessions will be conducted online through Microsoft Teams App.
- A test will be conducted at the end of the program.
- E- certificates will be issued to those participants who have attended the program with minimum 80% of attendance and scored minimum 60% marks in the test.

COMMITTEE MEMBERS

Chief Patrons

Er. Lakireddy Bali Reddy
Chairman, LBRCE

Sri L. Jaya Prakash Reddy
Co-Chairman, LBRCE

Sri L.R.N.K. Prasad Reddy
Vice-Chairman, LBRCE

Patrons

Sri G. Srinivasa Reddy
President, LBRCE

Dr. K. Appa Rao, Ph.D
Principal, LBRCE

Dr. K. Harinadha Reddy, Ph.D
Vice-Principal, LBRCE

Convener

Dr. S.Pichi Reddy, Ph.D
HOD- ME, LBRCE

Contact person

Coordinator
Dr. Murahari Kolli, Associate Professor,
Department of Mechanical Engineering,
Mobile Number: 8074139826
Co-coordinators
Mr. J.Subba Reddy, Associate Professor,
Department of Mechanical Engineering,
Mobile Number: 9985100936, 8919292437
Mr.K.V.Viswanadh, Sr. Assistant Professor,
Department of Mechanical Engineering,
Mobile Number: 7702893880

Email: mechlbrce3dfdp@gmail.com



Two Week Online
AICTE Sponsored FDP on
**Frontier of 3D Printing Technology and
Its Industrial Applications**

(7th -19th DEC-2020)



Organized
by
**DEPARTMENT OF
MECHANICAL ENGINEERING**
**LAKIREDDY BALI REDDY COLLEGE OF
ENGINEERING (A)**

(Accredited by NAAC & NBA (CSE,IT,ECE,EEE, MECH),
ISO 9001:2015 Certified Institution Approved by AICTE,
New Delhi and Affiliated to JNTUK,Kalacina
L.B.REDDY NAGAR, MYLAVARAM, KRISHNA DIST., A.P.-521 230.

About the Institute

The Lakireddy Bali Reddy College of Engineering (LBRCE), Mylavaram was established in the year 1998 by Lakireddy Bali Reddy Charitable Trust, whose architect is Er. Lakireddy Bali Reddy garu. The institute is established with the sole aim of providing high quality educational opportunities in the field of science, engineering, technology and management. It is spread over 60 acres of sprawling lush green landscape spotted with orchids and grooves. It is approved by AICTE, affiliated to JNTUK, Kakinada and attained autonomous status in the year 2010. It is accredited with NAAC and NBA (CSE, IT, ECE, EEE & ME) under Tier-I. A separate R&D cell is established in the college to focus on continuous sponsored research. It has various sponsored research projects funded by various funding agencies. At present, 8 B.Tech programmes are offered.

- ❖ Aerospace Engineering
- ❖ Artificial Intelligence & Data Science
- ❖ Civil Engineering
- ❖ Computer Science Engineering
- ❖ Electrical & Electronics Engineering
- ❖ Electronics and Communication Engineering
- ❖ Information Technology
- ❖ Mechanical Engineering

Four M.Tech programmes and M.B.A programme is offered. The M.Tech Programs are offered in.

- ❖ Computer Science and Engineering
- ❖ Thermal Engineering
- ❖ Power Electronics and Drives
- ❖ VLSI & Embedded systems

About the Department

The Department of Mechanical Engineering was started in the year 1998. The Department is accredited by NBA (Tier-I). It is recognized as a Research centre by JNTUK Kakinada and has sponsored projects worth of Rs.1.5 crores. Faculty of the department are actively engaged in publishing papers in national and international journals and conferences.

About the FDP

The aim of this program is to provide a basic understanding on techniques and developments in 3D geometric modeling and printing components to a broad spectrum of researchers, industry participants, faculty and post graduate students. Focus will be on describing different processes under the umbrella of 3D printing covering both polymer and metal based systems. Implementation of 3D printing in various segments will be demonstrated using industrial case studies.

Course Content

- ❖ Introduction to 3D printing.
- ❖ Metallic and Polymer materials used for 3D components.
- ❖ 3D Printing Softwares.
- ❖ 3D Printer Components.
- ❖ CAD models, Generation of STL files, calculations of layer by layer profiles.
- ❖ Support structure formation of 3D Printing.
- ❖ Applications of 3D Printing.
- ❖ Case studies on 3D Printing.

Resource persons

- ✓ Dr. K. P. Karunakaran, IIT Bombay
- ✓ Dr. Pankaj Biswas, IIT Guwahati
- ✓ Dr. Arvind Kumar, IIT Kanpur
- ✓ Dr. Mamilla Ravi Sankar, IIT Tirupati
- ✓ Dr. Kaushik Kumar, BITS Mesria
- ✓ Dr. S. Kanmani Subbu, IIT Palakkad
- ✓ Dr. M P Gururajan, IIT Bombay
- ✓ Dr. D. Chakradhar, IIT Palakkad
- ✓ Dr. Sajan Kapil, IIT Guwahati
- ✓ Dr. Murshid Imam, IIT Patna
- ✓ Dr. Adepu Kumar, NIT Warangal
- ✓ Dr. A. M. Kuthe, NIT Nagapur
- ✓ Dr.Mrityunjay Doddamani, NIT Surathkal
- ✓ Dr. Y. Ravi Kumar, NIT Warangal
- ✓ Dr. Manajaih, NIT Warangal
- ✓ Dr.Srikanth Bontha, NIT Surathkal
- ✓ Dr. Srinivasu, NIT Raipur
- ✓ Dr. Tella Babu Rao, NIT AP
- ✓ Dr. Prashant K. Jain, IIITDM Jabalpur
- ✓ Dr. Rupinder Singh, NITTTR Chandigarh
- ✓ Dr. K. Ponappa, IIITDM, Jabalpur
- ✓ Dr.Sriram Venkatesh, OU, Hyd
- ✓ Dr.M. Krishna Kishore, Dong Eui University, Busan South Korea
- ✓ Koppunur Rakesh, VSD3D enterpris, Hyderabad
- ✓ Dr. A.Manmadha Chary, IFHE University, Hyderabad.



Two-week online AICTE Sponsored Faculty Development Program on Frontier of 3D Printing Technology and Its Industrial Applications

(Phase-I) From 7th to 19th DEC-2020

Schedule



Date	9.30 - 11.00	11.00 - 11.15	11.15 AM -12.45	12.45 - 2.00	2.00-3.30
7.12.20	Dr. K. P. Karunakaran-IIT Bombay 3D Printing: A Disruptive Technology	Break	Dr.Adepu Kumar- NIT Warangal Non Beam Based Additive Manufacturing	Break	Dr. A.M.Kuthe-NIT Nagapur Role of 3D Printing in Medical Domain
8.12.20	Dr. S. KanmaniSubbu-IIT Palakkad Basic Concepts of 3D Printing		Dr. A.M.Kuthe-NIT Nagapur Innovative Product Development		Dr. SajanKapil-IITG Omnidirectionality in Additive Manufacturing Systems
9.12.20	Dr.A.Manmadachary ICFAI Tech University, Hyderabad Data Preparation for AM		Dr.Adepu Kumar- NIT Warangal Recent trends in Metal AM (Direct Energy Deposition)		Dr. Y.Ravi Kumar-NIT Warangal 3D Printing: A Game Changer Technology
10.12.20	Dr. Y.Ravi Kumar-NIT Warangal Design for 3D Printing (Df3DP)		Dr.G.Srinivasu- NIT Raipur Composites in 3D printing		Dr.A.Manmadachary ICFAI Tech University, Hyderabad Design and Manufacturing of Medical Modals by AM
11.12.20	Dr. Rupinder Singh, NITTTR, Chandigarh 3D Printing for Biomedical Applications		Dr. Ponappa K- IITDM Jabalpur Additive Manufacturing -Biometallic materials		Dr. A.Srinath, KLEF, Guntur Industry 4.0
12.12.20	Dr. Rupinder Singh, NITTTR, Chandigarh 3D Printing for Waste Management		Dr. Kaushik Kumar-BITS Mesra 3D and 4D Manufacturing		Dr. Ravi Sankar-IIT Tirupathi Functional Graded bio ceramic coating on Titanium alloy for Orthopedic applications-

13.12.20	Sunday – No Sessions				
14.12.20	Dr. Arvind Kumar-IIT Kanpur Fundamentals of Metal 3D printing	Break	Dr.M.RaviSankar-IIT Tirupathi Additive Manufacturing for Complex Features and Post Processing	Break	Dr.M Ravi Sankar-IIT Tirupathi Micro, Nano, Bio Manufacturing
15.12.20	Mr.K.Rakesh- VSD3D Enterprise-Hyd. Frontiers Materials in 3D printing		Dr.M.Santosh Kumar- AIT Bangalore 3D printing CURA slicing Software		Dr. S. KanmaniSubbu-IIT Palakkad Rapid Tooling: A Major Industrial Applications of 3D Printing
16.12.20	Dr. K. Krishna Kishore – Dong Eui University Wire Arc Additive Manufacturing Process: Challenges and Applications		Dr. TellaBabu Rao- NIT Andhra An overview on Wire Arc Additive Manufacturing Technologies		Dr. Y.Ravi Kumar-NIT Warangal Metal 3D printing -Virtual Lab
17.12.20	Dr. Arvind Kumar-IIT Kanpur Applications and Research Pathway in Metal 3D printing		Dr. Prashant K. Jain- IIITDM Jabalpur 3D printing Data Formats		Dr.L.Suvarna Raju Vignan University Polymer 3D Printing and WAAMprocess- Virtual Lab
18.12.20	Dr.K.Venkata Rao-Vignan University Modeling and Optimization of wall Geometry and power consumption in AM		Dr.Pankaj Biswas-IIT Guwahati Fundamental of LBW and Laser Based AM		Dr.Y.Ravi Kumar-NIT Warangal Standards, Qualification and certification of 3D printed parts
19.12.20	Dr. Arvind Kumar-IIT Kanpur Modelling and Simulation in Metal 3D Printing		Dr. M.Manjaiah-NIT Warangal Laser Assisted Metal Additive Manufacturing		Valedictory/ QUIZ Exam

FDP-Coordinators

Dr. Murahari Kolli

Mr.J.Subba Reddy, Mr. K.V.Viswanadh

Convener

**Dr. S.Pichi Reddy
Professor & HoD**

A Two-week online AICTE Sponsored Faculty Development Program on Frontier of 3D Printing Technology and Its Industrial Applications (Phase-I) From 7th to 19th DEC-2020. Completed a detailed description is mentioned below.

