

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

MECHANICAL ENGINEERING

COURSE DESCRIPTOR

Course Title	TOOL DESIGN								
Course Code	AME50	AME509							
Programme	B.Tech								
Semester	V ME								
Course Type	Professional Elective								
Regulation	IARE - R16								
		Theory		Practical					
Course Structure	Lecture	s Tutorials	Credits	Laboratory	Credits				
	3	-	3	-	-				
Chief Coordinator	Dr.CH.	Sandeep, Asso	ciate Profess	or, ME					
Course Faculty	Dr.CH. Sandeep, Associate Professor, ME								

I. COURSE OVERVIEW:

The primary objective of this course is to introduce the concept of tool design technology selection of tooling materials for cutting operations with the help of various processes widely employed in industries. To design Jigs and Fixtures and selection of drills for various operations are studies in this course. The course consists of tool material, design of cutting tools, design of jigs and fixtures, design of sheet metal forming-I and design of sheet metal forming-II.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AME004	III	Mechanics of Solids	4
UG	AME005	III	Metallurgy and Material Science	4

III. MARKSDISTRIBUTION:

Subject	Subject SEE Examination		Total Marks		
Tool Design	70 Marks	30 Marks	100		

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

~	Chalk & Talk	~	Quiz	~	Assignments	×	MOOCs
~	LCD / PPT	~	Seminars	×	Mini Project	~	Videos
×	Open Ended Experime	nts					

V. EVALUATION METHODOLOGY:

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 weight age 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).

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

Table 1: Assessment pattern for CIA

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th week 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 ARE ASSESSED:

	Program Outcomes (POs)	Strength	Proficiency
			assessed by
PO 1	Engineering knowledge : Capability to apply the knowledge of mathematics, science and engineering and Mechanical Engineering principles related to design and manufacturing works.	3	Presentation on Real-world problems
PO 2	Problem analysis : Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using manufacturing technology concepts and principles.	2	Seminars
PO 3	Design/ development of solutions: Design, implement, and evaluate a Mechanical Engineering component, to meet desired needs within realistic constraints	1	Assignments
PO 6	The engineer and society: Maintaining the engineering practices such as time, efficiency, as well as appropriate constraints related to economic, environmental, ethical, health and safety, manufacturability, and sustainability considerations	1	Videos

3 = High; **2** = Medium; **1** = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)	Strength	Proficiency
		assessed by
PSO 1 Professional Skills: To produce engineering professional	1 1	Seminars
capable of synthesizing and analyzing mechanical system	5	
including allied engineering streams.		
PSO 2 Problem-Solving Skills: An ability to adopt and integrat	2	-
current technologies in the design and manufacturing domain	1 -	
to enhance the employability		
PSO 3 Successful Career and Entrepreneurship: To build th	e	-
nation, by imparting technological inputs and managerial skill	8	
to become technocrats. Provide mechanical engineerin		
solutions to green and sustainable development.		

3 = High; **2** = Medium; **1** = Low

VIII. COURSE OBJECTIVES (COs):

The cou	The course should enable the students to:								
Ι	Compare the characteristics of various tool materials for cutting operations.								
II	Demonstrate the design of cutting tools and its importance in manufacturing industry.								
III	Understand the design of jigs and fixtures for holding the different components.								
IV	Illustrate the design for sheet metal forming-I in the field of design aspects.								
V	Compare the design for sheet metal forming-II in the manufacturing industry.								

IX. 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
AME509.01	CLO 1	Understand various tool materials used in various industries.	PO 1	3
AME509.02	CLO 2	Explain the characteristics of different tool materials	PO 1	3
AME509.03	CLO 3	Evaluate the properties of Non Metallic and Non Ferrous materials.	PO 1	3
AME509.04	CLO 4	Use design principles to incorporate in cutting tools.	PO 2	2

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AME509.05	CLO 5	Explain design of Point cutting tools: Milling, Drilling	PO 2	2
AME509.06	CLO 6	Demonstrate the selection of carbide tool steels for cutting operations.	PO 1	3
AME509.07	CLO 7	Solve problems and find methods to determine the shank size.	PO 2	1
AME509.08	CLO 8	Explain principles of Jigs and Fixtures.	PO 2	2
AME509.09	CLO 9	Demonstrate the general considerations in the design of drill jigs and drill bushing.	PO 2	2
AME509.10	CLO 10	Explain design of sheet metal blanking and piercing dies.	PO 2	2
AME509.11	CLO 11	Demonstrate the methods of construction of fixtures, vice, milling and boring.	PO 1	3
AME509.12	CLO 12	Explain the fundamentals of die cutting operation, power press types.	PO 3	1
AME509.13	CLO 13	Explain about material handling equipment.	PO 2	2
AME509.14	CLO 14	Solve problems on punches and dies.	PO 2	2
AME509.15	CLO 15	Understand the importance of sheet metal forming, bending, and deep drawing.	PO 3	1
AME509.16	CLO 16	Compare extrusion and forging processes to identify advantages and limitations.	PO 6	1
AME509.17	CLO 17	Enable students to understand various sheet metals forming for industrial applications.	PO 6	1
AME509.18	CLO 18	Enable students to understand importance of tool design for lifelong learning, Higher Education and competitive exams.	PO 3	1

3 = **High**; **2** = **Medium**; **1** = Low

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

Course Learning	urse rning Program Outcomes (POs)										Program Specific Outcomes (PSOs				
Outcomes (CLOs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3												1		
CLO 2	3												1		
CLO 3	3												1		
CLO 4	3														
CLO 5		2													
CLO 6	3														
CLO 7		2													
CLO 8		2													
CLO 9		2											1		
CLO 10		2											1		
CLO 11	3														

