Course Approval Form

For instructions:
http://registrar.gmu.edu/facultystaff/catalog-revisions/course/

Action Requested: (definitions available at website above)
[x] Create NEW [ ] Inactivate
[ ] Modify (check all that apply below)

[ ] Title (must be 75% similar to original) [ ] Repeat Status [ ] Prereq/coreq [ ] Grade Mode
[ ] Credits [ ] Schedule Type [ ] Restrictions [ ] Other: _____

Course Level:
[x] Undergraduate [ ] Graduate

College/School: College of Science **Department:** Mathematical Sciences
Submitted by: Daniel M. Anderson **Ext:** 3-1482 **Email:** danders1@gmu.edu

Subject Code: MATH **Number:** 401
(Do not list multiple codes or numbers. Each course proposal must have a separate form.)

Effective Term: [x] Fall [ ] Spring [ ] Summer *Year* 2017

Title: Current: Mathematics Through 3D Printing
Banner (30 characters max w/ spaces):
New:

Fulfills Mason Core Req? (undergrad only)
[ ] Currently fulfills requirement
[ ] Submission in progress

Credits: (check one)
[x] Fixed → 3
[ ] Variable → to
[ ] Lec + Lab/Rct→ 0 or

Repeat Status: (check one)
[x] Not Repeatable (NR)
[ ] Repeatable within degree (RD) →
[ ] Repeatable within term (RT) →
Max credits allowed: (required for RT/RD status only)

Grade Mode: (check one)
[x] Regular (A, B, C, etc.)
[ ] Satisfactory/No Credit
[ ] Special (A, B C, etc. +IP)

Schedule Type: (check one) LEC can include LAB or RCT if linked sections will be offered
[x] Lecture (LEC)
[ ] Lab (LAB)
[ ] Recitation (RCT)
[ ] Internship (INT)
[ ] Independent Study (IND)
[ ] Seminar (SEM)
[ ] Studio (STU)

Prerequisite(s) (NOTE: hard-coding requires separate Prereq Checking form; see above website):
MATH 290 and at least three credits of Mathematics above MATH 300

Corequisite(s):

Restrictions Enforced by System: Major, College, Degree, Program, etc. Include Code(s).

Equivalencies (check only as applicable):
[ ] YES, course is 100% equivalent to _____
[ ] YES, course renumbered to or replaces _____

Catalog Copy (Consult University Catalog for models)

Description (No more than 60 words, use verb phrases and present tense)	Notes (List additional information for the course)
Incorporates new mathematics from a large variety of fields into the design and creation of 3D printed models, as well as the written and oral communication of these mathematical ideas. Topics vary but might include regular and quasiregular tilings, Platonic and Archimedean solids and their duality, orientable and non-orientable surfaces, fractals, chaotic attractors, Riemann surfaces, and data visualization.	

Indicate number of contact hours: Hours of Lecture or Seminar per week: 3 Hours of Lab or Studio:
When Offered: (check all that apply) [x] Fall [ ] Summer [ ] Spring

Approval Signatures

College/School Approval Date

...by any other units, the originating department must circulate this proposal for review by ...ssion. Failure to do so will delay action on this proposal.

	Unit Approver's Signature	Date

Undergraduate or Graduate Council Approval

UGC or GC Council Member | Provost's Office | UGC or GC Approval Date

Form revised 9/2/2015

Course Proposal Submitted to the College of Science Curriculum Committee (COSCC)

The form above is processed by the Office of the University Registrar. This second page is for the COSCC's reference. Please complete the applicable portions of this page to clearly communicate what the form above is requesting.

FOR ALL COURSES (required)

Course Number and Title: MATH 401, Mathematics Through 3D Printing

Date of Departmental Approval: October 22, 2016

FOR INACTIVATED/REINSTATED COURSES (required if inactivating/reinstating a course)

- Reason for Inactivating/Reinstating:

FOR MODIFIED COURSES (required if modifying a course)

- Summary of the Modification:
- Text before Modification (title, repeat status, catalog description, etc.):
- Text after Modification (title, repeat status, catalog description, etc.):
- Reason for the Modification:

FOR NEW COURSES (required if creating a new course)

- Reason for the New Course: 3D printing is an emerging technology that has broad impacts in many areas of manufacturing and also has great promise in its connection to mathematics. This new course establishes a setting in which students can explore these mathematical connections through the design and creation of 3D printed models. The course is expected to meet the Mason Core Synthesis requirement.
- Relationship to Existing Programs: This course is expected expand the choice of MATH courses that meet the Synthesis requirement – currently MATH 400: History of Mathematics is the only MATH course that meets the Synthesis requirement.
- Relationship to Existing Courses: This is a new course but it has been taught one time previously as MATH 493.
- Semester of Initial Offering: Fall 2017
- Proposed Instructors: Evelyn Sander and Sean Lawton
- Insert Tentative Syllabus Below: See attached.

Math 493: Mathematics Through 3D Printing, Spring 2016

Exploratory Hall 4107, TR 10:30-11:45

Instructor: Evelyn Sander (4408 Exploratory Hall, 993-1490, esander@gmu.edu)
Office Hours: TR 3:30-4:15 (or by appointment)

Learning Assistant: Ratna Khatri (3D printer room, graduate office)
Office Hours: There will be 10 hours to be announced as soon as everyone's time slot has been finalized.

Text: *There is no textbook for this class, but regular reading assignments will be given on Blackboard.*
Software: You will need to download the following:

- Makerbot Desktop http://www.makerbot.com/desktop
- Open SCAD http://www.openscad.org
- Mathematica https://cos.gmu.edu/mathematica/ (available for students without charge, just follow the directions)
- Other software, as needed throughout the semester.

