INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

AERONAUTICAL ENGINEERING

COURSE DESCRIPTOR

Course Title	CAD/CIM				
Course Code	AAE521				
Programme	B.Tech				
Semester	VI				
Course Type	Elective				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	3	2
Chief Coordinator	Dr. D Govardhan, Professor				
Course Faculty	Dr. D Govardhan, Professor				

I. COURSE OVERVIEW:

Computer aided Design/ Computer aided Manufacturing (CAD/CAM) is a course o primary important to mechanical engineering students. The aim is to impart the overview of computer applications or design and manufacturing the 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 o structural, thermal, dynamic behaviors. This course also deals with creation of synthetic curves and surfaces. It imposes the knowledge o latest manufacturing techniques using CNC/DNC Machines centers with different CNC programming methods, Manufacturing processes, Group Technologies. It makes the student to understand the modern inspection methods and concepts of CIM.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AAE009	V	Finite Element Methods	4
UG	AAE005	IV	Aircraft Materials and Production	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
CAD/CIM	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**
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 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 basics of computer aided designing, computer aided manufacturing and computer integrated manufacturing.
II	To study about group technology, computer aided process planning, material requirement planning (MRP) Enterprise resource planning (ERP).
III	Gain knowledge about shop floor control and Flexible manufacturing systems (F.M.S).
IV	Emphasizes the integration of manufacturing enterprise using computer integrated manufacturing (CIM) technologies.

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 the working principles of machines, coding system and part programming	CLO 9	Explain the basic concepts of G. T in CAD/CAM integration.
		CLO 10	Classify the DCLASS and MCLASS and OPTIZ coding systems.
		CLO 11	Explain the approaches to computer aided process planning.
		CLO 12	Compare and contrast CAPP and CMPP systems.
CO 4	Understand concept of FMS and 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	Understand the production planning and control, cost planning and control, inventory management.
		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
AAE521.01	CLO 1	Describe basic structure of CAD workstation, Memory types, input/output devices and display devices and computer graphics.	PO 1	3
AAE521.02	CLO 2	Demonstrate the ability to create concepts design solutions through CAD tools that can be manufactured using CNC machinery.	PO 2	2
AAE521.03	CLO 3	Understand the Computers in industrial manufacturing, product cycle, CAD / CAM Hardware.	PO 1	3
AAE521.04	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
AAE521.05	CLO 5	Understand of the principles of CAD/CAM, including engineering drawing, geometric and surface modeling, and feature-based design.	PO 2	2
AAE521.06	CLO 6	Create accurate and precise geometry of complex engineering systems and use the geometric models in different engineering applications.	PO 2	2
AAE521.07	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
AAE521.08	CLO 8	Explain the basic concepts of G. T in CAD/CAM integration.	PO 2	2
AAE521.09	CLO 9	Explain the basic concepts of CNC programming and machining.	PO 3	1
AAE521.10	CLO 10	Classify the DCLASS and MCLASS and OPTIZ coding systems.	PO 3	1
AAE521.11	CLO 11	Explain the approaches to computer aided process planning.	PO 2	2
AAE521.12	CLO 12	Compare and contrast CAPP and CMPP systems.	PO 2	2
AAE521.13	CLO 13	Understand grouping of similar parts through group technology and developing automated process plans through computer aided process planning.	PO 1	3
AAE521.14	CLO 14	Illustrate group technology, computer aided quality control.	PO 1	3
AAE521.15	CLO 15	Understand different elements of robotic systems. Also understand the different components and design of FMS.	PO 1	3
AAE521.16	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
AAE521.17	CLO 17	Apply the concepts/components of computer integrated manufacturing and integrate them.	PO 1, PO 2	3
AAE521.18	CLO 18	Understand the production planning and control, cost planning and control, inventory management.	PO 1, PO 2	3
AAE521.19	CLO 19	Design automated material handling and storage systems for a typical production system	PO 1, PO 2	3
AAE521.20	CLO 20	Apply the concepts/components of computer integrated manufacturing and integrate them.	PO 1, PO 2	3
AAE521.21	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		

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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													

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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	INTRODUCTION
Computers in industrial manufacturing , product cycle, CAD/CAM hardware, basic structure, CPU, memory types, input devices, display devices, hard copy devices, and storage devices, computer graphics, raster scan graphics coordinate system, database structure for graphics modeling, transformation of geometry, three dimensional transformations, mathematics of projections, clipping, hidden surface removal.	
UNIT-II	**GEOMETRICAL MODELLING**
Requirements, geometric models, geometric construction models, curve representation methods, surface representation methods, modeling facilities desired, drafting and modeling systems, basic geometric commands, layers, display control commands, editing, dimensioning and solid modeling.	
UNIT-III	**GROUP TECHNOLGY COMPUTER AIDED PROCESS PLANNING**
History of group technology, role of G.T in CAD/CAM integration, part families, classification and coding, DCLASS and MCLASS and OPTIZ coding systems, facility design using G.T, benefits of G.T, cellular manufacturing. Process planning, role of process planning in CAD/CAM integration, approaches to computer aided process planning, variant approach and generative approaches, CAPP and CMPP systems.	
UNIT-IV	**COMPUTER AIDED PLANNING AND CONTROL, SHOP FLOOR CONTROL AND INTRODUCTION TO FMS**
Production planning and control, cost planning and control, inventory management, material requirements planning (ERP), control, phases, factory data collection system, automatic identification methods, bar code technology, automated data collection system; FMS, components of FMS, types, FMS workstation, material handling and storage system, FMS layout, computer control systems, applications and benefits.	
UNIT-V	**COMPUTER AIDED PLANNING AND CONTROL AND COMPUTER MONITORING**
Production planning and control, cost planning and control, inventory management, material requirements planning (MRP), shop floor control, lean and agile manufacturing, types of production monitoring systems, structure model of manufacturing, process control and strategies, direct digital control.	