In this FDP Initially 440 participants were registered. 433 participants are around the country, rest of them from other countries like Algeria, Bhutan, Ethiopia, Iraq, Malaysia, Kenya and UK. As per the AICTE guidelines we could only accommodate 220. This FDP covered all most all area of 3D Printing arena. From the basics of 3D printing, elements, Technologies, formats, process parameters, Different softwares, 3D printing design, ASTM standard of AM , modeling, optimization and specific applications. In this FDP 23 resource persons had delivered their valuable lectures. All the resource persons are from various reputed organizations like IITs, NITs, Central Universities and local universities.


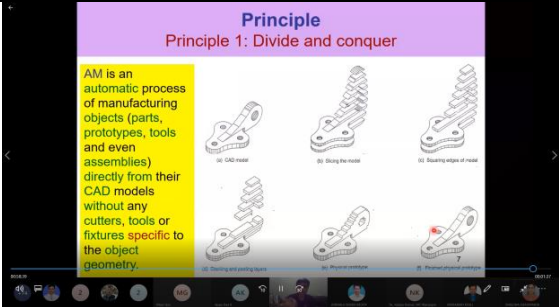
During the FDP, we have conducted a variety of sessions:

Day	Session	Name of the Resource Person	Name of the Institute	Topics Covered
1	1	Prof. K. P. Karunakaran	IIT Bombay	3D Printing: A Disruptive Technology
	2	Prof. Adep Kumar	NIT Warangal	Non Beam Based Additive Manufacturing
	3	Prof. A.M. Kuthe	NIT Nagapur	Biomedical Engineering
2	1	Dr. S. Kanmani Subbu	IIT Palakkad	Introduction 3D Printing
	2	Prof. A.M. Kuthe	NIT Nagapur	Innovative product development
	3	Dr. Sajan Kapil	IIT Guwahati	Omnidirectionality in Additive Manufacturing Systems
3	1	Dr. A. M. Chary	IFHE University, Hyderabad	Data Preparation for 3D printing using software
	2	Prof. Adep Kumar	NIT Warangal	Direct Energy Deposition Process
	3	Dr. Y.Ravi Kumar	NIT Warangal	3D Printing: A Game Changer Technology
4	1	Dr. Y.Ravi Kumar	NIT Warangal	Design for 3D Printing (Df3DP)
	2	Dr. G.Srinivasu	NIT Raipur	Composite Materials in 3D printing
	3	Dr. A. M. Chary	IFHE University, Hyderabad	3D Printing in Complex Oral and Maxillofacial Surgeries

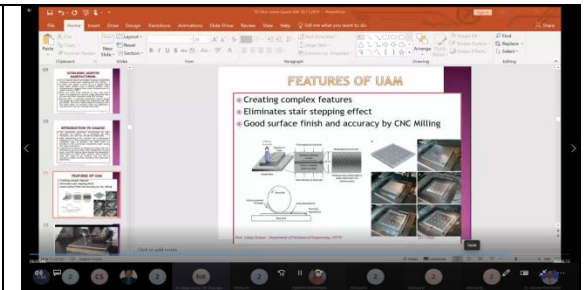
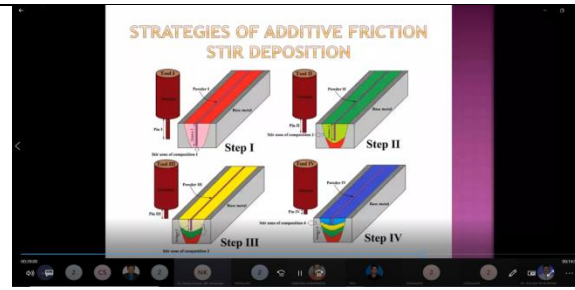
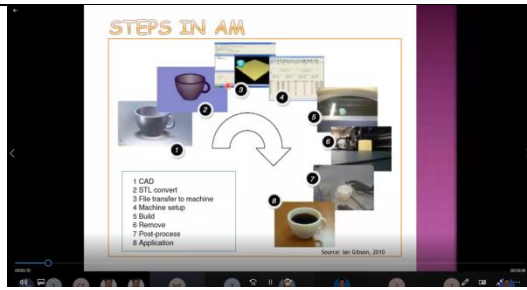
5	1	Prof. Rupinder Singh	NITTTR Chandigarh	3D printing for biomedical applications
	2	Dr. Ponappa K	IIITDM Jabalpur	Additive Manufacturing Processes - Biometallic materials
	3	Prof. A.Srinth	KLEF, Guntur	Industrial 4.0 and its applications
6	1	Prof. Rupinder Singh	NITTTR, Chandigarh	3D printing for Waste Management
	2	Prof. Kaushik Kumar	BITS Mesra	Advances in Additive Manufacturing Processes
	3	Dr. Ravi Sankar	IIT Tirupati	Laser Micro Cladding System
7	1	Dr. Arvind Kumar	IIT Kanpur	Fundamentals of Metal 3D printing
	2	Dr. Ravi Sankar	IIT Tirupati	Micro and Nano System in 3D printing
	3	Dr. Ravi Sankar	IIT Tirupati	Laser Assisted Metal Additive Manufacturing
8	1	Dr. S. Kanmani Subbu	IIT Palakkad	3D Printing in Rapid Tooling Industrial Applications
	2	Mr. K.Rakesh	VSD3D Enterprise, Hyd	Frontiers Materials in 3D printing collaboration with VSD3D enterprise, Pvt, Ltd, Hyderabad
	3	Dr. M.Santosh Kumar	AIT Bangalore	3D printing CURA slicing Software- Demo
9	1	Dr. K. Krishna Kishore	Dong Eui University, Busan, South Korea	Wire Arc Additive Manufacturing Process: Challenges and Applications
	2	Dr. Tella Babu Rao	NIT AP	An overview on Wire Arc Additive Manufacturing Technologies
	3	Dr. Y.Ravi Kumar and Team	NIT Warangal	Metal 3D printing -Virtual Lab collaboration with NIT Warangal, Warangal
10	1	Dr. Arvind Kumar	IIT Kanpur	Applications and Research Pathway in Metal 3D printing
	2	Prof. Prashant K. Jain	IIITDM Jabalpur	3D Printing Data Formats
	3	Prof. L.Suvarna Raju -	Vignan University, Vadlamudi, Guntur	Polymer 3D Printing and Wire Arc Additive manufacturing (WAAM) process- Virtual Lab collaboration with Vignan University, Vadlamudi, Guntur

11	1	Prof. K.Venkata Rao	Vignan University, Vadlamudi, Guntur	Optimization of Wire Arc Additive Manufacturing process
	2	Prof. Pankaj Biswas-	IIT Guwahati	Fundamental of LBW and Laser Based AM
	3	Dr. Y.Ravi Kumar	NIT Warangal	Standards, Qualification and certification of 3D printed parts
12	1	Dr. Arvind Kumar	IIT Kanpur	Modelling and Simulation in Metal 3D Printing
	2	Dr. M.Manjaiah	NIT Warangal	Laser Assisted Metal Additive Manufacturing
	3	Valedictory / QUIZ Exam		

Photographs:

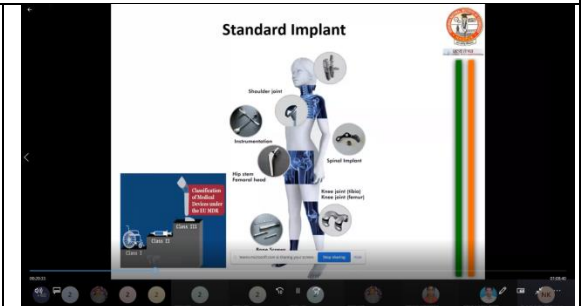
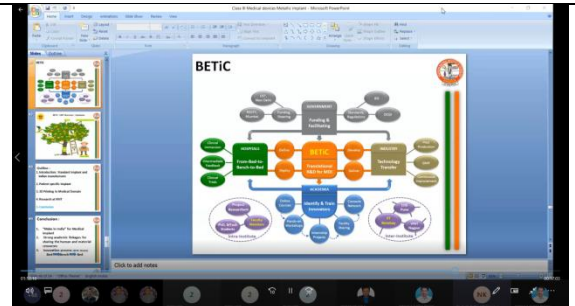
Days/ Sessions	9.30-11.00 AM	11.15-12.45 PM	2.00-3.30PM
Day 1 Session 1			
	<p>Dr. K. P. Karunakaran-IIT Bombay, 3D Printing: A Disruptive Technology</p>		

