Savitribai Phule Shikshan Prasarak Mandal's

SKN SINHGAD COLLEGE OF ENGINEERING, PANDHARPUR

(Approved by AICTE,New Delhi,Recognized by D.T.E .(M.S)& Affiliated to the Solapur

Accredited by NAAC with A+ Grade

Innovation in Teaching & Learning

Advances in Materials Composite Materials

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Linking of subject Syllabus

Section I

Unit-1: Basics of Casting Processes **No. of lectures-05**

Definition of casting, Basic steps in casting processes, Introduction to patterns, Types of patterns, materials used, Allowances, types of cores, Gating system, types of risers, Function of riser, method to improve efficiency of risers. Riser design (simple numerical problems).

Unit-2: Melting, Molding and Inspection processes **No. of lectures-06**

Construction and working in brief of melting furnaces such as Cupola, Arc furnaces, Induction furnaces. Green sand Molding (hand and machine molding), Shell molding, Investment casting, centrifugal casting, gravity and pressure die casting processes. Stages in Fettling, Common important defects in castings. Inspection procedure, Computer applications in foundry processes, foundry Mechanization.

Unit-3: Introduction to Joining processes **No. of lectures-04**

Welding processes, classification of welding process, arc welding, welding rod selection, TIG welding & MIG welding, submerged arc welding, gas welding, resistance welding, Brazing and soldering.

Section II

Unit-4: Conventional Forming Processes **No. of lectures-06**

Introduction to forming process, Classification of forming processes, forging, types of forging, simple numerical problem on upset forging. Extrusion, Types – direct extrusion, indirect extrusion, impact extrusion, hydrostatic extrusion, Wire drawing process, Methods of tube drawing, hot rolling, cold rolling of sheets, classification of Rolling mills, theory of rolling, simple numerical problems on rolling.

Unit-5: Advanced Forming Processes **No. of lectures-04**

Introduction to advanced forming process,High energy rate forming process-

explosive, Electro-hydraulic, magnetic pulse forming. Forming with hydrostatic pressure- hydro mechanical and hydro forming process

Unit-6: Advanced Manufacturing Processes **No. of lectures-05**

Introduction to Rapid prototyping (RP), Basic principles, Classification, Steps in RP, Advantages, disadvantages and applications of RP, Stereo lithography - Selective Laser Sintering (SLS), Selective Powder Binding (SBP), Fused Deposition Modelling (FDM), Direct Metal Laser Sintering (DMLS), Advantages, disadvantages and applications

Sr. No	Experiment Title	Course Outcome	Bloom's Level
1	Design of Pattern and core for simple component.	CO1	L3
2	Testing of silica sand for grain fineness and clay content.	CO2	L3
3	Testing of green sand for green compression strength, permeability.	CO2	L3
4	Study of mould for moisture content and core hardness tester.	CO2	L3
5	Study of VI characteristic of welding process.	CO3	L2
6	Study of manufacturing sequence of upset forging with example.	CO4	L2
7	Demonstration of any one rapid prototyping technique.	CO5	L3
8	Visit to Foundry and Forging unit.	CO6	L3
9	Produce a composite material by metal casting process from permanent mould.	CO1	L4

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Alumni Suggestions

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SKN Sinhgad College of Engineering Korti, Pandharpur.

Alumni Feedback (Survey)

(To be filled in by Alumni annually)

Please rate the following skills, abilities, and attributes generally expected of an engineering graduate. Please rate how important each has been relative to YOUR EMPLOYMENT EXPERIENCE since graduation and how well YOUR education at SKNSCOE prepared you.

A) Performance

Questions	Excellent (5)	Very Good (4)	Good (3)	Average (2)	Poor (1)
i. An ability to apply knowledge of mathematics, science, and engineering	✓				
ii. An ability to design and conduct experiments, as well as to analyze and interpret data		✓			
iii. An ability to design a system, component, or process to meet desired needs			✓		
iv. An ability to function on multi-disciplinary teams	✓				
v. An ability to identify, formulate, and solve engineering problems		✓			
vi. An understanding of professional and ethical responsibility		✓			
vii. An ability to communicate effectively	✓				
viii. The broad education necessary to understand the impact of engineering solutions in a global and societal context		✓			
ix. A recognition of the need for, and an ability to engage in, life-long learning		✓			
x. A knowledge of contemporary issues		✓			
xi. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice			✓		
xii. Overall rating of Engineering education at SKNSCOE		✓			

