The following provides a summary of the Recommendation Report decisions from the CCN Math Subcommittee, with the exception of amended Minority Report recommendations, which appear in red font in the report.

Recommendation	Vote
Course Number and Prefix: MTH or MATH 251Z	Yes 15 No 0 Abstain 0
Course Title: Differential Calculus	Yes 15 No 0 Abstain 0
Course Credits: 4	Minority Report Recommendation Yes 15 No 0 Abstain 0
Course Description: This course explores limits, continuity, derivatives, and their applications for real-valued functions of a single variable. These topics will be explored graphically, numerically, and symbolically in real-life applications. This course emphasizes abstraction, problem-solving, modeling, reasoning, communication, connections with other disciplines, and the appropriate use of technology.	
Course Learning Outcomes: At the end of the course, students will be able to… 1. Calculate limits graphically, numerically, and symbolically; describe the behavior of functions using limits and continuity; and recognize indeterminate forms. 2. Apply the definition of the derivative and analyze average and instantaneous rates of change. 3. Interpret and apply the concepts of the first and second derivative to describe and illustrate function features including the slopes of tangent lines, locations of extrema and inflection points, and intervals of increase, decrease, and concavity. 4. Apply product, quotient, chain, and function-specific rules to differentiate combinations of power, polynomial, rational, exponential, logarithmic, trigonometric, and inverse trigonometric functions, as well as functions defined implicitly. 5. Apply derivatives to a variety of problems in mathematics and other disciplines, including related rates, optimization, and L'Hôpital's rule.	Yes 15 No 0 Abstain 0
Required Course Content: At the end of the course, students will be able to…	Yes 15 No 0 Abstain 0

1. Calculate limits graphically, numerically, and symbolically; describe the behavior of functions using limits and continuity; and recognize indeterminate forms.
    a. Students will be able to calculate limits graphically, numerically, and algebraically.
    b. Students will be able describe the local and global behavior of functions using limits.
    c. Students will be able to describe the notion of continuity using limits and determine whether a function is continuous.
    d. Students will be able to recognize and evaluate indeterminate forms.
2. Apply the definition of the derivative and analyze average and instantaneous rates of change.
    a. Students will be able to state and use the definition of the derivative to calculate the derivatives of simple functions.
    b. Students will be able to determine whether a function is differentiable using limits.
    c. Students will be able to describe the connection between the definition of the derivative and the average and instantaneous rates of change of a function.
    d. Students will be able to use derivatives in applications using appropriate units.
3. Interpret and apply the concepts of the first and second derivative to describe and illustrate function features including the slopes of tangent lines, locations of extrema and inflection points, and intervals of increase, decrease, and concavity.
    a. Students will recognize and apply the concept of the derivative to describe and find the slopes of tangent lines.

   b. Students will be able to use the derivative to identify the intervals on which a function is increasing or decreasing, and the locations of extreme values.

   c. Students will be able to use the second derivative to identify intervals of concavity and the locations of inflection points.

4. Apply product, quotient, chain, and function-specific rules to differentiate combinations of power, polynomial, rational, exponential, logarithmic, trigonometric, and inverse trigonometric functions, as well as functions defined implicitly.
   a. Students will be able to differentiate power, polynomial, rational, exponential, logarithmic, trigonometric, and inverse trigonometric functions algebraically
   b. Students will be able to apply sum, constant multiple, product, quotient, and chain rules to differentiate combinations of functions listed above.
   c. Students will be able to differentiate functions defined implicitly.
5. Apply derivatives to a variety of problems in mathematics and other disciplines, including related rates, optimization, and L’Hôpital’s rule.
   a. Students will be able to recognize when L'Hôpital's rule is appropriate and use it to calculate limits involving indeterminate forms.
   b. Students will be able to use the derivative to solve related rates problems.
   c. Students will be able to use the derivative to solve optimization problems.
   d. Students will be able to interpret and communicate the meaning of the derivative and its application in context, including using appropriate notation.