Session 2



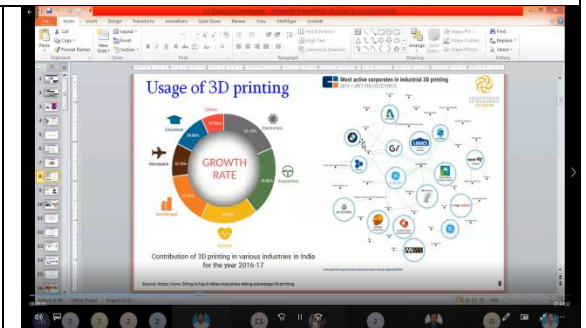
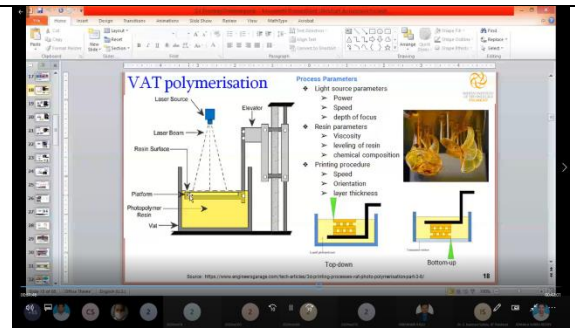
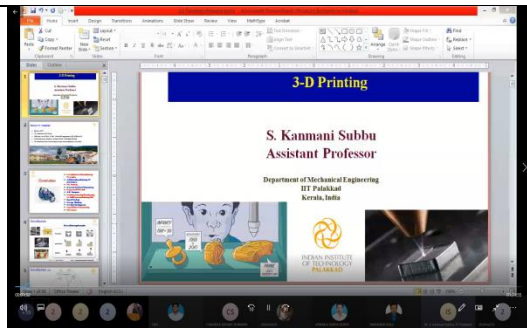
Dr.Adepu Kumar- NIT Warangal, Non Beam Based Additive Manufacturing

Session 3



Role of 3D Printing in Medical Domain, Dr. A.M.Kuthe- NIT Nagapur

Day 2
Session 4



Basic Concepts of 3D Printing, Dr. S. KanmaniSubbu- IIT Palakkad

Session 5

SMART Foundry 2020
Sustainable Metalcasting by Advanced Research and Technology

Conclusion in Two Points
2. To look at Technology vision 2035 as duty for societal benefit (to counter against?)

Innovative Product Development, Dr. A.M.Kuthe - NIT Nagapur

Session 6

Omnidirectionality in Additive Manufacturing Systems
Content
Introduction
Omnidirectional AM Systems
Definition: a property of the Additive Manufacturing machine tool
Inherently Omnidirectional AM systems
Omnidirectional Directed Energy Deposition
Omnidirectional Material Extrusion
Omnidirectional Vat Photopolymerization
Omnidirectional Sheet Lamination
Omnidirectional Powder - bed Fusion
Omnidirectional Material Jetting
Omnidirectional Binder Jetting
Challenges and Conclusions

Omnidirectionality Importance
Linear movement in the X-Y plane
Part fabrication using TIG welding setup with
Linear movement in X-Y, along with rotation about Z
Serrations in the deposit
Deviation of the deposited bead
Variation in substrate dilution

Omnidirectionality in Vat Photopolymerization
Methods of Achieving Omnidirectionality in Vat Photopolymerization
Method 40 Fusion source beam correction: Flying Optics
Unlike galvanometers, which use mirrors to deflect the energy beam, in flying optics, the laser optical head is mounted on a computer-controlled X-Y platform. The CNC motion of the platform results in the motion of the laser head. The planar (X-Y) motion of laser head to scan layer geometry is generally avoided in Stereolithography due to their slow scan speeds.
Flying optics-based Stereolithography apparatus

Omnidirectionality in Additive Manufacturing Systems, Dr. SajanKapil - IITG

Day 3 Session 7

Two Week Online AICTE Sponsored FDP
on
Frontier of 3D Printing Technology and Its Industrial Applications
Data preparation for Additive Manufacturing
Dr. A. Manmadha Chary
Department of Mechanical Engineering,
ICFAI Tech, Faculty of Science and Technology,
IFHE, Hyderabad, India.

Create STL file from Medical data
Medical Scanning Devices
Computed Tomography (CT)
Magnetic Resonance Imaging (MRI)
Ultrasound imaging
Cone beam computerized tomography (CBCT)
Micro computed tomography (MCT)
Positron Emission Tomography (PET)
Single Photon Emission Computed Tomography (SPECT)
Tandem aperture computer tomography

Data Preparation for Additive Manufacturing, Dr.A.Manmadachary, ICFAI Tech University, Hyderabad

Session 8

Recent trends in Metal AM (Direct Energy Deposition), Dr.Adepu Kumar- NIT Warangal

Session 9


3D Printing: A Game Changer Technology, Dr. Y.Ravi Kumar-NIT Warangal

Day 4 Session 10

Design for 3D Printing (Df3DP), Dr. Y.Ravi Kumar-NIT Warangal

Session 11


COMPOSITES IN 3D PRINTING



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Mechanical Engineering
National Institute of Technology Raipur
Raipur- 492010
Ph: (+91) -9575508465
sgsetti.me@nitrr.ac.in

Composites

- Definition:** A composite material is a structural material that consists of two or more combined constituents which are differ in shape and chemical composition are combined at macroscopic level and are not soluble in each other.
- Example:** Wood, Human bone, Concrete, etc.,



Short Fiber reinforcement

Author Name, Journal, Year	Material	Matrix	Wt%/Vol %	Mechanical Properties		Findings
				Tensile	Flexure	
Enair Anwar, Add. Mfg, 2019.	Carbon fiber L=100µm, Ø = 7 µm	PLA	3, 5, 7 & 10	55		Shear of fiber reinforcement slightly improved properties and no size variation in fiber explained.
Hanya Li, J.MPT, 2016	Carbon Fiber	PLA	34	68	156	Good improvement in strength but fiber pullouts observed due to uneven matrix formation.
Hing, J.Comp.Mat, 2016	Carbon fiber L=100µm, 150 µm and Ø=2.2 µm	ABS	3.15	42		Low mechanical properties and void is up to 33% occurred.
Hall, J. Teknol, Com.S&T, 2014.	Carbon fiber L= 300µm	ABS	10,20,30,40	60		Improved mechanical properties at 40% but no size variation in fiber reinforcements and Clagging around, single size of fiber used.
Zikang Weng[D], Materials, 2016	Montanilite	ABS	3.8	50	55	Improved strength but Brittleness observed.
Mahajan and Corrie, Mat.Sci, 2015	Carbon fibres (L=100µm, Ø=7.2 µm)	Epoxy	15	65		Brittle and complex shapes cannot be printed, and single size of fiber used.
Rafael Thiago Luis Ferreira, Comp. B, 2017	Carbon Fiber L= 100 µm	PLA	15	53		Failure in PLA of alignment at lower strains than in PLA, both cases used.

Composites in 3D printing, Dr.G.Srinivasu- NIT Raipur


Session 12

Two Week Online AICTE Sponsored FDP on
Frontier of 3D Printing Technology and Its Industrial Applications

Design and manufacturing of medical models by AM

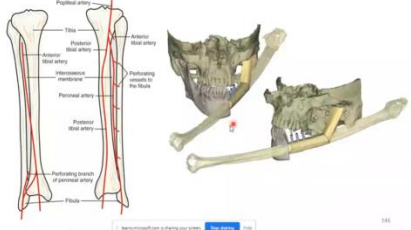
Dr. A. Manmadha Chary
Department of Mechanical Engineering,
ICFAI Tech, Faculty of Science and Technology,
IFHE Uni, Hyderabad, India.

Case Study-4
Mandibular distraction osteogenesis



Manmadhachary, A., Ravi Kumar, Y., Kumar Malyala, S., Abwala, A., Manufacturing of Patient specific AM medical models for Complex Surgeries, Mater. Sci. Eng. (2019) 1139

During surgery - Free Fibula Transfer for Mandible Reconstruction



Design and Manufacturing of Medical Modals by AM, Dr.A.Manmadachary, ICFAI Tech University, Hyderabad

Day 5 Session 13

AICTE sponsored Two Weeks Faculty Development Programme
Frontier of 3D Printing Technology and Its Industrial Applications

3D Printing for Bio-Medical Applications



Prof. Rupinder Singh

DEPARTMENT OF MECHANICAL ENGINEERING
NATIONAL INSTITUTE OF TECHNICAL TEACHERS TRAINING & RESEARCH
CHANDIGARH

Day-5 Session-1b.mp4



Day-5 Session-1b.mp4

Application of Additive manufacturing techniques in dental prosthesis



3D Printing for Biomedical Applications, Dr. Rupinder Singh, NITTR, Chandigarh

Session 14

Additive Manufacturing - Biometallic materials

Ponappa K
Assistant Professor
Mechanical Discipline
PDPM IITDM Jabalpur

BEFORE & AFTER PRICING LIMIT

an conditions listed in 4% for remains the same

PRICE RANGE AND PROFIT MARGIN

Margins at different levels in stent trade	Drug-eluting stents (%)	Bare metal stents (%)
Importer/manufacturer to distributor	25-30	25-50
Distributor to hospital	12-20	12-20
Hospital to patient	10-60	30-40
Distributor to patient	8-900	270-1000

Stent name/manufacturer	Material	0.2% Yield strength (MPa)	Stent thickness (mm)
BK Velocity® Johnson & Johnson	Ti6Al4V	340	140
Expander® Boston Sci.	Ti6Al4V	340	132
Driver® Medtronic	CoCr (MP35N)	415	81
Vision™ Abbott	CoCr (LA60)	510	81
Inflex™ Abbott	Ti6Al4V/Ti6Al4Zr	N/A	74

Additive Manufacturing -Biometallic materials, Dr. Ponappa K- IITDM Jabalpur

Session 15

Robotics and Industry 4.0

Dr. A. Srinath

Overview

- Though the charts indicate that the Nations have still not fully adopted Industry 3.0, there is an opportunity for the Nations nations to simultaneously adopt Industry 4.0 while implementing Industry 3.0 technologies.
- This is possible as Industry 4.0, which deals with technologies like connectivity of machines is an extension of Industry 3.0, which primarily involves automation.

