



INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

MECHANICAL ENGINEERING

COURSE DESCRIPTOR

Course Title	COMPUTER AIDED DESIGN/ COMPUTER AIDED MANUFACTURING				
Course Code	AME018				
Programme	B.Tech				
Semester	VII				
Course Type	Core				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lectures	Tutorials	Credits	Laboratory	Credits
	3	-	3	3	2
Chief Coordinator	Mr. M. Sunil Kumar, Assistant Professor				
Course Faculty	Dr. K. Raghu Ram Mohan Reddy, Professor				

I. COURSE OVERVIEW:

Computer aided Design/ Computer aided Manufacturing (CAD/CAM) is a course of primary importance to mechanical engineering students. The aim is to impart the overview of computer applications in design and manufacturing of discrete engine components, assemblies and final product to meet the global competition. The course covers the life cycle of a product, describes the product model generation, analysis of structural, thermal, dynamic behaviors. This course also deals with the creation of synthetic curves and surfaces. It imparts the knowledge of latest manufacturing techniques using CNC/DNC Machines, centers with different CNC programming methods, Manufacturing processes, Group Technologies. It makes the student understand the modern inspection methods and concepts of CIM.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AME014	VI	Finite Element Modelling	4
UG	AME010	V	Machine Tools and Metrology	3

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Computer Aided Design/Computer Aided Manufacturing	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

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 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
	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

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: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	1	Presentation on real-world problems
PO 2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	Seminar
PO 3	Design/development of solutions: Competence to design a system, component or process to meet societal needs within realistic constraints.	3	Term Paper

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 capable of synthesizing and analyzing mechanical systems including allied engineering streams.	1	Seminar
PSO 2	Software Engineering Practices: An ability to adopt and integrate current technologies in the design and manufacturing domain to enhance the employability.	-	-
PSO 3	Successful Career and Entrepreneurship: To build the nation, by imparting technological inputs and managerial skills to become technocrats.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES :

The course should enable the students to:	
I	Understand the concepts of implementation of automation and PLMS in industries practicing CIM.
II	Recognize the need of computer graphics in seamless manufacturing environment.
III	Summarize the historical development of CAD/CAM software and CNC Technology.
IV	Categorize the creation of group technology of part families and end-end utility.

IX. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Understand the basic foundation in computer aided design / manufacturing	CLO 1	Describe basic structure of CAD workstation, Memory types, input/output devices and display devices and computer graphics.
		CLO 2	Demonstrate the ability to create concepts design solutions through CAD tools that can be manufactured using CNC machinery.
		CLO 3	Understand the Computers in industrial manufacturing, product cycle, CAD / CAM Hardware.
		CLO 4	Generate and interpret engineering technical drawings of parts and assemblies according to design standards.

COs	Course Outcome	CLOs	Course Learning Outcome
CO 2	Understand the fundamentals used to create and manipulate geometric models	CLO 5	Understand of the principles of CAD/CAM, including engineering drawing, geometric and surface modeling, and feature-based design.
		CLO 6	Create accurate and precise geometry of complex engineering systems and use the geometric models in different engineering applications.
		CLO 7	Compare the different types of modeling techniques and explain the central role solid models play in the successful completion of CAD/CAM-based product development.
		CLO 8	Explain Synthetic curves and the concept of NURBS
CO 3	Learn working principles of NC machines CNC control and part programming	CLO 9	Explain the basic concepts of CNC programming and machining
		CLO 10	Develop CNC programs to manufacture industrial components.
		CLO 11	Generate tool path for part and to create CNC manual part program and APT part program
		CLO 12	Apply the concepts of machining for the purpose of selection of appropriate machining centers, machining parameters, select appropriate cutting tools for CNC milling and turning.
CO 4	Understand concept of Group Technology, FMS, CAPP.	CLO 13	Understand grouping of similar parts through group technology and developing automated process plans through computer aided process planning.
		CLO 14	Illustrate group technology, computer aided quality control.
		CLO 15	Understand different elements of robotic systems. Also understand the different components and design of FMS.
		CLO 16	Apply the contact and non-contact types inspection with computer aided testing with integration of computer aided quality with CAD/CAM
		CLO 17	Apply the concepts/components of computer integrated manufacturing and integrate them.
CO 5	Understand the concept of Computer integrated manufacturing.	CLO 18	Analyze various automated flow lines and line balancing problem.
		CLO 19	Design automated material handling and storage systems for a typical production system
		CLO 20	Apply the concepts/components of computer integrated manufacturing and integrate them.
		CLO 21	Understand data management and its important for decision making in computer integrated manufacturing system.

