

## Term Information

Effective Term Spring 2021  
*Previous Value* Spring 2020

## Course Change Information

### What change is being proposed? (If more than one, what changes are being proposed?)

Add two GE designations for this course: Culture and Ideas and Social Diversity in the US.

### What is the rationale for the proposed change(s)?

This course, as designed had elements of the GEs mentioned; however, they were not explicitly requested or written up at the time of the original course request.

### What are the programmatic implications of the proposed change(s)?

(e.g. program requirements to be added or removed, changes to be made in available resources, effect on other programs that use the course)?

None.

Is approval of the request contingent upon the approval of other course or curricular program request? No

Is this a request to withdraw the course? No

## General Information

Course Bulletin Listing/Subject Area	Mathematics
Fiscal Unit/Academic Org	Mathematics - D0671
College/Academic Group	Arts and Sciences
Level/Career	Undergraduate
Course Number/Catalog	2010S
Course Title	Intersections of Mathematics and Society: Hidden Figures
Transcript Abbreviation	Hidden Figures
Course Description	This course examines the intersections of race, gender, and mathematics as it relates to the accomplishments of the African-American mathematicians featured in the book. We analyze how mathematics and the advancement of American society were intertwined from WWII to the Space Race and focus on understanding the mathematical tools used by human computers and scientists at Langley during this time.
Semester Credit Hours/Units	Fixed: 3

## Offering Information

Length Of Course	14 Week, 8 Week
Flexibly Scheduled Course	Never
Does any section of this course have a distance education component?	No
Grading Basis	Letter Grade
Repeatable	No
Course Components	Lecture
Grade Roster Component	Lecture
Credit Available by Exam	No
Admission Condition Course	No
Off Campus	Sometimes
Campus of Offering	Columbus

## Prerequisites and Exclusions

Prerequisites/Corequisites	Prereq: A grade of C- or above in 1148 and 1149; or a grade of C- or above in 1150; or Math Placement Level L.
Exclusions	
Electronically Enforced	Yes

## Cross-Listings

Cross-Listings

## Subject/CIP Code

Subject/CIP Code	27.0101
Subsidy Level	Baccalaureate Course
Intended Rank	Sophomore, Junior, Senior

## Requirement/Elective Designation

General Education course:  
Culture and Ideas; Social Diversity in the United States; Service-Learning (new)

### *Previous Value*

*General Education course:  
Service-Learning (new)*

## Course Details

Course goals or learning objectives/outcomes	<ul style="list-style-type: none"><li>• Exposure to different careers in the mathematical sciences.</li><li>• Understand historical and contemporary mathematical tools and ideas.</li><li>• Critically examine the relationship between mathematical innovation, technological advancement, and society.</li><li>• Use intersectionality as a framework to critically examine how the intersections of race, gender, and socioeconomic status influence access to mathematical communities and opportunities in STEM.</li><li>• Effectively communicate mathematics to an audience of varying ages and mathematical backgrounds.</li><li>• Make connections between concepts and skills learned in class and service-learning activities.</li><li>• Demonstrate an understanding of the mathematical communities in which service-learning activities take place.</li><li>• Reflect on the impacts of mathematical outreach.</li></ul>
Content Topic List	<ul style="list-style-type: none"><li>• Intersections of Mathematics and Society: World War II</li><li>• When Computers Were Human: Mathematical Tools during World War II</li><li>• Mathematical Tools: from Slide Rules to TI-84s</li><li>• Mathematical Tools: Understanding Wind Tunnels</li><li>• Analytic Geometry: Mathematics of Space Travel</li><li>• Intersections of Mathematics and Society: Executive Orders and Advancement at Langley</li></ul>
Sought Concurrence	No
<i>Previous Value</i>	<b>Yes</b>

**Attachments**

- Math 2010S Syllabus.pdf: Syllabus  
*(Syllabus. Owner: Husen,William J)*
- Culture and Ideas GE Rationale.pdf: Culture-Ideas rationale  
*(GEC Model Curriculum Compliance Stmt. Owner: Husen,William J)*
- Culture and Ideas GE Assessment Plan.pdf: Culture-Ideas assessment  
*(GEC Course Assessment Plan. Owner: Husen,William J)*
- Social Diversity in the US GE Rationale.pdf: Social Diversity rationale  
*(GEC Model Curriculum Compliance Stmt. Owner: Husen,William J)*
- Social Diversity in the US GE Assessment Plan.pdf: Social Diversity assessment  
*(GEC Course Assessment Plan. Owner: Husen,William J)*
- Hidden\_Figures\_syllabus\_update\_10\_15\_2020l.pdf: Syllabus-update  
*(Syllabus. Owner: Husen,William J)*
- culture\_ideas\_rationale\_assessment\_update\_10\_15\_2020.pdf: Culture-ideas-assessment-update  
*(GEC Course Assessment Plan. Owner: Husen,William J)*
- social\_diversity\_rational\_assessment\_update\_10\_15\_2020.pdf: Social-diversity-assessment-update  
*(GEC Course Assessment Plan. Owner: Husen,William J)*

**Comments**

- Updated syllabus and assessment plans based on panel feedback - added new updates but did not delete originals.  
*(by Husen,William J on 10/16/2020 09:21 AM)*
- See panel feedback sent on 10-6-20 *(by Vankeerbergen,Bernadette Chantal on 10/06/2020 04:43 PM)*

**Workflow Information**

Status	User(s)	Date/Time	Step
Submitted	Husen,William J	09/01/2020 08:45 AM	Submitted for Approval
Approved	Husen,William J	09/01/2020 08:45 AM	Unit Approval
Approved	Haddad,Deborah Moore	09/01/2020 01:30 PM	College Approval
Revision Requested	Vankeerbergen,Bernadette Chantal	10/06/2020 04:43 PM	ASCCAO Approval
Submitted	Husen,William J	10/16/2020 09:21 AM	Submitted for Approval
Approved	Husen,William J	10/16/2020 09:21 AM	Unit Approval
Approved	Haddad,Deborah Moore	10/16/2020 11:08 AM	College Approval
Pending Approval	Jenkins,Mary Ellen Bigler Hanlin,Deborah Kay Oldroyd,Shelby Quinn Vankeerbergen,Bernadette Chantal	10/16/2020 11:08 AM	ASCCAO Approval

