INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

MECHANICALENGINEERING

COURSE DESCRIPTOR

Course Title	**ADVANCED COMPUTER AIDED DESIGN**				
Course Code	BCCB01				
Programme	M.Tech				
Semester	I	CAD/CAM			
Course Type	Core				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
Chief Coordinator	**Dr. K Raghu Ram Mohan Reddy, Professor, ME**				
Course Faculty	**Dr. K Raghu Ram Mohan Reddy, Professor, ME**				

I. COURSE OVERVIEW:

Computer-aided design (CAD) is the use of computers (or workstations) to aid in the creation, modification, analysis, or optimization of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing. CAD software enables engineers and architects to design, inspect and manage engineering projects within an integrated graphical user interface.CAD is an important industrial art extensively used in many applications, including automotive, shipbuilding, and aerospace industries, industrial and architectural design, prosthetics, and many more.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AME018	VII	Computer Aided Design/Computer Aided Manufacturing	4

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Advanced CAD	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	LCD / PPT	✔	Seminars	✔	Videos	✔	MOOCs
✘	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.
30 %	To test the analytical skill of the concept.
20 %	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**	**Technical Seminar and Term Paper**	
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.

Technical Seminar and Term Paper:
Two seminar presentations are conducted during I year I semester and II semester. For seminar, a student under the supervision of a concerned faculty member, shall identify a topic in each course and prepare the term paper with overview of topic. The evaluation of Technical seminar and term paper is for maximum of 5 marks. Marks are awarded by taking average of marks scored in two Seminar Evaluations.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	Apply advanced level knowledge, techniques, skills and modern tools in the field of computer aided engineering to critically assess the emerging technological issues.	3	Assignments
PO 2	Have abilities and capabilities in developing and applying computer software and hardware to mechanical design and manufacturing fields.	2	Seminar
PO 3	Conduct experimental and/or analytical study and analyzing results with modern mathematical / scientific methods and use of software tools.	2	Assignments
PO 4	Function on multidisciplinary environments by working cooperatively, creatively and responsibly as a member of a team.	2	Seminar
PO 5	Write and present a substantial technical report / document.	1	Seminar
PO 6	Independently carry out research/investigation and development work to solve practical problems	1	Assignments
PO 7	Design and validate technological solutions to defined problems and recognize the need to engage in lifelong learning through continuing education.	-	Assignments

3 = High; 2 = Medium; 1 = Low

VII. COURSE OBJECTIVES:

The course should enable the students to:	
I	Understand of basic trends in design and modeling applicable to CAD/CAM.
II	Applying the CAD tools for designing.
III	Create surface and geometric models.

VIII. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Understand the principles of computer graphics with mathematical simulation	CLO 1	Understand the basic concepts of Computer graphics
		CLO 2	Understand the basic primitives algorithms
		CLO 3	Apply the 2D and 3D transformations
CO 2	Understand the coordinate systems and transformation in graphics	CLO 4	Understand the various CAD tools
		CLO 5	Understand the various graphic standards associated to CAD
		CLO 6	Understand the representation of curves
CO 3	Understand representations of surface modelling	CLO 7	Understand the mathematical representation of analytical surfaces

		CLO 8	Understand the parametric representation of analytical surfaces
		CLO 9	Apply the analytical surfaces in CAD modeling
CO 4	Development of synthetic surface and its transformations	CLO 10	Understand the mathematical representation of synthetic surfaces
		CLO 11	Understand the parametric representation of synthetic surfaces
		CLO 12	Apply the synthetic surfaces in CAD modeling
CO 5	Analyze 3D - Geometric models to solve real time problems	CLO 13	Understand boundary representation and Constructive Solid Geometry
		CLO 14	Apply the data exchange formats for data transfer
		CLO 15	Design and analyze the engineering problems

