SCHOOL OF MINING ENGINEERING

Head of School
Jim Pae Lem, PhD (UniSA, Australia), MPhil (Unitech), BEng (Unitech**)**

Mining Section

Professors
……..
Adjunct Professors
Ernest Baafi, Associate Professor, University of Wollongong, Australia

Associate Professors
……
Senior Lecturers
Gabriel Arpa, PhD (Akita, Japan), MSc. (Akita, Japan), BEng (Unitech)……
Lecturers
Ken Kaepae Ail, PhD (Curtin, Australia), MSc. (Curtin, Australia), BEng (Unitech)
Gideon Yowa, Msc (JCU, Australia), BEng (Unitech)
David Peteri, MSc.(UK), BEng (Unitech)

Part-time Lecturer (On-line)
Clara Abuntori, PhD (UMaT, Ghana), BEng (Honors, UMaT, Ghana)

Mineral Processing Engineering Section

Professors
Prasana Kumar, Y.,PhD, M.Tech, BEng (India)
Adjunct Professors
Elaine Wightman, PhD (UniSA, Australia), GCHEd (UQ, Aust), BEng (Hons, UQ- Australia)
Senior Lecturers
John Witne, PhD (Camborne, UK), MSc. (Curtin, Australia), BSc. (Unitech)
Jim Pae Lem, PhD (UniSA, Australia), MPhil (Unitech), BEng (Unitech)
Lecturers
Wilson Kobal, PhD (QUT, Australia), MPhil (Unitech), BEng (Unitech)

Technical Instructor
Francis Kisai, BSc.(Unitech)
……..

Technical Team

Laboratory Manager
Joseph Tera, BSc. (Unitech), Dip (Polytech)
Principal Technical Officer
Raymond Korova, BEng (Unitech)
Senior Technical Officers
Philip Rumints…BEng (Unitech)
Technical Officers
Shealtiel Chapok, B. in commercial IT (Unitech)
Joicka Mosbi, Dipl (Polytech)

Administration Team
Admin Officer
Moses Pa'ak,
Executive Secretary
Padine Gaiwari
Secretary
Driver
Meksy Vaum
Janitor
Gibson Lumbo
John Awi
Roberk Koek
……..

Undergraduate Degree Programs

The School of Mining consists of two (2) sections, Mining Engineering and Mineral Processing Engineering. Apart from the service courses, the School offers the following four-year academic programs leading to:

(a) Bachelor of Mining Engineering (Honours)
(b) Bachelor of Mineral Processing Engineering (Honours)

These degree programs are designed to produce Mining Engineers and Mineral Processing Engineers who will be able to pursue careers in the Mining and Energy industries as well as academia and/or government sectors such as MRA, KPHL, Kumul Minerals and CEPA.

Similar to other engineering degrees, the first and second year of each course is designed to form common engineering foundation upon which years 3 and 4 of the separate professional options are based.

Entry requirements for undergraduate programs (any one of the following):

i) **Mining:** Grade 12 School Leavers: SAT_P Test Score, Minimum of B grades in Advanced Maths A, Physics, Chemistry & Language & Literature
ii) **Mineral Processing:** Grade 12 School Leavers: STAT_P Test Score, Minimum of B grades in… Advanced Maths A, Physics, Chemistry & Language & Literature
iii) All non-school leavers entering into Mining or Mineral Engineering programs: as in school leaver requirements except that upon acceptance with the minimum requirement will do entry exams instead of STAT-P test.

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Post graduate Degree Programs

The School also offers postgraduate degrees in Master of Philosophy (MPhil) and Doctor of Philosophy (PhD) by research in Mining, Mineral Processing and Hydrometallurgy

Entry requirements for post graduate:

Entry requirement for a Master of Philosophy is Bachelor's Degree in Mining or Mineral Processing with above average grades from a recognized university or more than 2 years industry experience equivalence. For a PhD program, a master degree in mining, mineral, geotech, petroleum or related field from recognised university.

COURSE STRUCTURE

BACHELOR OF MINING ENGINEERING (Honours)

First Year First Semester

Code	Subject	Contact Hours	Credit
EN111	Engineering practice and sustainability	6	15
EN112	Engineering mathematics I	6	22
EN113	Engineering materials and properties	6	18
EN114	Engineering computation	6	18
		24	**73**
First Year	**Second Semester**		
EN121	Engineering mathematics II	6	22
EN122	Engineering mechanics	6	18
EN123	Introduction to circuits and electronics	6	18
EN124	Introduction to engineering design	6	15
		24	**73**

Second Year First Semester

Code	Subject	Contact Hours	Credit
EN211	Computer aided design	6	18
EN212	Engineering mathematics III	6	18
MN211	Introduction to Minerals engineering	6	18
MN212	Thermo-fluids	6	18
		24	**72**
Second Year	**Second Semester**		
EN221	Engineering modelling (including statistics & probability)	6	18

MN222	Economic geology and mineralogy	6	18
MN223	Mining Technology	6	18
SE222	Spatial science	6	18
		24	**72**

Third Year First Semester

Code	**Subject**	**Contact Hours**	**Credit**
MN311	Bulk materials handling in mines	6	16
MN312	Underground mining	6	16
MN313	Engineering geology and geomechanics	6	16
MN314	Rock fragmentation	6	16
		24	**64**
Third Year	**Second Semester**		
MN321	Mine ventilation	6	16
MN322	Mineral resources estimation and geostatistics	6	16
MN323	Applied geomechanics	6	16
MN325	Surface mining engineering	6	16
***EN000**	Professional work experience		
		24	**64**

Fourth Year First Semester

Code	**Subject**	**Contact Hours**	**Credit**
EN411	Research project A	6	20
MN411	Project management and economics	6	18
MN412	Mine design I	6	18
MN413	Industry practice	6	18
		24	**74**
Fourth Year	**Second Semester**		
EN421	Research project B	6	28
MN421	Mine design II	6	18
,M422	Mine environments and safety engineering	6	18
MN423	Introduction to petroleum engineering	6	18
		24	**74**

***EN000: Professional work experience-Work integrated Learning begins in Yr.2 and ends in Yr.4, a total accumulated hour of 450. This subject will not have any credit point and will be assessed with pass/fail.**

Graduate Statement (GS)

The Unitech Mining graduate is innovative, creative, analytical, ethical and professional in designing and extraction of mineral resources sustainably for PNG

Course Learning Outcomes (CLOs)

On completion of the course the student will:

CLO1	Master the principles and methods of the sciences and mathematics that underpin engineering.
CLO2	Develop creative and sustainable solutions to complex problems
CLO3	Have in depth proficiency in applying the tools, methods, concepts, technology and knowledge of an engineering discipline.
CLO4	Be proficient in communication via written, oral and digital means across multiple audiences and within teams
CLO5	Have ability to research, evaluate and synthesize information from varied sources
CLO6	Manage project conception and operation involving complex technical systems and processes
CLO7	Conduct oneself in a professional, ethical manner consistent with sustainable economic development and society's expectations

EN111 Engineering Practices and Sustainability

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Engineering Practices and Sustainability

Subject Code: EN111

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**3 Lectures + 3Tutorial)

Delivery Mode On campus

Prerequisites: Grade 12 English

Co-requisites: None

Subject Coordinator: TBA

Synopsis

This subject provides students with an overarching introduction to broad engineering practice and its core components. The role of the engineers in society is explored along with the social, political and economic issues may influence the role. The subject adopts a problem-based learning approach where student teams review a hypothetical engineering case study involving multiple, ethical and environmental related issues to critically analyze possible outcomes. Findings are presented via progressive and final reports culminating in a team work presentation to allow students to demonstrate attainment of good communication skills.

Subject Topics

1. Introduction to professional conducts and ethical engineering practices

2. Team Building in Engineering Teams
3. Theories of Development
4. Social Change & Technology in economic and political context of society.
5. Sustainable engineering practice in social, economic and political contexts.
6. The role media communication in Engineers' world

Subject Outline

Topic	Content
1. Introduction to professional conducts and ethical engineering practices	• Role of Engineering in development context • Engineering ethics and Society
2. Team Building in Engineering Teams	• Effective Communication • Assertive Listening • Critical Thinking • Organizational • Communication

3. Theories of development	• Sociological Theory • Psychological Theory • Other relevant theories
4. Social change & technology in economic and political context of society	• Social Change • Technology Change
5. Sustainable engineering practice in social, economic and political context	• Principle of Sustainability • Environmental Sustainability • Engineering Economics & Development
6. The role media communication in Engineers' world	• Role of Media Communication • Engineers in the real world • Wrap uo of lectures

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Demonstrate various concepts of Professional and ethical conducts and Practices in this contemporary engineering and development context.

2. Demonstrate team building, relationship and stakeholder engagement behaviors in engineering and development problem solving situation.
3. Research the range of environmental, technical and social elements involved in engineering challenges.
4. Apply skills in accessing, evaluating and summarizing information to communicate ideas and present arguments.
5. Apply a variety of Engineering Practices and strategies to meet engineering needs in complex social, political, economic and environments.
6. Investigate, analyze and use a range of communication skills (speaking, writing, drawing and listening); and select and apply appropriate channels of communication in the sustainability process

Assessment Tasks and Weightings

100% Continuous

Students must also refer to the Subject Assessment Details.

Test	**(15 %)**
Short concept paper	**(20%)**
Major project report	**(40%)**
Problem-based project	**(25%)**

Assessment 1 – A Short Essay Paper: A concept based short essay paper outlining students' understanding of general concepts, definitions and explanations relevant to themes /topics 1 & 2 covered in the lectures. In this case it relates to professional conducts and ethical practices, their roles in the society covered and team building. The essay contributes 20% towards the final grade for the subject.
Assessment 2 – A Short Test: A concept based closed book assessment, testing students' abilities and comprehension of the various concepts covered in the lecture topics. The Test contributes 15% towards the final grade for the subject.
Assessment 3 – Major Project Report: A professional level project report with individual and team components that outlines and communicates the project design/initiation processes, objectives, rationale and outcomes. The Major Project Report contributes 40% towards the final grade for the subject.

Assessment 4 – Problem-Based Project: A professional report on resolving contemporary issues prevalent in PNG context. All team members will contribute. The presentation contributes 25% towards the final grade for the subject

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

No specific textbook

References

1. William E. Kelly, Ph.D., P.E.; Barbara Luke, Ph.D., P.E., D.GE; and Richard N. Wright, Ph.D., NAE (2017). Engineering for Sustainable Communities, ASCE
2. Amer Society of Civil Engineers, (2004). Sustainable Engineering Practice: An Introduction.
3. David T. Allen & David R. Shinnard (2011). Sustainable Engineering: Concepts, Design and Case Studies 1st Edition
4. Braden R. Allenby, (2011). The Theory and Practice of Sustainable Engineering 1st Edition
5. Other related materials

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

EN112 Engineering Mathematics I

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Engineering Mathematics I

Subject Code: EN112

Duration:	13 Teaching weeks
Contact Hours:	6 Hours per week
Credit Points:	**22 (**4 hrs Lectures + 2hrs Tutorial)
Delivery Mode	On campus
Prerequisites:	Grade 12 Mathematics
Co-requisites:	None
Subject Coordinator:	TBA

Synopsis

This subject provides students with an overarching introduction to broad engineering practice and its core components. The role of the engineers in society is explored along with the social, political and economic issues may influence the role. The subject adopts a problem-based learning approach where student teams review a hypothetical engineering case study involving multiple, ethical and environmental related issues to critically analyze possible outcomes. Findings are presented via progressive and final reports culminating in a team work presentation to allow students to demonstrate attainment of good communication skills.

Subject Topics

1. Functions and Limits
2. Sequence and Series
3. Differentiation & Applications
4. Integration and Applications
5. Complex Numbers.

Subject Outline

Topic	Content
1. Functions and Limits	• Types of functions • Composition of functions • Inverse functions • Logarithmic and exponential functions • Trigonometric and hyperbolic functions • Inverse trigonometric and hyperbolic function
2. Sequence and Series	• Infinite series and processes: sequences, partial sums, tests for convergence of a series of real numbers, power series, radius and interval of convergence of a power series • Taylor and MacLaurin series
3. Differentiation & Applications	• Differentiation: differentiation by using limits, techniques of differentiation, applications of differentiation - maxima and minima, tangents to curves, small increments
4. Integration and Applications	• Anti-derivatives, first and second fundamental theorems of calculus. • Techniques of integration – substitution and integration by parts • Applications of integration - the area enclosed between two curves, volumes of solids of revolutions
5. Complex Numbers	• Cartesian, polar and exponential forms of complex numbers. Euler's formula; • De Moivre's theorem, roots of complex numbers

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Demonstrate a clear understanding of trigonometric, logarithmic, exponential and hyperbolic functions, and their inverses
2. Test series for convergence, and find radii and intervals of convergence of power series
3. Apply the techniques of differentiation to solve problems involving maxima and minima and related rates
4. Use integration to find areas enclosed between curves, and volumes of solids of revolution
5. Solve problems involving complex numbers

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests **(35 %)**
Assignments **(15%)**
Final Examination **(50%)**

Assessment 1 -	**Tests:** There will be 3 Tests contributing 35% towards the final grade for the subject.
Assessment 2 -	**Assignment/Group work:** The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 15% towards the final grade for the subject
Assessment 3	**Final written examination:** A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

Anton, Howard – Calculus, Sixth Edition, John Willey and Sons, New York, 1999

References

1 Steward, James – Calculus, Early Transcendentals, Seventh Edition, Brooks Cole, Toronto, 2012
2 Mauch, Sean – Advanced Mathematical Methods for Scientists and Engineers, California Institute of Technology, 2002

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

EN113 Engineering Materials and Properties

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Engineering Practices and Sustainability

Subject Code: EN113

Duration:	13 Teaching weeks
Contact Hours:	6 Hours per week
Credit Points:	**18 (**3 hrs Lectures + 3hrs practical)
Delivery Mode	On campus
Prerequisites:	Grade 12 Chemistry
Co-requisites:	None
Subject Coordinator:	TBA

Synopsis

Engineering Materials and Properties enables student to attain the fundamental knowledge of materials used in different fields of engineering. It will impart cognitive skills to think critically about the materials relevant for engineering applications. The subject examines the physical-chemical properties of materials and how they impact on the design and applications in engineering. The materials studied cover the broad spectrum from hydrocarbons through to metals, cements, timbers, nanomaterials, polymers and

ceramics. The subject adopts a hands-on experimental approach through the use of laboratory practical sessions that enhance the theoretical concepts.

Subject Topics

1. Lubricants
2. Corrosion and corrosion control
3. Metals and metallic alloys
4. Ceramics

Subject Outline

Topic	Content
1. Lubricants	• Definition • Classification • Theory and mechanisms of lubrication • properties of lubricants
2. Corrosion and corrosion control	• Theoretical models of corrosion • corrosion control methods • Protective coatings
3. Metal & metallic alloys	• Properties • ferrous and non-ferrous materials • Phase diagrams
4. Ceramics	• Ceramics

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Demonstrate fundamental knowledge of how to classify lubricants and evaluate their advantages and limitations for engineering applications
2. Demonstrate how to assess the properties of metals and alloys to determine their uses for various engineering disciplines
3. Attain fundamental knowledge of the properties of adhesives and ceramics which are relevant to the various engineering
4. Achieve the capacity to investigate and evaluate the properties of advanced engineering materials for engineering applications
5. Undertake the selection of materials for engineering tasks based on non-dimensional analysis
6. Develop teamwork and communication skills by participating in laboratory practical sessions and writing reports

Assessment Tasks and Weightings

The summative exam (final examination) will carry 40% and formative assessment (continuous assessment) 60%.

Students must also refer to the Subject Assessment Details.