H.O.D.
Mechanical Engineering
SKN Sinhgad College of Engineering
Korti, Tal. Pandharpur, Dist. Solapur

xiii. Whether you are able to identify problem and design the product by utilizing scientific concept and engineering knowledge in the field of thermal/ design/ material science/ manufacturing and production technology?		✓			
xiv. Whether you are able to analyse real life mechanical engineering problems and provide solutions using software tools and techniques?		✓			
xv. Are you able to apply appropriate management techniques to develop leadership skill in professional engineering practice?	✓				

B) Have you been promoted to new, higher responsibilities since graduation? Please list all major promotions.

No

C) Have you received a Master degree since graduation from SKNSCOE? If yes, please indicate the university, department, and area of your graduate degree(s).

No

D) Any comments or suggestions for improving the SKNSCOE Engineering Programs? Also, include your comments about needs for coverage of new technical or non-technical topics in the existing areas of engineering. Please review the current degree offerings and curriculum given on our website.

Mechanical Engineering Students Should have knowledge of advances in material Science. they Should complete few Projects on advanced material like composite materials.

Name: Akshay Mallav

Discipline: Mechanical Engineering

Year of Graduation: 2022

Present Organization: Mehta Engineering Works, Bhosri

Email: akshaymallav@gmail.com

Contact Number: 7350504815

Date: 31/7/2022

Signature: Akshay M

H.O.D.
Mechanical Engineering
SKN Sinhgad College of Engineering
Korti, Tal. Pandharpur, Dist. Solapur

SKN Sinhgad College of Enginnering Korti, Pandharpur.

Alumni Feedback (Survey)

(To be filled in by Alumni personally)

Please rate the following skills, abilities, and attributes generally expected of an engineering graduate. Please rate how important each has been relative to YOUR EMPLOYMENT EXPERIENCE since graduation and how well YOUR education at SKNSCOE prepared you.

A) Performance

Questions	Excellent (5)	Very Good (4)	Good (3)	Average (2)	Poor (1)
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ii. An ability to design and conduct experiments, as well as to analyze and interpret data	✓				
iii. An ability to design a system, component, or process to meet desired needs			✓		
iv. An ability to function on multi-disciplinary teams	✓				
v. An ability to identify, formulate, and solve engineering problems		✓			
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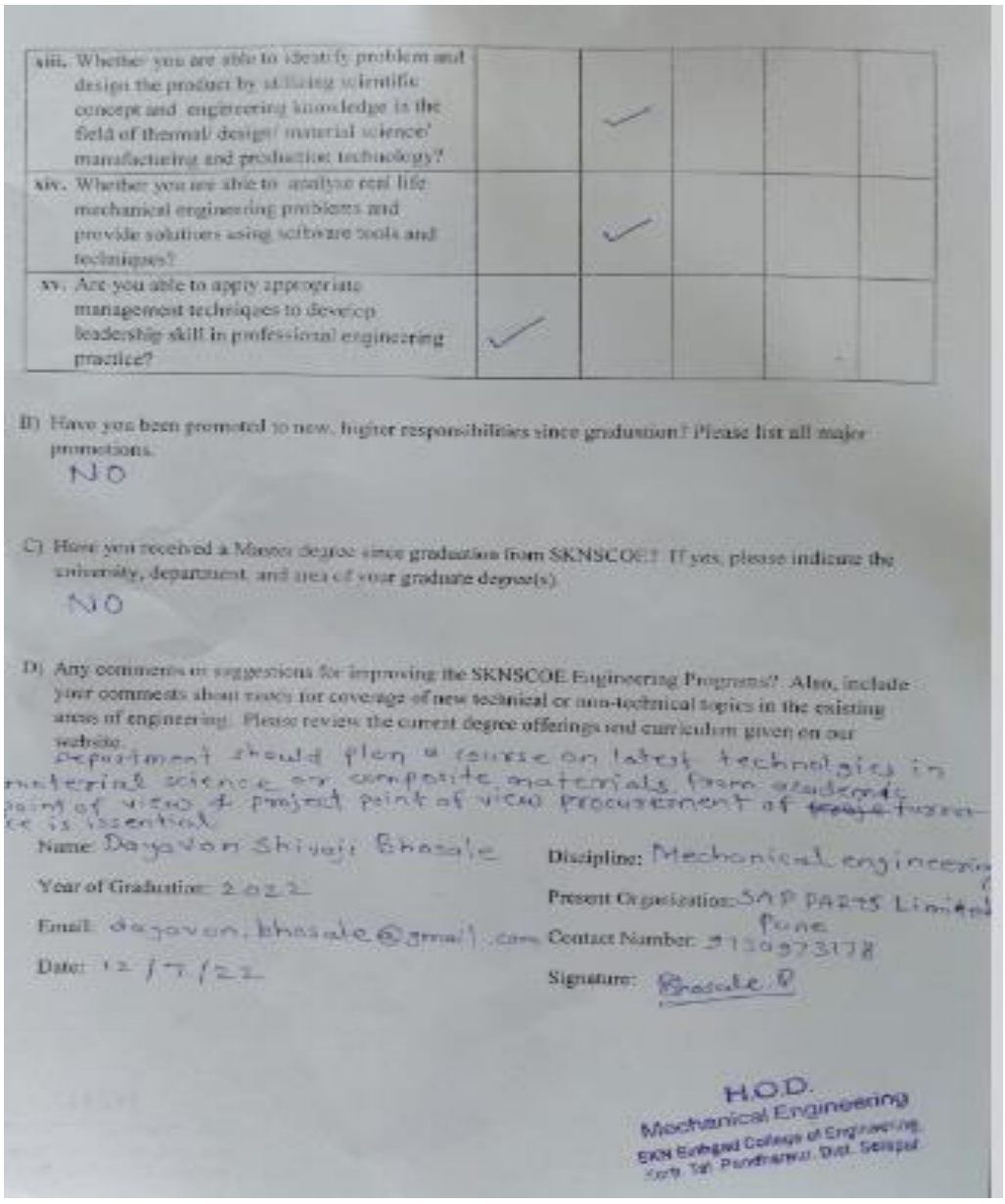
vii. An ability to communicate effectively	✓				
viii. The broad education necessary to understand the impact of engineering solutions in a global and societal context		✓			
ix. A recognition of the need for, and an ability to engage in, life-long learning		✓			
x. A knowledge of contemporary issues		✓			
xi. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice			✓		
xii. Overall rating of Engineering education at SKNSCOE		✓			

