FIJI INSTITUTE OF TECHNOLOGY

SCHOOL OF BUILDING AND CIVIL ENGINEERING

ADVANCED DIPLOMA IN CIVIL ENGINEERING

FIJI NATIONAL UNIVERSITY

SCHOOL OF BUILDING AND CIVIL ENGINEERING

1.0 PROGRAMME TITLE: Bachelor of Engineering (Civil)

2.0 SEGMENT TITLE: Advanced Diploma in Civil Engineering

3.0 INTRODUCTION:

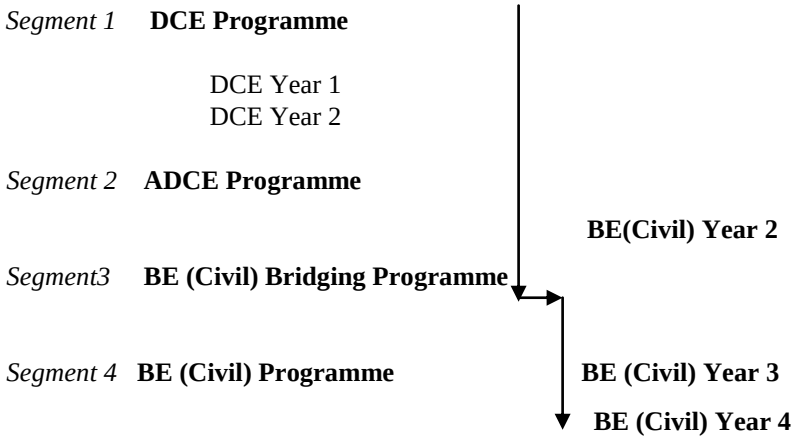
3.1. Background:

In 2010, the College of Engineering, Science and Technology (CEST) of the Fiji National University (FNU) offers a four-year degree programme leading to the award of a Bachelor of Engineering (Civil) degree.

The minimum entry requirement for the degree programme is a pass in the Fiji Form Seven.

Concurrent with the BE(Civil) degree programme at FNU are the Diploma in Civil Engineering programme(DCE) and the Advanced Diploma in Civil Engineering programme (ADCE). Minimum entry requirements for DCE programme is a pass in Fiji School Leaving Certificates (FSLC). DCE graduates are qualified to enrol in the ADCE programme, while ADCE graduates are qualify to enrol in Year 3 of the BE (Civil) programme, provided they complete a bridging course consisting of four units of the BE (Civil).

The three (3) programmes are hence directly related to each other as shown schematically in the diagram below.



3.2. Rationale

At present , students qualified to enrol in the BE(Civil) degree programme needed only four(4) years to complete a Civil Engineering Degree, while students enrolling in the DCE programme needed a minimum of continuous five(5) and one-half(1/2) years of study to become Civil Engineer. The **disparity** in number of years was because of the minimum entry requirements required for each programme. For DCE programme, FSLC is the minimum entry requirement, while for direct entry into BE (Civil) degree programme, Fiji Form Seven is the minimum entry requirement.

While it cannot be argued the Fiji Form Seven graduates are academically better than FSLC graduates, SBCE-CEST, however noted that the disparity of one and half year is not a reasonable disparity.

Also, upon review of the existing ADCE programme, there are some units which has the same course content as that of the DCE programme. The units are:

ADCE Units	Unit Description	Similar DCE Units	Unit Description	Remarks
ACE 601	Structural Mechanics 1			No similarity in DCE units
ACE602	Geomechanics	CIV 515	Soil Mechanics	Partial similarity between thetwo units. ACE 602 can be renamed as Advanced soil Mechanics and have additional topics
ACE603	Fluid Mechanics 1	CIV 412 & CIV 519	Hydraulics and FM 1 and 2	Course content are exactly similar. Can be replaced by BEC 607 of the Bridging programme
ACE 604/ MTH 603	Advanced Engineering Math 1	MTH 405 & MTH 504	Applied Math 1 & Engineering Math 2	Course content are exactly similar One Advanced Mathematics Unit are needed in ADCE.
ACE605 & ACE 6O1/	Structural Mechanics 1 & 2	CIV 520	Structural Design B	Partial similarity. Structural Mechanics 1 can be combined with Structural Mechanics 2 to form a single unit
ACE606	Environmental Engineering			No similarity in DCE units.
ACE 607	Design Challenge	CIV 521	Design Project	Can be replaced by BEC606– Curves,Earthworks & Hydrographic Survey
ACE608/ MTH 604	Advanced Engineering Math 2			Advanced Math 2 will remain as ADCE unit

Hence, SBCE- CEST is proposing to amend the course syllabus of the ADCE programme with the aim of including the four (4) units of the BE (Civil) degree bridging course in the ADCE course syllabus. This will in essence solve the similarities of some units in DCE and ADCE programmes and at the same time will have a reasonable disparity of number of years between the ADCE and BE (Civil) degree programmes for becoming a Civil Engineer.

3.3. Graduate Profile

The programme will prepare the student to meet the requirements for corporate membership as set down by the engineering institutions. At completion of the programme the student will be able to:

1. Carry out the duties of a graduate Civil Engineer either on site or in the design office.
2. Work constructively in a team to provide solutions to engineering problems.
3. Apply modern technological managerial and communication techniques in a Civil Engineering context
4. Through a system of electives offer a high level of expertise in his or her chosen specialisation.
5. Use engineering judgement to successfully carry out a scheme of works.

3.4. Philosophy

Throughout the programme the emphasis is on personal development, whether through project/investigative work or through more traditional teaching methods. Courses provide a mixture of theory to develop the intellectual skills of the student, with hands-on activities to develop the practical skills, which are vital to the practising Engineer. The programme provides three exit points:

1. Diploma in Civil Engineering,
2. Advanced Diploma in Civil Engineering,
3. Bachelor of Engineering (Civil).

These exit points are intended to correspond broadly to the three levels at which Engineers are engaged, viz.

1. Engineering Technician,
2. Engineering Technologist,
3. Professional Engineer.

3.5. Aims and Objectives

The Civil Engineering degree programme seeks to develop in the student the attitude and approach to problem solving which is the hallmark of a professional Civil Engineer. The aim is ultimately to prepare the student for corporate membership of an appropriate institution.

The Advanced Diploma Segment aims to provide a bridge to help students make the transition from diploma to degree level studies. This involves taking a more academic approach to the material and includes strengthening the student's knowledge base in key areas, particularly in Mathematics and Structural Mechanics. Beyond this, the Advanced Diploma emphasises the students need to take responsibility for his or her own studies. Thus, on completing Segment 2, the student should:

1. have a better grasp of the principles which underlie the material covered in the Diploma in Civil Engineering;
2. be able to apply basic engineering principles to find novel solutions to engineering problems;
3. demonstrate an integrated approach to the practical and theoretical aspects of engineering;
4. have the IT skills necessary to search modern resource centres and obtain information on any topic and;
5. be competent in the preparation of technical reports;

Specific aims and objectives are set out in each unit descriptor.

4.0 PROGRAMME STRUCTURE [Segment 2]

4.1. Award of Advanced Diploma

4.1.1. General Requirements

The Advanced Diploma in Civil Engineering is a unit-based segment of the BE (Civil) Degree programme. It is a full time, 120 credit segment held over two semesters. Entry to this segment is by selection based on performance in the programme up to the completion of the Diploma segment. Only holders of the FNU Diploma in Civil Engineering with an average grade of B, shall be eligible for the segment.