Tests **(20 %)**

Laboratory and field work	**(25%)**
Assignments	**(5%)**
Final Examination	**(40%)**

Assessment 1	**Tests:** There will be 2 Tests contributing 20. % towards the final grade for the subject.
Assessment 2	**Laboratory and field work (if any)** The Laboratory and field work will contribute 25% towards the final grade for the subject. The case studies will have some problems which will assess the student's ability to think outside the box to consider real design and quality tests.
Assessment 3	**Assignment/Group work:** The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 5. % towards the final grade for the subject
Assessment 4	**Final written examination:** A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Chemistry for Engineering Students | 4th Edition Lawrence S. Brown/Tom Holme
2. K.H. Buchel, H.H.Moretto, P. Woditsch , Industrial inorganic Chemistry 2nd edition Wiley-VCH- 1989.
3. A Textbook of Quantitative Analysis, Arthur J. Vogel.
4. Chemistry Practical Manual, Lorven Publications

References

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

EN114 Engineering Computation

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Engineering Computation

Subject Code: EN111

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**3 Lectures + 1Tutorial + 2lab)

Delivery Mode On campus

Prerequisites: None

Co-requisites: None

Subject Coordinator: TBA

Synopsis

The subject introduces student to problem solving in engineering though the application of databases. It explores the use of Excel as a tool to import, cleanse, manipulate and present engineering data. Modeling methods are investigated through the use of the underpinning VBA language. The uses of problem-solving methodologies using computer techniques in the engineering profession are outlined

Subject Topics

1. Excel as a database spreadsheet tool in engineering
2. Use of formulae on data manipulation using the coordinate system of data cells
3. Use of charting functions on data collections
4. VBA language
5. Data cleansing process
6. Implement modelling methods

Subject Outline

Topic	Content
1. Excel as a database spreadsheet tool in engineering	• Introduces Excel as a database spreadsheet tool in engineering
2. Use of formulae on data manipulation	• Explores the use of formulae on data manipulation using the coordinate system of data cells
3. Use of charting functions on data collections	• Explores the use of charting functions on data collections
4. VBA Language	• Introduces the grammar of the VBA language and uses it to develop automation on data manipulation
5. Data cleansing process	• Data cleansing process of data importation and data massage into a form that can be manipulated and analysed
6. Implement modelling methods	• Implement modelling methods using formulae and VBA including; Statistical Analysis, Time Series Analysis, Mathematical functions, Curve Fitting and Regression and Solving Equations

Subject Learning Outcomes (SLOs)

On completion of this subject 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 solve a variety of engineering problems.
4. Apply Excel built-in features and VBA to solve engineering problems

Assessment Tasks and Weightings

100% continuous

Students must also refer to the Subject Assessment Details.

Assessment task 1.	Assignment 1 is worth 10% of the overall marks for the subject.
Assessment task 2.	Assignment 2 is worth 20% of the overall marks for the subject.
Assessment task 3.	Assignment 3 is worth 30% of the overall marks for the subject.
Assessment task 4.	Assignment 4 is worth 40% of the overall marks for the subject

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

Thomas Mailund - Beginning Data Science in R Data Analysis, Visualization, and Modelling for the Data Scientist, Apress, 2017

References

1 Ronald Larsen - Engineering with Excel, Pearson, 2012
2 Bill Jelen - VBA and Macros Microsoft Excel 2010, Que Publishing, 2010

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

EN121 Engineering Mathematics II

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Engineering Mathematics II

Subject Code: EN121

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **22 (**4 hrs Lectures + 2hrs Tutorial)

Delivery Mode On campus

Prerequisites: EN112

Co-requisites: None

Subject Coordinator: TBA

Synopsis

This subject will continue to develop the fundamental mathematical concepts, principles and analytical processes that underpin professional Engineering studies. The topic of vectors expands mathematics concepts into 2D and 3D space and matrices helps to represent and solve systems of linear equations. The topics of Differential equations first and second order helps to model dynamic systems and teaches techniques to solve related problems and Laplace Transform as an adequate mathematical tool in solving differential equations.

Subject Topics

1. Vectors
2. Matrices
3. First Order ODE
4. Second Order ODE
5. Laplace Transform

Subject Outline

Topic	Content
1. Vectors	• Dot product; Cross product; scalar triple product; parametric equations of a line; planes in 3-space
2. Matrices	• Addition and multiplication of matrices; Systems of linear equations; Gauss elimination; Determinants; Inverses; Cramer's Rule
3. 1st order ODE	• Techniques of solving 1st ODE: Separation of variables, Homogeneous equations, Integrating factor, Transformation, Bernoulli Equations, Exact differential equations, Solutions by substitution. Applications of ODE – bacterial growth, half-life of radioactive matter, cooling and heating, current flow in series circuit, and concentration of mixtures in tank reservoirs
4. 2nd order ODE	• Formation, Solution of constant coefficient linear homogeneous and non-homogeneous equations, Method of undetermined coefficients, Applications
5. Laplace transform	• Definition of Laplace Transforms, Transform of standard functions, Table of transforms, Properties of transforms, Laplace inverse transforms. Heavy side functions, Unit functions, Dirac functions, etc. Solving systems of ODEs

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Solve problems involving the vector equations of lines and planes in 3-D space.
2. Use Cramer's rule and Gauss elimination to solve systems of linear equations, including those with infinitely many solutions, geometric interpretation.
3. Formulate and solve various first order differential equations,
4. Formulate and solve second order linear differential equations with constant coefficients,
5. Use Laplace and inverse Laplace Transforms to solve O.D.E.

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(35 %)**
Assignments	**(15%)**
Final Examination	**(50%)**

Assessment 1 -	**Tests:** There will be 3 Tests contributing 35% towards the final grade for the subject.
Assessment 2 -	**Assignment/Group work:** The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 15% towards the final grade for the subject
Assessment 3	**Final written examination:** A 3 hour written examination weighs 50%

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Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Stroud K.A .Engineering Mathematics: Programs and Problems. 6th Edition (ELBS/Macmillan 2000)
2. Anton H, Calculus with Analytical Geometry, 6th Edition (Wiley 1999)

References

1. Kreyszig E Advanced Engineering Mathematics, 7th Edition Wiley, 1999

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

EN122 Engineering Mechanics

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Engineering Mechanics

Subject Code: EN122

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**3 hrs Lectures + 1hrs Tutorial+2lab)

Delivery Mode On campus

Prerequisites: Grade 12 physics

Co-requisites: None

Subject Coordinator: TBA

Synopsis

The subject of engineering mechanics ensures that the students attain the knowledge of the fundamental engineering sciences that provide the foundation for all engineering disciplines. The subject incorporates topics from fundamental units of measurement, Kinematics, Force and Motion, Elasticity, rigid body dynamics and Waves.

Subject Topics

1. Fundamental Units of Scalars, Vectors and Quantities.
2. Kinematics
3. Force and Motion
4. Elasticity:
5. Rigid Body Kinematics, dynamics and Equilibrium
6. Waves:

Subject Outline

Topic	Content
1. Fundamental Units of Scalars, Vectors and Quantities	• Units of measurements, physical quantities, dimensional analysis, scalar and vector quantities. Vector additions and subtractions, Unit vectors, vectors in two and three dimensions (i, j, k), cross and dot products
2. Kinematics	• Definitions of parameters of motion, linear, parabolic and circular motion, graphical representation of motion
3. Force and motion	• Concepts of mass, weight, Inertia, force (Newton's laws), impulse and momentum. Kinetic and static friction, Free Body Diagrams, resolution of forces in two and three dimensions. Circular motion, Pendulum
4. Elasticity	• Pressure, Stress, strain, Elasticity modulus, toughness, tensile and comprehensive strength

5. Rigid body kinematics, dynamics & equilibrium	• Centre of mass and gravity, moment of inertia, torque and equilibrium
6. waves	• Definitions of wave parameters, types of waves (sound waves, light waves, surface waves), travelling and standing waves and their equations, wave interference

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Explain the basic laws and principles of mechanics.
2. Analyse and solve simple problems in mechanics.
3. Identify the assumptions and limitations of approaches used in calculation of mechanical problems.
4. Apply scalar and vector analytical techniques for analysing forces in statically determinate structures.
5. Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems.
6. Develop team work attributes and abilities.

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(20 %)**
Assignments	**(10%)**
Laboratories	**(20%)**
Final Examination	**(50%)**

Assessment Task1: Individual written assignments contribute 10% to the final marks.

Assessment Task2: Group Laboratories contribute 20% to the final marks.

Assessment Task 3: Tests(s) contributes 20% to the final marks.

Assessment Task 4: The Final Exam contributes 50% to the final mark

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

Relevant textbook

References

Relevant website
Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

EN123 Introduction to Circuits and Electronics

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Introduction to circuits and Electronics

Subject Code: EN123

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**3 hrs Lectures + 1hrs Tutorial + 2lab)

Delivery Mode On campus

Prerequisites: EN112

Co-requisites: None

Subject Coordinator: TBA

Synopsis

Introduction to Circuits and Electronic enables student to attain knowledge of electronic components and circuits obtained from their integration. It will impart skills to identify various electronic components and use them to design circuits which lead to a system. It introduces the fundamentals of the lumped circuit abstraction, the basic components of electronics such as resistive elements, diodes, transistors, amplifier and op amps. It examines the different ways to design basic analogue and digital electronic circuits for engineering applications.

Subject Topics

1. Basic Electronic Principles
2. Electronic Instruments
3. Analog Circuits and Their Applications
4. Digital Circuits and Their Applications
5. Introduction to Integrated Circuits

Subject Outline

Topic	Content
1. Basic electronic principles	• Ohm's Law • Semiconductors and Types • Diodes, Types and Applications • Transistors, Configuration and Biasing • Operational Amplifiers
2. Electronic instruments	• Importance and Application of General Purpose Instruments • Multi-meter • Cathode-ray Oscilloscope • Function Generators • Switched Mode Power Supply (SMPS) • Inverter and Uninterrupted Power Supply (UPS)

3. Analog circuits and their application	• Diode as Rectifier: Half wave and full wave • Bridge Rectifier • Capacitor Filter Circuit • Zener Diode as Voltage Regulator • Transistors as Amplifiers • Inverting and Non-inverting Operational Amplifiers • Operational Amplifier Applications: Addition, Subtraction, and Voltage Follower
4. Digital circuits and their application	• Number Systems and their Conversion • Logic Gates: OR, NOT, NOR, AND, NAND • De Morgan's Theorem • Algebraic Simplification • NAND and NOR Implementation • Half-added and Full-adder Circuits • Multiplexer and Demultiplexer
5. Introduction to integrated circuit	• Need of Integrated Circuits • Classifications of Integrated Circuits • Fabrication Process

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Analyze the fundamental principles of electronics
2. Employ simple lumped circuit models for resistors, sources, inductors, capacitors, and transistors in circuits.
3. Analyze circuits made up of linear lumped elements.
4. Employ Boolean algebra to describe the function of logic circuits.
5. Construct simple gates, amplifiers, or filters in the laboratory.
6. Design, build and test basic circuits which include both analog and digital components.

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(20 %)**
Laboratory and field work	**(20%)**
Assignments	**(10%)**
Final Examination	**(50%)**

Assessment 1 - **Tests:** There will be two (2) Tests contributing 20% towards the final grade for the subject.

Assessment 2 - **Laboratory and field work (if any)** The Laboratory and field work will contribute 20% towards the final grade for the subject. The case studies will have some problems which will assess the student's ability to think outside the box to consider real design and quality tests.

Assessment 3 - **Assignment/Group work:** The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 10% towards the final grade for the subject

Assessment 4 **Final written examination:** A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. David A. Bell, "Electronic Devices and Circuits", Oxford University Press, 5th Edition, 2008.
2. D.P. Kothari, I. J. Nagrath, "Basic Electronics", McGraw Hill Education (India) Private Limited, 2014.
3. Boylestad and Nashelsky, "Electronic Devices and Circuit Theory", 8th Ed., Pearson Education India, New Delhi, 2002

References

1. NPTEL Lecture series on basic electronics.
2. MIT Open courseware on basic electronics

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

EN124 Introduction to Engineering Design

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Introduction to Engineering Design

Subject Code: EN124

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **15 (**2 Lectures + 1Tutorial + 3 Proj/lab)

Delivery Mode On campus

Prerequisites:

Co-requisites: None

Subject Coordinator: TBA

Synopsis

The subject provides students with the opportunity to develop engineering design and communication skills via a problem based learning approach utilizing a design project obtained via Engineers Without Borders. Multidisciplinary engineering team creates solutions to real life issues, typically located in developing regions. Design outcomes are provided in the form of a professional engineering reports and presented by the team to a professional engineering panel.

Subject Topics

1. Engineering design processes and components.
2. Communication and Collaboration in Multi-disciplinary Teams
3. Design within the overarching project plan
4. Design conceptualization
5. Prototyping and modeling
6. Specifications
7. Communicating design concepts and outcomes

Subject Outline

Topic	Content
1. Introduction	• Engineering design processes • Design components
2. Communication and Collaboration in Multi-disciplinary Teams	• Effective Communication • Assertive Listening • Critical Thinking • Organizational • Communication
3. Design within the overarching project plan	• Design within the overarching project plan
4. Design conceptualization	• Design conceptualization
5. Prototyping and modeling	• Prototyping and modeling
6. Specifications	• Engineering design Specifications
7. Communicating design concepts and outcomes	• Communicating design concepts and outcomes

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Identify and apply the various phases and process within an engineering design process.
2. Participate within and contribute to a multidiscipline engineering design team through application of team roles and communication.
3. Differentiate between the application of technologies to small scale engineering projects in developing and developed societies.
4. Develop a conceptual design based on broad design parameters including cost and sustainability.
5. Construct a broad material specification to support the costing and tendering of a small project.
6. Present the design outcomes via a detailed report and an audio visual presentation, which include application of the design outcome to PNG

Assessment Tasks and Weightings

100% Continuous

Students must also refer to the Subject Assessment Details.

Test	**(15 %)**
Short concept paper	**(20%)**
Major project report	**(40%)**
Problem-based project	**(25%)**

Assessment Task 1: Project Concept Report: Team based report outlining team formation and roles, project selection, action plan and future schedule (10%).

Assessment Task 2: Progress Report: Team based report outlining team progress in achieving design outcomes in line with schedule (20%).

Assessment Task 3: Final Report: Individual and team-based report outlining design processes, rationale and outcomes (50%)

Assessment task 4: Team Presentation: Audio visual presentation of design outcomes (20%)

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

Relevant Engineering Designs text books

References
Engineers without boarders website

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

EN211 Computer Aided Design

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Engineering Practices and Sustainability

Subject Code: EN211

Duration:	13 Teaching weeks
Contact Hours:	6 Hours per week
Credit Points:	**18 (**3 Lectures + 3Tutorial)
Delivery Mode	On campus
Prerequisites:	EN 114 Engineering computation
Co-requisites:	EN124 Introduction to engineering design
Subject Coordinator:	TBA

Synopsis

The subject introduces students to the modern approach of 3D Computer Aided Design for generating and analysing solid models and assemblies related to Civil, Electrical, Mechanical and Mining Engineering systems and structures. The included topics address theoretical and practical aspects encountered in the creation, modification, analysis, and optimization of engineering design. Also included are topics dealing with the creation of technical drawings, generation of bills of materials and basic elements of static, dynamic and thermal analysis.

Subject Topics

1. Characteristics of Digital Engineering Documentation
2. Creation of Fully Defined Sketches
3. Basic 3D Component Modelling
4. Advanced 3D Component Modelling
5. Creation of Assemblies.
6. Creation of Technical Drawings for 3D Parts and 3D Assembly Models

Subject Outline

Topic	Content
1. Characteristics of Digital Engineering Documentation	• Characteristics of feature-based, parametric solid modeler. • Principal components of modern 3D CAD software user interfaces. • Relationships between digitally created sketches, components, assemblies and technical drawingsion
2. Creation of Fully Defined Sketches	• Characteristics of sketch geometry and relationships between geometrical features. Sketch tools. • State of the sketch and the creation of fully defined sketches. • Design intents function of dimensioning methodologies
3. Basic 3D Component Modelling	• Extrusions from sketches. • Boss and cut extrusions. • Hole wizard, fillets, basic drawings, dimension changes. • Associativity between solid models and drawings. • Feature parameter editing
4. Advanced 3D Component Modelling	• Revolved and sweep features. • Shellings and ribs. • Patterns. • Part configurations, repairs and design changes. • Design tables, equations, families of parts. • Selection of materials and calculation of physical properties of solid models: mass, center of gravity, moment of inertia. • 3D printing
5. Creation of Assemblies	• Bottom-up and top-down assemblies. • Import of commercial parts. • Geometrical, mechanical and advanced mating relationships between parts in assembly. • Mass properties and interferences. • Creation of exploded views. • Bills of materials
6. Creation of Technical Drawings for 3D Parts and 3D Assembly Models	• Templates, views, dimensions and tolerances. • Sections and technical notes

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Know the characteristics and requirements of digitally created engineering documentation and the relationships between sketches, parts, assemblies and technical drawings.
2. Create fully defined sketches
3. Perform basic 3D component modelling and understand design intend and associativity between 3D models and technical drawings.
4. Perform advanced 3D component modelling, implement design changes, assign materials to models and calculate physical properties of models. Use design tables and equations and create families of parts.
5. Create 3D assemblies, add mating relationships between parts, evaluate mass properties and implement changes for interference avoidance. Create exploded views and bills of materials.
6. Create technical drawings for parts and assemblies. Add dimensions, tolerances, technical notes, sections and isometric views to created drawings. Prepare parts for 3D printing and 3D print

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%

Students must also refer to the Subject Assessment Details.