Course Number and Prefix: MTH or MATH 252Z	Yes 15 No 0 Abstain 0
Course Title: Integral Calculus	Yes 15 No 0 Abstain 0

Course Credits: 4	Minority Report Recommendation
Course Description: This course explores Riemann sums, definite integrals, and indefinite integrals for real-valued functions of a single variable. These topics will be explored graphically, numerically, and symbolically in real-life applications. This course emphasizes abstraction, problem-solving, modeling, reasoning, communication, connections with other disciplines, and the appropriate use of technology.	Yes 15 No 0 Abstain 0
Course Learning Outcomes: At the end of the course, students will be able to… 1. Approximate definite integrals using Riemann sums and apply this to the concept of accumulation and the definition of the definite integral. 2. Explain and use both parts of the Fundamental Theorem of Calculus. 3. Choose and apply integration techniques including substitution, integration by parts, basic partial fraction decomposition, and numerical techniques to integrate combinations of power, polynomial, rational, exponential, logarithmic, trigonometric, and inverse trigonometric functions. 4. Use the integral to model and solve problems in mathematics involving area, volume, net change, average value, and improper integration. 5. Apply integration techniques to solve a variety of problems, such as work, force, center of mass, or probability.	Yes 15 No 0 Abstain 0

Required Course Content:
At the end of the course, students will be able to…
1. Approximate definite integrals using Riemann sums and apply this to the concept of accumulation and the definition of the definite integral.
    a. Students will be able to express finite sums using sigma notation.
    b. Students will be able to use Riemann sums to describe the process of approximating the net signed area between a curve and an axis.
	Yes 15 No 0 Abstain 0

   c. Students will be able to relate the definite integral with the concept of accumulation of area or other infinitesimal quantities, including the use of appropriate units.

2. Explain and use both parts of the Fundamental Theorem of Calculus.
   a. Students will be able to recognize and express the definite integral as a limit of a Riemann sum.
   b. Students will use and compare different methods for calculating definite integrals, such as linear properties of integrals, net-signed area, and graphical approaches.
   c. Students will explain and apply the concept of indefinite integrals and its connection to antidifferentiation.
   d. Students will explain the connection between derivatives and integrals and apply their understanding using the Fundamental Theorem of Calculus.
3. Choose and apply integration techniques including substitution, integration by parts, basic partial fraction decomposition, and numerical techniques to integrate combinations of power, polynomial, rational, exponential, logarithmic, trigonometric, and inverse trigonometric functions.
   a. Students will be able to integrate power, polynomial, rational, exponential, logarithmic, trigonometric, and inverse trigonometric functions using basic rules.
   b. Students will be able to use substitution and integration by parts to algebraically integrate appropriate combinations of functions.
   c. Students will be able to use partial fraction decomposition to evaluate integrals of rational functions whose denominators may be expressed as products of distinct linear factors.

d. Students will be able to use numerical techniques, such as Midpoint, Trapezoidal, and Simpson's rules, to approximate definite integrals. 4. Use the integral to model and solve problems in mathematics involving area, volume, net change, average value, and improper integration. a. Students will be able to use definite integrals to find the area between two curves. b. Students will be able to calculate volumes of solids, such as solids of revolution or prisms, using integrals. c. Students will be able to apply the integral to find the average value of a function over an interval. d. Students will be able to apply the integral to find the net change of a function over an interval. e. Students will be able to recognize, describe, and calculate improper integrals. 5. Apply integration techniques to solve a variety of problems, such as work, force, center of mass, or probability. a. Students will apply integration to problems in the instructor's choice of context, including but not limited to the possible options above. At least two distinct applications are recommended based on the population of students in the class.	
Course Number and Prefix: MTH or MATH 253Z **Course Title:** Calculus: Sequences and Series **Course Credits:** 4 **Course Description:** This course explores real-valued sequences and series, including power and Taylor series. Topics include convergence and divergence tests and applications. These topics will be explored graphically, numerically, and symbolically. This course emphasizes abstraction, problem-solving, reasoning, communication, connections with other disciplines, and the appropriate use of technology. **Course Learning Outcomes:**	Yes 15 No 0 Abstain 0 Yes 15 No 0 Abstain 0 Yes 15 No 0 Abstain 0 Yes 15 No 0 Abstain 0

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At the end of the course, students will be able to…

1. Recognize and define sequences in a variety of forms and describe their properties, including the concepts of convergence and divergence, boundedness, and monotonicity.
2. Recognize and define series in terms of a sequence of partial sums and describe their properties, including convergence and divergence.
3. Recognize series as harmonic, geometric, telescoping, alternating, or p-series, and demonstrate whether they are absolutely convergent, conditionally convergent, or divergent, and find their sum if applicable.
4. Choose and apply the divergence, integral, comparison, limit comparison, alternating series, and ratio tests to determine the convergence or divergence of a series.
5. Determine the radius and interval of convergence of power series, and use Taylor series to represent, differentiate, and integrate functions.
6. Use techniques and properties of Taylor polynomials to approximate functions and analyze error.
</td><td>Yes 15 No 0 Abstain 0</td></tr>
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Required Course Content:

