MATH 256 Differential Equations:
2019W Term 2, January-April 2020

This is the common outline for MATH 256 and contains course information, including the syllabus, course policies, course study materials. However, see the Canvas website for the definitive version. Access to online homework via Webwork is linked through Canvas and general announcements will be sent via UBC's central e-mail system.

The Instructor-in-Charge for MATH 256 is Dr Ian Frigaard

The instructors of the individual sections are:

1. Section 201: Dr Ian Frigaard
2. Section 202: Dr. Marjan Zare
3. Section 203: Dr. Marjan Zare

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Text:

There is no course text. This is an introductory course and the material can be found for free in many places online and/or in many textbooks, e.g. Boyce & di Prima. The online text "Diffy Qs: Differential Equations for Engineer" also covers all topics within the course in a reasonable way and may be downloaded for free at: http://www.jirka.org/diffyqs/

Course lecture notes are available for download and indicate the topics covered and ordering.

Course Outline:

Here is our expected progress through the course laid out in subjects and weeks. A week is roughly 3 lecture hours timetabled. Note the midterm dates and holidays.

Module 1**, 1st order linear differential equations:** basic terminology; direction fields; constant coefficient equations; method of undetermined coefficients; integrating factor method; some physical applications.

Approximately 4 hours, weeks 1 & 2

Module 2, 2nd order linear differential equations: different physical applications; existence and uniqueness of solutions (not proven); superposition, complementary and particular solutions; theory of homogeneous 2nd order DE's; constant coefficient DE's and solutions; inhomogenous DE's and method of undetermined coefficients; reduction of order; oscillations (using linear spring as example), resonance, damping, beats.

Approximately 7 hours, weeks 2 – 4

Midterm 1: Monday 3rd February for MWF sections; Tuesday 4th February for TuTh section, to cover modules 1 & 2.

Module 3, Systems of linear differential equations: origins of DE systems; examples; theoretical background and structure of solutions; fundamental solutions and matrices, the Wronskian; 2D phase plane examples; inhomogenous systems and solution methods

Approximately 6 hours, weeks 5-6

Spring break, no classes: 17th – 21st February

Module 4, Laplace transforms: Definition; theorems on derivatives, linearity, shifting and scaling; using LT's to solve IVPs; using LT transform pairs from tables; convolution theorem; transfer function introduced; inhomogeneous IVPs with steps and impulses

Approximately 5 hours, weeks 7 & 8

Midterm 2: Monday 9th March for MWF sections; Tuesday 10th March for TuTh section, to cover modules 3 & 4.

Module 5, Fourier series: BVPs for simple DE's; Fredholm alternative, eigenfunctions, eigenvalues and orthogonality; analogy with linear algebra; Fourier series definition & convergence theorem; examples, Gibbs phenomenon and intuitive notions; Fourier sine and cosine series

Approximately 5 hours, weeks 8 & 10

Module 6, Partial differential equations: PDE terminology and examples of derivation; Solving the heat/diffusion equation using superposition and separation of variables; IBVPs with different boundary conditions; steady states; inhomogeneities; examples of heat and diffusion problems; wave equation; superposition and separation of variables; d'Alembert's solution and relationship to separation of variables; Laplace's equation and solution with separation of variables.

Approximately 8 hours, weeks 10-13

<u>**Learning Goals**</u>:

The learning goals for MATH 256 are to become adept at solving linear DE's using analytical methods, to understand the theoretical framework of the solutions and develop intuition on choice of method for different problems. Students will have a brief introduction to Laplace transforms in the context of solving DE's. Students will understand how Fourier series work for representing functions and how these are used to help solve 3 principal PDE's (heat/diffusion, wave and Laplace), using the separation of variables method.

<u>**Learning Assessment:**</u>

Students will be assessed using online homework, in-class midterms and a final exam.

Grading Scheme:

- Your grade normally will be computed based on the following formula: **50% Final Exam + 19% Midterm1 + + 19% Midterm2 + 12% WebWork Assignments.** Please note that grades *may be scaled* to ensure fairness across sections and consistency with departmental expectations; this does not mean the distribution will be the same for all sections. The final exam is common to all sections and may be used to normalize grades across sections.
- FINAL EXAM PERFORMANCE REQUIREMENT: **Students need to achieve a minimum of 40% on the final exam to pass MATH 256.** Students who fail the course solely because they have failed to achieve the 40% minimum on the final exam will receive a grade of 47% in the course.
- Passing the MATH 256 final exam may not be sufficient to ensure a student passes MATH 256 if they have failed the term work.