Tests	**(30 %)**
Assignment/Projects	**(70%)**

Assessment Task 1:	Test: Individual computer-based test on Fully Defined Sketch Creation. This test contributes 15% towards the final grade of this subject.
Assessment Task 2:	Test: Individual computer-based test on 3D Component Modelling. This test contributes 15% towards the final grade of this subject.
Assessment Task 3:	Assignment: Creation of a 3D Assembly with related Technical Drawings. This assignment contributes 30% towards the final grade of this subject.
Assessment Task 4:	Assignment: Creation of full Technical Documentation consisting of 3D Modelled Parts, 3D Assembly with Created and Imported Parts, Exploded Views, Bill of Materials and Technical Drawings. This assignment contributes 40% towards the final grade of this subject

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. 3D CAD in SolidWorks – Tutorials

References

1. 1 Dassault Systems – *SolidWorks Fundamentals*, Concord, Massachusetts, United States, 2012
2. Leondes, C. - *Systems Techniques and Computational Methods*, CRC Press, Boca Raton, 2001

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

MN211 Introduction to Minerals Engineering

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Introduction to Minerals Engineering

Subject Code: MN211

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**3 Lectures + 3Tutorial)

Delivery Mode On campus

Prerequisites: None

Co-requisites: None

Subject Coordinator: TBA

Synopsis

The subject introduces students to the principals, concepts and science of Geology, Mining Engineering and Mineral Process Engineering. In Geology students comprehend geological processes resulting in the formation of rocks and the process of mineralization and the different resulting earth structures. In Mining Engineering, understanding the different stages in the mining stages, different mining methods and their selection and the design criteria. Surface Mining methods including alluvial mining, strip mining, open cast, leaching and open pit. Underground mining methods include caving, cut and fill, shrinkage, sub-level stoping, avoca. Students to attain clear knowledge of the different production unit operations from ore reserve estimation, grade control, drilling, blasting, loading, hauling and dumping. The students to comprehend the different processing and separation techniques for different ore minerals and the science of physio-chemical properties in designing and selecting processing, separation, concentration and refining the product.

Subject Topics

1. Introduction to Mining Engineering Technology
2. Mineral Deposits and Exploration Technology
3. Surface Mining Engineering Technology
4. Underground Mining Engineering Technology
5. Mineral Processing Engineering Technology
6. Mining Engineering Technology Model Design

Subject Outline

Topic	Content
1. Introduction to Mining Engineering Technology	• Introduction to Mining Engineering Technology
2. Mineral Deposits and Exploration Technology	• Mineral Deposits and Exploration Technology
3. Surface Mining Engineering Technology	• Surface Mining Engineering Technology

4. Underground Mining Engineering Technology	• Underground Mining Engineering Technology
5. Mineral Processing Engineering Technology	• Mineral Processing Engineering Technology
6. Mining Engineering Technology Model Design	• Mining Engineering Technology Model Design

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Review and evaluate mining technology and application and the challenges in contemporary Papua New Guinea environment.
2. Critically examine mineral deposits, ore genesis, mineral appraisal techniques and application; assess exploration program and evaluate mineral resources.
3. Differentiate between and define surface mining terminology; review and apprise surface mining techniques and application, and validate surface mine design.
4. Appraise and differentiate between underground mining terminology; underground mining techniques and design. List related technology and applications.
5. Describe contemporary mineral beneficiation technologies for the economic extraction of minerals and evaluate a processing plant design.
6. List and describe minerals development processes, apply mining techniques and technologies to develop a minerals development plan and communicate those outcomes

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(15%)**
Projects/Assignments	**(35%)**
Final Examination	**(50%)**

Assessment 1 - **Tests:** There will be 1 Test contributing 10% towards the final grade for the subject.

Assessment 2 - **Assignment/Group work:** The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 35% towards the final grade for the subject

Assessment 3 **Final written examination:** A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Howard, H.L, Introduction to Mining Engineering, John Wiley & Sons, New York, 1987.
2. B.A. Wills., Introduction to Mineral Technology, 7th ed. 2006

References

- Numerous links are provided within the Subject Topics to research organisations, international universities, YouTube clips, and research databases

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

MN212 Thermo-fluids

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Thermo-fluids

Subject Code: MN212

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**3 Lectures + 2Tutorial + 1lab)

Delivery Mode On campus

Prerequisites: EN113 Engineering materials & properties, EN122 Engineering mechanics

Co-requisites: None

Subject Coordinator: TBA

Synopsis

This course introduces the principles of Thermodynamics and Fluid Mechanics and examines the role of thermodynamics and fluid mechanics in engineering. It covers the basic properties of fluids, fluid statics, analysis of fluid flow through pipes and ducts. The later part of the subject covers the laws of thermodynamics, and the application of control volume techniques to engineering problems.

Subject Topics

1. Introduction to thermo-fluids
2. Thermodynamics
3. Fluid mechanics

Subject Outline

Topic	Content
1. Introduction to thermo-fluids	• Introduction to thermos-fluid sciences • fluid mechanics, thermodynamics • heat transfer

	• importance of dimensions and units • Problem solving technique
2. Thermodynamics	• Basic concept • Energy, energy transfer & general energy analysis • Properties of pure substances • Energy analysis of closed systems • Mass & energy analysis of controlled volumes • 2nd law of thermodynamics – heat engine • Entropy • Power cycle
3. Fluid mechanics	• Introduction and properties of fluid • Bernoulli and energy equation • Momentum equation and its application • Internal flow • Definition, types of flows, laminar and turbulent fluid flow

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Describe the basic properties, principles and applications of fluids, fluid statics, fluid flow, fluid boundary layers, fluid power and forces developed by flowing fluids
2. Identify the different types of fluid flows and describe their implications on physical or engineering systems
3. Perform fluid flow calculations
4. Describe the basic concepts and principles and perform relevant calculations with respect to thermodynamic concepts including the forms of energy available, energy transfer, its utilization in engineering applications.
5. Outline the basic applications of thermodynamics in engineering by describing the various aspects and performing relevant basic calculations in terms of heat transfer, combustion and fuels, steam and refrigeration/heat pumps

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(30 %)**
Laboratory and field work	**(10%)**
Assignments	**(10%)**
Final Examination	**(50%)**

Assessment 1 - **Tests:** There will be three (3) Tests contributing 30% towards the final grade for the subject.

Assessment 2 - **Laboratory and field work (if any)** The Laboratory and field work will contribute 10% towards the final grade for the subject. The case studies will have some problems which will assess the student's ability to think outside the box to consider real design and quality tests.

Assessment 3 - **Assignment/Group work:** The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 10% towards the final grade for the subject

Assessment 4 **Final written examination:** A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Thermodynamics and Statistical Mechanics: An intermediate Level Course by Richard Fitzpatrick (2007).
2. Basics of Fluid Mechanics. Genick Bar-Meir, 2014

References

- Numerous links are provided within the Subject Topics to research organisations, international universities, YouTube clips, and research databases

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

EN212 Engineering Maths III

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Engineering Maths III

Subject Code: MN211

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**3 Lectures + 3Tutorial)

Delivery Mode On campus

Prerequisites: EN121 Engineering Maths II

Co-requisites: None

Subject Coordinator: TBA

Synopsis

To enable students to acquire further basic mathematical concepts, principles and analytical processes needed for degree studies in Engineering. On completion of this subject students should be able to use the advanced mathematical method such as Fourier transforms and Laplace transform to solve ordinary and partial differential equations of the 1st and 2nd order.

Subject Topics

1. Numerical Methods
2. Multivariable Calculus
3. Partial Differential Equations
4. Vector Calculus

Subject Outline

Topic	Content
1. Numerical Methods	• Solution of equations - bisection, Newton -Raphson. Numerical methods of integration using trapezoidal Rule and Simpson's Rule. Numerical solutions of differential equations using Runge-Kutta technique
2. Multivariable Calculus	• Double integrals over rectangular and non-rectangular regions. Triple integrals. Applications including surface areas, centroids, and centre of gravity
3. Partial Differential Equations	• Partial differentiation. Applications including tangent planes, total derivatives, directional derivatives, gradient, maxima/minima. Introduction to partial differential equations. • Fourier's series, The One-Dimensional Wave Equation: The Heat Equation: The Two-Dimensional Wave equation:
4. Vector Calculus	• Inverse square fields, Divergence and curl, The del operator, The Laplacian operator. • Evaluation of line integrals in 2D and in 3D space, Change of parameter, Applications to the evaluation of a mass of a wire, arc length and work. • The Fundamental theorem of work Integrals, Independence of path, Recognition of conservative vector fields in 2 and 3 dimensional spaces. • Finding work using Green's Theorem, Greens Theorem for multiply connected regions. • Evaluation of surface integrals, Applications to the evaluation of a mass of a curved lamina, surface area and to vector fields associated with fluid flow and electrostatic forces. • Oriented surfaces, using the Divergence Theorem to find flux, Sources and sinks, Gauss's Law for inverse square fields. Relative orientation of curves and surfaces, using Stokes' Law to calculate work, Relationship between Green's Theorem and Stokes' Theorem, Curl viewed as circulation

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Use numerical techniques to solve equations, calculate definite integrals, and solve differential equations.
2. Find the integral of a function of several variables,
3. Apply Fourier series to solve Ordinary Differential equations and Partial Differential equations.
4. Evaluate line integrals in two and three dimensional space

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(20 %)**
Laboratory and field work	**(20%)**
Assignments	**(10%)**
Final Examination	**(50%)**

Assessment 1 - **Tests:** There will be three (3) Tests contributing 20% towards the final grade for the subject.

Assessment 2 - **Laboratory and field work (if any)** The Laboratory and field work will contribute 20% towards the final grade for the subject. The case studies will have some problems which will assess the student's ability to think outside the box to consider real design and quality tests.

Assessment 3 - **Assignment/Group work:** The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 10% towards the final grade for the subject

Assessment 4 **Final written examination:** A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Kreyszig E. Advanced Engineering Mathematics, 7th ed. (Wiley, 1993).
2. Anton H, Calculus with Analytical Geometry, 6th Edition (Wiley 1999

References

1. Stroud K.A .Engineering Mathematics: Programmes and Problems. 6th Edition (ELBS/Macmillan 2000)

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

EN221Engineering Modelling

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Engineering Modelling

Subject Code: EN221

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**3 Lectures + 3Tutorial)

Delivery Mode On campus

Prerequisites: EN211 Computer Aided Design

Co-requisites: None

Subject Coordinator: TBA

Synopsis

The subject introduces students to Engineering Modeling and Simulation and offers solutions for engineering analysis and design problems using physics-based computational models. The applications relate to Civil, Electrical, Mechanical and Mining Engineering systems and structures. The included topics address theoretical and practical aspects encountered in model creation, analysis, and optimization of virtual prototypes, with significant cost reduction of the development cycle. Also included are topics

dealing with advanced static, dynamic, fluid flow and thermal analysis applied to all fields of engineering and verification problems.

Subject Topics

1. Specific Features of Engineering Modeling and Simulation
2. Fundamental Concepts in Modeling and Simulation
3. Static Simulations.
4. Dynamic and Non-Linear Simulations.
5. Engineering Modeling and Simulations for Thermo-Fluidic Applications.
6. Validation Applications in Engineering Modeling

Subject Outline

Topic	Content
1. Specific Features of Engineering Modeling and Simulation	• Engineering **m**odeling and computer simulations as substitutes for prototyping and experiments. The benefits of evaluating the behaviour of engineering systems by virtual prototyping and simulation. The need for verification problems. Main components of software user interfaces for virtual prototyping and simulation. Steps in creating engineering models from 3D geometric models
2. Fundamental Concepts in Modeling and Simulation	• Stress and strain matrices. Finite Element Method. Vibration modes and buckling of structures. Variational statement and equations of heat transfer. Solutions of transient heat conduction governing equations. Physical capabilities of flow simulations and governing partial differential equations for laminar and turbulent flows. Conjugate and radiation heat transfer. Multi-flows. Boundary conditions
3. Static Simulations	• Static analysis of parts, sheet metal and assemblies. Displacement contacts, bolt connectors, remote loads, non-uniform pressure distributions and shrink fits. Beam diagrams and static analysis of trusses. Analysis of systems under bearing loads. Composite shells
4. Dynamic and Non-Linear Simulations	• Modal and harmonic analysis. Buckling, drop test and fatigue analysis. Modeling and optimization of systems under combined pressure, thermal and earthquake loads. Non-linear analysis of contacts. Elasto-plasticity modeling and analysis. Random vibrations, thermal contact and thermal stress analysis. Steady-state and transient thermal analysis of electronic components
5. Engineering Modeling and Simulations for	• Structure and interface of flow simulation applied to ball valve design, flow in porous media and conjugate heat transfer. Computational fluid dynamics with mesh optimization in evaluation of hydraulic losses, drag coefficients, non-Newtonian flows and heat exchanger efficiency. Building and electronic cooling simulations
6. Validation Applications in Engineering Modeling	• Static, buckling and vibrations verification problems. Unsteady heat conduction and thermoelectric cooling verification problems. Laminar and turbulent flows in pipes

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Know the benefits of engineering modeling and simulation, the need for verification problems, the modeling software interfaces and the steps in creating engineering models.
2. Know the fundamental theoretical concepts in engineering modeling and computer simulation related to the fields of statics, dynamics, fluid mechanics and thermodynamics.
3. Perform modeling and static simulation for components and systems encountered in all fields of engineering.
4. Perform advanced modeling and simulation for components and systems under dynamic and non-linear loading conditions. The gained skills and abilities should cover the large spectrum of all engineering fields.
5. Know the structure and interface of computational thermo-fluidic applications and perform advanced simulations related to the fields of civil, electrical, mechanical and mining engineering.
   Perform simulations for engineering models with known analytical solutions, compare the results, discuss the accuracy of computer modeling and understand its limitations

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(20 %)**
Laboratory and field work	**(20%)**
Assignments	**(10%)**
Final Examination	**(50%)**

Assessment 1 - **Tests:** There will be three (3) Tests contributing 20% towards the final grade for the subject.

Assessment 2 - **Laboratory and field work (if any)** The Laboratory and field work will contribute 20% towards the final grade for the subject. The case studies will have some problems which will assess the student's ability to think outside the box to consider real design and quality tests.

Assessment 3 - **Assignment/Group work:** The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 10% towards the final grade for the subject

Assessment 4 **Final written examination:** A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Engineering Modeling and Simulation in SolidWorks – Tutorials

References

1. Dassault Systems – *SolidWorks Simulation*, Concord, Massachusetts, United States, 2014
2. Dassault Systems – *SolidWorks Flow Simulation*, Concord, Massachusetts, United States, 2014

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

MN222 Economic Geology and Mineralogy

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Economic Geology and Mineralogy

Subject Code: MN222

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**3 Lectures + 3Tutorial)

Delivery Mode On campus

Prerequisites: MN211 Introduction to Minerals Engineering

Co-requisites: None

Subject Coordinator: TBA

Synopsis

The subject covers concepts of geology, geological earth materials and processes, rock forming minerals and their physical properties; rock classification. Form clear understanding of history of the earth, plate tectonics, volcanoes, earth quakes and the resulting geological structures as well as weathering products and profile, and tectonic settings of PNG. Enhance students to differentiate between a mineral, rock forming minerals and ore mineralogy and the associated crystalogy, crystal structure and optic mineralogy. Students acquire clear concepts on classification of mineral deposits; hydrothermal, metasomatic, sedimentary, geothermal and hydrothermal system, epithermal and porphyry mineral deposit systems and mineralization. Students apply modern advanced mineral exploration techniques based on classification of mineral deposit.

