General Information.

Discipline: Mathematics
Course code: 201-SH3-AB
Ponderation: 2-2-2
Credits: 2
Prerequisite: 201-SH2-AB
Objective: 0PU3

Your teacher will give you their schedule and availability.
Students are strongly advised to seek help promptly from their teacher if they encounter difficulties in the course.

Introduction. Calculus II is the sequel to Calculus I, and so is the second Mathematics course in the Social Science Program. It is generally taken in the second semester. In Calculus II, the notions of indefinite and definite integration are studied in depth, and their uses in other areas of social science are explored.

The primary purpose of the course is the attainment of objective 0PU3 (see below). To achieve this goal, the course must help the student understand the following basic concepts: limits, derivatives, indefinite and definite integrals, infinite sequences, and improper integrals (including algebraic, trigonometric, exponential, and logarithmic functions).

Emphasis is placed on clarity and rigour in reasoning and in the application of methods. The student will learn to interpret the integral both as an antiderivative and as a sum of products, and to use techniques of integration in several contexts related to the fields of Social Science such as population growth, the spread of rumour or disease, financial mathematics, cost-benefit analysis (cost, revenue and profit) and probability. The basic concepts are illustrated by applying them to various problems where their application helps to arrive at a solution. In this way, the course encourages the student to apply learning acquired in one context to problems arising in another.

Textbook. There is no required textbook for this course. Sets of exercises will be provided by your teacher. A good reference for the course material is *Applied Calculus for the Managerial, Life, and Social Sciences, 10th edition*, by Soo T. Tan. Note that this book may not be available for purchase at the bookstore, but reference copies are available in the Math Study Area and at the Library.

Calculator Policy. Only calculators which have previously been inspected and approved via sticker by the instructor will be permitted for use on quizzes, tests or the final examination. The only calculators that will be approved begin with the model number **SHARP EL-531**. An acceptable calculator model is available for purchase at the bookstore.

Course Costs. The approved model of scientific calculator costs about $25.

Teaching Methods. This course will be 60 hours, meeting three times a week for a total of four hours a week. It relies mainly on the lecture method, although some of the following techniques are also used: question-and-answer sessions, labs, problem-solving periods, and class discussions. In general, each class begins with a question period on previous topics, then new material is introduced, followed by worked examples. No marks are deducted for absenteeism (however, see below). Failure to keep pace with the lectures results in a cumulative inability to cope with the material and a failure in the course. A student will generally succeed or fail depending on how many problems have been attempted and solved successfully. It is entirely the student's responsibility to complete suggested homework assignments as soon as possible following the lecture, as the material will be fresher in their mind. This also allows the student the maximum benefit from any discussion of the homework (which usually occurs in the following class).

Evaluation Plan. The Final Evaluation in this course consists of the Final Exam, which covers all elements of the competency. A student's Final Grade is a combination of the Class Mark and the mark on the Final Exam. The Class Mark will be 75% (three or more in-class written tests) and 25% at your teacher's discretion (more tests, quizzes or assignments). The specifics of the Class Mark are included in an appendix that is distributed to students along with this course outline. The Final Exam is set by the course committee (which consists of all instructors currently teaching this course), and is marked by each individual instructor. Every effort is made to ensure equivalence between the various sections of the course.

The Final Grade will be the better of:

50% Class Mark and 50% Final Exam Mark
or
25% Class Mark and 75% Final Exam Mark

A student *choosing not to write* the Final Exam will receive a failing grade of 50% or their Class Mark, whichever is less.

Students must be available until the end of the final examination period to write exams.

Other Resources.

Math Website.
http://departments.johnabbott.qc.ca/departments/mathematics

Math Study Area. Located in H-200A and H-200B; the common area is usually open from 8:30 to 17:30 on weekdays as a quiet study space. Computers and printers are available for math-related assignments. It is also possible to borrow course materials when the attendant is present.

Math Help Centre. Located in H-216; teachers are on duty from 8:30 until 15:30 to give math help on a drop-in basis.

Peer Tutoring. Starting on the fifth week of each semester, first year students can be paired with a fellow finishing student for a weekly appointment of tutoring. Ask your teacher for details.

Academic Success Centre. The Academic Success Centre, located in H-139, offers study skills workshops and individual tutoring.

College Policies.

Policy No. 7 - IPESA, Institutional Policy on the Evaluation of Student Achievement: https://www.johnabbott.qc.ca/wp-content/uploads/2021/05/Policy-No.-7-IPESA-FINAL.pdf.

Religious Holidays (Article 3.2.13 and 4.1.6). Students who wish to miss classes in order to observe religious holidays must inform their teacher of their intent in writing within the first two weeks of the semester.

