The Engineering Technology Department, in cooperation with the Office of Disability Accommodation, complies with the Americans with Disabilities Act in making reasonable accommodations for qualified students with disabilities. Please present your written accommodation request to the instructor prior to the fourth day.

SAFETY CATEGORY: 1

ENGINEERING TECHNOLOGY
COLLEGE OF ENGINEERING
UNT RESEARCH PARK
Description
This is an advanced course for undergraduate students in Engineering Technology, with the intention of applying the fundamental and technological knowledge of Digitalization and Additive Manufacturing. Basic knowledge of materials behavior and manufacturing processes is required. As a learning outcome, the student will develop the ability to design, configure and implement processes of Additive Manufacturing and 3D scanning.

Prerequisites
ENGR 1304, Engineering Graphics

Course objectives
The goal of this course is to provide undergraduate Engineering Technology students fundamental and practical knowledge to:

a. Understand the adoption of non-traditional manufacturing technologies in the production of mechanical parts.
b. Appreciate the use of different technologies of Additive Manufacturing and 3D Digitizing for the development of engineering products.
c. Perform practical work with Digital Manufacturing technologies for product realization.
d. Develop technical abilities for the use of Additive Manufacturing and 3D Digitizing equipment for the fabrication of mechanical components.

Appropriate Program Outcomes
According to the Engineering Technology Accreditation Commission (ETAC) of ABET, an Engineering Technology program must demonstrate that graduates have:

1) an ability to apply knowledge, techniques, skills and modern tools of mathematics, science, engineering, or technology to solve broadly-defined engineering problems;
2) an ability to design solutions for well-defined technical problems and assist with engineering design of systems, components, or processes appropriate to the discipline;
3) an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results;
4) an ability to function effectively as a member of a technical team;
5) an ability to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature.

Course topics and subtopics:

1. Introduction to the basic principles of additive manufacturing.
   1.1 Fused Deposition Modeling (FDM) and associated technologies.
   1.2 Selective Laser Sintering and related technologies.
   1.3 Light-curing, Stereolithography and associated technologies.
   1.4 Other relevant processes for additive manufacturing.

2. Design for Additive Manufacturing.
2.1 Mechanical considerations for the re-design of plastics and metal components.
2.2 Validation and testing of prototypes manufactured by Additive Manufacturing.
2.3 Economic considerations of the re-design of consumer goods and capital goods.
2.4 Considerations for environmental sustainability of products manufactured by additive manufacturing life cycle.

3. 3D Digitizing technologies.
3.1 Basic principles of 3D digitizing of mechanical components.
3.2 Computational tools associated with the 3D digitizing.
3.3 Direct Digital Manufacturing of complex components.
3.4 New trends in the development of 3D digitizing technologies.

4. Applications of Additive Manufacturing and 3D digitizing technologies.
4.1 Biomedical applications: Tissue Engineering and implants prototyping.
4.2 Aeronautical applications: Development of components of free form shapes.
4.3 Automotive applications: Development of molds, dies and tooling.
4.4 Prospective impact of Additive Manufacturing and 3D digitizing.

Specific learning outcomes by topic
(ETAC of ABET Program Outcomes Addressed)
1. To know the basic principles of Additive Manufacturing (ABET 1).
1.1 To know Fused Deposition Modeling (FDM) and associated technologies.
1.2 To understand Selective Laser Sintering (SLS) and associated technologies.
1.3 To know Light-curing, Stereolithography and associated technologies.
1.4 To know other relevant processes for Additive Manufacturing.

2. To know and apply the principles of design for Additive Manufacturing (ABET 1 and 2).
2.1 To develop knowledge and practical exercises to apply mechanical considerations for the re-design of plastics and metal components.
2.2 To develop knowledge and practical exercises for validation and testing of prototypes manufactured by additive manufacturing.
2.3 To develop knowledge and practical exercises of the economic considerations of the re-design of consumer goods and capital goods.
2.4 To develop analysis of life cycle of products manufactured by Additive Manufacturing.

3. To know and apply 3D digitizing technologies (ABET 1 and 2).
3.1 To develop knowledge and practical exercises with the basic principles of 3D digitizing of mechanical components.
3.2 To develop practical exercises with computational tools associated with the 3D digitizing for pre-processing and post-processing of sculptured parts.
3.3 To develop practical exercises of the digital manufacturing of complex components.
3.4 To learn about new trends in the development of 3D digitizing technologies.

4. To understand and develop applications of additive manufacturing and 3D digitizing technologies (ABET 2 and 3).
4.1 To know and carry out practical exercises of biomedical applications: Tissue Engineering and implants development.
4.2 To generate knowledge and carry out practical exercises of aeronautical applications: development of free-form components.
4.3 To generate knowledge and carry out practical exercises of automotive applications: development of molds, dies and tooling.
4.4 To generate knowledge from the perspective of the impact of the Additive Manufacturing and 3D digitizing.
**Suggested methodologies and learning strategies**

Teaching techniques: Research-Based Learning (RBL) which allows the student to be incorporated into research based on scientific method.

**Learning activities guided by the teacher:**
1. Presentation of the theoretical framework that supports the key topics of the course: Additive Manufacturing Processes and 3D digitizing.
2. Exemplify the contents of the class with applications in industry.
3. Discussion for problem solving of course topics.
4. Practical sessions in workshop and laboratory to link theory and practice.

**Independent learning activities:**
1. Development of final project including all the subjects seen.
2. Solution of practical exercises for the understanding of each course topic.
3. Corroboration of the subjects seen in class with a report prior to practice in a workshop.

**Grading Elements and Weights**
The evaluation of student learning has procedures and criteria that allow monitoring and evaluation of the results of the learning process. The procedures and the weighting of each of them are the following:
15% --- Midterm exam. It is a mid-term exam that evaluates the understanding and application of concepts seen in class during the first half of the academic semester.
15% --- Final exam. It is a final exam that evaluates the understanding and application of concepts seen in class during the second half of the academic semester.
10% --- Homework, quizzes, exercises and activities. Activities carried out throughout the semester to reinforce the understanding of the course.
60% --- Final project. The knowledge of the contents of the whole semester is evaluated in a comprehensive final project about the application of Digital Manufacturing in an industrial scenario. The project is divided in three sections: one section dedicated to polymer Additive Manufacturing (20%), one section dedicated to Metal Additive Manufacturing (20%), and one section dedicated to 3D digitization (20%).

**Suggested Bibliography**

**Text Books:**

**Support Books:**

**Class policies**
   a. All rules relating to academic dishonesty will be enforced in accordance with University policies. Cheating on quizzes, examinations and laboratory assignments, and plagiarism on various papers and reports are types of disciplinary misconduct for which penalties are assessed under the UNT Code of Student Conduct and Discipline. Major responsibility for implementing the University’s policy on scholastic dishonesty rests with the faculty. Be advised that the instructor of this course supports and fully implements this policy. The following actions will be taken when evidence of such misconduct is observed. The student will be presented with the evidence of misconduct and given an opportunity to
explain same. Based on the outcome of this private conference, the matter will be either dropped or the student will be given a grade of "F" in the course and be referred to the Dean of Students for further counseling and/or disciplinary action.

b. During the course, handouts will be provided to enhance the presentation of certain concepts. These materials are provided strictly for instructional purposes and may otherwise be restricted. There is no authorization for further reproduction of distribution of handout materials beyond that intended to teach the course.

c. This syllabus is subject to change at any time during the semester with changes to be announced in class.

d. Each student should retain graded lecture notes, pop quizzes, homework, tests, software-generated files, and laboratory reports to document errors in recorded grades.

e. Requests for review of graded work must be submitted during the lecture in which such work is returned to the students. The request should be accompanied by a written justification of the request including any supporting data.

f. There is no limit to the use of calculators and computers for lecture, labs, pop quizzes, formal tests, or final examination. However, the use of cell phones during the class is not allowed, except in the case of an emergency.

g. Challenges to the course grade must be presented within 60 days of receipt of grade notices mailed by the university. This will insure that instructor’s records are still available to allow a review of the assigned grade. You should first discuss your complaint with the instructor. If you wish to carry it further, contact the Program Coordinator by calling (940) 565-2022. To further pursue your complaint, contact the Department Chair at (940) 565-2022, but ONLY after first discussing your concern with the previous two individuals.

h. An I (incomplete) grade is given only for extenuating circumstances and in accordance with University and Departmental Policies.