



# GUJARAT TECHNOLOGICAL UNIVERSITY

## Syllabus for Bachelor of Vocation (B.Voc.), 5<sup>th</sup> Semester

### Branch: Production Technology

### Subject Name: Rapid Prototyping and Reverse Engineering

### Subject Code: 21150302

**Type of course:** Core

**Prerequisite:** Zeal to learn the subject

**Rationale:** The course addresses the fundamentals of methods and techniques to support engineering design processes, by focusing on the opportunities provided by Reverse Engineering and Rapid Prototyping.

**Teaching and Examination Scheme:**

| Teaching Scheme |   |   | Credits<br>C | Examination Marks |       |           |        | Total<br>Marks |
|-----------------|---|---|--------------|-------------------|-------|-----------|--------|----------------|
| L               | T | P |              | Theory Marks      |       | Practical |        |                |
|                 |   |   |              | ESE (E)           | PA(M) | ESE (V)   | PA (I) |                |
| 3               | 0 | 0 | 3            | 50                | 0     | 0         | 0      | 50             |

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment

**Contents:**

| Sr. No. | Content  | Total Hrs. | Module % Weightage |
|---------|--|------------|--------------------|
| 01      | <b>Introduction to Rapid Prototyping</b><br>Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Classification of Rapid Manufacturing Processes: Additive, Subtractive, Formative, Generic RP process. Distinction between RP and CNC, other related technologies.  | 6          | 15                 |
| 02      | <b>CAD Modelling and Data Processing for RP</b><br>CAD Modelling and Data Processing for RP: CAD model preparation, Data interfacing: formats ( STL, SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP), conversation, validity checks, repair procedures; Part orientation and support generation, Support structure design, Model Slicing algorithms and contour data organization, direct and adaptive slicing, Tool path generation.  | 8          | 20                 |
| 03      | <b>RP Processes</b><br>Process Physics, Tooling, Process Analysis, Material and technological aspects, Applications, limitations and comparison of various rapid manufacturing processes. Photo polymerization (Stereolithography (SL)), Powder Bed Fusion (Selective laser Sintering (SLS), Electron Beam melting (EBM)), Extrusion Based RP Systems (Fused Deposition Modelling (FDM)), 3D Printing, Sheet Lamination (Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC)), Beam Deposition (Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD)). | 12         | 30                 |
| 04      | <b>RP Applications:</b><br>Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP  | 6          | 15                 |



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|              |  |           |            |
|--------------|--|-----------|------------|
| 05           | <b>Introduction to RE</b><br>Scope and tasks of RE, Process of duplicating, Definition and use of Reverse Engineering, Reverse Engineering as a Generic Process<br><b>Tools and Techniques for RE</b><br>Object scanning: contact scanners, noncontact scanners, destructive method, coordinate measuring machine, Point Data Processing: preprocessing and post processing of captured data, geometric model development, construction of surface model, solid model, noise reduction, feature identification, model verification | 10        | 20         |
| <b>Total</b> |  | <b>42</b> | <b>100</b> |

### 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      | -       | -       | -       |

R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

### Course Outcomes:

| SrNo. | CO Statement  | Marks % Weightage |
|-------|---|-------------------|
| CO 1  | To understand the basic concepts of rapid prototyping   | 15                |
| CO 2  | Understand and use techniques for processing of CAD models for rapid prototyping  | 20                |
| CO 3  | Understand and apply fundamentals of rapid prototyping techniques   | 30                |
| CO 4  | To understand various applications of rapid prototyping techniques  | 15                |
| CO 5  | To understand the basic concepts of Reverse Engineering and Familiarize with the tools and techniques for reverse engineering | 20                |

### Reference Books:

- 1) Chua C K, Leong K F, Chu S L, Rapid Prototyping: Principles and Applications in Manufacturing, World Scientific.
- 2) Gibson D W, Rosen, Brent Stucker., Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer.
- 3) Rapid Prototyping: Principles and Applications in Manufacturing by Noorani R, John Wiley & Sons.
- 4) Hilton P, Jacobs P F, Rapid Tooling: Technologies and Industrial Applications, CRC press.
- 5) Liou W L, Liou F W, Rapid Prototyping and Engineering applications: A tool box for prototype development, CRC Press.
- 6) Kamrani A K, Nasr E A, Rapid Prototyping: Theory and practice, Springer

### List of Open Source Software/learning website:

www.nptel.ac.in