4.1.2. Proposed new Segment model of ADCE programme.

Unit Code	Unit Description	Semester	Credit points	Hours/Week	
				Contact	S/D
ACE 601	Advanced Engineering Maths	1	5	5	5
ACE 602	Advanced Soil Mechanics	1	5	5	5
ACE 603	Environmental Engineering	1	5	5	5
ACE 604	Structural Mechanics	1	5	5	5
ACE 605/ BEC503	Geology	2	5	5	5
ACE 606/ BEC605	Engineering Analysis	2	7	6	7
ACE 607/ BEC 606	Earthworks, Curves & Hydro Graphic survey	2	7	6	7
ACE 608/ BEC607	Hydraulics 2	2	8	8	8
			47	92	

4.2. Mode of Delivery

Normal Full Time Attendance.

The segment is intended to be delivered over a period of two semesters on the basis of full time attendance. Tuition will be by a mixture of class contact and self directed learning.. 47 credit points run continuously over the year.

4.3. Student Assessment

4.3.1. Methods of assessment

The primary type of summative assessment is by final examination. These will normally be of three hours duration with ten minutes reading time. Examination questions will be of a similar type and standard to those set for the same subject at USQ. Specimen papers are available. Assignments are computer concentrated in some units and are being adopted to develop the students' problem solving skills using computer software program. Assignments will also form the basis of the tutorial programme. Laboratory exercises will be assessed on the basis of a report of the work carried out and the conclusions drawn. As part of the exercise, students will be expected to conduct a literature search and review and may be required to relate the results obtained to the solution of a practical engineering problem. Slightly different arrangements apply to the Mathematics units.

4.3.2. Criteria for assessment

All units require that a student obtain a total mark of at least 50%. In units with a final examination the student must also obtain a stated minimum mark in the examination. Laboratory assignments must be completed to an acceptable standard. Attendance at laboratory sessions and completion of laboratory reports is compulsory.

4.4. Monitoring and Review

4.4.1. Board of Studies

A Board of Studies, constituted for the purpose, will carry out monitoring of the programme. In accordance with Section 10 of the GAS, this Board of Studies will comprise:

1. the Head of School of Building and Civil Engineering;
2. the Programme co-ordinator;
3. all staff involved in delivering the programme including staff from other schools/departments;
4. a student representative drawn from the body of students currently participating in the segment;
5. co-opted members when this is deemed necessary; and

The Board of Studies will meet at least once per semester.

4.4.2. Examination Board

In accordance with Section 11 of the GAS, an Examination Board will be constituted. This board will meet once per semester.

4.4.3. Moderation.

External moderation will be done by the School of Building and Engineering which will include:

1. checking of examination papers for both content and standard;
2. scrutiny of a sample of examination scripts;
3. review of feedback from students and content providers; and
4. monitoring provisions of resources and suggest improvements.

4.5. Teaching and Learning Methods

4.5.1. Introduction

A variety of teaching methods will be used to facilitate the achievement of the aims and objectives of the segment. The emphasis will be on developing independent learning skills through the use of resource material. It is therefore essential that students have access to appropriate materials, textbooks etc.

4.5.2. Teaching Strategies

Tuition will be by a mixture of formal lectures, laboratory sessions and the solution of open-ended problems in engineering design and construction. Classroom-based activities will emphasise active participation in the learning process. Students will be expected to supply reasoned arguments in support of their approaches to solving assignment problems. Students will also be encouraged to extend their knowledge base through directed study of externally available resource material.

4.5.3. Research

The need to develop a research capability is recognised, as it provides a firm basis for project work which may involve both students and staff.

APPENDIX A

1.0 ASSESSMENT INSTRUMENTS

The instruments used to assess students in the programme may include the following.

- The Moot — This requires the student to investigate some aspect of civil engineering and to make a formal and persuasive presentation in support of his/her conclusions.
- Lab Work — This may involve individual or group research and requires a formal presentation of findings.
- Examination — The requirement in examinations is that the candidate should demonstrate understanding and the ability to apply knowledge appropriately to provide solutions to engineering problems. In Segment 2 of the programme, the problems will require some ingenuity to obtain the solution.
- Assignments — Assignments will be given to students on a regular basis to test whether they are assimilating the material.
- Skill Tests — This instrument will be applied mostly to assess practical aspects of information technology competencies

APPENDIX B

ASSESSMENT POLICIES

1.0 ASSESSMENT BY EXAMINATION

Where assessment is by examination, the following shall apply:

1.1 Examination rooms will be notified on a notice board designated for the purpose.

1.2 Where the school receives notification in writing that a candidate for an examination has a special need, appropriate arrangements for sitting the examination (eg a sheltered environment) will be made available.

1.3 No candidate will be permitted to leave the examination room during the first 30 minutes or the last 15 minutes of the scheduled examination time.

1.4 No candidate will be admitted to the examination room after the first 30 minutes of the scheduled examination time.

1.5 No candidate will be re-admitted to the examination room unless, during their period of absence, they have been under continuous approved supervision.

1.6 A candidate must not make any alteration to his/her examination script after being informed by the chief invigilator that the examination time has expired.

1.7 A candidate who fails to sit an examination will be marked as having been absent for the examination.

1.8 During the examination, a candidate shall not obtain or try to obtain assistance with his or her work, nor give or try to give assistance to any other candidate.

1.9 Where special conditions apply to an examination, e.g. an "open book examination", the unit co-ordinator will specify what items may be taken into the examination and any conditions or restrictions on their use or appearance.

1.10 Where a unit co-ordinator specifies special instructions under Section 1.9, these will be communicated in writing to all candidates at least 2 weeks before the scheduled date of the examination.

1.11 It is the responsibility of each candidate to ensure that their examination number is written clearly on each page of their examination script and on any additional sheets which they submit for assessment.

1.12 It is the responsibility of each candidate to ensure that the numbers of the questions they have attempted are entered on the front of their answer scripts.

1.13 Every candidate attending the examination must hand in an answer script before leaving and candidates are not allowed to remove any answer script from the examination room.

2.0 ASSESSMENT BY ASSIGNMENT

Where assessment is by assignment, the following shall apply:

2.1 Work presented for assessment after any stated deadline will not be accepted except under exceptional circumstances and at the discretion of the marker.

2.2 Work presented for assessment shall be the candidate's own work.

2.3 Work submitted for assessment will be marked and returned to the student as soon as practicable. No responsibility will be taken for the return of work not collected within a reasonable period (being a period of not less than two weeks after the work is available for collection).

3.0 ASSESSMENT BY LABORATORY/PRACTICAL WORK

Where assessment is by laboratory/practical work, the following shall apply:

3.1 Laboratory or other Reports presented for assessment after any stated deadline will not be accepted except under exceptional circumstances and at the discretion of the marker.

3.2 Reports presented for assessment shall be the candidate's own work. However, where laboratory work is conducted in a laboratory group, results may be shared within the group. Results may be shared between groups only under the direction of the member of staff in charge.

3.3 Reports submitted for assessment will be marked and returned to the student as soon as practicable. No responsibility will be taken for the return of work not collected within a reasonable period (being a period of not less than two weeks after the work is available for collection).

3.4 Attendance at laboratory sessions is compulsory.

APPENDIX C

ADDITIONAL REGULATIONS

1.0 ADMISSION

1.1 Admission to the Advanced Diploma in Civil Engineering shall be at the discretion of the Board of Studies who shall have regard to these regulations. The normal requirement for entry to the Advanced Diploma segment will be a pass in all subjects with an average of grade B in the last three stages of segment 1 of the FNU Bachelor of Engineering (Civil) programme.