Text Books:

1. A. Zimmers, P. Groover, —CAD/ CAM‖, Prentice- Hall India, 2008.
2. Zeid, Ibrahim, — CAD / CAM Theory and Practice, Tata McGraw-Hill, 1997.
3. Mikell. P.Groover — Automation, Production Systems and Computer Integrated Manufacturing; Pearson Education 2001.
4. Ranky, Paul G., — Computer Integrated Manufacturing, Prentice hall of India Pvt. Ltd.,2005
5. Yorem Koren, — Computer Integrated Manufacturing, McGraw Hill, 2005.

Reference Books:

1. P. Groover, Automation, — Production Systems & Computer Integrated Manufacturing, Pearson Education, 2nd Edition 1989.
2. Lalit Narayan, — Computer Aided Design and Manufacturing‖, Prentice-Hall India, 3rd Edition 2002.
3. Radhakrishnan, Subramanian, — CAD / CAM / CIM‖, New Age.4th Edition 2016.
4. Jami J Shah, Martti Mantyla, — Parametric and Feature-Based CAD/CAM: Concepts, Techniques, and Applications, John Wiley & Sons Inc, 1995.
5. Alavala, —CAD/ CAM: Concepts and Applications, PHI Publications, 4th Edition, 2016.
6. W. S. Seames, — Computer Numerical Control Concepts and Programming, 4th Edition 1999.

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	Computers in industrial manufacturing, product cycle, CAD/CAM hardware.	CLO 1	T2:1.1 R2:1.3
2-3	Basic structure, CPU, memory types, input devices, display devices	CLO 2	T2:1.2 R2:1.2
4-5	Hard copy devices, and storage devices.	CLO 2	T2:1.4 R2:2.2
6-7	Computer graphics, raster scan graphics coordinate system.	CLO 3	T2:26.7 R1:21.51
8-9	Database structure for graphics modeling, Transformation of geometry, three dimensional transformations.	CLO 3	R2:5.3 T2:2.4
10-11	Mathematics of projections, clipping, hidden surface removal.	CLO 4	T2:2.4
12-13	Requirements, geometric models, geometric construction models, curve representation methods	CLO 5	T2:26.14 R1:21.55
14-15	Surface representation methods, modeling facilities desired	CLO 5	T2:26.15 R1:21.58
16-18	Drafting and modeling systems, basic geometric commands, layers	CLO 6	T2:26.16 R1:21.61
19-20	Display control commands, editing, dimensioning and solid modeling	CLO 7	T2:25.12 R1:21.24
21-22	History of group technology, role of G.T in CAD/CAM integration	CLO 8	T2:25.16 R1:21.29
23	Part families, classification and coding, DCLASS and MCLASS and OPTIZ coding systems	CLO 9	T2:22.2 R1:1.2
24-25	Facility design using G.T, benefits of G.T, cellular manufacturing.	CLO 9	T2:20.7.1 R1:2.1

26-27	Process planning, role of process planning in CAD/CAM integration, approaches to computer aided process planning	CLO 10	R1:7.1 R2:9.4
28	Variant approach and generative approaches, CAPP and CMPP systems.	CLO 10	T2:27.2 R1:20.7.3
29	Production planning and control, cost planning and control, inventory management, material requirements planning (ERP), control, phases, factory data collection system	CLO 11	T2:20.4.1
30	Automatic identification methods, bar code technology	CLO 11	T2:27.2 R1:21.67
31-33	Automated data collection system	CLO 12	R1:3.3. T2:20.7.1
34-35	FMS, components of FMS	CLO 13	R2:12.1
36-37	Types, FMS workstation	CLO 13	R2:12.6
38	Material handling and storage system,	CLO 14	R2:13.2
39	FMS layout, computer control systems, applications and benefits.	CLO 14	R2:19.2
40-41	Production planning and control, cost planning and control, inventory management, material requirements planning (MRP),	CLO 15	R2:19.5
42	Shop floor control, lean and agile manufacturing,	CLO 15	R2:19.6
43	Types of production monitoring systems	CLO 20	T2:27.8 R2: 19.7
44-45	Structure model of manufacturing, process control and strategies, direct digital control.	CLO 20	R2:19.8

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 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

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