INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

MECHANICAL ENGINEERING

COURSE DESCRIPTOR

Course Title	**UNCONVENTIONAL MACHINING PROCESSES**				
Course Code	**AME507**				
Programme	B.Tech				
Semester	VII	ME			
Course Type	Elective				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	0	3	-	-
Chief Coordinator	Mr. VKVS Krishnam Raju, Assistant Professor.				
Course Faculty	Mr. VKVS Krishnam Raju, Assistant Professor.				

I. COURSEOVERVIEW:

This course focuses on the various unconventional machining processes, the process parameters associated with them. Selection of an appropriate machining process for a particular application, properties of the work material and shape to be machined, process capability and economic considerations of these processes.

II. COURSEPRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AME006	IV	Production Technology	3
UG	AME005	III	Metallurgy and Material Science	3

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Unconventional Machining Processes	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✘	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

V. EVALUATIONMETHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8thand 16thweek of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES AREASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering Knowledge**: Capability to apply the knowledge of mathematics, science and engineering in the field of mechanicalengineering.	3	Assignments
PO 2	**Problem Analysis:** An ability to analyze complex engineering problems to arrive at relevant conclusion using knowledge of mathematics, science and engineering.	1	Seminars
PO 4	**Conduct investigations of complex problems:** To design and conduct research oriented experiments as well as to analyze and implement data using researchmethodologies.	1	Assignments
PO 6	**The engineer and society:** To utilize the engineering practices, techniques, skills to meet needs of the health, safety, legal, cultural and societal issues.	2	Assignments & Seminars

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES AREASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Professional Skills:** To produce engineering professional capable of synthesizing and analyzing mechanical systems including allied engineering streams.	3	Seminar
PSO 2	**Problem solving skills**: An ability to adopt and integrate current technologies in the design and manufacturing domain to enhance the employability.	1	Assignments
PSO 3	**Successful career and Entrepreneurship**: To build the nation, by imparting technological inputs and managerial skills to become technocrats.	3	Assignments

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES:

The course should enable the students to:	
I	Understand the need and importance of non-traditional machining methods and process selection.
II	Gain the knowledge to remove material by thermal evaporation, mechanical energy process.
III	Apply the knowledge to remove material by chemical and electro chemical methods.
IV	Analyze various material removal applications by unconventional machining process.

IX. COURSE OUTCOMES(COs)

COs	Course Outcomes	CLO's	At the end of the course, the student will have the ability to:
CO1	Compare non-traditional machining, classification, material applications in material removal process.	CLO 1	Understand of fundamentals of the non- traditional machining methods and industrial applications.
		CLO 2	Compare Conventional and Non- Conventional machining and analyze the different elements of Ultrasonic Machining and its applications.
		CLO 3	Identify and utilize fundamentals of metal cutting as applied to machining.
CO2	Summarize the principle and processes of abrasive jet machining.	CLO 4	Understand a problem and apply the fundamental concepts and enable to solve problems arising in metal removal process.
		CLO 5	Explore the ability to define andformulate the properties of cutting tool materials and characteristics.

		CLO 6	Illustrate the variables in Abrasive Jet Machining.
CO3	Understand the principles, processes and applications of thermal metal removal processes.	CLO 7	Explain the different elements of Chemicaland Electro chemical Machining and its applications.
		CLO 8	Comparison between non-traditional machining process with the traditional parameters, energy sources, economics of processes, shape and size of the material.
		CLO 9	Illustrate different parameters of Electrical Discharge Machining.
CO4	Identify the principles, processes and applications of EBM.	CLO 10	Develop methods of working for minimizing the production cost.
		CLO 11	Apply the best suitable advanced manufacturing process for processing of unconventional materials employed in modern manufacturing industries.
		CLO 12	Study the parametric influences during processing of materials using developed models.
CO5	Understand the principles, processes and applications of Plasma Machining.	CLO 13	Analyze the different elements of Laser and Electronic Beam machining
		CLO 14	Apply unconventional machining process in various industrial applications.
		CLO 15	Analyze and simulate various industrial problems in advanced machining processes using EBM and LBM

