ENGR120 : 3D Printing and Modeling

General Information

Author:	• Christopher Herwerth
Course Code (CB01) :	ENGR120
Course Title (CB02) :	3D Printing and Modeling
Department:	ENGR
Proposal Start:	Spring 2025
TOP Code (CB03) :	(0924.00) Engineering Technology, General (requires Trigonometry)
CIP Code:	(15.0000) Engineering Technologies/Technicians, General.
SAM Code (CB09) :	Possibly Occupational
Distance Education Approved:	No
Will this course be taught asynchronously?:	No
Course Control Number (CB00) :	CCC000620917
Curriculum Committee Approval Date:	06/12/2024
Board of Trustees Approval Date:	10/15/2024
Last Cyclical Review Date:	06/12/2024
Course Description and Course Note:	ENGR 120 provides students with the basic knowledge of 3D printing (i.e., additive manufacturing; rapid prototyping) and modeling, as well as its impact within the engineering and manufacturing community. Students have the opportunity to explore the interaction between computer aided design (CAD), computer aided manufacturing (CAM), and additive manufacturing systems by participating in the design and prototyping of an actual part using the latest 3D printers.
Justification:	Mandatory Revision
Academic Career:	• Credit
Mode of Delivery:	No value
Author:	• Christopher Herwerth
Course Family:	No value

Academic Senate Discipline

Primary Discipline:	• Engineering Technology
Alternate Discipline:	No value
Alternate Discipline:	No value

Course Development

Basic Skill Status (CB08)

Course is not a basic skills course.

☐ Allow Students to Gain Credit by Exam/Challenge

Course Special Class Status (CB13)

Course is not a special class.

Pre-Collegiate Level (CB21)

Not applicable.

Grading Basis

- Grade with Pass / No-Pass Option

Course Support Course Status (CB26)

Course is not a support course

General Education and C-ID

General Education Status (CB25)

Not Applicable

Transferability

Transferable to CSU only

Transferability Status

Approved

Units and Hours

Summary

Minimum Credit Units (CB07)	2
Maximum Credit Units (CB06)	2
Total Course In-Class (Contact) Hours	72
Total Course Out-of-Class Hours	36
Total Student Learning Hours	108

Credit / Non-Credit Options

Course Type (CB04)

Credit - Degree Applicable

Noncredit Course Category (CB22)

Credit Course.

Noncredit Special Characteristics

No Value

Course Classification Code (CB11)

Credit Course.

☐ Variable Credit Course

Funding Agency Category (CB23)

Not Applicable.

☐ Cooperative Work Experience Education Status (CB10)

Weekly Student Hours

	In Class	Out of Class
Lecture Hours	1	2
Laboratory Hours	3	0
Studio Hours	0	0

Course Student Hours

Course Duration (Weeks)	18
Hours per unit divisor	0
Course In-Class (Contact) Hours	
Lecture	18

Laboratory	54
Studio	0
Total	72

Course Out-of-Class Hours

Lecture	36
Laboratory	0
Studio	0
Total	36

Time Commitment Notes for Students

No value

Units and Hours - Weekly Specialty Hours

Activity Name	Type	In Class	Out of Class
No Value	No Value	No Value	No Value

Pre-requisites, Co-requisites, Anti-requisites and Advisories

Advisory

ENGR111 - Computer Aided Design SOLIDWORKS I

Objectives

- demonstrate a basic knowledge of computer aided manufacturing by completion of a series of engineering documents;

OR

Advisory

ENGR122 - Engineering Graphics

Objectives

- use computer aided design software to create 3D models, assemblies, exploded views and engineering drawings;
- apply the engineering design process and demonstrate its steps in a design project.

AND

Advisory

ESL141 - Grammar And Writing IV

Objectives

- Compose a 400 to 450-word thesis-based essay which: (a) summarizes and cites appropriately a reading passage provided as a prompt, (b)includes a clear thesis statement, (c) uses evidence to support the thesis, (d) shows clear organization into an introduction, body, and conclusion, and (e) uses appropriate rhetorical modes such as comparison/contrast, cause/effect, and persuasion in order to support a thesis.

OR

Advisory

ENGL101 - Introduction to College Reading and Composition

Objectives

- Read, analyze, and evaluate a variety of primarily non-fiction readings for content, context, and rhetorical merit with consideration of tone, audience, and purpose.

AND

Advisory

MATH100 - College Algebra for STEM

Objectives

- Perform operations on functions.
- Solve equations including: linear, polynomial, radical, rational, absolute value, exponential and logarithmic.
- Model and solve STEM application problems.

