INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

MECHANICALENGINEERING

COURSE DESCRIPTOR

Course Title	**DESIGN FOR MANUFACTURING AND ASSEMBLY**				
Course Code	BCCB04				
Programme	M.Tech				
Semester	I	CAD / CAM			
Course Type	Foundation				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
Chief Coordinator	Dr. K. China Apparao, Associate Professor, ME				
Course Faculty	Dr. K. China Apparao, Associate Professor, ME				

I. COURSE OVER VIEW:

To provide an overview of Design for Manufacturing and Assembly (DFMA) techniques, which are used to minimize product cost through design and process improvements. Design for Manufacturing (DFM) and Design for Assembly (DFA) are now commonly referred to as a single methodology, Design for Manufacturing and Assembly (DFMA). This course bridges gap between design and manufacturing, it introduces the principles of design for developing the product, which includes design considerations in casting, forging, metal forming and in welding.

II. COURSEPRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AME006	IV	PRODUCTION ENGINEERING	3

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
DESIGN FOR MANUFACTURING AND ASSEMBLY	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	LCD / PPT	✔	Seminars	✔	Videos	✔	MOOCs
✗	Open Ended Experiments						

V. EVALUATIONMETHODOLOGY:

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 3hours 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 aquestion.

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
50 %	To test the application skill of the concept.

Continuous Internal Assessment (CIA):

For each theory course the CIA shall be conducted by the faculty/teacher handling the course as given in Table 4. CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Technical Seminar and Term Paper.

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 9th and 17th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration, consisting of 5 one-mark compulsory questions in part-A and 4 questions in part-B. The student has to answer any 4 questions out of five questions, each carrying 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 AREASSESSED:

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	Mini project
PO 3	Conduct experimental and/or analytical study and analyzing results with modern mathematical / scientific methods and use of software tools.	2	Industrial / Seminars
PO 4	Function on multidisciplinary environments by working cooperatively, creatively and responsibly as a member of a team.	1	Assignments

3 = High; 2 = Medium; 1 = Low

VII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Understanding the basics of Computer Graphics needed for CAD/ CAM applications.
II	Applying the geometrical modeling for computer graphics.
III	Applying data structures in computer graphics.

VIII. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Identifying primary and secondary components through functional analysis	CLO 1	Identify and understand of basic concepts of DFM and DFA
		CLO 2	Understand and Apply concepts of Generative DFMA
		CLO 3	Understand the Various types of materials, its classification, suitable materials for product design
CO 2	Calculate the design efficiency for their product design	CLO 4	Understand the selection of manufacturing sequences and optimal selection
		CLO 5	Identify the reasons for optimal selection of machining parameters.
		CLO 6	Identify the various casting design, machining design, designing of formed components
CO 3	Identifyy various design recommendation of design process	CLO 7	Identity various design recommendation for permanent joining such as welding, soldering and brazing
		CLO 8	understand the different design factors for forging, closed dies forging design
		CLO 9	Apply the different Design guidelines for extruded sections
		CLO 10	Understand various design principles for punching, blanking, bending, deep drawing.
CO 4	Analyze and derive the gripping, insertion and fixing	CLO 11	Understand the different conventional approach and Assembly optimization processes

	values through fitting analysis of the product	CLO 12	Create the knowledge on cost consciousness & an awareness of Designers' accountability in product design lifecycle .
		CLO 13	Understand the cost factors that play a part in DFA
CO 5	Apply the Design guidelines and assembly techniques to mechanical designs.	CLO 14	Understand the general design guidelines for manual assembly and development of the systematic DFA methodology
		CLO 15	Using CAD, apply design for manufacturing and assembly techniques to mechanical designs.
		CLO 16	Understand the effect of symmetry effect of chamfer design on insertion operations, estimation of insertion time.

