Mathematics 1 2019-20

COURSE

Advice for the December Degree Exam

This is the first year Mathematics 1 has run, so there are no past papers available. However, a specimen paper will be made available on the Moodle page.

See the sections below on Statements of Definitions and on Proofs and Theory for further explanation of what you are expected to know. The December exam counts for 20% of the Maths 1 grade and is 1.5 hours long. The exam will be 50% multiple choice questions and 50% written questions.

The exam has 60 marks and has **the same format as the specimen exam**.

The first part is **Multiple choice** and has ten questions, each worth 3 marks (for a total of 30 marks). For each question there will be five possible choices, labelled A, B, C ,D and E, with part E typically being "none of the above". Answers to the multiple choice questions must be entered on a scanning sheet, which will be provided with the exam booklet. **Please bring a black ball point pen to fill in the scanning sheet.**

The second part is **written answers** with 4 multi-part questions, with a total score of 30 marks. The order of questions may not be the same as the order of topics during the course. Most questions on the exam are the same as or very similar to questions and material from the Lecture notes, Feedback Exercises, WebAssignments, Textbook questions and YACRS questions. You should use all of these for your revision.

Office hours during the exam period

All office hours during the exam period will be in the Maths Hub, Room 109 in the Maths and Stats Building. The Hub will be open from 1-4pm daily in the week of December 9th - 13th, including Friday the 13th. There will be no office hours or help sessions in the week of December 16th, and we will not be answering questions via email. So please do ensure that your questions are all answered before December 13th.

Statements of Definitions

You could be asked to state any definition from the following list:

Liebeck:

- The Principle of Mathematical Induction
- The Principle of Mathematical Induction II
- The Strong Principle of Mathematical Induction
- Prime number
- Plane graph and connectedness of a plane graph
- Division of integers
- Highest Common Factor
- Coprimality
- Congruence of integers

Stewart:

- Derivative (First Principles)
- Critical Number
- Concavity
- Inflection Point
- Dot Product

- Cross Product

Proofs and Theory

You should be familiar with the examples and standard techniques from the course. You will be asked to prove statements on the degree exam, and to identify the type of proof used. These proofs typically involve applying one or more definitions, so it is crucial that you know definitions well enough to be able to use them (i.e. don't just memorise them without understanding). Some of the statements you will be asked to prove have already appeared in course materials.

In the exam you may be asked to State and/or prove any of the following theorems from lectures.
Liebeck:

- Proposition 2.3 ($\sqrt{2}$ is irrational): **statement and proof**
- De Moivre's Theorem (Theorem 6.1): **statement and proof**
- The Fundamental Theorem of Algebra (Theorem 7.1): **statement only**
- Euler's Formula (Theorems 9.1 and 9.2): **statement only**
- The Fundamental Theorem of Arithmetic (Theorem 11.1): **statement and existence proof (Prop 8.1) and uniqueness proof**
- Theorem 12.1 (there are infinitely many prime numbers): **statement and proof**
- Fermat's Little Theorem (Theorem 14.1): **statement only**

Stewart:

- Squeeze Theorem: **statement only**
- Differentiation Formulae: Power, Sum, Constant Multiple, Product, and Quotient Rules: **statement and proof**
- Differentiation Formulae: Chain Rule: **statement only**
- Rolle's Theorem: **statement only**
- Mean Value Theorem: **statement only**
- $\vec{a}$ and $\vec{b}$ are orthogonal if and only if $\vec{a} \cdot \vec{b} = 0$: **statement and proof**
- $\vec{a} \times \vec{b}$ is orthogonal to both $\vec{a}$ and $\vec{b}$: **statement and proof**

In the exam you may also be asked to prove previously unseen statements. You will also need to know how to *apply* theoretical results, including major results, to prove short statements. You will not necessarily be told which result(s) you should be using. However, you do not need to learn theorem numbers, but should know the name of major results. So if you are using a result from an unnamed theorem, you should write something like

Using a result from lectures, ...,

or if you are using a major result, you should write something like

Using the ... Theorem, ...

Computations

You will be asked to carry out computations. For example, you may be asked to carry out computations similar to the examples in the reading. For example:
Liebeck:

- Negating statements and recognising types of proofs
- Using geometric series to compute sums
- Converting between decimal and rational form of rational numbers
- Computing n^{th} roots or real and complex numbers
- Using Rule 5.1 to prove simple facts about the real numbers
- Converting between rectangular and polar forms of complex numbers
- Using the quadratic formula to solve real and complex quadratic equations
- Using various forms of the Principle of Mathematical inductions to prove basic facts

- Using Euler's formula
- Using the Euclidean algorithm
- Using the Fundamental Theorem of arithmetic and its consequences to prove basic facts
- Using congruence of integers to prove basic facts
- Using Fermat's Little Theorem

Stewart:

- Differentiate functions from first principles
- Differentiate expressions using differentiation formulae for polynomials and special functions
- Computing Taylor and Maclaurin series
- Computating inverse functions
- Calculation of critical points
- Computating dot and cross products of vectors
- Computating tangent lines and equations of planes

We note that the lists above are not exhaustive, and all computations on both the Webassign and Feedback Exercises and the examples from lectures should be considered examinable.

Finally

Best of luck!!!