

|                              |                                                                    |
|------------------------------|--------------------------------------------------------------------|
| <b>Branch Name:</b>          | Mechanical Engineering                                             |
| <b>Program Code:</b>         | ET101                                                              |
| <b>Course Name:</b>          | Computer Aided Design and Analysis                                 |
| <b>Course Code:</b>          | 2ET1010601T                                                        |
| <b>Pre-requisite Course:</b> | Engineering Graphics and Design, Machine Element and System Design |

### Course Objectives:

1. To provide an overview of how computers can be utilized in mechanical component design
2. To understand mathematical aspects of geometrical modeling
3. To use finite element methods for analysis of simple component

### Teaching and Examination Scheme:

| Credit | Teaching Scheme<br>Hours per week |   |   |       | Evaluation Scheme (Marks) |      |      |      |                   |      |      |      | Total<br>(Marks) |
|--------|-----------------------------------|---|---|-------|---------------------------|------|------|------|-------------------|------|------|------|------------------|
|        |                                   |   |   |       | Theory (Marks)            |      |      |      | Practical (Marks) |      |      |      |                  |
|        | L                                 | T | P | Total | SEE                       |      | CCA  |      | SEE               |      | CCA  |      |                  |
|        |                                   |   |   |       | Min.                      | Max. | Min. | Max. | Min.              | Max. | Min. | Max. |                  |
| 03     | 03                                | - | - | 03    | 24                        | 60   | 16   | 40   | -                 | -    | -    | -    | 100              |

### Course Contents:

| Sr. No | Topic                                                                                                                                                                                                                                                                                                                                 | Total Hours | Weightage (%) |
|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------------|
| 1      | <b>Module I:</b><br><b>Introduction:</b> Role of computers in design process; Computer aided design, analysis and manufacturing; Computer integrated manufacturing; Popular CAD software used in industry; Input and output devices.                                                                                                  | 04          | 10            |
| 2      | <b>Module II:</b><br><b>Transformations:</b> Matrix representation of points, lines and planes; 2D transformation for translation, scaling, rotation and reflection; Homogeneous representation & concatenation; 3D transformations.                                                                                                  | 06          | 15            |
| 3      | <b>Module III:</b><br><b>Curves and Surfaces:</b> Representation of curves; Hermite curves, Bezier curves, B-spline curves, Rational curves; Surface modelling – parametric representation, planar surface, surface of revolution, Coons and bicubic patches, Bezier and B-spline surfaces.                                           | 08          | 20            |
| 4      | <b>Module IV:</b><br><b>Solid Modelling:</b> Solid modelling techniques – sweep (linear and curved), Boolean (constructive solid geometry) and other techniques; Solid model representation (Boundary and Constructive Solid Geometry); Medical modelling (pixels, scans and voxels); Exchange standards (IGES, DXF, STEP, STL etc.). | 06          | 15            |

|   |                                                                                                                                                                                                                                                                                                                                                                                                                              |    |    |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|
| 5 | <b>Module V:</b><br><b>Engineering Analysis:</b> Introduction to finite element method; Principle of potential energy; FE analysis of 1D element problems (spring, bar, truss elements); Development of element stiffness equation and their assembly; Plain strain and plain stress problems; Domain discretization, pre-processing and post-processing; Verification and validation; Popular CAE software used in industry | 10 | 25 |
| 6 | <b>Module VI:</b><br><b>Introduction to CFD and HT:</b> Basic theoretical framework, Boundary conditions, Application Examples: thermal and fluid machines.                                                                                                                                                                                                                                                                  | 04 | 10 |
| 7 | <b>Module VII:</b><br><b>Design Optimization:</b> Purpose and application of optimum design, Primary and subsidiary design equations, Limit Equations, Normal, redundant and incompatible specifications problems; Computer-aided design optimization.                                                                                                                                                                       | 02 | 05 |

**Reference Books:**

1. Ibrahim Zeid, "Mastering CAD CAM," Tata McGraw Hill Publishing Co. 2007.
2. McMohan and J. Browne, "CAD/CAM Principles," Pearson Education, 2nd Edition, 1999.
3. Geometric Modeling, Michael E. Mortenson, Tata McGraw Hill, 2013.
4. W. M. Neumann and R.F. Sproul, "Principles of Computer Graphics," McGraw Hill, 1989.
5. D. Hearn and M.P. Baker, "Computer Graphics," Prentice Hall Inc., 1992.

**E-Resources:**

1. <https://nptel.ac.in/courses/112102101>
2. <https://nptel.ac.in/courses/112104031>
3. <https://ocw.mit.edu/courses/2-158j-computational-geometry-spring-2003/>

**Course Learning Outcomes (CLO):**

| <b>CLO</b>  | <b>Description</b>                                                               | <b>Bloom's Taxonomy Level</b>    |
|-------------|----------------------------------------------------------------------------------|----------------------------------|
| <b>CLO1</b> | Demonstrate basic concept of computer aided design and its applications.         | 1 Remembering<br>2 Understanding |
| <b>CLO2</b> | Understand mathematical aspects of transformation of basic geometric primitives  | 2 Understanding<br>3 Applying    |
| <b>CLO3</b> | Representation and analysis the of curves and surfaces                           | 2 Understanding<br>4 Analyze     |
| <b>CLO4</b> | Recognize the solid modelling techniques and exchange standards                  | 4 Analyze<br>5 Evaluating        |
| <b>CLO5</b> | Understand and use the finite element methods for analysis of simple components. | 4 Analyze<br>5 Evaluating        |
| <b>CLO6</b> | Understand basic framework of Computation Fluid Dynamics, HT and Optimization    | 2 Understanding                  |

**Mapping of CLOs with POs & PSOs:**

| <b>Course Learning Outcomes</b> | <b>Program Outcomes (POs)</b> |            |            |            |            |            |            |            |            |             |             |             | <b>Program Specific Outcomes(PSOs)</b> |             |
|---------------------------------|-------------------------------|------------|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|----------------------------------------|-------------|
|                                 | <b>PO1</b>                    | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> | <b>PO6</b> | <b>PO7</b> | <b>PO8</b> | <b>PO9</b> | <b>PO10</b> | <b>PO11</b> | <b>PO12</b> | <b>PSO1</b>                            | <b>PSO2</b> |
| <b>CLO1</b>                     | <b>M</b>                      | <b>M</b>   | <b>L</b>   |            |            |            |            |            |            |             |             |             | <b>M</b>                               |             |
| <b>CLO2</b>                     |                               |            | <b>M</b>   | <b>M</b>   | <b>L</b>   |            |            |            |            |             |             |             | <b>M</b>                               |             |
| <b>CLO3</b>                     |                               | <b>M</b>   | <b>M</b>   |            | <b>M</b>   |            |            |            |            |             |             |             | <b>L</b>                               |             |
| <b>CLO4</b>                     |                               |            | <b>H</b>   | <b>M</b>   | <b>M</b>   |            |            |            |            |             |             |             |                                        | <b>M</b>    |
| <b>CLO5</b>                     |                               |            | <b>H</b>   | <b>H</b>   | <b>M</b>   |            |            |            |            |             |             |             |                                        | <b>M</b>    |
| <b>CLO6</b>                     |                               |            |            |            | <b>H</b>   |            |            |            |            | <b>M</b>    | <b>M</b>    |             |                                        | <b>L</b>    |

**H: High, M: Medium, L: Low**