SYLLABUS FOR MATH 128: MATHEMATICAL DESIGN

General Information:

College: Queens College
Department: Mathematics
Course section, Day and Time of Class Meetings: Sec. 01, Mondays and Wednesdays 10:45-12:00
Building and Room Number: Kiely Hall, Room 061.
Instructor name and contact information: Christopher Hanusa, chanusa@qc.cuny.edu, 718-997-5964.

Course Description:

MATH 128. Mathematical Design. 3 hr.; 3 cr. Prereq.: MATH 115 or the equivalent. Students will program computers to create digital art based on mathematical exploration of two-dimensional geometry. Topics include transformations of the plane, trigonometric functions, polar coordinates, parametric functions, and Mobius transformations. No prior experience in programming is necessary.

Textbook Information:

All course information, including syllabus, assignments, and readings will be posted on the course webpage. We will use free online and open-source resources such as desmos.com and p5js.org, the latter of which has extensive documentation available at p5js.org/reference. Students will be expected to purchase pens and paper for use in the pen plotters provided through the Queens College Makerspace.

Attendance Policy:

Students are expected to attend class regularly; missing multiple classes will impact your grade negatively for the following reasons. Class participation (including daily informal assessments, asking questions in class, and active participation in class) contributes 10% to your final grade. Furthermore, your project grades include a component based on serious participation in the creative process, some of which will happen in class.

Discipline/Course Specific Learning Objectives:

LO1. Develop familiarity with cartesian and polar coordinates.
LO2. Develop familiarity with a variety of cartesian, trigonometric, polar, and parametric functions.
LO3. Understand geometric objects and the behavior of a variety of transformations on them.
LO4. Successfully implement algorithmic techniques including iteration and randomization.
LO5. Gain an ability to analyze a problem, and identify and define the mathematical foundations and computing requirements appropriate to its solution.
LO6. Develop an appreciation for mathematical constructs and their aesthetics.
LO7. Develop the ability to work productively and effectively with others.
LO8. Develop techniques for succeeding in college classes, including instilling a growth mindset.

Queens College General Education Statement.

This course satisfies a Mathematics and Quantitative Reasoning (MQR) Required Core.

Required Core Mathematics and Quantitative Reasoning courses must satisfy all six of the following criteria:

MQR1. Interpret and draw appropriate inferences from quantitative representations, such as formulas, graphs, or tables.
MQR2. Use algebraic, numerical, graphical, or statistical methods to draw accurate conclusions and solve mathematical problems.
MQR3. Represent quantitative problems expressed in natural language in a suitable mathematical format.
MQR4. Effectively communicate quantitative analysis or solutions to mathematical problems in written or oral form.
MQR5. Evaluate solutions to problems for reasonableness using a variety of means, including informed estimation.
MQR6. Apply mathematical methods to problems in other fields of study. Understand and use the concepts and methods of a discipline or interdisciplinary field.

This course satisfies: MQR1, MQR2, MQR3, MQR4, MQR5, and MQR6.

Description of Assignments & Exams:

Throughout the semester students will have the opportunity to show mastery of the learning objectives through daily informal assessments, formal summative assessments every two weeks, and projects created during the semester culminating in a portfolio of student work.

Informal assessments will give students the opportunity to show progress in reading comprehension. Formal assessments will assess student understanding of key mathematical and computing concepts. These are tentatively scheduled for 9/9, 9/18, 10/16, 10/28, 11/18, and 11/27.

Projects will afford students the opportunity to apply their knowledge to be creative with mathematics by designing mathematical constructions digitally that will be realized physically by pen plotters. There will be a writing component to these projects that demonstrate the intentionality behind them. These projects will be developed over time and subject to peer review. Project due dates are tentatively scheduled for 9/25, 11/6, and 12/11. Students will have the opportunity to revise their projects before their incorporation into a final portfolio of student work, which will be presented to the class during the final exam period.

Course Grade:

Students' grades will be determined by the following rubric:

Class Participation:	10%
Assessments:	30%
Project 1:	10%
Project 2:	15%
Project 3:	15%
Final Portfolio:	20%

QUEENS COLLEGE

Course Calendar:

#	Day & Date	Topic	Assignments	Objectives/ Criteria Met
1	Wed. Aug. 28, 2020	Introduction, x- and y-coordinates, functions, using desmos		LO1, LO2, MQR1
2	Wed. Sep. 04, 2020	Types of functions, horiz/vert shift/scaling		LO2, LO6, MQR1, MQR3
3	Thu. Sep. 05, 2020	Trigonometric functions and graphing		LO2, MQR1, MQR3
4	Mon. Sep. 09, 2020	Copies of functions in Desmos, exporting	ASSESS 1	LO4, LO5, MQR3
5	Wed. Sep. 11, 2020	How to: Pen plotting		MQR6
6	Mon. Sep. 16, 2020	Intentionality in art and math		LO6, LO8, MQR5, MQR6
7	Wed. Sep. 18, 2020	In-class work day	ASSESS 2	LO5, MQR2, MQR5, MQR6
8	Mon. Sep. 23, 2020	Peer Review Day		LO7, LO8, MQR4, MQR5
9	Wed. Sep. 25, 2020	Geometric Objects	PROJECT 1	LO3, LO6, MQR3
10	Wed. Oct. 02, 2020	Simple Coding in p5.js		LO3, LO5, MQR2, MQR6
11	Mon. Oct. 07, 2020	Transformations of objects		LO3, MQR1, MQR3
12	Wed. Oct. 16, 2020	For loops and if statements in p5.js	ASSESS 3	LO4, LO5, MQR2, MQR6
13	Mon. Oct. 21, 2020	Using random numbers to create generative art		LO4, LO5, LO6, MQR2, MQR3, MQR6
14	Wed. Oct. 23, 2020	Exporting in p5.js		LO5
15	Mon. Oct. 28, 2020	In-class work day	ASSESS 4	LO5, LO6, MQR2, MQR5, MQR6
16	Wed. Oct. 30, 2020	In-class work day		LO5, LO6, MQR2, MQR5, MQR6
17	Mon. Nov. 04, 2020	Peer Review Day		LO7, LO8, MQR4, MQR5
18	Wed. Nov. 06, 2020	Polar coordinates, Polar functions	PROJECT 2	LO1, LO2, MQR1, MQR3
19	Mon. Nov. 11, 2020	Parametric functions		LO2, MQR1, MQR3
20	Wed. Nov. 13, 2020	Coding parametric functions in p5.js		LO5, MQR2
21	Mon. Nov. 18, 2020	Mobius transformations	ASSESS 5	MQR1
22	Wed. Nov. 20, 2020	Mobius transformations		MQR1, MQR3
23	Mon. Nov. 25, 2020	Coding mobius transformations in p5.js		LO5, MQR2, MQR6
24	Wed. Nov. 27, 2020	In-class work day	ASSESS 6	LO5, LO6, MQR2, MQR5, MQR6
25	Mon. Dec. 02, 2020	In-class work day		LO5, LO6, MQR2, MQR5, MQR6
26	Wed. Dec. 04, 2020	In-class work day		LO5, LO6, MQR2, MQR5, MQR6
27	Mon. Dec. 09, 2020	Peer Review Day		LO7, LO8, MQR4, MQR5
28	Wed. Dec. 11, 2020	In-class portfolio preparation	PROJECT 3	LO6
29	Final Exam Day	Portfolio Presentations	PORTFOLIO	LO6, LO7, LO8, MQR4

Examples of assignments and assessments

Examples of daily informal assessments:

For 9/4/20:

Before class on Wednesday, September 4, go online and search for examples of pen plotter artwork. (The hashtags #plottertwitter, #axidraw, and #creativecoding can be good places to start.) Choose two pieces of art that speak to you and share them on our course discussion board.

For 9/11/20:

In class we have been using Desmos to create multiple copies of functions and exporting them. Before class on Wednesday, September 11, practice creating your own drawing of multiple copies of functions and exporting them. On the course discussion board, share the link to the Desmos notebook that you have created and attach a copy of an exported image that you are especially proud of. If you are running into trouble with any of the steps, then contribute a question about the process to the discussion board.

Example of a formal summative assessments:

Assessment 1:

1. On graph paper, plot and label the points (a) (-1,-1) (b) (2,0) (c) (0,-3) (d) (1/2,-1/2).
2. Give the definition of a function.
3. You have the graph of a function y=f(x) that you want to transform. Match the following mathematical transformations with the corresponding transformation in words

a. f(x+a)	I. Rotate the graph of f about the origin
b. af(x)	II. Do a vertical scaling of the graph by a factor of a.
c. -f(-x)	III. Do a vertical reflection about the y-axis
d. f(-x)	IV. Do a horizontal shift to the left by a units.

4. Consider the function g(x)=2sin(x-π)+4. It is the composition of multiple transformations of the function f(x)=sin(x). Determine the sequence of transformations that have been applied to f(x). Graph y=sin(x) and each of the intermediate functions until you have graphed y=g(x).

Example of a project:

Project 1:

Your goal is to create a pen plotter drawing of a family of related functions.

Specifications:

The final product of this project will be a Desmos notebook, a pen plotter drawing, and a two-page writeup.

The Desmos notebook must:

Include the plot of one or more functions.
Apply mathematical transformations to each function, involving one or more parameters.
Use a list to specify the values of each parameter.

The pen plotter drawing must:

Be created by exporting a digital design from your Desmos notebook.
Be created using an AxiDraw plotter in the Makerspace.
Have its paper and pen chosen carefully to provide a desired aesthetic.

The two-page writeup must:

Provide key details about your pen plotter drawing.
Discuss the choices you made.
Convey the mathematics behind the drawing.
Discuss how you stretched your knowledge.
Discuss the revision process.
Be formatted in a clear and organized manner, using full sentences and proper English.
Use 1 inch margins, 1.5x spacing, and 11-point Times New Roman font.

Your project will be graded on the following criteria:

Timeliness
Intentionality
Complexity
Discussion of Mathematical and Functional Techniques
Discussion of Artistic Qualities
Writing style and Format

While you are only submitting one drawing, you should keep three to five of your best drawings to add to your final portfolio.