Subject Topics

- Concepts of Geology, Rock forming minerals and Physical Properties
- Rock classification system; Igneous, Metamorphic & Sedimentary
- History of Earth, plate Tectonics, Volcanoes and Earth Quake
- Minerals, Rock forming Minerals and Ore Minerology
- Crystalogy,
- Classification of Mineral Deposits
- Morden Mineral Exploration Technology and Techniques

Subject Outline

Topic	Content
1. Concepts of Geology	• Concepts of Geology, Rock forming minerals and Physical Properties
2. Rock classification system	• Igneous, Metamorphic & Sedimentary

3. History of Earth, plate Tectonics, Volcanoes and Earth Quake	• History of Earth, plate Tectonics, Volcanoes and Earth Quake
4. Minerals, Rock forming Minerals and Ore Mineralogy	• Minerals, Rock forming Minerals and Ore Mineralogy
5. Crystalogy	• Crystal System and Optic Mineralogy
6. Classification of Mineral Deposits	• Magmatic, Hydrothermal, Metasomatic, Sedimentary, Geothermal & Hydrothermal System, Epithermal & Porphyry Mineral Deposits
7. Modern Mineral Exploration Technology and Techniques	• Modern Mineral Exploration Technology and Techniques

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Describe the Earth's Physical structures and composition, earth's geological process including plate tectonics, volcano crustal deformation and magmatism volcanism, mineral and rock formation, rock-cycle and mineral/ore deposition
2. Identify and distinguish rock forming from ore forming minerals based on crystalline structure, microscopic and physical properties. Distinguish the three rock types; igneous, metamorphic and sedimentary rocks using classification based on genesis, mineral composition, physical and chemical properties.
3. Identify and differentiate between alteration, mineralization, mineral deposit and ore deposit and classify different styles and types of mineral and ore deposits.
4. Differentiate between rock and ore forming minerals based on crystalline structure, microscopic and physical properties. Identify correctly the style of mineral deposits and the type of ore bodies to enable students to critically apply appropriate mining method and mine design.
5. Explain appropriate exploration techniques with respect to objective mineral commodity and application of current exploration technology

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(20 %)**
Laboratory and field work	**(20%)**
Assignments	**(10%)**
Final Examination	**(50%)**

Assessment 1 - **Tests:** There will be three (3) Tests contributing 20% towards the final grade for the subject.

Assessment 2 - **Laboratory and field work (if any)** The Laboratory and field work will contribute 20% towards the final grade for the subject. The case studies will have some problems which will assess the student's ability to think outside the box to consider real design and quality tests.

Assessment 3 - **Assignment/Group work:** The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 10% towards the final grade for the subject

Assessment 4 **Final written examination:** A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Blyth, F.G.H. & De Freitas, M.H., A Geology for Engineers, 7th Edition, ELBS with Edward Arnold, 1994

References

1. Sedra A S, Smith K C - Microelectronic Circuits, Fourth Edition, Oxford University Press, New York, 2009.
2. W. G. Shackleton, *Economic and Applied Geology*, Croom Helm Ltd, Provident House, 1986

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

MN223 Mining Technology

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Mining Technology

Subject Code: MN223

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**3 Lectures + 3Tutorial)

Delivery Mode On campus

Prerequisites: MN211 Introduction to Minerals Engineering

Co-requisites: None

Subject Coordinator: TBA

Synopsis

The subject introduces to students the unit operations and technologies employed in mineral beneficiation. At the start of the course, students learn the importance of mineralogy and how mineralogy influences processing of minerals. This is followed by sample types and sampling techniques. The stages of screening and size analyses are then examined in detail. In the later stages of the subject deals with analytical and mineralogical analyses techniques. Principles and application of various analytical tools as is applicable to the mineral industry are covered.

Subject Topics

1. Applied mineralogy
2. Sampling
3. Particle Sizing
4. Chemical analyses
5. Analytical Technique
6. Fire Assaying
7. Mineralogical analyses

Subject Outline

Topic	Content
1. Applied mineralogy	• mineral classification, physical properties, mineral texture, mineral liberation assessment, value of mineralogy
2. Sampling	• Theory of Sampling; Laboratory and industrial Sampling Equipment
3. Particle Sizing	• Properties of particles: sizes, shapes and comminution size distribution functions; Laboratory size measurements: wet and dry sieving, sub-sieve size analysis; interpretation and presentation of sizing data; performance evaluation • Industrial Screening
4. Chemical analyses	• General principles of analytical chemistry, errors and handling small data sets; Sensitivity and detection limits; Sample Preparation Techniques

5. Analytical Technique	• X-Ray fluorescence (XRF); Absorption Spectroscopy; UV-Visible absorption spectroscopy of molecules, and Infra-Red absorption Spectroscopy
6. Fire Assaying	• Principles and Practice
7. Mineralogical analyses	• Optical reflected light microscope, X-ray diffraction (XRD), automated mineralogy (MLA, QEMSCAN)

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Define and carry out mineralogical analyses of ores
2. Apply the theory and concept of sampling and understand the values of samples and/or sample types used for assaying
3. Plan and carry out sampling in laboratory, metallurgical plants or in the field in a team environment
4. Describe and explain the properties of particles (e.g. size, shape) and how they influence screening and/or classification in mineral processing operations
5. Select and apply suitable sizing method(s) and perform size analyses in a team environment
6. Plan and develop chemical and/or mineralogical analyses program and also carry out both chemical and mineralogical analyses in a team environment

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(20 %)**
Laboratory and field work	**(20%)**
Assignments	**(10%)**
Final Examination	**(50%)**

Assessment 1 - **Tests:** There will be three (3) Tests contributing 20% towards the final grade for the subject.

Assessment 2 - **Laboratory and field work (if any)** The Laboratory and field work will contribute 20% towards the final grade for the subject. The case studies will have some problems which will assess the student's ability to think outside the box to consider real design and quality tests.

Assessment 3 - **Assignment/Group work:** The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 10% towards the final grade for the subject

Assessment 4 **Final written examination:** A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Mineral Processing Technology, 7th Eds, Barry Wills, 2005
2. Principle of Instrumental analyses, Skoog, D.A.; West, D.M.; 1980

References

- Numerous links are provided within the Subject Topics to research organisations, international universities, YouTube clips, and research databases

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

SE222 Spatial Science

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Spatial Science

Subject Code: SE222

Duration:	13 Teaching weeks
Contact Hours:	6 Hours per week
Credit Points:	**18 (**3 Lectures + 3Tutorial)
Delivery Mode	On campus
Prerequisites:	None
Co-requisites:	None
Subject Coordinator:	School of Surveying & Property Studies

Synopsis

The subject provides students with basic surveying knowledge and skills relevant to mining engineering and civil engineering. It also provides mapping skill Remote Sensing, GIS, GPS and GNSS technologies.

Subject Topics

1. Terrestrial and Hydrographic surveying principals
2. Measurement of distance with bands, site plan preparation.
3. Simple co-ordinate calculations.
4. Field Management, Recording of results.
5. Use of materials manual.
6. Concepts of GIS, Remote Sensing, GPS and GNSS technologies
7. Management of spatial information and sources of GIS data
8. Drone/Aerial photo - flight planning.
9. Trend of Remote sensing and Drone technology; flight plan design, computation and pre-requisite.
10. High resolution LiDAR data and its application in topographic mapping.

Subject Outline

Topic	Content
1. Terrestrial and Hydrographic surveying principals	• Terrestrial and Hydrographic surveying principals
2. Measurement of distance with bands, site plan preparation.	• Measurement of distance with bands, site plan preparation.
3. Simple co-ordinate calculations	• Measurement of horizontal and vertical angles. Traversing and Tacheometric surveying. Contouring, plotting simple survey, site plans/ maps
4. Field Management, Recording of results	• Field Management, Recording of results
5. Use of materials manual	• Survey Data Entering Systems and Data Manipulation
6. Concepts of GIS, Remote Sensing, GPS and GNSS technologies	• Concepts of GIS, Remote Sensing, GPS and GNSS technologies
7. Management of spatial information and sources of GIS data	• Hardware and software components of GIS, Spatial data, non-spatial data, raster data, vector data, Satellite constellation, GPS signals and data, geo-positioning, control segment, space segments, user segment, GPS positioning types- absolute positioning, differential positioning
8. Drone/Aerial photo	• Drone/Aerial photo - flight planning
9. Trend of Remote sensing and Drone technology	• Trend of Remote sensing and Drone technology; flight plan design, computation and pre-requisite
10. High resolution LiDAR data and its application in topographic mapping	• High resolution LiDAR data and its application in topographic mapping. • Characteristic of LiDAR data, interpretation of LiDAR, application in topographic mapping. Exposure to mapping software. Converting of • Photographs to ESCI file format and • Aerial Photography or LiDAR Images

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Carry out site plan preparation using bands surveying for distance measurements;
2. Carry out contour surveys for long and cross sections;
3. Perform simple traversing by tacheometric surveying;
4. Familiar to the various components of a GIS and the types of geospatial data
5. Prepare and interpret remotely sensed data, LiDAR data
   Understand the basic applications of hand held GPS/GNSS receivers to surveying and mapping

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(20 %)**
Laboratory and field work	**(20%)**
Assignments	**(10%)**
Final Examination	**(50%)**

Assessment 1 - **Tests:** There will be three (3) Tests contributing 20% towards the final grade for the subject.

Assessment 2 - **Laboratory and field work (if any)** The Laboratory and field work will contribute 20% towards the final grade for the subject. The case studies will have some problems which will assess the student's ability to think outside the box to consider real design and quality tests.

Assessment 3 - **Assignment/Group work:** The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 10% towards the final grade for the subject

Assessment 4 **Final written examination:** A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. J. Uren and W.F. Price, Surveying for Engineers, MacMillar, London,
2. Mine Surveying Study Book, Darling Down, Institute of Advanced Education.
3. Lillesand & Keifer, (2015) Remote Sensing and Image Interpretation, 7th Edn. Published by Wiley and Sons ISBN 0-471-45152-5
4. Burrough, P.A., and McDonnell, R.A., Principles of Geographic Information Systems, 2nd Edn., (2015), Oxford University Press, Oxford. ISBN: 0-19-823365-5

References

1. Winiberg F., Mine Surveying, McMillan, London.
2. Surveying Problems and solutions, latest edition, Arnold, London.

3. Spencer, J., Frizzelle, B. G., Page, P. H. and Vogler, J. B. (2003), Global Positioning System: a field guide for the social sciences. London: Blackwell Publishers.
4. Gregory, I. N. (2003), A place in history: a guide to using GIS in historical research. Oxford: Oxbow Books

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

MN311 Bulk Materials Handling in Mines

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Bulk Material Handling in Mines

Subject Code: MN311

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**3 Lectures + 3Tutorial)

Delivery Mode On campus

Prerequisites: None

Co-requisites: None

Subject Coordinator: TBA

Synopsis

Bulk materials handling in mines enables the students to; review, assess, and formulate a bulk material handling system design by applying contemporary bulk materials handling technology. The students will apply their cognitive ability to critically assess, evaluate, formulate and apply engineering technology to design; storage facilities; stockpile, bins/hopper storage; bulk materials transportation system; haulage trucks, belt conveyor, slurry/ pipe transportation; placing and reclaiming technology and review and assess bulk material properties and apply quality control techniques and technology.

Subject Topics

1. Introduction
2. Storage of bulk materials in mines (Stockpile and bin storage design)
3. Placing and reclaiming technology and bulk material quality control
4. Belt conveyor technology and application in mines
5. Slurry/ pipe transporting technology and application in mines

Subject Outline

Topic	Content
• Introduction	• Review and assessment of a bulk material handling system and review of bulk materials properties.
• Storage of bulk materials in mines	• Storage of bulk materials in mines - Stockpile and bin storage design
• Placing and reclaiming technology and bulk material quality control	• Placing and reclaiming technology and bulk material quality control

• Belt conveyor technology and application in mines	• Belt conveyor technology and application in mines
• Slurry/ pipe transporting technology and application in mines	Slurry/ pipe transporting technology and application in mines

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Critically review and explain aspects of bulk materials handling condition and application, and, name and define bulk materials properties, discuss how they affect materials handling systems designs, and be able to calculate and demonstrate how to determine their values.

2. Name, differentiate, appraise, and apply contemporary technology in the design of bulk materials storage and their suitability and application in mines; critically assess and evaluate; stockpile techniques and formulate a stock piles system and assess its suitability, and formulate and design bins/hopper as surge storage facility in mines and assess its suitability.

3. Identify, and explain bulk material quality control techniques and demonstrate their application in mines, and review, appraise placing and reclaiming technology, and formulate and validate material placing and reclaiming design.

4. Explain the operating principles of a belt conveyor system and demonstrate applicability of belt conveyors. Examine, formulate, and validate a belt conveyor design.

5. Define and evaluate rheology of various types of fluids and explain the flow behaviour of various fluids and demonstrate their applications. Examine, formulate, and validate a slurry transport design.

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(20 %)**
Laboratory and field work	**(20%)**
Assignments	**(10%)**
Final Examination	**(50%)**

Assessment 1 - **Tests:** There will be three (3) Tests contributing 20% towards the final grade for the subject.

Assessment 2 - **Laboratory and field work (if any)** The Laboratory and field work will contribute 20% towards the final grade for the subject. The case studies will have some problems which will assess the student's ability to think outside the box to consider real design and quality tests.

Assessment 3 - **Assignment/Group work:** The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 10% towards the final grade for the subject

Assessment 4 **Final written examination:** A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Howard, H.L, Introduction to Mining Engineering, John Wiley & Sons, New York, 1987.
2. B.A. Wills., Introduction to Mineral Technology, 7th ed. 2006.

References

Numerous links are provided within the Subject Topics to research organisations, international universities, YouTube clips, and research databases

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

MN312 Underground Mining

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Underground Mining

Subject Code: MN312

Duration:	13 Teaching weeks
Contact Hours:	6 Hours per week
Credit Points:	**18 (**3 Lectures + 3Tutorial)
Delivery Mode	On campus
Prerequisites:	MN211 Introduction to minerals engineering
Co-requisites:	None
Subject Coordinator:	TBA

Synopsis

Underground mining engineering subject covers; elements of underground mining engineering technology and application; mining techniques and terminologies, mine development opening theory and practice; unit operations; and underground mine modelling and design.

Subject Topics

1. Introduction to underground mining
2. Underground mining methods and technologies
3. Underground mine development design and technology.
4. Unit operations in underground metal mines
5. Underground mine model design

Subject Outline

Topic	Content
1. Introduction	• Introduction to underground mining .
2. Underground mining methods and technologies	• Underground mining methods and technologies
3. Underground mine development design and technology	• Unit operations in underground metal mines
4. Underground mine model design	• Underground mine development design and technology

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Critically review and appraise of aspects of underground mining technology and application; compare and explain common underground terminologies.

2. Review, differentiate, compare and evaluate application of underground mining techniques and technologies in underground metal mines.

3. Critically review, and compare underground mine openings and apply cognitive ability to design development openings; assess, evaluate and select mine opening, review rock fragmentation theory and application, select rock drill technology and explosives, design mine opening drill and blast, and validate a mine development opening design.

4. Review and synthesis underground mining technologies and assess mine production plans and apply techniques to select mining equipment and demonstrate ability to; evaluate ground condition, formulate and design a production stope. Examine and validate stope designs and mine production system.

5. Critically assess, appraise underground conditions, and apply cognitive ability to practically synthesis, formulate and design underground mine, and communicate these professionally.

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(20 %)**
Assignments	**(30%)**
Final Examination	**(50%)**

Assessment 1 - **Test:** There will be one Test contributing 20% towards the final grade for the subject.

Assessment 2 - **Assignment/Group work:** The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 30% towards the final grade for the subject

Assessment 3 **Final written examination:** A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Cummins, A.B, and Given, (eds), SME, Mining Engineering Hanbook, SME, New York, 2nd Edition, 1993.

References

Numerous links are provided within the Subject Topics to research organisations, international universities, YouTube clips, and research databases

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

MN313 Engineering Geology and Geomechanics

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Engineering Geology and Geomechanics

Subject Code: MN313

Duration:	13 Teaching weeks
Contact Hours:	6 Hours per week
Credit Points:	**18 (**3 Lectures + 3Tutorial)
Delivery Mode	On campus
Prerequisites:	MN211 Introduction to minerals engineering
Co-requisites:	None
Subject Coordinator:	TBA

Synopsis

The subject enables students to acquire knowledge in engineering Geology: Geological structures, crustal deformation, rock defect morphology and geometry – including faults, joints and shear zones; methods of site investigation – measurement of engineering geological properties of rocks and presentation of defect analysis results; introduction to geotechnical logging, terminology and practice; use of three dimensional techniques for problem solving in mine batter slope failures: stereographic projection; geological hazard analysis and avoidance of risk areas, natural slopes and slope failure mechanisms; mine batter slopes and main types of batter failures. Geomechanics; provides students with the fundamental knowledge required to undertake more advanced geotechnical investigations and design tasks. Concept of Stress and Strain in Rock: Analysis of stress, strain and constitutive relations in isotropic and anisotropic rocks. Physico-mechanical Properties of Rock: Determination of physical properties, strengths, strength indices and static and dynamic elastic constants; parameters influencing strength; rock failure.