Course Policies:

1. The final examination in April for this course will be common to all sections of MATH 256. This examination will account for 50% of a student's final grade. The remaining 50% will be based on term work. The final examination generally will not be weighted higher for students who perform better on the final examination than they did during the term, although some allowance *may* be made for students who perform *much* better on the final examination than they did during the term. (In practice, this rarely happens and the criterion will be set by the Instructor-in-charge and applied uniformly across all sections.) The final examination is board marked to ensure consistency and fairness across sections.
2. IMPORTANT: The final mark distribution of the term work of each section may be scaled based on the final exam mark distribution of that section. These adjusted term marks would then be used to compute a student's final grade. Any scaling is performed to ensure fairness in the final grades across sections.
3. No unauthorized devices will be allowed at the final examination. This includes cell phones, smart phones, music players, and all other devices.
4. Formula sheets will be allowed as specified
5. A non-programmable calculator will be allowed on midterms and the final examination.
6. **Midterms: There will be two in-class midterms in MATH 256. The dates, which are subject to change, are Monday 3rd February and Monday 9th March for MWF classes; Tuesday 4th February & Tuesday 10th March for T Th classes.**
7. **Missing midterms:** There are *no make-up midterms* in this course. Missing the midterm for a valid reason normally results in the weight of that midterm being transferred to the final exam. Examples of valid reasons include illness and travel to play a scheduled game for a varsity team. Examples of reasons that are not valid include conflicts with personal travel schedules or conflicts with work schedules. Any student who misses the midterm is to present to their instructor the Department of Mathematics self-declaration form for reporting a missed assessment to their instructor within 72 hours of the midterm date.

This policy conforms with the UBC Vancouver Senate's [Academic Concession Policy V-135](#) and students are advised to read this policy carefully.

Please note that a student who misses the midterm and has otherwise not completed a substantial portion of the term work normally shall not be admitted to the final examination.

8. **Missing the Final Exam:** You will need to present your situation to the Dean's Office of your Faculty to be considered for a deferred exam. See the Calendar for [detailed regulations](#). Your performance in a course up to the exam is taken into consideration in granting a deferred exam status (e.g. failing badly generally means you will not be granted a deferred exam). In Mathematics, generally students sit the next available exam for the course they are taking, which could be several months after the original exam was scheduled. *Note that your personal travel schedule is NOT a valid reason for missing a final exam and students who miss the MATH 256 exam for this reason will receive a grade of 0 on the exam and fail the course.*

If you find yourself having serious academic difficulties in this course, it is best to talk to your instructor as soon as you can.

Academic Misconduct:

1. UBC takes cheating incidents very seriously. After due investigation, students found guilty of cheating on tests and examinations are usually given a final grade of 0 in the course and suspended from UBC for one year. [More information.](#)
2. While students are encouraged to study together, they should be aware that blatant copying of another student's work is a serious breach of academic integrity. Please discuss with your instructors their expectations for acceptable collaboration on any assigned coursework. Cases of suspected cheating will be investigated thoroughly.
3. Note that academic misconduct includes misrepresenting a medical excuse or other personal situation for the purposes of postponing an examination or quiz or otherwise obtaining an academic concession.

Extra Help:

- Each instructor and/or TA's will hold office hours each week for students in his/her section. These office hours may be by appointment.
- **Math Learning Centre:** There is a [Math Learning Centre](#) in LSK 301. Graduate student TAs are there to help you during the posted hours. There are some hours specific to courses in differential equations.

Weekly Webwork Assignments:

See the Canvas site

The UBC Vancouver Senate's [Academic Concession Policy V-135](#) applies to all assignments in this course, and students are advised to read this policy carefully.

Note that the intent of homework is to help you learn the material, and therefore it should be done as you are studying. **Data show that students who leave their homework to the night before do poorly in the course.**

Statement on UBC's Policies and Resources to Support Student Success:

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious and cultural observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions. Details of the policies and how to access support are available here.