At the end of the course, students will be able to…

1. Recognize and define sequences in a variety of forms and describe their properties, including the concepts of convergence and divergence, boundedness, and monotonicity.
    a. Students will be able to define and recognize sequences given explicitly or recursively.
    b. Students will be able to determine whether a given sequence is convergent or divergent by appropriate use of the limit laws for sequences, the Squeeze Theorem, or L'Hôpital's rule.
    c. Students will be able to determine the monotonicity and boundedness properties of a sequence, and use them to draw conclusions about convergence or divergence.
</td><td>Yes 15 No 0 Abstain 0</td></tr>
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2. Recognize and define series in terms of a sequence of partial sums and describe their properties, including convergence and divergence. a. Students will be able to represent a series as a limit of a sequence of partial sums, and describe the notions of convergence or divergence of the series. b. Students will be able to algebraically manipulate series, and apply series laws to draw conclusions about divergence, convergence, and the value of the limit. 3. Recognize series as harmonic, geometric, telescoping, alternating, or p-series, and demonstrate whether they are absolutely convergent, conditionally convergent, or divergent, and find their sum if applicable. 4. Choose and apply the divergence, integral, comparison, limit comparison, alternating series, and ratio tests to determine the convergence or divergence of a series. a. Students will be able to recognize when the divergence, integral, comparison, and limit comparison tests apply to a particular series, and draw conclusions about the convergence or divergence of the series. b. Students will be able to recognize when the ratio and alternating series tests apply to a particular series, and draw conclusions about the absolute convergence, conditional convergence, or divergence of a series. 5. Determine the radius and interval of convergence of power series, and use Taylor series to represent, differentiate, and integrate functions. a. Students will be able to find the radius and interval of convergence of a given power series. b. Students will be able to use power series to represent functions, and determine the radius of convergence of the series.	

c. Students will be able to differentiate and integrate power series that represent functions. d. Students will be able to find the Taylor series centered at a point *x=c* of a given function and determine its radius of convergence. 6. Use techniques and properties of Taylor polynomials to approximate functions and analyze error. a. Students will be able to approximate a function using a Taylor polynomial. b. Students will be able to estimate the error in a Taylor polynomial approximation using either Taylor's Inequality or the Alternating Series Estimation Theorem. c. Students will be able to approximate an alternating series to a desired error by a partial sum of the series.	

Chart approved by CCN Math Co-chairs Celeste Petersen and Leanne Merrill, November 6, 2023. Amended with Minority Report Recommendations for credits September 30, 2024.

Oregon Transfer Compass

CCN Subcommittee Minority Report

CCN Math

Amended September 30, 2024

Subcommittee Members
Randall Paul, Oregon Institute of Technology
Beatriz Lafferriere, Portland State University
Hayden Harker, University of Oregon
Sara Clark, Oregon State University

Co-chairs Celeste Petersen and Leanne Merrill

November 6, 2023

Re: Recommendation from the subcommittee

Be it resolved that the following members

Randall Paul	Oregon Institute of Technology
Beatriz Lafferriere	Portland State University
Hayden Harker	University of Oregon
Sara Clark	Oregon State University

of the CCN Math Subcommittee would like file a Minority Report to provide a record of their disagreement with the following motion:

I. In accordance with the mandates of SB 233, the Common Course Number Math Subcommittee recommends to the Transfer Council that: MTH 251Z-Differential Calculus be credited at 5 quarter credits.

II. In accordance with the mandates of SB 233, the Common Course Number Math Subcommittee recommends to the Transfer Council that: MTH 252Z-Integral Calculus be credited at 5 quarter credits.

Section A : Rationale & Alternative Recommendations

The above disagree with the following recommendation for the following reasons

I. We were all pleased to serve on the Common Course Numbering Mathematics subcommittee. Despite coming from a wide variety of backgrounds and institutions, discussions were always collegial and respectful. On almost every issue we were able to reach a consensus that was acceptable to everyone. The only issue on which we could not find consensus was on the committee's recommendation that Math 251Z and Math 252Z should be 5 credit courses across all Oregon institutions of higher education. On this we must respectfully disagree with our colleagues. We are convinced that these courses should remain 4 credit hour courses.