Subject Topics

1. Earth geological structure and deformation, engineering geological properties and behaviour of rock mass
2. Engineering geological structure measurement and analysis

3. Application of rock mechanics in mining and construction. Theory of elasticity, elastic deformation, plastic deformation. Stress-strain (axial and volumetric strain) curve measurement.
4. Rock deformation and failure criteria
5. Pre-Mining State of Stress - In-situ stress. Major, intermediate and minor principle stress Methods of Stress Analysis in Rocks. Stress induced crack initiation and damage threshold Introduction to Mining Engineering Technology
6. Plane stress and plane stress analysis, stress in underground openings

Subject Outline

Topic	Content
1. Geological structure and rock mass	• Earth geological structure and deformation, engineering geological properties and behaviour of rock mass.
2. Structural measurement and analysis	• Engineering geological structure measurement and analysis
3. Application of rock mechanics	• Application of rock mechanics in mining and construction. Theory of elasticity, elastic deformation, plastic deformation. Stress-strain (axial and volumetric strain) curve measurement
4. Rock deformation and failure criteria	• Rock deformation and failure criteria
5. Pre-Mining State of Stress	• Pre-Mining State of Stress - In-situ stress. Major, intermediate and minor principle stress Methods of Stress Analysis in Rocks. Stress induced crack initiation and damage threshold Introduction to Mining Engineering Technology
6. Plane stress	• Plane stress and plane stress analysis, stress in underground openings

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Recognize the effects of rock structural discontinuity on the stability of rock slopes and underground opening
2. Critically analyse rock and rock mass deformation behaviour for design of excavations.
3. Competently apply mechanical properties of rocks and geological structural data for design purpose
4. Evaluate, analyse and predict rock mass deformation based on structural and mechanical properties of rocks.
5. Appraise and apply structural geology and mechanical properties of rocks to design rock slopes and underground openings.

Assessment Tasks and Weightings

The summative exam (final examination) will carry 40% and formative assessment (continuous assessment) 60%.

Students must also refer to the Subject Assessment Details.

Tests **(20 %)**
Laboratory and field work **(30%)**

Assignments **(10%)**
Final Examination **(40%)**

Assessment 1 - **Tests:** There will be three (3) Tests contributing 20% towards the final grade for the subject.

Assessment 2 - **Laboratory and field work (if any)** The Laboratory and field work will contribute 30% towards the final grade for the subject. The case studies will have some problems which will assess the student's ability to think outside the box to consider real design and quality tests.

Assessment 3 - **Assignment/Group work:** The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 10% towards the final grade for the subject

Assessment 4 **Final written examination:** A 3 hour written examination weighs 40%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Beavis, F.C., Engineering Geology, Blackwell, Melbourne, Australia.
2. Introduction to rock mechanics. Richard E Goodman.
3. Fundamentals of Rock Mechanics, 4th Edition. John Conrad Jaeger, Neville G. W. Cook, Robert Zimmerman

References

Numerous links are provided within the Subject Topics to research organisations, international universities, YouTube clips, and research databases

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

MN314 Rock Fragmentation

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Rock Fragmentation

Subject Code: MN314

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**3 Lectures + 3Tutorial)

Delivery Mode On campus

Prerequisites: MN211 Introduction to minerals engineering

Co-requisites: None

Subject Coordinator: TBA

Synopsis

The Rock Fragmentation subject covers; review of rock fragmentation techniques and technology applied in surface and underground mining. Review theory and application of rock drilling: principles of rock penetration, rock-bit interactions, specific energy, and prediction of penetration rate, types of drilling and drill-bits, machine selection. Review theory of rock fragmentation by explosives as well as theory of crushing and grinding. Review recent developments in explosives and blasting technology; monitoring blasting results: Borehole pressure, transducer, V.O.D. Probe, vibration monitor, high speed video camera, blast design, mechanics of blasting. Computational models of blasting. Influence techniques, overcasting with explosives. Nuclear blasting and safety.

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Subject Topics

1. Introduction to rock fragmentation
2. Rock drilling
3. Explosives and blasting
4. Blasting damages
5. Blasting Systems

Recent developments in explosives and blasting techniques

Subject Outline

Topic	Content
1. Introduction	• Introduction to rock fragmentation.
2. Rock drilling	• Rock drilling
3. Explosives and blasting	• Explosives and blasting
4. Blasting damages	• Blasting damages
5. Blasting systems	• Blasting systems

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Critically review and explain rock fragmentation technology and their contemporary application in mines in both underground surface mines.

2. Review theory and application of rock drilling and, assess, compare and evaluate rock drill capability and select drilling equipment.

3. Name, classify and compare properties of explosives, blasting devices, safety consideration, and application. Review and explain theory of rock fragmentation by explosives as well as crushing and grinding.

4. Review, assess and evaluate ground vibrations and air blast; Examine and evaluate impact of ground vibration and air blast on the neighbouring structures and communities and formulate mitigation measures, reinforcement and design alternatives.

5. Identify and review blasting system; electric and non-electric methods, delay blasting techniques, priming, charge distribution, and mechanism of rock blasting, and examine and validate a blast system.

6. Review of recent development in drilling and blasting technology and, assess apply and formulate fragmentation optimization and environmental effect control. Examine, and validate a mine blast design and communicate this professionally.

Assessment Tasks and Weightings

The summative exam (final examination) will carry 40% and formative assessment (continuous assessment) 60%.

Students must also refer to the Subject Assessment Details.

Tests	**(20 %)**
Assignments	**(30%)**
Final Examination	**(50%)**

Assessment Task 1: Test: There will be one Test contributing 20% towards the final grade for the subject.

Assessment Task 2: Assignment/Group work: The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 30% towards the final grade for the subject

Assessment Task 3: Final written examination: A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. G. B. Clark, Principles of rock fragmentation, e-book, January 1987

References

Numerous links are provided within the Subject Topics to research organisations, international universities, YouTube clips, and research databases

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

MN321 Mine Ventilation

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Mine Ventilation

Subject Code: MN321

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**3 Lectures + 3Tutorial)

Delivery Mode On campus

Prerequisites: MN212 Thermo-fluids

Co-requisites: None

Subject Coordinator: TBA

Synopsis

This subject outlines the science and concepts of underground mine ventilation. It covers composition of underground mine atmosphere including mine climatic conditions, composition of mine air, toxic gas and sources of pollutants in non-metallic and metallic mines. It covers air flow through mine openings, distribution, and total volumetric requirement. The subject also covers total mine resistance, pressure drop across the system, natural ventilation pressure. Mechanical Ventilation: Types of mine fans and fan characteristics and selection to match the mine ventilation system requirement. Ventilation Planning: Planning of ventilation systems and economic considerations; ventilation layouts; calculation of air quantity required for ventilating a mine. Network analysis principles and computer applications; automation and remote control of ventilation installations; Ventilation, design, survey and simulation.

Subject Topics

1. Composition of atmospheric air and mine air, sources of contaminants, hazards, threshold limit and safety
2. Underground mine atmosphere, heat, humidity, sources of heat and cooling system.
3. Mine ventilation system characteristics, natural ventilation pressure, system resistance and total pressure
4. Fan selection, fan characteristics and fan curve.
5. Ventilation survey and monitoring technology
6. Ventilation network layout and design

Subject Outline

Topic	Content
1. Air composition, sources, hazards and safety	• Composition of atmospheric air and mine air, sources of contaminants, hazards, threshold limit and safety.
2. Underground operating condition	• Underground mine atmosphere, heat, humidity, sources of heat and cooling system

3. Mine ventilation	• Mine ventilation system characteristics, natural ventilation pressure, system resistance and total pressure
4. Ventilation monitoring	• Ventilation survey and monitoring technology
5. Ventilation design	• Ventilation network layout and design

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Identify of sources of air pollutants, and evaluate mine climatic conditions and environmental conditions
2. Critically analyse and evaluate mine ventilation system airflow requirement(s)
3. Undertake complex calculations in mine humidity and thermal comfort, contaminant dilution, sufficient airflow to dilute contaminants to meet production requirement.
4. Evaluate a ventilation system to select a fan to suit the system considering total mine resistance, energy loss in the ventilation system and select fans for efficient.
5. Conduct ventilation survey data using modern technology and use survey data to monitor ventilation using ventilation soft wares.
6. Critically design ventilation layout and ventilation network for efficient ventilation system

Assessment Tasks and Weightings

The summative exam (final examination) will carry 40% and formative assessment (continuous assessment) 60%.

Students must also refer to the Subject Assessment Details.

Tests	**(20 %)**
Assignments	**(30%)**
Final Examination	**(50%)**

Assessment Task 1: Test: There will be one Test contributing 20% towards the final grade for the subject.

Assessment Task 2: Assignment/Group work: The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 30% towards the final grade for the subject

Assessment Task 3: Final written examination: A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. G. B. Clark, Principles of rock fragmentation, e-book, January 1987

References

Numerous links are provided within the Subject Topics to research organisations, international universities, YouTube clips, and research databases

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

MN322 Mineral Resources Estimation and Geostatistics

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Mineral Resources Estimation & Geostatistics

Subject Code: MN322

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**3 Lectures + 3Tutorial)

Delivery Mode On campus

Prerequisites: MN212 Thermo-fluids

Co-requisites: None

Subject Coordinator: TBA

Synopsis

The Mineral Reserve Estimation and Geostatistics subject covers; mineral reserve estimation process, mineral resource terminologies and resource confidence classification; drilling program; theories, techniques and applications in estimating resources. It considers the resource parameters for estimation of mineral reserves including; grade, tonnage, engineering factors, grade-tonnage curves and sample data and program design. It reviews the theory and application of estimation techniques, validate resource estimates; geostatistical techniques in estimating mineral content, examine and validation of ore reserve estimates.

Subject Topics

1. Introduction to mineral reserve estimation
2. Resources code of practice and classification
3. Resource estimation parameters
4. Sampling and sample data evaluation
5. Mineral resource estimation techniques; theory and application
6. Introduction to geostatistics

Subject Outline

Topic	Content
1. Introduction to mineral reserve estimation	• Introduction to mineral reserve estimation

2. Resources code of practice and classification	• Resources code of practice and classification
3. Resource estimation parameters	• Resource estimation parameters
4. Sampling and sample data evaluation	• Sampling and sample data evaluation
5. Mineral resource estimation techniques; theory and application	• Mineral resource estimation techniques; theory and application
6. Introduction to geostatistics	• Introduction to geostatistics

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Identify of sources of air pollutants, and evaluate mine climatic conditions and environmental conditions
2. Critically analyse and evaluate mine ventilation system airflow requirements.
3. Undertake complex calculations in mine humidity and thermal comfort, contaminant dilution, sufficient airflow to dilute contaminants to meet production requirement.
4. Evaluate a ventilation system to select a fan to suit the system considering total mine resistance, energy loss in the ventilation system and select fans for efficient.
5. Conduct ventilation survey data using modern technology and use survey data to monitor ventilation using ventilation soft wares.
6. Critically design ventilation layout and ventilation network for efficient ventilation system.

Assessment Tasks and Weightings

The summative exam (final examination) will carry 40% and formative assessment (continuous assessment) 60%.

Students must also refer to the Subject Assessment Details.

Assessment 1 - Test: There will be one Test contributing 15% towards the final grade for the subject.

Assessment 2 - Assignments/Group projects: The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 25% towards the final grade for the subject

Assessment 3 – Laboratory – 20%

Assessment 4 - Final written examination: A 3 hour written examination weighs 40%

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Environmental engineering in mines / V.S. Vutukuri, R.D. Lama.
2. Subsurface Ventilation and Environmental Engineering, **McPherson**, M.J.
3. Howard, H.L, Introduction to Mining Engineering, John Wiley & Sons, New York, 1987

References

Numerous links are provided within the Subject Topics to research organisations, international universities, YouTube clips, and research databases

Relevant Unitech Policies

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MN323 Applied Geomechanics

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Applied Geomechanics

Subject Code: MN323

Duration:	13 Teaching weeks
Contact Hours:	6 Hours per week
Credit Points:	**18 (**3 Lectures + 3Tutorial)
Delivery Mode	On campus
Prerequisites:	MN 313 Engineering Geology & Geomechanics
Co-requisites:	None
Subject Coordinator:	TBA

Synopsis

The subject addresses various geomechanical factors affecting excavation behaviour. It includes stresses around mining excavations computational theory and methods used to determine rock behaviour and stress analysis. It covers rock mass characterisation and mine seismicity and related dynamic high stress events. Ground support systems and geotechnical aspects are addressed with stress relief and yield pillar systems and subsidence above underground mine excavations and slope stability in open pit mines. Data for surface mining geotechnical engineering collected for surface geotechnical is reviewed. Slope stability analysis is reviewed as well as design and optimisation of slopes; construction of slopes, ground and surface water management and analysis and interpretation of monitoring methods in open pit mines. Tailings and dam construction design is considered as well as waste dump design and construction. Geotechnical engineering issues are solved in a study and design project whilst consideration is given to the geotechnical aspects of haul road design and construction within regulatory frameworks.

Subject Topics

1. Rock mass strength, behaviour and classification
2. In-situ stress and induced stress calculation
3. Open pit slope Stability assessment and support design
4. Underground opening and mine stope stability and support design system
5. Instrumentation, data collection for design and monitoring Technology
6. Surface and ground water management and control system

7. Geotechnical aspects of haul road design, tailings dam design for safety compliance

Subject Outline

Topic	Content
1. Rock mass strength, behaviour and classification estimation	• Rock mass strength, behaviour and classification estimation
2. In-situ stress and induced stress calculation	• In-situ stress and induced stress calculation
3. Open pit slope Stability assessment and support design	• Open pit slope Stability assessment and support design
4. Underground opening and mine stope stability and support design system	• Underground opening and mine stope stability and support design system
5. Instrumentation, data collection for design and monitoring Technology	• Instrumentation, data collection for design and monitoring Technology
6. Surface and ground water management and control system	• Surface and ground water management and control system
7. Geotechnical aspects of haul road design, tailings dam design for safety compliance	• Geotechnical aspects of haul road design, tailings dam design for safety compliance

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Analyse and design soil and rock slopes in both open pit and underground mine openings.
2. Evaluate the possibility and consequence of ground failures and design support techniques to maintain soil/rock stability in mine excavations.
3. Analyse in-situ stress and stress distribution profile around underground openings and open pit mine spoils
4. Design open pit mine slope and underground excavation openings for safe and stable extraction of minerals
5. Design and assess stability of tailing dam and ground water management system
6. Collate, process and analyse data from modern monitoring technology

Assessment Tasks and Weightings

The summative exam (final examination) will carry 40% and formative assessment (continuous assessment) 60%.

Students must also refer to the Subject Assessment Details.

Tests **(20 %)**

Assignments	**(30%)**
Final Examination	**(50%)**

Assessment 1 - Test: There will be one Test contributing 20% towards the final grade for the subject.

Assessment 2 - Assignment/Group work: The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 30% towards the final grade for the subject

Assessment 3 Final written examination: A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. G. B. Clark, Principles of rock fragmentation, e-book, January 1987

References

Numerous links are provided within the Subject Topics to research organisations, international universities, YouTube clips, and research databases

Relevant Unitech Policies

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MN324 Surface Mine

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Surface Mine

Subject Code: MN324

Duration:	13 Teaching weeks
Contact Hours:	6 Hours per week
Credit Points:	**18 (**3 Lectures + 3Tutorial)
Delivery Mode	On campus
Prerequisites:	MN211 Introduction to Minerals Engineering
Co-requisites:	None
Subject Coordinator:	TBA

Synopsis

Surface mining engineering subject covers; elements of alluvial mining and open pit mining engineering technology; theory and principles of alluvial minerals development, surface mining concepts, principles and application; pit design parameters; bench

height, pit slope angles, haul road, cut-off grade, stripping ratio; open pit design and pit optimisation techniques; manual and computerised techniques. It reviews the assessment and formulation of a mine plan and the design of a surface mining project.

Subject Topics

1. Introduction to Surface Mining
2. Alluvial mining techniques and technology
3. Open Pit Mine Design Parameters
4. Open pit mine design and pit optimization techniques and technology
5. Mine planning and design

Subject Outline

Topic	Content
1. Introduction	• Introduction to Surface Mining .
2. Alluvial mining techniques and technology	• Alluvial mining techniques and technology
3. Open Pit Mine Design Parameters	• Open Pit Mine Design Parameters
4. Open pit mine design and pit optimization techniques and technology	• Open pit mine design and pit optimization techniques and technology
5. Mine planning and design	• Mine planning and design

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Critically review aspects of surface mining and surface mining technology, evaluate conditions and applications in mines;

2. Identify and explain alluvial mineral deposits; examine, and formulate a mining technique to design a mining production system.

