JOHN ABBOTT CEGEP/COLLEGE

Mathematical Models II

(Engineering Technologies)

COURSE OUTLINE
WINTER 2021

General Information.

Discipline: Mathematics *Course code*: 201-225-AB
Ponderation: 3-2-3 *Credits*: $2\frac{2}{3}$
Prerequisite: 201-115-AB or equivalent
Competency Code: 027B (in progress)
Competency information is explained in your Engineering Technologies program CD.

Introduction. Mathematical Models II is the second Mathematics course in the Engineering Technology Program. Students in this program who have successfully completed the prerequisite course should be familiar with the derivative and how to derive Trigonometric, Exponential and Logarithmic Functions. In Mathematical Models II, students will study the notions of the indefinite and definite integration as well as their applications in science and engineering. In addition, the course explores differential equations (Separation of Variables, First Order Equations etc.) and the concept of Fourier Series. The primary purpose of the course is the attainment of Objective 027B ("To organize information of the working environment of engineering technology"). To achieve this goal, the course covers derivatives, indefinite and definite integrals, Fourier series, solution of simple differential equations. Emphasis is placed on clarity and rigor in reasoning and in the application of methods. The student will learn to use the techniques of integration in several contexts, and to interpret the integral both as an antiderivative and as a sum of products. The basic concepts are illustrated by applying them to various problems where their application helps arrive at a solution. In this way, the course encourages the student to apply learning acquired in one context to problems arising in another. Students will be encouraged to use a scientific calculator. Suitable mathematical software programs (such as MAPLE V) are available for student use in the Mathematics Lab.

Teaching Methods. This course is 75 hours, meeting three times a week for a total of 5 hours a week. Classes are primarily lectures, with discussions and problem-solving. If a student is absent from class, it is their responsibility to get the material covered that day. In addition, it is very important that students spend several hours per week reviewing the course material and solving suggested exercise. In the event that a student is experiencing difficulty, contact your instructor as soon a possible or one of the other resources listed directly below.

Required Text. The textbook for this course is *Basic Technical Mathematics with Calculus, 11th Edition*, by Ally J. Washington (Pearson); it is available from the college bookstore for about $190.

Course Costs. In addition to the cost of the text (about $190), the instructor may recommend purchase of a scientific, non-programmable calculator (approximately $15 - $25).

Departmental Attendance Policy. Due to the COVID-19 health crisis, attendance policies may need to be adjusted by your teacher. Regular attendance is expected, and your teacher will inform you of any details or modifications as needed. Please note that attendance continues to be extremely important for your learning, but your teacher may need to define it in different terms based on the way your course is delivered during the winter semester.

Additional Software. In addition to LEA, Teams and Moodle, additional software may be used for the submission of essays or projects or for testing. Further details will be provided if applicable.

Class Recordings. Classes on Teams or other platforms may be recorded by your teacher and subsequently posted on Teams and/or LEA to help for study purposes only. If you do not wish to be part of the recording, please let your teacher know that you wish to not make use of your camera, microphone or chat during recorded segments. Any material produced as part of this course, including, but not limited to, any pre-recorded or live video is protected by copyright, intellectual property rights and image rights, regardless of the medium used. It is strictly forbidden to copy, redistribute, reproduce, republish, store in any way, retransmit or modify this material. Any contravention of these conditions of use may be subject to sanction(s) by John Abbott College.

Course Outline Change. Please note that course outlines may be modified if health authorities change the access allowed on-site.

Test Accommodations. Should you need a special accommodation to write the On-Campus Midterm or Final Exam, please read the Math Department's policy.

Evaluation Plan. The Final Evaluation in this course consists of the Final Exam, which covers all elements of the competency. In the case an On-Campus Final Exam cannot be administered, the Final Evaluation will consist of the On-Campus Midterm Exam and/or the Major at-home Assessments. The Final Grade will be calculated based on one of the following scenarios:

Scenario 1:

On-Campus Midterm ☑ On-Campus Final ☑

The better of:

Final Grade	
Minor Assessments	25%
On-Campus Midterm Exam after week 7	25%
On-Campus Final Exam	50%

or

Final Grade	
Minor Assessments	20%
On-Campus Midterm Exam after week 7	15%
On-Campus Final Exam	65%

Scenario 2

On-Campus Midterm ☑ On-Campus Final ☐

Final Grade	
Minor Assessments	25%
On-Campus Midterm Exam after week 7	50%
Two* At-Home Major Assessments after week 9	25%

* One At-Home Major Assessment if time does not permit two.

Scenario 3

On-Campus Midterm ☐ On-Campus Final ☑

Final Grade	
Minor Assessments	25%
Two At-Home Major Assessments	15%
On-Campus Final Exam	60%

Scenario 4

On-Campus Midterm ☐ On-Campus Final ☐

Final Grade	
Minor Assessments	40%
Two–Five At-Home Major Assessments	60%

Scenario 1 will be prioritized, but the grading scheme will move to another scenario if it is impossible to hold an On-Campus Midterm and/or an On-Campus Final.

The distribution of Minor Assessments will be given by your teacher on the first day of classes (see the supplement to 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.

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

Academic Success Centre. The Academic Success Centre, located in H-117, offers study skills workshops and individual tutoring.

College Policies.

