1. **Working Title of Course Proposal**

Course Proposal: *Intersections of Mathematics and Society: Hidden Figures*

2. **Applicant(s) Information**

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Name: John H. Johnson Jr.
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3. **Course Description**

Course Goals

The goal of this course is to use the text *Hidden Figures: the American Dream and the Untold Story of the Black Women Mathematicians Who Helped Win the Space Race* by Margot Shetterly as a starting point to explore the role of mathematics as a tool for advancement in society and to study diversity and inclusion in mathematical communities. Students will be exposed to careers in STEM via a research project on local Hidden Figures, and will learn how to communicate mathematically via the service-learning component with the Columbus Metropolitan Library branches. The general course goals can be summarized as follows:

1) Conduct a research project from start to finish. (This includes identifying a topic, collecting data, analyzing data, and presenting the findings of the study.)
2) Understand historical and contemporary mathematical tools.
3) Explore the intersections of mathematics and society by examining the relationship between mathematical innovation and societal and technological advancement.
4) Examine the sociological factors that influence mathematical access and opportunities.
5) Communicate mathematics to a variety of audiences.

Based on the aforementioned course goals, we have established the following learning objectives (LOs) for the course:

LO1: Investigate and research a Hidden Figure in the Greater Columbus Community.

LO2: Understand the mathematical tools used by human computers and scientists during pre and post-World War II.

LO3: Critically examine the relationship between mathematical innovation, technological advancement, and society in the early days of NASA.

LO4: 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.

LO5: Effectively communicate mathematics to an audience of varying ages and mathematical backgrounds.

Course Content

Math 1194, Intersections of Mathematics and Society: Hidden Figures will be the first service-learning course offered by the Department of Mathematics. It is inspired by the award-winning book by Margot Shetterly, *Hidden Figures: the American Dream and the Untold Story of the Black Women Mathematicians Who Helped Win the Space Race.* In this course we will use this book to facilitate a critical examination of the intersections of race, gender, and mathematics as it relates to the accomplishments of the African-American mathematicians featured in the text. 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.

A key theme of this course is understanding mathematics as a tool. The course will begin with a discussion about the role of power and mathematics as a tool to advance society. We will also discuss tools that women in *Hidden Figures,* who were called 'computers,' used in their work. We will focus on two tools in particular for course projects, a mechanical tool, the slide rule, and an analytic tool, orbital geometry, giving insight into what is involved in the mathematics of space travel.

We will use intersectionality as a framework to understand access to mathematical communities. In particular, we will use this as a framework to discuss the role that race, gender, and socioeconomic status played in the work and home environment of the Hidden Figures in the text, and how these three identities influenced their accomplishments. In addition, we will discuss the historical context of World War II that that both limited and granted the Hidden Figures opportunities in mathematics.

For a more detailed description of our proposed topics broken down by class period please see the syllabus attached in of this course proposal.

Service-Learning Component

We have developed a service-learning model with the Columbus Metropolitan Library (CML) where our students will deliver original STEM programming related to the course to patrons of various branches of CML. Students will create their presentations based on feedback from two mini-projects related to mathematical tools and progress made towards the final project where students will investigate Hidden Figures in the Greater Columbus Community. These projects will be worth 30% and 40% of the grade respectively. After the mini-projects are graded and before the final projects are due, students will then spend the last 7 weeks of the course giving presentations on the concepts and ideas assessed in these projects to select branches of CML.

The presentations will reflect major themes of the course, which include mathematical tools and the intersection of mathematics and society. After the work done in the two mini-projects, students will create programming related to each tool. We will purchase a classroom set of slide rules that students will learn how to use, and in turn will be able to teach patrons of the library to use in a discussion about the evolution of mathematical tools during pre and post-World War II. In addition, students will be able to describe via simulation software on their iPads how orbital geometry was used as a tool at NASA. Students will also be able to create programming related to the Hidden Figures themselves and the local Hidden Figures they are researching. Each CML branch will determine the type of programming they would like when the presentations are scheduled mid semester.

