APPLIED MATHEMATICS B 242 20753-242

(Vector Analysis)

MODULE INFORMATION SHEET

Lecturer: Dr M F Maritz Second semester, 2017.

1. Introduction

This module is about the extension of calculus (i.e. differentiation and integration) to multivariate functions, such as $f(x, y, z)$ and is also about the extension of calculus to functions with more than one component (vector functions), such as $\mathbf{F}(x) = [f(x), g(x), h(x)]$. Eventually you will also do calculus on multivariate vector functions, for example $\mathbf{F}(x, y, z) = [f(x, y, z), g(x, y, z), h(x, y, z)]$.

You will become acquainted with the vector operators, **grad**, **div**, and **curl** and will learn how to apply them correctly. You will learn to integrate over a surface, on the boundary of a surface, through a volume and on the boundary of a volume, and you will find tangent planes to curves and directional derivatives in space. There will be ample opportunity for exercise and the development of technical skills in handling these operations.

The crux of this module consists of three important theorems in vector calculus, viz. Green's theorem, Stokes' theorem and the divergence theorem of Gauss. Each of these theorems proves the equivalence between two types of integrals: one over a domain and the other on the boundary of the same domain. By applying these theorems, difficult integrals can sometimes be calculated in a much easier way. Furthermore, by studying the origin of these theorems specific insight into the behaviour of vector fields may be obtained.

Fundamental knowledge of vector analysis is required for the handling of concepts in electromagnetism, fluid dynamics, elasticity and every other application where physical quantities are represented as continuous vector functions of more than one variable. Double and triple integration is used everywhere in applications where area, volume, mass, the position of the centroid and moment of inertia are required.

The emphasis in this module will be on interpretation of results and in particular on the visual understanding of what each operation does and how each result is represented in physical space.

The software package MATLAB will be used in this module to illustrate concepts graphically. It is not expected of you to be acquainted with MATLAB, although a little knowledge of how it is used will be an advantage. Some class time will be allocated to present a short introduction in the use of this software package.

2. Web site

Information for this module will be updated regularly on the following web site:

`http://http://http://appliedmaths.sun.ac.za/TWB242/index.html`

there is also a URL link under SunLearn that directs you to this website.

You can also get to this site by following the following path from the university home page:

Students→ Faculties and Departments (in the top line) → Mathematical Sciences → Applied Mathematics → BEng Modules → 20753-242 Vector Analysis.

3. Module information

Module code: 20753-B242(8)	Module: Applied Mathematics B242		US Credits 8
Year: 2 Semester: 2	Lecturing load: 2.00ℓ, 1.50t (per week)	Home department: Mathematical Sciences: Applied Mathematics	
Lecturer: Dr MF Maritz	Office: A416	Telephone: 808-4228	Email: mfmaritz@sun.ac.za
Classification:	Mathematics: 95%	Basic Science: 5%	Applied Science: 0%
Prerequisites:	Pass None	Prerequisite Eng. Math. 145	Co-requisite Appl. Math. B224
Other knowledge:	Basic knowledge of calculus and vectors		
Assessment	Method: Flexible assessment method	Formula: PM = 0.12 SM + 0.38 A1 + 0.50 A2	

4. Handbook

The following handbook is prescribed:

— Advanced Engineering Mathematics, Fifth Edition, Dennis G. Zill and Warren S. Wright, Jones and Bartlett Publishers, ISBN-13: 978-1-4496-7977-4.

Previous editions (4th by ZILL & WRIGHT as well as 2nd, 3rd, same title but under the author names: ZILL & CULLEN) will also do. The authors have not changed anything in the chapters that we are doing.

If additional notes are made available, it will be posted on the web site for AM B242 for downloading.

5. Test dates

It is the responsibility of the student to consult the official time tables of the university for test dates, times and venues.

6. Assessment

The assessment of this module is done according to the *Flexible assessment method*. See

SunLearn for documentation on exactly how this evaluation method is applied.

The mark is made up of three components: SM (the Semester Mark), A1 (the first test) and A2 (the second test).

The SM is accumulated out of the marks of Tutorial tests (or *Tut tests* for short). Each Tut test is written at the end of the relevant tutorial session and covers the work done during that tutorial session. You should therefore not waste time during the tutorial session, but start working immediately. Tutorial problems will be from Zill and Wright and the numbers of problems to be done will be given during the lectures that precede the tutorial session. You should therefore already start working on these problems at home.

Calculators according to the prescriptions of the Engineering Faculty may be used during all tests.

7. Module Content

A table of contents that is updated after every lecture is available on the web site for this module under the link "Schedule". This table not only shows what is planned for a particular lecture, but also what was actually done.

The following topics will be covered (numbers refer to paragraphs in Zill and Wright):

7.5	Lines and Planes in 3D
9.1	Vector functions
9.4	Functions of several variables
9.5	The Directional Derivative
9.6	Tangent planes and Normal Lines
9.7	Divergence and Curl
9.8	Line Integrals
9.9	Line Integrals Independent of Path
9.10	Double integrals in Cartesian Coordinates
9.11	Double integrals in Polar Coordinates
9.12	Green's Theorem
9.13	Surface Integrals
9.14	Stoke's Theorem
9.15	Triple Integrals
9.16	The Divergence Theorem

8. Registration

It is the responsibility of each student to see that he/she is registered for the module.