

B.Tech III Year I Semester

**JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA
19AME55c – DESIGN FOR MANUFACTURING AND ASSEMBLY**

(Open Elective – I)

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Course Objectives: The objectives of the course are to make the students learn about

- Discuss various factors influencing the manufacturability of components and use of tolerances in manufacturing
- Explain various considerations in casting, welding, forging and machining processes.
- Demonstrate on the design factors dependent on the assembly methods.
- Teach the principles and rules of design for assembly.

UNIT I: INTRODUCTION TO DFM

12 Hours

Significance of design, qualities of a designer and Design factors, Systematic working plan, The engineering problem to be solved, The basic design, Factors influencing choice of materials and the factors influencing manufacturing Process Capability Mean, Median, Variance, Mode, Standard Deviation, Normal Distribution and Process capability metrics, Process Capability, Tolerances-symbols and definition, Tolerances relevant to manufacturing, assembly and material condition, Tolerance stack-effects on assembly with examples, Methods of eliminating tolerance stack with examples.

Learning Outcomes:

At the end of this unit, the student will be able to

- Explain the desirable qualities of a designer. L2
- List various factors influencing the choice of materials. L1
- Recall the concepts of Mean, Median, Variance and Mode. L1
- Discuss the methods of eliminating tolerance stack with examples. L2

UNIT II: FORM DESIGN-CASTING AND WELDING

10 Hours

Influence of loading, Materials, Production methods on form design, Casting considerations, Grey iron castings, Steel castings, Aluminum Casting Requirements and rules for casting, Form design of pressure die castings, Welding considerations welding Processes, Requirements and rules for welding, Redesign of components for casting-pattern-mould- Parting Line, Redesign of components for welding, Case studies in form design-simple problems in form design.

Learning Outcomes:

At the end of this unit, the student will be able to

- Recall the function of various components (pattern, mould, parting line, etc) in casting L1
- Explain the various production methods on form design. L2
- Understand the requirements and rules for casting and welding. L2
- Make use of case studies to understand redesign of the components. L3

UNIT III: FORM DESIGN-FORGING AND MACHINING

8 Hours

Forging considerations hammer forging drop forging, Requirements and rules for forging, Choice between casting, forging and welding, Machining considerations Drills, Milling-Keyways, Dwells and Dwelling Procedure Countersunk Head screws Requirements and rules for Machining considerations and Reduction of machined areas Redesign of components for Forging, Redesign of components for Machining, Simplification by separation and Simplification by amalgamation, Case studies.

Learning Outcomes:

At the end of this unit, the student will be able to

- Choose the manufacturing process depending upon the shape and size of the product. L3

- Classify various machining processes L2
- Discuss the rules and design considerations of forging L2
- Recall the redesign concepts of forging and machining. L1

UNIT IV: INTRODUCTION TO DFA

8 hours

DFA, Introduction, Distinction between assembly methods and processes, Factors Determining assembly methods and processes, Success and failure-Causes of failure, Product Design factors independent of methods and processes , Introduction-Number of operations in the product, Assembly Precedence, Standardization, Design factors dependent on Assembly methods , Introduction-Single Station Assembly Line Assembly, Hybrid Systems, Manual Assembly lines, Flexible Assembly lines, Design factors dependent on Assembly processes, Factors Influencing Production rate to Facility Ratio- Parts Presentation, Manual Assembly, Dedicated Assembly, Transportation, Separation and Orientation-Flexible Assembly, Gripping, Transferring, Part Insertion, Failures and Error Recovery

Learning Outcomes:

At the end of this unit, the student will be able to

- Illustrate manual assembly lines and flexible assembly lines. L2
- Explain the product design factors independent of methods and processes L2
- Discuss the importance of standardization in design for assembly. L2
- List the design factors that are dependent and independent on the Assembly processes. L1

UNIT V: DESIGN FOR ASSEMBLY METHODS

8 Hours

Approaches to design for assembly and Introduction, Approaches based on design principles and rules, Example DFA method using Design Principles, DFA Systems employing Quantitative evaluation procedures, IPA Stuttgart Method, DFA Methods employing a Knowledge based approach, Knowledge representation Computer Aided DFA methods, Part model, Feature, Processing. Assembly measures like Qualitative and Quantitative measures, Boothroyd and Dewhurst DFA method. Redesign of a simple product , Small consumer product and Fastener solution redesign using symmetry, Case Studies Designing of a disposal valve, Design of a lever-arch file mechanism

Learning Outcomes:

At the end of this unit, the student will be able to

- Explain various approaches to design for assembly. L2
- Demonstrate on DFA systems employing quantitative evaluation procedures. L2
- Discuss DFA methods employing a knowledge based approach. L2
- Understand the qualitative and quantitative measures in assembly. L2

Text Books:

1. Harry Peck., "Design for Manufacture", Pittman Publications, 1983.
2. Alan Redford and chal, "Design for Assembly-Principles and Procedures", McGraw Hill International Europe, London, 1994.

Reference Books:

1. Robert Matousek, "Engineering Design A Systematic Approach", Blackie &sons Ltd., 1963
2. James G.Bralla, "Hand Book of Product design for Manufacturing", McGraw Hill Co., 1986
3. Swift, K.G., "Knowledge Based Design for Manufacture", Kogan Page Ltd., 1987

Course Outcomes:

At the end of this Course the student will be able to

- Recall the importance of Design for Manufacturing and Assembly. L1
- Explain the form design factors with the help of Case study. L2
- Evaluate how the factor of redesign affects the product life cycle. L5
- Make use of DFA methods proposed by Boothroyd and Dewhurst. L3