# Syllabus: Math 2010S

## Intersections of Mathematics and Society: Hidden Figures

### Instructors



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### Course Description

In this course we will critically examine the intersections of race, gender, and mathematics as it relates to the accomplishments of the African-American mathematicians featured in the book *Hidden Figures: the American Dream and the Untold Story of the Black Women Mathematicians Who Helped Win the Space Race* by Margot Lee Shetterly. In particular, we will contextualize the historical climate in which these accomplishments occurred and analyze how mathematics and the advancement of American society were intertwined from World War II to the Space Race. Finally, we will focus on understanding the mathematical tools used by human computers and scientists at Langley during pre and post-World War II.

### GE Information

Math 2010S satisfies the Social and Diversity in the US, Culture and Ideas, and the open option Service-Learning GE requirements.

#### Social and Diversity in the US GE

- **ELO 1:** Students describe and evaluate the roles of such categories as race, gender and sexuality, disability, class, ethnicity, and religion in the pluralistic institutions and cultures of the United States.
- **ELO2:** Students recognize the role of social diversity in shaping their own attitudes and values regarding appreciation, tolerance, and equality of others.

This course will accomplish these learning outcomes by (1) evaluating the juxtaposition between scientific and social progress during the Space Race to critically examine the relationship between mathematical innovation, technological advancement, and society; and (2) use intersectionality as a framework to critically examine how the intersections of race, gender, and socioeconomic status influence access to mathematical communities and opportunities in STEM.

#### Culture and Ideas GE

- **ELO 1:** Students analyze and interpret major forms of human thought, culture, and expression.
- **ELO2:** Students evaluate how ideas influence the character of human beliefs, the perception of reality and the norms which guide human behavior.

This course will accomplish these learning outcomes by (1) evaluating how social context influences a sense of belonging in STEM; and (2) identify and analyze major components of scientific culture and community.

#### Service-Learning GE

- **ELO 1:** Students make connections between concepts and skills learned in an academic setting and community-based work.
- **ELO 2:** Students demonstrate an understanding of the issues, resources, assets, and cultures of the community in which they are working.
- **ELO 3:** Students evaluate the impacts of the service-learning activity.

This course will accomplish these learning outcomes through student application of knowledge from the course through civic engagement with the local Columbus Community through participation in COSIs Color of Science Initiative, and STEM programming at the Columbus Metropolitan Library (CML) branches.

#### Course Materials

##### Required Text

*Hidden Figures: the American Dream and the Untold Story of the Black Women Mathematicians Who Helped Win the Space Race.* Margot Lee Shetterly, ISBN: 978-0-06-236359-6

Available for purchase at [Barnes & Noble](#) or [Amazon](#) and other book sellers

##### Supplementary Text

*Living Proof: Stories of Resilience Along the Mathematical Journey.* Allison Henrich, Emille D. Lawrence, Matthew A. Pons, and David G. Taylor, Editors., ISBN: 978-1-47-045281-0 (available at [https://www.maa.org/sites/default/files/pdf/ebooks/pdf/LivingProof WEB.pdf](https://www.maa.org/sites/default/files/pdf/ebooks/pdf/LivingProof_WEB.pdf))

All other supplementary readings will be provided by the instructors.

## Course Prerequisites

A grade of C- or above in Math 1148 and Math 1149; or a grade of C- or above in Math 1150; or credit for Math 150; or Math Placement Level L.

## Grading

Assignment Category	Percentage of Final Grade
<a href="#">Hidden Figures Project</a>	30%
<a href="#">Service Learning Project</a>	40%
Worksheets	15%
Discussion Posts/Quizzes	15%
Total	100%

### Hidden Figures Project

The Hidden Figures project will be broken into three components with all three components totaling 30% of the course grade. A more detailed description of each component can be found in the table below. Complete rubrics for these projects will be made available throughout the course.

Part	Percentage	Description
I. Hidden Figure Analysis	10%	In this project students will describe how their research figure meets the criteria of being a hidden figure using intersectionality as a framework for their discussion.
II. Mathematical Description	10%	In this project students will describe the mathematical tools used by their hidden figure. Students should also research connections between these modern tools and their historical roots. In addition, student will describe the relevance of the work being done by the hidden figure to their company and/or society at large.
III. Profile	10%	The first two parts of the research project will culminate in a digital profile of the Hidden Figure that highlights their personal and professional background along with mathematical tools used in their work.

### Service-Learning Project

The service-learning project will be broken into three components, with all three components totaling 40% of the course grade. A more detailed description of each component can be found in the table below. Complete rubrics for these projects will be made available throughout the course.

Part	Percentage	Description
I. Service Learning Program	20%	Students will be paired in groups and workshop an original STEM program to be delivered to select branches of the Columbus Metropolitan Library.
II. Service Learning Reflections	10%	There will be multiple reflection activities throughout the semester in order to connect the service-learning activities with the content covered during class. Each short reflection will typically be 1 to 2 pages in length. These will be completed through the Carmen course site.
III. Service Learning Portfolio	10%	The portfolio will be comprised of the service learning reflections, artifacts from the service learning program, and the digital profile from the Hidden Figures Project. The portfolio will include cover letter where students reflect on the historical mathematical communities studied in class, the local communities they served, and their own sense of belonging within STEM.

### Worksheets

There will be worksheets throughout the semester that focus on examining historical and contemporary mathematics related to the mathematical tools that were integral to the advancements related to the Space Race discussed in the Hidden Figures text, as well as mathematical ideas presented by guest speakers.

### Discussion Posts/Quizzes

There will be weekly reading quizzes and discussion prompts comprising 15% of the course grade. The quizzes will be based on the Hidden Figures text and relevant course topics. The weekly discussion forum will take place on the Carmen course site. Students will use the discussion board to discuss themes related to course objectives.