3. Describe and explain the concept of bench design, the principles of haul road design and layout, stripping ratio and its application in mine design and mining operation, and the concept of ultimate pit-slope design.

4. Undertake open pit design and apply pit optimization techniques to design surface mine.

5. Apply mine planning and design technologies for a surface mine production system, including mining equipment selection, pit design, and haulage system, and mine production planning and scheduling. Validate surface mine design and communicate those outcomes professionally

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(20 %)**
Assignments	**(30%)**
Final Examination	**(50%)**

Assessment 1 - Test: There will be one Test contributing 20% towards the final grade for the subject.

Assessment 2 - Assignment/Group work: The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 30% towards the final grade for the subject

Assessment 3 Final written examination: A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Text Book: Kennedy, B.A (Ed) Surface Mining SME, 1990

References

Numerous links are provided within the Subject Topics to research organisations, international universities, YouTube clips, and research databases

Relevant Unitech Policies

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EN411 Research Project A

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Research Project A

Subject Code: EN411

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **20 (**1 hour lecture, 5 hours project)

Delivery Mode On campus

Prerequisites: Year 2 to Year 4 subjects

Co-requisites: None

Subject Coordinator: TBA

Synopsis

This subject outlines the commencement of undertaking of research that will augment professional work in the students engineering discipline and form a foundation for future learning and professional development. It is intended to help students develop the cognitive skills for to think critically about research methods and literature reviews. The subject covers the introduction to research investigation through the creation of a research hypothesis, critical review and interpretation of literature on an approved topic and communication of those outcomes. The research provides an opportunity for the practical application and integration of the students' professional background and skills, and previous studies in the discipline's supporting subjects.

Subject Topics

1. Concerns developing a research proposal and outlines the various types of research that may be undertaken by engineers and suggests that most engineers typically undertake research in the applied research space, using a quantitative approach.
2. Stresses the importance of developing the research question and topic is stressed along with the need to ensure that the proposed research can be completed within the time allocated to the project.
3. Succinctly outlines definitions, structures and the role of the literature review in a research report. It stresses how one of the most important roles of the literature review is to show where the proposed research fits within, and augments, the existing international contemporary literature.
4. Involves the provision of guidance on structuring and writing the Literature Review Report and communication the outcomes via an audio visual presentation

Subject Outline

Topic	Content
1. Topic 1	• Concerns developing a research proposal and outlines the various types of research that may be undertaken by engineers and suggests that most engineers typically undertake research in the applied research space, using a quantitative approach.
2. Topic 2	• Stresses the importance of developing the research question and topic is stressed along with the need to ensure that the proposed research can be completed within the time allocated to the project

3. Topic 3	• Succinctly outlines definitions, structures and the role of the literature review in a research report. It stresses how one of the most important roles of the literature review is to show where the proposed research fits within, and augments, the existing international contemporary literature
4. Topic 4	• Involves the provision of guidance on structuring and writing the Literature Review Report and communication the outcomes via an audio visual presentation

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Explain the various types of research that may be undertaken by engineers and the use of quantitative and qualitative research methodologies.
2. Develop and justify a research question/hypothesis and proposal.
3. Source and critically evaluate and synthesize research literature to determine the level of contemporary knowledge in a specialist area.
4. Construct a literature survey that places a research question within the international contemporary space and justifies the research hypothesis.
5. Create an audio visual presentation that communicates the outcomes of the literature survey to a diverse audience

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the Research Literature Review Final Report.

Students must also refer to the Subject Assessment Details.

Research Proposal	**(10 %)**
Progressive report	**(25%)**
Final Report	**(45%)**
Audio-visual presentation	**(20%)**

Assessment Task 1 requires the development of the ***Research Proposal***, the research question and outlining the proposed research methodology to ensure that the proposed research is achievable. It is worth 10% of the total marks for the Subject.

Assessment Task 2 helps to facilitate the structured developed of the research literature review by requiring a ***Research Literature Review Progress Report***, which must include a critical review of the international literature. The progress report will be presented as a concise engineering report. It is worth 25% of the total marks for the Subject.

Assessment Task 3 requires the production of the ***Research Literature Review Final Report*** that will be a critical review of the international literature and include ethical and sustainability aspects. The final report will be presented as a concise engineering report. It is worth 45% of the total marks for the Subject.

Assessment Task 4 provides an opportunity for the ***Audio-visual Presentation of the Research Literature Review Outcomes***. The presentation must include both visual and audio and must be delivered to the student cohort for the Subject. It is worth 20% of the total marks for the Unit

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

References

Numerous links are provided within the Subject Topics to research organisations, international universities, YouTube clips, and research databases

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

MN411 Project Management and Economics

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Project Management & Economics

Subject Code: MN411

Duration:	13 Teaching weeks
Contact Hours:	6 Hours per week
Credit Points:	**18 (**1 hour lecture, 5 hours project)
Delivery Mode	On campus
Prerequisites:	Year 2 to Year 4 subjects
Co-requisites:	None
Subject Coordinator:	TBA

Synopsis

The subject covers project management and economics as an interdisciplinary area of management decision-making techniques for imparting management skills required to evaluate plan and scope projects, manage risk and cost budgeting. Conceptual understanding of business strategies and market structures affect the economic and financial evaluation of mining projects and operation management tools. As such, the subject ensures the students attain the knowledge and hands-on skills that provide the foundation for achieving competency in mining project evaluation and operation management.

Subject Topics

1. Business Management Strategies:
2. Critical Path Method (CPM):
3. Linear Programming (LP):
4. Queuing Models:
5. Economic Order Quantity (EOQ) model:

6. Financial derivatives:

7. Time value of money applications:

8. Discounted Cash Flow (DCF) analysis.

Subject Outline

Topic	Content
1. Business Management Strategies	• Generic strategies, low-cost production strategy, Porter's Five Forces of competition, sustainable competitive advantage, market structure and factors of production and business growth horizons, organisation structures.
2. Critical Path Method (CPM)	• Construct CPM for scheduling time and resource allocations for managing and completing a project under time and cost constraints.
3. Linear Programming (LP)	• Convert descriptive problems into linear models (equations) solve LP problems using graphical technique and Solver in Excel™.
4. Queuing models	• Define different waiting line systems and calling population, and use average time and Poison Distribution to optimise productivity associated with time management and the cost of waiting.
5. Economic order quantity (EOQ) model	• Define ordering and holding costs and ordering cycle (graphical), optimal order size, total inventory costs, number of orders per year, and order cycle time
6. Financial derivatives	• Understanding of price commodity price cycles, the different type of interest rates, inflation, depreciation techniques and mining taxes, including royalties
7. Time value of money applications	• Define present, future and annual worth or values as they apply to complex investment decision-making associated with mutually and non-mutually investment options. It also covers equipment replacement analysis
8. Discounted cash flow (DCF) analysis	• Definition of cash flows, net present value (NPV), internal rate of return (IRR), capital efficiency (KE) and discounted payback period (DPP), construct a linear DCF model (nominal and real) and derive the financial variables (NPV, IRR, KE & DPP) for investment decision-making

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Be able to analyse the market structure, competitive strategies and have the ability to strategize different business outcomes under competitive forces that influence management decisions that are subject to dynamic market structures.

2. Be able to use operation research management tools such as Critical path method (CPM), Linear Programming (LP), and Economic Quantity Order (EQO) and other management tools to analyse problems using numerical data and confidentially provide recommendations for managerial decision-making.

3. Be able to analyse the basic principles of financial derivatives and the time value of money applications and have the ability to construct liner DCF financial model for the economic and financial evaluation of mining projects using economic, fiscal, mineral deposit and market information.

4. Be able to explain, analyse and apply competitive forces that influence management decisions and optimise operation productivity using operation research tools and confidently evaluate a project at the feasibility stage for assessing investment viability, planning, designing and construction of mining investment.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the Research Literature Review Final Report.

Students must also refer to the Subject Assessment Details.

Assignment 1	**(12.5%)**
Assignment 2	**(12.5%)**
Test 1	**(12.5%)**
Test 2	**(12.5%)**
Final exam	**(50%)**

Assessment Task 1: Assignment 1 contributes about 12.5% of the final marks. This designed to ensure the students explain business strategies and principles that are applied to manage the competitive forces that shape business decision-making within a market structure, especially for the mining industry. Also, the students will critically analyse management problems using operation research techniques that will demonstrate their abilities to analyse and interpret the numerical results and recommend suitable win-win solutions for different aspects of business operations.

Assessment Task 2: Assignment 2 contributes about 12.5% of the final marks. This assignment is designed for students to conceptualise the principles of the time value of money and solve application problems for making mutually and non-mutually investment decisions given the market and economic conditions. The students will be able to use spatial (geological), fiscal, economic and incorporate risks into the linear DCF model to derive financial decision-making variables such as the net present value (NPV) that enable them to make financial management decisions for analysing the financial viability of a mining project.

Assessment Task 3: Test 1 contributes to 12.5% of the total marks. This test is designed to assess the students' cognitive ability to apply the principles of business management strategies within different market structures and analyse the problems associated with optimal management decision-making, which includes construction scheduling, production optimisation and inventory management of material supplies of production.

Assessment Task 4: Test 2 contributes to 12.5% of the total marks. This test is designed to assess students' ability to apply the time value of money applications and use economic, market, financial and spatial data to construct a DCF model of a hypothetical business operation, derive the decision variables and

be able to interpret and analyse the results and provide recommendations for investment decision-making.

Assessment Task 5: Final written examination contributes to 50% of the total marks. The final examination covers the entire lectures, assignments and quizzes to assess students' ability to apply business strategies competently and solve management problems using operation research tools and the time value of money problems. Additionally, it tests students' ability to apply geological data, economic, fiscal and market risk conditions to construct a linear DCF and be able to use the results to evaluate the economic and financial viability of a mining project

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Allan Trench and Thomas Judge, (2002), The Insider's Guide to Success in Australian Business Management, Wrightbooks, McPherson's Printing Group, Australia
2. Stermole, F.J. (2000), Economic evaluation and investment decision methods 7th ed. Investment evaluations Corp
3. Thomas F. Torries, (1998), Evaluating mineral projects: Applications and misconceptions, SMME Inc.
   DeGrom, E.P., Sullivan, W.G. & Bontadelli, J.A, (1993), Engineering economy 9th Ed. MacMillan.

References

Numerous links are provided within the Subject Topics to research organisations, international universities, YouTube clips, and research databases

Relevant Unitech Policies

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MN412 Mine Design I (Open Pit Design)

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Mine Design I (Open Pit)

Subject Code: MN412

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**1 hour lecture, 5 hours project)

Delivery Mode On campus

Prerequisites: Year 1 to Year 4 subjects

Co-requisites: None

Subject Coordinator: TBA

Synopsis

The subject provides students with the opportunity to design a surface mine and the development of a pre-feasibility study of a metalliferous surface mining project. The subject enables the student to competently apply the knowledge and skills acquired in years 1 to year 4 into designing a surface mine. Activities includes: Interpretation of geological and log information and model the deposit, assessing the geometry of the deposit, rock mechanics of the ore body and host rock, ground water conditions and geometrical orientation of the deposit. Design inputs for surface mines, bench compositing and stripping ratios, design of mine

layouts including service facilities; short term and long term mine plans. Pit limit and Ultimate pit configuration, Calendar plans and scheduling. Design of waste dumps, haulage systems, face design, bench designs, cost estimations, economic analysis. Environmental and economic assessment of a mine and use of computer applications in mine design. Finally, produce a feasibility study report for the project.

Subject Topics

1. Ore body modelling and reserve estimation
2. Geology and geotechnical model
3. Mine production planning and pit design
4. Design of Environmental system. (waste dump, tailing dump, socio-economic issues, environmental impact mitigation)
5. Economic evaluation and modelling of mine and project management

Subject Outline

Topic	Content
1. Topic 1	• Concerns developing a research proposal and outlines the various types of research that may be undertaken by engineers and suggests that most engineers typically undertake research in the applied research space, using a quantitative approach.
2. Topic 2	• Stresses the importance of developing the research question and topic is stressed along with the need to ensure that the proposed research can be completed within the time allocated to the project
3. Topic 3	• Succinctly outlines definitions, structures and the role of the literature review in a research report. It stresses how one of the most important roles of the literature review is to show where the proposed research fits within, and augments, the existing international contemporary literature
4. Topic 4	• Involves the provision of guidance on structuring and writing the Literature Review Report and communication the outcomes via an audio visual presentation

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Assess, evaluate and interpret geological data, log results and synthesize exploration information
2. Create and model a typical mineral deposit and evaluate ore resource and produce ore body model.
3. Critically assess and evaluate geological, geomechanical, production and economic data and apply to mine design.
4. Critically assess, evaluate and create pit design, production plan and schedules.
5. Synthesis, appraise, formulate and design a surface mine through team work and be able to communicate in both oral and written report.

Assessment Tasks and Weightings

100% Continuous

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the Final Report.

Students must also refer to the Subject Assessment Details.

Report 1 (Resource Estimation)	**(15 %)**
Report 2 (Pit design)	**(15%)**
Report 3 (Drill & Blast Design)	**(15%)**
Report 4 (Economic evaluation)	**(15%)**
Final Report (overall)	**(40%)**

Assessment Task 1 The report involves students to evaluate the resources from drill hole data, using appropriate resource estimation method to calculate the total ore reserve and model the ore body geometry for mine design. It contributes 15% of the total marks for the Subject.

Assessment Task 2 The report involves use of geological and rock mechanics data as well as rock mass data to design the pit limit, bench specification, mining sequence. The assignment is worth 15% of the total marks for the Subject.

Assessment Task 3 Use the ore resource data and model production system, equipment selection, drill and blast design and design of other surface services. The assignment is worth 15% of the total marks for the Subject.

Assessment Task 4 Produce economic evaluation and viability of the project including project economic sensitivity analysis. Design waste handling and environmental management system. The assessment is worth 15% of the total marks for the Subject

Assessment Task 5 compilation of final report including visual oral presentation (40%)

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Kennedy, B.A.(Ed)., Surface Mining, SME, New York, 1990

References

Numerous links are provided within the Subject Topics to research organisations, international universities, YouTube clips, and research databases

Relevant Unitech Policies

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MN413 Contemporary Industry Practice

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Contemporary Industry Practice

Subject Code: MN413

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **16 (**1 hour lecture, 5 hours project)

Delivery Mode On campus

Prerequisites: Year 2 to Year 4 subjects

Co-requisites: None

Subject Coordinator: TBA

Synopsis

This subject involves the study and review of case studies supplied and delivered by professional engineers with the mining industry. Being of a contemporary nature actual content reflects recent developments in operational practice such as the increase use of drones in aerial survey for mapping of resources and evolving technology to enhance mine production.

Subject Topics

1. Evolution of Technology Development in Mining Engineering
2. Contemporary Technology applications in Mining Engineering
3. Technology application for optimization

Subject Outline

Topic	Content
1. Evolution of Technology Development in Mining Engineering	• Evolution of Technology Development in Mining Engineering .
2. Contemporary Technology applications in Mining	• Contemporary Technology applications in Mining

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Critically analyze and discuss case studies and their outcomes.
2. Apply team skills to communicate outcome of case study.
3. Describe and explain the application of technological developments in the mining industry

Assessment Tasks and Weightings

This subject has no final exam and is assessed through both formative and summative means. 100% Continuous

Students must also refer to the Subject Assessment Details.

Team formative	**(20 %)**
Case study report	**(80%)**

Assessment Task 1 Team formative. - Team of normally 4 students will document team formation, performance, leadership and interaction and provide a team journal and self-evaluation report. Assessment is worth 20%.

Assessment Task 2 A series of written concise reports that review the 5 case studies provided by the external professional experts. The report will follow a specific format and critically analyze the content and quality of delivery. Total marks of 80%.

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

References

Numerous links are provided within the Subject Topics to research organisations, international universities, YouTube clips, and research databases

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

EN421 Research Project B

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Research Project B

Subject Code: EN421

Duration:	13 Teaching weeks
Contact Hours:	6 Hours per week
Credit Points:	**20 (**1 hour lecture, 5 hours project)
Delivery Mode	On campus
Prerequisites:	EN411
Co-requisites:	None
Subject Coordinator:	TBA

Synopsis

This subject continues the undertaking of research that was commenced in Research Project A. It is intended to continue to augment the professional work in the students engineering discipline to form a foundation for future learning and professional development and assist to develop cognitive skills. The subject covers research methods, literature reviews, plans, analysis and

presentation. The subject provides an introduction to planning a research investigation, developing testing regimes, and data analysis, interpretation and presentation. The final outcomes of the subject will be creation of a Research Project Thesis.