Policy No. 7 - IPESA, Institutional Policy on the Evaluation of Student Achievement: http://johnabbott.qc.ca/ipesa.

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 (with selected exercises)**.** The exercises listed should help you practice and learn the material taught in this course; they form a good basis for homework. Your teacher may supplement this list during the semester. Regular work done as the course progresses should make it easier for you to master the course.

DIFFERENTIATION

Section	Topic	Exercise
27-7	L'Hospital's Rule	1-36
27-3	Derivatives of Inverse Trig. Functions	3-31, 46-52
24-2	Newton's Method for solving equations	5-16, 24, 27
24-4	Related Rates	7-26, 29, 33-38, 41-44
24-7	Applied Max Min Problems	3-5, 8-13, 16-24, 26, 29, 31, 43, 51, 52
24-5	Using Derivatives in Curve Sketching	5-45
24-6	More on Curve Sketching	1-30
24-8	Differentials (notation only)	5-16, 21-24

Recall Implicit Derivatives using $\frac{dy}{dx}$ or y' in the above topics.

INTEGRATION

Section	Topic	Exercise
25-1	Antiderivatives	13-38
25-2	Indefinite Integral	5-36. 47-56
25-3	Area under a curve	5-23
25-4	Definite Integral	3-34, 44-48
25-5	Trapezoidal Rule	3-16
25-6	Simpson's Rule	3-14
26-1	Application of the Indefinite Integral	3-16
26-2	Areas by Integration	3-30, 37, 38
26-3	Volumes by Integration	7-26
28-1	General Power Formula	3-30
28-2	Substitution - Logarithmic Function	3-30, 33-35, 39, 42
28-3	Substitution -Exponentials Function	3-28. 32, 34
28-4	Substitution - Trigonometric Forms	3-26, 30
28-5	Other Trig. Forms - Emphasize Root Mean Square	3-14, 49, 50
28-6	Substitution - Inverse Trigonometric Forms	3-24, 31-34, 36
28-7	Integration by Parts	3-22, 24, 33-35
28-8	Integration by Trigonometric Substitution	3-24
28-9	Integration by Partial Fraction	3-24
28-10	Integration by Partial Fraction (Other Cases)	5-20, 27, 28
30-6	Fourier series	3-12
31-1	Solutions of Differential Equations	3-32
31-2	Separation of Variables	3-32, 33, 35, 38, 40-42
31-4	P/Q Differential Equations	3-28, 30, 33, 35, 36, 39

OBJECTIVES	**STANDARDS**
Statement of the Competency	**General Performance Criteria**
To organize information of the working environment of engineering technology. To solve mathematical problems in applied situations.	- Appropriate use of concepts - Correct algebraic operations - Correct choice and application of integration techniques - Accurate calculations - Proper justification of steps in a solution - Correct interpretation of results - Appropriate use of terminology
Elements of the Competency	**Specific Performance Criteria**
1. To use methods of differentiation and integration. 2. To present and justify the steps necessary to solve problems.	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 ...".
Specific Performance Criteria	**Intermediate Learning Objectives**
1. Differentiation	
1.1 Use of basic differentiation formulas and rules to calculate derivatives of standard functions.	1.1.1 Recognize when and how to use the basic differentiation formulas and rules for algebraic functions. 1.1.2 Recognize when and how to use the basic differentiation formulas and rules for trigonometric and inverse trigonometric functions. 1.1.3 Recognize when and how to use the basic differentiation formulas and rules for logarithmic and exponential functions. 1.1.4 Use the differentiation rules to find the slope and equation of the tangent line to a curve at a point. 1.1.5 Use the differentiation rules to find the slope and equation of the normal line to a curve at a point.
1.2 Solution of optimization problems	1.2.1 Represent an optimization word problem in functional form 1.2.2 Take the derivative of the function. 1.2.3 Find all the possible critical values by solving the equation $f'(x) = 0$. 1.2.4 Interpret (explain) the results found in the optimization problem.
2. Integration	
2.1 Use of basic substitutions to determine simple indefinite integrals.	2.1.1 Express basic differentiation rules as anti-differentiation rules. 2.1.2 Use these antidifferentiation rules and appropriate substitutions to calculate indefinite integrals.
2.2 Use of more advanced techniques to determine more complex indefinite integrals.	2.2.1 Use algebraic identities to prepare indefinite integrals for solution by substitution. 2.2.2 Evaluate an indefinite integral by integration by parts. 2.2.3 Evaluate an indefinite integral by selecting the appropriate technique. 2.2.4 Evaluate an indefinite integral using a combination of techniques.
3. Areas	
3.2 Calculation of areas of planar regions.	3.2.1 Set up a definite integral to calculate an area.
4. Fourier Series	
4.1 Use the appropriate formulas to represent a function by its Fourier series.	4.1.1 Calculate the definite integrals necessary to calculate the Fourier series of a function. 4.1.2 Calculate the Fourier series of a function given by its graph.
5. Differential equations	
5.1 Use of antidifferentiation to obtain general solutions to simple differential equations.	5.1.1 Express a simple differential equation in the language of integration, and obtain the general solution.
5.2 Use of antidifferentiation to obtain particular solutions to simple initial value problems.	5.2.1 Express a simple initial value problem in the language of integration, and obtain the particular solution.