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
BCCB04.01	CLO 1	Identify and understand of basic concepts of DFM and DFA	PO 1	1
BCCB04.02	CLO 2	Understand and Apply concepts of Generative DFMA	PO 1	3
BCCB04.03	CLO 3	Understand the Various types of materials, its classification, suitable materials for product design	PO 2	2
BCCB04.04	CLO 4	Understand the selection of manufacturing sequences and optimal selection	PO 2	2
BCCB04.05	CLO 5	Identify the reasons for optimal selection of machining parameters.	PO 2	3
BCCB04.06	CLO 6	Identify the various casting design, machining design, designing of formed components	PO 4	2
BCCB04.07	CLO 7	Identity various design recommendation for permanent joining such as welding, soldering and brazing	PO 3	2
BCCB04.08	CLO 8	understand the different design factors for forging, closed dies forging design	PO 4	3
BCCB04.09	CLO 9	Apply the different Design guidelines for extruded sections	PO 3	1
BCCB04.10	CLO 10	Understand various design principles for punching, blanking, bending, deep drawing.	PO 4	3
BCCB04.11	CLO 11	Understand the different conventional approach and Assembly optimization processes	PO 3	2
BCCB04.12	CLO 12	Create the knowledge on cost consciousness & an awareness of Designers' accountability in the product design lifecycle.	PO 2	3
BCCB04.13	CLO 13	Understand the cost factors that play a part in DFA	PO 3	3
BCCB04.14	CLO 14	Understand the general design guidelines for manual assembly and development of the systematic DFA methodology	PO 1,PO3	3
BCCB04.15	CLO 15	Using CAD, apply design for manufacturing and assembly techniques to mechanical designs.	PO 2	1
BCCB04.16	CLO 16	Understand the effect of symmetry effect of chamfer design on insertion operations, estimation of insertion time.	PO 2	2

3 = High; 2 = Medium; 1 = Low

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

Course Outcomes (COs)	Program Outcomes (POs)						
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	2		2				
CO 2	2	2		1			
CO 3		2	2				
CO 4		2		1			
CO 5	2		2	1			

3 = High; 2 = Medium; 1 = Low

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

Course Outcomes (COs)	Program Outcomes (POs)						
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CLO 1	2		2				
CLO 2	2						
CLO 3			2				
CLO 4		2					
CLO 5	2						
CLO 6				1			
CLO 7		2					
CLO 8							
CLO 9			2				
CLO 10		2					
CLO 11							
CLO 12				1			
CLO 13							
CLO 14	2	2					
CLO 15	2			1			
CLO 16			2				

3 = High; 2 = Medium; 1 = Low

XII. ASSESSMENTMETHODOLOGIES–DIRECT

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

XIII. ASSESSMENTMETHODOLOGIES-INDIRECT

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

XIV. SYLLABUS

UNIT-I	INTRODUCTION TO DESIGN	Classes:09
Introduction: Design philosophy steps in design process, general design rules for manufacturability, basic principles of design Ling for economical production, creativity in design; Materials selection of materials for design developments in material technology, criteria for material selection, material selection interrelationship with process selection process selection charts.		
UNIT-II	**MACHINING PROCESS**	**Classes:09**
Machining process: Overview of various machining processes, general design rules for machining, dimensional tolerance and surface roughness, design for machining, ease of redesigning of components for machining ease with suitable examples. General design recommendations for machined parts; Metal casting: Appraisal of various casting processes, selection of casting processes, general design considerations for casting, casting tolerances, use of solidification simulation in casting design, product design rules for sand casting.		
UNIT- III	**METAL JOINING**	**Classes:09**
Metal joining: Appraisal of various welding processes, factors in design of weldments, general design guidelines, pre and post treatment of welds, effects of thermal stresses in weld joints, design of brazed joints; Forging, design factors for forging, closed dies forging design, parting lines of die drop forging die design general design recommendations. Extrusion and sheet metal work: Design guidelines for extruded sections, design principles for punching, blanking, bending, deep drawing, Keeler Goodman forming line diagram, component design for blanking.		
UNIT- IV	**ASSEMBLY ADVANTAGES**	**Classes:09**
Assembly advantages: Development of the assemble process, choice of assemble method assemble advantages social effects of automation, automatic assembly transfer systems: Continuous transfer, intermittent transfer, indexing mechanisms, and operator, paced free, transfer machine.		
UNIT-V	**DESIGN OF MANUAL ASSEMBLY**	**Classes:09**
Design of manual assembly: Design for assembly fits in the design process, general design guidelines for manual assembly, development of the systematic DFA methodology, assembly efficiency, classification system for manual handling, classification system for manual insertion and fastening, effect of part symmetry on handling time, effect of part thickness and size on handling time, effect of weight on handling time, parts requiring two hands for manipulation, effects of combinations of factors, effect of symmetry effect of chamfer design on insertion operations, estimation of insertion time.		
Text Books:		
1. GeoffreyBoothroyd, "Assembly Automation and Product Design", CRC Press, 2nd Edition, 2013. 2. George E. Deiter, "Engineering Design - Material & Processing Approach", Tata McGraw Hill, 2nd Edition, 2000. 3. Geoffrey Boothroyd, "Hand Book of Product Design", Marcel and Dekken, 1st Edition, 1990 .		

