INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad- 500043

MECHANICAL ENGINEERING

COURSE DESCRIPTION FORM

Course Title	**UNCONVENTIONAL MACHINING PROCESSES**			
Course Code	**A70359**			
Regulation	**R15-JNTUH**			
Course Structure	**Lecture**	**Tutorial**	**Practical**	**Credit**
	4	**0**	**-**	**4**
Course Coordinator	**Mr. S. Srikrishnan, Assistant Professor ME**			
Team of Instructors	**Mr. S. Srikrishnan, Assistant Professor ME**			

I. COURSE OVERVIEW

The objective of this course is to impart knowledge 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. PREREQUISITE(S)

Level	Credits	Periods	Prerequisite
UG	4	4	Metallurgy and material science, Mechanics of solids, Engineering Chemistry, Engineering physics, Mathematics.

III. MARKSDISTRIBUTION

Sessional Marks	University End Exam Marks	Total Marks
There shall be 2 midterm examinations. Each midterm examination consists of subjective type and Objective type tests. The subjective test is for 10 marks, with duration of 1 hour. Subjective test of each midterm exam shall contain 4 questions. The student has to answer 2 questions, each carrying 5 marks. The objective type test is for 10 marks with duration of 20minutes. It consistsof10Multiplechoiceand10objectivetypequestions.Thestudent has to answer all the questions and each carries half mark. First midterm examination shall be conducted for the first 2 ½ units of syllabus and second midterm examination shall be conducted for the remaining 2 ½ units. Five marks are earmarked for assignments. There shall be two assignments in every theory course. Marks shall be awarded considering the average of two assignments.	75	100

IV. EVALUATIONSCHEME

S.NO	Component	Duration	Marks
1	I Mid examination	80 minutes	20
2	I Assignment	--	05
3	II Mid examination	80 minutes	20
4	II Assignment	--	05
5	External examination	3 hours	75

V. COURSEOBJECTIVES

I. Understand the need and importance of non-traditional machining methods.
II. Apply basic principle, equipment, process variables and mechanics of metal removal in abrasive jet machining and water jet machining.
III. Knowledge of fundamentals of tool design, surface finishing and metal removal rate of electro chemical grinding, electro chemical machining and electro chemical honing.
IV. Understand principles of operations, types of electrodes and process parameters and machine tool selection in EDM and Electric discharge grinding and wire cut process.
V. Comprehend basics of Electron Beam Machining and comparison of thermal and non-thermal processes.
VI. Understand metal removal mechanism, process parameters of plasma arc machining.

VI. COURSEOUTCOMES

After completing this course the student must demonstrate the knowledge and ability to:

1. Knowledge about the modern manufacturing processes and their applications in various industry
2. Understand the need for unconventional machining processes in comparison with conventional manufacturing processes
3. Knowledge about abrasive jet machining and understanding the various limiting factors in using abrasive jet machining process
4. Understand the advantages of water jet machining and explore the various possibilities of utility in modern tool utility
5. Application of ultrasonic machining for modern manufacturing process concurring with advanced practices of aerospace industry
6. Understand the working of electric discharge machining effecting the surface finish of work pieces in medical and engineering fields
7. Knowledge of electric equipment required for effective running of EDM with the complexity of power losses and economy
8. Understand the difference between EDM and wire cut EDM with in depth understanding of the better technology between both
9. Understand the application of CHM in high precision machining used in aerospace industries and other mechanical industries requiring lower tolerances
10. Understand the utility of Maskants and etchants in electro chemical machining
11. Knowledge of working of laser for application in laser beam machining with acute understanding of the various types and power requirement of lasers
12. Understand the principle of plasma arc machining with basic understanding of the methods used for evolving the plasma state using inert gases
13. Knowledge of electrons and bombardment in electron beam machining with current understanding of the speed of electrons and the safety requirements
14. Knowledge of beam control techniques with vector control measures used for electron beam machining for effective utility
15. Understand the need for utility manufacturing and application in modern industries and comparative study with reference to the conventional machining processes

VII. HOW PROGRAM OUTCOMES AREASSESSED

Program outcomes		Level	Proficiency Assessed by
PO1	**Engineering knowledge:** Capability to apply the knowledge of Mathematics, science and Engineering in the field of Mechanical Engineering	S	Assignments and Tutorials
PO2	**Problem Analysis:** An Ability to analyze complex engineering problems to arrive at relevant conclusions using knowledge of Mathematics, Science and Engineering.	S	Tutorials
PO3	**Design/ Development of Solutions:** Competence to design a system, component or process to meet societal needs within realistic constraints.	S	Exams
PO4	**Conduct investigations of complex problems:** To design and conduct research oriented experiments as well as to analyze and implement data using research methodologies.	S	Mini Projects
PO5	**Modern tool usage:** An ability to formulate solve complex engineering problem using modern engineering and Information technology tools.	H	Assignments
PO6	**The Engineer and society:** To utilize the engineering practices, techniques, skills to meet needs of the health, safety, legal, cultural and societal issues.	H	Mini Projects
PO7	**Environment and society**: To understand impact of engineering solutions in the societal context and demonstrate the knowledge for sustainable development.	N	----
PO8	**Ethics:** An understanding responsibilities and implementation of professional and Ethical	N	----
PO9	**Individual and Team work:** To function as an effective individual and as a member or leader in Multi- disciplinary environment and adopt in diverse teams.	N	----
PO10	**Communication:** An ability to assimilate, comprehends, communicate, give and receive instructions to present effectively with engineering community and society.	N	----
PO11	**Project management and finance**: An ability to provide leadership in managing complex engineering projects at multi-disciplinary environment and to become a professional engineer.	H	Mini Projects
PO12	**Life-Long learning**: Recognition of the need and an ability to engage in lifelong learning to keep abreast with technological changes.	S	Tutorials

