THOMPSON RIVERS UNIVERSITY | Mathematics and Statistics

Course Outline

MATH 1230 – 02
Calculus 2 for Engineering (3,1.5,0)
Winter 2020

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Calendar Description

Students learn the ideas and techniques of single-variable integral calculus from an engineering perspective. Integrals are defined, evaluated and used to calculate areas, volumes, arc lengths and physical quantities such as force, work and centres of mass. Differential equations are introduced and used to model various physical phenomena. Ideas about infinite series are pursued, including some convergence tests, with particular emphasis on Taylor series.

Education Objectives/Outcomes

On completion of the course, the student will be expected to:

1. Set up and evaluate Riemann sums using left endpoints, right endpoints or midpoints, and interpret these sums in terms of areas of rectangles.
2. Define the definite integral of a function as a limit of a Riemann sum and, conversely, recognize a limit of this form as a definite integral.
3. Interpret definite integrals in terms of area and use definite integrals to compute areas.
4. Evaluate antiderivatives (indefinite integrals) that can be determined directly from basic differentiation rules.
5. Relate definite integrals to derivatives by the Fundamental Theorem of Calculus.
6. Evaluate integrals by the methods of substitution and integration by parts.
7. Evaluate trigonometric integrals using substitution and trigonometric identities.
8. Evaluate integrals using trigonometric substitution when appropriate.
9. Evaluate integrals using algebraic techniques such as completing the square, polynomial division and partial fraction decomposition.
10. Approximate definite integrals by Riemann sums, the Trapezoid Rule and Simpson's Rule.
11. Interpret improper integrals as limits of proper integrals and evaluate them accordingly (or show divergence).
12. Find areas of regions in the plane bounded by curves, using appropriate integrals.
13. Compute the average value of a function over an interval.
14. Find the volume of a solid in cases where the volume may be computed by integrating the cross-sectional area of the solid (in particular, for solids that can be generated by rotating a planar region about an axis).

15. Find volumes using cylindrical shells, when appropriate.
16. Set up an integral for the length of a curve defined as the graph of a function.
17. Set up an integral for the area of a surface of revolution.
18. Set up an integral for the work done on an object by a force in various instances where the force is not constant or different parts of the object move different distances, such as when water is pumped up (against gravity) out of a tank.
19. For an object that can be idealized as one-dimensional (such as a straight piece of wire), calculate moments of various types, and find the centre of mass.
20. Determine whether a given function is a solution to a given ordinary differential equation or initial-value problem.
21. Solve first-order ordinary differential equations by separation of variables when possible.
22. Use ordinary differential equations to model growth and decay, especially for populations.
23. Solve problems involving Newton's law of cooling and chemical mixing.
24. Apply the divergence test and the integral test when appropriate to determine the convergence or divergence of a series of real numbers.
25. Use the Ratio Test when appropriate to determine convergence or divergence of a series of real numbers and to determine the radius of convergence for a real power series.
26. Compute the Taylor series for a function at a point using the formula for the coefficients.
27. Manipulate power series using various operations, including substitution, differentiation and integration, and thereby obtain Taylor series by indirect methods.
28. Draw the graph of a curve defined parametrically, calculate slopes and arc lengths for parametric curves, and find areas bounded by parametric curves.
29. Draw the graph of a curve defined by a polar equation, calculate slopes and arc lengths for polar curves, and find areas bounded by polar curves.

Prerequisites

Prerequisite: MATH 1130 (Calculus 1 for Engineering). Required seminar: MATH 1230S.

Texts/Materials

W. Briggs, L. Cochran, B. Gillett, *Calculus: Early Transcendentals, Single Variable*, 3rd Edition, Pearson Education.

Student Evaluation

Weekly quizzes (×8) 15%
Midterm exams (×2) 40%
Final exam 45%

In the event a student misses an exam, a mark of zero will be given unless the student contacts the instructor prior to the exam, informing the instructor of the particular situation. Students are responsible for checking the final examination schedule which shall be posted each semester by the Registrar, and for advising the Registrar of any conflicts within the schedule. Attendance at a scheduled final examination is mandatory, and the responsibility is on the student to seek remedy for a missed final exam.

Students who require special accommodation due to a disability are encouraged to contact Accessibility Services.

Attendance Regulations

A registered student who does not attend the first two events (e.g., lectures/labs/etc.) of the course and who has not made prior arrangements acceptable to the instructor may, at the discretion of the instructor, be considered to have withdrawn from the course and have his/her course registration deleted. A registered student is expected to attend a minimum of 90% of lectures and seminars for which he/she is enrolled. In the case of deficient attendance without cause, a student may, on recommendation of the instructor to the instructors Dean or Chairperson, be withdrawn from a course. Admission to a lecture or seminar may be refused by the instructor for lateness, class misconduct, or failure to complete required work.

Academic Integrity Policy

TRU students are required to comply with the standards of academic integrity set out in Student Academic Integrity policy (ED 5-0), available at TRU website. Cheating, academic misconduct, fabrication, and plagiarism could result in failure of a course or even suspension from TRU.

Prior Learning Assessment and Recognition/Challenges

Students may receive credit for Prior Learning Assessment and Recognition (PLAR) by writing a challenge examination designed by a qualified specialist approved by the Department of Mathematics and Statistics. More information can be obtained from the Office of the Registrar.

Use of Technology

A (non-calculus enabled) scientific calculator is allowed. Graphing calculators are not permitted on tests or quizzes. Cell phones are to be turned off and not used during class.

Math Help Centre

All students are welcome to consult with a math tutor on a drop-in basis, free of charge, at the Math Help Centre, which is located in House of Learning Room 304. More information is available on the following webpage: `https://www.tru.ca/science/programs/math/math_help_centre.html`

Course Topics

1. **Antiderivatives & Integration ..... Ch. 5**
   Antiderivatives
   Riemann Sums
   Indefinite and Definite Integrals
   The Fundamental Theorem of Calculus
   Average Value of a Function
   Integration by Substitution

2. **Applictions of Integration ..... Ch. 6 & 7**
   Displacement, Velocity and Acceleration
   Volumes of Solids
   Lengths of Curves
   Areas of Surfaces
   Force, Work and Pressure
   Moments, Centroids, Centres of Mass, Inertia
   Logarithms and Exponential Models
   Probability (Time Permitting)

3. **Techniques of Integration ..... Ch. 8**
   Basic Approaches
   Integration by Parts
   Trigonometric Integrals and Inverse Trigonometric Integrals
   Trigonometric Substitutions
   Partial Fractions
   Tables of Integrals and Computer Algebra Systems
   Numerical Methods
   Improper Integrals

4. **Differential Equations ..... Ch. 9**
   Basic Ideas and Definitions
   Direction Fields and Eulers Method
   Separable Differential Equations
   First-Order Linear Differential Equations
   Modeling

5. **Sequences and Series ..... Ch. 10 & 11**
   Infinite Sequences
   Infinite Series
   Convergence Tests
   Power Series
   Taylor & MacLaurin Series

6. **Parametric Curves and Polar Coordinates (time permitting) ..... Ch. 12**