1.2 Notwithstanding C.1.1, the Board of Studies may, on the recommendation of the FNU Diploma in Civil Engineering Programme leader, vary the entry requirement where there is reason to believe that candidate has the background and relevant experience to be able to progress through the programme and to attain the standard required for the award of the Advanced Diploma.

2.0 PATHWAYS OF STUDY

2.1. Every candidate's pathway of study shall be approved by the Board of Studies.

2.2. Every pathway of study shall satisfy the requirements for pre-requisites and co-requisites set out for the unit**.**

2.3. Pre-requisite requirements may be waived by the Board of Studies.

2.4. There is no provision for obtaining the Advanced Diploma in Civil Engineering through part time study.

2.5. The Board of studies may, at its discretion, allow a student to attend one or more units of the Advanced Diploma as an associate student. Associated students will receive credit for passing a unit but such credit will not necessarily be counted towards the later award of an Advanced Diploma.

2.6. No candidate shall take a unit of study which is the same as, or substantially equivalent to, any other unit and obtain credit for both units in the programme.

3.0 TIME LIMIT FOR COMPLETION

3.1. The normal time limit for completion to the Advanced Diploma segment of the programme will be three calendar years from the date of commencement.

3.2. The Board of Studies may grant leave of absence to any candidate and such leave of absence will not be counted for the purpose of imposing the time limit.

3.3. Where a candidate fails to meet the requirements in C3.1 then on any subsequent enrolment, the Board of Studies may decline to approve the enrolment of the student.

3.4. Where a candidate fails an examination that candidates will normally be required to re-sit at the next regular examination (i.e. at the end of the following academic year). Special (re-sit) examinations will only be provided in proven cases of hardship. Such cases will be considered individually by the Board of Studies.

4.0 ATTENDANCE REQUIREMENT

4.1. There is no specified minimum attendance requirement attached to the units other than attendance at laboratory sessions. However, attendance will be monitored and may be taken into account by the examination board when considering either a case of marginal failure or a request for an award under the Aegrotat procedure.

4.2. Requirements for eligibility to sit the 'end of semester' examinations are as follows:

i) Evidence of having attended all scheduled laboratory classes during the semester.

ii) A mark of at least 50% for laboratory work including all required laboratory reports.

All candidates satisfying the above will be deemed eligible to sit for the segment 'end of semester' examinations. It should be noted that this requirement will be applied to the examinations as a whole. Eligibility to sit unit examinations will not be considered separately.

4.3. In a case of a marginal failure in laboratory work a candidate may be offered the opportunity to re-submit the work. In such cases the candidate will be permitted to sit the examinations. However, the examination mark will not stand to the candidate's credit unless and until laboratory work of a satisfactory standard has been submitted.

4.4. Rules 4.2 and 4.3 above will not apply to associate students.

APPENDIX D

UNIT DESCRIPTORS

Advanced Engineering Mathematics

ACE 601

ASSESSMENT :

Mid semestral examination	15%
Pre final examinations	15%
Assignments	20%
Final Examinations	50%

CREDIT POINTS: 5

PHILOSOPHY AND PURPOSE

This unit extends the concepts of mathematical modelling covered in Advanced Engineering Mathematics I.

Advanced Engineering Mathematics II provides:

- ♥ A review of the use and solution of first order differential equations;
- ♥ An introduction to second order differential equations including their application to unforced and forced oscillating systems;
- ♥ Practice in the use of MatLab's numerical procedures to solve ordinary differential equations ;
- ♥ Practice in solving initial value problems using Laplace Transforms;
- ♥ Tools for solving sets of linear equations and for finding eigenvalues and eigenvectors;
- ♥ An introduction to the calculus of vectors with applications
- ♥ An introduction to multivariate calculus (eg partial differential equations)
- ♥ An brief introduction to Fourier series and their application.

SYLLABUS/UNIT CONTENT

1.0 MODULE 1

♥ **Ordinary Differential Equations : Revision**

Text Mathematical Modelling I notes; Attenborough : Chapter 20;

Pre-requisites Advanced Engineering Mathematics I

1.1. Introduction

This module is the first of five on ordinary differential equations [ODEs]. In working through these five modules you should be developing skills in three areas:

- ❑ The ability to describe a physical problem by means of an ODE with appropriate boundary conditions;
- ❑ The ability to solve second order ODEs with constant coefficients;
- ❑ The ability to solve an ODE on a computer using MATLAB.

This module begins this development by revising material from Advanced Engineering Mathematics I dealing with the formulation and solution of first order ODEs. A new technique for solving linear, nonhomogeneous 1st order ODEs, called the integrating factor method, is also introduced.

1.2. Learning Objectives:

After you have studied this material, you should be able to:

- identify the order of an ODE and tell whether it is linear or non-linear, homogeneous or nonhomogeneous and understand the physical significance of these terms.
- distinguish between a particular solution and the general solution.
- apply initial conditions or boundary conditions to give a particular solution to an ODE.
- derive first order ODEs governing a number of simple physical problems [e.g. exponential decay problems].
- reduce [if possible] a first order ODE to *separable* form and then solve the equation in that form.
- solve any *linear* first order ODE.
- use the integrating factor method to solve linear, nonhomogeneous 1st order ODEs.
- plot any function of one variable using MATLAB.

1.3. Syllabus/Unit Content

Classification of ordinary differential equations and their solutions; Some useful physical interpretations of ODE's; Significance of initial and boundary conditions in obtaining particular solutions; Examples including exponential decay problems; Solution methods for linear first order differential equations;

Revise lecture notes on ODEs. The **Exercises** section which follows gives a set of exercise problems each of which you should be able to solve as part of this module. Some of these will be set as an assignment. There are also some formulation or modelling problems for you to practise on

2.0 MODULE 2

♥ **Ordinary Differential Equations : Unforced ODEs**

Text Jordan and Smith [2nd Ed.] : Chapter 18, Appendix 2.1 attached.

Prerequisites Module 1

2.1. Introduction

This module deals with a special class of differential equations: linear second-order unforced ODEs with constant coefficients. The equations are very common in engineering and arise in physical problems which involve an exchange of energy between two storage modes.

The two examples we shall be considering in detail are:

- mass-spring problems, where kinetic energy is exchanged with elastic energy.
- Inductive-capacitive circuits, where the electrical energy is exchanged between the field of an inductor and the plates of a capacitor.

One of the most important features of second-order ODEs is that they have two types of solution [corresponding to two types of physical behaviour] and in general an initial disturbance to the system represented by the ODE will initiate some of each of the two types of behaviour. In this module you will learn how to find the two different solutions and combine them together to match the given initial conditions.

2.2. Learning Objectives:

After you have studied this module, you should be able to:

- derive the linear second order equation governing the behaviour of some simple problems involving the exchange of energy between two storage modes in mass-spring systems and inductive-capacitive circuits.
- find the roots of the auxiliary or characteristic equation and write down the two solutions [basis of solutions] appropriate to the type of roots, i.e.:

    i) real distinct roots.
    ii) complex roots.
    iii) repeated real roots.

  for any homogeneous constant coefficient linear second order problem.
- combine the two solutions to form a general solution and use initial data to evaluate coefficients in the general solution.
- interpret the behaviour of a damped harmonic oscillator in terms of the type of solution obtained, and understand the difference between overdamped, underdamped, and critically damped spring-mass systems.