H.O.D.
Mechanical Engineering
SKN Sinhgad College of Engineering
Korti Tal. Pandharpur Dist. Solapur



xiii. Whether you are able to identify problem and design the product by utilizing scientific concept and engineering knowledge in the field of thermal/ design/ material science/ manufacturing and production technology?		✓			
xiv. Whether you are able to analyse real life mechanical engineering problems and provide solutions using software tools and techniques?		✓			
xv. Are you able to apply appropriate management techniques to develop leadership skill in professional engineering practice?	✓				

B) Have you been promoted to new, higher responsibilities since graduation? Please list all major promotions.

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NO

D) Any comments or suggestions for improving the SKNSCOE Engineering Programs? Also, include your comments about topics for coverage of new technical or non-technical topics in the existing areas of engineering. Please review the current degree offerings and curriculum given on our website.

Department should plan a course on latest technologies in material science on composite materials from academic point of view & project point of view Procurement of ~~raw~~ furnace is essential

Name: Dayavan Shivaji Bhosale

Discipline: Mechanical engineering

Year of Graduation: 2022

Present Organization: SAP PAPES Limited Pune

Email: dayavan.bhosale@gmail.com

Contact Number: 9130973178

Date: 12/7/22

Signature: Bhosale.D

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Korti Tal. Pandharpur, Dist. Solapur

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Introduction- Process (Flow chart)

- Advances in Materials Composite Materials

Fabrication of Metal Matrix Composites (MMCs):

Metal Matrix Composites (MMCs) play a crucial role in various industries due to their ability to offer superior performance over conventional materials like metals and alloys. Their significance stems from their unique combination of properties, which make them ideal for applications demanding high strength, low weight, durability, and thermal stability. Here's why MMCs are important across different industries

Definition and importance of Metal Matrix Composites (MMCs):

Metal Matrix Composites (MMCs) are materials composed of a metal or metal alloy as the primary matrix and embedded reinforcement materials (which can be ceramics, fibers, or particles) to enhance specific properties such as strength, stiffness, wear resistance, and thermal stability.

Key Features:

Matrix: The continuous phase is the metal, which holds the reinforcement material together. Common metal matrices include aluminum, titanium, magnesium, and copper.