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
BCCB01.01	CLO 1	Understand the basic concepts of Computer graphics	PO 3	2
BCCB01.02	CLO 2	Understand the basic primitives algorithms	PO 5	2
BCCB01.03	CLO 3	Apply the 2D and 3D transformations	PO 6	3
BCCB01.04	CLO 4	Understand the various CAD tools	PO 1	1
BCCB01.05	CLO 5	Understand the various graphic standards associated to CAD	PO 2	2
BCCB01.06	CLO 6	Understand the representation of curves	PO 4	2
BCCB01.07	CLO 7	Understand the mathematical representation of analytical surfaces	PO 1	1
BCCB06.08	CLO 8	Understand the parametric representation of analytical surfaces	PO 2	2
BCCB01.09	CLO 9	Apply the analytical surfaces in CAD modeling	PO 5	2
BCCB01.10	CLO 10	Understand the mathematical representation of synthetic surfaces	PO 2	2
BCCB01.11	CLO 11	Understand the parametric representation of synthetic surfaces	PO 2	2
BCCB01.12	CLO 12	Apply the synthetic surfaces in CAD modeling	PO 4	2
BCCB01.13	CLO 13	Understand boundary representation and Constructive Solid Geometry	PO 3	2
BCCB01.14	CLO 14	Apply the data exchange formats for data transfer	PO 3	2
BCCB01.15	CLO 15	Design and analyze the engineering problems	PO 7	1

3 = High; 2 = Medium; 1 = Low

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

(COs)	Program Outcomes (POs)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	-	-	2	-	2	3	-
CO 2	1	2	-	2	-	-	1
CO 3	1	2	-	-	2	-	-
CO 4	-	2	-	2	-	-	-
CO 5	-	-	2	-	-	-	1

3 = High; 2 = Medium; 1 = Low

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

Course Learning Outcomes (CLOs)	Program Outcomes (PO)						
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CLO 1			2				
CLO 2					2		
CLO 3						3	
CLO 4	1						
CLO 5		2					
CLO 6				2			
CLO 7	1						
CLO 8		2					
CLO 9					2		
CLO 10		2					
CLO 11		2					
CLO 12				2			
CLO 13			2				
CLO 14			2				
CLO 15							1

3 = High; 2 = Medium; 1 = Low

XII. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO 1, PO 2, PO 3, PO 4, PO 5, PO 6, PO 7	SEE Exams	PO 1, PO 2, PO 3, PO 4, PO 5, PO 6, PO 7	Assignments	PO 3, PO 6, PO 7	Seminars	PO 2, PO 4, PO 5
Laboratory Practices	PO 3	Student Viva	PO 3	Mini Project	-	Certification	-

XIII. ASSESSMENT METHODOLOGIES-INDIRECT

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

XIV. SYLLABUS

UNIT-I	PRINCIPLES OF COMPUTER GRAPHICS	Classes:09
Principles of computer graphics: Introduction, graphic primitives, point plotting, lines, Bresenham"s circle algorithm, ellipse, transformation in graphics, coordinate systems, view port, 2D and 3D transformation, hidden surface removal, reflection, shading and generation of character.		
UNIT-II	**CAD TOOLS**	**Classes: 09**
Definition of CAD Tools, Types of system, CAD/CAM system evaluation criteria, brief treatment of input and output devices. Graphics standard, functional areas of CAD, Modeling and viewing, software documentation, efficient use of CAD software; Geometric modeling: Types of mathematical representation of curves, wire frame models wire frame entities parametric representation of synthetic curves hermite cubic splines Bezier curves Bezier splines rational curves.		
UNIT-III	**SURFACE MODELING**	**Classes: 09**
Mathematical representation surfaces, surface model, surface entities surface representation. Parametric representation of surfaces, plane surface, rule surface, surface of revolution, tabulated cylinder.		
UNIT-IV	**PARAMETRIC REPRESENTATION OF SYNTHETIC SURFACES**	**Classes: 09**
Parametric representation of synthetic surfaces: Hermite Bicubic surface, Bezier surface, Bezier Spline surface, COONs surface, Blending surface Sculptured surface, Surface manipulation; Displaying, Segmentation, Trimming, Intersection, Transformations (both 2D and 3D).		
UNIT-V	**GEOMETRICMODELLING-3D**	**Classes: 09**
Geometricmodelling-3D: Solid modeling, solid representation, boundary representation (B-rep), Constructive solid geometry (CSG). CAD/CAM exchange: Evaluation of data, exchange format, IGES data representations and structure, STEP Architecture, implementation, ACIS and DXF; Design applications: Mechanical tolerances, mass property calculations, finite element modeling and analysis and mechanical assembly; Collaborative engineering: Collaborative design, principles, approaches, tools, design systems.		
Text Books:		
1. Ibrhim Zeid, "Mastering CAD/CAM", Tata McGraw Hill, 2nd Edition, 2013. 2. P. N. Rao, "CAD/CAM Principles and Applications", Tata McGraw Hill, 3rd Edition, 2010. 3. M. P. Groover, E. Zimmers, "CAD/ CAM Computer- Aided Design and Manufacturing", Pearson, 1st Edition, 2003. 4. R. Alavala Chennakesava, "CAD/ CAM Concepts and Applications", PHI, 1st Edition, 2013.		

