Course Outline

DeAnza College

General Information

COURSE ID (CB01A AND CB01B)

DMT 53

COURSE TITLE (CB02)

Introduction to 3D Printing/Additive Manufacturing

COURSE CREDIT STATUS

Credit - Degree Applicable

EFFECTIVE TERM

Fall 2024

COURSE DESCRIPTION

This course provides a comprehensive overview of additive manufacturing, also known as 3D printing, spanning from fundamentals to applications and industry trends. Students will understand how to design, fabricate (produce), and measure 3D printed parts using a range of printing technologies and materials. They will develop knowledge of the seven (7) ISO/ASTM-defined 3D printing processes and evaluate each process's capabilities, material characteristics, parameters, and design considerations. Emphasis will be placed on current additive manufacturing industry applications, design principles, and production standards. In-class sessions will feature demonstrations and projects using the latest industry-grade 3D printers and post-processing equipment.

FACULTY REQUIREMENTS

DISCIPLINE 1

Manufacturing Technology (Quality control, process control)

FSA

FHDA FSA - MACHINE TOOL TECH

COURSE FAMILY

Not Applicable

Course Justification

This course is a major employment preparation CTE course for our Design and Manufacturing Technologies program and is a CSU transferable course. It is intended to prepare students for work as a 3D printing technician in the additive manufacturing industry, as advised by our industry advisory committee. This introductory course is also part of the Additive Manufacturing Technology: 3D Design and Production certificate in the Design and Manufacturing Technologies program.

Foothill Equivalency

DOES THE COURSE HAVE A FOOTHILL EQUIVALENT?

No

FOOTHILL COURSE ID

Formerly Statement

Course Development Options

BASIC SKILL STATUS (CB08)

Course is not a basic skills course.

GRADE OPTIONS

- Letter Grade
- Pass/No Pass

REPEAT LIMIT

0

Transferability & Gen. Ed. Options

Information below is subject to change. For the official listing of courses, their approval dates, and transfer credit limitations, check the De Anza catalog (by academic year), ASSIST.ORG (https://assist.org/) and C-ID.NET (https://c-id.net/).

TRANSFERABILITY

Transferable to CSU only

Units and Hours

Summary

MINIMUM CREDIT UNITS	4.0
MAXIMUM CREDIT UNITS	4.0

Weekly Student Hours

Type	In Class	Out of Class
Lecture Hours	4.0	8.0
Laboratory Hours	0.0	0.0

Course Student Hours

COURSE DURATION (WEEKS)

12.0

HOURS PER UNIT DIVISOR

36.0

Course In-Class (Contact) Hours

LECTURE

48.0

LABORATORY

0.0

TOTAL

48.0

Course Out-of-Class Hours

LECTURE

96.0

LABORATORY

0.0

NA

0.0

TOTAL

96.0

Prerequisite(s)

Corequisite(s)

Advisory(ies)

ESL 261 and ESL 265, or ESL 461 and ESL 465, or eligibility for EWRT 1A or EWRT 1AH or ESL 5

Limitation(s) on Enrollment

Entrance Skill(s)

General Course Statement(s)

Methods of Instruction

Lecture and visual aids
Discussion of assigned reading and problem solving performed in class Quiz and examination review performed in class Homework and assigned projects

Assignments

A. Research and compile report on selected topics in 3D printing/additive manufacturing (AM).
B. In class exercises to recognize various materials strength and design processes.
C. Manipulate CAD models provided by instructor, export to STL/3MF files, set up and operate 3D printer, and complete post processing of printed part.

Methods of Evaluation

A. Accuracy and completeness of assigned reading and research projects.
B. Mid-term examination covering assigned video lectures, textbook readings, and basic 3D printing/additive manufacturing concepts. The exam will be evaluated based on demonstrating an understanding of 3D printing/additive manufacturing processes, materials, and applications.
C. Final examination evaluating student's comprehensive understanding of basic 3D printing/additive manufacturing workflow, from design, CAD modeling, conversion to STL/3MF files, 3D printer set up and operation, post processing and part inspection.

Essential Student Materials/Essential College Facilities

Essential Student Materials:

- None

Essential College Facilities:

- DMT CAD/3D printing laboratory

Examples of Primary Texts and References

Author	Title	Publisher	Date/Edition	ISBN
Gibson, I. Rosen, D. Stucker, B.	Additive Manufacturing Technologies	Springer	2021/3rd	978-3030561260

Examples of Supporting Texts and References

None.