Reinforcement: The reinforcement can be in the form of fibers (e.g., carbon fibers, silicon carbide fibers), particles, or whiskers. These materials provide additional mechanical strength and improve the properties of the metal matrix.

Properties: MMCs offer enhanced properties over traditional metals, such as:

Higher strength-to-weight ratio.

Improved stiffness and thermal stability.

Better wear resistance.

Higher temperature resistance compared to pure metals.

Applications:

MMCs are used in industries such as aerospace, automotive, and defense, where lightweight materials with superior mechanical properties are required.

In summary, MMCs combine the best properties of metals and reinforcing materials to produce materials with superior performance characteristics.

Experimental set up of Fabrication of Metal Matrix Composites by Casting:

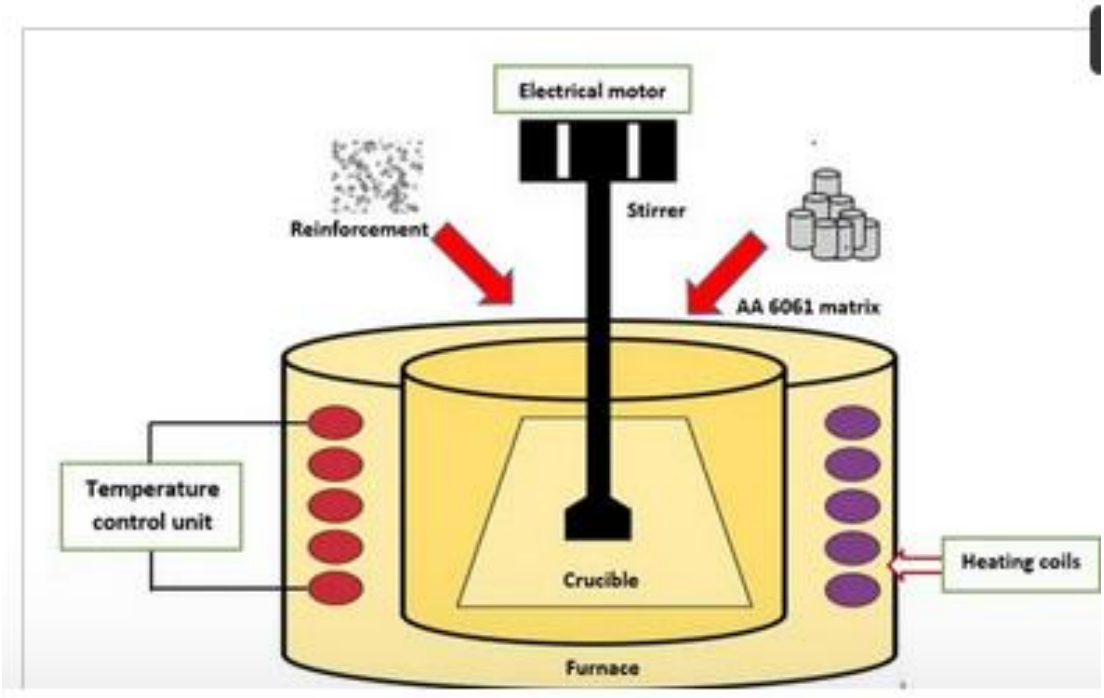


Fig: Experimental Setup

The following are the various steps involved in the casting process:

1. **Matrix Material Selection**:

- A suitable metal or alloy is selected as the matrix material, typically aluminum, magnesium, titanium, or copper, depending on the required properties of the MMC.

2. **Reinforcement Material Selection**:

- Reinforcement materials are chosen based on the desired mechanical properties. These materials can be particles (e.g., silicon carbide, aluminum oxide), fibers (e.g., carbon fibers, silicon carbide fibers), or whiskers.

3. **Melting the Metal Matrix**:

- The matrix material (metal or alloy) is melted in a furnace at a temperature slightly above its melting point.
- In this step, care is taken to ensure that the molten metal remains clean, and inert gases or fluxes may be used to minimize oxidation and contamination.

4. **Incorporation of Reinforcement**:

- Once the matrix metal is in the molten state, the reinforcement material is introduced into the melt. There are different methods to incorporate the reinforcement, depending on the type of reinforcement used:

Methods for Incorporation:

- **Stirring**: In **stir casting**, the reinforcement particles or fibers are mechanically stirred into the molten metal to ensure uniform distribution.
- **Direct Addition**: In some cases, the reinforcement is directly added to the molten matrix, and mechanical or electromagnetic stirring is used to enhance dispersion.

