

<b>BMEE406E</b>	<b>Advanced Manufacturing Processes</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>
<b>Pre-requisite</b>	<b>BMEE302L, BMEE302P, BMEE304L, BMEE304P</b>	<b>Syllabus version</b>			
		<b>1.0</b>			
<b>Course Objectives</b>					
<ol style="list-style-type: none"> <li>1. To impart knowledge on the advancements of metal forming and metal casting processes.</li> <li>2. To give an insight on specialized moulding process, micromachining and finishing processes with potential applications in medical field.</li> <li>3. To facilitate students to understand the advanced machining and hybrid machining processes.</li> </ol>					
<b>Course Outcomes</b>					
At the end of the course, the student will be able to					
<ol style="list-style-type: none"> <li>1. Demonstrate the basics of advanced metal forming and metal casting processes.</li> <li>2. Discuss various advanced metal casting process with industrial applications.</li> <li>3. Select the appropriate machining process based on tool-workpiece interaction and source of energy for the end product.</li> <li>4. Recognize the material removal mechanism and process parameters of ultra-precision machining process and micromanufacturing process.</li> <li>5. Identify and use various hybrid machining process for state of art application.</li> </ol>					
<b>Module:1</b>	<b>Advanced Metal forming Process</b>	<b>6 hours</b>			
Unconventional Forming Methods: Classification, Process Principle, Applications, Equipment's, Process Analysis and Die Design of Explosive Forming, Stretch forming, Contour roll forming Laser Beam Bending and Laser Assisted Deep Drawing. Micro Forming Processes: Classification, Process Principle and Applications of Conventional Micro Forming Processes, Unconventional Micro-Forming Processes.					
<b>Module:2</b>	<b>Advanced Metal casting Process</b>	<b>5 hours</b>			
Metal mould casting basics, continuous casting, permanent mould casting, pressure die casting, Vacuum mould casting, Evaporative pattern casting (EPC)- Hybrid and vacuum, Ceramic shell investment casting.					
<b>Module:3</b>	<b>Specialized Molding Techniques</b>	<b>6 hours</b>			
Injection moulding using pressurized gas assistance, Injection moulding using reaction gas assistance, Injection Moulding for Thin-Wall Applications, Multi-Material Injection Moulding, Water-Assisted Foaming, Moulding by direct compounding, <a href="#">Injection Compression Moulding</a> , Ultrasonic Molding Technology: Recent Advances and Potential Applications in the Medical Industry, Variable Mold Temperature Technologies, Micro injection molding-Issues in Molding Parts with Microfeatures, Influencing Factors in Microinjection Molding, Applications.					
<b>Module:4</b>	<b>Welding-Based Additive Manufacturing (WAM)</b>	<b>6 hours</b>			
Classification of WAM by motion controller, raw material and heat source. Powder-bed AM: Selective laser sintering (SLS), Selective Laser Melting (SLM) and Electron Beam Melting (EBM). Wire-feed based WAM: Wire and Laser Additive Manufacturing (WLAM), Electron Beam Freeform Fabrication (EBF3), Wire and Arc Additive Manufacturing (WAAM).					
<b>Module:5</b>	<b>Ultra-Precision Machining</b>	<b>6 hours</b>			
Diamond turning- mechanism of material removal - process Parameters and Optimization- tool path strategies in surface generation- applications.					
<b>Module:6</b>	<b>Micromanufacturing</b>	<b>7 hours</b>			
Focused ion beam (FIB) Micro-/Nano-fabrication, Laser Micro structuring. Hot Embossing, Hot punching, Roller Embossing, Applications-Micro optical devices, Micro fluidic devices. Net Shape Manufacture of Freestanding Ceramic Micro-components through Soft Lithography, micro-fields-activated sintering technology (Micro-FAST). Micromachining- Micro turning, Micro grinding, Ultra Sonic Micromachining, Abrasive Water Jet Micro Machining, Chemical and Electro Chemical Micro Machining – Electric discharge micro					

