

**Subject Code: 01CA0105**
**Subject Name: Design for Manufacturing and Assembly**
**M.Tech. (I Year) Semester-I: CAD/CAM**
**Type of course:** Program Elective

**Rationale:** The course is intended to strengthen fundamentals of applied mechanics of solids and build understanding of design and analysis of machine components under dynamic loading. The course introduces design and analysis of machine components at elevated temperature. The course also includes fundamentals and application of fracture mechanics and surface failures in machine component design.

**Teaching and Examination Scheme:**

Teaching Scheme			Credits	Examination Marks					Total Marks
L	T	P		Theory Marks			Practical Marks		
			ESE	IA	CSE	VIVA	TW		
4	--	2	5	50	30	20	25	25	150

Sr. No	Topics	Teaching Hours	Module weight age
1	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 tolerance 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	7	18%

2	<p><b>Form design of castings, weld ments, forging and sheet metal components:</b></p> <p>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.</p>	9	21%
3	<p><b>Design for Assembly - Machining Considerations:</b></p> <p>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 capability, 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.</p>	9	21%
4	<p><b>DFMA Tools:</b></p> <p>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.</p>	9	21%

<b>5</b>	<p><b>Design for the Environment:</b></p> <p>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</p>	8	19%
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R Level	U Level	A Level	N Level	E Level
15	30	25	15	15

### 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 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.