Course Learning	Program Outcomes (POs)										Program Specific Outcomes (PSOs)				
Outcomes (CLOs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 12			1												
CLO 13		2													
CLO 14		2											1		
CLO 15			1												
CLO 16						1									
CLO 17						1									
CLO 18			1												

3 = High; **2** = Medium; **1** = Low

XI. ASSESSMENT METHODOLOGIES-DIRECT

CIE Exams	PO1,PO2 PO3,PO6	SEE Exams	PO1,PO2, PO3,PO6	Assignments	PO 3	Seminars	PO 2
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES-INDIRECT

v	Early Semester Feedback	~	End Semester OBE Feedback
×	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

UNIT-I	TOOL MATERIAL					
Tool mater and nonferr	Tool materials: Properties of materials: Tools steels, Cast Iron, Mild or low carbon steels, Non metallic and nonferrous materials, Heat treating.					
UNIT-II	DESIGN OF CUTTING TOOLS					
Design of determinati tools.	Design of cutting tools: Point cutting tools: Milling cutters, drills, selection of carbide steels, determination of shank size for single point carbide tools, determining the insert thickness for carbide tools.					
UNIT-III	DESIGN OF JIGS AND FIXTURES					
Design of j	igs and fixtures: Basic principles of location and clamping; Locating methods and devices,					
Jigs, definit General con fixtures, mi	non types. Insiderations in the design of drill jigs, drill bushing, methods of construction; Fixtures, vice lling, boring lathe grinding fixtures.					
UNIT-IV	DESIGN FOR SHEET METAL FORMING – I					
Design of sheet metal blanking and piercing dies: Fundamentals of die cutting operation, power press types, general press information, materials handling equipment, cutting action in punch and die operations, die clearance, types of die construction, die design fundamentals, banking and piercing die construction, pilots, stripper and pressure pads presswork material, strip layout, short run tooling for piercing.						

 UNIT-V
 DESIGN FOR SHEET METAL FORMING – II

 Design of sheet metal bending, forming and drawing dies: Bending dies, drawing dies, drawing operations, variables that effect metal flow during drawing, determination of blank size, drawing force, single and double action draw dies

 Text Books:

- 1. Donaldson, "Tool Design", Tata McGraw-Hill, 1stEdition, 2013.
- 2. HMT, "Production Technology", Tata McGraw-Hill, 1st Edition, 2012.

3. R.K. Jain, S. C. Gupta, "Production Technology", Tata McGraw-Hill, 1stEdition, 2013. **References:**

1. George F Dieter, "Mechanical Metallurgy", Tata McGraw-Hill, 1stEdition, 2015.

2. C. Elanchezhian, M.Vijayan, "Machine Tools", Anuradha Publications, 1stEdition, 2010

XIV. COURSE PLAN:

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

Lecture	Topics to be covered	CLOs	Reference
No	_		
1-4	Define principle of tool materials	CLO 1	T1:28.7
			R1:2.6
5-7	Examine various types of tool materials	CLO 2	T1:27.5
			R1:2.7
8-10	Relate various types of Non metallic and non ferrous materials	CLO 2	T1:29.6
	and heat treatment process		R1:2.6
11-14	Describe the design of cutting tools	CLO 3	T1:29.7
			R1:4.4
15-16	Compare various cutting operations	CLO 4	T1:30.7
			R1:4.10
17-20	Explain the selection of carbide tools	CLO 5	T1:30.8
			R1:4.25
21-23	Explain jigs and fixtures	CLO 6	T1:22.9
			R1:5.4
24-26	Discuss various types of clamping	CLO 7	T1:31.2
			R1:5.8
27-28	Define the location methods of jigs	CLO 7	T2:31.10
			R1:6.8
29-30	Describe the considerations of drill jigs and bushing	CLO 8	T2:32.10
			R1:6.13
31-32	Describe the methods of constructions	CLO 8	T2:33.9
			R1:7.5
33-34	Discuss the sheet metal design	CLO 9	T2:34.10
			R2:7.5
35	Compare different types of cutting operations and material	CLO 9	T2:35.10
	handling equipments		R3:8.1
36-37	Die constructions	CLO 10	T2:35.12
			R1:9.2
38	Explain Blanking and piercing processes	CLO 11	T2:36.1
			R2:9.4
39	Discuss stripper and pressure work	CLO 12	T2:37.1
			R2:9.9
40-41	Discuss tooling for piercing	CLO 12	T1:23.1
			R1:9.10
42	Explain the design of sheet metal bending	CLO 13	T2:27.5
			R1:10.2
43-44	Discuss forming and drawing	CLO 14	T2:27.7
			R1:11.3
45	Explain various types of dies	CLO 15	T2:27.8
			R1:11.6
46	Explain the drawing process and its effects	CLO 16	T2:27.12
			R1:11.7

Lecture No	Topics to be covered	CLOs	Reference
47-48	Describes the design of blank size	CLO 17	T2:27.12 R1:11.8
49-50	Explain equipment used for single and double action draw	CLO 18	T2:27.12 R1:11.9

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	To improve standards and analyze the concepts.	Seminars	PO 1	PSO 1
2	Concepts related to Jigs and fixtures, tooling material, Working principles of quality control, Analysing cutting tools and their design concepts	Seminars / NPTEL	PO 2,PO 3	PSO 1
3	Encourage students to solve real time applications and prepare towards competitive examinations.	Guest Lectures	PO 2,PO 6	PSO 1

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