Subject Topics

1. **Topic 1** provides an overarching framework to planning a research program, outlining the need to develop a schedule for the entire project and to identify the breadth and depth of testing required to generate adequate and reliable data.
2. **Topic 2** outlines the importance of accurate analysis, interpretation and presentation of experimental results and explores the use of regression and correlation as tools to help explain trends in data. The role of hypothesis testing in engineering is introduced.
3. **Topic 3** involves the provision of guidance on structuring and writing the Research Project Thesis and preparing the accompanying audio visual presentation

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Develop and justify an integrated research plan and select and apply appropriate research methodologies
2. Source and critically evaluate and synthesise research literature to determine the level of contemporary knowledge in a specialist area.
3. Undertake experimentation, data collection through laboratory and/or field studies and/or critical analysis of the literature.
4. Judge the degree to which research outcomes are supported by the research data and form appropriate conclusions and recommendations based on the research.
5. Apply established theories and techniques to present the significance of their research findings and make informed recommendations for future research directions.
6. Create a research report and audio visual presentation that communicates the outcomes of the research to a diverse audience

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the Research Literature Review Final Report.

Students must also refer to the Subject Assessment Details.

Research Plan	**(10%)**
Progressive Report	**(20 %)**
Final Report	**(60%)**
Audio-visual presentation	**(10%)**

Assessment Task 1 requires the development of the ***Research Plan***, outlining the proposed research schedule to ensure that the proposed research is achievable. It is worth 10% of the total marks for the Subject.

Assessment Task 2 helps to facilitate the structured development of the research by requiring a ***Research Progress Report***, which must include a critical review of the international literature. The progress report will be presented as a concise engineering report. It is worth 20% of the total marks for the Subject.

Assessment Task 3 requires the production of the ***Research Project Thesis***. The thesis is the capstone of the degree and be around 6000 words excluding tables, graphs and appendices. It will include ethical and sustainability aspects. It is noted that some theses may vary significantly in length due to the research topic. It is worth 60% of the total marks for the Subject.

Assessment Task 4 provides an opportunity for the ***Audio-visual Presentation of the Research Outcomes***. The presentation must include both visual and audio and must be delivered to the student cohort for the Subject. It is worth 10% of the total marks for the Subject

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Theil, D.V 2014 Research Methods for Engineers, Cambridge University Press, Cambridge

References
Numerous links are provided within the Subject Topics to research organisations, international universities, YouTube clips, and research databases

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

MN421 Mine Design II – Underground Mine Design

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Underground Mine Design

Subject Code: MN413

Duration:	13 Teaching weeks
Contact Hours:	6 Hours per week
Credit Points:	**18 (**1 hour lecture, 5 hours project)
Delivery Mode	On campus
Prerequisites:	Year 1 to Year 4 subjects
Co-requisites:	None
Subject Coordinator:	TBA

Synopsis

The subject provides students with the opportunity to design a underground mine and the development of a pre-feasibility study for a metalliferous surface mining project. The subject enables the student to competently apply the knowledge and skills acquired in years 2 to year 3 into designing an underground mine. Activities includes: Interpretation of geological and log information and model the deposit, assessing the geometry of the deposit, rock mechanics of the ore body and host rock, ground water conditions and geometrical orientation of the deposit. Design inputs for underground mine, mining method, stope design, ventilation design, design of mine layouts including service facilities; short term and long term mine plans. Calendar plans and scheduling. Design of waste dumps, haulage systems, face design, drill and blast designs, cost estimations, economic analysis. Environmental and

economic assessment of a mine and use of computer applications in mine design. Finally, produce a feasibility study report for the project.

Subject Topics

1. Ore resources evaluation and ore body modelling
2. Rock mass evaluation and application to underground mine design
3. Selection of and appropriate underground mining method.
4. Design of production (drilling, blasting, loading and hauling) and auxiliary mining system
5. Design of Environmental system. (waste dump, tailing dump, socio-economic issues, environmental impact mitigation)
6. Economic evaluation of the mine and project management

Subject Outline

Topic	Content
1. Resource Evaluation	• Ore resources evaluation and ore body modelling
2. Rock mass Evaluation	• Rock mass evaluation and application to underground mine
3. Underground mining method	• Selection of and appropriate underground mining method
4. Design of production	• Design of production (drilling, blasting, loading and hauling) and auxiliary mining system
5. Design of environmental system	• Design of Environmental system. (waste dump, tailing dump, socio-economic issues, environmental impact mitigation)
6. Economic evaluation & project management	• Economic evaluation of the mine and project management

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Interpret geological data, log results and synthesize exploration information
2. Model a typical mineral deposit and evaluate ore resource and produce ore body model.
3. Select and Design an underground mining method based on, geological, geomechanical, production and economic data
4. Apply Optimization of Underground mine Production using mine design software and technology
5. Write a conceptual mine design report or a feasibility study report

Assessment Tasks and Weightings

This subject has no final exam and is assessed through both formative and summative means. 100% Continuous

Students must also refer to the Subject Assessment Details.

Report 1	**(15 %)**
Report 2	**(15%)**
Report 3	**(15%)**
Report 4	**(15%)**
Final report plus oral presentation	**(40%)**

Report 1. The report involves students to evaluate the resources from drill hole data, using appropriate resource estimation method to calculate the total ore reserve and model the ore body geometry for mine design. It contributes 15% of the total marks for the Subject.

Report 2. The report involves use of geological and rock mechanics data as well as rock mass data to design the underground mining method and mining sequence. The assignment is worth 15% of the total marks for the Subject.

Report 3. Use the ore resource data and model production system, equipment selection, drill and blast design and design of other surface services. The assignment is worth 15% of the total marks for the Subject.

Report 4. Produce economic evaluation and viability of the project including project economic sensitivity analysis. Design waste handling and environmental management system. The assessment is worth 15% of the total marks for the Subject.

Final Design Report. Produce final write up or project feasibility study report worth 30% and report oral presentation worth 10% of the total marks for the Subject.

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. V Kennedy, B.A.(Ed)., Underground Mining, SME, New York, 1990.
2. Underground Mining Methods: Engineering Fundamentals and International Case Studies, by William A. Hustrulid (Editor), Richard L. Bullock (Editor)

References

Numerous links are provided within the Subject Topics to research organisations, international universities, YouTube clips, and research databases

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

MN422 Mine Environments & Safety Engineering

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Mine Environments and safety engineering

Subject Code: MN422

Duration:	13 Teaching weeks
Contact Hours:	6 Hours per week
Credit Points:	**18 (**1 hour lecture, 5 hours project)
Delivery Mode	On campus
Prerequisites:	Year 1 to Year 4 subjects
Co-requisites:	None
Subject Coordinator:	TBA

Synopsis

The subject of Mine Environment and Safety Engineering is designed as a multidisciplinary area of study, which provides students information of the physical and chemical processes that cause disturbances to a biological environment that in turn affect human life. The physical and chemical impacts of mining require risk-based environmental engineering, which comprises of competent waste rock designs, active and passive mine waste management (treatment) techniques, land reclamation, mine water quality, air pollution and ventilation systems in underground mining. The subject covers the different aspects of environmental impacts of mining and how the impacts are reduced by adopting the best environmental code of practice against PNG's tailings disposal policies such as the water use permit (WUP) and deep seas tailings disposal (DSTD) provisions. The subject covers standard operation procedures (SOP), safety management and supervision procedures, PPE and Medical Kits, handling of chemicals and dangerous goods and record keeping, safety regulations and codes of practice by mining companies.

Subject Topics

1. **Chemical and physical impacts of mining:** types of mine wastes and their impacts, physical features of environmental footprints, chemical processes mainly kinetic iron transfers formation of AMD.
2. **Active and Passive mine waste treatment techniques:** Define active and passive treatments, incineration of mine tailings before disposal, membrane processes for desalination, biological treatment of mine waste and water quality management.
3. **Waste rock dump and tailings dam designs**: Principles of risk-based designing of waste rock dumps, slope stability and progressive rehabilitation, and principles for designing stable tailings dam for containing mine tailings and deep tailing practices
4. **Air and Noise pollution**: Categorise air pollution related to mining (surface air), management techniques, air quality and ventilation systems in underground mining, and techniques for controlling noise pollution.
5. **Mine Safety Act and Mining Act**: Safety regulations for the mining industry in PNG and mining policy.
6. **Mine Safety**: safety management strategies, standard operation procedures (SOP), management and supervision, PPE and Medical Kits, handling of chemicals and dangerous goods and record keeping.
   Regulation and Policy: Environmental and Safety Regulations and policies and water

Subject Outline

Topic	Content
1. Chemical & physical impacts of mining	• Types of mine wastes and their impacts, physical features of environmental footprints, chemical processes mainly kinetic iron transfers formation of AMD
2. Active and passive mine waste management techniques	• Define active and passive treatments, incineration of mine tailings before disposal, membrane processes for desalination, biological treatment of mine waste and water quality management
3. Waste rock dump and tailings dam design	• Principles of risk-based designing of waste rock dumps, slope stability and progressive rehabilitation, and principles for designing stable tailings dam for containing mine tailings and deep tailing practices
4. Air and noise pollution	• Categories air pollution related to mining (surface air), management techniques, air quality and ventilation systems in underground mining, and techniques for controlling noise pollution system
5. Mine safety act & mining act	• Safety regulations for the mining industry in PNG and mining policy.
6. Mine safety	• Safety management strategies, standard operation procedures (SOP), management and supervision, PPE and Medical Kits, handling of chemicals and dangerous goods and record keeping
7. Regulation and policy	• Environmental and Safety Regulations and policies and water

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Apply their knowledge of mathematics, science and engineering principles and appropriate mastery of the knowledge, techniques, skills and modern tools to predict environmental impacts and provide suitable environmental engineering designs.
2. Identify and assess risks and provide solutions to mine waste by designing stable waste rock dumps and tailings dams to control acid rock drainage that poise social and environmental risks during and after a mine closes.
3. Synthesise information regarding mine site rehabilitation by classifications of soil and plant species that support wildlife and social activities for long-term sustainability in the post-mine period.
4. Identify and incorporate key risk factors into all facets of mine design and risk-based mining operation challenges that are compliant with PNG's Mine Safety Act. Plan, organise, direct and control risks through mine safety procedures and regulations required at the workplace, which includes standard operation procedures (SOP), safety management strategies, safety management and supervision.
5. Describe, explain the overall environmental impacts of mining and apply the existing policies that regulate the codes of environmental practice in PNG and abroad, and safety regulations, ethical social and environmental responsibilities

Assessment Tasks and Weightings

This subject has no final exam and is assessed through both formative and summative means. 100% Continuous

Students must also refer to the Subject Assessment Details.

Assignment 1	**(12.5 %)**
Assignment 2	**(12.5%)**
Test 1	**(12.5%)**
Test 2	**(12.5%)**
Final Exam	**(50%)**

Task 1: This is an individual written assignment that contributes about 12.5% of the final mark. This assignment is designed to allow students to demonstrate their understanding of the physical and chemical impacts of mining including waste rock dump and tailing disposals systems and waste management systems including deep sea mine tailing practices.

Task 2: Assignment 2 contributes 12.5% of the total mark. This assignment covers the environmental impacts of underground mining, notably the mine ventilation, which is critical for attaining air quality standards and design procedures for taking fresh air into underground workplaces and taking contaminated air out of the underground openings.

Task 3: Test 1 contributes 12.5% of the total marks. This test is designed to assess the students' knowledge of environmental impacts of mining and how the impacts are reduced by designing mitigating strategies for acidic waste rocks and tailings disposals for attaining water quality standards and rehabilitation initiatives undertaken by mining companies.

Task 4: Test 2 contributes 12.5% of the total marks. This test assesses the students' knowledge of the main environmental impacts of underground metallic mining and how the impacts are reduced by designing ventilation systems for taking fresh air in and out of the underground working environment. It also includes the main safety issues encountered in surface and underground mining.

Task 5: Final Examination contributes 50% of the total marks. The examination covers all lectures and assignments to assess students' overall attainment of the Subject Learning Outcomes.

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. VS Vutukuri, RD Lama – 1986, Environmental Engineering in Mines, Cambridge University Press; Reissue edition (November 25, 2010), ISBN-10: 0521157390

References

Numerous links are provided within the Subject Topics to research organisations, international universities, YouTube clips, and research databases

Relevant Unitech Policies

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MN423 Introduction to Petroleum Engineering

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Introduction to petroleum engineering

Subject Code: MN423

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**4 hour lecture, 2lab/project)

Delivery Mode On campus

Prerequisites: MN212, MN222

Co-requisites: None

Subject Coordinator: TBA

Synopsis

The subject of Introduction to Petroleum Engineering is designed to provide students with an introduction to petroleum geology and petroleum engineering. This prepares students to transitioned well into the booming energy section in the country and abroad. The fundamental principle of petroleum regarding its origin, migration and accumulation, chemical composition, stratigraphy, nature of source rocks, reservoirs and traps are covered in this course. In the petroleum industry space, aspects such as petroleum prospecting, drilling operation, formation evaluation, petroleum production management, reservoir management, oil & gas separation & transportation as well as utilisation of oil and natural gas are covered. In the later part of the course covers the location and characterisation of producing gas and oilfields of PNG.

Subject Topics

1. Introduction to Petroleum and natural gas engineering.
2. Origin and occurrence of hydrocarbons
3. Rock and fluid properties
4. Reservoir engineering for oil reservoir
5. Reservoir engineering for gas reservoir
6. Production engineering – flow in tubing
7. Production engineering – well intervention
8. Drilling engineering – drilling contracts, the rig crew, drilling rigs
9. Drilling engineering – drilling rig systems and the drilling process

Subject Outline

Topic	Content
1. Introduction to Petroleum and natural gas engineering	• Overview, petroleum and natural gas, oil& gas industries, oil recovery methods, engineering ethics
2. Origin and occurrence of hydrocarbons	• Overview, basic earth geology, rock types & rock cycle, basic petroleum geology, origin of oil & natural gas, hydrocarbon types, types of hydrocarbon reservoirs, the gibbs phase rule, undersaturated black oil (low shrinkage oil) reservoirs, saturated black oil (low shrinkage oil) reservoirs, undersaturated volatile oil (high shrinkage) reservoirs, gas condensate reservoirs, wet gas reservoirs, dry gas reservoirs
3. Rock and fluid properties	• Oilfield measures and unit, reservoir rock properties, porosity and laboratory measurements, porosity from well logs, reservoir fluid (water, oil & gas) properties, reservoir rock – fluid interaction properties

4. Reservoir engineering for oil reservoir	• Est. of stock tank oil originality in-place, STOOIP using the volumetric method, drive mechanisms in oil reservoirs, performance of oil wells, field performance of oil reservoirs,
5. Reservoir engineering for gas reservoir	• Est. of stock tank gas originality in-place, STOOIP using the volumetric method, drive mechanisms in gas reservoirs, performance of gas wells, field performance of gas reservoirs
6. Production engineering – flow in tubing	• Intro. to gas and oil flow through tubing, tubing or pipe calculations
7. Production engineering – well intervention	• Introduction, well design, well design considerations, well orientation, well completion design
8. Drilling engineering – drilling contracts, the rig crew, drilling rigs	• Introduction (Exploration phase, appraisal & delineation phase, etc), drilling contracts, drilling rig
9. Drilling engineering – drilling rig system & the drilling process	• Introduction, major systems on drilling rig, the drilling process

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Understand the basic principle of petroleum geology
2. Understand petroleum engineering processes
3. Perform oil and gas reserve calculations
4. Understand drilling for oil and gas and systems of drilling
5. Identify and evaluate locations and logistic of prospective and producing oil and gas oil fields in PNG
6. Be part of a team in oil and gas well drilling and production

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%

Students must also refer to the Subject Assessment Details.

