

DEMONSTRATING THE USE OF DIGITAL TOOLS IN THE BLENDED INSTRUCTION



**Maynooth
University**

National University
of Ireland Maynooth

PÁDHRAIC O'HANRAHAN

DEPARTMENT OF MATHEMATICS AND
STATISTICS,

MAYNOOTH UNIVERSITY

PADHRAIC.OHANRAHAN@MU.IE

SOME BACKGROUND

- I am a tutor for the MU MSC.
- I also teach a one-year pre-degree Certificate in Science program for mature students.
- Every MU student has access to Microsoft365.

DIGITAL TOOLS I USE FOR LECTURES

- Useful for MSC?

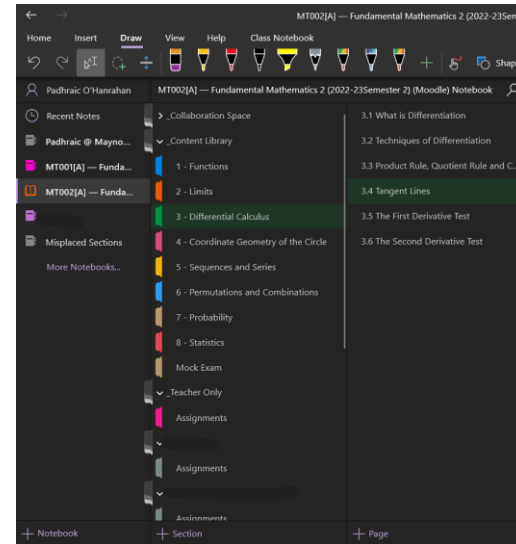
Before lecture

Skeletal Notes

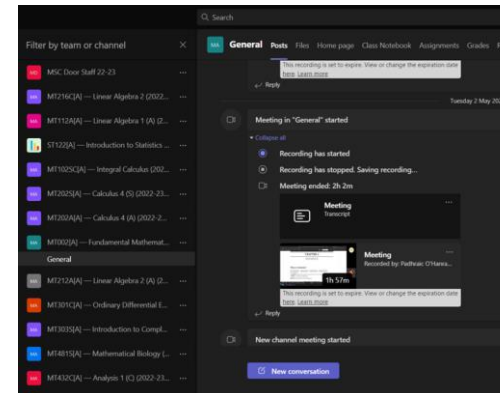
TABLE OF CONTENTS	
1	1
1.1 Introduction to Functions	1
1.2 Evaluating Functions at Largest Domains	6
1.3 Graphing Functions	8
1.4 Transformations	13
1.5 Piecewise Functions	20
2	24
2.1 Introduction to Limits	24
2.2 Finding Limits using Tables	27
2.3 Limits Involving Infinity	28
2.4 Evaluating Limits Algebraically	32
3	35
3.1 What is Differentiation?	35
3.2 Techniques of Differentiation	41
3.3 Product Rule, Quotient Rule & Chain Rule	45
3.4 Tangent Lines	49
3.5 The First Derivative Test	51
3.6 The Second Derivative Test	57
4	61
4.1 The Equation of the Circle (Standard Form)	61
4.2 The Equation of Semi-Circles	64
4.3 The Equation of the Circle (General Form)	66
4.4 Tangent Lines to Circles	67
5	71
5.1 Sequences	71
5.2 Summation Notation	74
5.3 Arithmetic Progression	75
5.4 Geometric Progression	78
6	83
6.1 The Fundamental Principle of Counting	83
6.2 Permutations	84
6.3 Permutations (Arrangements)	86
6.4 Combinations/Selections	89

