SUBJECT OUTLINE - EN114 ENGINEERING COMPUTATIONS

Course	Common to all Bachelor of Engineering Courses
Subject Name	Engineering Computations
Subject Code	EN114
Duration	13 teaching weeks, 1 exam week, 1 mid semester break week
Contact Hours	6 (4 Lectures, 2 Laboratories)
Credit Points	18
Delivery Mode	On campus
Prerequisites	Nil
Co-requisites	Nil
Course Coordinator	Mr. Wilson Kepa

Synopsis

The subject introduces student to engineering problem solving though the use of computer-aided engineering software with a strong emphasis on data collection and analysis tools. It explores the use of Excel, Matlab and SAP JMP as a tool to import, cleanse, analyze, manipulate and reporting of engineering data. Data science methodology are implemented through the use of the Excel VBA framework, Matlab scripts of the Matlab computational software and the JMP programming language of SAS JMP - emphasis on the trade-off between efficiency and accuracy of computational methods versus algebraic analytical methods.

Subject Topics

1. **Introduces Excel as data handling tool in engineering**
   - 1.1. Explores the use of formulae on data manipulation using the coordinate system of data cells
   - 1.2. Explores the use of charting functions on data collections
   - 1.3. Introduces the grammar of the VBA language and uses it to develop automation on data manipulation
   - 1.4. Data cleansing process of data importation and data massage into a form that can be manipulated and analyzed
   - 1.5. Implement modeling methods using formulae and VBA including; Statistical Analysis, Time Series Analysis, Mathematical functions, Curve Fitting and Regression and Solving Equations
   - 1.6. Numerically differentiating, integrating and integration of differential equations for engineering applications.

2. **Introduces Matlab as a computational tool for engineering applications**
   - 2.1. Matlab fundamentals: Matlab interface, Matlab data types, Matlab script and function files.
   - 2.2. Matlab programming: Loop Commands, Logical Branching Statements, Combining Loops and Logic, elementary vectorisation of algorithms
   - 2.3. Matlab Data Plotting

2.4. Matlab Engineering Applications: Finding Roots of Equations, Matrix Mathematics, Solving Simultaneous Equations, Numerical Integration, Solving Ordinary Differential Equations, Solving Partial Differential Equations, Solving Nonlinear Algebraic Equations.

3. **Introduces JMP SAS for engineering data analytics.**
   3.1. Data: Importing Data into JMP, JMP Data Table, Cleaning and Formatting Data, Analyzing Row States.
   3.2. Index of Graphs: Basic Charts, Thematic Maps, Graphs of One, Two and Multiple Columns.
   3.3. Graphing: Using Graph Builder to produce graphs of Data and Maps.
   3.4. Problem Solving with One, Two and Multiple Columns.

Subject Learning Outcomes (SLOs):

On completion of this subject, the students will be able to:

1. Demonstrate qualitative and quantitative understanding of the use of Excel Spreadsheet.
2. Develop a working knowledge of the required mathematical solution procedures for engineering analysis.
3. Illustrate the use of spreadsheets to compute a variety of engineering problems.
4. Apply Excel built-in features and VBA, Matlab and SAP JMP to compute engineering problems.
5. Apply necessary skills to design and implement an emerging engineering application.

Assessment Tasks and Weightings:

To obtain a pass grade in this subject a student must achieve 50% overall. There is no final examination for this subject. Students must also refer to the *Subject Assessment Details* as prescribed by the subject coordinator.

Computer Laboratory Reports and Quizzes are worth 40% of the overall marks for the subject. Assignments and Projects are worth 40% and Tests are worth 20%.

Subject Assessment Task (AT) Details

AT Item	Component	Marks	Week(s)
1. Laboratory	Lab 01	3 %	03
	Lab 02	3 %	04
	Lab 03	3 %	05
	Lab 04	3 %	06
	Lab 05	3 %	07
	Lab 06	3 %	08
	Lab 07	3 %	09
	Lab 08	3 %	10
	Lab 09	3 %	11
	Lab 10	3 %	12
2. Quizzes	Quiz 01	5 %	05
	Quiz 02	10 %	08
	Quiz 03	10 %	11
3. Assignments	Assignment 01	5 %	3 - 6
	Assignment 02	5 %	7 - 9
	Assignment 03	10 %	9 – 12
4. Test	End-Semester Practical Test	10 %	07
	Mid-Semester Practical Test	15 %	13

It is important that all students familiarize themselves with the university's Assessment Guidelines including those on plagiarism. This can be viewed on the university's website: **http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies**

Laboratory Classes

All lab classes start in Week 2, such that week 1 lab sessions will be allocated to software installation required for the labs. Each weekly lab class is 2 hours long.

