Tutorial Letter 101/3/2018

COMPUTER ALGEBRA

APM2616

Semesters 1 & 2

Department of Mathematical Sciences

IMPORTANT INFORMATION:

This tutorial letter contains important information about your module.

BAR CODE

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1 INTRODUCTION

Dear Student

Welcome to the APM2616 module in the department of Mathematical Sciences at Unisa. We trust that you will find this module both interesting and rewarding.

Some of this tutorial matter may not be available when you register. Tutorial matter that is not available when you register will be posted to you as soon as possible, but is also available on *my*Unisa.

Please read this tutorial letter in detail as it contains vital information.

You must be registered on *my*Unisa (http://my.unisa.ac.za) to be able to submit assignments online, gain access to the library functions and various learning resources, download study material, "chat" to your lecturers and fellow students about your studies and the challenges you encounter, and participate in online discussion forums. *my*Unisa provides additional opportunities to take part in activities and discussions of relevance to your module topics, assignments, marks and examinations.

A tutorial letter is our way of communicating with you about teaching, learning and assessment. You will receive a number of tutorial letters during the course of the module.

This particular tutorial letter contains important information about the scheme of work, resources, assignments, the assessment criteria, admission requirements for the examination as well as instructions on the preparation and submission of assignments for this module. We urge you to read it and read all following subsequent tutorial letters carefully and to keep it at hand when working through the study material, preparing and submitting the assignments, preparing for the examination and addressing queries that you may have about the course (course content, textbook, worked examples and exercises, theorems and their applications in your assignments, tutorial and textbook problems, etc.) to your APM2616 lecturers. More general and detailed information and an orientation to your studies at Unisa is contained in the *Study @ Unisa* brochure which is included in your study package.

Please note that this is a special module in that it is supported through Extended Science Pathway (ESP). The program provides additional learning support in different forms, which is designed to make your studies easier and to help you succeed. The additional support is largely in the form of tutorials, and is offered to you free of charge. It is very important that you take advantage of the support to ensure your own success.

The main course material for this module is presented in the form of a study guide. Other study materials include Tutorial Letter 102, which contains the Tutorial Resource for the module. Tutorial Letters 201 and 202 contain solutions to assignments 1 and 2. A Tutorial letter containing the examination guidelines to help you to prepare for the examination will be made available in due course. Lastly, Tutorial Letter 301 contains general but important information on foundation support interventions in modules. Some of this study material may not have been available to you when you registered. Study material that was not available when you registered will be posted to you as soon as possible, and will also be available on *my*Unisa.

Both the study guide and the tutorial resource are divided into study or tutorial units in which there are different learning activities which you should complete at specific periods during the year. Please take time to complete the activities in these study materials. The activities have been designed to help you to understand the difficult concepts, and to supplement the theoretical knowledge with practical experience.

Remember that your lecturer and tutor are always available to assist you with your studies, but the responsibility to contact us if you experience any difficulties lies with you. Please feel free to contact us during office hours. You will find our contact details in Tutorial Letter 102. During the year, your lecturer will be communicating with you by means of sms and through *my*Unisa.

You are strongly advised to spend as much time as you can on learning sites on the internet to which you may referred to, and to *my*Unisa. On *my*Unisa, besides the mentoring by a tutor, you have a variety of opportunities to interact with other students to enrich your learning experience. To register on *my*Unisa, log onto the Unisa website *my*Unisa (http://my.unisa.ac.za) and follow the relevant links. On *my*Unisa, you will see two sites, the main lecturer's teaching site with the code APM2616 -18-Y1, and the tutoring site with the code APM2616 -18-Y1-S1. The site APM2616 -18-Y1-S1 is hosted by your e-tutor and contains the tutorials and online assignments. The site APM2616 -18-Y1 contains the main study materials for the module. It is also the site from which your lecturer will communicate to you about various learning activities during the year, and from which your lecturer will control the learning activities, including your tutorials.

We hope that you will enjoy APM2616 and we wish you all the best in your studies at Unisa!

2 PURPOSE AND OUTCOMES FOR THE MODULE

2.1 Purpose

General properties of modern computer algebra systems; use of computer algebra

(a) to solve analytically a variety of mathematical problems including algebraic equations (both linear and nonlinear), differentiation, integration, differential equations, matrix manipulation, series expansions, and limits;

(b) to represent mathematical functions graphically, in 2D and 3D.

(c) Scientific document preparation and produce mathematical reports using LaTeX.

2.2 Assumed prior learning

The prerequisites for this module are COS1511, MAT1511, MAT1503 or APM1513, MAT1512 or (MAT101 and MAT102).
Computer algebra is a form of computer using; so, although you will not be using a previously learned computer language, you need to have experience in programming a computer. The most common applications of computer algebra are in calculus and linear algebra, and you need a thorough theoretical knowledge of these subjects before applying the tool of computer algebra to problems in these areas.

2.3 Outcomes

2.3.1 **Study unit 1**: Practicalities of gaining access, and running the software needed for the module.

2.3.2 **Study unit 2**: Use of the MuPAD online help facility to solve (simple) problems. Identifiers and assignments.

2.3.3 **Study unit 3**: Simplification and substitution.

2.3.4 **Study unit 4**: Functions, differentiation and integration.

2.3.5 **Study unit 5**: Data types, packages, the linear algebra package, linalg, matrices over a specified structure.

2.3.6 **Study unit 6**: Basic syntax,l local and global variables, output from a procedure, input variables to a procedure, evaluation within a procedure.

2.3.7 **Study unit 7**: Algebraic equations, ordinary differential equations, solving recurrence relations.

2.3.8 **Study unit 8**: Taylor series, general series, extracting the coefficient of a series, example of the use of series.

2.3.9 **Study unit 9**: The command `collect`, The command `combine`, The command `rewrite`, The command `partfrac`, The command `rectform`, The command `radsimp`, The command `assume`, The command `limit`.

2.3.10 **Study unit 10**: Linear algebra, definite integrals, ordinary differential equations.

2.3.11 **Study unit 11**: Output, creating a plot of a given function, parametric and other plots, other 2D plots.

2.3.12 **Study unit 12**: Plots of functions in 3-dimensions, plotting options in 3D, customized graphics.

2.3.13 **Study unit 13**: Getting started with LaTeX, getting help with LaTeX, the structure of a LaTeX document.

2.3.14 **Study unit 14**: Mathematical expressions in LaTeX, MuPAD and LaTeX, LaTeX packages.

2.3.15 **Study unit 15**: Tables in LaTeX, miscellaneous features of LaTeX.

2.3.16 **Study unit 16**: Project.