VIII. HOW PROGRAM SPECIFIC OUTCOMES AREASSESSED

Program Specific Outcomes		Level	Proficiency Assessed by
PSO 1	**Professional Skills**: To produce engineering professional capable of synthesizing and analyzing mechanical systems including allied engineering streams.	H	Lectures, Assignments
PSO 2	**Design/Analysis:**An ability to adopt and integrate current technologies in the design and manufacturing domain to enhance the employability.	S	Projects
PSO 3	**Successful and Entrepreneurship**: To build the nation, by imparting technological inputs and managerial skills to become Technocrats.	H	Guest Lectures

N- None **S–Supportive** **H – Highly Related**

IX. SYLLABUS

UNIT-I

Introduction: Need for non-traditional machining methods-Classification of modern machining processes- considerations in process selection. Materials, applications.

Ultrasonic machining – elements of the process, mechanics of metal removal process parameters, economic considerations, applications and limitations, recent development.

UNIT-II

Abrasive jet machining, water jet machining and abrasive water jet machine: Basic principles, equipment, process variables, mechanics of metal removal, MRR, application 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 aspects of ECM-Simple problems for estimation of metal removal rate.

UNIT-III

Thermal Metal Removal Processes: General Principle and applications of Electric Discharge Machining, Electric Discharge Grinding and electric discharge wire cutting processes-Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, surface finish and machining accuracy, characteristics of spark eroded surface and machine tool selection. Wire EDM-principle and applications.

UNIT-IV

Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes- General Principle and application of laser beam machining-thermal features, cutting speed and accuracy of cut.

UNIT-V

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:

T1. Advanced machining processes-VK Jain, Allied Publishers.

REFERENCE BOOKS:

R1.Modern Machining Process- Pandey P.C. and Shah H.S., TMH
R2.New Technology – Bhattacharya A, The Institution of Engineers, India 1984.
R3.Unconventional Machining Processes- C. Elanchezhian., B. Vijaya Ramnath and M Vijayan, Anuradha Publications, 2005.
R4. Unconventional Machining Processes – M.K Singh, New Age International Publisher.

X. COURSEPLAN:

The course plan is meant as a guideline. There may probably be changes.

Lecture No.	Course Learning Outcomes	Topics to be covered	Reference
1	Explain Non-traditional machining methods	**UNIT-I** Introduction: Need for non-traditional machining methods	T1 1.1
2	Explain Non-traditional machining methods	Introduction: Need for non-traditional machining methods	T1 1.1
3	Categorize & Describe Modern machining processes	Classification of modern machiningprocesses	T1 1.2
4	Categorize & Describe Modern machining processes	Classification of modern machiningprocesses	T1 1.2
5	Illustrate process, selection and materials	Considerations in process selection, Materials, applications.& Overview of the unit	T1 1.3