Industry 4.0, Dr. A.Srinath, KLEF, Guntur

Day 6 Session 16

3D Printing for Waste management

Dr. Rupinder Singh
Dept. of Mechanical Engineering
NITTTR, Chandigarh

Melting point (°C)	TPI (°C)	SPF (°C)	SPF (°C)
300-350	200-250	200-250	200-250
100-150	2.5-3	2.5-3	2.5-3
100-150	1.6-2	1.6-2	1.6-2
100-150	2.2	2.2	2.2
100-150	2.8	2.8	2.8
100-150	0.8-1	1.5	1.5

MFI, TSE and FDM working principle

Build material → Inlet → Anticlockwise rotation → Screws → Die → Solid Phase → Melting phase → Extrusion stage → Movable platform → Moves in x-y plane

3D Printing for Waste Management, Dr. Rupinder Singh, NITTTR, Chandigarh

Session 17

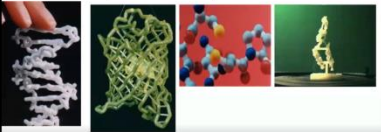
3D AND 4D MANUFACTURING



Dr. Kaushik Kumar
Department of Mechanical Engineering
Birla Institute of Technology, Mesra, Ranchi, INDIA
Ph: 09431597463
Email: kkumar@bitmesra.ac.in, kaushik.bit@gmail.com

Unusual Applications of RP technology:-
Biomolecular modeling


Tim Herman of the Center for Biomolecular Modeling at the Milwaukee School of Engineering (MSOE) is exploring the use of rapid prototyping to make physical models of molecules directly from atomic maps.



DNA Molecule, Protein Molecule, Org. Comp

Mashable

Which can cause complications when the patient lacks a pulse



3D and 4D Manufacturing, **Dr. Kaushik Kumar - BIT Mesra**

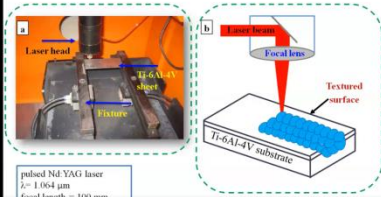
Session 18

Functionally Graded Bio-Ceramic Coatings on Titanium Alloys for Orthopedic Applications



Dr. Mamilla Ravi Sankar
Associate Professor,
Department of Mechanical Engineering,
Indian Institute of Technology Tirupati, India

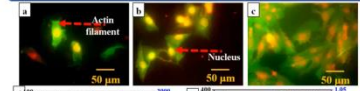
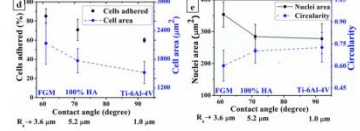
Laser Surface Micro Texturing



Experimental set up and schematic diagram for laser surface texturing process.

pulsed Nd:YAG laser
λ = 1.064 μm
focal length = 100 mm
focus spot dia = 200 μm
SOD = 2 mm

Cell Morphology and Adhesion

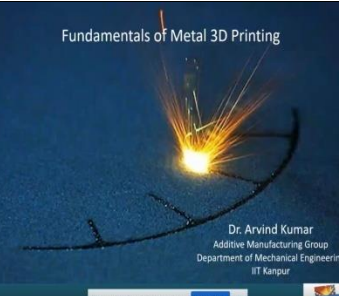



Photofluorescent images for MG63 cells adhered on the surface of (a) uncoated Ti-6Al-4V, laser coated with different precursors: (b) TiO₂, (c) TiO₂/HA, (d) TiO₂/HA. (d) % cells adhered and average cell area and (e) average nuclei area and circularity of adhered cells.

Functional Graded bio ceramic coating on Titanium alloy for Orthopedic, **Dr. Ravi Sankar- IIT Tirupathi**

Day 7 Session 19

Fundamentals of Metal 3D Printing



Dr. Arvind Kumar
Additive Manufacturing Group
Department of Mechanical Engineering
IIT Kanpur

Supports

Support structures have several functions:

- support the part in case of overhangs,
- strengthen and fix the part to the building platform,
- conduct excess heat away,
- prevent warping or complete build failure

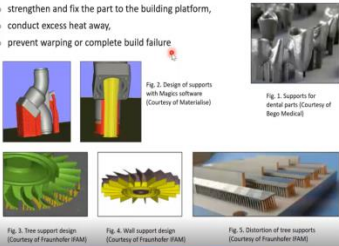
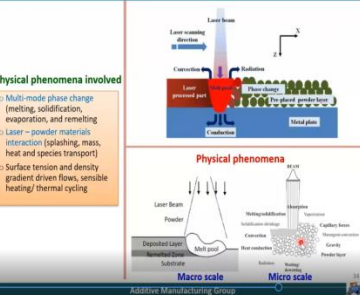


Fig. 1. Supports for dental parts (Courtesy of Bepi Medical)
Fig. 2. Design of supports with Magics software (Courtesy of Materialise)
Fig. 3. Tree support design (Courtesy of Fraunhofer IPA)
Fig. 4. Wall support design (Courtesy of Fraunhofer IPA)
Fig. 5. Distortion of tree supports (Courtesy of Fraunhofer IPA)

Phenomena

Physical phenomena involved

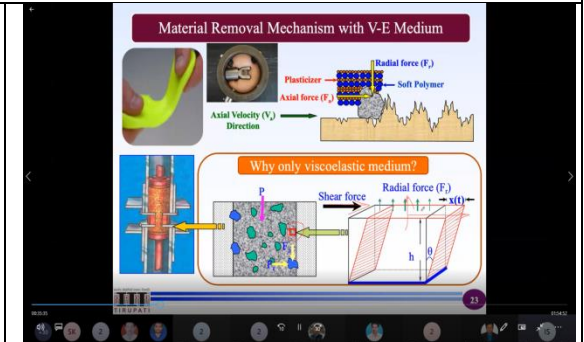
- Multi-mode phase change (melting, solidification, evaporation, and remelting)
- Laser - powder materials interaction (splashing, mass, heat and species transport)
- Surface tension and density gradient driven flows, sensible heating/thermal cycling



Macro scale
Micro scale

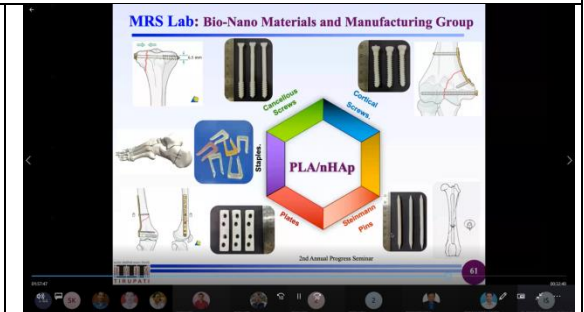
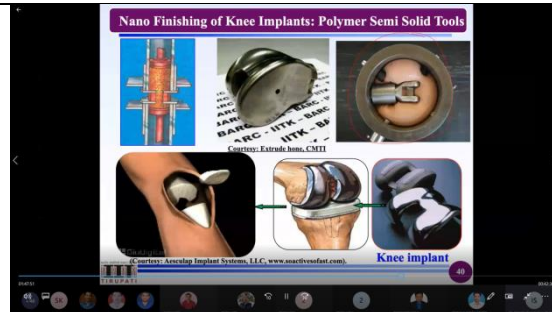
Fundamentals of Metal 3D printing, **Dr. Arvind Kumar- IIT Kanpur**

Session 20



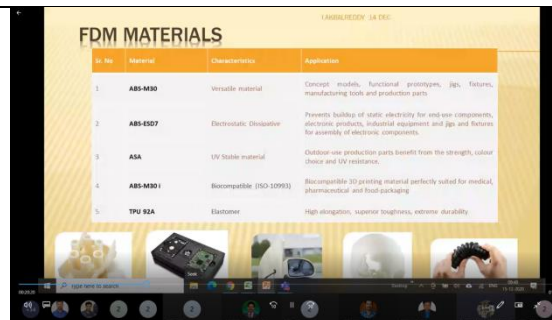
Additive Manufacturing for Complex Features and Post Processing, **Dr.M.RaviSankar- IIT Tirupati**

Session 21



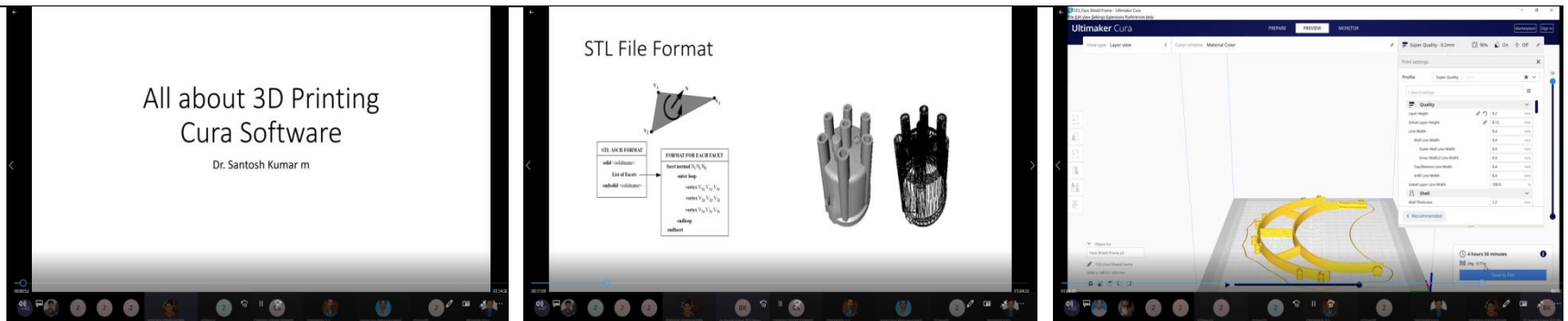
Micro, Nano, Bio Manufacturing, **Dr.M Ravi Sankar- IIT Tirupati**

