Oregon TECH

Applied Mathematics
2022-23 Program Assessment Report

Section 1 – Program Mission

The mission of the Applied Mathematics degree program is to prepare students for immediate participation in the workforce, or for graduate study. Employment opportunities include pharmaceutical companies, government agencies (like the National Security Agency), insurance companies (as actuaries), publishing companies (as editors of technical publications) and public K-12 and higher education. Graduates will have knowledge and appreciation of the breadth and depth of mathematics, including the connections between different areas of mathematics, and between mathematics and other disciplines.

The mission, objectives, and student learning outcomes for the Applied Mathematics program are reviewed annually by the department during Fall convocation.

Section 2a – Program Educational Objectives

Graduates of the Applied Mathematics Program will be prepared to do the following in the first few years after graduation.

1) Apply critical thinking and communication skills to solve applied problems.
2) Use knowledge and skills necessary for immediate employment or acceptance into a graduate program.
3) Maintain a core of mathematical and technical knowledge that is adaptable to changing technologies and provides a solid foundation for future learning.

Section 2b – Program Student Learning Outcomes

Upon graduation, students will be able to

1. apply mathematical concepts and principles to perform computations
2. apply mathematics to solve problems
3. create, use and analyze graphical representations of mathematical relationships
4. communicate mathematical knowledge and understanding
5. apply technology tools to solve problems
6. perform abstract mathematical reasoning
7. learn independently

Section 3 – Curriculum Map

		Program Student Learning Outcome							ISLO					
Semester	**Course**	1	2	3	4	5	6	7	Com	Team	Ethics	IA	QL	DivP
Fresh-Fall	MATH 251	F	F	F	F								F	
	SPE 111								F					
	WRI 121								F					
	Social Science Elective										F			
	General Elective													F
Total Credits	16													
Fresh-Winter	MATH 252	F	F	F	F									
	ENGR 266					F								
	PHY 221 & lab	F	F	F								F		
	WRI 122								F					
	Social Science Elective											F		
Total Credits	17/18													
Fresh-Spring	MATH 253	F	F	F	F									
	PHY 222 & lab	F	F	F	F									
	Humanities Elective													F
	Social Science Elective													
Total Credits	16													
		Program Student Learning Outcome							ISLO					
Semester	**Course**	1	2	3	4	5	6	7	Com	Team	Ethics	IA	QL	DivP
Soph-Fall	MATH 254	F	F	F	F									
	MATH 310	F			F		F		F					
	PHY 223 & lab	F	F	F										
	WRI 227								P					
Total Credits	15													
Soph-Winter	MATH 341	F	F	F	F	F	F							
	MATH 354	F/P	F/P	F/P	F			F						
	General Elective													
	Humanities Elective													F
Total Credits	15													
Soph-Spring	MATH 361			F									F	
	Humanities Elective													F
	General Elective													
	General Elective													
	General Elective													
Total Credits	16													
		Program Student Learning Outcome							ESLO					
Semester	**Course**	1	2	3	4	5	6	7	Com	Team	Ethics	IA	QL	DivP
Junior-Fall	MATH 321	F/P	F/P	F/P	P				P	P				
	SPE 321								P	P				
	Focused Elective		F											

	Elective (Upper Div)													
Total Credits	14													
Junior-Winter	MATH 311	P			C		C	P						
	WRI 227								P					
	Focused Elective	P	P	P	P	P								
	Elective (Upper Div)													
	Elective													
Total Credits	16													
Junior-Spring	MATH 322									P				
	MATH 451	P	P	P	P	P								
	Focused Elective	P	P	P	P	P								
	MATH/PHY Elec UD	P	P	P	P	P								
	Elective													
Total Credits	16													
		Program Student Learning Outcome							**ESLO**					
Semester	**Course**	1	2	3	4	5	6	7	Com	Team	Ethics	IA	QL	DivP
Senior-Fall	MATH 421	C	C	C	C	P	P	C						
	Focused Elective	P	P	P	P	P								
	MATH/PHY Elec UD	P	P	P	P	P								
	Elective													
Total Credits	15													
Senior-Winter	MATH CORE UD	C	C	C	C	C	C	C						
	Focused Elective	P	P	P	P	P								
	Social Science Elective													P
	Elective													
	Elective													
Total Credits	16													
Senior-Spring	MATH CORE UD	C	C	C	C	C	C	C						
	WRI 327 -0r- WRI 350								P					
	Elective													
	Elective													
Total Credits	16													
Total Program	180 - 184													
Key: F = Foundation, P = Practicing, C = Capstone														

Section 4– Assessment Cycle

The department assesses the 7 Program student learning outcomes using a 3-year cycle. The following table shows the schedule.