### Percentage Grading Scale

A	A-	B+	B	B-	C+	C	C-	D+	D	E
[100, 93)	[93, 90]	(90, 87]	(87, 83]	(83, 80]	(80, 77]	(77, 73]	(73, 70]	(70, 67]	(67, 60]	< 60

### Tentative Course Schedule

Week	Topics	Assignments/Events
1	<ul style="list-style-type: none"> <li>Hidden Figures in Mathematics</li> <li>Introduction to Service-Learning</li> </ul>	<ul style="list-style-type: none"> <li>Perceptions of Mathematics Survey Due</li> </ul>

2	<ul style="list-style-type: none"> <li>• Intersections of Mathematics and Society: World War II</li> <li>• Introduction to Intersectionality</li> <li>• Civil Rights in World War II: "The Double V"</li> </ul>	<ul style="list-style-type: none"> <li>• Hidden Figure Project: Subject Ranking Due</li> <li>• Hidden Figure Project: Groups Assigned</li> <li>• Discussion Prompt 1 Due</li> <li>• Reading Quiz 1 (HF Ch.1,2,3,4) Due</li> <li>• Service-Learning Reflection 1 Due</li> </ul>
3	<ul style="list-style-type: none"> <li>• When Computers Were Human: Mathematical Tools during World War II</li> <li>• Mathematical Tools: from Slide Rules to TI-84s</li> </ul>	<ul style="list-style-type: none"> <li>• Hidden Figures Project: Interview Questions Due</li> <li>• Discussion Prompt 2 Due</li> <li>• Reading Quiz 2 (HF Ch.5,6) Due</li> </ul>
4	<ul style="list-style-type: none"> <li>• Computing with Slide Rules</li> <li>• Mathematical Communities</li> <li>• Dorothy Vaughn: Opportunities in STEM</li> </ul>	<ul style="list-style-type: none"> <li>• Worksheet 1 Due</li> <li>• Discussion Prompt 3 Due</li> <li>• Reading Quiz 3 (HF Ch.7,8,9)</li> </ul>
5	<ul style="list-style-type: none"> <li>• Mathematical Tools: Understanding Wind Tunnels</li> <li>• What about the Men at NACA?</li> <li>• Mary Jackson: Advocacy in STEM</li> </ul>	<ul style="list-style-type: none"> <li>• Discussion Prompt 4 Due</li> <li>• Reading Quiz 4 (HF Ch.10,11) Due</li> <li>• Hidden Figure Analysis Due</li> </ul>
6	<ul style="list-style-type: none"> <li>• Analytic Geometry: Mathematics of Space Travel</li> <li>• Understanding Trajectories: Go, No Go</li> </ul>	<ul style="list-style-type: none"> <li>• Discussion Prompt 5 Due</li> <li>• Reading Quiz 5 (HF Ch.12,13,14) Due</li> <li>• Mathematical Description Consultations Scheduled</li> </ul>
7	<ul style="list-style-type: none"> <li>• Katherine Johnson: Belonging in STEM</li> <li>• FORTRAN: Mathematical Training to Computer Programming</li> </ul>	<ul style="list-style-type: none"> <li>• Worksheet 2 Due</li> <li>• Discussion Prompt 6 Due</li> <li>• Reading Quiz 6 (HF Ch.15,16) Due</li> <li>• Service Learning Reflection 2 Due</li> </ul>
8	<ul style="list-style-type: none"> <li>• Communicating Mathematics: Technical Reports</li> <li>• Communicating Mathematics: Science Writing and Breaking things down for a General Audience</li> <li>• Sputnik: from NACA to NASA</li> </ul>	<ul style="list-style-type: none"> <li>• Discussion Prompt 7 Due</li> <li>• Reading Quiz 7 (HF Ch.17,18) Due</li> <li>• Mathematical Description Consultation Deadline</li> </ul>
9	<ul style="list-style-type: none"> <li>• Civil Rights and the Space Race: A Tale of Two Virginias</li> <li>• Mathematical Access: Mentors and Trail Blazers</li> <li>• Christine Darden: On Their Shoulders</li> </ul>	<ul style="list-style-type: none"> <li>• COSI Passport to Color of Science [service learning begins]</li> <li>• Discussion Prompt 8 Due</li> <li>• Reading Quiz 8 (HF Ch.19,20) Due</li> <li>• Mathematical Description Due</li> </ul>



10	<ul style="list-style-type: none"> <li>• Evolution of the West Computers</li> <li>• Intersections of Mathematics and Society: Executive Orders and Advancement at Langley</li> <li>• Katherine Johnson and Orbital Flight: “Get the Girl to Check the Numbers”</li> </ul>	<ul style="list-style-type: none"> <li>• Discussion Prompt 9 Due</li> <li>• Reading Quiz 9 (HF Ch.21) Due</li> <li>• COSI Passport to Color of Science</li> </ul>
11	<ul style="list-style-type: none"> <li>• Mathematics of Getting to the Moon: Apollo 11 and Apollo 13</li> <li>• Intersectionality and the Women in Hidden Figures</li> </ul>	<ul style="list-style-type: none"> <li>• Service Learning Reflection 3 Due</li> <li>• Discussion Prompt 10 Due</li> <li>• Reading Quiz 10 (HF Ch.22,23) Due</li> <li>• COSI Passport to Color of Science</li> </ul>
12	<ul style="list-style-type: none"> <li>• Civil Rights and the Space Race</li> <li>• Being a “Hyphen”-Scholar: Career Compromise in Hidden Figures</li> </ul>	<ul style="list-style-type: none"> <li>• Reading: HF Epilogue Due</li> <li>• COSI Passport to Color of Science</li> </ul>
13	<ul style="list-style-type: none"> <li>• Belonging in STEM</li> <li>• The Role of Service in Science</li> </ul>	<ul style="list-style-type: none"> <li>• Reading: Gloria Champine Transcripts; Excerpts from <i>Living Proof: Stories of Resilience Along the Mathematical Journey</i>.</li> <li>• COSI Passport to Color of Science</li> </ul>
14	<ul style="list-style-type: none"> <li>• Intersections of Mathematics and Society: Understanding your STEM identity</li> </ul>	<ul style="list-style-type: none"> <li>• <b>CML Presentation</b></li> <li>• Service Learning Reflection 4 Due</li> </ul>
15	<ul style="list-style-type: none"> <li>• Course Reflections</li> </ul>	<ul style="list-style-type: none"> <li>• Service Learning Portfolio</li> <li>• Hidden Figures Profile Due</li> </ul>

## Academic Misconduct

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term “academic misconduct” includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct <http://studentlife.osu.edu/csc/>.