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
AME18.01	CLO 1	Describe basic structure of CAD workstation, Memory types, input/output devices and display devices and computer graphics.	PO 1	3
AME18.02	CLO 2	Demonstrate the ability to create concepts design solutions through CAD tools that can be manufactured using CNC machinery.	PO 2	2
AME18.03	CLO 3	Understand the Computers in industrial manufacturing, product cycle, CAD / CAM Hardware.	PO 1	3
AME18.04	CLO 4	Generate and interpret engineering technical drawings of parts and assemblies according to engineering design standards.	PO 1	3

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AME18.05	CLO 5	Understand of the principles of CAD/CAM, including engineering drawing, geometric and surface modeling, and feature-based design.	PO 2	2
AME18.06	CLO 6	Create accurate and precise geometry of complex engineering systems and use the geometric models in different engineering applications.	PO 2	2
AME18.07	CLO 7	Compare the different types of modeling techniques and explain the central role solid models play in the successful completion of CAD/CAM-based product development.	PO 2	2
AME18.08	CLO 8	Explain Synthetic curves and the concept of NURBS.	PO 2	2
AME18.09	CLO 9	Explain the basic concepts of CNC programming and machining.	PO 3	1
AME18.10	CLO 10	Develop CNC programs to manufacture industrial components.	PO 3	1
AME18.11	CLO 11	Generate tool path for part and to create CNC manual part program and APT part program	PO 2	2
AME18.12	CLO 12	Apply the concepts of machining for the purpose of selection of appropriate machining centers, machining parameters, select appropriate cutting tools for CNC milling and turning.	PO 2	2
AME18.13	CLO 13	Understand grouping of similar parts through group technology and developing automated process plans through computer aided process planning.	PO 1	3
AME18.14	CLO 14	Illustrate group technology, computer aided quality control.	PO 1	3
AME18.15	CLO 15	Understand different elements of robotic systems. Also understand the different components and design of FMS.	PO 1	3
AME18.16	CLO 16	Apply the contact and non-contact types inspection with computer aided testing with integration of computer aided quality with CAD/CAM	PO 1, PO 2	3
AME18.17	CLO 17	Understand automated material handling systems and integration of material handling and storage	PO 1, PO 2	3
AME18.18	CLO 18	Analyze various automated flow lines and line balancing problem.	PO 1, PO 2	3
AME18.19	CLO 19	Design automated material handling and storage systems for a typical production system	PO 1, PO 2	3
AME18.20	CLO 20	Apply the concepts/components of computer integrated manufacturing and integrate them.	PO 1, PO 2	3
AME18.21	CLO 21	Understand data management and its important for decision making in computer integrated manufacturing system.	PO 1	3

3= High; 2 = Medium; 1 = Low

XI. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes (COs)	Program Outcomes (POs)			
	PO 1	PO 2	PO 3	PSO1
CO 1	3	2		1
CO 2		2	1	
CO 3	3	2		1

Course Outcomes (COs)	Program Outcomes (POs)			
	PO 1	PO 2	PO 3	PSO1
CO 4	3	2		1
CO 5	3	2		

3= High; 2 = Medium; 1 = Low

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

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	3												1		
CLO 2		2													
CLO 3	3												1		
CLO 4	3												1		
CLO 5		2													
CLO 6		2													
CLO 7		2													
CLO 8		2													
CLO 9			1												
CLO 10			1												
CLO 11		2											1		
CLO 12		2											1		
CLO 13	3														
CLO 14	3														
CLO 15	3														
CLO 16	3	2											1		
CLO 17	3	2											1		
CLO 18	3	2											1		
CLO 19	3	2											1		
CLO 20	3	2											1		
CLO 21	3	2													

3 = High; 2 = Medium; 1 = Low

XIII. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1, PO2, PO3	SEE Exams	PO1, PO2, PO3, PSO1	Assignments	-	Seminars	PO1, PO2, PO3, PSO1
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO1, PO2, PO3, PSO1						

XIV. ASSESSMENT METHODOLOGIES - INDIRECT

✓	Early Semester Feedback	✓	End Semester OBE Feedback
✗	Assessment of Mini Projects by Experts		