Student Rights and Responsibilities: (Article 3.2.18). It is the responsibility of students to keep all assessed material returned to them and/or all digital work submitted to the teacher in the event of a grade review. (The deadline for a Grade Review is 4 weeks after the start of the next regular semester.)

Student Rights and Responsibilities: (Article 3.3.6). Students have the right to receive graded evaluations, for regular day division courses, within two weeks after the due date or exam/test date, except in extenuating circumstances. A maximum of three (3) weeks may apply in certain circumstances (ex. major essays) if approved by the department and stated on the course outline. For evaluations at the end of the semester/course, the results must be given to the student by the grade submission deadline (see current Academic Calendar). For intensive courses (i.e.: intersession, abridged courses) and AEC courses, timely feedback must be adjusted accordingly.

Academic Procedure: Academic Integrity, Cheating and Plagiarism (Article 9.1 and 9.2). Cheating and plagiarism are unacceptable at John Abbott College. They represent infractions against academic integrity. Students are expected to conduct themselves accordingly and must be responsible for all of their actions.

College definition of Cheating: Cheating means any dishonest or deceptive practice relative to examinations, tests, quizzes, lab assignments, research papers or other forms of evaluation tasks. Cheating includes, but is not restricted to, making use of or being in possession of unauthorized material or devices and/or obtaining or providing unauthorized assistance in writing examinations, papers or any other evaluation task and submitting the same work in more than one course without the teacher's permission. It is incumbent upon the department through the teacher to ensure students are forewarned about unauthorized material, devices or practices that are not permitted.

College definition of Plagiarism: Plagiarism is a form of cheating. It includes copying or paraphrasing (expressing the ideas of someone else in one's own words), of another person's work or the use of another person's work or ideas without acknowledgement of its source. Plagiarism can be from any source including books, magazines, electronic or photographic media or another student's paper or work.

Course Content. The topics listed below will be covered in the course. The section numbers are references to *Applied Calculus for the Managerial, Life, and Social Sciences, 10th edition*, by Soo T. Tan, which is available for reference in the Math Study Area and at the Library. Your teacher will provide you with practice problems during the semester. Regular work done as the course progresses should make it easier for you to master the course.

Exercises #1 - L'Hospital's Rule (B.2)
Exercises #2 - Infinite Sequences (11.2)
Exercises #3 - Basic Integration (6.1, 12.4)
Exercises #4 - Integral as Area (6.3)
Exercises #5 - Riemann Sums (6.4)
Exercises #6 - Definite Integrals (6.5)
Exercises #7 - Area Between Curves (6.6)
Exercises #8 - Substitution (6.2)
Exercises #9 - Integration by Parts (7.1)
Exercises #10 - Mixed Integrals
Exercises #11 - Improper Integrals (7.4)
Exercises #12 - Consumer and Producer Surplus (6.7)
Exercises #13 - Lorenz Curves (6.7)
Exercises #14 - Differential Equations (9.1, 9.2)
Exercises #15 - Applications of Differential Equations (9.3)
Exercises #16 - Probability (10.1, 10.2, 10.3)

OBJECTIVES	STANDARDS
Statement of the competency Analyze problems studied in the social sciences by using integral calculus (0PU3).	**Performance criteria for the competency as a whole** • Accurate recognition of the context in which integral calculus emerged • Appropriate mathematical modelling of real-world situations studied in the social sciences • Correct use of mathematical syntax • Demonstration of rigorous mathematical reasoning • Accurate and coherent interpretation of results
Elements of the competency	**General performance criteria**
1. Apply mathematical models to current human realities.	1.1 Accurate recognition of the characteristics of different sequences pertaining to current human realities 1.2 Accurate determination of the behaviour of a sequence (including finding the general term, analyzing variations, and determining the behaviour of the sequences at infinity) 1.3 Establishment of relevant relationships between different sequences and current human realities
2. Determine the definite and indefinite integrals of a function in order to model current human realities.	2.1 Accurate recognition of the transition from the discrete level to the continuous level 2.2 Correct calculation of a definite integral using Riemann sums 2.3 Appropriate use of the fundamental theorem of calculus 2.4 Appropriate application of basic integration formulas, the change of variable techniques and the integration by parts technique 2.5 Correct calculation of a limit using l'Hospital's rule 2.6 Correct analysis of the convergence of an improper integral 2.7 Establishment of relevant relationships between definite and indefinite integrals of a function and current human realities
3. Use integrals to understand a current human reality.	3.1 Correct solution of separable differential equations related to economics, finance and demographics 3.2 Correct calculation of bounded areas useful for solving problems
4. Solve problems specific to a current human reality.	4.1 Accurate recognition of problems requiring the use of integral calculus 4.2 Appropriate application of definite integrals in economics, including consumer/producer surplus and equilibrium points, the Lorenz curve and the Gini coefficient. 4.3 Establishment of relevant relationships between probabilities and the calculation of areas and definite integrals, including the probability density function, expected value and variance and the normal distribution.