Service-Learning Activities Contributions to Course Goals

In this class, the course assignments will heavily influence the design of the STEM focused programming to be delivered by the students at the various branches of CML. One of the primary learning objectives in this course is to have the students investigate and research a Hidden Figure in the Greater Columbus community. Students will meet this objective by completing a final project throughout the semester that is worth 40% of the course grade. This final project will be broken into three components. The first is a description of how the subject of their project meets the criteria of being a Hidden Figure using intersectionality as a framework, called the Hidden Figure Analysis. The second is a mathematical description of the mathematical tools used by their Hidden Figure and the relevance of their work. The last is a final presentation in-class and at the Hidden Figures Showcase at CML in the final week of the semester. There are two smaller mini-projects on mathematical tools due in the course before the description of mathematical tools for the final project must be turned in. Together, these written assignments are what will be turned into group presentations for service to CML.

These group presentations align with Learning Objective (LO) 5: effectively communicate mathematics to an audience of varying ages and mathematical backgrounds. Both the presentations and the mini-projects themselves align with LO 2, which states that we want the students to understand the mathematical tools used by human computers and scientists during pre and post-World War II. We have also established a communication component of the course grade, tentatively set to be 20% of the overall score, that will include CML presentations. This component of the course grade also aligns with LO 5.

LO 3, which emphasizes the connection between mathematical innovation and the advancement of societies, and LO 4, which emphasizes intersectionality as a framework for understanding access and opportunities in STEM, will drive our in-class discussions on the readings and lessons on the mathematical tools. By having students intentionally reflect on these ideas via quizzes and written reflections, we believe that the group presentations they give at CML will be richer in content. Our course structure ensures that each of our learning objectives are infused in every project and student-lead presentation, significantly contributing to our new service-learning model and meeting the needs of CML's Young Minds initiative, outline in more detail in section 4 of this proposal. As mentioned previously, this project will culminate in a final *Hidden Figures Revealed* showcase at the end of the course. This final event will be open to the public and will tentatively be held at the Main Branch of CML.

Course Syllabus

Please see attached course syllabus in section 5 of this grant proposal.

4. Community Focus and Reciprocity

Community Partner

We will be partnering with the Columbus Metropolitan Library (CML). The CML system includes a main branch and twenty-two branch locations that serve, in particular, the K-12 student population throughout the Columbus Metropolitan area. CML's vision is to create "a thriving community where wisdom prevails" via their mission to "inspire reading, share resources, and connect people." They serve 10 school districts in the Columbus Metropolitan area by providing programs and resources to students and parents to help with success in school.

CML is an urban library system. In 2017, they signed a statement from the Urban Libraries Council affirming its commitment to racial and social equity. Part of this statement includes the library's commitment to "eliminating racial and society equity barriers in library programs, services, policies, and practices" and to "creating and maintaining an environment of diversity, inclusion, and respect both in our library systems and in all aspects our community role." In addition to valuing diversity, the CML has recently supported STEM (science, technology, engineering, and mathematics) initiatives, including a March 2019 Central Ohio STEM Expo at a local high school and a Girls in Science Program in the summer of 2018.

Collaboration with Community Partner

In their 2019 Strategic Plan, the CML outlined a high priority initiative called Young Minds. This initiative consists of three main themes: Ready for Kindergarten, Third Grade Reading, and High School Graduation. Our partnership with CML contributes to the 'career and college preparation' component of their High School Graduation theme and aligns with their strategic focus to engage the community via partnerships with higher education.

We have consulted with Kelli Bates, the Young Minds Program Leader, and developed an original service-learning model with CML that serves their initiatives but also facilitates the

learning objectives of our course. Traditionally, the Ohio State service-learning model with CML involves students spending hours volunteering in CML's Homework Help Centers. The model we have discussed with Kelli is unique: our students will use what they have learned in the course to develop a series of presentations that will in turn be given by student groups at the various library branches. Thus, rather than helping with routine homework problems, our students will be providing the library with original hands-on STEM programming that will shine a light on 'math in real life.'

These presentations will take place during the last seven weeks of the course, starting in mid-October of 2019. This has been noted as an ideal time frame for CML. These presentations will focus on the mathematical tools emphasized in two course projects: a mechanical tool, the slide rule, which predates our modern calculators, and an analytical tool, geometry, to understanding issues involved in orbital flight. They will also focus on the Hidden Figures in the text, along with Hidden Figures the students are investigating in the Great Columbus Community. This gives three possible presentation topics per group to be presented at CML branches.