3 LECTURER(S) AND CONTACT DETAILS

3.1 Lecturer(s)

The contact details for the lecturer responsible for this module is

Postal address: The APM2616 Lectures
Department of Mathematical Sciences
Private Bag X6
Florida
1709
South Africa

Load Level	No daylight saving time		In Daylight saving time	
	Monday-Saturday	Sunday & holidays	Tuesday-Sunday	Sunday & holidays
Light	00:10-06:08	00:05-16:09 22:07-23:22	00:04-06:59	00:03-17:09 23:05-23:05
Medium	07:03-17:56 21:02-23:54	17:00-21:52	07:01-18:50 22:00-23:53	18:20-22:55
Heavy	18:20-20:57		19:10-21:58	

Information concerning lecturers responsible for this module will be included in Tutorial Letter 102, which you will receive shortly. If you need to contact a lecturer before you receive Tutorial Letter 102 you may phone the secretary of the department at 011 670 9147, i.e. the Department of Mathematical Sciences. When you contact the secretary, please say which module you are enquiring about. She will put you through to an available lecturer. Please have your study material with you when you contact us. When you speak to a lecturer, it is helpful to be very specific about your problem.

It may help you explain your problem more clearly over the telephone if you first write it down yourself. Make sure you have paper and a pen available when you phone, so that you can write down the explanation. Please remember, if you want to visit a lecturer you must make an appointment. If you do not make an appointment beforehand there may not be anyone available to help you. To make an appointment, phone the secretary at (011) 670 9147. She will put you through to the relevant lecturer. Not all the lecturers are always available, but there will usually (except, for example, when all the lecturers have to attend a meeting) be someone to see you between 08:00 and 13:00. When you phone to make an appointment, please give the lecturer your name and student number, the code of the module for which you want to make an appointment, a contact telephone number (if possible).

If for some reason you cannot keep the appointment, please let the lecturer know. When you have made an appointment to see someone, please bring with you your initial attempts at solving the problem. It is usually more helpful if we can show you where you have misunderstood a particular concept, or applied a method incorrectly, and then suggest how to carry on from there.

All queries that are not of a purely administrative nature but are about the content of this module should be directed to your lecturer(s). Tutorial letter 301 will provide additional contact details for your lecturer. Please have your study material with you when you contact your lecturer by telephone. If you are unable to reach us, leave a message with the departmental secretary. Provide your name, the time of the telephone call and contact details. If you have problems with questions that you are unable to solve, please send your own attempts so that the lecturers can determine where the fault lies.

Please note: Letters to lecturers may not be enclosed with or inserted into assignments.

3.2 Department

Fax number: 011 670 9171 (RSA)	+27 11 670 9171 (International)
Departmental Secretary: 011 670 9147 (RSA)	+27 11 670 9147 (International)

3.3 University

If you need to contact the University about matters not related to the content of this module, please consult the publication *Study @ Unisa* that you received with your study material. This booklet contains information on how to contact the University (e.g. to whom you can write for different queries, important telephone and fax numbers, addresses and details of the times certain facilities are open). Always have your student number at hand when you contact the University.

4 RESOURCES

For library service request procedures (listed below), please consult the *Study @ Unisa* brochure.

4.1 Prescribed Book

There is no prescribed book for this module; recommended books are listed in Section 4.2 below. Please note that all tutorial matter will not necessarily be available at registration. Tutorial matter that is not available when you register will be posted to you as soon as possible.

4.2 Recommended Books

LIST OF RECOMMENDED BOOKS WITH REQUEST NUMBERS

APM2616 /2018

When requesting recommended books from the Library, please supply **full Request number** on your request card.

Books supplied subject to availability

*Limited copies available. If unavailable, please request alternative.

TITLE CALLNUMBER	AUTHOR BOOKNUMBER
LATEX: a document preparation LAMP	Lamport, Leslie 09–015399–APM216–r
MuPAD tutorial: a version and GERH	Gerhard, J 09–015398–APM216–r

4.3 Electronic Reserves (e-Reserves)

There are no e-Reserves for this module.

5 Library services and resources information

For brief information go to http://www.unisa.ac.za/brochures/studies

For detailed information, go to http://www.unisa.ac.za/library. For research support and services of personal librarians, click on "Research support".

The library has compiled a number of library guides:

- finding recommended reading in the print collection and e-reserves – http://libguides.unisa.ac.za/request/undergrad
- request material – http://libguides.unisa.ac.za/request/request
- postgraduate information services – http://libguides.unisa.ac.za/request/postgrad
- finding, obtaining and using library resources and tools to assist in doing research – http://libguides.unisa.ac.za/Research_Skills
- how to contact the Library/finding us on social media/frequently asked questions – http://libguides.unisa.ac.za/ask

5.1 STUDENT SUPPORT SERVICES

Extended Science Pathway

Science Pathway provides additional learning support so that you have a better chance of passing the module. Your learning is supported through special tutorials which are designed to ensure that you master the basic concepts in the module first, and to help you through the concepts that are known to be typically difficult for students. The tutorials are also designed to help you to develop your reading, writing and study skills, and to understand your curriculum in relation to your career choices. To achieve these goals, the tutorials provide ample time for you to constantly interact with a tutor and with your fellow students to clarify difficult questions and concepts.

The tutorials are important because your formative assessment is inbuilt in the tutoring, whereby tutors mark your assignments, give you self-assessment tasks to do, and provide you with feedback on the learning activities. Tutors are also tasked to prepare you for the final examination. You have the choice of attending face-face tutorials at a learning centre, and/or on-line on *my*Unisa. Upon registration, an E-tutor is automatically allocated to you. For face-face tutorials, you have to register at the learning center nearest to you. The tutorials are contained in Tutorial Letter 102, the **Tutorial Resource for the Module** APM2616 . You will receive the printed version of the tutorial resource before the tutorials start. By that time, you will also be able to access the electronic tutorial resource among the official study materials on the module site, and the on-line version on the tutorial site, on *my*Unisa.

You are strongly advised to prepare for the tutorials by reading through the tutorial resource before you start your tutorials. It is important to understand the rules and your responsibilities with regard to the tutorials and to your assessment. Remember, the tutorial resource does not replace your study guide, but complements it with more basic content and interactive learning activities that target the difficult concepts. The tutorial resource must be used with reference to the study guide which is your main learning resource.

As a word of caution, please note that in distance learning, the fact that students are enrolled in self-study is frequently the reason for failure. This is because in the distance education environment, minimal yet vital interaction takes place among students, and between students and mentors such as tutors and lecturers. It is therefore your responsibility to take full advantage of the tutorials by sparing as much time as you can for tutorials, and by aggressively engaging with the tutor and with other students, to deepen your own understanding, which will enrich your learning experience. Details on other student support are contained in Tutorial Letter 301 and in the *Study @ Unisa* brochure.

6 STUDY PLAN

The due dates of the assignments set the pace at which you should work through the content. (See Section 8.5).