## Mental Health Statement

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may

lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting [ccs.osu.edu](https://ccs.osu.edu) or calling 614- 292-5766. CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on call counselor when CCS is closed at 614-292-5766 and 24 hour emergency help is also available through the 24/7 National Suicide Prevention Hotline at 1-800-273- TALK or at [suicidepreventionlifeline.org](https://suicidepreventionlifeline.org).

## Disability Services

The University strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability (including mental health, chronic or temporary medical conditions), please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. SLDS contact information: [slds@osu.edu](mailto:slds@osu.edu); 614-292-3307; [slds.osu.edu](https://slds.osu.edu); 098 Baker Hall, 113 W. 12<sup>th</sup> Avenue.

## Title IX Statement

Title IX makes it clear that violence and harassment based on sex and gender are Civil Rights offenses subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories (e.g., race). If you or someone you know has been sexually harassed or assaulted, you may find the appropriate resources at <https://titleix.osu.edu> or by emailing the Ohio State Title IX Office at [titleix@osu.edu](mailto:titleix@osu.edu).

## Diversity Statement

The Ohio State University affirms the importance and value of diversity in the student body. Our programs and curricula reflect our multicultural society and global economy and seek to provide opportunities for students to learn more about persons who are different from them. We are committed to maintaining a community that recognizes and values the inherent worth and dignity of every person; fosters sensitivity, understanding, and mutual respect among each member of our community; and encourages each individual to strive to reach his or her own potential. Discrimination against any individual based upon protected status, which is defined as age, color, disability, gender identity or expression, national origin, race, religion, sex, sexual orientation, or veteran status, is prohibited.

# Culture & Ideas GE Proposal

## Math2010S: Intersections of Mathematics and Society: Hidden Figures

Our aim in this proposal is to highlight the ways in which our new course, Math 2010S, *Intersections of Mathematics and Society: Hidden Figures* fits seamlessly into the criteria for courses that satisfy the general education requirement for Culture & Ideas at the Ohio State University. Math 2010S was offered initially in the Spring of 2020 (under Math 2194), and was approved as a Service Learning GE in the 2019-2020 academic year.

We have included a description of our course, the expected learning outcomes (noting those that align with social diversity in the united states general elective), our assessment plan, and an appendix which includes a syllabus along with excerpts from selected assignments.

## Course Description

This course examines the intersections of race, gender, and mathematics as it relates to the accomplishments of the African-American mathematicians featured in the text *Hidden Figures: The American Dream and the Untold Story of the Black Women Who Helped Win the Space Race*. We analyze how mathematics and the advancement of American society were intertwined from WWII to the Space Race and focus on understanding the mathematical tools used by human computers and scientists at Langley during this time.

This is a project-based service-learning course, where one of the primary projects involves pairing students with leaders in STEM positions at companies in the Greater Columbus Community that are local 'Hidden Figures.' The students will learn about a particular mathematical community from their local Hidden Figure, and investigate the mathematical tools used in their work. In addition to this project, students will also participate in service-learning with the Columbus Metropolitan Library branches by creating original STEM programming related to the major course projects.

## GE Rationale

Here we identify the ways in which our course will meet the expected learning outcomes for the Culture & Ideas GE:

- **ELO1:** Students analyze and interpret major forms of human thought, culture, and expression.

- **ELO2:** Students evaluate how ideas influence the character of human beliefs, the perception of reality and the norms which guide human behavior.

## Course Objectives

A primary goal of our course Math 2010S *Intersections of Mathematics and Society: Hidden Figures* is to use the Space Race as a case study to understand how society influences the development of scientific communities. In particular, we focus on the juxtaposition of scientific versus social progress that occurred during the time period, and examine the paradox of slow racial progress for African Americans in the United States compared to the unprecedented access to opportunity at NASA’s Langley Research Center for the African American women featured in the *Hidden Figures* text by Margot Shetterly.

This historical perspective will allow students to develop the capacity to understand diversity and inclusion in scientific communities. Students will understand how race, gender, and socioeconomic status influenced access to mathematical communities during the time period of the *Hidden Figures* story. They will then use partnerships with local ‘Hidden Figures’ in the Columbus Metropolitan Area to further develop a framework for diversity and inclusion in STEM. Students will also be able to understand their own journey’s in STEM and better position themselves to create and join inclusive communities, and to have experiences within the major with more healthy STEM identities.

Below we highlight compatibility of select existing course goals with the two expected learning outcomes of the Culture & Ideas GE.

Course Goal	Culture & Ideas ELO Compatibility
(1) Students evaluate the juxtaposition between scientific and social progress during the Space Race to critically examine the relationship between mathematical innovation, technological advancement, and society.	ELO2
(4) Use intersectionality as a framework to critically examine how the intersections of race, gender, and socioeconomic status influence access to mathematical communities and opportunities in STEM.	ELO1
(6) Students evaluate how social context influences a sense of belonging in STEM.	ELO2

(7) Students identify and analyze major components of scientific culture and community.	ELO1, ELO2
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## Course Readings

1. Primary text (ELO1, ELO2): *Hidden Figures: the American Dream and the Untold Story of the Black Women Mathematicians Who Helped Win the Space Race* by Margot Lee Shetterly

Two themes in the *Hidden Figures* story are (1) how African American women, along with others, obtained new opportunities to join and contribute to mathematical communities in the context of WWII and throughout the Space Race, and (2) how the availability of new mathematical tools facilitate rapid scientific advancement surrounding aviation and space flight. A focus of the course is on having students understand and explore how these two themes of rapid cultural changes facilitating expanded opportunities and development of new mathematical techniques and tools were mutually reinforcing phenomenon.