2.3. Syllabus/Unit Content

Modelling of common engineering systems using 2^{nd} order differential equations; Solution of 2^{nd} order differential equations. Determination of coefficients from initial values; Analysis of mass-spring systems;

2.4. Study Guide

Read Chapter 18 of Jordan & Smith and Appendix 2.1 which is taken from Section 2.5 of E. Kreyszig, Ádvanced Engineering Mathematics".

3.0 MODULE 3

♥ **Ordinary Differential Equations : Forced ODEs**

Text **Jordan and Smith [2nd ed.]: Chapters 19, 20. Attenborough, Chapter20.**

Prerequisites **Module 2**

3.1. Introduction

The study of linear constant coefficient equations continues in this module but with extensions to include non-homogeneous equations – here a right-hand-side term or "forcing function" is also included and a "particular solution" is added to the homogeneous solution ["complementary function"] studied in the previous module.

3.2. Learning Objectives

After you have studied this module, you should be able to:

- find the particular solution for right-hand-side terms of polynomial, exponential or trigonometric form by the method of undetermined coefficients.
- add the homogeneous equation solution to the particular solution and then apply the initial conditions in order to obtain the final solution to the problem.
- apply the method of undetermined coefficients in the case where the right-hand-side contains part of the homogeneous solution.
- compute the form of oscillations of a forced damped harmonic oscillator, and determine its resonant frequency.

3.3. Syllabus/Unit Content

Non-homogeneous 2nd order differential equations; Solution methods including use of the complimentary function; Method of undetermined coefficients; Substitution of boundary conditions; Application to damped harmonic oscillation;

3.4. Study Guide:

Read Chapters 19 and 20 of Jordan and Smith.

4.0 MODULE 4

♥ **Ordinary Differential Equations : Systems**

Text **Attenborough, Chapter 20, Section 20.2, Appendix 4.1**

Prerequisites **Module 3**

4.1. Introduction

ODEs of any order can be formulated as a system of simultaneous first-order ODEs.

For the special case of linear constant coefficient ODEs., the equivalent system of 1st order ODEs can be solved using clever analytical techniques [using matrices, and not treated until Year 3 of Engineering].

4.2. Learning Objectives

After you have studied this module, you should be able to:

- formulate any forced second-order constant coefficient ODE as a system of two first-order ODEs.
- write down one iteration of Euler's method for a system of two first-order ODEs.

4.3. Syllabus/Unit Content

Method of reduction of a 2nd order ODE to a pair of 1st order ODEs; Euler's method for solution simultaneous ODEs;

5.0 MODULE 5

♥ **Laplace Transforms**

Text: Attenborough, Chapter 21, Jordan and Smith [2nd ed.], Chapter 24.

Prerequisites **Modules 1-4**

5.1. Introduction

The key idea underlying Laplace Transforms is that the only functions which retain their form under differentiation and integration are exponentials. This means that when computing solutions for ODEs with constant coefficients and zero right-hand sides [i.e. the transient solution], it makes sense to look for exponential solutions. [These are the only functions which when differentiated a few times and combined together with the constant coefficients in the ODE give a result of zero.] The Laplace Transform is a clever [and mysterious] way of representing a function [and its derivatives and integrals] in terms of exponential functions. Solving ODEs is then reduced to carrying out algebraic manipulations to find the coefficients of the exponential functions present in the answer. In this context we are really carrying out another form of undetermined coefficients.

5.2. Learning Objectives:

After you have studied this module, you should be able:

- write down the definition of the Laplace transform, and derive the Laplace Transforms of elementary functions using the definition.
- use the linearity property to obtain transforms and inverse transforms of various functions.
- find the transforms of derivatives and integrals of functions and solve initial value problems represented by differential equations.
- use the shift theorems and unit step function to construct transforms and inverses of discontinuous and delayed functions.

- use the convolution theorem to invert more complicated transforms.
- use partial fractions to convert quotients of polynomials in a Laplace Transform to a sum of terms corresponding to transforms of elementary functions of those available in tables.

5.3. Syllabus/Unit Content

Introduction to Laplace transform concept with sample derivations; Obtaining the Laplace transforms of functions; Use of Laplace transforms to solve a range of initial value problems. Derivation and application of the shift, unit step and convolution theorems. Use of partial fractions;

5.4. Study Guide

Read Chapter 21 of Attenborough and Chapter 24 of Jordan and Smith.

You will find that, like most textbooks, these authors treat Laplace Transforms in much the same way, and it is difficult to find much in the way of motivation for the definitions and formulae. Nevertheless, you should get used to doing the algebraic manipulations necessary to solve an ODE using Laplace Transforms.

6.0 MODULE 6

♥ **Linear Algebra**

Text Attenborough Chapter 19, Jordan & Smith [2nd ed.] Chapter 8, 10, 13.

Prerequisites Mathematical Modelling 1

6.1. Introduction

In Mathematical Modelling 1 you learnt how to solve linear equations using Gaussian elimination. This module revises this material and looks at some related tools which are used to deal with linear equations. Chapter 19 of Attenborough gives a good summary of most of the material we shall cover.

6.2. Learning Objectives

After you have studied this module, you should be able to:

- solve by hand a set of linear equations in n unknowns, for n up to 5.
- compute the determinant of an *n* by *n* matrix, for *n* up to 4.
- determine the eigenvalues and eigenvectors of any 2 by 2 matrix.
- compute a matrix which rotates axes in 2 dimensions.
- express any quadratic form in terms of a symmetric matrix.
- given its equation find the principal directions of an ellipse.
- determine the definiteness of any quadratic form in 2 variables.

6.3. Syllabus/Unit Content

Solution of simultaneous linear equations by numerical techniques; Determinants; Eigen values and eigen vectors; Transformation matrices; Applications to analytical geometry; Definiteness of the quadratic form.

6.4. Study Guide

Review sections 19.1-19.5 of Attenborough, and Chapters 7 and 10 of Jordan and

Chapter 8 of Jordan and Smith, 2nd ed

Section 19.6 [determinants and inverses][of Attenborough.

Chapter 13 of Jordan and Smith, 2nd ed

7.0 MODULE 7

♥ **Series and Approximations**

Text **Attenborough Chapter 18, Jordan & Smith [2nd ed'] Ch' 5**

Prerequisites **None**

7.1. Introduction

Modelling engineering systems using mathematics involves the development of a set of equations and relationships which attempt to mirror the real system. These relationships may be based on the laws of science, or might be obtained by taking measurements and constructing formulae which fit the data. In both cases engineers are using an approximation. For example, Newton's laws of motion could be made more accurate by including the effects predicted by the theory of relativity, but these are typically so small that they are ignored. Deciding which small effects to ignore is a skill developed over years of practice.

In this module we shall look at a fundamental tool for approximation, called Taylor's series. This is an extension of the idea of a linear approximation to a function at a point [i.e. using the tangent at the point to represent the function] to higher order, so as to encompass quadratic, cubic, quartic, etc. approximations to a function at a given point.

7.2. Learning Objectives

After you have studied this module, you should be able to:

- determine a linear and a quadratic approximation to any function at a given point.
- derive the Taylor's series approximation for any function of one variable.
- write down the power series expansions for common functions such as e^x.
- determine the interval of validity for a power series.