Day 8 Session 22



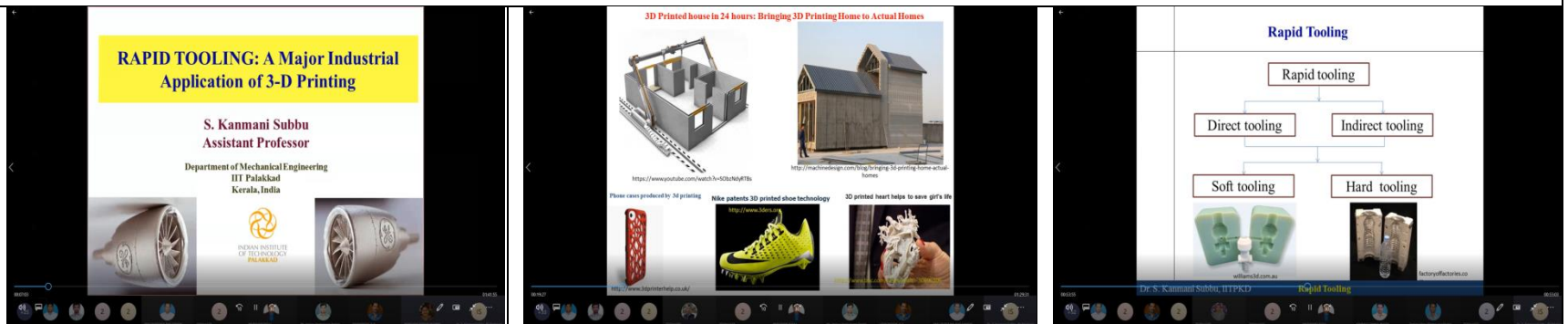
Frontiers Materials in 3D printing, **Mr.K.Rakesh- VSD3D Enterprise-Hyd.**

**Session
23**



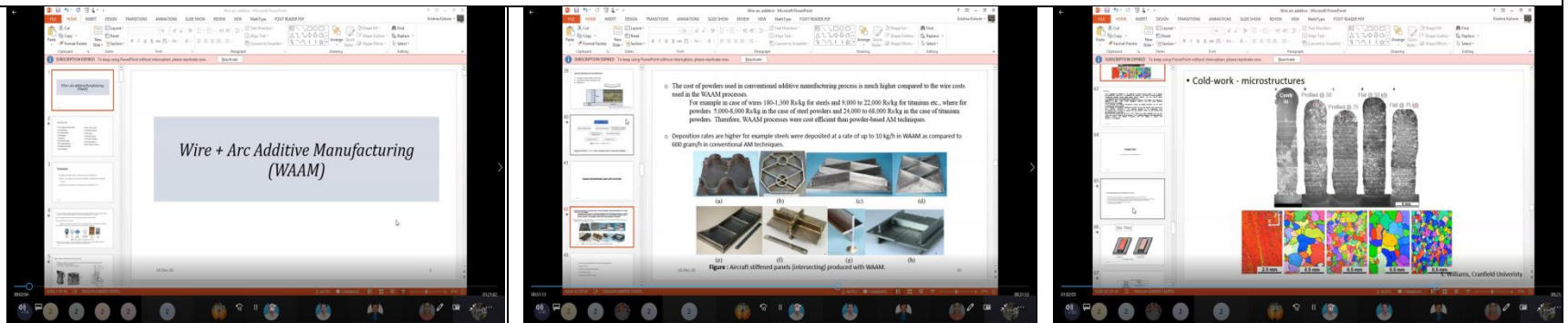
3D printing CURA slicing Software, **Dr.M.Santosh Kumar - AIT Bangalore**

**Session
24**



Rapid Tooling: A Major Industrial Applications of 3D Printing, **Dr. S. KanmaniSubbu - IIT Palakkad**

**Day 9
Session
25**



Wire Arc Additive Manufacturing Process: Challenges and Applications, **Dr. K. Krishna Kishore - Dong Eui University**

Session 26

Contents:

- Introduction Metal Additive Manufacturing.
- Classification of Metal AM Technologies
- Key attributes of Metal AM
- Wire-Arc Additive Manufacturing
- Classification of WAAM processes
- Materials processing challenges in WAAM
- Primary process selections in WAAM
- Secondary process selections in WAAM
- Summery

Dr. Thella Babu Rao, Assistant Professor, NIT Andhra Pradesh

Materials processing challenges in WAAM:

- WAAM performance measures:
 - Deposition rate
 - Geometrical properties: Accuracy, surface waviness, effective wall thickness.
 - Physical properties: Porosity, cracks, micro-fusions, distortion.
 - Material properties: Tensile strength, corrosion resistance, residual stress, fatigue life, composition, anisotropy.

near NPS

(source: Van et al., 2020)

Dr. Thella Babu Rao, Assistant Professor, NIT Andhra Pradesh

Secondary process selections in WAAM:

- Build volume oscillation refine the microstructure and hence reduce the hot cracking susceptibility and improve solute distribution.
- Direct weld pool oscillation produces a localized force, which leads to rotation of the molten metal in the weld pool.
- Cooling localized to the weld pool is an effective way of maintaining stable heat dissipation characteristics without reducing the heat input and wire feed speed.
- Heating localized to the weld pool reduce residual stresses.
- Heating of the wire increase volume of wire deposition compared to cold wire.
- Heating/Cooling of build volume maintain geometric consistency was impossible without inter-pass cooling, the continuously cooled base plate continuous stable deposition was possible.

(source: Bai et al., 2015) (source: X. Lu et al., 2017)

Dr. Thella Babu Rao, Assistant Professor, NIT Andhra Pradesh

An overview on Wire Arc Additive Manufacturing Technologies, **Dr. Thella Babu Rao - NIT AP**

Session 27

YouTube Channel: **AM LAB NIT Warangal**

AM Facility at NIT Warangal

- 3D Printer/3D Scanner**
 - DMP Flex Metal 3D Printer
 - Dimension FDM Machine
 - Mojjo 3D Printer
 - Ultimaker 2+
 - EinScan-S
 - Sense 3D Scanner
 - Muffle Furnace
 - Shot Peening Machine
- 3D Printing Software**
 - MIMICS
 - Magics
 - 3-matic
 - Catalyst
 - 3DXpert

clideo.com

Metal 3D printing -Virtual Lab, **Dr. Y.Ravi Kumar - NIT Warangal**

Day 10 Session 28

Applications and Research Pathway in Metal 3D Printing

Dr. Arvind Kumar
Additive Manufacturing Group
Department of Mechanical Engineering
IIT Kanpur

Additive Manufacturing Group

Additive manufacturing-assisted conformal cooling channels in mold manufacturing processes

Conventional vs. Conformal Cooling channels
Adv. Mech. Engg., 2017

Thermal simulation: Conventional drilled cooling channels (T_{max} 191 °C, Optimized cooling channels by AM with significantly lower thermal load (T_{max} 93 °C)

Tools and tool inserts

Additive Manufacturing Group

Typical Repair Applications

Fig. 1— Low-wattage TIG repair and microstructure

Fig. 2— Low-wattage repair of Ti-6Al-4V bearing housing

Fig. 3— Comparison of thermal spray repaired (top) shaft and LDED repaired shaft

Fig. 4— Successfully repaired abrasion drive coupler gear

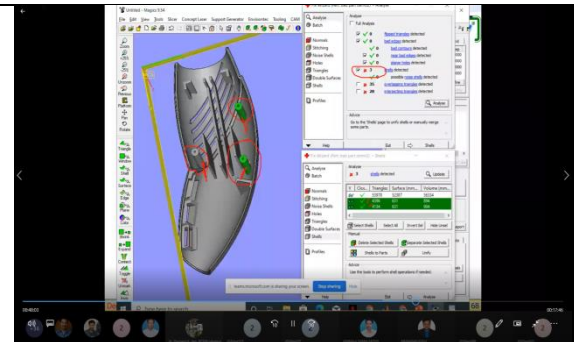
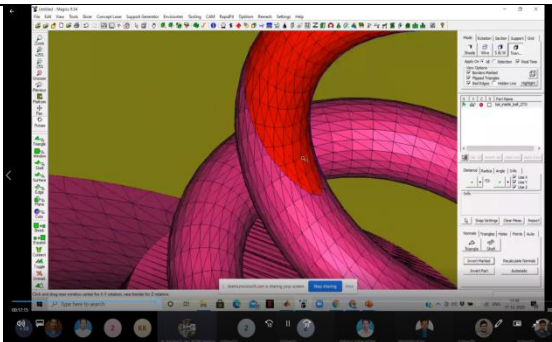
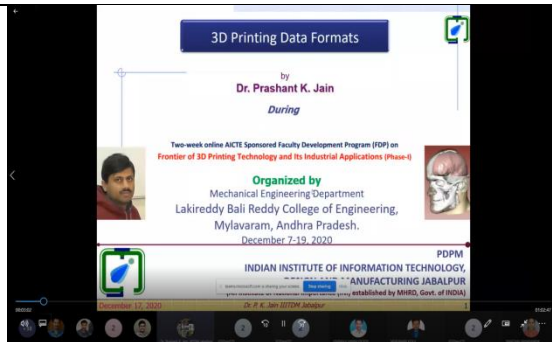
Fig. 4— Repair of worn-out Ti6 compressor seal