During lecture

OneNote

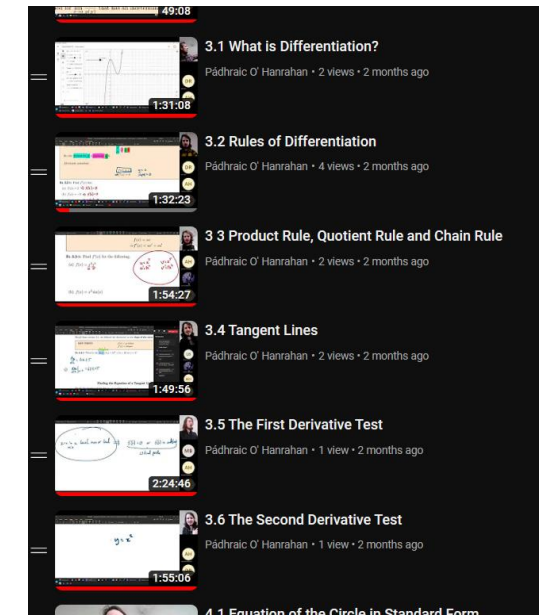


Teams



After lecture

YouTube



LECTURE NOTES: 2016-19

- Lectures followed a traditional style of chalk talk.
- Some issues with chalk talk method:
 - Some students found it difficult to take down notes and pay attention to lecturer.
 - If student absent, they would not have access to notes.*
 - Student can't corroborate with what they've written down.*

LECTURE NOTES: 2019-20

- Used skeletal notes in similar fashion to Cardetti *et al.* (2012), leaving gaps for exercises.
- I would fill in these gaps with chalk talk.

3.4 Tangent Lines

Finding the Slope of a Tangent Line

Recall from section 3.1, we defined the derivative as the **slope of the curve at a point**.

KEY POINT: $f(x) = y$ -values
 $f'(x) = \text{slopes}$

Ex 3.4-1: What is the slope of $y = 3x^2 + 5x + 10$ at $x = 2$?

Finding the Equation of a Tangent Line

Recall the equation of the line $y - y_1 = m(x - x_1)$.

Ex 3.4-2: Find the equation of the line containing the point $(4, 5)$ and slope of 3

We can repurpose this equation for the equation of a tangent line to the curve $y = f(x)$ at $x = a$. In this scenario,

$$\begin{aligned}x_1 &= a \\y_1 &= f(a) \\m &= f'(a)\end{aligned}$$

So the equation of a tangent line to the curve $y = f(x)$ at the point $(a, f(a))$ is

$$y - f(a) = f'(a)(x - a)$$

Ex 3.4-3: Find the equation of the tangent line for the following.

(a) $f(x) = 2x^3 - 5x + 10$ at the point $(-1, 13)$.



Maynooth University
National University of Ireland Maynooth

LECTURE NOTES: 2020-22

- In this period, I used Microsoft Whiteboard.
- During an in-person lecture, I would project screen to students.

Microsoft Whiteboard

MT102SC Summer Tutorials Week 2

Integration by substitution

Example:

1. $\int 5x^4 \cos(x^5) dx$

$\int 5x^4 \cos(u) dx$

$\int 5x^4 \cos(u) \frac{1}{5x^4} du$

$\int \cos(u) du$

$= \sin(u) + C$

$= \sin(x^5) + C$

2. $\int x^2(5+x^2)^{100} dx$

$u = x^2$

$dx = \frac{1}{2} du$

3. $\int x(5+x)^{100} dx$

$\int x(u) du$

$= \int (u-5) u^{100} du$

$= \int u^{101} - 5u^{100} du$

$= \frac{u^{102}}{102} - \frac{5u^{101}}{101} + C = \frac{(5+x)^{102}}{102} - \frac{5(5+x)^{101}}{101} + C$