7.3. Syllabus/Unit Content

Curve fitting using linear and quadratic approximations; Taylor's and power series approximations; goodness of fit; piecewise approximation;

7.4. Study Guide

Revise briefly sections 18.1-18.6 of Attenborough

Chapter 5 of Jordan and Smith, 2nd edition

8.0 MODULE 8

♥ **Curves, Tangents, and Line Integrals**

Texts Jordan & Smith [2nd ed.] Section 3.10, 32.1, 32.2, 32.3, 32.7 Appendix 8.1.

Prerequisites Mathematical Modelling 1

8.1. Introduction

This module covers the mathematical description of how vector quantities [such as fluid flow velocity or electric field strength] change on particular curves in space. It provides the mathematical tools for dealing with quantities in 2 and 3 dimensions such as velocity and work which you have already met in a 1-D context. Most of the ideas and techniques are illustrated by considering the simple problem of the motion of an object along a curved path in space but there are many other engineering applications.

8.2. Learning Objectives

After you have studied this module, you should be able to:

- calculate the derivative of a vector function of one variable.
- write down parametric formulae for 2-D and 3-D curves and calculate the tangent vector.
- given the position vector of an object, calculate its velocity vector and acceleration vector.
- calculate the length of a curve and other simple line integrals.
- understand the physical significance of line integrals such as work done in moving through a force field.

8.3. Syllabus/Unit Content

vector calculus in 2 and 3 dimensions; space curves; differentiation and integration of position vectors; Line integrals.

8.4. Study Guide

Read Section 3.10 of Jordan and Smith, 2nd edition and Appendix 8.1

The above is taken from Section 8.5 and 8.6 of E. Kreyszig, "Advanced Engineering Mathematics"

Sections 32.1-32.3, 32.7 of Jordan and Smith, 2nd edition.

9.0 MODULE 9

♥ **Multivariate Calculus and Related Topics**

Text **Jordan and Smith : Chapters 25, 26, 27 and 29. Appendix 9.1**

Prerequisites **Module 8**

9.1. Introduction

In many engineering problems you will be concerned with how various quantities change in both space and time [e.g. tidal currents in a harbour, signal strength in a cell-phone network, stresses in an earth dam]. This module develops the basic mathematical tools for dealing with quantities which depend on more than one variable. In the module functions of only two variables are considered but all the ideas can be extended to functions of any number of variables [although sketching pictures is difficult.]

9.2. Learning Objectives

After you have studied this module, you should be able to:

- sketch the surface shapes and contour maps for simple 2-D functions.
- work out the first and second partial derivative of simple 2-D functions.
- calculate the tangent plane to a surface.
- calculate the gradient vector, and directional derivatives for functions of two variables.
- understand how to calculate Taylor series approximations of functions of two variables.
- calculate and classify stationary points of functions of two variables.
- understand the concept of a vector field and be able to calculate the divergence of a 2-D vector field.
- demonstrate an understanding of the geometric interpretation of a double integral.
- calculate simple double integrals.
- change the order of integration in a double integral.

9.3. Syllabus/Unit Content

Surface mapping of function with two independent variables; partial differentiation; tangent planes; Gradient s; Taylor's series; peaks, troughs and saddles; 2-D vector fields including divergence; Double integration;

9.4. Study Guide

Read Chapters 25, 26, 27 and 29 of Jordan and Smith.

The following sections may not be covered and can be regarded as optional extras for the enthusiast: 25.7, 25.8, 27.2. The divergence of a vector field is not covered in the textbook. Brief notes on the topic are included as Appendix 9.1 [which is taken from Section 8.10 of E. Kreyszig, *'Advanced Engineering Mathematics"*].

10.0 MODULE 10

♥ **Fourier Series**

Text **Attenborough Chapter 22, Jordan & Smith Chapter 24.**

Prerequisites **Ordinary Differential Equations Modules**

10.1. Introduction

Fourier Analysis is a powerful tool for studying periodic behaviour in engineering problems, as well as being used to solve linear differential equations with discontinuous forcing functions. The importance of Fourier analysis arises from the fact that sine and cosine forcing functions for a constant coefficient ordinary differential equation give responses which are also sines and cosines, with a possible change in amplitude and phase [recall the ODE Modules]. Thus, if we can express a forcing function as a combination of sines and cosines [called a Fourier series] then we can obtain the response of each of these components and combine the responses to give the overall response to the original forcing function.

This technique is very useful in studying vibration problems. For example, we might have designed a system [such as a bike suspension] with a known resonant frequency. For any periodic forcing function [e.g. a set of bumps which are not sines or cosines] we can compute its Fourier Series and see to what extent oscillations at this frequency [or close frequencies] are present in the forcing function. This gives an indication of the amplitude of the response without having to solve any ODEs.

10.2. Learning Objectives:

After you have studied this module, you should be able to:

- determine the period of a given function.
- write down the general form of the Fourier series representing a periodic function and use the Euler formulae to determine the coefficients.
- determine whether a given function is even or odd, and if it is also periodic, write down the Fourier cosine or sine series [as appropriate] for the function and determine the coefficients.
- make a periodic extension of a function defined only on some finite interval, and represent the extension by a half-range Fourier series.

10.3. Syllabus/Unit Content

Introduction to Fourier series; period of a function; Euler's method for obtaining the coefficients of a Fourier series approximation; ½ range Fourier series.

10.4. Study Guide

Read Chapter 24 of Jordan and Smith,

The formulae [24.9] at the top of page 414 are called the *Euler Formulae* for the Fourier coefficients.

Prescribed Texts

Mathematical Modelling 1 Course Notes by S Laird, Department of Engineering Science, [will be available for purchase from the School of BCE Office].

Formulae and Tables [2nd Edition], Department of Engineering Science, [will be available for purchase from the School of BCE Office].

Recommended Texts

Engineering Mathematics Exposed by Mary Attenborough, McGraw Hill.

Mathematical Techniuques. An introduction for the engineering, physical and mathematical sciences. 2ND Edition by D W Jordan and P Smith, Oxford University Press.

ADVANCED SOIL MECHANICS

ACE602

LABORATORY

Three 2-hour laboratory sessions are held. These are intended as a practical way of assisting students to understand the subject, and are an integral part of the unit. Examination questions may include materials covered in laboratory sessions.

ASSESSMENT

Mid-semester test		10%
Assessments		10%
Project		20%
Examinationxam	[2 hours]	60%

CREDIT POINTS: 5

PHILOSOPHY AND PURPOSE

To introduce students to:

The basic concepts and principles governing the mechanical behaviour of soil, and how these are used in engineering applications. Central to these concepts is the *Two phase* or *Three phase* nature of soil and the *Principle of Effective Stress*, as well as the associated concepts of *Drained and Undrained behaviour*. Considerable time is devoted to explaining these concepts and their engineering relevance.

SYLLABUS/UNIT CONTENT

♥ **The Principle of Effective Stress**

The concept of total stress: Pore water pressure, effective stress and the implications for soil behaviour: Vertical and horizontal stresses in the ground, the K_o concept: Behaviour of soils in the Undrained and drained state: The undrained shear strength of soils and its relevance to engineering practice: Effective stress and compressibility: definition of m_n parameter: Examples.

♥ **Hydraulic Properties of Soils**

Permeability and seepage: One-dimensional flow, hydraulic gradient, Darcy's law: two dimensional flow, the Laplace equation and flow nets including sketching: and quantitative analysis: confined and unconfined flow problems: seepage through embankments: filter criteria, critical hydraulic gradient, uplift pressure on weirs.