Prerequisites: Math 290 and at least one semester of mathematics above Math 300.

Course Goals: This course gives you an opportunity to learn about geometric visualization and its uses within 3D printing.

The course will consist of a series of projects concentrating on the understanding of different types of mathematics through 3D visualization. The idea is to learn to understand and present math both in words and in terms of visualizations. There will be some lectures, and some reading assigned to the whole class, but for the most part the class will work on a series of assigned projects.

The mathematical content of the course consists of an overview of a number of diverse subjects. Thus the reading materials will consist of research papers and small portions of textbooks rather than a single assigned textbook. Software used consists of Mathematica and various free software specially designed for 3D printing. In some cases, students will also use Matlab for creating data and a free software for visualizing it.

Students will design, create, and print physical models to demonstrate the mathematical theory that they have learned. These prints will be displayed in the departmental display case on the ground floor of Exploratory Hall as well as in the Tutoring Center. These printed objects will be accompanied by a brief description on a museum-style placard prepared by the student. In addition to the print and placard, students will incorporate the mathematics they have learned and the print they have created to explain it in a variety of both written and oral forms such as blog posts, poster presentations, oral presentations, and a writeup. As outreach opportunities arise, students are encouraged to present their poster or talk. Projects will each be in a different general category of mathematics, as follows:

- Regular and irregular tilings in two and three dimensions: wallpaper patterns, Penrose tilings, quasicrystals
- Polyhedra and their properties: five Platonic solids, duality, truncation

- Surfaces and hypersurfaces: quadric surfaces, complex surfaces, isosurfaces, Hopf fibration
- Fractals and dynamical systems: Mandelbrot and Julia sets, attractors, chaos, invariant manifolds
- Differential equations: isosurfaces of solutions with complex pattern formation

Grading Policy:

Weekly Projects 100%

In general, 90%-100% = A, 80%-89% = B, 70%-79% = C, 60%-69% = D, below 60% = F. Plus and minus grades will be approximately 2 or 3 percentage points above or below these boundaries (e.g. 88% would correspond to a B+). I reserve the right to lower the curve, but will not raise the curve.

Blackboard: This class will be using Blackboard. Other than this syllabus, all handouts or information will be on blackboard.

Schedule The list is tentative. Check Blackboard periodically for the most up to date information.

Intro *Intro to the class, 3D printer, and software*
Proj. 1 *Wallpaper patterns (create museum placard only)* 2/10
Proj. 2 *Penrose tilings* 2/17
Proj. 3 *Platonic solids and duality* 2/24
Proj. 4 *Archimedian solids and truncation* 3/2
Proj. 5 *Creation of Surfaces* 3/16
------ *Spring Break*
Proj. 6 *Hopf Fibration* 3/23
Proj. 7 *Mandelbrot and Julia Sets* 3/30
Proj. 8 *Attractors* (4/6)
Proj. 9 *Invariant manifolds* 4/13
Proj. 10 *Differential equations* 4/20
Proj. 11 *PDE Isosurfaces* 5/2
Final presentations *TBD*

Presentation of Projects: One of the goals of this class is effective communication of mathematics. For all projects, every student will create a museum placard and submit to me their working code and STL file. In addition, there will be a rotation of who does what presentation type, and each student will be assigned each format two times:

1. Blog post
2. Formal writeup
3. Poster
4. Oral presentation
5. Thingiverse entry with code and description of your STL file

Honor System: THIS IS IMPORTANT. PAY ATTENTION TO THIS. It is expected that each student in this class will conduct themself within the guidelines of the Honor Code. All academic work should be done with the level of honesty and integrity that this University demands.

How that applies: I encourage collaborative discussion. You are welcome to interact and discuss your code ideas and mathematics with other students, as well as getting ideas from others. However, your ultimate writeup, presentation, and code structure should be completely your own.

The following is a list of resources and official university guidelines:

ACADEMIC INTEGRITY

GMU is an Honor Code university; please see the University Catalog for a full description of the code and the honor committee process. The principle of academic integrity is taken very seriously and violations are treated gravely. What does academic integrity mean in this course? Essentially this: when you are responsible for a task, you will perform that task. When you rely on someone else's work in an aspect of the performance of that task, you will give full credit in the proper, accepted form. Another aspect of academic integrity is the free play of ideas. Vigorous discussion and debate are encouraged in this course, with the firm expectation that all aspects of the class will be conducted with civility and respect for differing ideas, perspectives, and traditions. When in doubt (of any kind) please ask for guidance and clarification.

GMU EMAIL ACCOUNTS

Students must use their Mason email accounts - either the existing "MEMO" system or a new "MASONLIVE" account to receive important University information, including messages related to this class. See http://masonlive.gmu.edu for more information.

OFFICE OF DISABILITY SERVICES

If you are a student with a disability and you need academic accommodations, please see me and contact the Office of Disability Services (ODS) at 993-2474. All academic accommodations must be arranged through the ODS. http://ods.gmu.edu

OTHER USEFUL CAMPUS RESOURCES:

WRITING CENTER: A114 Robinson Hall; (703) 993-1200; http://writingcenter.gmu.edu

UNIVERSITY LIBRARIES "Ask a Librarian" http://library.gmu.edu/mudge/IM/IMRef.html

COUNSELING AND PSYCHOLOGICAL SERVICES (CAPS): (703) 993-2380; http://caps.gmu.edu

UNIVERSITY POLICIES

The University Catalog, http://catalog.gmu.edu, is the central resource for university policies affecting student, faculty, and staff conduct in university academic affairs. Other policies are available at http://universitypolicy.gmu.edu/. All members of the university community are responsible for knowing and following established policies.