Learning Outcomes and Objectives

Course Objectives

- Apply knowledge of Occupational Health and Safety Administration (OSHA), Environmental Protection Agency (EPA), and International Standards Organization (ISO) workplace environmental health and safety standards.
- Describe the development and evolution of additive manufacturing/3D printing technology from its inception to the present.
- Identify the seven (7) ISO/ASTM additive manufacturingÂ (AM) processes.
- Differentiate the major categories of AM/3D print media, identify their applications, and interpret Safety Data Sheets (SDS).
- Contrast additive vs. traditional manufacturing by identifying advantages and limitations of AM and the integration of traditional manufacturing processes with AM.
- Survey applications of additive manufacturing/3D printing across major industries, products and understand the requirements and constraints of each through case studies.
- Read and interpret blueprints and technical drawings.
- Manipulate product designs usingÂ parametric solid modeling tools.
- Explain the principles of Design for Additive Manufacturing (DfAM).
- Translate CAD designs into standard triangle language (STL) or 3D manufacturing format (3MF) for export.
- Prepare, initiate, and monitor 3D printing process.
- Determine optimal 3D print process and materials.
- Implement post-processing procedures on 3D printed parts.
- Inspect finished parts using precision measuring tools.
- Conduct non-destructive testing of finished parts.

CSLOs

- Apply knowledge of 3D Printing (AM) to analyze, compare, explain and utilize the various processes to prototyping and fabricate new mechanical designs and tools for industry.

Outline

A. Apply knowledge of Occupational Health and Safety Administration (OSHA), Environmental Protection Agency (EPA), and International Standards Organization (ISO) workplace environmental health and safety standards.
    1. Safety Data Sheets (SDS) for 3D printing materials
    2. Personal Protective Equipment (PPE) for handling 3D printing media
    3. Proper recycling and disposal methods of materials
B. Describe the development and evolution of additive manufacturing/3D printing technology from its inception to the present.
    1. First patents for 3D printer and processes
    2. Early stereolithographic (SLA) 3D printers
    3. Evolution of 3D printing from rapid prototyping to the production of industry-grade parts for commercial and end-user applications
    4. Additive manufacturing/3D printing industry expansion
C. Identify the seven (7) ISO/ASTM additive manufacturing (AM) processes.
    1. Material extrusion (MEX)
        a. Fused filament fabrication (FFF)
        b. Fused deposition modeling (FDM)
    2. Powder bed fusion (PBF)
        a. Selective laser sintering (SLS)
        b. Direct metal laser sintering (DMLS)
        c. Multi jet fusion (MJF)
    3. VAT photopolymerization (VPP)
        a. Stereolithography (SLA)
        b. Digital light processing (DLP)
        c. Continuous liquid interface production (CLIP)
    4. Material jetting (MJT)
    5. Binder jetting (BJT)
    6. Directed energy deposition (DED)
    7. Sheet lamination
D. Differentiate the major categories of AM/3D print media, identify their applications, and interpret Safety Data Sheets (SDS).
    1. Polymers
    2. Nylon
    3. Metals
    4. Ceramics
    5. Composites
E. Contrast additive vs. traditional manufacturing by identifying advantages and limitations of AM and the integration of traditional manufacturing processes with AM..
    1. Compare additive manufacturing with machining and molding in terms of production rate and cost.
    2. Produce models and prototype parts.
    3. Manufacture industrial and consumer-quality parts in relatively small numbers.
F. Survey applications of additive manufacturing/3D printing across major industries, products and understand the requirements and constraints of each through case studies.
    1. Aerospace and automotive
    2. Medical devices
    3. Energy and electronics
    4. IT and Industrial Internet of Things (IIoT)
    5. Consumer products
G. Read and interpret blueprints and technical drawings.
    1. Create basic sketches.
    2. Apply dimensions and constraints to sketches.
H. Manipulate product designs using parametric solid modeling tools.
    1. Create Computer Aided Design (CAD) of concept drawing.
    2. Optimize design in CAD.
I. Explain the principles of Design for Additive Manufacturing (DfAM).
    1. Recognize the importance to optimize part design.
    2. Describe the concept of topology optimization.
J. Translate CAD designs into standard triangle language (STL) or 3D manufacturing format (3MF) for export.
    1. Clean and repair mesh (STL/3MF) files.
    2. Create new or modify existing lattice structures.
K. Determine optimal 3D print process and materials.
    1. Optimize part orientation.
    2. Prepare printer and load materials.
    3. Inspect printer and initiate print process
L. Prepare, initiate, and monitor 3D printing process.
    1. Inspect printer sensors, lenses, rollers, print heads, print chamber and resin vat.
    2. Build and optimize print supports.
    3. Pack and nest 2D and 3D printer build volume.
    4. Send design file to 3D printer.
    5. Monitor print process and troubleshoot problems as they arise.
M. Implement post-processing procedures on 3D printed parts.
    1. Evaluate post process options.
    2. Apply procedures as determined by 3D print processes.
N. Inspect finished parts using precision measuring tools.
    1. Complete surface, visual, and microscopic parts inspection.
    2. Analyze metrological characteristics.
O. Conduct non-destructive testing of finished parts
    1. Perform surface roughness testing and leak detection.

2. Implement mechanical and analytical tests to sample parts