- **Shear Strength of Soils**

  General shear strength expression in terms of c' and ϕ', Undrained shear strength; shear box and Triaxial tests including undrained, consolidated undrained and drained tests: Application of Mohr's circle use of total stress(undrained) and effective stress (drained) analysis.

- **Consolidation behaviour and settlement of foundations**

  Basic concepts of soil compressibility m_v: normal and over consolidation: application of C_c and C_s to sedimentary and residual soils: Terzaghi's theory of consolidation: Estimating settlement magnitude and rate:

- **Geotechnical Stability Analysis:**

  Introduction to types of slope stability analysis of roadway embankment : effect of water pressure on the failure surface and of inertia loading due to seismic activity.

- **Bearing capacity of shallow foundations**

  Bearing capacity of shallow foundations;Ultimate bearing capacity,Allowable bearing capacity.Terzaghi bearing capacity Theory;Meyerhoffs bearing capacity Theory.

- **L:ateral Earth Pressure Theory**

  Rankine's Theory of earth pressure for sand,saturated ubdrained clay and drained clay

- **Laboratory Course**

  undrained Triaxial test on a clay soil: drained Triaxial test on sand.

- **Laboratory Sessions**

  Students will be assigned to groups and given a schedule of laboratory times for each group.

LABORATORY/PRACTICAL

The unit Practical work provides an opportunity for students to apply the principles and concepts being taught to an actual engineering situation. This counts for 20% of the overall marks. The complete the set tasks the student requires an understanding of seepage behaviour the principle of effective stress, soil compressibility The task also requires the exercise of engineering judgement.

RECOMMENDED TEXTS

The following texts are recommended:

CRAIG RF. Soil Mechanics. Van Nostrand Reinhold.

WILUN Z and STARZEWSKI. Soil Mechanics in Foundation Engineering Vols 1 & 2.

Principles of foundation engineering by Braja M. Das,5th Edition

ENVIRONMENTAL ENGINEERING
ACE603

ASSESSMENT

Assignments	20%
Mid-semester test.	15%
Pre Final Test	15%
Final Examination	50%

CREDIT POINTS: 5

PHILOSOPHY AND PURPOSE

- To introduce the student to
  - the concept of environmental engineering stressing the interdisciplinary nature of this discipline.
  - Parameters used to characterise the quality of wastewater, raw water and treated water.
  - the basic unit operations and the processes of water and wastewater treatment.
  - Techniques used in the handling and disposal of Solid waste.
  - Techniques used in handling Hazardous waste.
  - The identification and handling of environmental risk.

LEARNING OUTCOMES/OBJECTIVES

The student should be able to:

- list the main types of water source and characteristics which are considered when testing a water sample.
- discuss the quality of a sample having given characteristics and suggest suitable options for treating the sampled water.
- describe the unit operations used in a typical raw water treatment plant.
- use the operational principles to design the components of a typical raw water treatment facility.
- discuss wastewater quality and its effect on human health.
- describe the unit operations used in a typical wastewater treatment plant.
- use the operational principles to design the components of a typical wastewater treatment facility.
- use appropriate terminology as used in water and wastewater treatment.
- enunciate the principles of land fill design.
- define hazardous waste.
- explain aspects of the treatment of hazardous waste.
- discuss the importance of risk assessment in environmental, systems design.

SYLLABUS/UNIT CONTENT

- **Water Supply and Treatment**
  - Sources
  - Treatment Options
- **Wastewater Treatment**
  - Water quality – public health, environment
- **Solid Wastes – Residual Management**
  - Most treatment processes generate solids
  - Municipal/domestic waste – protection of human health and the environment
- **Hazardous Wastes**
  - Protection of public health [risk management]
  - Protection of water supplies
  - Safe management of hazards/minimising risk.

In treating these aspects it is intended that the students will:

- develop a working knowledge of the relevant vocabulary;
- be able to identify the nature of the environmental problems;
- be able to select an appropriate treatment method;
- be able to develop a preliminary design;
- understand the role of risk assessment in environmental engineering.

LABORATORY/PRACTICAL/FIELD STUDY

Two laboratory sessions will be held.. The first laboratory session will be on determination of the dissolved, volatile and non-volatile fractions of a water sample. The second laboratory session will be on evaluating the performance of a bench-scale activated sludge unit.

As part of the unit, students will be expected to actively participate in site visits to both a water treatment plant and a wastewater treatment plant .

RECOMMENDED TEXTS

DAVIS, M.,., CORNWELL, D.A. 'Introduction to Environmental Engineering.' 3rd Edition, 1998.

OTHER REFERENCES

HENRY, JG, HEINKE, GW., 'Environmental Science and Engineering.' 2nd Edition, 1995

KIELY, G. 'Environmental Engineering.' 1997

MASTERS, G. 'Introduction to Environmental Engineering and Science.' 1991.

VESLIND, A. 'Introduction to Environmental Engineering.' 1997.

WANIELISTA, MP., OUSEF, YA., TAYLOR, JS., COOPER, CD. 'Engineering and the Environment.' 1984.

STRUCTURAL MECHANICS

ACE 604

ASSESSMENT

Assignments	20%
Mid Semestral & Pre Final Test	30%
Final Examination	50%

CREDIT POINTS: 5

PHILOSOPHY AND PURPOSE

This unit aims to strengthen the student's knowledge base in this core subject for Civil Engineering students. The unit reviews the basic concepts. Principles of equilibrium and elasticity are revisited. The techniques of structural analysis that are developed are an essential tool in the design process and their use is demonstrated in the design of some simple structural components.

SYLLABUS/UNIT CONTENT

- **Equilibrium**

  Revision of concept of the free body diagram, Determination of axial force, shear force, bending moment and torque: Extensions of the use of free body diagrams to include analyse of; arches, gravity dams, retaining walls, suspended cables and simple suspension bridges.

- **Beam Theory**

  Analysis of statically Indeterminate Beams and Frames using Matrix. Analysis of composite beams.

- **Elasticity**

  Stress and strain relationships in one, two and three dimensions, Principal values, Mohr's circle, failure theories and simple material models.

- **Torsion**

  Torsion of members with thin walled open and closed sections and selected sections of other shapes: The membrane analogy.

- **Load Resistance Factor Method (Plastic Design Analysis)**

  Bending beyond the elastic limit: fully plastic moment of steel sections: Yield and mechanism conditions: Calculation of plastic collapse loads of simple beams and frames: Plastic limit theorems: Design of Hot Rolled structural steel Universal Beam.

- **Introduction to analysis of stresses on Prestress beams**

  The determination of the required jacking force of prestress beams in two prestress beam stages, immediately after transfer and when the prestress is at full service.

RECOMMENDED TEXT

MEGSON, T.H.G. 'Structural and stress analysis', Arnold, 1996

GERE, J.M. and TIMOSHENKO, S.P. "Mechanics of Materials 3rd or 4th Ed., PWS, 1997

GEOLOGY
ACE605/BEC503

PROGRAMME	Advanced Diploma in Civil Engineering
SUBJECT	Geology
CODE	ACE605/BEC503
Year 1	Semester 2
HOURS PER WEEK	Lecture -4Hrs ; Tutorial – 1 hour Self Directed Learning Hours- 5 hours
CREDIT POINTS	5
ASSESSMENT	*Coursework* Assignments 20% Tests 30 % Final examination (3hrs) 50%

1.1 AIMS

The aim of this unit is to extend the students knowledge of the origin, composition, structure, & history of Earth. Also, to develop an appreciation of the importance of geology to civil engineering particularly with regards to the sensitive development of natural earth resources, and the need to take account of ecological & environment protection matters.