5. **Stirring and Mixing**:

- **Mechanical Stirring**: This is critical to ensure even distribution of the reinforcement throughout the molten matrix. The molten metal is stirred at high speed to prevent particle agglomeration and promote uniform dispersion.
- **Temperature Control**: During stirring, the temperature of the molten metal is carefully controlled to prevent premature solidification and ensure that the reinforcement is well distributed.

6. **Degassing**:

- To remove trapped gases, **degassing** is often carried out. Gases like hydrogen can form during the melting process and lead to porosity in the final composite. Degassing agents or an inert gas like argon may be bubbled through the melt to remove these gases.

7. **Pouring into the Mold**:

- The molten composite material is then poured into a mold, which may be pre-heated to avoid rapid cooling and to ensure good bonding between the matrix and reinforcement.
- **Gravity casting** is common method used in casting of Composite material.

8. **Solidification**:

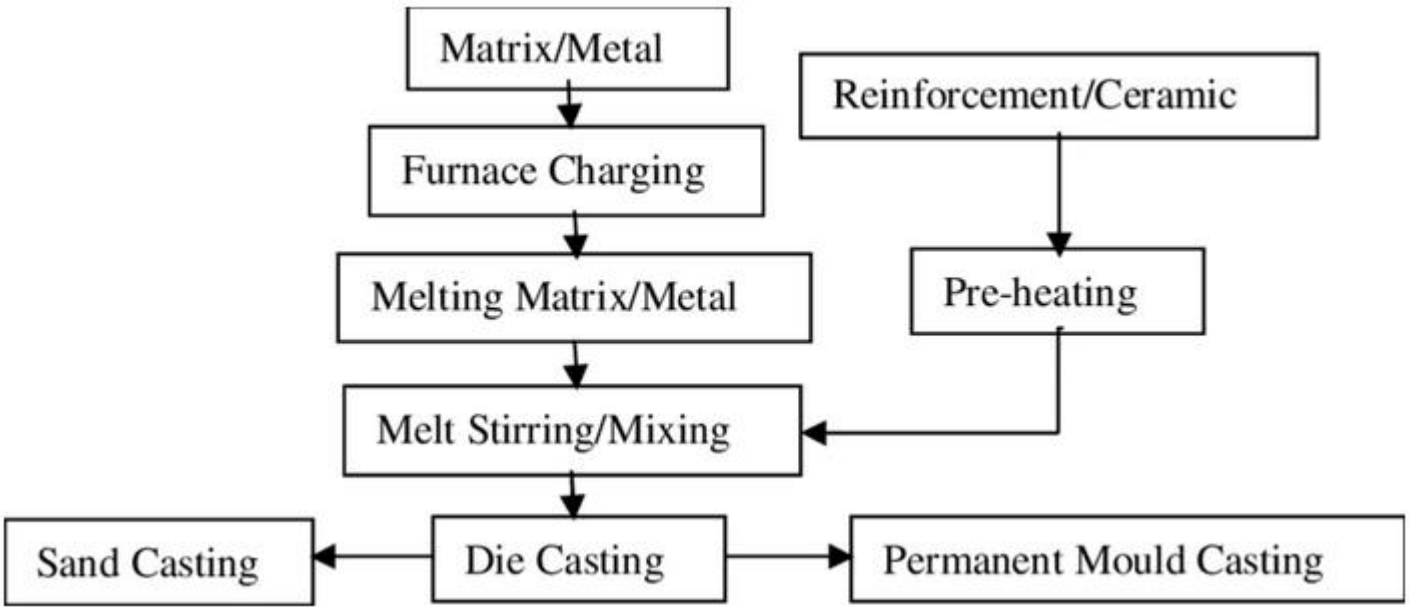
- The molten material cools and solidifies in the mold, taking the shape of the desired component. The rate of cooling and solidification can affect the microstructure and, consequently, the mechanical properties of the composite.
- **Controlled cooling** may be used to optimize the properties of the composite, such as grain size, distribution of reinforcements, and residual stresses.

9. **Machining and Finishing**:

- Once the composite has solidified, it may require further machining to achieve the final shape and dimensions.

10. **Inspection and Testing**:

- Mechanical properties such as hardness, tensile strength, and wear resistance are tested to ensure the MMC meets the required specifications.