2. Supplementary Text (ELO2 “myth of a math person”): *Living Proof: Stories of Resilience Along the Mathematical Journey*

This text is a collection of accounts of how different contemporary mathematicians have navigated their STEM journeys. It was written to inspire students encountering various struggles in their pursuit of learning mathematics. In particular, it is written to help encourage students to challenge their beliefs of what it means to be a ‘math person,’ and how their own limiting beliefs affect their sense of belonging in mathematics. This reading helps aid students to understand how their self perception plays a role in how they interact with others in STEM communities.

## Course Topics

The following list of relevant course topics are taken from our course schedule of topics. We have categorized them according to the expected learning outcomes relevant to the Culture and Ideas GE.

**ELO1:** Students analyze and interpret major forms of human thought, culture, and expression.

- Intersections of Mathematics and Society: World War II

- When Computers Were Human: Mathematical Tools during World War II
- Mathematical Tools: from Slide Rules to TI-84s
- Analytic Geometry: Mathematics of Space Travel
- Understanding Trajectories: Go, No Go
- FORTRAN: Mathematical Training to Computer Programming

**ELO2:** Students evaluate how ideas influence the character of human beliefs, the perception of reality and the norms which guide human behavior.

- Intersections of Mathematics and Society: World War II
- When Computers Were Human: Mathematical Tools during World War II
- Mathematical Tools: from Slide Rules to TI-84s
- Mathematical Tools: Understanding Wind Tunnels
- Communicating Mathematics: Technical Reports
- Mathematical Access: Mentors and Trail Blazers
- Evolution of the West Computers
- Mathematics of Getting to the Moon

## Written Assignments

1. Hidden Figures Analysis (ELO1, ELO2)
  - **ELO1:** One significant component of this assignment is the mathematical analysis. For this component students explain the important and fundamental mathematical tools (either conceptual, hardware, or software) their STEM professionals use in their day-to-day work. One common theme students discover is that contemporary mathematical tools are often complex instruments that require specialized training but are critical to their STEM professionals' workflows. In Appendix C, we have included an excerpt of the assignment instructions students receive for the 'Hidden Figures Mathematical Analysis' component..
  - **ELO2:** The other significant component of this assignment is the background analysis. For this component students learn how mentorship and their STEM professionals' personal backgrounds both helped and hindered their access to STEM communities. One common theme students discover is that access to STEM communities and professional success is (outside the technical training all STEM professionals receive) mostly influenced by the "local culture" created by these mentorship and personal networks. In Appendix C, we have included an excerpt of the 'Hidden Figures Background Analysis' component.
2. Service Learning Portfolio (ELO2)
  - **ELO2:** One component of the portfolio is that students are asked to write a cover letter reflecting on the STEM communities discussed in class, the local

communities students themselves are members of, and students' sense of belonging in STEM. This summary reflection connects with a major theme of the course: access to mentorship, personal, and professional networks create a "local culture" that mediates access to opportunities and feelings of belonging in STEM communities.

3. Discussion Board Posts (ELO1, ELO2):

- **ELO1:** Many of the discussion board posts ask students to analyze the changing historical context in the hidden figures story. Students' responses form the basis of in-class discussions where we explore both the institutional and structural changes necessary to create new avenues of opportunities and understand how the intersections of different racial, gender, and socioeconomic backgrounds/identities of the hidden figures enabled or hindered access to these opportunities. In Appendix A, we include a sample of our discussion board prompts 1 and 6.
- **ELO2:** One significant idea we talk about in the course is how the rapidly expanding aviation industry and the rapid need for new workers due to World War II combined with social activism to create new professional opportunities for African American men and women in federal jobs despite ongoing legal segregation. Once African American professionals gained access to these spaces, we analyze the institutional and individual forces that helped many of them to integrate (in a fashion) into the various research subcommunities at NACA (the predecessor organization for NASA). In Appendix A, we include a sample of our discussion board prompts 2 and 8.

## Other Course Components

- Service learning reflections (ELO2)
  - **ELO2:** In the service-learning reflections, students are asked to consider how their STEM programming and interactions with our community partners and their clients should positively influence our partners and their clients' notion of belonging and opportunities in STEM and the central role mathematical tools and collaboration play in the day-to-day work STEM communities engage in. In Appendix C, we include a sample of our first service-learning reflection assignment.
- Mathematical Worksheets (ELO1)
  - **ELO1:** Because performing computations without the aid of a digital computer or electronic calculator is outside of the experience of most current students, the mathematical worksheet asks students to explore computations using slide rules and

logarithm tables in a way that mimics how human computers would have used them circa World War II. A copy of a worksheet is attached to this proposal in Appendix C.

- Reading Quizzes (ELO1)
  - **ELO1:** A major idea in the course is that the hidden figures story provides a vivid example showing how individuals' backgrounds and changing institutional policies/legislation intertwine to create access and opportunities in STEM communities. To ensure that students focus on these intertwining stories, the reading quizzes ask students to reflect both on the individual backgrounds of the hidden figures and the broader social/cultural/institutional changes occurring in the United States from 1940–1970. We include excerpts from a few of our reading quiz prompts in Appendix B.