1.2 SYLLABUS

1.2.1 Introduction

An overview of the scope of Geological science: The place of geology within the family of sciences: Some applications of geology. Geology in relation to our history: The study of ancient life forms: Geological study of the earth's resources.

1.2.2 Minerals and Rocks

Discussion of minerals and mineralogy. Classification of minerals, their general characteristic etc, origin of minerals and rocks, ore minerals, uses of minerals. Mineralogy of Fiji including an introduction to Fiji's mineral wealth.

1.2.3 Petrology - The study of Rocks

Classification of rocks as igneous rocks, sedimentary or metamorphic: –Description, origin and occurrence of igneous rocks, Description of rock melts and the rock that form from them: Study of the processes that lead to the formation of sedimentary rocks, classification of sedimentary rocks including a discussion of the sediment type: Study of the processes of metamorphism, classification of metamorphic rocks including the basic types: Classification of rock types by consideration of their chemistry: Other aspects of geochemistry.

1.2.4 Geomorphology - The study of land forming processes

Discussion of geomorphologic processes including the actions of water, wind and ice: Visible signs indicating that a particular formation is the result of such actions: typical examples of geomorphologic action

1.2.5 Volcanology - The study of volcanoes and other volcanic activity

Discussion of the origin and occurrence of volcanoes: Classification of volcanoes: Volcanic actions including intrusion and its effects: origin of magma; magma as source of geothermal energy. Three primary ways of using geothermal energy.

1.2.6 Hydrogeology - The study of underground waters

Discussion of the occurrence of water in the rocks: Study of groundwater including its movement: Description of an aquifer: Exploitation of underground water through exploration and development.

1.2.7 Glaciology - The study of glaciers and their effects on landscape

Discussion of Glaciers, their formation and subsequent motion, Study of the effects of glacial action on the landscape: Effects of glaciations on the engineering properties of a formation

1.2.8 Structural Geology and Plate Tectonics

Introduction to tectonics including folding of the landscape, Naming of fold types, e.g. Monocline, Anticline and syncline: Occurrence of faults, normal faults, reverse faults, transform faults, etc: Joints and Dips: The use of Stereo-nets. Study of the science of plate tectonics: Locations and origins of plate boundaries: Boundary classification as either divergent, convergent or transform: Study of the tectonic history of Fiji.

1.2.9 Applied Geology

Geology in the service of man: Review of valuable geological resources including the hydrocarbons, coal, oil and natural gas; minerals and ores including Gold, silver, etc, Mineral Waters such as Fiji water,

1.2.10 Engineering Geology

Application of geological knowledge to the design of foundation works for large structures including dams, bridges, large buildings etc. Considerations of Geological events and the risks posed to structural integrity, Geological risk analysis, precautions etc: Discussion of the role of seismology (the study of earthquakes) in the design of earthquake resistant buildings.

1.2.11 Marine Geology

Study and classification of under sea rocks and rock formations, discussion of under sea geological processes e.g. turbidity currents, land slides etc including their associated risks:

1.2.12 Geophysics

Introduction to the study of the physics of the earth: Discussion of geophysical techniques for investigating the earth’s crust both locally and at planet scale.

1.2 Recommended Textbooks

Geology 3rd Edition by Richard M. Pearl
Catalogue Card No. 66-26803

Alison, I.S. and Patter, D.F., *Geology, the science of the Changing Earth,*
McGraw-Hill inc, New York.

Ministry of Resource Development of Fiji Information Notes,
Fiji Government, Suva, Fiji. ISSN 1016-2135.

Geology , An introduction to principles of physical and Historical geology (Third Edition) by Richard M. Pearl, Barnes and Noble ,Inc,New York

ENGINEERING ANALYSIS

ACE 606/BEC605

PROGRAMME	Advanced Diploma in Civil Engineering	
SUBJECT	Engineering Analysis	
CODE	ACE606/BEC605	
Year 2	Semester 2	
HOURS PER WEEK	Lecture -4Hrs ; Tutorial – 2 hours; Self Directed Learning Hours- 7 hours	
CREDIT POINTS	7	
ASSESSMENT	*Coursework*	
	Computer Exercises	20%
	Tests	30%
	Examination	
	Final Examination (2 Hrs)	50%

1.1AIMS

To provide the students with MATLAB knowledge and create awareness that Mathlab can be a powerful computing tool to solve many engineering problems.

1.2SYLLABUS

1.2.1 MATLAB Windows

Using the MATLAB command window. Using MATLAB for arithmetic operations. Appropriate Use of control formats for display. Taking advantage of elementary Math built-in-functions in programming. Defining scalar variables. Learning commands for managing variables. MATLAB applications and problem solving

1.2.2 Creating Arrays

Creating one (vector) and two (matrix) dimensional arrays. The zeros, ones and eye commands. Variables in MATLAB. Creating transpose vectors. Array Addressing: using a colon in addressing vectors and matrices. Adding Elements to existing variables. Deleting elements and using built-in functions for handling arrays.

1.2.3 Mathematical operations with Arrays

Array addition and subtraction. Array multiplication and division. Element-by-element operation. Using arrays in MATLAB built-in-math function. Built-in functions for analysing arrays. Generation of random numbers.

Examples of MATLAB applications.

1.2.4 Script File

Creating and saving a script file. Running a script file. Using current directory and search path. Declaration of Global variables. Input and output to a script file. The display and print command. Exporting and importing data. Use of commands and wizard for exporting and importing data. Examples of MATLAB applications.

1.2.5 Two- Dimensional Plots

The plot command: plot of given data. Using the hold on and off and the line command. Formatting a plot using commands such as the plot editor. Plots with logarithmic axes. Plots with special graphics. Graphs and polar plots. Plotting multiple plots on the same page. Examples of MATLAB applications.

1.2.6 Functions Files

Creating a function file. Structure of a function file and function definition line. Input and output arguments. Proper use of H1line and help text lines. Body of a function with coding. Local and global variables. Saving a function file. Using a function file. Example of simple function file. Comparison between script file and function files. Inline function and the feval command. Examples of MATLAB applications.

1.2.7 Programming in MATLAB

Relational and logical operators. Conditional statements: the if- end structure: the if- else- end structure: the if-else-end structure. The switch- case statement. Loops: for-end loops: while-end loops. Nested loops and nested conditional statements. The break and continue commands. Examples of MATLAB applications.

1.2.8 Polynomials, Curves Fitting, and Interpolation

Polynomials: value of a polynomial: roots of a polynomial: addition, multiplication, and division of polynomials: derivatives of polynomials. Curve Fitting: curve fitting with polynomials, the polyfit function: curve fitting with functions other than polynomials. Interpolation and the basic fitting interface. Examples of MATLAB applications.

1.2.9 Three- Dimensional Plots

Line plot. Mesh and surface plots. Plots with special graphics. The view command. Examples of MATLAB applications.

1.2.10 Applications in Numerical Analysis

Solving an equation with one variance. Finding a minimum or a maximum of a function. Numerical Integration. Ordinary differential equations. The trapz and quadl commands. Examples of MATLAB applications.