Entry Standards

Entry Standards

Course Limitations

Cross Listed or Equivalent Course

Specifications

Methods of Instruction

Methods of Instruction	Lecture
Methods of Instruction	Laboratory
Methods of Instruction	Discussion

Methods of Instruction	Multimedia
Methods of Instruction	Tutorial
Methods of Instruction	Collaborative Learning
Methods of Instruction	Demonstrations
Methods of Instruction	Presentations

Out of Class Assignments

- Homework (e.g. reading, 3D modeling of a part, question sets
- Individual and/or group projects (e.g. design, print, and assemble headphone parts)

Methods of Evaluation	Rationale
Activity (answering journal prompt, group activity)	Assignments
Exam/Quiz/Test	Quizzes
Presentation (group or individual)	Midterm presentation
Project/Portfolio	Project evaluations
Presentation (group or individual)	Final project presentation

Textbook Rationale

No Value

Textbooks

Author	Title	Publisher	Date	ISBN
Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani	Additive Manufacturing Technologies	Switzerland, Springer	2021	978-3-030-56127-7

Other Instructional Materials (i.e. OER, handouts)

No Value

Materials Fee

No value

Learning Outcomes and Objectives

Course Objectives

Describe key characteristics and various types of additive manufacturing.

Design a 3D part file to convert to STL (Stereolithography) file.

Operate a Fused Deposit Modeling (FDM) system.

Apply safety rules, regulations and procedures.

Convert STL file to gcode with Slicing Software for direct manufacturing on a FDM (Fused Deposit Modeling system, also known as a 3D printer.

Troubleshoot and maintain 3D printers.

SLOs

Manage the additive manufacturing process from design conception to prototype. Expected Outcome Performance: 70.0

ILOs Core ILOs	Analyze and solve problems using critical, logical, and creative thinking; ask questions, pursue a line of inquiry, and derive conclusions; cultivate creativity that leads to innovative ideas.
	Demonstrate depth of knowledge in a course, discipline, or vocation by applying practical knowledge, skills, abilities, theories, or methodologies to solve unique problems.
ENGR Civil Engineering	Apply knowledge of mathematics, science and engineering; identify, form and solve engineering problems
	Demonstrate introductory skills using modern engineering tools necessary for engineering practice.
ENGR Engineering Technology - CAD & Design Drafting	Demonstrate techniques to accomplish drawings and 3D models utilizing different various computer aided design (CAD) software
ENGR Engineering Entrepreneurship Skill Award	Learn hands-on skills and problem solving techniques for businesses related to engineering design, installation, manufacturing, testing, technical sales, maintenance, and other such topics in engineering technology.
	Learn the engineering design process and how technical products are made, assembled, and integrated into complex systems.

ENGR Electrical Engineering A.S. Degree Major	analyze engineering problems and make appropriate decisions with the supervision of a licensed engineer;
	demonstrate appropriate technical written, verbal, drawing, and communication skills;
	design a system, component, or process with supervision of a licensed engineer to meet desired needs.
	use science and mathematical skills required for occupational needs;
ENGR Computer Engineering AS	analyze engineering problems and make appropriate decisions with the supervision of a licensed engineer;
	demonstrate appropriate technical written, verbal, drawing, and communication skills;
	design a system, component, or process with supervision of a licensed engineer to meet desired needs.
ENGR Mechanical Engineering - A.S. Degree Major	analyze engineering problems and make appropriate decisions with the supervision of a licensed engineer;
	demonstrate appropriate technical written, verbal, drawing, and communication skills;
	design a system, component, or process with supervision of a licensed engineering to meet desired needs.
	use science and mathematical skills required for occupational needs;

Describe various types of additive manufacturing technology and their relative advantages and disadvantages. Expected Outcome Performance: 70.0

ILOs Core ILOs	Analyze and solve problems using critical, logical, and creative thinking; ask questions, pursue a line of inquiry, and derive conclusions; cultivate creativity that leads to innovative ideas.
ENGR Civil Engineering	Apply knowledge of mathematics, science and engineering; identify, form and solve engineering problems
	Demonstrate introductory skills using modern engineering tools necessary for engineering practice.
ENGR Engineering Technology - CAD & Design Drafting	Discuss how the design process and design/drawing techniques are used with other engineering processes to create a finished product.
ENGR Engineering Entrepreneurship Skill Award	Learn hands-on skills and problem solving techniques for businesses related to engineering design, installation, manufacturing, testing, technical sales, maintenance, and other such topics in engineering technology.
	Learn the engineering design process and how technical products are made, assembled, and integrated into complex systems.
ENGR Electrical Engineering A.S. Degree Major	demonstrate appropriate technical written, verbal, drawing, and communication skills;
ENGR Computer Engineering AS	demonstrate appropriate technical written, verbal, drawing, and communication skills;
ENGR Mechanical Engineering - A.S. Degree Major	demonstrate appropriate technical written, verbal, drawing, and communication skills;

