Aegis: Charutar Vidya Mandal (Estd.1945)

FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: **Bachelor of Technology (Mechanical Engineering)**

Semester: **VI**

Course Code: **202090605**

Course Title: **Advanced Manufacturing Processes**

Course Group: **Professional Elective Course-II**

Course Objectives: At the end of the course, the student will be able to understand the working principle of various Non – Traditional Machining Processes like Abrasive Jet Machining (AJM), Ultrasonic Machining (USM), Electron Beam Machining (EBM), Laser Beam Machining (LBM) and Electro – Chemical Machining (ECM). The students can understand different types of Composite Material Characteristics and its Manufacturing Methods and Types of Micro & Macro Machining Processes. Students will enhance their knowledge in Rapid Prototyping /3D Printing Technologies like Stereolithography (SLA), Fused Deposition Modelling (FDM) and many more.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Theory		J/V/P*		Total
Lecture	Tutorial	Practical		Internal	External	Internal	External	
3	0	2	4	50 / 18	50 / 17	25 / 9	25 / 9	150/53

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	**Introduction** Limitation of conventional manufacturing processes, Need for Advanced Manufacturing Processes, Considerations in process selection and Applications.	02

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2	**Non – Traditional Machining Processes:** Introduction and Classification of Non – Traditional Machining Processes. **Mechanical Energy Based Processes:** Abrasive Jet Machining (AJM), Water Jet Machining (WJM), Abrasive Water Jet Machining (AWJM), Ultrasonic Machining (USM). Working Principles – Equipment used – Process Parameters – MRR – Applications. **Electrical Energy Based Processes:** Electric Discharge Machining (EDM) – Working Principle – Equipment used – Process Parameters – Surface Finish & MRR – Electrode / Tool – Power and control Circuits – Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications. **Chemical and Electro-Chemical Energy Based Processes:** Chemical machining and Electro - Chemical Machining (CHM & ECM) - Etchants – Maskant – Techniques of applying Maskants – Process Parameters – Surface Finish and MRR – Applications. Principles of ECM – Equipments – Surface Roughness and MRR Electrical Circuit – Process Parameters – ECG & ECH – Applications. **Thermal Energy Based Processes:** Laser Beam Machining (LBM), Plasma Arc Machining (PAM) & Electron Beam Machining (EBM). Principles – Equipment – Types – Beam Control Techniques – Applications.	**25**
3	**Overview of MEMS and Microsystems:** MEMS and Microsystems, Typical MEMS and Microsystem products, Evolution of Microfabrication, Multidisciplinary nature, Application of MEMS, Working principle of microsystem.	**04**
4	**Manufacturing of Composite Materials:** Introduction, Classification of Composites, Manufacturing Methods: Spray Lay – up, Wet/Hand Lay – up, Vacuum Bagging, Filament Winding, Pultrusion, Resin Transfer Moulding (RTM), Resin Film Infusion (RFI), Mechanical Properties – Stiffness and Strength.	**05**
5	**Rapid Prototyping / 3d Printing Process:** Introduction: Need for the compression in Product Development, History of RP systems, Survey of applications, Growth of RP industry and classification of RP systems. **Stereo Lithography Systems (SLA):** Principle, Process Parameters, Process details, Data preparation, Data files and Machine details, Application. **Selective Laser Sintering (SLS):** Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications. **Fusion Deposition Modelling (FDM):** Principle, Process parameter, Path generation, Applications. **Solid Ground Curing (SGC):** Principle of operation, Machine details, Applications. **Laminated Object Manufacturing (LOM):** Principle of operation, LOM materials, Process details, Applications.	**09**
	Total	**45**

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List of Practicals / Tutorials:

1	To Understand Non – Traditional Machining Processes and its Classification.
2	To Understand Mechanical Energy Based Non – Traditional Machining Processes.
3	To Understand Electrical Energy Based Non – Traditional Machining Processes.
4	To Understand Chemical and Electro-Chemical Energy Based Non – Traditional Machining Processes.
5	To Understand Thermal Energy Based Non – Traditional Machining Processes.
6	To Understand MEMS (micro-electromechanical systems) and its applications.
7	To Understand Manufacturing of Composites, its Classification and Applications.
8	To Understand Rapid Prototyping / 3d Printing Processes and its Classification.
9	To Design and Manufacture a Part on Fused Deposition Modeling (FDM).
10	To Design and Manufacture a Part on Stereolithography (SLA).

Reference Books:

1	Foundation of MEMS/ Chang Liu/Pearson, 2012.
2	"MEMS and Microsystems Design and Manufacture" by Tai-Ran Hsu. Tata McGraw-Hill Publishing Company Ltd.
3	Unconventional Machining process, Dr. Senthil, A R S Publishers
4	Modern Machining Processes, P. C. Pandey, H. S. Shan, Tata McGraw-Hill
5	Design for Advanced Manufacturing: Technologies and Processes, LaRoux K. Gillespie, McGraw-Hill Education
6	Advanced Machining Processes / Non-Traditional and Hybrid Machining Processes, Hassan El-Hofy, McGraw-Hill
7	3D Printing and Additive Manufacturing: Principles and Applications, Chee Kai Chua and Kah Fai Leong, World Scientific
8	Rapid Prototyping, Adithan M., Atlantic Publisher
9	An Introduction to Composite Materials, 2nd Edition, by D. Hull and T. W. Clyne, Cambridge University Press.
10	"Manufacturing Science" A. Ghosh, and A.K. Mallik, Affiliated East-West Press Pvt. Ltd. New Delhi.
11	Composite Materials: Design and Applications, Third Edition by, Daniel Gay.

Supplementary learning Material:	
1	NPTEL resources

Pedagogy:

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods
- Industrial/ Field visits

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Internal Evaluation:

The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						**R**: Remembering; **U**: Understanding; **A**: Applying; **N**: Analyzing; **E**: Evaluating; **C**: Creating
R	**U**	**A**	**N**	**E**	**C**	
20%	25%	25%	15%	10%	5 %	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	To understand the Working Principles and Applications of Non - Traditional Manufacturing Processes.	**45**
CO-2	To get familiar with MEMS and its Applications.	**15**
CO-3	To understand various Rapid Prototyping Processes & its applications in various fields.	**25**
CO-4	To have proper insight for Composite Materials, Manufacturing Techniques & its Applications in Industries.	**15**

Curriculum Revision:	
Version:	2
Drafted on (Month-Year):	June-2022
Last Reviewed on (Month-Year):	--
Next Review on (Month-Year):	June-2025

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