Advanced Engineering Syllabus

UW-Green Bay

Parametric Engineering (ET207)

Number of Credits: Three Credits
Level(s) to be served: 11-12

Brief description of the course (150 words or less):

This course provides students with an interactive advanced 3D design experience. Students will continue to explore the practical applications of the concepts they learn through quad copter designs and engineering challenges provide by local business as well as many other opportunities. Along the way they will also have the opportunity to prove their ability to design and analyze parametric parts and moveable assemblies using a variety of complex features on the Certified SolidWorks Professional Examination.

- General Requirements: This course is recommended for students in Grades 11-12.
- Introduction: This course provides students with an interactive advanced 3D design experience. Students will continue to explore the practical applications of the concepts they learn through quad copter designs and engineering challenges provide by local business as well as many other opportunities. Along the way they will also have the opportunity to prove their ability to design and analyze parametric parts and moveable assemblies using a variety of complex features on the Certified SolidWorks Professional Examination.
- Knowledge and skills.
    - (1) The student demonstrates understanding of sketch entities. The student is expected to:
        - Create lines, rectangles, circles, arcs, ellipses, planes, text, and centerlines
    - (2) The student demonstrates understanding of sketch tools. The student is expected to:
        - Create offsets, conversions, and trim pieces
        - Construct parts that utilize these new sketch tools
    - (3) The student demonstrates understanding of sketch relations. The student is expected to:
        - Fully define each sketch
        - Define the different types of sketch relations
        - Understand when to use sketch relations in place of equations, or linked dimensions
    - (4) The student demonstrates understanding of boss and cut features. The student is expected to:

        - Create Boss/Base extrudes, revolves, sweeps, and lofts
        - Create Cut extrude, revolves, sweeps, lofts, and boundaries
        - Create Quad Copter design
    - (5) The student demonstrates understanding of fillets and chamfers. The student is expected to:
        - Define the fillet and chamfer features
        - Construct parts using the fillet and chamfer features
            - Face/s, edge, edge loop, vertex fillets and chamfers
    - (6) The student demonstrates understanding of drafting. The student is expected to:
        - Define the drafting feature
            - Neutral plane, parting line, step draft
        - Construct parts using the drafting feature
            - Moldable parts
    - (7) The student demonstrates understanding of shelling. The student is expected to:
        - Define the shell feature
            - Uniform thickness and multi-thickness faces
        - Construct parts using the shell feature
    - (8) The student demonstrates understanding of the hole wizard. The student is expected to:
        - Define the hole wizard feature
        - Construct parts using the hold wizard feature
    - (9) The student demonstrates understanding of linear, circular, and fill patterns. The student is expected to:
        - Define linear, circular, and fill pattern features
        - Construct parts using the linear, circular, and fill pattern features
    - (10) The student demonstrates understanding of linked dimensions. The student is expected to:
        - Define linked dimensions
        - Construct parts using linked dimensions
            - Link values vs. Global variables
        - Understand when to use linked dimensions in place of equations, or relations
    - (11) The student demonstrates understanding of equations. The student is expected to:
        - Define how an equation is used in CAD
        - Construct parts using equations
        - Understand when to use equations in place of linked dimensions, or relations
    - (12) The student demonstrates understanding of mirroring. The student is expected to:
        - Define the mirror feature

        - Construct parts using the mirror feature
            - Mirror about centerlines, lines, linear model edges, and linear edges on drawings
- (13) The student demonstrates understanding of dimensions. The student is expected to:
    - Fully define each sketch
    - Explain over/under defined sketches
- (14) The student demonstrates understanding of feature conditions. The student is expected to:
    - Define feature conditions
    - Determine both start and ends of features
- (15) The student demonstrates understanding of multi-body parts. The student is expected to:
    - Define multi-body parts
    - Construct parts using multi-body parts
        - Wheel - Rim and Axle, create spokes using multi-body part
- (16) The student demonstrates understanding of a rib. The student is expected to:
    - Define a rib
    - Construct parts using the rib feature
        - From single or multiple sketches, draft a reference contour to draft
- (17) The student demonstrates understanding of feature scope. The student is expected to:
    - Define feature scope
    - Construct a parts using feature scope
        - All vs. Selected components, propagate feature to parts, auto-select, components to affect
- (18) The student demonstrates understanding of mass properties. The student is expected to:
    - Define mass properties
    - Construct CSWP practice parts from a blueprint to meet the correct mass properties
    - Determine correct mass properties on CSWP exam questions
- (19) The student demonstrates understanding of moving/deleting faces. The student is expected to:
    - Define moving/deleting faces
    - Construct parts where moving/deleting faces is used
        - Move - offset, translate, rotate
- (20) The student demonstrates understanding of materials. The student is expected to:
    - Define materials used in parts/assemblies