4. $\int \frac{2x+3}{x^2+3x+7} dx$

$u = x^2+3x+7$

$dx = \frac{1}{2} du$

$\int \frac{2x+3}{u} \cdot \frac{1}{2} du$

$\int \frac{1}{u} du$

$= \log|u| + C$

$= \log|x^2+3x+7| + C$

$\int \cos(x) dx$

$\int x^{100}(x+5) dx$

$\int x^{101} + 5x^{100} dx$

$\int \frac{1}{x} dx = \log|x| + C$

LECTURE NOTES: 2022-24

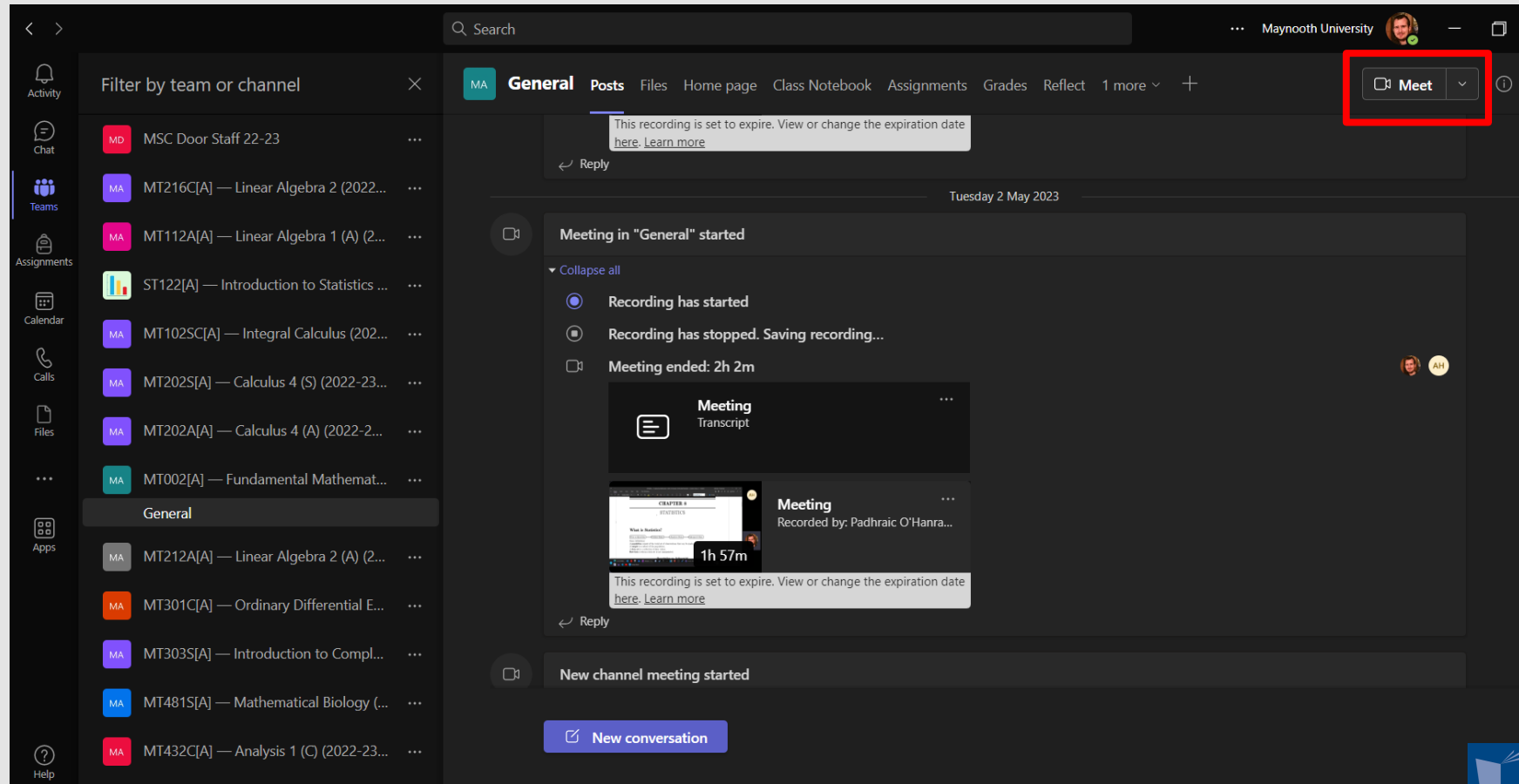
- I used Microsoft OneNote to store the filled-in notes.