In order to prepare for the service, a representative from the CML will come visit the course. This representative will discuss the Young Mind's Initiative and review expectations for general decorum and interactions with students. The system of accountability for the library presentations will also be discussed. In early October, around week six of the semester, student presentation titles and descriptions will be generated and distributed to the various branches. Each branch will then indicate the type of programming they are interested in and possible dates and times. Working with local coordinators at the appropriate branches, we will facilitate student sign-ups for these presentations. The local library coordinators will facilitate time tracking for each student group.

There will also be short surveys completed by the students after each presentation. These surveys will ensure that students will metacognitively reflect on their communication skills in preparation for the final showcase and in order to identify possible areas of improvement for future presentations at other branches. In addition, we will be giving students a pre-survey and a post-survey to address understanding of key course ideas reflected in the learning objectives. This survey, along with general student evaluations will help influence future directions for the course. We will also meet with staff from CML in the Spring of 2020 to determine any modifications that should be made to our service-learning model, so that our partnership remains mutually beneficial.

Anticipated Community Benefit and Impact

Based on our initial consultations with the CML, their Young Minds initiative is an integral part of their long-term strategic plan. Thus, as we work to make this course a permanent elective offered from our department, they are willing to continue working with us and adapt our service model as needed. Presently, the STEM programming model aligns very well with the High School Graduation theme of the Young Minds initiative, which has community impact as its primary goal.

Young patrons of the library will be exposed to different careers in mathematics by learning about historical and contemporary local Hidden Figures. Having hands-on programming from college students will also give the library patrons exposure to applications of mathematics beyond what is typically seen in K-12 classrooms. We anticipate course enrollment from predominately first and second year students. Because our students are recent high school graduates, they can serve as relatable role models and examples of community engagement, thus exemplifying the High School Graduation theme. Lastly, in addition to supporting the Young Minds initiative, each presentation will tie in with the libraries broader mission, by "inspiring reading" about Hidden Figures, "sharing course resources" to teach the students about mathematical tools, and "connecting students" from The Ohio State University to the local Columbus Community.

This course will use the mathematical journeys of four African-American women to connect OSU's Department of Mathematics to the Columbus Metropolitan Library and by extension the K-12 schools in the area via our service-learning model. In addition to the STEM programming established via our service-learning model, the students will also be reporting on a local Hidden Figure, thus establishing partnerships between local industry leaders concerned with civic engagement and the Math department, and by extension the College of Arts and Sciences. The final of the course will be an event entitled, *Hidden Figures Revealed*, which will be open and advertised to the Greater Columbus Community. We believe the "pay it forward" aspects of connecting with the community, coupled with the critical analysis of mathematical tools and rigorous exploration of mathematics and society that characterize the course, will contribute to the impact of Education for Citizenship that epitomizes service-learning.

5. Letter of Support from Chair and Supplemental Documents

Attached we have included the following supplementary documents:

A. Draft of Course Syllabus
B. Support Letter from the Department of Mathematics Chair
C. Support Letter from the Columbus Metropolitan Library
D. Concurrence from the Department of Women, Gender, and Sexuality Studies
    (*Note that when we first corresponded with WGSS the course was Math 2194 and is now Math 1194. We are presently discussing a concurrence with the Department of African American and African Studies.*)

<p style="text-align: center; color: blue;">Syllabus: Math 1194
Intersections of Mathematics and Society: *Hidden Figures*
Fall 2019</p>

Instructor: Ranthony A.C. Edmonds
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Instructor: John H. Johnson
Phone: (614) 292-6353
Email: johnson.5316@osu.edu
Office: 756MW

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.

Course Objectives:

The main learning objectives for the course included below will influence the Final Project, the Mini-Projects, quizzes, reflections, and course discussions.

LO1: Investigate and research a Hidden Figure in the Greater Columbus Community.

LO2: Understand the mathematical tools used by human computers and scientists during pre and post-World War II.

LO3: Critically examine the relationship between mathematical innovation, technological advancement, and society in the early days of NASA.