machining, Laser Beam Micro Machining. Handling for Micromanufacturing.		
<b>Module:7</b>	<b>Hybrid Machining Process (HMPs)</b>	<b>7 hours</b>
Classification of Hybrid Machining process, Elements of Hybrid Machining Technology (Hybrid Machine Tools, Hybrid Tooling, Hybrid Machining Processes, Metrology System, Work Handling System, Process Monitoring Technique). Vibration assisted grinding, Vibration Assisted EDM, Ultrasonic assisted ECM. Heat Assisted HMPs, Laser assisted turning, laser-assisted ECM(LAECM), Laser-Assisted EDM (LAEDM). Magnetic Field assisted EDM, Magnetic field Assisted electro discharge deposition (EDD) process. Electro chemical discharge machining (ECDM), Electro chemical honing, Electro chemical discharge grinding.		
<b>Module:8</b>	<b>Contemporary Issues</b>	<b>2 hours</b>
<b>Total Lecture hours:</b>		<b>45 hours</b>
<b>Text Books</b>		
1.	Kalpakjian and Schmid, Manufacturing Processes for Engineering Materials, 2017, 5 <sup>th</sup> edition, Prentice Hall.	
2.	Hassan Abdel-Gawad ElHofy, Fundamentals of Machining Processes (Conventional and Nonconventional Processes), 2018, 3 <sup>rd</sup> Edition, CRC press.	
3.	A. Ghosh, and A.K. Mallik, Manufacturing Science, Affiliated East-West Press Pvt. Ltd. New Delhi.	
4.	V.K.Jain, Micro manufacturing processes, 2013, CRC Press.	
<b>Reference Books</b>		
1.	Balasubramaniam R, Sarepaka RV, Subbiah S. Diamond turn machining: Theory and practice. 2017, CRC press.	
2.	Heine R. W., Loper C. R., and Rosenthal P. C. Principles of Metal Castings, 1997, 2 <sup>nd</sup> Edition, Tata McGraw Hill, New Delhi.	
3.	Murty, R. L., Precision Engineering in Manufacturing, New Age International (P) Limited, New Delhi.	
4.	Mark J. Jackson, Micro and Nano fabrication, 2010, CRC Press, Taylor & Francis Group	
5.	Yi Qin, Micro-Manufacturing Engineering and Technology, 2010, Elsevier Publisher, ISBN: 978-0-8155-1545-6	
6.	MuammerKoc, TrugelOzel, Micro manufacturing, Design and manufacturing of micro products, 2011, Wiley Publishers	
Mode of Evaluation: CAT, Written assignment, Quiz, FAT		
<b>Indicative Experiments</b>		
1.	Learn the forming characteristics of sheet metal specimens with Deep Drawing operation.	
2.	Extrude a cylindrical cup by backward extrusion, determine the load variation with the thickness of the bottom of the cup.	
3.	Evaluate the machinability of difficult to machine materials by EDM die sinking and EDM milling.	
4.	Evaluate the process parameters (Wire feed, wire tension, wire material, WWR) for machining the given material by WEDM process.	
5.	Study on Electric discharge coating process by P/M tool and conventional tool.	
6.	Study on Micro turning process parameters on the given job.	
7.	Experimental investigation on metals and alloys by micro drilling process and analyzing the responses and tool wear.	
8.	Experimental Analysis on drill preparation by micro drilling on natural fiber composites and studying the roundness error.	
9.	Experimental study on slot preparation by micro milling on metals and alloys.	
10.	Experimental study on slot preparation by micro milling on natural fiber composites.	
<b>Total Laboratory Hours</b>		<b>30 hours</b>

<b>Text book</b>			
Lab manual prepared by the Faculty member			
Mode of assessment: Continuous assessment, FAT, Oral examination			
Recommended by Board of Studies	09-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022