The screenshot shows a Microsoft OneNote interface with the following content:

- Navigation Pane (Left):** Shows a tree view with sections like "3 - Differential Calculus" and "3.4 Tangent Lines" selected.
- Top Bar:** Includes "View", "Help", "Class Notebook", and various drawing tools like pens, highlighters, and eraser.
- Main Content Area:**
 - Handwritten notes at the top left: $f(3) = \sqrt{13-9}$, $f(3) = \sqrt{4}$, and $f(3) = 2$.
 - Handwritten notes at the top right: $f(3) = -\frac{2}{2}$ and $3x +$.
 - Title:** Find Points on a Curve with a Specific Slope
 - Text:** Ex 3.4-4: Find all points on $y = 5x^2 - 23x + 20$ where its slope is 7.
 - Handwritten Solution:**
 - First, let $y = f(x)$.
 - Question: For what x is $f'(x) = 7$?
 - Next, find $f'(x)$: $f'(x) = 10x - 23$
 - Let $f'(x) = 7$: $10x - 23 = 7$
 $\Rightarrow 10x = 30$
 $\Rightarrow x = 3$
 - Find y , when $x = 3$:
 - \therefore At the point $(3, -$
- Section 3.4 Questions:** A large empty box for student questions.

MICROSOFT TEAMS

- I use Microsoft Teams to provide hybrid lectures.



HYBRID LECTURES

- How I delivered hybrid lectures:
 - Ideal situation is to attend in person.
 - Only attend online if in person is not possible.

The screenshot shows a digital whiteboard interface with handwritten mathematical work. At the top, there are three equations: $f(x) = \sqrt{13-x}$, $f(x) = \sqrt{4}$, $f(x) = 2$, and $f'(x) = -\frac{3}{2}$. To the right, a box contains the equation $7x + 2y = 13$. The main title of the whiteboard is "Find Points on a Curve with a Specific Slope". Below this, the text reads: "Ex 3.4-4: Find all points on $y = 5x^2 - 23x + 20$ where its slope is 7." The handwritten solution follows: "First, let $y = f(x)$. Question: For what x is $f'(x) = 7$? Next, find $f'(x)$: $f'(x) = 10x - 23$. Let $f'(x) = 7$: $10x - 23 = 7$ ". At the bottom of the whiteboard, there is a section titled "Section 3.4 Questions:". To the right of the whiteboard, a chat window is visible with a video feed of a person in the top right corner. The chat messages include: "not well it seems", "I was going to ask to talk to you about this after class today", "if get home on my phone to talk", "yes if possible", "thanks", and "ahh it seems very familiar to me from last year".

LECTURE RECORDINGS

- Recordings get stored on Microsoft Stream.

Stream Meeting in _General_-20230502_100509-Meeti... Search

+ New + Add to playlist Move to Copy to ...

CHAPTER 8
STATISTICS

What is Statistics?

Pose a Question → Collect Data → Analyse Data → Interpret Data

Some definitions:
A **population** consist of the total set of observations that can be made.
A **sample** is a subset of the population.
A **data set** is a collection of data values.
Raw data is when a data set is not manipulated.

Descriptive vs. Inferential

0:05 / 1:57:17

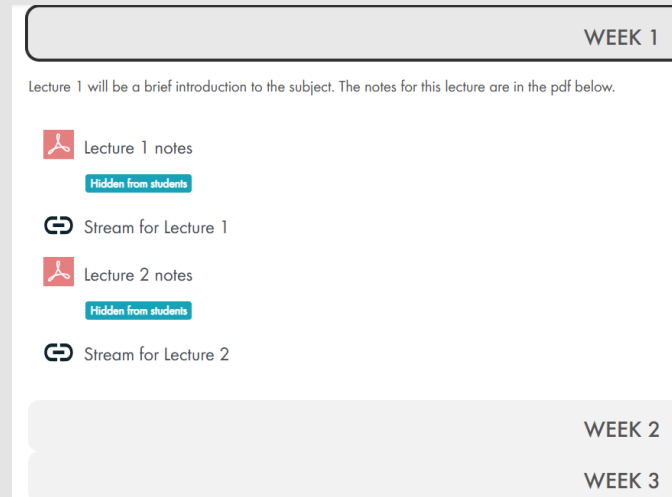
Meeting in "General"

