TABLE OF CONTENTS

We strongly recommend you to read this section as it helps orient you to the course material and explains how you should proceed with your studies.

ABOUT THE COURSE

Welcome to **MATH 1111**. This is a first year course for both diploma and degree students.

The course is designed to be completed within fifteen weeks.

MATH 1111 is a prerequisite course for **MATH 1211,** which will be introduced in Semester II.

HOW TO PROCEED?

Support Materials

The Support Materials is self-contained and the textbook recommended below is for reference only and you ***will not be required to buy the book***.

Recommended Book:

Kreyszig E (1993), *ADVANCED ENGINEERING MATHEMATICS*, (7^{th} Edition), John Wiley & Sons.

HOW DO I USE THE SUPPORT MATERIALS?

Take a few minutes now to glance through the entire support materials to get an idea of its structure. Notice that the format for each unit is fairly consistent. For example, each unit begins with a **UNIT STRUCTURE**, an **OVERVIEW** and a list of **LEARNING OBJECTIVES**.

The **UNIT STRUCTURE** and **OVERVIEW** identify the main topics in the Unit. You should begin your study of each unit by reading this brief introduction.

You should then read the **LEARNING OBJECTIVES** for each unit. The importance of these objectives cannot be overstated. They identify the knowledge and skills you will

have acquired once you have successfully completed the study of a particular unit. he learning objectives also provide a useful guide for review.

WHERE DO I BEGIN?

You should begin by taking a look at the **TABLE OF CONTENTS**. The table provides you with a framework for the entire course and outlines the organisation and structure of the material you will be covering. The **Suggested Course Map** indicates how you should allocate your workload and what you should be working on in each week to be ready for the respective tutorial. As far as possible, stick to the Suggested Course Map to ensure that you are working at a steady pace and that your workload does not pile up.

After completing each instructional unit, review them to confirm that you have achieved the learning goals for it. If you realise that you are not clear about some aspects of the section, go back and redo relevant readings and activities. It is important to build your understanding of Mathematics patiently and thoroughly.

The units contain directions to do various practice **ACTIVITIES**. You will find answers to most of these activities in the unit itself. These activities are designed to reinforce the learning objectives for each part of the course. Thinking through these activities will train you in the skills you need for the examination, and for later applications of Mathematics.

TUTORIAL SHEETS 1- 9 are found at the back of the support materials. You must work through them (as indicated in the Suggested Course Map) ***before attending the tutorial sessions*** and discuss any related problems ***during*** the tutorials.

The **SUGGESTED COURSE MAP** which follows is provided to show you how to allocate your workload over the fifteen weeks. It also indicates on what unit you should be working for the respective tutorial and the tutorial sheets you must complete for the tutorials. It also provides dates for submission of assignments and the Class Test.

SUGGESTED COURSE MAP

Week	Unit	Topic	Tutorial Sheet
1	**1**	**Further Differentiation**	1
2	**1, 2**	**Integration; Polar Coordinates**	2
3 4	**3**	**First-Order Ordinary Differential Equations**	3
5 6	**4**	**Complex Numbers**	4
7	**5**	**Limits**	5
8 9	**6**	**Hyperbolic Functions**	6
10	**Class Test**		
11	**7**	**Partial Differentiation**	7
12 13	**8**	**Homogeneous Equations; D operators. Particular Integrals.**	8 9
14 15		**Revision**	

SUGGESTED ASSESSMENT CRITERIA

COURSE GRADING SCHEME

Invigilated Class Test	**25** marks
Final Examination	**75** marks

Final Examination

- Scheduled and administered by the Registrar's Office
- A two-hour paper at the end of the Semester.

STUDY TIPS

Studying requires that you take an active role. Therefore, use your support materials **actively**, recognising it for the useful "learning tool" that it is. You should be studying pencil in hand, circling an important concept, and making summary notes to crystallise your understanding.

Now, it's time to get to work. Good luck and enjoy the course!

GLOSSARY

1. The Greek Alphabet

A	α	Alpha
B	β	Beta
Γ	γ	Gamma
Δ	δ	Delta
E	ε	Epsilon
Z	ζ	Zeta
H	η	Eta
Θ	θ	Theta
I	ι	Iota
K	κ	Kappa
Λ	λ	Lambda
M	μ	Mu
N	ν	Nu
Ξ	ξ	Xi
O	ο	Omicron
Π	π	Pi
P	ρ	Rho
∑	σ	Sigma
T	τ	Tau
Y	υ	Upsilon
Φ	ϕ,φ	Phi
X	χ	Chi
Ψ	ψ	Psi
Ω	ω	Omega

2. Algebra

Completing the Square

$$ax^2 + bx + c = a\left[\left(x + \frac{b}{2a}\right)^2 + \frac{4ac - b^2}{4a^2}\right].$$