XV. SYLLABUS

UNIT-I	FUNDAMENTAL CONCEPTS IN CAD
Computers in Industrial Manufacturing, Product cycle, CAD / CAM Hardware, Basic structure, CPU, Memory types, input devices, display devices, hard copy devices, storage devices, raster scan graphics coordinate system, database structure for graphics modeling, transformation of geometry, 3D transformations, mathematics of projections, clipping, hidden surface removal.	
UNIT-II	GEOMETRICAL MODELLING AND DRAFTING SYSTEMS
Requirements, geometric models, geometric construction models, curve representation methods, surface representation methods, solid modeling, modeling facilities desired, Basic geometric commands, layers, display control commands, editing, dimensioning.	
UNIT-III	COMPUTER AIDED MANUFACTURING
Numerical control: NC, NC modes, NC elements, NC machine tools, structure of CNC machine tools, features of machining center, turning center; CNC part programming: fundamentals, manual part programming methods, computer aided part programming.	
UNIT-IV	GROUP TECHNOLOGY, CAPP AND CAQC
Group technology: Part family, coding and classification, production flow analysis, advantages and limitations, computer Aided Processes Planning, Retrieval type and generative type, terminology in quality control, the computer in QC, contact inspection methods, non-contact inspection methods, optical, computer aided testing, integration of CAQC with CAD/CAM.	
UNIT-V	COMPUTER INTEGRATED MANUFACTURING SYSTEMS
Types of manufacturing systems, machine tools and related equipment, material handling systems, computer control systems, human labor in the manufacturing systems, CIMS benefits.	
Text Books:	
<ol style="list-style-type: none"> 1. William M Neumann and Robert F.Sproull, “Principles of Computer Graphics”, McGraw-Hill Book Co. Singapore, 1st Edition, 1989. 2. Ibrahim Zeid, “Mastering CAD/CAM”, McGraw-Hill, 1st Edition, 2007. 3. K. Lalit Narayan, K. Mallikarjuna Rao and M.M.M. Sarcar, Computer Aided Design Manufacturing, PHI, 1st Edition, 2008. 	
Reference Books:	
<ol style="list-style-type: none"> 1. Yoram Koren, “Computer Control of Manufacturing Systems”, McGraw-Hill, 1st Edition, 1983. 2. Groover, M. P. and Zimmers, E. W., “CAD/CAM: Computer Aided Design Manufacturing”, Pearson Education India, 1st Edition, 2006. 	

XVI. COURSE PLAN:

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	Define the concept of computer in industrial manufacturing.	CLO 1	T2:1.1 R2:1.3
2-3	Describe the concept of product cycle.	CLO 2	T2:1.2 R2:1.2
4-5	Describe the Concept of CAD/CAM hardware.	CLO 2	T2:1.4 R2:2.2
6-7	Describe Basic structure, CPU, Memory types, input devices, display devices, hard copy devices, storage devices.	CLO 3	T2:26.7 R1:21.51 R2:5.5
8-9	Explain raster scan graphics coordinate system, database structure for graphics modeling.	CLO 3	R2:5.3 T2:2.4
10-11	Describe transformation of geometry, 3D transformations.	CLO 4	T2:2.4
12-13	Define mathematics of projections, clipping, hidden surface removal.	CLO 5	T2:26.14 R1:21.55
14-15	Discuss requirements, geometric models, geometric construction models.	CLO 5	T2:26.15 R1:21.58
16-18	Define curve representation methods, surface representation methods.	CLO 6	T2:26.16 R1:21.61
19-20	Explain solid modeling, modeling facilities desired.	CLO 7	T2:25.12 R1:21.24
21-22	Discuss basic geometric commands, layers, display control commands, editing, dimensioning.	CLO 8	T2:25.16 R1:21.29
23	Explain the NC, NC modes, NC elements.	CLO 9	T2:22.2 R1:1.2
24-25	Explain NC machine tools.	CLO 9	T2:20.7.1 R1:2.1
26-27	Discuss structure of CNC machine tools.	CLO 10	R1:7.1 R2:9.4
28	Explain the features of machining center.	CLO 10	T2:27.2 R1:20.7.3
29	Explain the features turning center.	CLO 11	T2:20.4.1
30	Discuss fundamentals, manual part programming methods	CLO 11	T2:27.2 R1:21.67
31-33	Explain the concept of computer aided part programming.	CLO 12	R1:3.3. T2:20.7.1
34	Explain group technology Part family, coding and classification.	CLO 13	R2:12.1
35	Discuss production flow analysis, advantages and limitations.	CLO 13	R2:12.6
36	Explain the concept retrieval type and generative type.	CLO 14	R2:13.2
37	Discuss terminology in quality control, the computer in QC.	CLO 14	R2:19.2
38	Explain the concept of contact inspection methods.	CLO 15	R2:19.5
39	Explain the concept of non-contact inspection methods, optical, Non-optical	CLO 15	R2:19.6
40	Discuss the computer aided testing.	CLO 20	T2:27.8 R2: 19.7
41	Integration of CAQC with CAD/CAM.	CLO 20	R2:19.8

42-43	Explain types of manufacturing systems.	CLO 21	T2:27.14 R2:20.2
44	Machine tools and related equipment.	CLO 21	R2:20.3
45	Material handling systems.	CLO 17	R1:21.82
46-47	Computer control systems.	CLO 17	R2:20.5
48	Human labor in the manufacturing systems.	CLO 18	R2:20.6
49	CIMS benefits.	CLO 18	R2:20.7

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

S NO	Description	Proposed Actions	Relevance With POS	Relevance With PSOS
1	Third Degree expression in Beizer Curves and splines can be introduced	Seminars	PO 1	PSO 1
2	Production planning problems can be inculcated in manufacturing.	NPTEL	PO 2	PSO 1
3	Inclusion detailed types of productions can be inculcated in CAM	Seminars / NPTEL	PO 3	PSO 1

Prepared by:

Mr. M. Sunil Kumar, Assistant Professor
Dr. K. Raghu Ram Mohan Reddy, Professor

HOD, MECHANICAL ENGINEERING