Prepared by the Department of Natural Science and Applied Technology
Date of Departmental Approval: December 2, 2013
Date Approved by Curriculum and Programs: February 19, 2014 Effective: Fall 2014

1. **Course Number:** ENR102 / ENR102L
   Course Title: 3D Mechanical Design I / 3D Mechanical Design I Laboratory

2. **Description:** This is an introductory course for students interested in exploring careers as engineers, architects, and designers. Principles associated with 3D design, visualization, documentation, and product simulation are taught through hands-on use of Computer Aided Design (CAD) modeling software. In addition, student designed parts are fabricated in a 3D printer to enhance the understanding of the design to manufacturing process. (3 class hours / 2 laboratory hours)

3. **Student Learning Outcomes** (instructional objectives, intellectual skills)**:**
   Upon successful completion of this course, students are able to do the following.
   - Create 3D solid models (parts and assemblies) that showcase familiarity with the SolidWorks CAD software
   - Design a complex 3D CAD part by evaluating a set product requirements
   - Construct a 3D part design by arranging a set of 3D CAD features
   - Justify correct usage of construction geometry, axes, and profiles of revolution in creating a solid
   - Develop a volume from a profile revolved around an axis
   - Apply, categorize, and justify the process steps to develop a product's design
   - Collect and assess an existing product's dimensional information using calipers
   - Choose appropriate engineering drawing standards for incorporation in part and assembly drawings
   - Create 2D standard views and isometric views by interpreting the orthographic projection of a product
   - Explain how units of measurement, adding and subtracting material to create a product's design definition, perpendicularity, and the x-y-z coordinate system are applied in designing a product
   - Differentiate fastener vocabulary (e.g., thread length, screw size, and diameter) from product dimensional characteristics. Relate diameter of screw to screw size
   - Justify fastener selection based on hole diameter and depth, strength, cost, material, appearance, and ease of installation
   - Diagram how design intent governs the relationship between sketches of a feature, features in a part, and parts in an assembly
   - Manage and evaluate manufacturing vendors by marking up engineering drawings utilizing eDrawings comments
   - Compare and contrast the different modeling techniques that are utilized for molded parts and parts machined in a lathe
   - Propose when to use a shell feature and when to use an extruded cut feature for a thin wall plastic part
   - Interpret and illustrate how material properties, forces, and restraints affect part behavior
   - Synthesize mechanical product shape analysis into a potential engineering/advanced manufacturing solution
   - Demonstrate knowledge of finite element techniques for analyzing structural integrity of a part or assembly
   - Formulate a demonstration on how additive manufacturing techniques such as 3D printing can be used to rapidly prototype a design to facilitate evaluation and incorporate design changes to improve the product design
   - Conclude when to use 3D CAD software as a tool in solving a wide variety of engineering design problems
   - Examine how material selection and manufacturing intent impact the sustainability of a design
   - Evaluate and justify the positive impact CAD solid modeling has had on the modern world
   - Differentiate between the roles and responsibilities of the most common design engineering disciplines
   - Exhibit an understanding of professional ethics and the application to real-life product design situations
   - Argue why the design engineer is a team worker who needs to design a 3-dimensional computer model, write a design report, and justify the design

4. **Credits:** 4 credits

5. **Satisfies General Education Requirement:** Interdisciplinary Studies/General Education

6. **Prerequisites:** (MAT030 or MAT035), ENL020, and ENL050 or satisfactory basic skills assessment scores

7. **Semesters Offered:** Fall, Spring

8. **Suggested General Guidelines for Evaluation:** The course grade will be based on homework assignments; class work and participation; one-hour exam(s); laboratory work and reports; and a final examination. Specific course grading procedures and make-up policies are detailed in a student handout.

9. **General Topical Outline:**

	Subject Area	Lecture Topics
1	Basic Part Modeling Techniques	SolidWorks Interface, Viewing Options, Feature Manager Design Tree, View Orientations
2	Basic Part Modeling Techniques	Introduce Design Intent, Revolved Features, Dimensions, Relations, Fully Defined Sketches
3	Engineering Drawings	Paper Size/Format, Units, Importing Dimensions, Section View, Detail View, Pictorial View,
4	Engineering Drawings (Continued)	Tolerances, Geometric Tolerances, Title Block, eDrawings
5	Additional Part Modeling Techniques	Planes Of Symmetry, Multi-Configuration Part,
6	Additional Part Modeling Techniques	Multi-Configuration Part, Mirroring
7	Creation of Assembly Models	Assemblies, Assembly Mates,
8	Creation of Assembly Models	Hidden Features, Filters
9	Advanced Part Modeling	Lofting, Sweeping, Re-Ordering Operations, Shell Tool, Swept Geometries, 3-D Sketch
10	Advanced Part Modeling	Simulation Analysis
11	Advanced Part Modeling	Sustainability Analysis
12	Advanced Assembly Operations	Subassembly, Interference Detection, Collision Detection
13	The Use of SolidWorks to Accelerate the Product Development Cycle	Role of Solid Modeling within the Product Development Cycle, Rapid Prototyping, Product Data Management