Reference Books:
1. Farid Amirouche, "Principles of Computer-Aided Design and Manufacturing, Pearson, 2nd Edition, 2004. 2. P. Radha Krishnan, "CAD/ CAM/ CIM", New Age International, 4th Edition, 2016. 3. Warren. S. Seames, "Computer Numerical Control Concepts and Programming", Delmar Cengage Learning, 4th Edition, 2013

XV. 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
1-2	**Classify** principles of computer graphics	CLO 1	T1:28.7 R1:2.6
3	**Explain** graphic primitives, plotting lines	CLO 1	T1:27.5 R1:2.7
4-5	**Explain** the Bresenham's circle algorithm, ellipse	CLO 2	T1:29.6 R1:2.6
6-7	**Compare** transformations in graphics, coordinate systems, view port, 2D and 3D transformations	CLO 3	T1:29.7 R1:2.7
7	**Illustrate** hidden surface removal, reflection	CLO 1	T1:29.8 R1:4.4
8-9	**Illustrate** shading and generation of character.	CLO 3	T1:29.7 R1:2.7
10-11	**Describe** the CAD tools, types of system, CAD/CAM evaluation criteria, i/p and o/p devises	CLO 4	T1:30.7 R1:4.10
12-13	**Explain** Graphics standard, functional areas of CAD, modelling and viewing, software documentation	CLO 4	T1:29.8 R1:4.4
14-15	**Compare** geometric modeling and mathematical representation of curves, wire frame models and entities	CLO 5	T1:30.7 R1:4.10
16	**Explain** the parametric representation of synthetic curves	CLO 6	T2:33.9 R1:7.5
17-18	**Categorize** hermite cubic xplines, Bezier curves and splines rational curves	CLO 6	T2:35.10 R3:8.1
19-20	**Explain** mathematical representation of surfaces	CLO 7	T2:34.10 R2:7.5
20	**Explain** mathematical representation of surface model	CLO 7	T2:35.12 R1:9.2
21-22	**Explain** mathematical representation of surface entities and representation	CLO 8	T2:36.1 R2:9.4
23-24	**Describe** parametric representation of surfaces, plane surface	CLO 8	T2:37.1 R2:9.9
25-26	**Explain** parametric representation of surfaces, rule surface, surface of revolution	CLO 9	T2:37.1 R2:9.9
27	**Explain** parametric representation of surfaces, tabulated cylinder	CLO 9	T2:27.12 R1:11.9
28	**Explain** the Hermite bicubic surface	CLO 10	T2:27.12 R1:11.9
29	**Explain** beizer surface	CLO 10	T2:27.5 R1:10.2
30	**Explain** beizer spline surface	CLO 11	T2:27.5 R1:10.2
31-32	**Explain** COONs surface, Blending, sculptured surfaces	CLO 11	T2:27.7 R1:11.3

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
33	**Explain** Surface manipulation, displaying, segmentation	CLO 12	T2:27.8 R1:11.6
34-35	**Explain** trimming, intersection	CLO 12	T2:27.12 R1:11.7
36-37	**Illustrate** transformations – both 2D and 3D, solid modeling and representation and boundary representation	CLO 13	T2:27.12 R1:11.8
38	**Illustrate** CSG, evaluation of data, exchange format	CLO 13,14	T2:27.12 R1:11.8
39-40	**Compare** IGES data representations and structure, STEP architecture, implementation ACIS, DXF	CLO 14	T2:27.12 R1:11.10
41-42	**Explain** Design applications, mechanical tolerances, mass property calculations	CLO 15	T2:27.12 R1:11.10
43	**Distinguish** FEM analysis and mechanical assembly	CLO 15	T3:27.14 R1:12.3
44	**Explain** collaborative design, principles and approaches	CLO 15	T2:27.12 R1:11.10
45	**Explain** the collaborative tools and design systems	CLO 15	T2:27.14 R1:12.3

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

S NO	Description	Proposed Actions	Relevance with POs
1	Analysis of industry problems	Seminars / Guest Lectures / NPTEL	PO 7
2	Design of advanced components using surface modelling	Seminars / Guest Lectures / NPTEL	PO 3, PO 7

Prepared by:
Dr. K Raghu Ram Mohan Reddy, Professor

HOD, ME