Ref.: Laser Engineered Net Shaping Advances Additive Manufacturing and Repair
Robert P. Mudge And Nicholas R. Wild

Additive Manufacturing Group

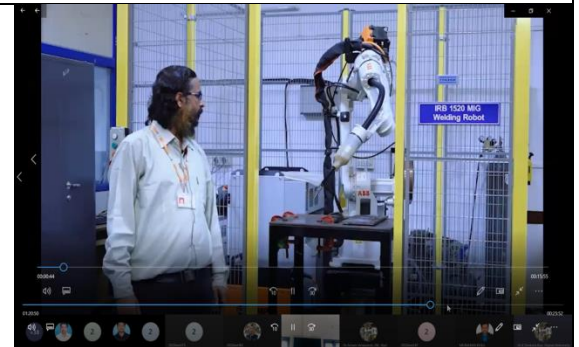
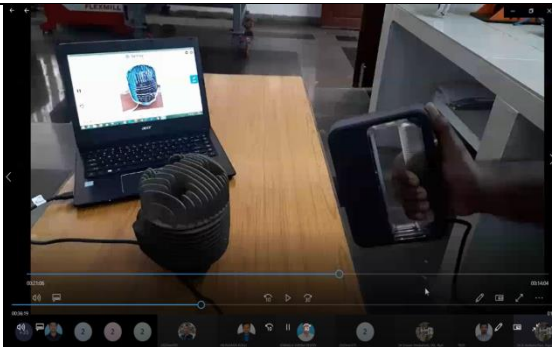
Applications and Research Pathway in Metal 3D printing, **Dr. Arvind Kumar - IIT Kanpur**

**Session
29**



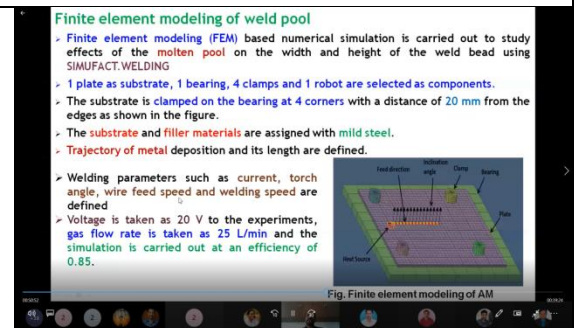
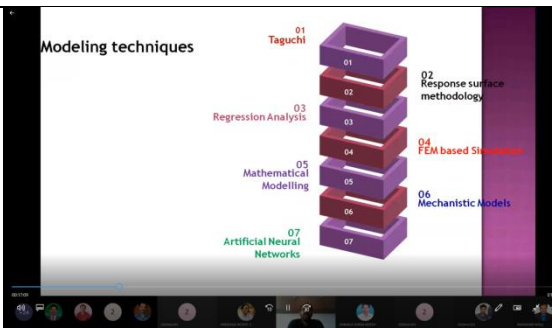
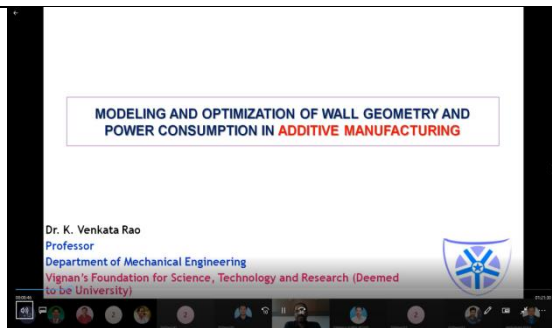
3D printing Data Formats, Dr. Prashant K. Jain - IITDM Jabalpur

**Session
30**



Polymer 3D Printing and WAAMprocess- Virtual Lab, Dr.L.Suvarna Raju, Vignan University

**Day 11
Session
31**



Modeling and Optimization of wall Geometry and power consumption in AM, Dr.K.Venkata Rao- Vignan University

Session 32

WHAT IS LASER BEAM?

- The term laser is an acronym for Light Amplification by Stimulated Emission of Radiation.
- The use of laser welding was reported in 1971 using CO₂ laser heat source.
- Non-conventional and Non-traditional methods of welding
- High-power density (10^5-10^7 W/cm²)
- A laser beam is a powerful, narrow, monochromatic and directional beam of electromagnetic radiation.
- Laser is a highly coherent (in space and time) beam of electromagnetic radiation with wavelength varying from 0.1-70 μm.
- Often, these beams are within the visible spectrum of light.
- A laser device excites the atoms in a lasing medium. The electrons of these atoms move to a higher orbit, then release photons, creating a laser beam.

Principle of LBW

- A laser beam is produced inside of the Ruby Crystal. The Ruby Crystal is made of aluminum oxide with chromium dispersed throughout it.
- Silver coated mirrors are fitted internally in the both side of crystal. The one side of mirror has a tiny hole, a beam is come out through this hole.
- A flash tube is placed around the Ruby Crystal, which is filled with xenon inert gas.
- The flash is specially designed such as which is made flash rate about thousands flashes per seconds.
- The electrical energy is converted into light energy, this is worked by flash tube.

Classification of Laser AM Processes

- Laser Metal Deposition (LMD)**
 - The intensive research attempts on laser metal deposition (LMD) technology started from 1993. The production of metallic parts with favorable mechanical properties by LMD has been reported in the nineties.
 - For instance, Mazumder et al. have reported DMD or LMD fabrication of fully dense aluminum 1100 parts as early as 1993, demonstrating to provide metal properties equivalent to a wrought process.
- Process Overview**
 - Although the processing strategy of LMD follows the general additive manufacturing principle, the manner of powder supply changes from prespreading in the LSLM process to coaxial feeding in the LMD process.
 - The LMD powder delivery system consists of a specially designed powder feeder that delivers powder into a gas delivery system via the nozzles.

Fundamental of LBW and Laser Based AM, Dr.Pankaj Biswas - IIT Guwahati

Session 33

Standards, Qualification and Certification of 3D Printed Parts

Dr. Y. Ravi Kumar
Associate Professor
Dept. of Mechanical Engineering
National Institute of Technology
Warangal – 506 004, India
E-mail: yrk@nitw.ac.in
Mobile: 9440868867

Structure of AM Standards

General AM Standards: ISO/ASTM 52900, ISO/ASTM 52901, ISO/ASTM 52902, ISO/ASTM 52903, ISO/ASTM 52904, ISO/ASTM 52905, ISO/ASTM 52906, ISO/ASTM 52907, ISO/ASTM 52908, ISO/ASTM 52909, ISO/ASTM 52910, ISO/ASTM 52911, ISO/ASTM 52912, ISO/ASTM 52913, ISO/ASTM 52914, ISO/ASTM 52915, ISO/ASTM 52916, ISO/ASTM 52917, ISO/ASTM 52918, ISO/ASTM 52919, ISO/ASTM 52920, ISO/ASTM 52921, ISO/ASTM 52922, ISO/ASTM 52923, ISO/ASTM 52924, ISO/ASTM 52925, ISO/ASTM 52926, ISO/ASTM 52927, ISO/ASTM 52928, ISO/ASTM 52929, ISO/ASTM 52930, ISO/ASTM 52931, ISO/ASTM 52932, ISO/ASTM 52933, ISO/ASTM 52934, ISO/ASTM 52935, ISO/ASTM 52936, ISO/ASTM 52937, ISO/ASTM 52938, ISO/ASTM 52939, ISO/ASTM 52940, ISO/ASTM 52941, ISO/ASTM 52942, ISO/ASTM 52943, ISO/ASTM 52944, ISO/ASTM 52945, ISO/ASTM 52946, ISO/ASTM 52947, ISO/ASTM 52948, ISO/ASTM 52949, ISO/ASTM 52950, ISO/ASTM 52951, ISO/ASTM 52952, ISO/ASTM 52953, ISO/ASTM 52954, ISO/ASTM 52955, ISO/ASTM 52956, ISO/ASTM 52957, ISO/ASTM 52958, ISO/ASTM 52959, ISO/ASTM 52960, ISO/ASTM 52961, ISO/ASTM 52962, ISO/ASTM 52963, ISO/ASTM 52964, ISO/ASTM 52965, ISO/ASTM 52966, ISO/ASTM 52967, ISO/ASTM 52968, ISO/ASTM 52969, ISO/ASTM 52970, ISO/ASTM 52971, ISO/ASTM 52972, ISO/ASTM 52973, ISO/ASTM 52974, ISO/ASTM 52975, ISO/ASTM 52976, ISO/ASTM 52977, ISO/ASTM 52978, ISO/ASTM 52979, ISO/ASTM 52980, ISO/ASTM 52981, ISO/ASTM 52982, ISO/ASTM 52983, ISO/ASTM 52984, ISO/ASTM 52985, ISO/ASTM 52986, ISO/ASTM 52987, ISO/ASTM 52988, ISO/ASTM 52989, ISO/ASTM 52990, ISO/ASTM 52991, ISO/ASTM 52992, ISO/ASTM 52993, ISO/ASTM 52994, ISO/ASTM 52995, ISO/ASTM 52996, ISO/ASTM 52997, ISO/ASTM 52998, ISO/ASTM 52999.

