MACH A158: ADDITIVE MANUFACTURING/3D PRINTING

Item	Value
Curriculum Committee Approval Date	12/02/2020
Top Code	095600 - Manufacturing and Industrial Technology
Units	.5 Total Units
Hours	27 Total Hours (Lab Hours 27)
Total Outside of Class Hours	0
Course Credit Status	Credit: Degree Applicable (D)
Material Fee	No
Basic Skills	Not Basic Skills (N)
Repeatable	No
Grading Policy	Standard Letter (S)

Course Description

Additive Manufacturing deals with aspects of additive, subtractive, and joining processes to form three-dimensional parts with applications ranging from prototyping to production. Additive manufacturing processes directly from computer-aided-design (CAD) models. In this course, students will learn about a variety of AM and other manufacturing technologies, their advantages and disadvantages for producing both prototypes and functional production quality parts. Transfer Credit: CSU.

Course Level Student Learning Outcome(s)

1. Demonstrate an understanding of several AM 3D printing processes to produce a 3D part.

Course Objectives

- 1. Understand several AM processes SLA, FDM, SLS, DMLS, Polyjet Printing, SLM, Bio Printing, LENS, and EBM.
- 2. Set up and run a FDM machine and a Concept laser DMLS using 316L Stainless Steel material.
- 3. Remove support materials from both FDM and DMLS.
- 4. Methods of finishing prototypes.
- 5. Understand how to use AM systems to create injection molds and tools to create models from silicones and urathanes.

Lecture Content

1. Introduction to Additive Manufacturing a. History of AM b. Benefits of AM c. Safety d. Machining vs. AM e. Seven Additive Manufacturing technologies i. Material Extrusion ii. Vat Photopolymerization iii. Material Jetting iv. Sheet Lamination v. Binder Jetting vi. Powder Bed Fusion vii. Directed Energy Deposition 2. Additive Manufacturing Process Chain a. CAD b. STL c. AM Software d. Support Construction e. Machine Setup f. Build/build removal g. Postprocessing and Finishing 3. Material Extrusion a. Stratasys/ Fused Deposition Modeling b. Materials c. Applications 4. Vat Photopolymerization a. 3DSystems/Stereolithography b. EnvisionTEC/DLP Technology c. Micro-SL d. Materials e. Applications 5. Material Jetting a. Stratasys/Objet b. Startasys/Solidscape c. Materials d. Applications 6. Binder Jetting a. 3D Systems/Zcorp b. ExOne i. Sand Casting ii. Metals 8. Powder Bed Fusion a. Polymer AM i. 3DSystems/Selective Laser Sintering b. Metals AM i. Selective Laser Melting 1. Laser Base AM a. EOS/ SLM/ConceptLaser/Renishaw/Phenix b. Materials c. Applications 2. Electron Beam AM a. Arcam b. Materials c. Applications 9. Direct Energy Deposition a. Laser b. Electron Beam 10. AM Applications a. Medical i. Medical Modeling Inc. ii. Pre-surgical Modeling iii. Hearing Aids iv. Invisaline v. Surgical Guides vi. Dental Industry b. Aerospace i. GE Aviation fuel nozzles b ii. Boeing air ducts c. Automotive i. Tooling / Fixtutres ii. Prototyes / Models d. Consumer Market i. Jigs and Fixtures ii. ATM Machines iii. Low Production/High value

Lab Content

1. Set up and run a FDM machine and a Concept laser DMLS using 316L Stainless Steel material.2. Remove support materials from both FDM and DMLS.3. Methods of finishing prototypes.4. Understand how to use AM systems to create injection molds and tools to create models from silicones and urathanes.

Method(s) of Instruction

- Lab (04)
- DE Live Online Lab (04S)

Instructional Techniques

Lecture and visual aids Discussion of assigned reading Discussion and problem solving performed in class Quiz and examination review performed in class Homework and extended projects Laboratory experience which involve students in formal exercises of data collection and analysi

Reading Assignments

Reading from text and reference materials.

Writing Assignments

In-class exercises and written reports.

Out-of-class Assignments

Project, test preparation and research for written reports.

Demonstration of Critical Thinking

Apply AM techniques to a challenging rapid manufacturing application. Identify, explain, and prioritize some of the important research challenges in AM

Required Writing, Problem Solving, Skills Demonstration

Written reports explaining the capabilities, limitations, and basic principles of AM technologies. Evaluate and select appropriate AM technologies for specific applications

Eligible Disciplines

Machine tool technology (tool and die making): Any bachelors degree and two years of professional experience, or any associate degree and six years of professional experience.

Other Resources

1. Instructor handouts 2. Concept Laser Manual by Hoffman Innovation Group, 2014 3. uPrint SE Manual by Stratasys, 2011