Study plan	Semester 1	Semester 2
Outcomes 2.3.1 to 2.3.7 to be achieved by	12 March	28 August
Outcomes 2.3.8 to 2.3.16 to be achieved by	9 April	27 September
Revision of Assignments	20 April	10 October
Revision of the Study Guide	30 April	20 October

Draw up your own study schedule and keep to it!

See the brochure *Study @ Unisa* for general time management and planning skills.

7 PRACTICAL WORK AND WORK-INTEGRATED LEARNING

There are no practical sessions for this module.

7.1 Computer facilities

Most of the work that you will be doing in this module will be practical work on a computer. Thus, you should take this module only if you have regular access to a suitable computer and printer.
The software needed for this module is available on the CD which comes with your Tutorial Letter 101.
Unisa has computer laboratories in Pretoria, Cape Town, Durban, Johannesburg, Florida and Polokwane, and these provide one way to obtain all the computer facilities needed for the module.

7.1.1 Licence conditions

The software that you may download is distributed to you free of charge, but on certain conditions. You may use it for private study in connection with this module, but its use for other purposes, in particular for any commercially related purpose, may be prohibited. Details vary according to the package; if you would like to use any software for a purpose not related to this module, then you should check the licence conditions on the software-supplier's home page.

7.2 Installation of the module software

The following files are available on the APM2616 software folder that you will download from the Dropbox link given in section **??**:

- basic-miktex-2.8.3761.exe
- mupad_light_253.exe
- winzip80.exe
- install.linux
- mupad_linux_311.tgz

Installation under MS-Windows

MuPAD

Simply double click the mupad_light_253.exe icon and follow the installation instructions.

LaTeX

Double click the small_miktex_2.4.1705.exe icon, and follow the subsequent installation instructions.

Installation under Linux

If your computer is using the Linux operating system, you will not need to install LaTeX because it is now part of the standard Linux distribution. You install MuPAD using the file mupad_linux_311.tgz – instructions are given in the file install.linux.

7.3 Testing the installation

MuPAD

Under Windows, click on Start, then Programs, then MuPADLight, then double click on MuPAD-Light. Under Linux, at a command shell prompt, type xmupad. In both cases, a MuPAD window should appear. You should register your installation using the following information:
User name: 7GU47
Then enter the following key

- Under MS-Windows: 40200-308D5-89464-5B6B8-09C7C
- Under Linux:
  Run xmupad as root and enter register (“7GU47”, “112100-72CBF-57F13-7CCA6-F5435”)

You can test that the system is working correctly by entering

```
diff(x^2,x);
```

The system should return

```
2 x
```

LaTeX

Use a plain text editor (i.e. do not use a word processing system like MS-Word, wordpad, rather use NotePad. If you use NotePad, make sure when you save your file, to select ”All files” under ”Save as type:”) to create THE file ”t.tex” containing the following

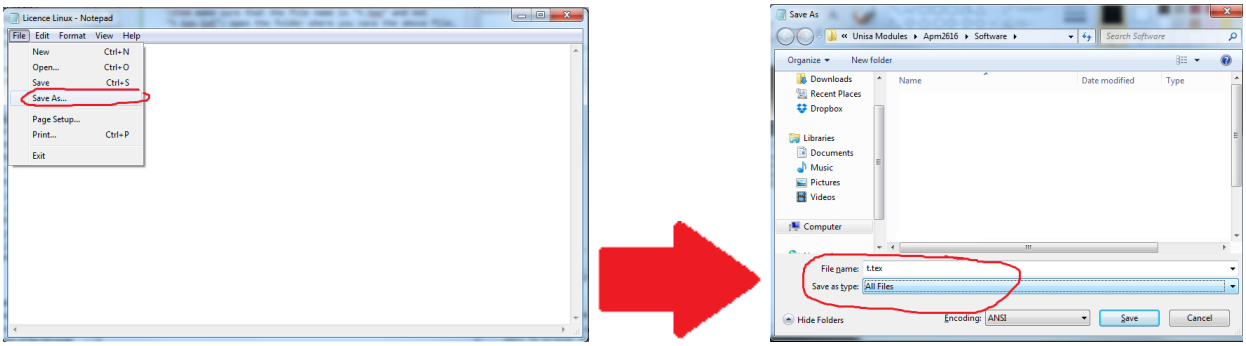


Figure 1: How to save ”t.tex” file in NotePad.

```
\documentclass{article}
\begin{document}
Hello
\end{document}
```

Save the file, then open an MS-DOS prompt (or, in Linux, at a command shell prompt), and make the current directory the one containing ”t.tex”. Type
latex t
The system should produce some screen output, and create files t.aux, t.dvi, t.log. Next, you should view what the document would look like if printed. Under Linux, at a shell prompt, type xdvi t. Under MS-Windows, click on Start, then Programs, then MikTeX, then click on DVI Viewer; once the viewer has been opened, click on file, then Open and (after changing to the appropriate directory), double click on t.dvi. There should appear on the viewer

```
Hello
```

7.4 Common problem and path issue

The system reports that the software has been successfully installed, but when you run it, it complains “file not found”. In every case, the file was there, but the problem was that the file search was incorrect, so the operating system did not find the file. If this happens:

1. make sure that the file name is ”t.tex” and not ”t.tex.txt”: open the folder where you save the above file, right click it, and choose ”properties”, under ”General” tab, check that ”Type of file” is ”LaTex Document (.tex)”. If is not, open the file with ”NotePad” and follow the instruction in figure 1. If the name and extension are correct, go to 2.

2. Reboot – often the installation software has correctly updated the filepath, but the filepath is fixed at boot–up time.

3. If rebooting does not work, then use “Find” to make sure that the desired file really does exist and note the directory in which it is located. You will probably need to update manually the path setting. If you haven’t done this before, get someone who has to help you because setting the path incorrectly can mess up various features on your computer.

8 ASSESSMENT

8.1 Assessment criteria

There are no assessment criteria for this module.

8.2 Assessment plan

Assignments are seen as part of the learning material and assessment for this module. As you do the assignments, discuss with fellow students or tutor, you are actively engaged in learning. It is therefore important that you complete all the assignments. This tutorial letter contains the assignments for this year's semesters. With respect to assignments, I want to emphasize the following points:

8.2.1 Please take note that: there are two assignments for each semester, **ONLY DO THE ASSIGNMENTS FOR THE SEMESTER YOU ARE REGISTERED FOR.** Each assignment covers a new section of work. The questions for Assignments are attached at the end of this tutorial letter.