ASTM F42 Subcommittee

- F42.01 Test Methods (3 existing + 4 New)
- F42.04 Design (2 Existing + 5 New)
- F42.05 Materials and Processes (9 Existing + 20 New)
- F42.06 Environment, Health, and Safety-NIL
- F42.90 Executive-NIL
- F42.90.01 Strategic Planning-NIL
- F42.91 Terminology – 01 existing standard
- F42.95 US TAG to ISO TC 261-NIL

Standards, Qualification and certification of 3D printed parts, Dr.Y.Ravi Kumar - NIT Warangal

Day 12 Session 34

Modelling and Simulation in Metal 3D Printing

Dr. Arvind Kumar
Mechanical Engineering
IIT Kanpur

PBF simulation results : Thermo – fluidic transport

Single track simulations

Temperature distribution and flow orientation shown in the half domain as well as enlarged views of melt pool and cross-section

Melt pool temperature and flow field orientation shown on (a) longitudinal, (b) transverse cross-sections

Research Activities

- Melt pool dynamics during powder melting, RAPID cooling and non-equilibrium RAPID solidification, Vaporization, Thermal cycling.
- System/Meso/ Micro-scale studies of powder melting, and coupling of multi scale and multi physics phenomena, Experimental and Modeling.
- Microstructure, residual stress, mechanical properties.
- Process-Structure map.
- Steel, Aluminum, Inconel and Titanium metal materials.
- Additive manufacturing Applications in Aerospace, Automotive, Tooling Industries.

Spot Melting, Single Track Traversal, Multi Track Traversal, Multi Layer Melting

Test coupons and actual parts Post-manufacturing characterizations

Modelling and Simulation in Metal 3D Printing, Dr. Arvind Kumar - IIT Kanpur

**Session
35**

Laser Assisted Metal Additive Manufacturing

Dr. Manjiah M.
Dept. of Mechanical Engineering
National Institute of Technology- Warangal
manjiah.m@nitw.ac.in

Feedstock quality

- Important to the quality of the final part.
- Powder or a metal wire feedstock is introduced to an energy source.
- The quality of the powder is determined by size, shape, surface morphology composition and amount of internal porosity.
- The quality of powder determines physical variables, such as flowability and apparent density

Repair and Functionalization

- Inconel 625 and Monel 500
- It has a wide range of applications in oil & gas and aerospace, chemical industries, though comparatively expensive.

(a) Optical micrograph
b Etched cross-section
c EBSD maps showing base material, transition zone
d Melted zone internal crystallographic orientations

Laser Assisted Metal Additive Manufacturing, **Dr. M.Manjiah** - NIT Warangal

**Session
36**



QUIZ Exam

Valedictory/ QUIZ Exam

Phase-II Brochure (From 25.01.2021 to 06.02.2021)

Who Can Attend

Faculty members/ research scholars/
Scientists/ Engineers working in Private/
Public/ Govt. organizations/ industries etc.

Registration Fee Particulars

There is **no registration fee**

Registration Link

<https://tinyurl.com/AICTE-3D-PRINTING-II>

Important Dates

- ❖ Submission of Application on or before **22/01/2021**
- ❖ Confirmation of Acceptance on **23/01/2021**
- ❖ The selected candidates will be intimated through email only.

Instructions to Participants

- ❖ All the sessions will be conducted online through **Microsoft Teams App**.
- ❖ A test will be conducted at the end of the program.
- ❖ E- certificates will be issued to those participants who have attended the program with minimum 80% of attendance and scored minimum 60% marks in the test.

Chief Patrons

Er. Lakireddy Bali Reddy
Chairman, LBRCE

Sri L. Jaya Prakash Reddy
Co-Chairman, LBRCE

Sri L.R. N.K. Prasad Reddy
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Principal, LBRCE

Dr. K. Harinadha Reddy, Ph.D
Vice-Principal, LBRCE

Convener

Dr. S.Pichi Reddy, Ph.D
HOD- ME, LBRCE

Coordinator

Dr. Murahari Kolli, Associate Professor,
Department of Mechanical Engineering,
Mobile Number: 8074139826

Co-coordinators

Mr. J.Subba Reddy, Associate Professor,
Mobile Number: 9985100936, 8919292437

Mr.K.VViswanadh, Sr. Assistant Professor,
Mobile Number: 7702893880

Mr.K. Lakshmi Prasad, Assistant Professor,
Mobile Number: 9885827526

Mail ID: mechlbrce3dfdpl@gmail.com



Two Week Online
AICTE Sponsored FDP
on



Frontier of 3D Printing Technology and Its Industrial Applications (Phase-2)

(25th JAN - 06th FEB 2021)

Organized by
**DEPARTMENT OF MECHANICAL ENGINEERING
LAKIREDDY BALI REDDY COLLEGE OF
ENGINEERING (A)**

(Accredited by NAAC & NBA),
ISO 9001:2015 Certified Institution,
Approved by AICTE, New Delhi and
Affiliated to JNTUK, Kakinada





LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING

The Lakireddy Bali Reddy College of Engineering (LBRCE), Mylavaram was established in the year 1998 by Lakireddy Bali Reddy Charitable Trust, whose architect is Fr. Lakireddy Bali Reddy garu. The institute is established with the sole aim of providing high quality educational opportunities in the field of Science, Engineering, Technology and Management. It is spread over 60 acres of sprawling lush green landscape spotted with orchids and grooves. It is approved by AICTE, affiliated to JNTUK, Kakinada and attained autonomous status in the year 2010. It is accredited with NAAC and NBA (CSE, IT, ECE, EEE & ME) under Tier-I. A separate R&D cell is established in the college to focus on continuous sponsored research. It has various sponsored research projects funded by various funding agencies.



ISTE STUDENT
CHAPTER



ROBOTIC
CLUB



AUTOMOBILE
CLUB



ISHRAS STUDENT
CHAPTER

About the Department

The Department of Mechanical Engineering was started in the year 1998. The Department is accredited by NBA (Tier-I). It is recognized as a Research centre by JNTUK Kakinada and has sponsored projects worth of Rs.1.5 crores. Faculty of the department are actively engaged in publishing papers in national and international journals and conferences.

About the FDP

The aim of this program is to provide a basic understanding on techniques and developments in 3D geometric modeling printing components to a broad spectrum of researchers, industry participants, faculty and postgraduate students. Focus will be on describing different processes under the umbrella of 3D printing covering both polymer and metal based systems. Implementation of various segments will be demonstrated using case studies.

Course Contents

- ❖ Introduction to 3D printing
- ❖ Metallic and Polymer materials used for 3D Printing
- ❖ 3D Printing Softwares
- ❖ 3D Printing Components
- ❖ CAD models, Generation of STL files, Calculations of layer by layer profiles.
- ❖ Support Structure Formation of 3D Printing
- ❖ Applications of 3D Printing

Resource Persons

- ❖ Dr. S. V. S. Narayana Murty, Vikram Sarabhai Space Center, Trivandrum
- ❖ Dr. S. Kanmani Subbn, IIT Palakkad
- ❖ Dr. Sajan Kapil, IIT Guwahati
- ❖ Dr. M. Ravi Sankar, IIT Tirupati
- ❖ Dr. Mursbid Imam, IIT Patna
- ❖ Dr. R. Lakshmi Narayan, IIT Delhi
- ❖ Dr. Somashekara M. A., IIT Dharwad
- ❖ Dr. Prateek saxena, IIT Mandi
- ❖ Dr. Pankaj Biswas, IIT Guwahati
- ❖ Dr. Viswanath Chinthapenta, IIT Hyderabad
- ❖ Dr. K. Krishna Kisbore, South Korea
- ❖ Dr. Y. Ravi Kumar, NIT Warangal
- ❖ Dr. Adepu Kumar, NIT Warangal
- ❖ Dr. Rupinder Singh, NITTTR Chandigarh
- ❖ Dr. Prashanth K. Jain, IIITDM Jabalpur
- ❖ Dr. Srikanth Bontha, NIT Suratbkal
- ❖ Dr. Mrityunjay Doddamani, NIT Suratbkal
- ❖ Dr. Harshit dave, SVNIT Surat
- ❖ Dr. Gururaj Telasang, ARCI Hyderabad
- ❖ Dr. U. Chandrasekhar, Wipro 3D, Bangalore
- ❖ Dr. M. Manjajiah, NIT Warangal
- ❖ Dr. Sriram Venkatesh, OU Hyderabad
- ❖ Dr. Sivarama Krishna, OU Hyderabad
- ❖ Dr. Kaushik Kumar, BIT Mesra
- ❖ Dr. A. Manmadha Chary, ICEAI, Hyderabad
- ❖ Mr. Koppunur Rakesh, VSD3D, Hyderabad



**Two-Week Online AICTE Sponsored Faculty Development Program on
Frontier of 3D Printing Technology and Its Industrial Applications (Phase-II)**