Laboratory classes give you a chance to practice problem solving, engineering computations, and programming skills on small, guided and well-defined examples. The examples have been chosen to highlight particular aspects of problem solution, and will give you enough grounding in problem solving to assist you in completing your assessable work. Your tutor will be present in your lab class to answer any questions you may have and to assess your competencies.

IMPORTANT: Please note that at the time of marking the lab exercises, the tutor may ask the student to solve other similar problems. You need to demonstrate that you are able to solve lab exercises and related problems, in order to receive any marks for your lab work. In other words, using some else's lab solution is pointless!

Finally, you can only have your lab work marked during your scheduled lab class. It is not possible to have your work marked in another class.

Quizzes

Quizzes will be conducted for not more than 30 minutes. Quizzes will start from Week 5 and in a span of three successive weeks. The quizzes will challenge student understanding and assess comprehension of course modules delivered.

Assignments

Assignments give you the chance to practice what you have learned on relatively large problems (compared to the small exercises in the Lab Classes). Assignments are a very important part of this course, therefore it is essential that you attempt them yourself.

There will be four assignments:

- ✓ **Assignment 1** is due in Week 6 (requirements available in week 3).
- ✓ **Assignment 2** is due in Week 10 (requirements available in week 6).
- ✓ **Assignment 3** is due in Week 12 (requirements available in week 10).

Assignments are to be completed in your own time. To maximize the learning benefits from doing assignments, it is essential that you start work on assignments early. Do not leave your assignments until the last minute. If you submit an assignment late, the maximum available mark is reduced by an amount (2%) per day that it is late such that submission beyond 2 days late will not be assessed. Assignments are submitted using the courses Google Classroom submission links.

All assignments are aimed at developing skills in all stages of computational engineering problems which include:

1. Requirements comprehension,
2. Design a method to solve the problem,
3. Design refinement,
4. Implement and document the design and test extensively to validate that the program meets the requirements.

Test and Examinations

The final End of Semester Practical Test will be held during the examination period. It will examine all materials covered in the course, but will emphasize the material in the second half of the course.

IMPORTANT: It is important that all students familiarize themselves with the PNG University of Technology Assessment guidelines including those on **plagiarism**.

Subject Mapping

Subject Learning Outcomes (SLO) are mapped to each of; PNG National Qualifications Framework Level 8 (NQF), Course Learning Outcomes (CLO), Unitech Graduate Attributes (GA), Assessment Tasks (AT) and Engineers Australia (EA) Stage 1 Competencies.

All SLOs combine to collectively deliver the CLOs and EA Stage 1 Competencies.

Subject Mapping Matrix

SLO	SLO to NQF	SLO to CLO	SLO to GA	SLO to AT	SLO to EA Stage 1 Competencies
1	Knowledge and skills	1 & 3	Critical thinker	1, 4	1.1, 1.2, 2.2
2	Knowledge and skills Application	1 & 3	Critical thinker	1, 4	1.1, 1.2, 2.1, 2.2, 2.3
3	Application & Autonomy	1, 3 & 4	Critical thinker	1, 4	1.2, 1.3, 1.4, 2.1, 3.2, 3.3, 3.4
4	Knowledge and skills Application	1, 3 & 4	Critical thinker	2, 4	1.1, 1.2, 2.1, 2.2, 2.3, 2.4
5	Knowledge and skills Application	1, 3 & 4	Critical thinker	2, 4	1.2, 1.4, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 3.3, 3.4

Engineers Australia Stage 1 Competencies

1. KNOWLEDGE AND SKILL BASE	2. ENGINEERING APPLICATION ABILITY	3. PROFESSIONAL AND PERSONAL ATTRIBUTES
1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline.	2.1 Application of established engineering methods to complex engineering problem solving.	3.1 Ethical conduct and professional accountability.
1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline.	2.2 Fluent application of engineering techniques, tools and resources.	3.2 Effective oral and written communication in professional and lay domains.
1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline.	2.3 Application of systematic engineering synthesis and design processes.	3.3 Creative, innovative and pro-active demeanour.
1.4 Discernment of knowledge development and research directions within the engineering discipline.	2.4 Application of systematic approaches to the conduct and management of engineering projects.	3.4 Professional use and management of information.
1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline.		3.5 Orderly management of self, and professional conduct.
1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline		3.6 Effective team membership and team leadership.