Flow chart: Fabrication of Metal Matrix Composite (MMCs)

Applications of Composite Materials:

- **High Strength-to-Weight Ratio**: Essential in aerospace, automotive, and defense for reducing weight while maintaining strength.
- **Wear and Corrosion Resistance**: Important in industrial tools, automotive, and marine applications where durability is key.
- **Thermal Stability**: Used in aerospace, electronics, and energy sectors for components that need to withstand high temperatures and thermal cycling.
- **Tailorability**: MMC properties can be tailored by adjusting the reinforcement material and matrix, making them highly versatile for specific applications.

A few examples:

- – Aerospace Industry
- – Automotive Industry
- – Defense and Military
- – Marine Industry
- – Electronic Industry
- – Sports Equipment
- – Energy Sector
- – Industrial and Manufacturing
- – Biomedical Applications

Limitations:

In summary, despite their excellent mechanical properties, MMCs face limitations related to high costs**,** machining difficulties**,** reinforcement distribution challenges**,** reduced ductility**,** and complex recycling **processes**. These factors can restrict their wider use in certain industries or applications where cost-effectiveness, ease of processing, and material recycling are crucial.

- Additional Facility for fabrication of Metal Matrix Composites (MMCs)-

Fig: Induction Furnace with stirring arrangement.

Technical Specifications:

- Maximum Temperature:1200 C
- Working Temperature: 1150 C.
- Speed Variable:200-600 RPM
- Crucible Capacity-2-3 kg.

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Use of ICT

Using **Information and Communication Technology (ICT)** in the development, analysis, and manufacturing of **Metal Matrix Composites (MMCs)** can significantly enhance the efficiency, precision, and innovation in this field. ICT plays an essential role across various stages of MMC development, from material design and simulation to production and quality control.

Computer-Aided Design (CAD) and Computer-Aided Engineering (CAE):

- **Material and Component Design**: ICT tools like CAD and CAE software help design complex MMC components with high precision. Students can model the geometry and structure of MMC parts to optimize the placement and orientation of reinforcements for enhanced properties.
- **Finite Element Analysis (FEA)**: CAE tools like FEA are used to simulate the behavior of MMCs under various loads and environmental conditions. This helps in predicting the mechanical, thermal, and fatigue performance of components before physical production, reducing the need for costly prototypes.

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Outcome (Projects & Publications)

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Herewith attached List of the journal papers published for the research carried for the projects in the Advanced Material and Composite Materials

Sr. No	Title of paper	Name of the author	Name of journal	Year of publication
1	The impact of friction material on Disc brake performance: A review	Indrajeet Wadagave	International Journal of Engineering Research and Technology	2023-24
2	Material selection and analysis of knee joint implant	Suyash Mahamuni, Adinath Mhalgi	VDI-Z Integrate Production Journal	2023-24
3	Modelling on wear behaviour of Al 6061/bagasse ash composite using response surface methodology	Mr. S.S. Salunkhe	AIP Conference Proceedings	2023-24
4	A Comprehensive Review on the Effect of Thermal Post Processing on DMLS Processed SS316L Components	Purushottam Balaso Pawar*, Swanand G. Kulkarni	Materials Science Forum(Volume 1120)	2023-24
5	Corrosion behaviour of fly ash, alumina and hybrid particles reinforced A356composites	S. G. Kulkarni, J. V. Menghani, Achchhe Lal	Journal of Computing Science and Engineering	2023-24
6	Manufacturing of Aluminum Alloy 6061 Composite Material using Bagasse Ash-	Subodh Salunkhe Balasaheb Gandhare Swanand Kulkarni	AIJR Proceedings	2023-24
7	Modeling on wear behavior of Al 6061/bagasse ash composite using response surface methodology	Subodh Salunkhe Dr.Balasaheb Gandhare Dr.Swanand Kulkarni	AIP Conference Proceeding	2023-24
8	Acoustical and Mechanical Characterization of Natural Fibre Reinforced Composite: A Review	Dr. Sham Kulkarni, Dr. Sameer Katekar	International Journal of Scientific Research in Science, Engineering and	2022-23

			Technology	
9	Analysis of Various Machine Learning Algorithms for Cast Aluminium Alloy to Estimate Fatigue Strength	Vedant Shrikant Utpat, Dr. Swanand Gajanan Kulkarni	Journal of The Institution of Engineers (India) Series	2022-23