May 2, 2023 Expires in 12 days • 4 views • Padhraic O'Hanrahan • > General > Recordings

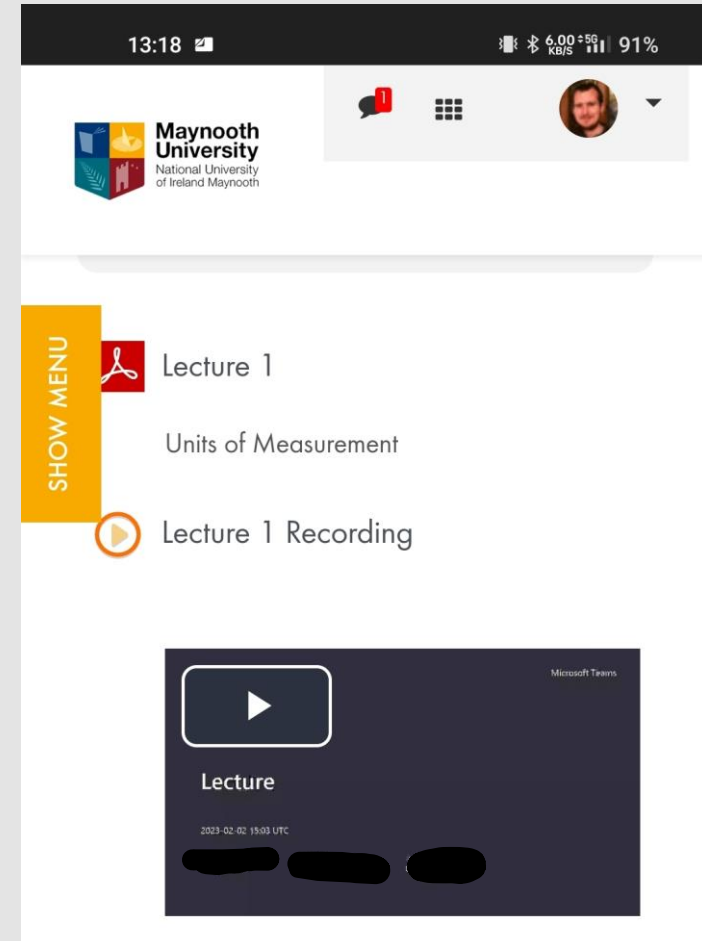
Add a description to explain what this video is about.

LECTURE RECORDINGS

- Lecturers can organise these videos on Moodle.



- Some issues with this organising videos this way:
 - Hard for students to find the video they want.
 - When they find the video, it can be hard to find the part of the video they want.



LECTURE RECORDINGS

- Solution? Use a video editing software to edit videos by subsection.
- Upload video to a YouTube playlist.