Trigonometry

Multiple Angle:

$$\sin 3A = 3\sin A - 4\sin^3 A \;; \quad \cos 3A = 4\cos^3 A - 3\cos A\,.$$

Factor Formulae:

$$\sin A + \sin B = 2\sin\left(\frac{A+B}{2}\right)\cos\left(\frac{A-B}{2}\right) \;;\; \sin A - \sin B = 2\cos\left(\frac{A+B}{2}\right)\sin\left(\frac{A-B}{2}\right);$$

$$\cos A + \cos B = 2\cos\left(\frac{A+B}{2}\right)\cos\left(\frac{A-B}{2}\right) \;;\; \cos A - \cos B = -2\sin\left(\frac{A+B}{2}\right)\sin\left(\frac{A-B}{2}\right)$$

$$\sin A\sin B = \tfrac{1}{2}[\cos(A-B) - \cos(A+B)]\mathbf{;}\;\; \sin A\cos B = \tfrac{1}{2}[\sin(A+B) + \sin(A-B)];$$

$$\cos A\cos B = \tfrac{1}{2}[\cos(A+B) + \cos(A-B)]\,.$$

General Solutions:

$\sin\theta = \sin\alpha$	$\cos\theta = \cos\alpha$	$\tan\theta = \tan\alpha$
$\theta = n\pi + (-1)^n\alpha$	$\theta = 2n\pi \pm \alpha$	$\theta = n\pi + \alpha$

where $n = 0, \pm 1, \pm 2, \pm 3, \ldots$, and α is the principal value.

Note: $\sin n\pi = 0, \cos n\pi = (-1)^n, \tan n\pi = 0; \sin[(2n+1)\pi/2] = (-1)^n, \cos[(2n+1)\pi/2] = 0,$

$n = 0, \pm 1, \pm 2, \pm 3, \ldots$

Inverse Trig. Functions:

To obtain the values of $\text{cosec}^{-1}x, \quad \sec^{-1}x, \quad \cot^{-1}x$ on your calculator use the definitions:

$$\text{cosec}^{-1}x = \sin^{-1}(1/x), \quad \sec^{-1}x = \cos^{-1}(1/x), \quad \cot^{-1}x = \tan^{-1}(1/x)\,.$$

Hyperbolic Functions

$$\sinh x = (e^x - e^{-x})/2, \quad \cosh x = (e^x + e^{-x})/2.$$

$$\sinh^{-1}x = \ln[x + \sqrt{x^2+1}], \quad \cosh^{-1}x = \pm\ln[x + \sqrt{x^2-1}], \quad \tanh^{-1}x = \frac{1}{2}\ln\left(\frac{1+x}{1-x}\right).$$

3. Some Mathematical Notations

$\forall$ **For all;** $\exists$ **There exists;** $\therefore$ **Therefore;** $\because$ **Because, since.**

P **Set of Real numbers.** X **Set of Complex numbers.**

4. The Intervals:

$x \in (a,b)$ means $a < x < b$;
$x \in [a,b]$ means $a \le x \le b$;
$x \in [a,b)$ means $a \le x < b$;
$x \in (a,b]$ means $a < x \le b$.

5. A few important integrals (*constants omitted*):

$\int 0\, dx = C$ (Arbitrary constant); $\int_a^b 0\, dx = 0$.

$\int \ln x\, dx = x \ln x - x$;

$\int \tan x\, dx = \ln \sec x$;

$\int \cot x\, dx = \ln \sin x$;

$\int \sec x\, dx = \ln(\sec x + \tan x)$, or $\ln \tan\left(\frac{\pi}{4} + \frac{x}{2}\right)$;

$\int \operatorname{cosec} x\, dx = \ln(\operatorname{cosec} x - \cot x)$, or $\ln \tan \frac{1}{2} x$;

$\int \frac{dx}{a^2 + x^2} = \frac{1}{a} \tan^{-1} \frac{x}{a}$;

$\int \frac{dx}{a^2 - x^2} = \frac{1}{a} \tanh^{-1} \frac{x}{a}$;

$\int \frac{dx}{\sqrt{a^2 - x^2}} = \sin^{-1} \frac{x}{a}$;

$\int \frac{dx}{\sqrt{x^2 - a^2}} = \cosh^{-1} \frac{x}{a}$;

$\int \frac{dx}{\sqrt{x^2 + a^2}} = \sinh^{-1} \frac{x}{a}$.

Differential Equations:

$$y'' + \omega^2 y = 0 \quad \Rightarrow \quad y = A\cos\omega x + B\sin\omega x \,;$$

$$y'' - \omega^2 y = 0 \quad \Rightarrow \quad y = A\cosh\omega x + B\sinh\omega x \,,$$

$$\text{or} \qquad y = C_1 e^{-\omega x} + C_2 e^{+\omega x} \,.$$