Reference Books:
1. A Delbainbre, “Computer Aided Assembly”, 1992. 2. Geoffrey Boothroyd, Peter Dewhurst, Winston. A. Knight, “Product Design for Manufacturing and Assembly”, CRC Press, 3rd Edition, 2013.

XV. COURSEPLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes	Reference
1-4	Introduction: Design philosophy steps in design process, general design rules for manufacturability	CLO 1	T1:1.7 R1:3.7
5-7	Basic principles of design Ling for economical production, creativity in design	CLO 2	T1:1.8 R1:3.12
8-10	Materials selection of materials for design developments in material technology,	CLO 3	T1:3.1 R1:3.13
11-14	Criteria for material selection, material selection interrelationship with process selection process selection charts.	CLO 3	T1:2.1 R1:4.2
15-16	Machining process: Overview of various machining processes, general	CLO 4	T1:3.3 R1:3.14
17-20	Design rules for machining, dimensional tolerance and surface roughness	CLO 4	T1:4.1 R1:4.4
21-23	Metal casting: Appraisal of various casting processes, selection of casting process,	CLO 5	T1:5.1 R1:5.2
24-26	General design considerations for casting, casting tolerances, use of solidification simulation in casting design.	CLO 6	T1:6.1 R1:7.2
27-28	Metal joining: Appraisal of various welding processes, factors in design of weldments, general design guideline.	CLO 7	T1:6.6 R:7.4
29-30	Pre and post treatment of welds, effects of thermal stresses in weld joints, design of brazed joints.	CLO 7	T1:6.11 R1:8.5
31-32	Forging, design factors for forging, closed dies forging design,	CLO 8	T1:7.1 R1:6.5
33-34	Parting lines of die drop forging die design general design recommendations	CLO 8	T1:8.1 R3:3.2
35	Extrusion and sheet metal work: Design guidelines for extruded sections, ,	CLO 9	T1:9.1 R3:3.4
36-37	Design principles for punching, blanking	CLO 9	T1:9.5 R3:4.4
38	Bending, deep drawing, Keeler Goodman forming line diagram,	CLO 10	T1:10.1 R3:5.3
39	Component design for blanking.	CLO 10	T1:10.4 R3:7.2
40-41	Assembly advantages: Development of the assemble process	CLO 11	T1:10.8 R3:7.6
42	Choice of assemble method assemble , advantages social effects of automation	CLO 12	T1:10.9 R3:7.7
43-44	Indexing mechanisms, and operator, paced free, transfer machine.	CLO 13	T1:10.10 R3:7.8
45-47	Design of manual assembly: Design for assembly fits in the design process	CLO 13	T1:15.1 R3:7.9

48-49	General design guidelines for manual assembly, development of the systematic DFA methodology	CLO 14	T1:13.5 R3:9.2
50-52	Assembly efficiency, classification system for manual handling,	CLO 14	T1:13.7 R3:9.4
53-55	Classification system for manual insertion and fastening, effect of part symmetry on handling time,	CLO 15	T1:13.8
56-57	Effect of part thickness and size on handling time, effect of weight on handling time	CLO 14	T1:13.6 R3:10.3
58-59	Parts requiring two hands for manipulation, effects of combinations of factors,	CLO 15	T1:13.9 R3:12.3
59-60	Effect of symmetry effect of chamfer design on insertion operations, estimation of insertion time.	CLO 16	T1:14.8 R3:12.6

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

S No	Description	Proposed actions	Relevance with POs
1	Assembly efficiency, classification system for manual handling	Industrial visits	PO1, PO2, PO4
2	Design of manual assembly	Seminar/ industrial visit	PO4
3	CAD application in design for manufacturing and assembly	Seminar/NPTEL	PO3

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