LO4: 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.

LO5: Effectively communicate mathematics to an audience of varying ages and mathematical backgrounds.

Course Prerequisites:

College Algebra and/or precalculus.

Course Materials:

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

Grading:

Final Project	40%
Mini-Projects	30%
Communication	20%
Reflections/Quizzes	10%

Final Project
The final 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. 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	15%	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. Presentation	15%	The first two parts of the research project will culminate in a final in-class presentation during the last two weeks of class and a poster presentation at the Hidden Figures Showcase.

Mini-Projects
There will be two mini-projects throughout the semester, each worth 15% of the course grade. These mini-projects will focus on examining a mathematical tool that was integral to the advancements related to the Space Race discussed in the Hidden Figures text. Mini-Project 1 will focus on a mechanical tool, the slide rule, while Mini-Project 2 will focus on an analytical tool, the geometry involved in orbital flight.

Communication
The communication grade will be based on presentations given at the various CML branches, attendance, and meaningful contributions to in-class discussion.

Reflections/Quizzes

There will be 5 quizzes and 5 reflection assignments, each worth 1% of the total course grade. The quizzes will be based on the readings and weekly course topics. The reflections assignments will be one-page responses to prompts inspired by different themes explored throughout the course.

Tentative Schedule

Week	Date	Topic	Assignments/Events
1	8-19	No Class	
	8-21	Hidden Figures in Mathematics	
	8-23	**Introduction to Service-Learning with CML**	Perceptions of Mathematics Survey Due
2	8-26	Intersections of Mathematics and Society: World War II	Hidden Figure Project: Subject Ranking Due
	8-28	Introduction to Intersectionality	Hidden Figure Project: Groups Assigned
	8-30	Civil Rights in World War II: "The Double V"	Reflection 1 Due; Reading: HF Ch.1,2,3,4 Due
3	9-2	No Class: Labor Day	
	9-4	When Computers Were Human: Mathematical Tools during World War II	Hidden Figures Project: Interview Questions Due
	9-6	Mathematical Tools: from Slide Rules to TI-84s	Quiz 1 Reading: HF Ch.5,6 Due
4	9-16	Computing with Slide Rules	
	9-18	Mathematical Communities	Exponents, Radicals, and Logarithms Worksheet Due
	9-20	Dorothy Vaughn: Opportunities in STEM	Reflection 2 Due; Reading: HF Ch.7,8,9 Due
5	9-23	Mathematical Tools: Understanding Wind Tunnels	
	9-25	What about the Men at NACA?	Mini Project 1 Due
	9-27	Mary Jackson: Advocacy in STEM	Quiz 2; Reading: HF Ch.10,11 Due
6	9-30	Analytic Geometry: Mathematics of Space Travel	Hidden Figure Analysis Due
	10-2	Analytic Geometry: Mathematics of Space Travel	
	10-4	Understanding Trajectories: Go, No Go	Reflection 3 Due; Reading: HF Ch.12,13,14 Due
7	10-7	Katherine Johnson: Belonging in STEM	Trajectories Worksheet Due