6	Describe Ultrasonic machining process	Ultrasonic machining – elements of the process	T1 1.4,R1
7	Illustrate metal removal process	The process and mechanics of metal removal process parameters, economic considerations	T1 1.5,R1
8	Illustrate metal removal process	Mechanics of metal removal process parameters, economic considerations	T1 1.6,R1
9	Discuss applications and limitations of Ultrasonic machining process	Applications and limitations, recent development.	T1 1.6,R1
10	Evaluate the unit content	Overview of the unit	T1,R1
11	Describe Abrasive jet machining	**UNIT-II** Abrasive jet machining	T1 2.1
12	Describe Abrasive jet machining	Abrasive jet machining	T1 2.1
13	Describe water jet machining	water jet machining	T1 2.2,R1
14	Describe Abrasive water jet machining	Abrasive water jet machining	T1 2.3,R1
15	Define principles of jet machining process	Basic principles, equipment, process Variables	T1 2.3,R1
16	Illustrate metal removal process	Mechanics of metal removal	T1 2.4,R1
17	Discuss applications and limitations	MRR, application and limitations & Overview of the unit	T1 2.5,R1
18	Evaluate the unit content	Electro – Chemical Processes: Fundamentals of electro-chemical	T1 2.6,R1
19	Describe Electro-Chemical processes	Electro –Chemical Grinding	T1 2.7,R1
20	Describe Electro chemical honing process	Electro-Chemical honing and deburring process	T1 2.8,R1
21	Describe Electro chemical honing process	Electro-Chemical honing and deburring process	T1 2.8,R1
22	Illustrate metal removal process	Metal removal rate in ECM,Tool design, surface finish and accuracy	T1 2.9,R1
23	Illustrate metal removal process	Metal removal rate in ECM,Tool design, surface finish and accuracy	T1 2.9,R1
24	Analyze Economic aspects of ECM and MRR	Economic aspects of ECM- Simple problems for estimation of metal removal rate.	T1 2.9,R1
25	Analyze Economic aspects of ECM and MRR	Economic aspects of ECM- Simple problems for estimation of metal removal rate.	T1 2.9,R1
26	Describe Fundamentals of chemical in ECM	Fundamentals of chemical, machining	T1 2.10,R1
27	Discuss advantages and applications.	Advantages and applications.	T1 2.10,R1
28	Evaluate the unit content	Overview of the unit	T1,R1
29	Illustrate Thermal metal removal processes	**UNIT-III** Thermal metal removal processes	T1 3.1,R1
30	Discuss applications of Electric Discharge Machining	General Principle and applications ofElectric Discharge Machining	T1 3.1,R1
31	Describe Electric Discharge Grinding	Electric Discharge Grinding	T1 3.2,R1
32	Explain Electric Discharge wire cutting processes	Electric Discharge wire cuttingprocesses	T1 3.3,R1
33	Illustrate Power circuits and metal removal process for EDM	Power circuits for EDM, Mechanicsof metal removal in EDM	T1 3.3,R1
34	Evaluate process parameters of EDM	Process parameters, selection of toolelectrode and dielectric fluids, surfacefinish and machining accuracy	T1 3.4,R1

35	Evaluate process parameters of EDM	Process parameters, selection of tool electrode and dielectric fluids, surface finish and machining accuracy	T1 3.4,R1
36	Illustrate machine tool selection	Characteristics of spark eroded surface and machine tool selection	T1 3.4,R1
37	Illustrate machine tool selection	Characteristics of spark eroded surface and machine tool selection	T1 3.4,R1
38	Define wire EDM-principle	Wire EDM- principle and applications.	T1 3.5,R1
39	Evaluate the unit content	Overview of the unit	T1,R1
40	Evaluate the unit content	Overview of the unit	T1,R1
41	Explain control of electron beam for machining	**UNIT-IV** Generation and control of electron beam for machining	T1 4.1,R1
42	Describe electron beam machining	Theory of electron beam machining	T1 4.2,R1
43	Compare thermal and non-thermal processes	Comparison of thermal and non-thermal processes	T1 4.2,R1
44	Compare thermal and non-thermal processes	Comparison of thermal and non-thermal Processes	T1 4.2,R1
45	Discuss applications of laser beam machining	General principles and applications oflaser beam machining	T1 4.3,R1
46	Discuss applications of laser beam	General principles and applications oflaser	T1 4.4,R1
47	Explain Thermal features, cutting speed of LBM.	Thermal features, cutting speed and accuracy of cut.	T1 4.5,R1
48	Explain Thermal features, cutting speed of LBM.	Thermal features, cutting speed and accuracy of cut.	T1 4.5,R1
49	Evaluate the unit content	Overview of the unit	T1,R1
50	Discuss applications of plasma for machining	**UNIT-V** Application of plasma for machining	T1 5.1,R1
51	Discuss applications of plasma for machining	Application of plasma for machining	T1 5.1,R1
52	Illustrate metal removal	Metal removal mechanism, process parameters, accuracy and surface finish	T1 5.2,R1
53	Illustrate metal removal	Metal removal mechanism, process parameters, accuracy and surface finish	T1 5.2,R1
54	Discuss applications of plasma in manufacturing industries	Applications of plasma in manufacturing industries	T1 5.3,R1
55	Discuss applications of plasma in manufacturing industries	Applications of plasma in manufacturing industries	T1 5.3,R1
56	Define Chemical machining principle	Chemical machining principle	T1 5.4,R1
57	Discuss applications	Maskants – etchants – applications	T1 5.5,R1
58	Evaluate the unit content	Overview of the unit.	T1,R1
59	Evaluate the unit content	Overview of the unit.	T1,R1

XI. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
I.	H				S			H					S		
II.					S						H				S
III.	H		S				S					H		H	
IV.		S									H				S
V.						S			H				H		
VI.				H				S			S			H	S

N=None **S=Supportive** **H = Highly Related**

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

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
1	H		S	S	H								S	H	
2	H		S								S				S
3			S										S		H
4	H			S	H						H			H	
5		H	S								H				
6				S	H								S	H	
7	H	H													S
8							S						S		H
9	H			S			S				H			H	
10			S			S							S	S	
11	H			S							S		S		
12		H												H	S
13	H				H		H						S		H
14			S	S			S							H	
15	H	H	S		H						S		S	S	

N=None **S=Supportive** **H =Highly Related**

Prepared by:

Mr. S, Srikrishnan, Assistant Professor

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