The committee agreed that the fundamental problem lies in the fact that different Oregon institutions of higher education serve very different populations. For many years, a four hour calculus class has been quite adequate for the population of Oregon's public universities, which is dominated by full-time students, living on-campus, and arriving with reasonably good high school math preparation. (This is not to say that all of these students pass. Far from it---calculus is hard.) However, members representing primarily community colleges argued passionately and convincingly that they cannot effectively teach calculus with just four weekly contact hours to their population of part-time, commuting students, many of whom have poor high school math preparation. Further, they argue, this is an equity issue, as their population consists of a much higher percentage of students who are historically underrepresented and underserved, including many people of color (POC). We agree with all of that, particularly that this is an equity issue. Where we disagree, is in the proposed solution of requiring all institutions to offer five credit calculus classes.

The committee agreed that the simplest solution would be to continue to let the individual institutions decide how many credit hours are appropriate for a calculus class serving their particular student populations. We understood, though, that that was not our charge. Forced to make a choice, the committee chose to require that MTH 251Z and MTH 252Z be five hour calculus classes. This choice comes with very real costs to both institutions and students. Besides the actual monetary cost of two additional credit hours (not a trivial expense at many of our universities), there is a significant additional cost in student time. Each hour spent in class requires several hours of study out of the classroom, yet there are only so many hours in each week. A full-time student trying to graduate in four years with a STEM degree will find those five-hour calculus classes onerous.

We should also not ignore the effect this change will have on STEM programs, almost all of which require calculus. These programs are already under significant pressure to reduce the total credit hours required for their degree, ideally to 180 credit hours. An additional two hours of calculus (for the two-course sequence) translates to half a course fewer in their program. This will be frustrating for both faculty and students in these programs since, at many of our universities, the two additional hours of calculus would be unnecessary.

a. We whole-heartedly agree that all students should have the contact hours and support that they need to be successful. But there are other ways to increase contact hours and support at those institutions that need them besides imposing a fifth credit hour on all Oregon institutions. We suggest a math lab support course. Similar courses to support precalculus and statistics courses (MTH 111Z, MTH 112Z, STAT 243Z) are already in place at several institutions. This model will require that students in a four-hour calculus class also register for a one credit hour “math lab" which consists of three hours per week of additional examples, homework discussion, and one-on-one mentoring. Institutions that feel their students need the additional contact hours can require the math lab as a corequisite. The four-hour calculus class would transfer cleanly, as envisioned in the legislation. The math lab class would transfer as a 1 credit math elective.

Some of our colleagues stressed that, under this model, they were not fairly compensated for the time they spent teaching in this math lab.

They also point out that their institutions do not provide adequate tutoring opportunities for their students. We are very sympathetic to these concerns. (One of us went on strike a few years ago in part over these issues.) Nonetheless, we feel that it is incumbent on the individual institutions to provide the resources their students need to be successful, rather than imposing a burden on all Oregon institutions.

II. Rationale is the same as point I, above.

   a. We believe the math lab model will also work for Math 252Z.

Section B: Considerations

In conclusion, we ask the Transfer Council to consider these issues carefully and to do/consider the following:

I. It is an enormous challenge to provide Oregon's diverse population with the access to higher education that they deserve. Students with weaker mathematical preparation, who come into higher education from more difficult circumstances, really should receive the additional support they need. But we do not believe that a blunt instrument like a credit hour added to all Oregon Math 251Z and Math 252Z courses is the correct approach. It will have real costs to Oregon students and Oregon's STEM programs. There are other, better ways to address this important challenge.

Name Randall Paul	Signature Randall Paul
Name Beatriz Lafferriere	Signature Beatriz Lafferriere
Name Hayden Harker	Signature Hayden Harker
Name Sara Clark	Signature Sara Clark

Signed by:
Date: Amended October 1, 2024

Provide copies to:

CCN Mathematics Chair/Co-chairs	Celeste Petersen cpetersen@clatsopcc.edu Leanne Merrill merrill@mail.wou.edu
Transfer Council Co-chairs	Jose Coll David Plotkin
	Donna Lewelling, Director of Community Colleges and Workforce Development, HECC Veronica Dujon, Director of Academic Policy and Authorization, HECC

— END OF REPORT–