1.2.11 Symbolic Math

Symbolic objects and symbolic expressions: creating symbolic objects: creating symbolic expressions: the findsym command and the default symbolic variable. Changing the form of an existing symbolic expression: the collect, expand and factor commands: the simplify and simple commands: the pretty command. Solving algebraic equations. Differentiation and integration of difficult expressions. Solving an ordinary differential equation (ODE) using Euler's method. Plotting symbolic expressions. Numerical calculations with symbolic expressions. Examples of MATLAB applications.

1.3 Recommended Text Book

Gilat , Amos. "*MATLAB: An Introduction with Applications*, John Wiley, New York.

EARTHWORKS, CURVES & HYDROGRAPHIC SURVEY

ACE607/BEC606

PROGRAMME	Advanced Diploma in Civil Engineering	
SUBJECT	Earthworks , Curves & Hydrographic Survey	
CODE	ACE607/BEC606	
Year 2	Semester 2	
HOURS PER WEEK	Lecture -4Hrs ; Tutorial – 1 hour; Laboratory - 3 hours ; Self Directed Learning Hours- 6hours	
CREDIT POINTS	3 hours	
ASSESSMENT	*Coursework*	
	Practical work	30%
	Assignments and tests	20%
	Examination	
	Final examination (3hrs)	50%

1.1 AIMS

To introduce to the students the basic principle and analysis of earthworks, roadway curves and the basic principle of hydrographic surveying in order to increase the students' depth of knowledge in the field of engineering surveying. After reviewing the basic surveying procedures the student will be exposed to more advanced topics involving both practice and calculation which are of particular relevance to Civil Engineering.

1.2 SYLLABUS

1.2.1 Review of Surveying Procedures

Procedure for leveling including recording of field data: Procedure for Measuring both horizontal and vertical angles using the theodolite; reasons for traversing and transiting, reiterating and repeating. Review of instrument checks for accuracy and serviceability, Review of instrument errors and how to correct them.

1.2.2 Horizontal Alignment of Roadway

Discussion of the determination of the geometric properties of plain horizontal curves, compound curves, and reversed curves. To layout in the field the horizontal curves by method of deflection angles.

1.2.3 Vertical Alignment of Roadway

Discussion of the determination of the geometric properties of symmetrical and unsymmetrical vertical parabolic curves. To layout in the field the horizontal curves by offset from tangents.

1.2.4 Spiral Easement Curves

Discussion of the determination of the geometric properties of spiral easement curves. The purpose of spiral easement curves in design of geometric horizontal alignment of roadway. The basic principles of super elevation in treatment of the spiral easement curvbes.

1.2.5 Basic principle of hydrographic surveying

The purpose of Hydrographic survey are to determine shore lines of harbors, lakes and rivers from which to draw an outline map of the body of the water; to obtain data, in case of rivers, related to studies of flood control, power development, water supply and storage. In brief, the principal object of all hydrographic surveying is to secure information concerning the water areas and the adjacent coast for the preparation and compilation of nautical charts and coast pilots also known as sailing directions..

1.2.6 Measurement of Discharge of a River by Slope Area Method

Three basic factors that are to be determined in measuring the discharge of the river by using the slope area method, they are determining the area of a longitudinal reach of channel of known or measured length; the slope of water surface or slope of the energy gradient in the same reach of channel; the character of the stream bed for determining the suitable roughness factor or coefficient of roughness "n".

1.2.7 Measurement of Discharge of a River by Price Current Meter or by Floats

The basic factors that are to be determined in measuring the discharge of the river by using the slope area method are; the kind of support in crossing the stream, by wading; by cableway; by bridge or by boat; measurement of depth; measurement of velocity either by the vertical velocity curve method, two-point method, sixth tenths depth method, two tenths depth method.

1.2.8 Earthwork and Mass Diagram

Definition of terms: haul, overhaul; Free haul distance; length of overhaul, limit of economical haul, plotting of mass diagrams and the importance of mass diagram in roadway construction.

1.3 Field Exercises

Layout and determination of

i) A horizontal curve

ii) A vertical curve

iii) Measuring discharge of a river by slope area method or by Velocity - area method using current meter.

1.4 Recommended Textbooks

Irvine, William (1980). *Surveying for Construction* (*4th Edition*), McGraw-Hill, ASIN 0070846359.

The Town and Country Planning Standards, Fiji Government Pubs', Suva.

The Public Works Department Subdivision Standards, Fiji Government Pubs', Suva.

HYDRAULICS 2

ACE608/BEC607

PROGRAMME	Advanced Diploma in Civil Engineering
SUBJECT	Hydraulics 2
CODE	ACE608/BEC607
Year 2	Semester 2
HOURS PER WEEK	Lecture -4Hrs ; Tutorial – 2 hours; Computer programming exercises -3 hours ;Self Directed Learning Hours- 8hours
CREDIT POINTS	8
ASSESSMENT	*Coursework* Computer program exercises 25% Tests 25% *Examination* Final examination (3hrs) 50%

1.1 AIMS

To enhance the students understanding of fluid behavior in unsteady flow of incompressible fluids: To extend the students ability to apply the fundamental principles to engineering problems.

1.2 SYLLABUS

1.2.1 Review of Steady Flow in Open Channel Flow

Flow with free surface, flow classification, natural and artificial channel and their properties, laminar and turbulent flow, rapidly varied flow, critical depth meters and gradually varied flow.

1.2.2 Unsteady Flow in Open channel

Propagation of solitary wave, surges in open channels, positive surge waves, negative surge waves, Dam break; gradually varied flow, gradually varied unsteady flow

1.2.3 Uniform Flow in Loose Boundary Channel

Sediment Transport, Bed load transport, suspended load transport, Design of erodible channel(trapezoidal channel using shear force method), Design of best economic section of trapezoidal channel.

1.2.4 Pipe Network Analysis using Matrices

Turbulent flow, empirical equations, the Hardy Cross method, quantity balance method, the linear theory method of pipeline network analysis.

1.2.5 Pump/Pipeline Systems

Pump affinity laws, pipeline pump system curve, pipeline –pump system analysis based on suction considerations.

1.2.6 Unsteady Flow in Pipeline

The principle of transient pressure/surge pressure in an incompressible fluid in a pipeline/valve system; Variation of flow in Surge Tank; unsteady compressible flow in a rigid pipeline; unsteady compressible flow in an elastic pipeline.

1.2.8 Hydraulic Structures

Descriptive treatment of Dams: Spillways, Stilling basins, Gates, Weirs, Headworks. Hydraulic analysis of pipe culvert, venturi flume and weirs

1.3 Computer Program exercises

a. Computer program (using any programming language or spreadsheet) for an explicit numerical solution of a kinematic wave equations

b. Computer program (using any programming language or spreadsheet) for the preparation of a tailwater rating curve of a vertical sluicegate

c. . Computer program (using any programming language or spreadsheet) for a numerical solution of pipeline network analysis by linearization method

d. . Computer program (using any programming language or spreadsheet) for a numerical solution of variation of water level in a surge tank chamber

1.4 Recommended Textbooks

Douglas, Gasiorek and Swaffield. *Fluid Mechanics* (*4th Edition*), Prentice Hall, ISBN 0-582-41476-8.

Hydraulics in Civil and Environmental Engineering, 4th Edition by Andrew Chadwick and Martin Borthwick ISBN 0-415-30609-4

Civil engineering Hydraulics by C. Nalluri & R.E. Featherstone, 4th Edition, ISBN 13: 978-0-632-05514-2

Open Channel Flow by F.M. Henderson, Prentice Hall, Upper Saddle River, NJ 07458 ISBN 0.-02-353510-5