MT002 2024 Videos

Pádraic O' Hanrahan

Unlisted

32 videos 323 views Last updated on May 17, 2024

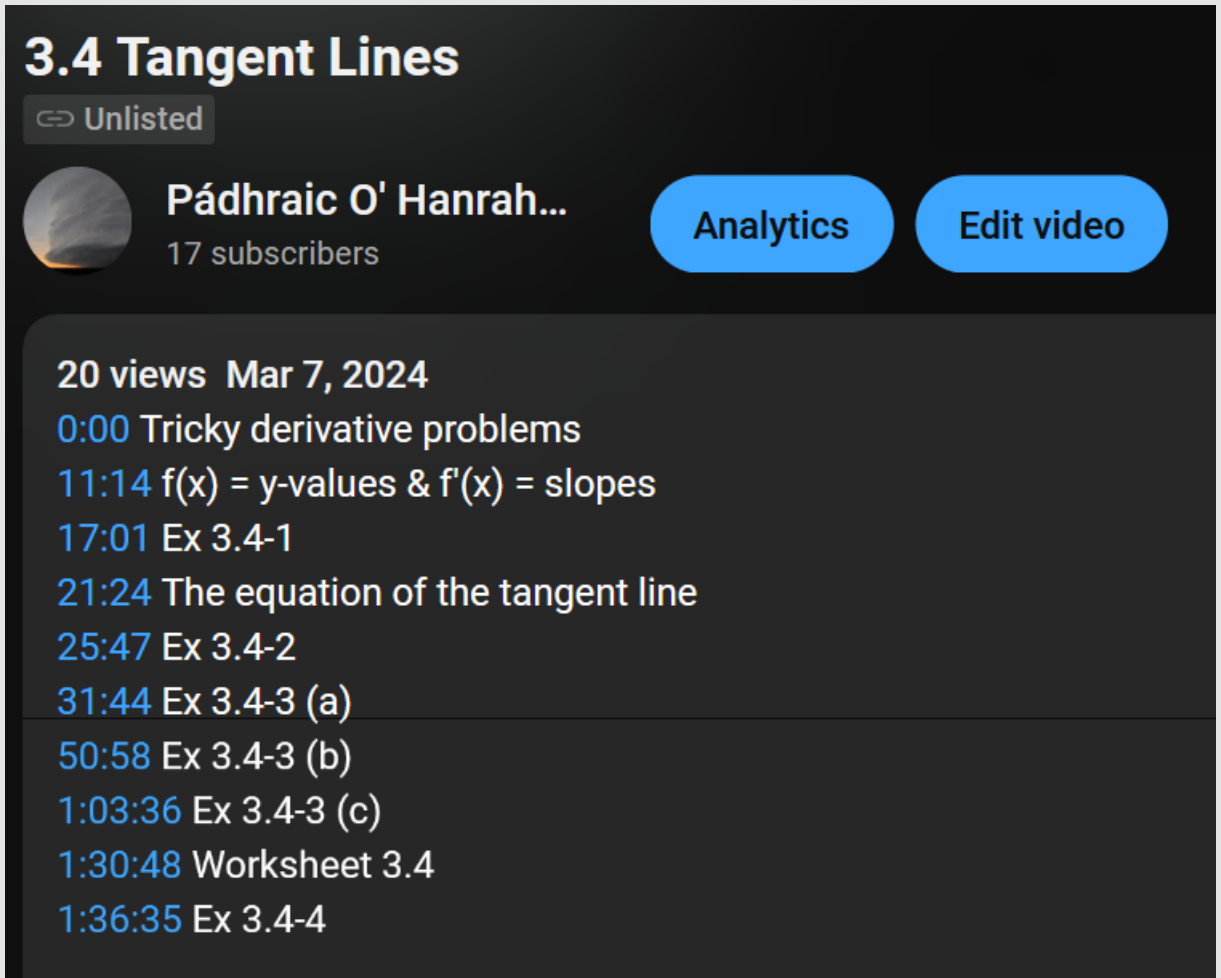
Play all Shuffle

No description

- 1.1 Intro to Functions**
Pádraic O' Hanrahan • 18 views • 4 months ago
- 1.2 Evaluating Functions & Largest Domain**
Pádraic O' Hanrahan • 26 views • 4 months ago
- 1.3 - Graphing Functions**
Pádraic O' Hanrahan • 27 views • 4 months ago
- 1.4 Transformations**
Pádraic O' Hanrahan • 31 views • 3 months ago
- 1.5 Piecewise Functions**
Pádraic O' Hanrahan • 29 views • 3 months ago
- 2.1 Intro to Limits**
Pádraic O' Hanrahan • 17 views • 3 months ago

LECTURE RECORDINGS

- Benefits of using YouTube:
 - Can timestamp the video for quick access to specific parts.
 - Students are familiar with YouTube.
 - Watching videos on YouTube is a smooth experience.



