I YEAR M. TECH (MACHINE DESIGN) FIRST SEMESTER

17MEMD1T5C **RAPID PROTOTYPING** **Credits 4**

Lecture: 4 periods/week **Internal assessment: 40 marks**

Tutorial: - - **Semester end examination: 60 marks**

COURSE OBJECTIVES:

- To explore the automatic fabrication of 3D physical parts using additive manufacturing technology.
- To describe the principles embedded into the basis of Rapid Prototyping (RP).
- To acquaint students with the basic kinds of RP-systems.
- To show the progress in RP-technology in the context of shortening lead-time for new production.
- To consider the concept of Rapid Tooling (RT), to show its current and prospective application.
- To discuss the concept of Rapid Manufacturing in terms of its potential applicability, practicability, and expedience.

COURSE OUTCOMES:

Upon completion of the subject, students will be able to

1. To understand the Rapid Prototyping principles and apply appropriate tools and techniques in Rapid Prototyping
2. Get acquainted with the basic kinds of RP-systems understand the progress in RP-technology in the context of shortening lead-time for new production.
3. Appreciate the concept of Rapid Manufacturing in terms of its potential applicability, practicability, and expedience.
4. Identify, characterize and select the ideal materials for a given Rapid Prototyping system.

UNIT-I

INTRODUCTION:

Prototype fundamentals – Definition, types of prototype, roles of prototype; historical development, development of RP in the primary areas – input, method, materials and applications; advantages of rapid prototyping, categorization of rapid prototyping systems liquid based, solid based, powder based. **Rapid Prototyping Process Chain-** Fundamental Automated Processes - process chain, 3D modeling, data conversion and transmission, checking and preparing, building, post processing.

UNIT-II

LIQUID-BASED RAPID PROTOTYPING:

3Dsystems Stereo Lithography Apparatus (SLA) - products, process, principle - photo polymers, photo polymerization, layering technology, laser and laser scanning; strength and weaknesses of the SLA, Applications. Example: INCS Prototyping and Manufacturing Services Make Japan a Model for the World Market. Cubital's Solid Ground Curing (SGC)- ,

products, Advantages and disadvantages, Process, Principle, Applications. Rapid Freeze Prototyping, Micro Fabrication,

UNIT-III

SOLID-BASED RAPID PROTOTYPING:

Stratays's Fusion Deposition Modeling (FDM) Products: FDM MC Machines, Dimension Series, Process, Principle, Strengths and Weaknesses, Applications, Example- Toyota Uses FDM for Design and Testing. Cubic Technologies Laminated Object Manufacturing (LOM) Products, Process: Pre Processing, Building, Post-Processing, System Structure, Materials; Principle, Strengths and Weaknesses, Applications. Example: National Aeronautical and Space Administration (NASA) and Boeing Rocket dyne Use of LOM to Create Hot Gas Manifold for Space Shuttle Main Engine. 3D Systems Multi-jet Modeling System (MJM)- , products, process, principles, Advantages and disadvantages, Applications. The shape deposition Manufacturing Process, Introduction, process, Advantages and disadvantages

UNIT-IV

POWDER-BASED RAPID PROTOTYPING:

3D Systems Selective Laser Sintering (SLS) - Products, Process - The SLS Process, materials, Principle - Sinter Bonding, Strengths and Weaknesses, Applications. Example: Los-Angeles-Based TEST A Architecture/Design Utilizes SLS for Large-Scale Models of Carbon Tower Prototype OPTOMEC's Laser Engineered Net Shaping (LENS)- , products, Principle, Advantages and disadvantages, Applications and examples.

Learning Resources

Text books

1. Rapid Prototyping Principles and Applications (3rd Edition) by Chee Kai Chua, Kah Fai Leong, World Scientific Publishing Co. Pt. Ltd.
2. Rapid Manufacturing An Industrial Revolution for the Digital Age by N. Hopkinson, R.J.M. Hague and P.M. Dickens Lough borough University, UK

References:

1. Rapid Manufacturing by Pham, D.T, Dimov, S.S, , Springer, 2001.
2. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing by Ian Gibsn., David W Rosen., Brent Stucker, Springer, 2010