Graduate Capability Statement

This subject is common to all Bachelor of Engineering courses. Each engineering discipline will map subject learning outcome to its own CLOs and the graduate statement and capabilities that stem from those CLOs. Refer to each engineering discipline for the relevant graduate statement.

Engineering Course Learning Outcomes – Mapped to EA Stage 1 Competencies

This Subject is common to all engineering courses and its Learning Outcomes are mapped to the following broad engineering Course Learning Outcomes, which mesh with those of each engineering discipline.

The following table is included to demonstrate to students that overall, the Engineering CLOs address all Competencies. The combined mapping matrix for all SLOs to Engineers Australia Stage 1 Competencies for each course provides finer detail.

Course Learning Outcomes*	**Engineers Australia Stage 1 Competencies**
1. Deep understanding of the sciences, math, information systems and engineering fundamentals that underpin the electrical and communication engineering discipline.	1.1, 1.2
2. An in-depth understanding of the body of knowledge of the electrical and communication engineering discipline.	1.2, 1.3
3. Collection, synthesis and application of electrical and communication engineering information.	1.4, 1.5, 2.1, 2.3, 2.4, 3.4
4. Undertaking research, analysis & evaluation of ideas and concepts within electrical and communication engineering	1.3, 1.4, 1.6, 2.1, 2.3, 2.4, 3.2, 3.4
5. Applying problem solving skills to complex electrical and communication systems and processes.	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3
6. Undertake design in electrical and communication engineering and manage engineering projects.	1.6, 2.2, 2.4, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6
7. Communication via multiple media to diverse audiences, undertaking team roles, teamwork and providing team leadership.	2.4, 3.2, 3.3, 3.4, 3.5, 3.6
8. Behaving in an ethical and professional manner and respecting others.	1.6, 2.4, 3.1, 3.4, 3.5, 3.6
9. Being cognizant of the importance of sustainability and the environmental impact of engineering.	1.5, 1.6, 3.1, 3.3, 3.4

***Note:** While the course learning outcomes will have minor differences for each engineering course the above mapping remains valid for use in all courses.

Unitech Graduate Attributes

Attribute	Academic dimension	Personal Dimension	Transferable Dimension
1. Lifelong learner	Sustained intellectual curiosity and use of feedback to reflect on their own work.	Sets aspirational goals for personal improvement and career growth.	Takes responsibility for one's learning and development.
2. Critical thinker	Uses rules of inference to analyse complex issues and find solutions.	Calmly uses logic and critical thinking, and not emotion, in all situations.	Ability to find solutions to problems by using logical and imaginative thinking.
3. Effective communicator	Ability to discuss and debate issues articulately and confidently and convincingly.	Character of producing high quality written essays and oral presentations.	Ability to communicate and negotiate with others and to listen to them.
4. Cultural modernist	Familiarity with international standards and world cultures and human rights.	Tolerance of the religions and cultures of others.	Ability to work in a multicultural setting and comprehension and tolerance of religious and cultural differences.
5. Moral uprightness	Understand and act upon the ethical responsibilities of their actions.	Character of acting in a morally upright way in all situations.	Professional behaviour at all times.
6. Technologically savvy	Familiarity and use of technologies appropriately.	Keeping up to date with innovations.	Character of accepting new technology and quickly adapting to it.

Student Workload:

The total workload for the subject for the 'average' student is a nominal 140 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Textbooks:

- Ronald Larsen - Engineering with Excel, Pearson, 2012
- Svein Linge & Hans Petter Langtangen - Programming for Computations – MATLAB/Octave, 2010
- JMP ® Essentials An Illustrated Guide for New Users, 2nd Edition, 2012

References:

- Bill Jelen - VBA and Macros Microsoft Excel 2010, Que Publishing, 2010
- Joseph C. Musto, William E. Howard & Richard R. Williams – Engineering Computations: An Introduction Using Matlab and Excel, 2009.

Readings and resources:

https://www.youtube.com/watch?v=T_ekAD7U-wU

https://www.jmp.com/en_us/home.html

https://www.youtube.com/watch?v=AKsj0sxCtFA&list=PL3mwk0Db0keIwDJopA_rRD1aTXT92PLE6

https://www.youtube.com/watch?v=xge-f1KV_oc&list=PL411D719858B57C47

Relevant University Policies:

It is important that all students familiarize themselves with the PNG Unitech Assessment Guidelines including those on plagiarism. This can be viewed on the PNG Unitech website: http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies