

**ME 49601**  
**Additive Manufacturing: Fundamentals, Equipment and Applications**

**Course Outcomes** [Related ME Program Outcomes in brackets]

1. Fundamentals of **materials, properties and testing** for additive manufacturing. [1,2]
2. Develop understanding of **processes and equipment** for additive manufacturing. [2]
3. Understanding **engineering design** [*convergence of bio-inspired design(s)*] with material(s) and process(es) for application specific functional specifications. [2]
4. Apply combination of understanding of designs, materials and additive manufacturing process(es) for a **product innovation**. [1, 2]
5. Adopt an interdisciplinary approach to additive manufacturing across science, engineering, economics, and social innovations. [2]

**Foundations for materials, additive process fundamentals and testing (5 wks)**

1. Fundamentals of metals, ceramics, cells (and bio-materials), and polymers for additive manufacturing
2. Properties and testing methods of additive manufactured parts
3. Tradeoffs for additive manufactured parts over subtractive manufacturing

**Develop understanding of processes and equipment for additive manufacturing (4 weeks)**

1. Fundamentals of additive process mechanisms for various materials
2. Introduction to additive manufacturing equipment and suppliers
3. Combination of additive processes with other manufacturing processes
4. Decision making for process(es) selection

**Bio-inspired designs for Additive Manufacturing (3 weeks)**

1. Multifunctionality for surfaces and bulks for engineering applications
2. Nature's design tool box and sustainability
3. Biologicalization: bio-inspired, bio-mimetic and bio-integrated
4. Designs and biologicalization

**Implementation of Additive Manufacturing for Product Applications (3 weeks)**

- Applications for additive manufacturing
- Social Innovations
- Application of additive manufacturing for social innovations
- Open source product development and intellectual property
- Future trends of additive manufacturing

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| <b>COURSE NUMBER:</b> ME 49601   |  | <b>COURSE TITLE:</b> Additive Manufacturing: Fundamentals, Equipment and Applications (3 credits)  |  |
| <b>REQUIRED COURSE OR ELECTIVE COURSE:</b> Elective  |  | <b>TERMS OFFERED:</b> Fall semester (once in a year)   |  |
| <b>TEXTBOOK/REQUIRED MATERIAL:</b><br>None. Reading material provided by the instructor.   |  | <b>PRE-REQUISITIES:</b> Fundamental of knowledge of design, materials, heat transfer, fluid flow and CAD<br><b>ATTRIBUTES:</b> Upper Division (junior and senior status)   |  |
| <b>COORDINATING FACULTY:</b> Ajay P. Malshe  |  |  |  |
| <b>COURSE DESCRIPTION:</b> Foundations for materials, additive process fundamentals and testing; Develop understanding of processes and equipment for additive manufacturing; Bio-inspired designs for Additive Manufacturing; Implementation of Additive Manufacturing for Product Applications |  | <b>COURSE OUTCOMES</b> [Related ME Program Outcomes in brackets]:<br>1. Fundamentals of materials, properties and testing for additive manufacturing. [1,2]<br>2. Develop understanding of processes and equipment for additive manufacturing. [2]<br>3. Understanding engineering design [ <i>convergence of bio-inspired design(s)</i> ] with material(s) and process(es) for application specific functional specifications. [2]<br>4. Apply combination of understanding of designs, materials and additive manufacturing process(es) for a product innovation. [1, 2]<br>5. Adopt an interdisciplinary approach to additive manufacturing across science, engineering, economics, and social innovations. [2] |  |
| <b>ASSESSMENTS TOOLS:</b><br>1. Homework<br>2. Project reports<br>3. Project presentations<br>4. Participation in Guest lectures   |  |  |  |
| <b>NATURE OF DESIGN CONTENT:</b> Bio-inspired designs for surface and bulk for multifunctionality; design for sustainability; design-for-additive manufacturing approach; implementation of additive manufacturing for product design innovations and analysis                                   |  | <b>RELATED ME PROGRAM OUTCOMES:</b><br>1. Engineering fundamentals<br>2. Bio-inspired design<br>3. Communication skills<br>4. Ethical/Prof. responsibilities<br>5. Teamwork skills<br>6. Experimental skills<br>7. Critical thinking and innovation skills<br>8. Knowledge acquisition and importance of philosophy of convergence   |  |
| <b>PROFESSIONAL COMPONENT:</b><br>1. Engineering Topics: Materials and manufacturing science – 50%<br>Engineering design and innovations – 50%   |  |  |  |
| <b>COMPUTER USAGE:</b> The design and manufacturing projects require students to apply computer programs.  |  |  |  |
| <b>COURSE STRUCTURE/SCHEDULE:</b><br>Lecture - 2 days per week at 75 minutes per lecture.  |  |  |  |
| <b>PREPARED BY:</b> Ajay P. Malshe   |  | <b>REVISION DATE:</b> May 3, 2020  |  |