Table 1. Assessment Cycle

	Academic Year Assessed		
Learning Outcomes	**'23-24**	**'24-25**	**'25-26**
1. Apply mathematical concepts and principles to perform symbolic computations.			**X**
2. Apply mathematics to solve problems.		**X**	
3. Create, use and analyze graphical representations of mathematical relationships.	**X**		
4. Communicate mathematical knowledge and understanding.		**X**	
5. Apply technology tools to solve problems.			**X**
6. Perform abstract mathematical reasoning.	**X**		
7. Learn independently.	**X**		

Applied Mathematics B.S. Cycle for PSLOs and ESLO's			
Outcome	2023/2024	2024/2025	2025/2026
PSLO 1	Act	Plan	Assess
PSLO 2	Plan	Assess	Act
PSLO 3	Assess	Act	Plan
PSLO 4	Plan	Assess	Act
PSLO 5	Act	Plan	Assess
PSLO 6	Assess	Act	Plan
PSLO 7	Assess	Act	Plan
ISLO: Communication	Plan	Assess	Act
ISLO: Teamwork	Plan	Assess	Act
ISLO: Ethical Reasoning	Plan	Assess	Act
ISLO: Inquiry & Analysis	Assess	Act	Plan
ISLO: Quantitative Lit	Assess	Act	Plan
ISLO: Diverse Perspectives	Act	Plan	Assess

ISLO	PSLO	2021-2022	2022-2023	2023-2024
	PSLO1		Math 354	
	PSLO2	Math 321		
	PSLO3			
	PSLO5		M452	
	PSLO3			
	PSLO4	Math 311		
	PSLO6			
	PSLO7			
Communication				
Teamwork		*See Notes Below		
Ethical Reas.		*See Notes Below		
Inquiry and Analysis				
Quantitative Literacy				
Diverse Perspect			*See Notes Below	

Notes: (1) The applied math program does not have a Junior or Senior project as part of its curriculum. Several years ago the faculty representatives responsible for the Teamwork ISLO and provost office have given permission for the omission of assessment for this ISLO. (2) Part of the action plan for the next year is to resolve the fact that currently there are no Math courses that address Ethics and Diversity. Please see Section 7 for more details.

Section 5– Assessment Data Collection Process 2022-23

Assessment of two student learning outcomes was planned during this academic year (Outcomes 1,5). A combined rate of proficiency and high proficiency of at least 70% is considered a minimum acceptable performance. The faculty that taught the courses were directly involved with the data collection and initial analysis and later the Math Major Committee met to discuss the results. We used two direct measures for each outcome and one indirect measure. The department had planned to also include an additional indirect measure for each outcome by using the student exit survey, however, since the response rate was only one student, we decided to omit this data as it was deemed statistically insignificant.

Section 6 – Assessment Data

Outcome 1: *Apply mathematical concepts and principles to perform symbolic computations*, was assessed in Math 354, Winter of 2023. The instructor was Dr. Jim Fischer.

a) Set up and evaluate a multi-variable integral.
b) Apply a form of Stokes' theorem to convert between integrals.

These criteria were measured by exams and the results *for only the math majors* are given in Table 1. There were only 3 math majors enrolled in Math 354 this term. Each was given the same three problems on a final exam. Here is a description of the two problems.

Problem 1: Compute a triple integral using spherical coordinates.

Problem 2: Use Stokes's theorem to compute a double integral of a curl.

	Student Performance		
Criterion	Some/no proficiency	Proficient	High Proficiency
(a)	0	33	67
(b)	0	0	100

Table 1. Assessment results for Outcome 1.

Indirect Measure : Course Grade in Math 354 Winter Term 2020

Students with grade **above satisfactory** – (100%)

Students with **satisfactory grade** – (0%)

Students with grade **below satisfactory** – (0%)

The students in Math 354 performed strongly in the area of symbolic computation as it related to setting up multiple integrals. The course grade distribution also supports this conclusion. In our next cycle of assessing symbolic computation we might want to consider assessing symbolic computation in more than one course so as to get a more complete picture of student performance in this area. Historically speaking the OIT math majors perform quite well in the area of symbolic computation.

Outcome 5: *Apply technology tools to solve problems,* was to be assessed in Math 451. Since there was only one math major enrolled in Math 451. The department chose to omit this assessment this year.

