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 at the fall retreat during convocation.)

Section 2 – 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 3 – Program Description and History:

The Applied Mathematics Degree was approved by the Oregon University System in the spring of 2006, and the program was implemented beginning in the fall of that year. The program graduated its first student in the spring of 2008. We have had problems identifying the number our students because some of them are dual majors and are not required to declare themselves as an Applied Math major or have a math advisor until two terms before graduating. However, we currently estimate there are approximately 35 Applied Mathematics majors, 20 of which are earning dual degrees.

Coursework for Applied Mathematics intends to provide a solid foundation of mathematical theory and a broad selection of applied work both in and outside mathematics and across many fields. Graduates with a B.S. in Applied Mathematics work for such organizations as pharmaceutical companies (doing statistical analysis, or modelling the behavior of developing drugs using differential equations), insurance companies (as actuaries), publishing companies (as editors of technical publications), government agencies (like the National Security Agency), and public schools and colleges.

Program Location: Klamath Falls Campus Only

Program Graduates:

2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
5	3	7	4	4	5	7	8	8

Employment Rates and Salaries:

The following data were combined with information collected for the classes of 2015, 2016, 2017 and 2018. More information regarding the data used is available from Oregon Tech's Career Services.

Years	Employed	Continuing Education	Median Salary	Success Rate
2015/2016/2017	70%	30%	$47,000	100%
2016/2017/2018	33%	44%	$47,000	78%

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Section 4 – 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 5 – Curriculum Map

Freshman Year

Fall
MATH 251 - Differential Calculus (4)
SPE 111 - Public Speaking (3)
WRI 121 - English Composition (3)
Social Science Elective (3)
Elective Credit Hours: (3)
Total: 16 Credit Hours

Winter
ENGR 266 - Engineering Computation (3)
MATH 252 - Integral Calculus (4)
PHY 221 - General Physics with (4)
WRI 122 - Argumentative Writing (3)
Social Science Elective (3)
Total: 17/18 Credit Hours

Spring
MATH 253N - Sequences and Series (4)
PHY 222 - General Physics with Calculus (4)
Humanities Elective (3)
Social Science Elective (3)
Total: 14 Credit Hours

Sophomore Year

Fall
MATH 254N - Vector Calculus I (4)
MATH 310 – Mathematical Structures (4)
PHY 223 - General Physics with Calculus (4)
Elective (3)
Total: 15 Credit Hours

Winter
MATH 341 - Linear Algebra I (4)
MATH 354 - Vector Calculus II (4)
Elective (4)
Humanities Elective (3)
Total: 15 Credit Hours

Spring
MATH 361 - Statistical Methods I (4)
Elective (3)
Elective (3)
Elective (3)
Humanities Elective (3)
Total: 16 Credit Hours

Junior Year

Fall
MATH 321 - Applied Differential Equations I (4)
SPE 321 - Small Group and Team Communication (3)
Focused Elective (3)
Elective (4) (upper division)
Total: 14 Credit Hours

Winter
MATH 311 - Introduction to Real Analysis (4)
WRI 227 - Technical Report Writing (3)
Focused Elective (3)
Elective (3) (upper division)
Elective (3)
Total: 16 Credit Hours

Spring
MATH 322 - Applied Differential Equations II (4)
MATH 451 - Numerical Methods I (4)
Focused Elective (3)
Math/Physics Elective (3) (upper division)
Elective (2)
Total: 16 Credit Hours

Senior Year

Fall
MATH 421 - Applied Partial Differential Equations I (4)
Focused Elective (4)
Math/Physics Elective (4)(upper division)
Elective (3)
Total: 15 Credit Hours

Winter
Mathematics Core (4) (upper division)
Focused Elective (3)
Social Science Elective (3)
Elective (3)
Elective Credit Hours: 3
Total: 16 Credit Hours

Spring
Mathematics Core (4) (upper division)
WRI 327 - Advanced Technical Writing Credit Hours: 3 **or** WRI 350 - Documentation Development (3)
Elective (3)
Elective (3)
Total: 13 Credit Hours

BS Applied Mathematics
Total Credit Hours: 183-184

Section 6 – 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	**'18-19**	**'19-20**	**'20-21**
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**

Comment: The assessment cycle was changed in 18-19 due to lack of math majors enrolled in Math 451 where SLO 5 was to be assessed. We swapped SLOs 5 and 6 in years 18-19 and 19-20.

Section 7 – Assessment Activities 2019-20

Assessment of two learning outcomes was conducted during this academic year. A combined rate of proficiency and high proficiency of at least 60% is considered a minimum acceptable performance. We used three direct measures for each outcome and one indirect measure. We had planned to also include an additional indirect measure for each by using the student exit survey, however, since the response rate was only 1student, we decided to omit this data as it was deemed statistically insignificant.

Outcome 1: *Apply mathematical concepts and principles to perform symbolic computations*, was assessed in Math 354, in the Winter of 2020. The instructor was Dr. Dibyajyoti Deb. There were three criteria assessed.

a) Set up and evaluate a multi-variable integral.
b) Apply a form of Stokes' theorem to convert between integrals.
c) Solve a problem related to conservative vector fields

These criteria were measured by exams and the results *for only the math majors* are given in Table 2. Percent indicates the percentage of students performing at the given level for each criterion. There were 10 math majors enrolled in Math 354 this term. Each was given the same three problems on a final exam. Dibyajyoti Deb has a copy of the problems given to the students and the data used to complete Table 2. Here is a description of the three problems.