From 25th Jan to 06th Feb-2021

Tentative Schedule



Date	9.30 - 11.00AM	11.00 - 11.15	11.15 AM -12.45 PM	12.45 - 2.00	2.00-3.30PM
25.01.21	Dr. U. Chandrasekhar, Wipro 3D, Bangalore Metal 3D Printing – Applications in Industrial and Strategic Sectors	Break	Dr. Rupinder Singh, NITTTR, Chandigarh 3D Printing For Recycling	Break	Dr. Y.Ravi Kumar-NIT Warangal 3D Printing: A Game Changer Technology
27.01.21	Dr. Srikanth Bontha, NIT Surathkal Additive Manufacturing of Metals: An Overview		Dr. Rupinder Singh, NITTTR, Chandigarh Virtual Reality & 3D Printing for Non-Structural Engineering Applications		Dr.Viswanath Chinthapenta, IIT Hyderabad Modelling Aspects of GMAW
28.01.21	Dr. R. Lakshmi Narayan, IIT Delhi Frontiers in Metal Additive Manufacturing For Aerospace and Bio implant Applications		Dr.Adepu Kumar- NIT Warangal Solid State Based Additive Manufacturing		Dr.Pankaj Biswas-IIT Guwahati Basic of 3D Printing and Its Classification
29.01.21	Dr.Adepu Kumar- NIT Warangal Challenges in Metal Additive Manufacturing		Dr. Somashekara M. A., IIT Dharwad 3D Printing : Material Extrusion Process		Dr Gururaj Telasang, ARCI, Hyderabad Case Studies of Selective Laser Melting: DFAM and Conformal Cooling Channels
30.01.21	Dr. Sajan Kapil, IIT Guwahati Computer-Aided Process Planning for Additive Manufacturing		Dr. Sajan Kapil, IIT Guwahati Omni Directionality in Additive Manufacturing Machine Tools		Dr. Sriram Venkatesh, OU Hyderabad Overview of SLM, SLS and Polyjet AM Technologies: Some Case Studies
31.01.21	Dr. Murshid Imam, IIT Patna Recent Trends in Metal Based 3D		Dr. Murshid Imam, IIT Patna Hybrid 3d Metal Printing		Dr. Sivarama Krishna, OU Hyderabad Innovative Applications of 3D Printing

	Printing				
01.02.21	Dr. Harshit Dave, SVNIT Surat 3D Printing For Innovative Product Design	Break	Dr. Y. Ravi Kumar, NIT Warangal Design For 3D Printing (Df3DP)	Break	Dr. S. Kanmani Subbu, IIT Palakkad From Rapid Prototyping to Additive Manufacturing
02.02.21	Dr. Srikanth Bontha, NIT Surathkal Computational Modeling of Laser-Assisted Metal Additive Manufacturing Processes		Dr. Harshit Dave, SVNIT Surat 3D Printing of Pomposites		Dr. A. Manmadha Chary, ICFAI, Hyderabad STL File Errors Correction For 3D Printing
03.02.21	Dr. S. Kanmani Subbu, IIT Palakkad Rapid Tooling : A Major Industrial Applications of 3D Printing		Dr. M. Manjaiah, NIT Warangal Metal Powder Production For Additive Manufacturing Process.		Dr. Prashanth K. Jain, IITDM Jabalpur MATLAB Programming For STL File Error Repair and Slicing
04.02.21	Dr. Mrityunjay Doddamani, NIT Surathkal Additive Manufacturing of PMCs		Dr. Pankaj Biswas-IIT Guwahati Thermo-Mechanical Analysis of 3D Printing Process		Dr. M. Ravi Sankar, IIT Tirupati Functional Graded Bio Ceramic Coating on Titanium Alloy For Orthopedic Applications
05.02.21	Dr. K. Krishna Kishore - Dong Eui University Wire Arc Additive Manufacturing Process: Challenges and Applications		Dr. Sivarama Krishna, OU Hyderabad Case Studies on Biomedical Applications of 3D Printing		Dr. M. Ravi Sankar, IIT Tirupati Additive Manufacturing for Complex Features and Post Processing
06.02.21	Dr. Prashanth K. Jain, IITDM Jabalpur Recent Research Trends in Additive Manufacturing		Dr. S. V. S. Narayana Murty, Vikram Sarabhai Space Center, Trivandrum 3D Printing For Aerospace Applications		Valedictory/ QUIZ Exam

FDP-Coordinators

Dr. Murahari Kolli
Mr. J. Subba Reddy
Mr. K. V. Viswanadh
Mr. K. Lakshmi Prasad

Convener

Dr. S. Pichi Reddy
Professor & Head

**A Two-week online AICTE Sponsored FDP on
Frontier of 3D Printing Technology and Its Industrial Applications (Phase-II)**

From 25th Jan - 06th Feb 2021

In this FDP Initially 433 participants were registered. 431 participants are around the country, rests of them from two countries are Ethiopia and Myanmar.

This FDP covered all most all area of 3D Printing arena. From the basics of 3D Printing-elements, Technologies, STL formats, Software's, Design of 3D printing, Component fabrications, Composites, Hybrid composites, FEA Modeling, Optimization, Characterization, Pre & Post processing methods and various industrial applications.

In this FDP 23 resource persons and two participants had delivered their valuable lectures. All the resource persons are from various reputed organizations like IITs, NITs, Central Universities, R&D Institutes, Industries and local universities.

Day	Session	Topic Name	Name of the Resource Person & Institute
Day 1	1	Metal 3D Printing: Applications in Industrial and Strategic Sectors Chief Guest	Dr. U. Chandrasekhar, Program Director-Wipro3D, Bangalore.
	2	3D Printing For Recycling Guest of Honour	Dr. Rupinder Singh, Professor NITTTR-Chandigarh.

	3	3D Printing: A Game Changer Technology	Dr. Y.Ravi Kumar, Associate Professor, NIT-Warangal
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Day 2	1	Additive Manufacturing of Metals: An Overview	Dr. Srikanth Bontha, Associate Professor NIT-Surathkal
	2	Virtual Reality & 3D Printing for Non-Structural Engineering Applications	Dr. Rupinder Singh, Professor, NITTTR-Chandigarh
	3	Numerical Modelling wire arc additive manufacturing of INCONEL 625 superalloy	Dr. Viswanath Chinthapenta, Assistant Professor, IIT-Hyderabad
Day 3	1	Solid State Based Additive Manufacturing	Dr. Adepu Kumar, Professor & HoD, NIT-Warangal
	2	Fundamental Basic of 3D Printing and Its Classification	Dr. Pankaj Biswas, Professor IIT-Guwahati
	3	Additive Manufacturing of Metal and Alloys: Processing and Material Challenges	Dr. R. Lakshmi Narayan, Assistant Professor, IIT-Delhi
	1	STL File Errors Correction for 3D Printing	Dr. A. Manmadha Chary, Assistant Professor, ICFAI-Hyderabad
	2	3D Printing: Material Extrusion Process	Dr. Somashekara M. A., Assistant Professor, IIT-Dharwad

Day 4	3	Case Studies of Selective Laser Melting:DFAM and Conformal Cooling Channels	Dr. Gururaj Telasang,Scientist –E, ARCI-Hyderabad
Day 5	1	Omni Directionality in Additive Manufacturing Machine Tools	Dr. Sajan Kapil, Associate Professor, IIT-Guwahati
	2	Computer-Aided Process Planning for Additive Manufacturing	Dr. Sajan Kapil, Associate Professor, IIT-Guwahati
	3	Case Studies on Biomedical Applications of Additive Manufacturing	Dr. Sivarama Krishna, Professor, Osmania University- Hyderabad
Day 6	1	Recent Trends in Metal 3D Printing	Dr. Murshid Imam, Assistant Professor, IIT-Patna
	2	Trends in Metal 3d Printing of Refractory alloys	Dr. Murshid Imam, Assistant Professor, IIT-Patna
	3	Innovative Applications of 3D Printing	Dr. Sivarama Krishna, Professor, Osmania University- Hyderabad
Day 7	1	Design For 3D Printing (Df3DP)	Dr. Y. Ravi Kumar, Associate Professor, NIT-Warangal
	2	3D Printing For Innovative Product Design	Dr. Harshit K. Dave, Associate Professor, SVNIT-Surat
	3	A Journey from: Rapid Prototyping to Additive Manufacturing	Dr. S. Kanmani Subbu, Assistant Professor, IIT-Palakkad

Day 8	1	Computational Modeling of Laser-Assisted Metal Additive Manufacturing Processes	Dr. Srikanth Bontha, Associate Professor, NIT-Surathkal
	2	Composite 3D Printing	Dr. Harshit K. Dave, Associate Professor, SVNIT-Surat
	3	Challenges in Metal Additive Manufacturing	Dr. Adepu Kumar, Professor & HoD, NIT-Warangal
Day 9	1	Rapid Tooling: A Major Industrial Applications of 3D Printing	Dr. S. Kanmani Subbu, Assistant Professor, IIT-Palakkad
	2	Metal Powder Production and Characterisation for Additive Manufacturing	Dr. M. Manjaiah, Assistant Professor, NIT-Warangal
	3	MATLAB Programming For STL File Error Repair and Slicing	Dr. Prashanth K. Jain, Professor, IIITDM-Jabalpur
Day 10	1	Additive Manufacturing of PMCs	Dr. Mrityunjay Doddamani, Associate Professor, NIT-Surathkal
	2	Thermo-Mechanical Analysis of 3D Printing Process	Dr. Pankaj Biswas, Professor, IIT-Guwahati
	3	Bio Ceramic Functionally Graded Micro, Nano Coatings on Titanium Alloy For Bio- Medical Applications	Dr. M. Ravi Sankar, Associate Professor, IIT-Tirupati
	1	Overview of SLM, SLS and Polyjet AM Technologies: Some Case Studies	Dr. Sriram Venkatesh, Professor & Director (CIA) Osmania University-Hyderabad

Day 11	2	Friction Stir Welding: Applications and variants	Dr. M. Krishna Kishore Postdoctoral Fellow Dong Eui University-South Korea
	3	3D Printing of Complex Features and It's Post Processing	Dr. M. Ravi Sankar, Associate Professor, IIT-Tirupati
Day 12	1	Recent Research Trends in Additive Manufacturing	Dr. Prashanth K. Jain, Professor, IIITDM-Jabalpur
	2	3D Printing For Aerospace Applications	Dr. S. V. S. Narayana Murty, Scientist-G, Vikram Sarabhai Space Centre- Trivandrum
	3	Valedictory Chief Guest QUIZ EXAM	Dr. S. V. S. Narayana Murty, Scientist-G, Vikram Sarabhai Space Centre- Trivandrum