X. COURSE LEARNING OUTCOMES(CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AME507.01	CLO 1	Understand of fundamentals of the non-traditional machining methods and industrial applications.	PO 1 PO 2	2 2
AME507.02	CLO 2	Compare Conventional and Non-Conventional machining and analyze the different elements of Ultrasonic Machining and its applications.	PO 1	1
AME507.03	CLO 3	Identify and utilize fundamentals of metal cutting as applied to machining.	PO 1 PO 2 PO 5	3
AME507.04	CLO 4	Understand a problem and apply the fundamental concepts and enable to solve problems arising in metal removal process.	PO 1	2
AME507.05	CLO 5	Explore the ability to define andformulate the properties of cutting tool materials and characteristics.	PO 1	2
AME507.06	CLO 6	Illustrate the variables in Abrasive Jet Machining.	PO 1	3
AME507.07	CLO 7	Explain the different elements of Chemical and Electro chemical Machining and its applications.	PO 2 PO 5	1 3
AME507.08	CLO 8	Comparison between non-traditional machining process with the traditional parameters, energy sources, economics of processes, shape and size of the material.	PO 1 PO 2	3 3
AME507.09	CLO 9	Illustrate different parameters of Electrical Discharge Machining.	PO 1 PO 6	2 3
AME507.10	CLO 10	Develop methods of working for minimizing the production cost.	PO 1 PO 2	3 2

AME507.11	CLO 11	Apply the best suitable advanced manufacturing process for processing of unconventional materials employed in modern manufacturing industries.	PO 1	3
AME507.12	CLO 12	Study the parametric influences during processing of materials using developed models.	PO 1	3
AME507.13	CLO 13	Analyze the different elements of Laser and Electronic Beam machining	PO 6	3
AME507.14	CLO 14	Apply unconventional machining process in various industrial applications.	PO 6	3
AME507.15	CLO 15	Analyze and simulate various industrial problems in advanced machining processes using EBM and LBM	PO 6	3

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XI. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFICOUTCOMES:

Course Outcomes (COs)	Program Outcomes (POs)				Program Specific Outcomes (PSOs)		
	PO1	PO2	PO5	PO6	PSO1	PSO2	PSO3
CO 1	2	2	3		2	1	3
CO 2	3				3	3	
CO 3	3	3	3	3	2	2	
CO 4	3	2			3		
CO 5				3		3	

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XII. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFICOUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	2	2											1	1	3
CLO 2	1												1		
CLO 3	1	2			3								2		
CLO 4	2												1	3	
CLO 5	2													1	
CLO 6	3												3		
CLO 7		1			3								1		
CLO 8	3	3											2	1	
CLO 9	2					3								2	
CLO 10	3	2											3		

CLO 11	3												3		
CLO 12													3		
CLO 13						3								2	
CLO 14						3								3	
CLO 15						3								3	

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XIII. ASSESSMENTMETHODOLOGIES–DIRECT

CIE Exams	PO 1, PO 2, PO 4, PO 6, PSO 1	SEE Exams	PO 1, PO 2, PO 6, PSO 1 PSO 2, PSO 3	Assignments	PO 4	Seminars	PO 6 PO 8
Laboratory Practices	-	Student Viva	PO 1	Mini Project	-	Certification	-
Term Paper	-						

XIV. ASSESSMENTMETHODOLOGIES-INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XV. SYLLABUS

UNIT-I	INTRODUCTION
Need for non-traditional machining methods, classifications of modern machining processes, considerations in process selection, materials application, Ultrasonic machining: Elements of the process, mechanics of metal removal, process parameters, economic considerations, application and limitations, recentdevelopments.	
UNIT-II	**ABRASIVE JET MACHINING**
Abrasive jet machining, water jet machining and abrasive water jet machining: basic principles, equipments process variables, mechanics of metal removal, MRR, applications and limitations; Electro chemical processes: Fundamentals of electro chemical machining, electro chemical grinding, electro chemical honing and deburring process, metal removal rate in ECM, tool design, surface finish and accuracy, economic aspect of ECM, simple problem for estimation of metal removal rate.	
UNIT-III	**THERMAL METAL REMOVAL PROCESSES**
General principle and applications of Electric discharge machining, electric discharge grinding, electric discharge wire cutting processes, power circuits in EDM, mechanism of metal removal in EDM, process parameters. Selection of tool electrodes and dielectric fluids, surface finish and accuracy, characteristics of spark eroded surface and machine tool selection, wire EDM principle and applications.	
UNIT-IV	**ELECTRON BEAM MACHINING**
Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non thermal processes, general principle and applications of laser beam machining, thermal features, cutting speed and accuracy of cut.	
UNIT-V	**PLASMA MACHINING**
Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries; Chemical machining principle, maskants, etchants, applications.	

Text Books:
1. V. K. Jain, "Advanced Machining Processes", Allied Publishers, 1st Edition,2013. 2. Pandey P. C., Shah H.S., "Modern Machining Processes", Tata McGraw-Hill, 1st Edition, 2013.
Reference Books:
1. Bhattacherya A, "New Technology", The Institute for Engineers, 1st Edition,1973. 2. C. Elanchezhian, B. VijayaRamnath, M. Vijayan, "Unconventional Machining processes", Anuradha Publication, 1st Edition,2005. 3. M. K. Singh, "Unconventional Machining processes", New Age International Publishers, 1st Edition, 2010.

