GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: PG

Branch: Machine Design

Course / Subject Code : ME01000491

Course / Subject Name : Design for manufacturing & assembly

w. e. f. Academic Year:	2024-25
Semester:	1st Semester
Category of the Course:	PEC

Prerequisite:	Nil
Rationale:	To introduce the basic concepts and design guidelines of different manufacturing processes. It is also equally important to understand concepts of design for assembly to reduce number of parts and to optimize design without compromising function. Also, current global trends and requirements of environmental design required to be addressed.

Course Outcome:

After Completion of the Course, Student will be able to:

No	Course Outcomes	RBT level
1	Understand the quality aspects of design for manufacture and assembly.	N
2	Apply various techniques of DFM for product design and assembly.	N
3	Apply the concept of designs for casting, welding, forming and assembly.	A
4	Identify the design factors and processes along customer desires for manufacturing.	A

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage

1.	**Introduction to tolerances:** Tolerances: Limits and Fits, tolerance Chains and identification of functionally important dimensions. Dimensional chain analysis-equivalent tolerances method, equivalent standard tolerance grade method, equivalent influence method. Geometric tolerances: applications, geometric tolerancing for manufacture as per Indian Standards and ASME Y 14.5 standard; surface finish, Tolerance stackup calculations; Review of relationship between attainable tolerance grades and different machining.	08	18
2.	**Form design of castings, weldments, forging and sheet metal components:** Materials choice, Influences of materials, Space factor, Size, Weight-Surface properties and production method on form design. Redesign of castings based on parting line considerations, Minimizing core requirements, redesigning cast members using Weldments-Form design aspects in Forging and sheet metal components.	09	21
3.	**Design for Assembly - Machining Considerations:** Design features to facilitate machining, Drills, Milling cutters, Keyways, Doweling procedures, Counter sunk screws, Reduction of machined area, Simplification by separation, Simplification by amalgamation, Design for machinability, Design for economy, Design for clampability, Design for accessibility, Design for assembly. Redesign For Manufacture, Design features to facilitate machining: datum features, functional and manufacturing. Component design, machining considerations, redesign for manufacture.	10	21
4.	**DFMA Tools:** Rules and methodologies used to design components for manual, automatic and flexible assembly, traditional design and manufacture Vs concurrent engineering, DFA index, poke -yoke, lean principles, six sigma concepts, DFMA as the tool for concurrent engineering, three DFMA criteria for retaining components for redesign of a product; design for manual assembly; design for automatic assembly- Computer-aided design for assembly using software.	09	21
5.	**Design for the Environment:** Introduction, Environmental objectives, Global issues, Regional and local issues, Basic DFE methods, Design guidelines, Weighted sum assessment method, Lifecycle assessment method, Techniques to reduce environmental impact, Design to minimize material usage, Design for	09	19

	disassembly, Design for Recyclability, Design for remanufacture, Design for energy efficiency, Design to regulations and standards.		
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	**20**	**20**	**30**	**20**	**-**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Product Design for Manufacture and Assembly, G. Boothroyd, P. Dewhurst, W. A. Knight, CRC Press.
2. Assembly Automation and Product Design, G. Boothroyd, CRC Press.
3. Product Design and Development,K. T. Ulrich and S. D. Eppinger, McGraw-Hill Higher Education
4. Handbook of Product Design for Manufacturing, Bralla, James G., McGraw Hill.
5. Engineering Design - A Material Processing Approach, G E Dieter, McGraw Hill
6. Mechanical Tolerance stackup and analysis, B. R. Fischer, CRC Press.
7. Mechanical assemblies: their design, manufacture, and role in product development, D E WhitneyOxford Press

(b) Open-source software and website:

1. https://nptel.ac.in/

Suggested Course Practical List:

Following is the list of representative exercises. More exercises should exercises should be developed.

1. For a given products/component, identify differences and dissimilarities between Design for Manufacturing and Design for Assembly.

2. Perform an exercise to identify features (self-locating, self-fastening, minimize orientation during assembly, retrieval, handling and insertion, symmetry) for assembly of a component.
3. Redesign: Perform exercise for a product to minimize number of parts without compromising its function.
4. Tolerance stack up analysis: Worst Case tolerance analysis, Statistical tolerance analysis
5. Geometric Dimensioning and Tolerancing in Tolerance Analysis.
6. Design evaluation of the components on the basis of casting, welding and machining requirements.
7. Design and manufacture of a plug gauge.

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