Problem 1: Compute a surface integral over a parameterized surface.

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

Problem 3: Verify that a vector field is conservative and find the potential function.

	Student Performance		
Criterion	Some/no proficiency	Proficient	High Proficiency
(a)	0	10	90
(b)	70	10	20
(c)	50	20	30

Table 2. Assessment results for Outcome 1.

Indirect Measure : Course Grade in Math 354 Winter Term 2020

Students with grade **<u>above satisfactory</u>** – (40%)

Students with **<u>satisfactory grade</u>** – (40%)

Students with grade **<u>below satisfactory</u>** – (20%)

The students in Math 354 performed strongly in the area of symbolic computation as it related to setting up multiple integrals. The low score of 70% for criteria (b) resulted because most of the students started the problem but did not finish it. If we omit question (b) the data suggests that our Junior/Senior students are performing at a very high level in the area of symbolic computation. The course grade distribution also supports this conclusion. In our next cycle of assessing symbolic computation we might want to consider assessing the specific question about using Stokes Theorem in a different way, for example in a non-timed assignment. Additionally we may want to assess symbolic computation in more than once course so as to get a more complete picture of student performance in this area.

Outcome 5: *Apply technology tools to solve problems* was assessed in Math 452, Numerical Methods II, in Winter 2020. The instructor was Dr. Cristina Negoita. There are four performance criteria for this PSLO.

a) Write appropriate code.
b) Provide proper documentation of code.
c) Presentation and output of results.
d) Validity of solutions via comparison or other means.

These criteria were measured by considering the first of the four major assignments on which their grade was based. The course used the Matlab and Python programming languages. The results are given in Table 3. Percents indicate the percentages of students performing at the given level for each criterion. There were fourteen math majors in the course (four were dual majors, software and math, and the remaining 10 were applied math majors).

	Student Performance		
Criterion	Some/no proficiency	Proficient	High Proficiency
Write code	21%	58%	21%
Document code	35%	42%	23%
Presentation	35%	43%	22%
Solution validity	0%	79%	21%

Table 3 Assessment results for Outcome 5.

Some students were unable to produce working code – mainly because they did not dedicate sufficient time to work on their assignment. Students were given the option to write their code in Matlab or Python, depending on which language they were more comfortable with. Most of the students who were duals (software and math) chose to write their code in Python. The instructor provided support in both languages, and students who chose to use Python generally performed well.

Program documentation was mixed – some students performed really well and identified the relevant pieces of code, including necessary variable and their initialized value, the output produced by their code, and the methods embedded in their logic.

Presentation followed similarly with program documentation. Students did well overall in including appropriate graphs, and only relevant numerical information, formatted in tables or other visually appropriate displays. Some however lacked details in their graphical presentation (no labeling of axes for example) or did not follow directions in organizing their data appropriately.

Validity of solutions was stressed in each problem, and most students were asked to include some metric for assessing the validity of their solutions. They were also asked to write conclusions in each case that asked them to compare numerical with theoretical results. Students were able to self-assess in this category when their numerical results did not match theoretical results, and this was considered a positive measure of their ability to validate solutions produced numerically.

Indirect Measure : Course Grade in Math 452 Winter Term 2020

Students with grade **above satisfactory** – (36%)

Students with **satisfactory grade** – (29%)

Students with grade **below satisfactory** – (35%)

8. Evidence of Improvement – Closing the Loop

There were no “closing the loop” items to discuss this year.

9. Data-driven Action Plans: Changes Resulting from Assessment

Teamwork: This year (19-20) OIT assessed the ISLO on teamwork. The Applied Mathematics Department did not participate in this exercise because the Applied Math Program does not currently have a substantial teamwork component such as a Junior or Senior project. The department discussed this and decided that we would like to pursue the idea of incorporating such a project. Our discussions led us to the conclusion that we like the idea of requiring a senior project but there are some concerns that need to be addressed before we make formal commitments. One concern has to do with faculty workload. The faculty union is currently under negotiations and it is uncertain at this time if faculty will be compensated for work related to student group projects. Another concern is that for some students, a solo senior project might make more sense than a group project. The department agreed to continue discussing the idea of incorporating group projects in the program and will update our position concerning teamwork in future assessment reports.

The faculty assessed two program student learning outcomes during the 2019-20 academic year. The faculty reviewed the results during the fall term 2020 during a faculty meeting and had the following conclusions.

Outcome 1:

Students met all performance criteria and no further action is required at this time. The student performance was quite good except for one specific question. As noted above, the instructor felt that the student performance was over-all excellent

Outcome 5:

Students met all performance criteria and no further action is required at this time.

Changes Resulting From Assessment

Based on our assessment results for the learning outcomes PSLO 1, for the next cycle of assessing symbolic computation we will consider altering the question about Stokes Theorem and also consider assessing in more than one course, for example, assess in Math 421 as well as Math 354. Considering PSLO 5, no changes were deemed necessary.