8.2.2 The work you submit for marking should be your best version, an assignment should not just be neat, but also logical. An example of sloppy presentation is to simply write down a series of statements without any indication of connection between them

8.2.3 The semester mark for APM2616 in 2018 is 20% of the average mark obtained in Assignment 01 and 02. Your final mark will be the sum of your semester mark and 80% of the exam mark (For example, if you get 60% in Assignment 01, 50% in Assignment 02, and 64% in Exam; your average semester mark will be (60+50)/2=55% and your semester mark will be 20% of 55 which is 55/5=11, the contribution of the exam toward final mark will be 80% of 65 which is 65*80/100=52. Thus, your final mark will be 11+52=**63%.** Please apply the following formula to calculate your final mark, where AS1 and AS2 are marks (in percentage) obtained in Assignment 01 and Assignment 02 respectively, EX is your exam mark (in percentage), and FM your final mark (in percentage): $FM = \frac{AS1 + AS2}{10} + \frac{4EX}{5}$.

Please, see also section 9 on how the examination system works.

8.2.4 These minimum requirements must not be regarded as sufficient preparation for success in the examination. It is important that you complete all the assignments.

8.2.5 Your assignments must be correctly numbered, i.e. the number must correspond with the number given in the Tutorial Letter. Even though Assignment 02 may be the first assignment done by you, it must be numbered 02 not 01.

8.2.6 The assignments are somewhat long, please avoid repeating the proof of formulae already done in the Study Guide and Prescribed Book, apply them directly instead.

No mark will be awarded if you copy solution from past assignments and exam solutions or repeat proof of formulae already done in the Study Guide and Prescribed Book.

8.2.7 Please take heed of the closing dates for the assignments. In order to obtain full credit for your work, you must see to it that your assignments reach me on or before the closing

dates. You will receive the solution for both assignments, only if you submit the relevant assignment. No solution will be posted to you if the relevant assignment is not received. These solutions will be available about two weeks after the closing date of the relevant assignment.

8.3 Very Important: Authentic Work

PLEASE NOTE: COPYING AND PLAGIARISM

Although students may work together when preparing assignments, each student must write and submit his or her own individual assignment. In other words, you must submit your own ideas in your own words, sometimes interspersing relevant short quotations that are properly referenced. It is unacceptable for students to submit identical assignments on the basis that they worked together. That is copying (a form of plagiarism) and none of these assignments will be marked. Furthermore, you may be penalised or subjected to disciplinary proceedings by the University. This also applies to solutions taken from books and previous years assignments and exams.

8.4 Assignment numbers

8.4.1 General assignment numbers

Each of your assignments has a general identification number which is assigned consecutively starting from 01 to 02 for each semester.

8.4.2 Unique assignment numbers

Each assignment also has a unique 6-digit assignment number (e.g. 102717).

SEMESTER AND ASSIGNMENT NUMBER	UNIQUE NUMBER
SEMESTER 1 / ASSIGNMENT 01	837310
SEMESTER 1 / ASSIGNMENT 02	746096
SEMESTER 2 / ASSIGNMENT 01	882933
SEMESTER 2 / ASSIGNMENT 02	691739

8.5 Assignments due dates

This module has two assignments for each semester, with the following closing dates:

	ASSIGNMENT 01	ASSIGNMENT 02
SEMESTER 1	19 MARCH 2018	16 APRIL 2018
SEMESTER 2	31 AUGUST 2018	1 OCTOBER 2018

Solution to all assignments will be available on myUnisa website about 2 weeks after closing dates.

8.6 Submission of assignments

You can submit your assignments in different ways, depending on the type of assignment as follows;

SEMESTER AND ASSIGNMENT NUMBER	FORMAT	METHOD OF SUBMISSION
SEMESTER 1 / ASSIGNMENT 01	Written	Postal or electronically via *my*Unisa
SEMESTER 1 / ASSIGNMENT 02	Written	Postal or electronically via *my*Unisa
SEMESTER 2 / ASSIGNMENT 01	Written	Postal or electronically via *my*Unisa
SEMESTER 2 / ASSIGNMENT 02	Written	Postal or electronically via *my*Unisa
EXAM PAPER	Written	In venue and handed in

For detailed information on assignments, please refer to the *Study @ Unisa* brochure which you received with your study package.

To submit an assignment via *my*Unisa:

- Go to *my*Unisa.
- Log in with your student number and password.
- Select the module.
- Click on "Assignments" in the menu on the left-hand side of the screen.
- Click on the assignment number you wish to submit.
- Follow the instructions.

8.7 The assignments

Before you proceed with the assignments please refer to this brief list of DO'S and DON'TS.
DO

- use the assignments to plan your work schedule
- work regularly at the assignment once you have begun
- read each question carefully
- check your answers and presentation for errors in logic as well as careless calculation errors
- discuss difficult questions with other students if possible
- read the comments carefully when marked assignments are returned to you, and where possible apply these comments in future
- compare the solutions you receive with your own answers.

DON'T

- rush through questions

- leave out questions if you think your answer is wrong – we can help you more effectively if we see where you have made mistakes
- scribble changes over other work – rather begin again
- write down someone else's answer, hence possibly duplicating someone else's mistakes
- be discouraged when you make mistakes and get low marks.

In each written assignment, clearly show all workings, calculations, possible diagrams and reasoning used in determining your answers. Note that marks will be deducted for unsatisfactory presentation of answers.

Do not use of a calculator. Doing numerical calculations mentally or by using the definitions and properties of the different functions will be good exercise in view of the exam at the end of the year. The assignments for 2018 follow below.
NOTE: All numbers and sections in brackets refer to the Study Guide
Please avoid repeating proofs of formulae already done in the Study Guide and Prescribed Book, use or apply them directly instead.
Very Important: Only do the assignment for the semester you registered for.

8.8 Assignments Semester 1/2018

ONLY FOR SEMESTER 1
ASSIGNMENT 01
UNITS 2–10 OF STUDY GUIDE
CLOSING DATE: 19 MARCH 2018
Unique Number: 837310

PLEASE DO ONLY THE ASSIGNMENTS FOR THE SEMESTER YOU ARE REGISTERED FOR.

NOTES:

- The answer to the questions will be MuPAD and LaTeXcode and output. Thus, the assignment should be submitted in the form of a computer print out, either physically or electronically via myUnisa. Comments etc. can be made by editing the file before printing it. **All hand written assignments will not be marked and will result to zero mark awarded.**
- In the exercises that involve plots, you are expected to use MuPAD various options by means of MuPAD code, and not by using the *Vcam* edit menus, the plots and the resulting graphs must be included in the assignment: **half of the marks for the concerned exercises will be automatically deducted if the graphs and plots are not included**.
- In the exercises that involve LaTeX, manual reference and labeling of equations, bibliography, pages, etc. **will automatically nullify the concerned question**.
- In the exercises that involve plots, you are expected to use MuPAD the various options by means of MuPAD code, and not by using the *Vcam* edit menus.
- No mark will be awarded if you copy solution from past assignments and exam solutions or repeat proof of formulae already done in the Study Guide and Prescribed Book.

QUESTION 1

(a)Use the protocol command and WRITEPATH variable to output a portion of a MuPAD session to a file not in the current directory. **(5 Marks)**
(b)Use MuPAD to find the prime factors of a integer (Hint: see *ifactor*). **(5 Marks)**
[10 Marks]

QUESTION 2

Use MuPAD to prove

$$\frac{2\cos 5x}{\sin 2x\cos^2 x} = -10\sin x + \frac{\cos^2 x}{\sin x} + \frac{5\sin^3 x}{\cos^2 x}.$$

[10 Marks]

QUESTION 3

Find the values of a, b and c for which the following matrix is not invertible $\begin{pmatrix} 1 & a & b \\ 1 & 1 & c \\ 1 & 1 & 1 \end{pmatrix}$.

[10 Marks]

QUESTION 4

Consider the following matrices $A = \begin{pmatrix} 1 & 3 & 0 \\ -1 & 2 & 7 \\ 0 & 8 & 1 \end{pmatrix}$, $B = \begin{pmatrix} 7 & -1 \\ 2 & 3 \\ 0 & 1 \end{pmatrix}$.

Let B^T represent the transpose of B. Compute the inverse of $A + BB^T$, both over the rational numbers and over the integers modulo 7. **[10 Marks]**

QUESTION 5

Define the function f, from the positive integers to the positive integers

$$f(x) = \begin{cases} 3x+1 & \text{for odd } x \\ \dfrac{x}{2} & \text{for even } x. \end{cases}$$

Next, define the sequence $x_{i+1} := f(x_i)$.Write a procedure that, on input of a positive integer n, returns the smallest index i with $x_i = 1$ **[15 Marks]**

QUESTION 6

Solve the following algebraic equations, or systems of algebraic equations, and in each case verify your solution(s) by substitution into the original equations

(a) $x + 2y = 3,\ y + \dfrac{1}{x} = 1,$

(b) $\sin\dfrac{x}{2} = -2\sin\dfrac{x}{2}\cos 2x,\ \ -2\pi \le x \le 2\pi.$ **[10 Marks]**

QUESTION 7

Find the first five terms of the asymptotic expansion of $\sqrt{x+1} - \sqrt{x-1}$. **[10 Marks]**

QUESTION 8

Use MuPAD to show that

$$\frac{4^{x-1} + 2^{2x-4}}{2^{2x+1} + 5 \times 2^{2x-3}} = \frac{5}{42}.$$

[10 Marks]

QUESTION 9

Solve the following system of equations

1. $x_{i-1} - (2 - h^2)\, x_i + x_{i+1} = 0,\ \ i = 2, \cdots, 49,\ x_1 = 1,$ and $x_{50} - x_{49} = h,$ where $h = 0.1.$

[15 Marks]

TOTAL: 100 Marks]

ONLY FOR SEMESTER 1
ASSIGNMENT 02
UNITS 11–16 OF STUDY GUIDE
CLOSING DATE: 16 APRIL 2018
Unique Number: 746096

PLEASE DO ONLY THE ASSIGNMENTS FOR THE SEMESTER YOU ARE REGISTERED FOR.

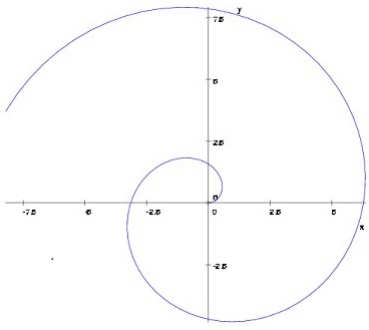
- The answer to the questions will be MuPAD and LaTeXcode and output. Thus, the assignment should be submitted in the form of a computer print out, either physically or electronically via myUnisa. Comments etc. can be made by editing the file before printing it. **All hand written assignments will not be marked and will result to zero mark awarded.**
- In the exercises that involve plots, you are expected to use MuPAD various options by means of MuPAD code, and not by using the *Vcam* edit menus, the plots and the resulting graphs must be included in the assignment: **half of the marks for the concerned exercises will be automatically deducted if the graphs and plots are not included**.
- In the exercises that involve LaTeX, manual reference and labeling of equations, bibliography, pages, etc. **will automatically nullify the concerned question**.
- In the exercises that involve plots, you are expected to use MuPAD the various options by means of MuPAD code, and not by using the *Vcam* edit menus.
- No mark will be awarded if you copy solution from past assignments and exam solutions or repeat proof of formulae already done in the Study Guide and Prescribed Book.

QUESTION 1

Write MuPAD code to draw a graph that plots the functions $f(t) = e^{\sin x}$ and $g(t) = \dfrac{t^2}{1+t^2}$ in the range $t = -1$ to 5. The axes should be appropriately labelled, and horizontal directions should be the same. The graph of f is to be blue and that of g green. **[10 Marks]**

QUESTION 2

Write MuPAD code to plot a spiral $(u\cos u, u\sin u)$ coloured blue so as to produce the result given below. **[10 Marks]**



QUESTION 3

Plot contours of the function $f(u,v) = u^2 - 3v$ at $f = 0, 1, 2, 3$ and 4. The axes, contours and graph should be appropriately labelled. **[10 Marks]**

QUESTION 4

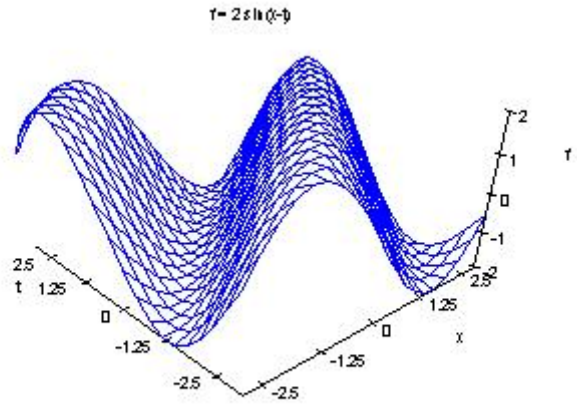
Using smooth functions, construct a *3D* graph that looks like a wide-brimmed hat. **[10 Marks]**

QUESTION 5

Find the eigenvalues and eigenfunctions of the matrix $\begin{pmatrix} 5 & 2 & 1 \\ 2 & 3 & 2 \\ 1 & 2 & 6 \end{pmatrix}$. Draw a *3D* graph showing the eigenvectors, with each eigenvector having the magnitude of its corresponding eigenvalue. Each axis should have the same scale. **[15 Marks]**

QUESTION 6

The following diagram is a plot of $f(x,t) = 2\sin(x-t)$. Write MuPAD code that reproduces the diagram (the graphical object is uniformly coloured blue). **[15 Marks]**



QUESTION 7

Write LaTeX code to reproduce the text on Pages 22–24. Use the packages *"amsfonts" and "amsmath",* the pages must be 126mm wide, 180mm high and the top margin is 0.4cm. Please note that manual numbering/reference of/to equation, bibliography, page, section or any other item will not be accepted. **[30 Marks]**

A Stability results on the Orientation of Red Blood Cells in Large Arteries

J. M .W. Munganga

1 Introduction

Mathematical modeling of blood flow has become a useful tool in supplementing experimental data and hence enhance that understanding of the hemostatic system. A model that could predict the effect of magnetic fields on the orientation of red blood cells could be of great value to the study of clot formation, the effect of foreign objects like pace makers, electrodes and artificial heart valves in the body. Munganga and Al [1, 2, 3] studied the thermodynamic stability, existence, stability and uniqueness of solutions in the absence of body forces.
A closure approximation (linear and quadratic), is used to approximate the tensor $\mathcal{A}$ which features in equations (1), (2) and (5), by a function of the second order tensor $\mathbf{A}$.

2 Constitutive Equations for Particle Suspensions

In this section we construct constitutive equations for the orientation tensors as well as for the stress tensor.

2.1 The Constitutive equation for the orientation tensors

$$\frac{DA_{ij}}{Dt} + (W_{ij}A_{ik} - A_{jk}W_{kj}) - \lambda(D_{ik}A_{kj} + A_{ik}D_{kj} - 2\mathcal{A}_{ijkl}D_{kl}) - D_r(\delta_{ij} - nA_{ij}) = 0, \quad (1)$$

$(n = 2 \text{ or } 3)$

or

$$\frac{D\mathbf{A}}{Dt} + (\mathbf{AW} - \mathbf{WA}) - \lambda(\mathbf{AD} + \mathbf{DA} - 2\mathcal{A}\mathbf{D}) - D_r(\mathbf{I} - n\mathbf{A}) = 0, \quad (2)$$

Equation (1) and (2) are know as the "evolution equation" for the orientation tensor $\mathbf{A}$, [1, 2, 3].

2.2 Constitutive Equation for the Stress

The total stress $\mathbf{T}$ is a modification of the constitutive equation for incompressible Newtonian fluids, and is given by

$$\mathbf{T} = -p\mathbf{I} + 2\mu\mathbf{D} + \mathbf{E} \quad (3)$$

where p is the pressure, μ is the solvent viscosity, $\mathbf{D}$ is the deformation tensor. The extra stress $\mathbf{E}$ is found by solving for the stress field around a single massless particle.
Often the contribution of D_r to the stress is not significant, and this term is usually neglected. This will be the case henceforth. Thus, the stress will be expressed in the form;

$$\mathbf{T} = -p\mathbf{I} + 2\mu_I\mathbf{D} + \mathbf{S} \quad (4)$$

where

$$\mathbf{S} = 2\mu_I[N_p\mathcal{A}\mathbf{D} + \mathbf{N}_s(\mathbf{AD} + \mathbf{DA})] \quad (5)$$

and

$$\mu_I = \mu(1 + hH), \qquad N_p = \frac{hK}{1 + hH}, \qquad N_s = \frac{hB}{1 + hH}, \quad (6)$$

N_p and N_s are positive constants known as the particle and shear number respectively.

The linear approximation is exact for random distribution of particles, for which

$$\mathbf{A} = \begin{bmatrix} \frac{1}{3} & 0 & 0 \\ 0 & \frac{1}{3} & 0 \\ 0 & 0 & \frac{1}{3} \end{bmatrix} \quad \text{in } \mathbb{R}^3 \quad \text{or} \quad \mathbf{A} = \begin{bmatrix} \frac{1}{2} & 0 \\ 0 & \frac{1}{2} \end{bmatrix} \text{ in } \mathbb{R}^2. \tag{7}$$

3 Conclusion

In this article blood has been modelled on pages 1– 3, as a suspension with particles which represented a rouleaux formation of erythrocytes adhering side by side forming a cylindrical body. Normal human blood was regarded as semi-diluted suspension, in which rouleaux (thereafter referred to as particles) have a low probability of making contact, though the motion of the rouleaux and the fluid are coupled. We assumed that the number of the particles per unit volume is uniform though the orientation of particles may not be.

References

[1] Munganga J.M.W., Reddy B.D., Diatezwa K.J., Aspect of the thermodynamic stability of fibre suspension flows, *Journal of Non-Newtonian Fluid Mechanics*, **92** (2000) 135-150.

[2] Munganga J.M.W., Reddy B.D., Local and Global Existence of solution to Equations for flows of fibre suspensions, *Mathematical Models and Methods in Applied Sciences*, **Vol. 12, No 8** (2002) 1177-1203.

[3] Munganga J.M.W., Existence and Stability of Solutions to the Equations of Fibre Suspension Flows, Doctoral Thesis, University of Cape Town, Septembre 1999.

8.9 Assignments Semester 2/2018

ONLY FOR SEMESTER 2
ASSIGNMENT 01
CHAPTER 1 – CHAPTER 5 OF STUDY GUIDE
CLOSING DATE: 31 AUGUST 2018
Unique Number: 882933

PLEASE DO ONLY THE ASSIGNMENTS FOR THE SEMESTER YOU ARE REGISTERED FOR.
NOTES:

- The answer to the questions will be MuPAD and LaTeXcode and output. Thus, the assignment should be submitted in the form of a computer print out, either physically or electronically via myUnisa. Comments etc. can be made by editing the file before printing it. **All hand written assignments will not be marked and will result to zero mark awarded.**
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QUESTION 1

Assign the values $x_1 = 1, x_2 = 2, \ldots, x_{100} = 100$ to the identifiers $x_1, x_2, \ldots, x_{100}$. **[10 MARKS]**

QUESTION 2

Use a simple command to generate the double sum

$$\sum_{i=1}^{10} \sum_{j=1}^{i} \frac{1}{i+j}.$$

[10 MARKS]

QUESTION 3

The *Chebyshev polynomials* are defined recursively by the following formulae:

$$\begin{aligned} T_0(x) &= 1, \quad T_1(x) = x, \\ T_k(x) &= 2xT_{k-1}(x) - T_{k-2}(x) \text{ for } n \geq 2. \end{aligned}$$

a. Compute $T_2(x), \cdots, T_5(x)$. [5MARKS]

b. Compute the values of $T_2(x), \cdots T_5(x)$ for $x = 1/3$, $x = 0.33$. [5MARKS]

[10 MARKS]

QUESTION 4

A polynomial is called irreducible (over a coefficient field) if it cannot be factored into a product of more than one nonconstant polynomials. The function `"irreducible"` tests a polynomial for irreducibility. Find all irreducible quadratic polynomials $ax^2 + bx + c$, $a \neq 0$ over the field of integers modulo 3. **[10 MARKS]**

