Purdue University
School of Materials Engineering

MSE 597 Additive Manufacturing of Materials                                             New  Spring 2021

Lecture:  TTh 12:00-1:15  WANG 2599
Instructor:  Prof. Kevin Trumble, ARMS 2333,  driscol@purdue.edu
Teaching Assistants:  Indrani Biswas, biswas19@purdue.edu
Mohammed Issahaq, missahaq@purdue.edu
Website:  Brightspace

Synchronous:  Based on demand, office hours will be held via Webex in Prof. Trumble’s personal
room:  https://purdue.webex.com/meet/driscol.  Days/times will be established starting week 2 of
the semester, depending on student input.  Individual (or small group) consultations can also be
arranged by e-mail.

Objective:  Apply the general materials processing approach to additive manufacturing for
ceramics, metals and polymers and their composites.

Description:  The course will take a materials science and engineering approach to additive
manufacturing (AM), following the structure of the general materials processing series (MSE 512
Powder Processing, MSE 536 Solidification Processing and MSE 548 Deposition Processing)
taught in the School of Materials Engineering.  The overarching goal is to learn how microstructure
development is controlled by the interaction of physical, chemical, thermal and mechanical
phenomena in the shaping of materials by additive processing.  All major classes of materials and
AM processes will be included.  Other objectives are to develop the ability to quantitatively
analyze the capabilities and limitations of AM processes relative to current commercial processes;
and critically analyze the AM research literature.  The course will also provide opportunities for
students to explore AM topic area(s) of their own interest.

Outline:  Introduction and materials background; manufacturing and materials processing;
introduction to additive manufacturing; AM process classes: vat polymerization, powder bed,
directed energy deposition, printing (jetting), binder jetting, extrusion, sheet lamination;
comparative processing, including AM process design, selection and applications.  Supporting
fundamentals segments will include, powder characterization and behavior, lasers and other
intense heating sources, polymerization, rheology of pastes, etc., as needed to support the
physical, chemical and mechanical phenomena processes underpinning the AM processes.

Prerequisites:  An introductory course in engineering materials and/or manufacturing processes
or permission of instructor.

Textbooks
Recommended:
Any introductory Engineering Materials text (e.g., Callister, Shackelford, Askeland, Flinn and
Trojan) and any introductory Manufacturing Processes text (e.g. Schey, Kalpakjian, DeGarmo,
Groover) will be useful references for reviewing related fundamentals.  Earlier editions of these
books can be had for next to nothing from online sellers.  Although the latest editions may contain
some treatment of additive manufacturing, this is hardly worth spending $200 and the
fundamental content will be hardly changed from earlier editions.
Primary sources (all available electronically from the Purdue library):

Course format
The course is running in a hybrid in-person/online mode in Spring 2021 through the Engineering Professional Education (EPE) program. Lectures will be recorded with an in-person (on-campus) class in the WANG 2599 studio-classroom and posted to Brightspace usually the same day. The lecture recordings will be available to all student any time.

Lecture format
The lectures will be presented using partially completed template slides that can be downloaded from the website and used to follow along as the instructor fills them in on the document camera. This method accomplishes some of the feel of a chalkboard lecture and (hopefully) avoids the “death by powerpoint,” i.e., talking through a deck of slides, which you might just as well read.

Exams
The two midterm exams (February 25 and April 8) and comprehensive final exam (May 3-8 TBA) will be administered online through Gradescope via Brightspace. For each exam, a pdf exam file identical to an in-class exam paper (~6 pages) will be downloaded and worked, either electronically on a tablet or printed and worked on paper and then scanned or photographed, and then uploaded as a single electronic file to Gradescope.* The midterm exams, which would normally be given in a 50-minute class period, will have a 75-minute limit. The final exam will have a 2-hour limit. Students are on their honor to work the exam by themselves and without any internet resources.

*If you do not have a tablet computer or other way to write out the exam electronically, you must have your own printer so you can print out the exam to work.

Assessments and Grading (percentage of final grade):
Homework problem sets throughout the semester (5%)*; a critical review paper (10%) and a virtual (recorded) oral presentation (15%) on an AM topic of particular interest to the student; two midterm exams (20% each); a comprehensive final exam (30%). Final grades will include “+” and “-“ divisions; divided evenly by score within each letter grade range.

*Homework assignments will be collected, but only nominally graded: Check plus (100)/Check (75)/Check minus (50). Solutions will be posted.

In-class Attendance
Extensive preparations have been made for safe practices under the Covid-19 pandemic conditions and Prof. Trumble hopes the lectures will be well attended by the on-campus student, as they were last semester. The capacity of WANG 2599 has been restricted to 37 students (half-capacity). Attendance will require following all Purdue Covid-19 safety protocols (masks and spacing). See the Protect Purdue website for the latest information (link below).
Emergency Procedures
Fire, weather, and civil emergency procedures specific to the WANG 2599 will be reviewed in class. Information on emergency preparedness at Purdue is available on the Purdue homepage and at http://www.purdue.edu/emergency_preparedness/.

For a shelter-in-place siren (tornado, hazardous material release, civil disturbance) stay in WANG 2599 and wait for further instructions. In case of a fire alarm, exit WANG via the stairway and assemble in the Northwestern Avenue parking garage.

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. These changes would be posted on the course website on Brightspace. In case of an extended disruption in which classes on campus are suspended the course will continue in the online only mode via Brightspace.

Covid-19 Protocols
The Protect Purdue plan has a central website for Covid-19 questions: https://protect.purdue.edu/. It is critically important that all students on campus monitor for and report any Covid-19-related symptoms to the Protect Purdue Health Center by calling 765-496-INFO (4636) or toll-free at 833-571-1043. If you feel sick it is very important to see a doctor as soon as possible and not to come to class. If you anticipate an extended absence from the course for any reason please inform Prof. Trumble as soon as possible, to discuss how you can make up any missed work.

Mental Health Resources
If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at 765-494-6995 and http://www.purdue.edu/caps/ during and after hours, on weekends and holidays, or by going to the CAPS office on the second floor of the Purdue University Student Health Center (PUSH) during business hours. Students should also feel welcome to discuss any concerns they have with Prof. Trumble.

Students with Disabilities
If you anticipate or experience physical or academic barriers based on disability, you are welcome to discuss options with Prof. Trumble. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247; https://www.purdue.edu/drc/.

Diversity and Inclusion
Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. Purdue's nondiscrimination policy can be found at the following website: http://www.purdue.edu/purdue/ea_eou_statement.html. If you see, hear or experience discrimination in any form you are always welcome to discuss it with Prof. Trumble. The College of Engineering also has a website that provides extensive resources for diversity at: https://engineering.purdue.edu/Engr/AboutUs/Diversity/DiversityResources.
Academic Dishonesty Policy
Purdue University Regulations, Part 5, Section III-B-2-a describes the formal policies governing academic dishonesty. A guide providing specific examples, tips, and consequences is available at http://www.purdue.edu/odos/osrr/academic-integrity/index.html. You are encouraged to study together and discuss coursework, but any work you turn in for grading is expected to be your own original work. Notes presented in the lectures are subject to copyright. Students in the course are granted permission to copy and exchange these notes with other students in the course, but they cannot be sold, bartered or posted on any website.