Demonstrate an understanding of operation and maintenance of an Fused Deposit Modeling (FDM) modeling machine.
Expected Outcome Performance: 70.0

ILOs Core ILOs	Analyze and solve problems using critical, logical, and creative thinking; ask questions, pursue a line of inquiry, and derive conclusions; cultivate creativity that leads to innovative ideas.
	Demonstrate depth of knowledge in a course, discipline, or vocation by applying practical knowledge, skills, abilities, theories, or methodologies to solve unique problems.
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	Learn the engineering design process and how technical products are made, assembled, and integrated into complex systems.
ENGR Computer Engineering AS	analyze engineering problems and make appropriate decisions with the supervision of a licensed engineer;
	demonstrate appropriate technical written, verbal, drawing, and communication skills;
ENGR Mechanical Engineering - A.S. Degree Major	use science and mathematical skills required for occupational needs;
ENGR Electrical Engineering A.S. Degree Major	use science and mathematical skills required for occupational needs;

Additional SLO Information

Does this proposal include revisions that might improve student attainment of course learning outcomes?

No

Is this proposal submitted in response to learning outcomes assessment data?

No

If yes was selected in either of the above questions for learning outcomes, explain and attach evidence of discussions about learning outcomes.

No Value

SLO Evidence

No Value

Course Content

Lecture Content

Introduction and Overview (6 hours)

- Definition of Additive Manufacturing (AM)
- Various AM processes and materials
- American Society for Testing and Materials (ASTM) standards
- Current industrial trends
- Existing hardware and software systems
- Relationship to traditional manufacturing methods
- Secondary processes
- Uses of additively manufactured parts

3D Model Generation (4 hours)

- Review of 3D modeling principles
- Part sketching and extrusion
- Dimensioning

- 3D laser scanning
- Laser scanned file cleaning and assembly

Input File Preparation (5 hours)
- Stereolithography (STL) file format
- STL faceting and resolution
- Exporting CAD model to STL file
- Insight software application
- Modeler setup
- Orientation and scaling
- STL slicing
- Toolpath creation and parameter settings
- Identification and correction of toolpath problems
- Exporting to Chromeleon Backup Archive (CMB) file format
- Control Center software application

Modeling System (3 hours)
- Safety protocols
- Operator console
- System components
- Sensor and instrument status
- Maintenance procedures
- Tip and material change
- Calibration
- Building a job
- Model and support material removal

Total Hours: 18

Laboratory/Studio Content

Introduction and Overview (3 hours)
- Definition of Additive Manufacturing (AM)
- Various AM processes and materials
- American Society for Testing and Materials (ASTM) standards
- Current industrial trends
- Existing hardware and software systems
- Relationship to traditional manufacturing methods
- Secondary processes
- Uses of additively manufactured parts

3D Model Generation (11 hours)
- Review of 3D modeling principles
- Part sketching and extrusion
- Dimensioning
- 3D laser scanning
- Laser scanned file cleaning and assembly

Input File Preparation (13 hours)
- Stereolithography (STL) file format
- STL faceting and resolution
- Exporting CAD model to STL file
- Insight software application
- Modeler setup
- Orientation and scaling
- STL slicing
- Toolpath creation and parameter settings
- Identification and correction of toolpath problems
- Exporting to Chromeleon Backup Archive (CMB) file format
- Control Center software application

Modeling System (11 hours)
- Safety protocols
- Operator console
- System components

- Sensor and instrument status
- Maintenance procedures
- Tip and material change
- Calibration
- Building a job
- Model and support material removal

Final Comprehensive Project (16 hours)

- Team formation
- Project selection/proposal
- Generation of models
- Preparation of CMB file
- Completion of part
- Project presentation

Total Hours: 54

Additional Information

Is this course proposed for GCC Major or General Education Graduation requirement? If yes, indicate which requirement in the two areas provided below.

No

GCC Major Requirements

No Value

GCC General Education Graduation Requirements

No Value

Repeatability

Not Repeatable

Justification (if repeatable was chosen above)

No Value

Resources

Did you contact your departmental library liaison?

No

If yes, who is your departmental library liason?

No Value

Did you contact the DEIA liaison?

No

Were there any DEIA changes made to this outline?

No Value

If yes, in what areas were these changes made:

No Value

Will any additional resources be needed for this course? (Click all that apply)

No Value

If additional resources are needed, add a brief description and cost in the box provided.

No Value