QUESTION 5

Predict the results of the following statement sequences explain your answer:

a. delete u1,v1,w1:

u1:=v1:v1:=w1:w1:=u1:u1: (5 MARKS)

b. delete u2,v2:

u2:=v2:u2:=u2^2-1:u2 (5 MARKS)

[10 MARKS]

QUESTION 6

The fibonacci numbers are defined by the recurrence $f_n = f_{n-1} + f_{n-1}$ with the initial values $f_0 = 0, f_1 = 1$. Use `solve` to find an explicit representation for f_n. **[10 MARKS]**

QUESTION 7

Use MuPAD to prove the following identities:

a. $$\frac{\sin^2 x - e^{2x}}{\sin^2 x + 2e^x \sin x + e^{2x}} = \frac{\sin x - e^x}{\sin x + e^x},$$ (5 MARKS)

b. $$\frac{sin(2x) - 5\sin x \cos x}{(1 + \tan^2 x)\sin x} = -\frac{9\cos x}{4} - \frac{3\cos(3x)}{4},$$ (5 MARKS)

c. $$\sqrt{14 + 3\sqrt{3 + 2\sqrt{5 - 12\sqrt{3 - 2\sqrt{2}}}}} = \sqrt{2} + 3.$$ (5 MARKS)

[15 MARKS]

QUESTION 8

Use MuPAD to show that

$$\lim_{x\to\infty} x^a = \begin{cases} \infty \text{ for } a > 0, \\ 1 \text{ for } a = 0, \\ 0 \text{ for } a < 0. \end{cases}$$

Hint: Use the function `assume` to distinguish the cases.

[10 MARKS]

QUESTION 9

Use MuPAD to determine the following indefinite integrals:

a. $\int \frac{xdx}{\sqrt{(2ax - x^2)^3}}$, (5 MARKS)

b. $\int \sqrt{t^2 - a^2}dx$, (5 MARKS)

c. $\int \frac{dx}{x\sqrt{1 + x^2}}$. (5 MARKS)

[15 MARKS]
TOTAL: [100 MARKS]

ONLY FOR SEMESTER 2
ASSIGNMENT 02
CHAPTER 5 – CHAPTER 7 OF STUDY GUIDE
CLOSING DATE: 1 OCTOBER 2018

Unique Number: 691739

PLEASE DO ONLY THE ASSIGNMENTS FOR THE SEMESTER YOU ARE REGISTERED FOR.

- The answer to the questions will be MuPAD and LaTeXcode and output. Thus, the assignment should be submitted in the form of a computer print out, either physically or electronically via myUnisa. Comments etc. can be made by editing the file before printing it. **All hand written assignments will not be marked and will result to zero mark awarded.**
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- In the exercises that involve plots, you are expected to use MuPAD the various options by means of MuPAD code, and not by using the *Vcam* edit menus.
- No mark will be awarded if you copy solution from past assignments and exam solutions or repeat proof of formulae already done in the Study Guide and Prescribed Book.

QUESTION 1

Write MuPAD code to produce a graph of two circles, radii 2 and 3, with the centre of the smaller circle at $(x = -2,\ y = 1)$ and the centre of the larger circle at $(x = 3,\ y = 1)$. The axes should be labelled appropriately, and there should be suitable titles for each circle, and for the scene. The colour of the smaller circle should be blue and that of the larger circle should be red. **[15 Marks]**

QUESTION 2

Plot the vectorfield $(1, \cos(2x))$ in the range $0 < x < 5$, $0 < y < 4$, and with the same scale on the x and y axes. Also plot, on the same axes, the curves $y = \sin(2x) + C$, for $C = 0, 1$ and 2.**[20 marks]**

QUESTION 3

Produce a plot demonstrating the behaviour of $y(x)$ in the range $x = 1$ to 50 when $y(x)$ satisfies the differential equation $x^2y''(x) + xy'(x) + x^2y(x) = 0$, with $y(1) = 1$ and $y'(1) = 0$. **[15 Marks]**

QUESTION 4

Plot the following on a $3-D$ graphs
•Sphere, centred at the origin and radius 2
•Surface $z = x - y + 1 + \frac{xy}{5}$.
•Cylindrical surface $(x-10)^2 + y^2 = 81,\ z$ any value
Estimate the points at which all three surfaces intersect, and then use this information as starting point in a numerical procedure to find accurately (to 10 significant figures) the coordinates of the points at which the surfaces intersect. **[20 Marks]**

QUESTION 5

Write LaTeX code to re–create the paper on pages 30–32).
Please take note that manual referencing and manual labelling of equations, pages and citations will not be allowed.

[30 MARKS]
TOTAL: 100 MARKS

Continuity Stability of flows of Suspended Particles

JMW MUNGANGA

Abstract

We investigate the long-time behavior of the fields ($\mathbf{u}$,ψ, $\mathbf{T}$) , by showing exponential convergence of the solution to a stationary solution. The entropy method is used to prove convergence for a constant velocity gradient.
Keywords:
Fiber suspension flows - entropy method - Long-time behavior.

1 Mathematical Modeling

1.1 Distribution function

We will investigate the long-time behavior of a suspension of short fibers immersed in a viscous incompressible Newtonian fluid. Particles are assumed to be axisymmetric, and uniform in length and diameter. The orientation of a particle can be described by a unit vector $\mathbf{p}$ directed along the fibre axis. With respect to spherical coordinates (θ, ϕ),

$$p_1 = \sin\theta\cos\phi, p_2 = \sin\theta\sin\phi, p_3 = \cos\theta,$$

where (p_1, p_2, p_3) are the cartesian components of $\mathbf{p}$. The choice of direction for $\mathbf{p}$ is arbitrary, since the "head" of the fibre is identical to its "tail". Therefore, any description of the orientation of the fibre must be unchanged if one substitutes

$$-\mathbf{p} \quad for \quad \mathbf{p} \tag{1}$$

or

$$\pi - \theta \quad for \quad \theta \text{ and } \quad \phi + \pi \quad for \quad \phi.$$

The orientation of fibers is described by a internal structure distribution function ψ, satisfying the following conservation equation [5]:

$$\frac{\partial\psi}{\partial t} + u_j\frac{\partial\psi}{\partial x_j} = \frac{\partial\left(\psi\dot{p}_j\right)}{\partial p_j} + D_r\frac{\partial^2\psi}{\partial x_j^2} + D\frac{\partial^2\psi}{\partial p_j^2}, \tag{2}$$

where $\mathbf{x}$ varies in a regular and bounded domain $\Omega \subset \mathbb{R}^n$, $n = 2$ or 3, and $\dot{p}$ is the angular velocity of the particle given by

$$\dot{p}_i = -W_{ij}p_j + \lambda D_{ij}p_j - \lambda D_{kl}p_k p_l p_i, \tag{3}$$

