GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL (CAD/CAM) (08)/ MECHANICAL (MACHINE DESIGN) (09)

DESIGN FOR MANUFACTURING AND ASSEMBLY
SUBJECT CODE: 2720816
SEMESTER: II

Type of course: Post Graduate

Prerequisite: Zeal to learn the Subject

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.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks		Practical Marks				
L	T	P	C	ESE (E)	PA (M)	ESE (V)		PA (I)		
						ESE	OEP	PA	RP	
3	0	2#	4	70	30	20	10	10	10	150

Content:

Sr. No.	Content	Total Hrs	% 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.	**8**	**20%**
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.	**10**	**25%**
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**	**25%**

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.	**9**	**20%**
5	**Design for the Environment:** Introduction, Environmental objectives, Global issues, Regional and local issues, Basic DFE methods, Design guide lines, Weighted sum assessment method, Lifecycle assessment method, Techniques to reduce environmental impact, Design to minimize material usage, Design for disassembly, Design for Recyclability, Design for remanufacture, Design for energy efficiency, Design to regulations and standards.	**8**	**10%**

Reference 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 Whitney Oxford Press.

Course Outcome:

After learning the course the students should be able to:

1. Understand the quality aspects of design for manufacture and assembly.
2. Apply various techniques of DFM for product design and assembly.
3. Apply the concept of designs for casting, welding, forming and assembly.
4. Identify the design factors and processes along customer desires for manufacturing.

List of Experiments:

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.

Design based Problems (DP)/Open Ended Problem:

1. Redesign a given part to make it modular.
2. Introduce CAE techniques for product design using DFMA.

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website