Specific Performance Criteria	**Intermediate Learning Objectives**
Specific performance criteria for each of these elements of the competency are shown below with the corresponding intermediate learning objectives.	*For the items in the list of learning objectives, it is understood that each is preceded by: "The student is expected to . . . ".]*
1. *The Development of Calculus*	
1.1 The history of Calculus	1.1.1. Place integral calculus in historical context by an investigation of area of a planar region bounded by an arbitrary curve, a problem posed by Newton and Leibniz, and its relevance in today's society.
2. *Indefinite Integrals*	
2.1 Use of fundamental integration techniques.	2.1.1. Give the definite of the indefinite integral as an antiderivative. 2.1.2. Express the basic differentiation formulas as antidifferentiation formulas. 2.1.3. Recognize when and how to use the constant multiple rule and the sum and difference rule in the evaluation of integrals. 2.1.4. Use the antidifferentiation formulas from 2.1.2 and the rules from 2.1.3 to evaluate indefinite integrals.
2.2 Use of basic substitutions to determine simple indefinite integrals.	2.2.1. Use these antidifferentiation rules and appropriate substitutions to calculate indefinite integrals.
2.3 Use of more advanced techniques to determine more complex indefinite integrals.	2.3.1. Use algebraic identities to prepare indefinite integrals fro solution by substitution. 2.3.2. Evaluate an indefinite integral using integration by parts. 2.3.3. Evaluate an indefinite integral by selecting the appropriate technique. 2.3.4. Evaluate an indefinite integral by using a combination of techniques.
3. *Infinite Sequences*	
3.1 Determine the general term of a sequences	3.1.1. Determine the behaviour of a sequence (including arithmetic, geometric and other types) and write a formula for the general term of the sequence.
3.2 Determine of the convergence of a sequence.	3.2.1. State the definition of the limit of a sequences. 3.2.2. Use 3.1.1 to calculate the limit of a sequences and indicate whether the sequence converges or diverges.
3.3 Applications of infinite sequences.	3.3.1. Use sequences to solve problems in the social science disciplines.
4. *Definite Integrals and Area*	
4.1 Define the definite integral as the limit of Riemann sums.	4.1.1. Use the limit of Riemann sums (wtih right endpoints) to define the definite integral. 4.1.2. Evaluate the exact integrals of constant, linear and quadratic functions using limits of Riemann sums.
4.2 Use the fundamental theorem of calculus to evaluate definite integrals.	4.2.1. Use the fundamental theorem of calculus to calculate a definite integral.
4.3 Calculate of areas of planar regions	4.3.1. Set up a definite integral to calculate an area. 4.3.2. Sketch a region bounded by two functions $y = f(x)$ and $y = g(x)$ and calculate its area.
5. *Limits & Indeterminate Forms*	
5.1 Use l'Hospital's rule to determine limits involving indeterminate forms.	5.1.1. State l'Hospital's rule and the conditions for which it is valid. 5.1.2. Calculate limits yielding the indeterminate forms $\frac{0}{0}$ and $\frac{\infty}{\infty}$ using l'Hospital's rule.
6. *Improper Integrals*	
6.1 Use limits to calculate improper integrals.	6.1.1. Calculate an improper integral where at least one of the bounds is infinite. 6.1.2. Calculate an improper integral where the integrand is discontinuous at one of the bounds.
7. *Differential Equations*	
7.1 Use antidifferentiation to obtain general solutions of simple differential equations.	7.1.1. Express a simple differential equation in the language of integration and obtain the general solution. 7.1.2. Express a simple initial value problem in the language of integration and obtain the particular solution.
7.2 Use integration to solve separable differential equations.	7.2.1. Express a simple differential equation in separable form. 7.2.2. Find the general solution of a separable differential equation. 7.2.3. Find a particular solution of a separable differential equation given an initial condition.
8. *Applications of Integration*	
8.1 Use integral calculus to solve problems in economics.	8.1.1. Given supply and/or demand curves, find the equilibrium point and sketch/compute the consumer and producer surpluses. 8.1.2. Sketch the Lorenz curve of an income distribution and compute the Gini coefficient.
8.2 Use integral calculus to compute probabilities.	8.2.1. Determine whether a function has the properties of a probability density function and use integrals to calculate probabilities. 8.2.2. Use integrals to calculate expected value, variance and standard deviation. 8.2.3. Determine probabilities associated with normal distributions using the standard normal distribution table.
8.3 Use differential equations to solve problems	8.3.1. Use separable equations to represent and solve problems in economics, finance and demographics.