The screenshot shows a YouTube video player interface. At the top, the video title is "3.4 Tangent Lines" in white text on a dark background. Below the title, there is a "Unlisted" status indicator. The channel name is "Pádhraic O' Hanrah..." with a profile picture and "17 subscribers" listed below. To the right of the channel name are two blue buttons: "Analytics" and "Edit video". Below this information, the video statistics show "20 views" and "Mar 7, 2024". A list of timestamps and corresponding content is displayed in white text on a dark background:

- 0:00 Tricky derivative problems
- 11:14 $f(x) = y$ -values & $f'(x) =$ slopes
- 17:01 Ex 3.4-1
- 21:24 The equation of the tangent line
- 25:47 Ex 3.4-2
- 31:44 Ex 3.4-3 (a)
- 50:58 Ex 3.4-3 (b)
- 1:03:36 Ex 3.4-3 (c)
- 1:30:48 Worksheet 3.4
- 1:36:35 Ex 3.4-4

IN SUMMARY...

Before lecture

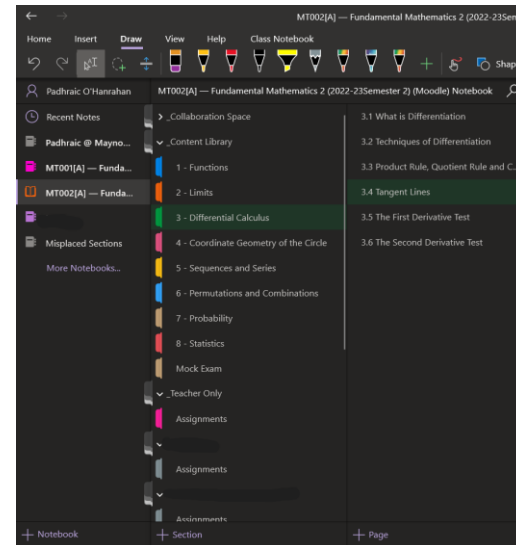
Skeletal Notes

TABLE OF CONTENTS

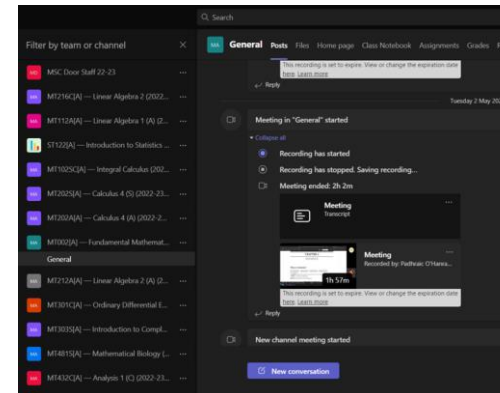
1	Functions	1
1.1	Introduction to Functions	1
1.2	Evaluating Functions at Largest Domains	6
1.3	Graphing Functions	8
1.4	Transformations	13
1.5	Inverse Functions	20
2	Limits	24
2.1	Introduction to Limits	24
2.2	Finding Limits using Tables	27
2.3	Limits Involving Infinity	28
2.4	Evaluating Limits Algebraically	32
3	Differential Calculus	35
3.1	What is Differentiation?	35
3.2	Techniques of Differentiation	41
3.3	Product Rule, Quotient Rule & Chain Rule	45
3.4	Tangent Lines	49
3.5	The First Derivative Test	51
3.6	The Second Derivative Test	57
4	Coordinate Geometry of the Circle	61
4.1	The Equation of the Circle (Standard Form)	61
4.2	The Equation of Semi-Circles	64
4.3	The Equation of the Circle (General Form)	66
4.4	Tangent Lines to Circles	67
5	Sequences & Series	71
5.1	Sequences	71
5.2	Summation Notation	74
5.3	Arithmetic Progression	75
5.4	Geometric Progression	78
6	Permutations & Combinations	83
6.1	The Fundamental Principle of Counting	83
6.2	Factorials	84
6.3	Permutations (Arrangements)	86
6.4	Combinations (Selections)	89