# Culture and Ideas GE Assessment Plan

GE Expected Learning Outcomes	Methods of Assessment	Level of student achievement expected for the GE ELO.	What is the process that will be used to review the data and potentially change the course to improve student learning of GE ELOs?
<p><b>ELO 1</b> Students analyze and interpret major forms of human thought, culture, and expression.</p>	<p><b>Direct:</b> course-embedded questions, rubric-based evaluation of student work</p> <p><b>Indirect:</b> student survey</p>	<p><b>Direct:</b> We expect 80% or more on the assessments involving course-embedded questions and rubric-based evaluation from at least 75% or more of our students.</p> <p><b>Indirect:</b> We expect 75% or more of our students to select “strongly agree or agree.”</p>	<p>After each offering (one per academic year as of 2020-2021), aggregate data on assessments will be collected. If benchmark scores are not met on major course assignments, the course calendar will be revised to include in-class workshop time and discussion to address components of these assignments that are causing difficulty. We will also consult with math education specialists within the department about the assignments and rubrics for suggestions of improvement.</p>
<p><b>ELO 2</b> Students evaluate how ideas influence the character of human beliefs, the perception of reality, and the norms which guide human behavior.</p>	<p><b>Direct:</b> course-embedded questions, portfolio evaluation, rubric-based evaluation of student work</p> <p><b>Indirect:</b> student survey</p>	<p><b>Direct:</b> We expect 80% or more on the assessments involving course-embedded questions and rubric-based evaluation from at least 75% or more of our students.</p> <p><b>Indirect:</b> We expect 75% or more of our students to select “strongly agree or agree”.</p>	<p>We will consult with the community partner about the service-learning portion of the course, and this ongoing assessment of the partnership with the course will influence modifications to the service learning reflections.</p>

# Appendix

## Examples of direct measures:

1. Students will answer course-embedded questions to assess their achievement with respect to ELO1 and ELO2. Here we have included an excerpt from a reading quiz:

### **Reading Quiz Open Response**

- (ELO1) Does intersectionality provide a framework to analyze race, gender, and socioeconomic status in society and culture?
  - (ELO2) In your own words, describe the norms which guide behavior in mathematical communities. Provide examples from the course text, your Hidden Figure interviews, and your own life experiences.
  - (ELO2) Reflect on how your own background influences your perception of mathematical communities. Highlight how the idea of inclusivity influences your belief in the utility of service learning and mathematical outreach.
2. We will use rubrics to evaluate students' work to assess their achievement with respect to ELO1 and ELO2. One way we will do this is in the evaluation of the Hidden Figures analysis project. Students will be evaluated on a scale of *Excellent-Good-Acceptable-Needs Improvement-No Marks*.

Here we have included an excerpt for the Hidden Figures Background Analysis written assignment that highlights the relevant portions of that assignment to ELO1 and ELO2.

### **Mathematical Description Assignment**

- (ELO1) Describe how mathematics can be thought of as a tool to advance society and culture.
- (ELO2) How does perception of mathematical ability play a role in an individual's access to mathematical tools?
- Describe how specialized tools can influence the character of mathematical communities, and discuss the ways in which a mathematical community organizes itself influences the perception of the problems the community can solve.

Examples of indirect measures:

1. Students will be given a survey asking them to indicate how their views on the contributions of mathematicians to both scientific and non-scientific communities, and how their understanding of the norms of mathematical communities have changed. In the survey, responses are *Strongly Disagree-Disagree-Neither-Agree-Strongly Agree*

We provide examples of survey questions related to ELO1 and ELO2.

- a. I have learned to analyze and interpret major forms of human thought, culture, and expression.
- b. I have learned how ideas influence the character of human beliefs, the perceptions of reality and the norms which guide human behavior.

\*Please see an attached syllabus which follows the ASC template guidelines.

# Social Diversity in the US GE Proposal

## Math2010S: Intersections of Mathematics and Society: Hidden Figures

Our aim in this proposal is to highlight the ways in which our new course, Math 2010S, *Intersections of Mathematics and Society: Hidden Figures* fits seamlessly into the criteria for courses that satisfy the general education requirement for Social Diversity in the United States at the Ohio State University. Math 2010S was offered initially in the Spring of 2020 (under Math 2194), and was approved as a Service Learning GE in the 2019-2020 academic year.

We have included a description of our course, the expected learning outcomes (noting those that align with social diversity in the united states general elective), our assessment plan, and an appendix which includes a syllabus along with excerpts from select course assignments.

## Course Description

This course examines the intersections of race, gender, and mathematics as it relates to the accomplishments of the African-American mathematicians featured in the text *Hidden Figures: The American Dream and the Untold Story of the Black Women Who Helped Win the Space Race*. We analyze how mathematics and the advancement of American society were intertwined from WWII to the Space Race and focus on understanding the mathematical tools used by human computers and scientists at Langley during this time.

This is a project-based service-learning course, where the primary project involves pairing students with leaders in STEM positions at companies in the Greater Columbus Community that are local 'Hidden Figures.' The students will learn about a particular mathematical community from their local Hidden Figure, and investigate the mathematical tools used in their work. They will also be participating in service-learning with the Columbus Metropolitan Library branches by providing STEM programming related to the major course projects.

## GE Rationale

Here we identify the ways in which our course will meet the expected learning outcomes for the Social Diversity in the US GE:

- **ELO1:** Students describe and evaluate the roles of such categories as race, gender and sexuality, disability, class, ethnicity, and religion in the pluralistic institutions and cultures of the United States.
- **ELO2:** Students recognize the role of social diversity in shaping their own attitudes and values regarding appreciation, tolerance, and equality of others.

## Course Objectives

One of the course objectives is to use “intersectionality as a framework to critically examine how the intersection of race, gender, and socioeconomic status influence access to mathematical communities and opportunities in STEM.” At the start of the Hidden Figures story, the United States was a legally segregated society with less than 2% of all black women having a college degree. A major thematic strand of the course is understanding how our historical hidden figures were able to gain access to educational opportunities and NACA. For instance, all of the four of main hidden figures (Dorothy Vaughan, Katherine Johnson, Mary Jackson, and Christine Darden) were black women and all came from middle to upper-middle class socioeconomic backgrounds. In addition to using intersectionality as a framework, another focus of the course is to understand and contextualize how access to institutions and opportunities started to significantly change during WWII via social activism, executive orders, and legislative and judicial rulings.