Performance Criteria	Assessment Methods	Performance Target	Results	Met?
PSLO1- Symbolic Computations…	Assignments in Classes assessed /Course Grade	At least 70% of students proficient	100% Math 354	Yes
PSLO5- Communicate Mathematics…	Assignments in Classes assessed	At least 70% of students proficient	NA	NA
Graduation Rate	University Dashboard	6-year rate >50%	85.7%	Yes
Retention	University Dashboard	1-year rate >75%	50%	No**

Certification	Accreditor's report	1-year >75%	NA	
DFWI	University Dashboard	All program <30%	16%	Yes*

* Regarding the DFWI. The DWFI rate for mathematics can be significantly higher than 12% and still be acceptable due to national averages. For example the national DWFI rate for college algebra is around 50% . There is further discussion about the DWFI rate below in Section 7.

** Regarding Retention: See the discussion under action items in Section 7.

Evidence of Improvement in Student Learning

Performance Criteria	Previous Action Plan	Previous Data	Current Data	Interpretation
PSLO1	None Indicated	**80%**	100%	Success
PSLO5	None Indicated	70%	NA	NA
Graduation Rate	None Indicated	92%	Need this Data	
Retention	None Indicated	89%	Need this Data	
Certification		NA	NA	
DFWI	None Indicated	26.3%	Need this Data	Met

Program Headcounts*:

Fall 2016	Fall 2017	Fall 2018	Fall 2019	Fall 2020	Fall 2021	Fall 2022	
32	28	35	31	36	21	16	

* The headcount is often difficult to measure since many students are dual majors and sometimes not counted.

Program Graduates:

2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-2	2022-23
5	7	8	4	7	11	6	0

Adendum:

ISLO Diverse Perspectives. This ISLO was not assessed in any course. Currently there are no courses within the OIT Applied Mathematics Program that addresses this ISLO. The department is working on a program overhaul where we hope to address this deficiency. It is likely that we will need to require coursework outside of the math department.

Section 7 – Data-driven Action Plans:

The faculty assessed one program student learning outcomes (1) during the 2023-23 academic year. The faculty reviewed the results during the fall term 2023 during a faculty meeting and had the following conclusions.

Outcome 1 (Apply mathematical concepts and principles to perform symbolic computations.**)**: Students met all performance criteria and no further action is required at this time. The student performance was quite good, 100% were at least proficient.

Changes Resulting From Assessment of PSLOs

Based on our assessment results for the learning outcomes PSLO 1, we decided no formal changes are deemed necessary of PSLO 1.

Changes Resulting From Assessment of ISLOs

There was no assessment of diverse perspectives ISLO during the 2022-23 academic year. Throughout the 2023-4 year, the department will be working on a significant overhaul of the applied math program where we hope to address the issue of not being able to assess some ISLOs.

Changes Resulting From Assessment Enrollment and Retention

The applied math program enrollment has been rather consistent for the past 10 years at around 35 to 40 majors. While this number may seem low, it is consistent with the national average of about 1 to 2% of total university enrollment. However, this past year we saw a considerable drop in the number of majors; the drop was from 36 to 21 students (see table above). This is the reason for the 50% retention number in the table from Section 6. The department has met to discuss what we can do to improve these enrollment numbers. Throughout this academic year the department will be working on a significant overhaul of the math program. For example, we are considering moving away from the current "Focused Elective" model and replacing this with an Applied Mathematics Major with a number of more specific options or tracks. Initial discussions indicate that we feel such a change would help with recruitment and retention of new majors.

Changes Resulting From Assessment of DWFI

It is difficult to assess DWFI rate for all math majors as many of our courses only have 1 or 2 math students enrolled. When computing the overall DWFI for our Math Majors, we chose to look at the Junior and Senior level courses for which only Math majors enroll. For this last year we chose to consider Math 310, 311, 322, 421, 452, 453. The overall DWFI rate is 26.3% . However, when Math 311 is removed, the DWFI rate drops to 19.2%, an acceptable DWFI rate for Mathematics. This year we will be looking at significant changes to the

Math program. One of the changes could be the removal of the abstract course Math 311 Intro to Real Analysis and replacing it with Math 346 Number Theory.

Summary of possible changes resulting from Assessment

- Retention: Work on new structure for the program, one that includes options or tracks.
- DWFI: Replace the Math 311 Intro to Real Analysis with Math 346.
- Deficiency in Program aligning with the OIT ISLOs:
  (1) In addition to adding STAT 201, consider requiring a course such as "Ethics in the Professions" to help with assessing the ISLO on Ethics
  (2) Consider requiring coursework outside of mathematics to help with assessing the ISLO on Diverse Perspectives.

Section 8 – Closing the Loop: Reflection on previous work

Last year (2022-23) the department submitted a CPC proposal for minor changes to our program. Beginning in Fall 2023 all applied mathematics majors are required to take STAT 201 *Introduction to Data Science.* The STAT 201 has a significant component of ethics and we plan to use the course to assess foundation work in the area of ethics.