During lecture

OneNote

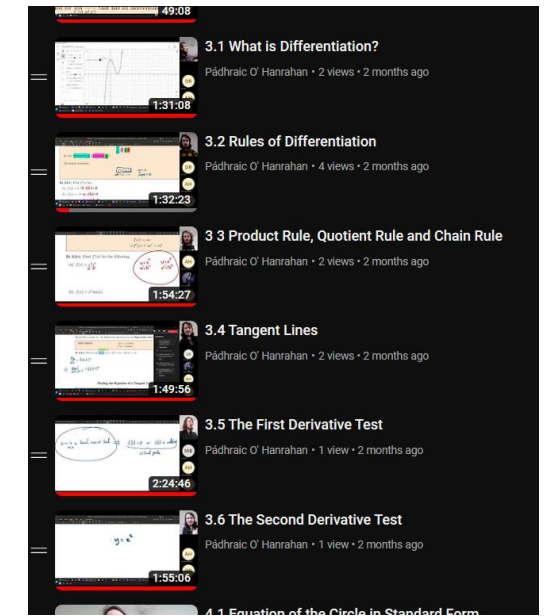


Teams



After lecture

YouTube



REFERENCES

- Biggers, B., and Luo, T. (2020) 'Guiding students to success: A systematic review of research on guided notes as an instructional strategy from 2009-2019', *Journal of University Teaching & Learning Practice*, 17(3), 12 pp. <https://ro.uow.edu.au/jutlp/vol17/iss3/12/>
- Cardetti, F., Khamsemanan, N. and Orgnero, M. C. (2012) 'Insights Regarding the Usefulness of Partial Notes in Mathematics Courses', *Journal of the Scholarship of Teaching and Learning* 10(1), 80–92, available: <https://scholarworks.iu.edu/journals/index.php/josotl/article/view/1735>
- Engelbrecht, J., Llinares, S. and Borba, M.C. (2020) 'Transformation of the mathematics classroom with the internet', *ZDM Mathematics Education*, 52(5), 825–841, available: <https://doi.org/10.1007/s11858-020-01176-4>
- Iannone, P. and Miller, D. (2019) 'Guided notes for university mathematics and their impact on students' note-taking behavior', *Educational Studies in Mathematics*, 101(3), 387–404, available: <https://doi.org/10.1007/s10649-018-9872-x>
- Krapf, R. and Pfefferkorn, L. (2022) 'How Does the Provision of Guided Notes Affect Student Learning in Undergraduate Mathematics?', *International Journal of Research in Undergrad. Mathematics Education* 8(3), 642–670, available: <https://doi.org/10.1007/s40753-021-00160-x>
- Lindsay, E. and Evans, T. (2021) 'The use of lecture capture in university mathematics education: A systematic review of the literature', *Mathematics Education Research Journal*, 34(4), 911–931, available: <https://doi.org/10.1007/s13394-021-00369-8>
- Meehan, M. and Howard, E. (2023) 'The university mathematics lecture: to record, or not to record, that is the question', *Mathematics Education Research Journal*, available: <https://doi.org/10.1007/s13394-023-00444-2>
- Richardson, J. (1994) 'Mature students in higher education: I. A literature survey on approaches to studying', *Studies in Higher Education*, 19(3), 309–325, available: 10.1080/03075079412331381900
- Wong, S. S., Wong S. F. and Mahmud M. (2022) 'Embracing OneNote as an online Pedagogy', *Asian Social Science* 18(8). 12–19. available: <https://doi.org/10.5539/ass.v18n8p12>
- IMLSN Maths & Stats Resource Index Project: <https://www.imlsn.ie/index.php/resources-index>