Another course objective is to have students connect the Hidden Figures story with their own experiences in STEM and analyze similarities/differences between the personal and professional backgrounds of the four hidden figures and their assigned local hidden figure. Students reflect on the relevance of the hidden figures story via weekly discussion prompts (a few examples are included in Appendix A), and these prompts form the basis for classroom discussions. Students also performed a background analysis on their assigned local hidden figures. In the background analysis, students must argue, using intersectionality as their framework, why their hidden figures meet the “criteria of being a hidden figure” (which for our course was focused on being a STEM professional and part of a traditionally underrepresented racial group). Furthermore, the intention of the service learning partnership in the course is for students to serve as role models and hidden figures themselves for our community partner’s clients.

Below we highlight compatibility of a few existing course goals with the two expected learning outcomes of the Social Diversity GE.

Course Goal	Social Diversity ELO Compatibility
(1) Students evaluate the juxtaposition between scientific and social progress during the Space Race to critically examine the relationship between mathematical innovation, technological advancement, and society.	ELO1
(4) Use intersectionality as a framework to critically examine how the intersections of race, gender, and socioeconomic status influence access to mathematical communities and opportunities in STEM.	ELO1 ELO2
(5) Students evaluate how social context influences a sense of belonging in STEM	ELO2
(6) Students evaluate how social context influences a sense of belonging in STEM.	ELO1 ELO2
(7) Students identify and analyze major components of scientific culture and community.	ELO1 ELO2

### Course Readings

1. Primary text (ELO1, ELO2): *Hidden Figures: the American Dream and the Untold Story of the Black Women Mathematicians Who Helped Win the Space Race* by Margot Lee Shetterly

The African American women in *Hidden Figures*, along with other characters in the story, are used to study mathematical communities and opportunities in STEM during the Space Race. By understanding the background and individual journey's of these women, students are able to use an intersectional lens to critique diversity and inclusion in

mathematics by noting how their gender, race, and socioeconomic status influenced their access to mathematical opportunities.

The historical perspective gleaned from the reading of this text allows students to create a historical narrative for their own STEM journeys, to compare and contrast their background with those of the women in the text, and to consider how they can create inclusive scientific communities.

2. Supplementary Text (ELO2): *Living Proof: Stories of Resilience Along the Mathematical Journey*

This text is a collection of accounts of how different contemporary mathematicians have navigated their STEM journeys. It was written to inspire students encountering various struggles in their pursuit of learning mathematics. In particular, it is written to help encourage students to challenge their beliefs of what it means to be a ‘math person,’ and how their own limiting beliefs affect their sense of belonging in mathematics. This reading helps aid students to understand how their self perception plays a role in how they interact with others in STEM communities.

### Course Topics

The following list of relevant course topics are taken from our course schedule of topics. We have categorized them according to the expected learning outcomes relevant to the Social Diversity in the US GE.

**ELO1:** Students describe and evaluate the roles of such categories as race, gender and sexuality, disability, class, ethnicity, and religion in the pluralistic institutions and cultures of the United States.

- Introduction to Intersectionality (Guest Speaker)
- Civil Rights in World War II: “The Double V”
- When Computers Were Human: Mathematical Tools during World War II
- Dorothy Vaughn: Opportunities in STEM
- Katherine Johnson: Belonging in STEM
- Civil Rights and the Space Race
- Being a “Hyphen”-Scholar: Career Compromise in Hidden Figures

**ELO2:** Students recognize the role of social diversity in shaping their own attitudes and values regarding appreciation, tolerance, and equality of others.

- Introduction to Service-Learning with CML (Guest Speaker)
- Introduction to Intersionality (Guest Speaker)

- Dorothy Vaughn: Opportunities in STEM
- Katherine Johnson: Belonging in STEM

## Written Assignments (see Appendix C for more details)

### Hidden Figures Analysis (ELO1, ELO2)

The Hidden Figures Analysis requires the students to investigate the personal and professional background of their local Hidden Figure. Students will use intersectionality as a framework to understand the Hidden Figures access to mathematical and scientific communities and professional opportunities, aligning with ELO1.

Students will also use an intersectional lens to compare the STEM journeys of their local Hidden Figures, the women in the *Hidden Figures* text, and their own STEM journey to date. This aligns with ELO2.

### Service Learning Portfolio (ELO2)

The service learning portfolio will consist of artifacts from the service learning project and service learning reflections. It will include a cover letter where students reflect on the historical mathematical communities studied in class, the local communities they served, and their own sense of belonging within STEM over the course of the class.

Thus, portfolio will reflect on how social diversity, historically and also contemporary through the local Hidden Figures, has contributed to their understanding of mathematical culture and scientific communities, and what they can do to make these spaces more inclusive, which is the essence of ELO2.

## Other Course Components

### Service Learning Reflections (ELO2)

In the service learning reflections, students are asked to comment on the social diversity of our community partner's clientele who have different backgrounds, expectations, and needs and discuss how service learning can be used for community building and engagement. In Appendix C, we include a sample of the course's first service learning reflection questions.

### Discussion Boards (ELO1, ELO2)

In the discussion board posts, students are asked to analyze how race, gender, and socioeconomic status and institutional/societal changes intertwined to create or hinder



access and opportunities in STEM communities (ELO1).. They also use this as a forum to understand the role that social diversity plays a role in the development of mathematical communities (ELO2).

Students are also asked to respond to their peers' posts and comment on common or new themes raised. In Appendix A, we include a sample of the discussion prompts along with an indication of the learning objective that particular prompts is most aligned to.

#### Reading Quizzes (ELO1)

In the reading quizzes, students are tested on their comprehension of the *Hidden Figures* reading assignments with regards to details from the story and their relevance to major themes of the course. These feature open response questions that are used to address ELO1.

#### Classroom Discussions (ELO1 ELO2)

Classroom discussions are a component of the course whose discussion points are drawn from students' previous board responses. The main purpose of the classroom discussion is to analyze the connections between the *Hidden Figures* story and students' own experience with feelings of inclusion and access to STEM communities (ELO1).