        - Demonstrate knowledge of proper material selection during part creation
        - Apply proper material selection during simulations
    - (21) The student demonstrates understanding of restraints. The student is expected to:
        - Define restraints
        - Construct parts using restraints in order to run a proper simulation
    - (22) The student demonstrates understanding of inserting components, both new and existing. The student is expected to:
        - Construct assemblies by inserting new and existing components
        - Properly align these components along the proper X, Y, and Z(origin) coordinates
    - (23) The student demonstrates understanding of standard mates and advanced mates. The student is expected to:
        - Define the different types of standard mates
            - Angle, coincident, concentric, distance, lock, parallel, perpendicular, and tangent
        - Define the different types of advanced mates
            - Limit, linear/linear coupler, path, symmetry, and width mates
        - Construct parts that use these different type of standard and advanced mates
    - (24) The student demonstrates understanding of reference geometry. The student is expected to:
        - Create planes, axes, coordinate systems, points, and mate references
        - Determine when a new plane, axis, coordinate system, point, or mate reference is needed during part/assembly construction
    - (25) The student demonstrates understanding of in-context features. The student is expected to:
        - Define in-context features
        - Construct parts using in-context features
    - (26) The student demonstrates understanding of interference detection. The student is expected to:
        - Define interference detection
        - Construct parts and simulations that show the use of interference detection
    - (27) The student demonstrates understanding of suppression states. The student is expected to:
        - Define suppression states
            - Resolved, suppressed, and lightweight
        - Explain which suppression state should be used during the construction of a part or an assembly

- (28) The student demonstrates understanding of moving/rotating components. The student is expected to:
  - Define the rotation and movement tools
    - Move, rotate, smart-mates, collision and dynamic clearances
  - Demonstrate movement and rotation of parts/assemblies in relation to the origin
- (29) The student demonstrates understanding of assembly features. The student is expected to:
  - Define the different types of assembly features
    - Welding, grinding, holes, patterns, etc…
  - Construct parts utilizing the different types of assembly features
- (30) The student demonstrates understanding of collision detection in an assembly. The student is expected to:
  - Define collision detection
  - Construct parts and simulations that show the use of collision detection
- (31) The student demonstrates understanding of external references. The student is expected to:
  - Define external references
  - Construct a part/assembly where external references are used
- (32) The student demonstrates understanding of design tables. The student is expected to:
  - Develop a Design Table with Microsoft Excel to create families of parts
  - Explore how values in an EXCEL spreadsheet automatically change dimensions and features of an existing part to create multiple parts of different size and shapes
  - Engineering: Explore family of parts with a Design Table. Understand how design intent can be built into a part to all for changes
  - Technology: Link an Excel spreadsheet with a part or an assembly and how they relate a manufactured component
  - Math: Work with numerical values to change overall size and shape of a part and assembly
  - Math: Develop width, height and depth values to determine size of Quad Copter modifications
- (33) The student demonstrates understanding of dimensions and model item. The student is expected to:
  - Fully dimension parts, assemblies, and drawings
- (34) The student uses knowledge gained in previous lessons to engage in a national design certification. The student is expected to:
  - Understand the SolidWorks certification process

        - Summarize a CSWP basic, intermediate, and expert part sample
        - Summarize a CSWP assembly model
        - Construct a CSWP drawing
    - (35) The student is able to apply techniques learned to a large scale industry based design challenge. The student is expected to
        - Create a timeline complete with formatting tasks, dates and persons assigned to tasks
        - Accurately represent who the prototype is used and or developed with complete drawings, pictures and or photos
        - Design a prototype that is complete, matches the proposed design and needs little improvement
        - Create a 3D software model of prototype
        - Select appropriate materials for the application and properly applied manufacturing
        - Describe Human/prototype interaction
        - Report the results of a complete finite element analysis (FEA) or simulation
        - Construct a prototype that is aesthetically pleasing, has no visible flaws with logos or colors that are appropriate
        - Clearly state the problem to be solved
        - Review how Business and Industry were involved with the development of the prototype
        - Describe the sources for supplies and the utilization of appropriate materials for their application
        - Defend the data and information that is presented in the solution
        - Presents easy-to-follow information that is logical and adequately detailed
        - Convey a clear and concise message about the process taken to design the prototype, and its features
        - Describe calculations, complete with detail, relevant formulas and labels
        - Design drawings complete with detail and relevant materials and labels & associated back with a 3D model
        - Perform a complete formatted cost analysis with pricing, sources and total costs per item
        - Accurately represent the team and prototype and the process that was completed to generate prototype
        - Conduct a presentation was with no bias and in a professional manner

Description of the specific student needs this course is designed to meet:

Advanced Engineering provides students who have an interest in Science, Technology, Engineering and/or Math the opportunity enhance their prior knowledge and become nationally certified. This national certification is integrated into the course offering to afford students the opportunity to bolster their credentials, leading them to significant opportunities in post secondary educational settings, or the professional world. Students who grow their 3D Modeling skills develop mechanical CAD, design validation, and data management skills that are in high demand among employers. In the job market, engineers who excel at 3D Solid Modeling have a clear advantage.

Major resources and instructional materials to be used in the course:

Curriculum resources and materials will include multiple sources in various formats to ensure student learning. Online course content, Industry standard software programs, field tested classroom hardware and hands on projects and experiments as well as teacher generated resources, and other resources as appropriate will be utilized to deliver this advanced course.

Required activities and sample optional activities to be used:

Research, demonstrations, observations, applications, case studies and experiments will be required of all students. Students will be expected to demonstrate proficiencies as outlined by the course learning objectives as well as engage in individual and team oriented lessons.

Methods for evaluation student outcomes:

Students will be evaluated on how well they master the learning outcomes, essential knowledge and skills. Students will collect all learning outcomes and national standards achieved through learning activities, case studies, experiments, and the CSWP exam. Students will be tested in both oral and written formats concerning their knowledge of the various learning outcomes and technical content. Visual observation will be the basis for evaluation for how the students follow protocol, perform work safely, stay on task, and how they work as a team on group activities with their fellow students.