XVI. COURSEPLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Explain the need for non-traditional machining methods.	CLO 1	T1:1.1, R1:1.1
2	Discuss Classification of modern machining processes.	CLO 2	T21.2, R31.2
3	Illustrate considerations in process selection, Materials, applications and overview of theunit.	CLO 2	T1, 1.2 R: 1.3
4-5	Demonstrate ultrasonic machining, elements of the process	CLO 4	T1: 1.3.3
6-7	Emphasize process and mechanics of metal removal process parameters, economic considerations.	CLO 4	T1,1.3.2
8-9	Visualize mechanics of metal removal process parameters, economic considerations.	CLO 6	T1, 1.3
10	Summarize applications and limitations, recent development.	CLO 6	T2:2.1, R1: 3.4
11	Explain the overview of abrasive jet machining.	CLO 6	T1: 2.3
12-13	Explain the water jet machining processes	CLO 7	T2: 3.1
14	Discuss abrasive water jet machining.	CLO 7	T1: 3.1
15-16	Summarize basic principles, equipment, process variables.	CLO 7	T1: 3.2
17	Illustrate mechanics of metal removal.	CLO 8	T2:3.3
18	Explain MRR, application and limitations and overview of the unit.	CLO 8	R3: 3.1, T1:4.1
19	Discusselectro-chemical processes, electro-chemical grindingelectro-chemical honing and deburringprocess.	CLO 9	R3:4.1 T2:5.1
20	Explain the phenomena metal removal rate in ECM, tool design, surface finish and accuracy.	CLO 9	T2:5.1 R2:4.1
21-22	Discuss economic aspects of ECM, solve simple problems for estimation of metal removal rate.	CLO 10	R3:4.3 T2:5.1
21-22	Discuss economic aspects of ECM, solve simple problems for estimation of metal removal rate.	CLO 10	R3:4.3 T1:4.3
23-24	Discuss economic aspects of ECM, Simple problems for estimation of metal removalrate.	CLO 14	R3: 3.1, T1:4.1
25-26	Explain fundamentals of chemical, machining, thermal metal removal processes.	CLO 14	R3:4.1 T2:5.1
27-28	Discuss general Principle and applications of electric discharge machining.	CLO 14	T2:5.1 R2:4.1
27-28	Explain general Principle and applications of electric discharge machining.	CLO 15	R3:4.3 T2:5.1
31-32	Explain electric discharge grinding process.	CLO 15	R3:4.3 T1:4.3
33-34	Discuss electric discharge wire cutting processes.	CLO 16	R3: 3.1, T1:4.1

35-36	Explain power circuits for EDM, mechanics of metal removal in EDM.	CLO 14	R3:4.1 T2:5.1
37-38	Demonstrate process parameters, selection of tool electrode and dielectric fluids, surface finish and machining accuracy.	CLO 14	T2:5.1 R2:7.1
39	Discuss characteristics of spark eroded surface and machine tool selection.	CLO 14	R3: 4.3 T2: 7
40-41	Explain wire EDM principle and applications.	CLO 15	R3:4.3 T1:4.3
42	Emphasize Generation and control of electron beam for machining.	CLO 16	R3: 3.1, T1:8.1
43-44	Discuss theory of electron beam machining.	CLO 16	R3: 4.1 T2: 8.3.1
45	Comparison of thermal and non -thermal processes.	CLO 16	T2:5.1 R2:8.3
46	Explain general principles and applications of laser beam machining.	CLO 15	R3: 4.3 T2: 8.3.1
47	Discuss thermal features, cutting speed and accuracy of cut, application of plasma for machining	CLO16	R3: 4.3 T1: 8.3.2
48	Discuss metal removal mechanism, process parameters, accuracy and surface finish, applications of plasma in manufacturing industries.	CLO 17	R3: 3.1, T2:8.4
49	Discuss chemical machining principle and process.	CLO17	R3:4.1 T2:8.5

XVII. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSIONREQUIREMENTS:

S NO	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Machining of high hardened material using EDM	Guest Lecture	PO 1	PSO 1
2	Plasma cutting for Aerospace applications	Seminars / NPTEL	PO 4	PSO 1
3	Recent development in Ultrasonic machining.	NPTEL	PO 2	PSO 1

Prepared by:
Mr. VKVS Krishnam Raju, Assistant Professor. **HOD, ME**