During these discussions, we focus on identifying the institutions/structures that have helped/hinder students' access to STEM, and we also focus on how the students' backgrounds have also helped/hindered access to STEM. The point of these discussions is to recognize how race, gender, socioeconomic status and their influence on institutional hierarchies and structures mediate access to STEM (ELO2).

## Social Diversity in the US GE Assessment Plan

GE Expected Learning Outcomes	Methods of Assessment	Level of student achievement expected for the GE ELO.	What is the process that will be used to review the data and potentially change the course to improve student learning of GE ELOs?
<p><b>ELO 1</b></p> <p>Students describe and evaluate the roles of such categories as race, gender and sexuality, disability, class, ethnicity, and religion in the pluralistic institutions and cultures of the United States.</p>	<p><b>Direct:</b></p> <p>course-embedded questions, rubric-based evaluation of student work</p> <p><b>Indirect:</b> student survey</p>	<p><b>Direct:</b> We expect 80% or more on the assessments involving course-embedded questions and rubric-based evaluation from at least 75% or more of our students.</p> <p><b>Indirect:</b> We expect 75% or more of our students to select “strongly agree or agree”.</p>	<p>At the end of each offering (one per academic year as of 2020-2021), aggregate data on assessments will be collected. If benchmark scores are not met on major course assignments, the course calendar will be revised to include in-class workshop time and discussion to address components of these assignments that are causing difficulty. We will also consult with math education specialists within the department about the assignments and rubrics for suggestions of improvement.</p> <p>We will consult with the community partner about the service-learning portion of the course, and this ongoing assessment of the partnership with the course will influence modifications to the service learning reflections.</p>
<p><b>ELO 2</b></p> <p>Students recognize the role of social diversity in shaping their own attitudes and values regarding appreciation, tolerance, and equality of others.</p>	<p><b>Direct:</b></p> <p>course-embedded questions, rubric-based evaluation of student work</p> <p><b>Indirect:</b> student survey</p>	<p><b>Direct:</b> We expect 80% or more on the assessments involving course-embedded questions and rubric-based evaluation from at least 75% or more of our students.</p> <p><b>Indirect:</b> We expect 75% or more of our students to select “strongly agree or agree”.</p>	

# Appendix

## Examples of direct measures

1. Students will answer course-embedded questions to assess their achievement with respect to ELO1 and ELO2. A specific example includes discussion board posts. Students will be evaluated on a scale of *Excellent-Good-Satisfactory-Poor*. We provide two example discussion board questions:

- a. (ELO1) In the first four chapters of *Hidden Figures* we are introduced to Dorothy Vaughan amongst the backdrop of World War II Society and the Civil Rights Movement. In this post, describe what you have learned about Dorothy Vaughn thus far. What was she like? Examine the role that the interplay of her race, gender, and socioeconomic status played in her access to professional and personal opportunities.

After you complete your discussion prompt, respond to at least 2 other posts giving your thoughts and views on the original poster's reply. If you observe common themes between your post and the post you're responding to, be sure to note this. Be sure to also note differences in responses.

- b. (ELO2) Chapters 19 and 20 of *Hidden Figures* refocuses on Mary Jackson and continues illustrating resistance to integration along with rapid scientific progress in the space race.

In this post, discuss the importance of Mary Jackson's development and cultivation of her local community. In particular, address why it's important to have mentors and sponsors when those outside a particular community are attempting to join or access the community's resources. After this, explore the role that social diversity has played in shaping your own attitudes and values regarding appreciation, tolerance, and equality of others, especially in scientific communities.

After you complete your discussion prompt, respond to at least 2 other posts giving your thoughts and views on the original poster's reply. If you observe common themes between your post and the post you're responding to, be sure to note this. Be sure to also note differences in responses.

2. We will use rubrics to evaluate students' work to assess their achievement with respect to ELO1 and ELO2. One way we will do this is in the evaluation of the Hidden Figures analysis project. Students will be evaluated on a scale of *Excellent-Good-Acceptable-Needs Improvement-No Marks*.

Here we have included an excerpt for the Hidden Figures Background Analysis written assignment that highlights the relevant portions of that assignment to ELO1 and ELO2.

*Written Portion: In this second part, your group will be analyzing the interviews on the professional background and history of your group's hidden figure. In your analysis be sure to address the following:*

- a. (ELO1) Analyze the roles of race, gender, and socioeconomic status in the STEM journeys of each of your local hidden figures.
- b. (ELO1) Executive Orders, Supreme Court Rulings, and activism work together to indirectly open access to opportunities for the Hidden Figures in the text. Research and identify similar efforts that created opportunities for your group's hidden figure.
- c. (ELO1) Identify at least three professional challenges your hidden figure experienced while starting their career, pay particular attention to whether these challenges were rooted in their gender, socioeconomic status, race, or other demographic factor.
- d. (ELO2) Compare and contrast the personal and/or professional journeys of your local hidden figure, the women in *Hidden Figures*, and your own STEM journey to date.
- e. (ELO2) Critically examine the role that social diversity has played in shaping your own attitudes and values regarding appreciation, tolerance, and equality of others. How has this changed (or not) from your interactions with your Hidden Figure?

Example of indirect measure:

1. Students will be given a survey and several reflections asking them to reflect on their perceptions and attitudes towards mathematics along with their progress toward each ELO. In the survey, responses are *Strongly Disagree-Disagree-Neither-Agree-Strongly Agree* We provide examples of survey questions related to ELO1 and ELO2.

- a. I have learned to describe and evaluate the roles of categories as race, gender, and sexuality, disability, class, ethnicity, and religion in the pluralistic institutions and cultures of the United States.
- b. I have learned to examine the role that social diversity has played in shaping my own attitudes regarding appreciation, tolerance, and equality of others as a result of taking this course.

\* Please see an attached syllabus which follows the ASC template guidelines.