$\mathbf{D} = \frac{1}{2}\left(\nabla\mathbf{u} + (\nabla\mathbf{u})^T\right), \mathbf{W} = \frac{1}{2}\left(\nabla\mathbf{u} - (\nabla\mathbf{u})^T\right)$ are the deformation rate and the vorticity tensors respectively and $\psi = \psi(t, \mathbf{x}, \mathbf{p})$ is the distribution function

Substituting (3) into (2), we obtain the constitutive equations for the dimensionless equations [1, 2, 3, 4, 5, 6]:

$$\left(\frac{\partial\mathbf{u}}{\partial t} + (\mathbf{u}\cdot\nabla)\mathbf{u}\right) - \nabla_{\mathbf{x}}\cdot(\mu\nabla_{\mathbf{x}}\mathbf{u} + p\mathbf{I} + \mathbf{T}) = \mathbf{b}; \tag{4}$$

$$\partial_t\psi + \nabla_{\mathbf{x}}\psi\cdot\mathbf{u} - D_r\Delta_{\mathbf{p}}\psi - D\Delta_{\mathbf{x}}\psi + \mathrm{div}_{\mathbf{p}}\left(\left(\mathbf{W}\mathbf{p} + \lambda\mathbf{D}\mathbf{p} - \lambda(\mathbf{p}\cdot\mathbf{D}\mathbf{p})\mathbf{p}\right)\psi\right) = 0; \tag{5}$$

$$\lambda\int_{\mathbb{R}^d}\left(3\mathbf{p}\otimes\mathbf{p} - \mathbf{I}\right)\psi d\mathbf{p} = \mathbf{T} \tag{6}$$

$$\mathrm{div}\mathbf{u} = 0; \tag{7}$$

$$\mathbf{u}\cdot\mathbf{n}\int_{\mathbb{R}^d}\psi\ln\left(\frac{\psi}{\psi_\infty}\right)dp = 0, \forall\mathbf{x}\in\Gamma, \quad \text{where } \mathbf{n} \text{ is the outward normal to } \Omega; \tag{8}$$

$$\psi(t, \mathbf{x}, \cdot) \geq 0, \qquad \int_{\mathbb{R}^d}\psi(t, \mathbf{x}, \mathbf{p})\, d\mathbf{p} = 1; \tag{9}$$

$$\mathbf{u}|_\Gamma = 0, \qquad \psi(0, \mathbf{x}, \mathbf{p}) = \psi_0(\mathbf{x}, \mathbf{p}); \tag{10}$$

where ρ is the mass density, p is the pressure, $\mathbf{u} = \mathbf{u}(\mathbf{x},t)$ is the velocity, μ is the solvent viscosity, $\mathbf{I}$ is the identity tensor, D_r and D describe the Brownian effects: rotational and translational diffusion respectively, $\lambda = \frac{r^2-1}{r^2+1}$ is a parameter depending on particle aspect ratio, r being the particle aspect ratio. For the sphere $\lambda \longrightarrow 0$, and for the slender rod $\lambda \longrightarrow 1$.

Otto and Al [4] investigated the long-time behavoir of some mocro-macro models for polymeric fluid (Hookean models and FENE model), in various settings, using both probabilistic approach (coupling methods) and analytic approaches (entropy methods) for the system (4)–(10).

References

[1] Advani S.G and Tucker C.L, The use of tensors to describe and predict particle orientation in short fiber composites. *Journal of Rheology*, **31** (1987) 751-784.

[2] Advani S.G and Tucker C.L, Closure approximations for three-dimensional structure tensors, *Journal of Rheology*, **34 (3)**(1990) 367-386.

[3] Extra stress tensor in fiber suspenions: Mechanics and thermodynamics. *Journal of Rheology*

[4] Jourdain B., Le Bris C., Lelièvre T. and Otto F., Long-time asymptotics of a multiscale model for polymeric fluid flows, *Archive for Rational Mechanics and Analysis*, **Vol. 181**, Issue 1 (2006) 97-148.

[5] Lin J.Z., Sun K. and Zhang W., Orientation distribution of fibers and rheological property in fiber suspensions flowing in a turbulent boundary layer. *Acta Mech Sin,* **24,** (2008) 243-250.

[6] Otto F. and Tzavaras A.E., Continuity of Velocity Gradients in Suspensions of Rod-like Molecules, *Commun. Math. Phys* **277** (2008) 729–758

8.10 Other assessment methods

There are no other assessment methods for this module.

9 The EXAMINATIONS

For general information and requirements as far as assignments are concerned, see the brochure Unisa: *My studies @Unisa* which you received with your study material.

9.1 Examination admission, Examination period and Examination paper

The examination consists of one two–hour paper, and the procedure for gaining admission to this examination is as follows:

1. You are automatically admitted to the exam on the submission of Assignment 01 by a specific date, see Section 8.5. Please note that the lecturers are not responsible for exam admission, and ALL enquiries about exam admission should be directed by email to exams@unisa.ac.za.

   If you are registered for the first semester, you will write the examination in May/June 2018 and the supplementary examination will be written in October/November 2018. If you are registered for the second semester you will write the examination in October/November 2018 and the supplementary examination will be written in May/June 0.

   During the relevant semester, the Examination Section will provide you with information regarding the examination in general, examination venues, examination dates and examination times.

   The exam consists of a two hour paper.

2. The module will be assessed by means of: the two assignments, and a 2-hour written examination. The weighting of the two components will be: Assignments(semester mark): 20% and Examination: 80%

9.2 Moderation of Exam

The exam paper will be set and marked by the first examiner (your 2018 Lecturer), their names will be displayed on the exam paper.

9.3 Examination Period

Registered for ...	Examination period	Supplementary examination period
Semester 1	May/June 2018	October/November 2018
Semester 2	October/November 2018	May/June 2019

9.4 Previous examination papers

Previous examination papers are available to students on myUnisa. Please note that the papers are not posted by the lecturer and, **NO SOLUTION** is available to students. You will have to query with your lecturer, if you have difficulties answering the exam paper. I am not prepared to discuss in details and/or answer questions concerning past exam papers. I will help you to solve the questions of past exam papers, only if you ask the questions in the general context of the module. Questions such that, please send me the memorandum of May/June 2012 exam paper, or I do not know how to solve question 5 of October/November 2013 question paper, will not be entertained.

9.5 Book work for the examination

All sections .

10 FREQUENTLY ASKED QUESTIONS

The *Study @ Unisa* brochure contains an A–Z guide of the most relevant study information.

11 SOURCES CONSULTED

None

12 IN CLOSING

Remember, you are important to us and we are very willing and available to assist you with your course content related problems.

Our best wishes.
Your APM2616 lecturers.