	10-9	FORTRAN: Mathematical Training to Computer Programming	Quiz 3; Reading: HF Ch.15,16 Due
	10-11	No Class: Autumn Break	
8	10-14	Communicating Mathematics: Technical Reports	Mathematical Description Consultations Scheduled
	10-16	Communicating Mathematics: Science Writing and Breaking things down for a General Audience	Mini Project 2 Due **CML Presentations Signup**
	10-18	Sputnik: from NACA to NASA	Reflection 4; Reading: HF Ch.17,18 Due
9	10-21	Civil Rights and the Space Race: A Tale of Two Virginias	**CML Presentations Begin**
	10-23	Mathematical Access: Mentors and Trail Blazers	Mathematical Description Consultation Deadline
	10-25	Christine Darden: On Their Shoulders	Quiz 4: Reading: HF Ch.19,20 Due
10	10-28	Evolution of the West Computers	
	10-30	Intersections of Mathematics and Society: Executive Orders and Advancement at Langley	Mathematical Description Due
	11-1	Katherine Johnson and Orbital Flight: "Get the Girl to Check the Numbers"	Reflection 5; Reading: HF Ch.21 Due
11	11-4	Mathematics of Getting to the Moon: Apollo 11 and Apollo 13	
	11-6	Mathematics of Getting to the Moon: Apollo 11 and Apollo 13	
	11-8	Intersectionality and the Women in Hidden Figures	Quiz 5; Reading: HF Ch.22,23 Due
12	11-11	No Class: Veterans Day Observed	
	11-13	Civil Rights and the Space Race	
	11-15	Being a "Hyphen"-Scholar: Career Compromise in Hidden Figures	Reading: HF Epilogue Due
13	11-18	Hidden Figures Revealed	Group Presentations
	11-20		
	11-22		
14	11-25	Hidden Figures Revealed	Group Presentations
	11-27	No Class: Thanksgiving Break	
	11-29	No Class: Indigenous Peoples' Day Observed	
15	12-2	Hidden Figures Revealed	Group Presentations
	12-4	**Last Day of Classes** Intersections of Math and Society: World War II to Present	**Hidden Figures Showcase 6:00pm (tentatively CML Main Library)**

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THE OHIO STATE UNIVERSITY

April 1st, 2019

Dear College of Arts and Sciences Curriculum Committee:

I am writing to express my enthusiastic support for Drs. Ranthony A.C. Edmonds and John H. Johnson Jr.'s new ASC Service-Learning Grant Course Proposal *Intersections of Mathematics and Society: Hidden Figures.* Their course would occupy a unique and valuable place in the Mathematics Department's course catalog.

This will be the Department's first service-learning course offered. It will be an excellent course for recruitment for our math major and minor, and it will serve as one of the many components in the Department's Diversity and Inclusion efforts.

The Department will support this course by offering a pilot during the academic year 2019–2020 as Math 1194 Group Studies, co-taught by Drs. Edmonds and Johnson. During the pilot year, we anticipate the course will be submitted to our Undergraduate Committee to start the process of creating a permanent course listing. We also anticipate offering the permanent course annually, and the course structure is flexible enough to accommodate teaching by other faculty members.

I hope you will look favorably on this course proposal.

Sincerely,

Dr. Jean-François Lafont

Professor and Chair

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96 S. Grant Ave.
Columbus, Ohio 43215

columbuslibrary.org | **645-2275**

March 29, 2019

To Whom It May Concern:

I am pleased to write in support of ASC Grant for New Service-Learning Course Proposals funding for Drs. Ranthony Edmonds and John Johnson's course, *Intersections of Mathematics and Society: Hidden Figures*. Presentations at branch sites by course participants will give K-12 students who attend our Homework Help Centers a chance to learn about local mathematicians and mathematical tools while providing a window into a future career.

In support of the course, Columbus Metropolitan Library (CML) will deliver an in-class presentation to introduce the Young Minds strategy, provide an overview of service-learning at CML, and discuss our expectations for interactions with our customers.

We will provide logistical support via a contact person at each hosting location to schedule the presentations, introduce the presenters, and track students' service-learning hours.

At CML, one of our key strategic areas of focus is Young Minds, children from birth through the teen years. Our strategy is to encourage the learning and growth of Young Minds to build a foundation for a successful life. Through our 23 locations, we offer many programs for youth and their families including programs and services intended to support high school graduation and college and career readiness.

CML is open to an ongoing collaboration with the math department at OSU. With this grant, opportunity to learn about career opportunities in mathematics will be amplified. Thank you for your consideration of this request as we continue our pursuit to engage K-12 students in out-of-school learning opportunities that give them inspiration for their future careers.

Sincerely,

Kathy

Kathy Shahbodaghi
Public Services Director

Subject: Concurrence for Math 2914

Date: Tuesday, March 26, 2019 at 1:10:50 PM Eastern Daylight Time

From: Lindsey, Treva B.

To: Edmonds, Ranthony A.C.

CC: Stotlar, Jackie

Good Afternoon,

On behalf the WGSS Department, the Undergraduate Studies Committee accepts your request for concurrence.

We are very excited about this class and will be sure to publicize among our undergraduates.

Respectfully,
Treva B. Lindsey

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   Sexuality Studies
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