Assignment 1	**(10 %)**
Assignment 2	**(10%)**
Test 1	**(15%)**
Test 2	**(15%)**
Final Exam	**(50%)**

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Faizan Gul– 2024, Introduction to Petroleum Engineering, ISBN-10: 0521157390

References

Numerous links are provided within the Subject Topics to research organisations, international universities, YouTube clips, and research databases

Relevant Unitech Policies

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ENOOO Professional Work Experience (PWE)

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Professional Work Experience

Subject Code: EN000

Duration:	450 hours of Professional Engineering Practice
Contact Hours:	NIL
Credit Points:	**0**
Delivery Mode	On campus
Prerequisites:	Year 1 subjects
Co-requisites:	None
Subject Coordinator:	TBA

Synopsis

Students must complete a minimum of 450 hours in total of professional practice in their broad engineering discipline area to meet professional requirements and to be eligible to graduate from their Bachelor's degree course. Where possible the 450 hours will normally consist of up to 3 periods of employment with each period normally being of 150 hours duration. However, the broader mechanisms through which the hours can be are met are documented in the '*Unitech Introduction to Engineering Professional Work Experience'*. As outlined in that document students may obtain work experience over their full course in numerous forms ranging from roles as junior members of engineering teams, leading parts of engineering projects, and early in their course as non-engineering work. Students must maintain a dairy and prepare a Reflective Journal for each professional engineering practice experience. Refer to *'The Unitech Guide to Writing a Reflective Journal for Professional Engineering Practice (Work Experience)'* for detailed information. The Reflective Journals will describe all the activities undertaken and how the work experience has contributed to the development of Engineers Australia Stage 1 Competencies. A journal diary with regular entries must be maintained to support the Reflective Journal. Each professional practice experience period must be certified by the employer and graded by a member of academic staff.

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Subject Topics

1. Reviewing Unitech Graduate Capability statements, Course Learning Outcomes and Engineers Australia Stage 1 Competencies;
2. Preparing for Professional Work Experience;
3. Maintaining a work diary;

4. Writing a Reflective Journal Document for periods of Professional Work Experience; Completing the Professional Work Experience requirements for graduation

On completion of this subject students will be able to:

1. Demonstrate practical skills in a selected discipline
2. Understand and apply basic workplace health and safety principles in their discipline setting
3. Undertake and complete assigned tasks in the workplace and maintain a professional level record of those tasks
4. Communicate their workplace experiences and achievements through a Reflective Journal
5. Critically reflect on achievements within the workplace within the context of Engineers Australia Stage 1 Competencies

Assessment Tasks and Weightings

Assessment – Reflective Journals for Professional Engineering Practice. Each Reflective Journal provides details of at least 2 weeks/10 days/75 hours of minimum of professional engineering practice. A total of 450 hours must be covered within the total number of reflective journals.

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

BACHELOR OF MINERAL PROCESSING ENGINEERING (Honours)

First Year First Semester

Code	Subject	Contact Hours	Credit
EN111	Engineering practice and sustainability	6	15
EN112	Engineering practice I	6	22
EN113	Engineering materials and properties	6	18
EN114	Engineering computation	6	18
		24	**73**
First Year	**Second Semester**		
EN121	Engineering mathematics II	6	22
EN122	Engineering mechanics	6	18
EN123	Introduction to circuits and electronics	6	18
EN124	Introduction to engineering design	6	15
		24	**73**

Second Year First Semester

Code	Subject	Contact Hours	Credit
EN211	Computer aided design	6	18
EN212	Engineering mathematics III	6	18
MN212	Thermo-fluids	6	18
MP213	Physical Chemistry for chemical engineers	6	18
		24	**72**
Second Year	**Second Semester**		
EN221	Engineering modelling (including statistics & probability)	6	18
MN221	Introduction to Minerals Engineering	6	18
MN222	Economic geology and mineralogy	6	18
MP225	Mineral Technology I	6	18
		24	**72**

Third Year First Semester

Code	Subject	Contact Hours	Credit
MP311	Mineral Technology II	6	16
MP312	Hydrometallurgy I	6	16
MP313	Physical Processing and metallurgical accounting	6	16
MP314	Pyrometallurgy	6	16
		24	**64**
Third Year	**Second Semester**		
MN311	Bulk materials handling in mines	6	16
MP322	Hydrometallurgy II	6	16
MP323	Tailings disposal & waste management	6	16
MN324	Surface chemical processing	6	16
***EN000**	Professional work experience		
		24	**64**

Fourth Year First Semester

Code	Subject	Contact Hours	Credit
EN411	Research project A	6	20
MN411	Project management and economics	6	18
MP412	Plant design I	6	18
MP413	Process Control, Instrumentation & simulation	6	18
		24	**74**
Fourth Year	**Second Semester**		
EN421	Research project B	6	28
MP421	Plant design II	6	18
,M422	Mine environments and safety engineering	6	18
MN423	Introduction to petroleum engineering	6	18
		24	**74**

***EN000: Professional work experience-Work integrated Learning begins in Yr.2 and ends in Yr.4, a total accumulated hours of 450. This subject will not have any credit point and will be assessed with pass/fail.**

Graduate Statement (GS)

The Unitech Mineral Processing Engineering graduate is innovative, creative, analytical, ethical and professional in designing and extraction of mineral resources sustainably for PNG

Course Learning Outcomes (CLOs)

On completion of the course the student will:

CLO1	Master the principles and methods of the sciences and mathematics that underpin engineering.
CLO2	Develop creative and sustainable solutions to complex problems
CLO3	Have in depth proficiency in applying the tools, methods, concepts, technology and knowledge of an engineering discipline.
CLO4	Be proficient in communication via written, oral and digital means across multiple audiences and within teams
CLO5	Have ability to research, evaluate and synthesize information from varied sources
CLO6	Manage project conception and operation involving complex technical systems and processes

CLO7	Conduct oneself in a professional, ethical manner consistent with sustainable economic development and society's expectations

EN111 Engineering Practices and Sustainability

Course(s): Mineral Processing Engineering (Honours) (NQF Level 8)

Subject Name: Engineering Practices and Sustainability

Subject Code: EN111

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**3 Lectures + 3Tutorial)

Delivery Mode On campus

Prerequisites: Grade 12 English

Co-requisites: None

Subject Coordinator: TBA

Synopsis

This subject provides students with an overarching introduction to broad engineering practice and its core components. The role of the engineers in society is explored along with the social, political and economic issues may influence the role. The subject adopts a problem-based learning approach where student teams review a hypothetical engineering case study involving multiple, ethical and environmental related issues to critically analyze possible outcomes. Findings are presented via progressive and final reports culminating in a team work presentation to allow students to demonstrate attainment of good communication skills.

Subject Topics

1. Functions and Limits
2. Sequence and Series
3. Differentiation & Applications
4. Integration and Applications
5. Complex Numbers.

Subject Outline

Topic	Content
7. Functions and Limits	• Types of functions • Composition of functions • Inverse functions • Logarithmic and exponential functions • Trigonometric and hyperbolic functions • Inverse trigonometric and hyperbolic function

8. Sequence and Series	• Infinite series and processes: sequences, partial sums, tests for convergence of a series of real numbers, power series, radius and interval of convergence of a power series • Taylor and MacLaurin series
9. Differentiation & Applications	• Differentiation: differentiation by using limits, techniques of differentiation, applications of differentiation - maxima and minima, tangents to curves, small increments
10. Integration and Applications	• Anti-derivatives, first and second fundamental theorems of calculus. • Techniques of integration – substitution and integration by parts • Applications of integration - the area enclosed between two curves, volumes of solids of revolutions
11. Complex Numbers	• Cartesian, polar and exponential forms of complex numbers. Euler's formula; • De Moivre's theorem, roots of complex numbers

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Demonstrate a clear understanding of trigonometric, logarithmic, exponential and hyperbolic functions, and their inverses
2. Test series for convergence, and find radii and intervals of convergence of power series
3. Apply the techniques of differentiation to solve problems involving maxima and minima and related rates
4. Use integration to find areas enclosed between curves, and volumes of solids of revolution
5. Solve problems involving complex numbers

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(25 %)**
Laboratory and field work	**(10%)**
Assignments	**(10%)**
Quiz	**(5%)**
Final Examination	**(50%)**

Assessment 1 - **Tests:** There will be Tests contributing …25% towards the final grade for the subject.

Assessment 2 - **Laboratory and field work (if any)** The Laboratory and field work will contribute 10% towards the final grade for the subject. The case studies will have some problems which will assess the student's ability to think outside the box to consider real design and quality tests.

Assessment 3 - **Assignment/Group work:** The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 10% towards the final grade for the subject

Assessment 4 - **Quizzes:** These are very short, short answer, or multiple choice questions which are to check if students did understand some of the important components of lectures and collectively weigh 5%.

Assessment 5 **Final written examination:** A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

Anton, Howard – Calculus, Sixth Edition, John Willey and Sons, New York, 1999
……

References

1 Steward, James – Calculus, Early Transcendentals, Seventh Edition, Brooks Cole, Toronto, 2012
2 Mauch, Sean – Advanced Mathematical Methods for Scientists and Engineers, California Institute of Technology, 2002

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

EN112 Engineering Mathematics I

Course(s): Mineral Processing Engineering (Honours) (NQF Level 8)

Subject Name: Engineering Mathematics I

Subject Code: EN112

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**3 Lectures + 3Tutorial)

Delivery Mode On campus

Prerequisites: Grade 12 Mathematics

Co-requisites: None

Subject Coordinator: TBA

Synopsis

This subject provides students with an overarching introduction to broad engineering practice and its core components. The role of the engineers in society is explored along with the social, political and economic issues may influence the role. The subject adopts a problem-based learning approach where student teams review a hypothetical engineering case study involving multiple, ethical and environmental related issues to critically analyze possible outcomes. Findings are presented via progressive and final reports culminating in a team work presentation to allow students to demonstrate attainment of good communication skills.
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Subject Topics

1. Functions and Limits
2. Sequence and Series
3. Differentiation & Applications
4. Integration and Applications
5. Complex Numbers.

Subject Outline

Topic	Content
12. Functions and Limits	• Types of functions • Composition of functions • Inverse functions • Logarithmic and exponential functions • Trigonometric and hyperbolic functions • Inverse trigonometric and hyperbolic function
13. Sequence and Series	• Infinite series and processes: sequences, partial sums, tests for convergence of a series of real numbers, power series, radius and interval of convergence of a power series • Taylor and MacLaurin series
14. Differentiation & Applications	• Differentiation: differentiation by using limits, techniques of differentiation, applications of differentiation - maxima and minima, tangents to curves, small increments
15. Integration and Applications	• Anti-derivatives, first and second fundamental theorems of calculus. • Techniques of integration – substitution and integration by parts • Applications of integration - the area enclosed between two curves, volumes of solids of revolutions
16. Complex Numbers	• Cartesian, polar and exponential forms of complex numbers. Euler's formula; • De Moivre's theorem, roots of complex numbers

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Demonstrate a clear understanding of trigonometric, logarithmic, exponential and hyperbolic functions, and their inverses
2. Test series for convergence, and find radii and intervals of convergence of power series
3. Apply the techniques of differentiation to solve problems involving maxima and minima and related rates
4. Use integration to find areas enclosed between curves, and volumes of solids of revolution
5. Solve problems involving complex numbers

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests **(25 %)**
Laboratory and field work **(10%)**
Assignments **(10%)**

Quiz	**(5%)**
Final Examination	**(50%)**

Assessment 1 - **Tests:** There will be Tests contributing …25% towards the final grade for the subject.

Assessment 2 - **Laboratory and field work (if any)** The Laboratory and field work will contribute 10% towards the final grade for the subject. The case studies will have some problems which will assess the student's ability to think outside the box to consider real design and quality tests.

Assessment 3 - **Assignment/Group work:** The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 10% towards the final grade for the subject

Assessment 4 - **Quizzes:** These are very short, short answer, or multiple choice questions which are to check if students did understand some of the important components of lectures and collectively weigh 5%.

Assessment 5 **Final written examination:** A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

Anton, Howard – Calculus, Sixth Edition, John Willey and Sons, New York, 1999

References

1 Steward, James – Calculus, Early Transcendentals, Seventh Edition, Brooks Cole, Toronto, 2012
2 Mauch, Sean – Advanced Mathematical Methods for Scientists and Engineers, California Institute of Technology, 2002

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

EN113 Engineering Materials and Properties

Course(s): Mineral Processing Engineering (Honours) (NQF Level 8)

Subject Name: Engineering Practices and Sustainability

Subject Code: EN113

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**3 Lectures + 3Tutorial)

Delivery Mode On campus

Prerequisites: Grade 12 Chemistry

Co-requisites: None

Subject Coordinator: TBA

Synopsis

Engineering Materials and Properties enables student to attain the fundamental knowledge of materials used in different fields of engineering. It will impart cognitive skills to think critically about the materials relevant for engineering applications. The subject examines the physical-chemical properties of materials and how they impact on the design and applications in engineering. The materials studied cover the broad spectrum from hydrocarbons through to metals, cements, timbers, nanomaterials, polymers and ceramics. The subject adopts a hands-on experimental approach through the use of laboratory practical sessions that enhance the theoretical concepts.

Subject Topics

1. Lubricants
2. Corrosion and corrosion control
3. Metals and metallic alloys
4. Ceramics

Subject Outline

Topic	Content
5. Lubricants	• Definition • Classification • Theory and mechanisms of lubrication • properties of lubricants
6. Corrosion and corrosion control	• Theoretical models of corrosion • corrosion control methods • Protective coatings
7. Metal & metallic alloys	• Properties • ferrous and non-ferrous materials • Phase diagrams
8. ceramics	• Ceramics

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Demonstrate fundamental knowledge of how to classify lubricants and evaluate their advantages and limitations for engineering applications
2. Demonstrate how to assess the properties of metals and alloys to determine their uses for various engineering disciplines
3. Attain fundamental knowledge of the properties of adhesives and ceramics which are relevant to the various engineering
4. Achieve the capacity to investigate and evaluate the properties of advanced engineering materials for engineering applications
5. Undertake the selection of materials for engineering tasks based on non-dimensional analysis
6. Develop teamwork and communication skills by participating in laboratory practical sessions and writing reports

Assessment Tasks and Weightings

The summative exam (final examination) will carry 40% and formative assessment (continuous assessment) 60%.

Students must also refer to the Subject Assessment Details.

Tests	**(20 %)**
Laboratory and field work	**(30%)**
Assignments	**(10%)**
Final Examination	**(40%)**

Assessment 1 - **Tests:** There will be Tests contributing …25% towards the final grade for the subject.

Assessment 2 - **Laboratory and field work (if any)** The Laboratory and field work will contribute 10% towards the final grade for the subject. The case studies will have some problems which will assess the student's ability to think outside the box to consider real design and quality tests.

Assessment 3 - **Assignment/Group work:** The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 10% towards the final grade for the subject

Assessment 4 - **Quizzes:** These are very short, short answer, or multiple choice questions which are to check if students did understand some of the important components of lectures and collectively weigh 5%.

Assessment 5 **Final written examination:** A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

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References

Relevant Unitech Policies

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EN114 Engineering Computation

Course(s): Mineral Processing Engineering (Honours) (NQF Level 8)

Subject Name: Engineering Computation

Subject Code: EN111

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**3 Lectures + 3Tutorial)

Delivery Mode On campus

Prerequisites: None

Co-requisites: None

Subject Coordinator: TBA

Synopsis

The subject introduces student to problem solving in engineering though the application of databases. It explores the use of Excel as a tool to import, cleanse, manipulate and present engineering data. Modeling methods are investigated through the use of the underpinning VBA language. The uses of problem-solving methodologies using computer techniques in the engineering profession are outlined

Subject Topics

1. Excel as a database spreadsheet tool in engineering
2. Use of formulae on data manipulation using the coordinate system of data cells
3. Use of charting functions on data collections
4. VBA language
5. Data cleansing process
6. Implement modelling methods

Subject Outline

Topic	Content
1. Excel as a database spreadsheet tool in engineering	• Introduces Excel as a database spreadsheet tool in engineering
2. Use of formulae on data manipulation	• Explores the use of formulae on data manipulation using the coordinate system of data cells
3. Use of charting functions on data collections	• Explores the use of charting functions on data collections

4. VBA Language	• Introduces the grammar of the VBA language and uses it to develop automation on data manipulation
5. Data cleansing process	• Data cleansing process of data importation and data massage into a form that can be manipulated and analysed
6. Implement modelling methods	• Implement modelling methods using formulae and VBA including; Statistical Analysis, Time Series Analysis, Mathematical functions, Curve Fitting and Regression and Solving Equations

Subject Learning Outcomes (SLOs)

On completion of this subject 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 solve a variety of engineering problems.
4. Apply Excel built-in features and VBA to solve engineering problems

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(25 %)**
Laboratory and field work	**(10%)**
Assignments	**(10%)**
Quiz	**(5%)**
Final Examination	**(50%)**

Assessment 1 - **Tests:** There will be Tests contributing …25% towards the final grade for the subject.

Assessment 2 - **Laboratory and field work (if any)** The Laboratory and field work will contribute 10% towards the final grade for the subject. The case studies will have some problems which will assess the student's ability to think outside the box to consider real design and quality tests.

Assessment 3 - **Assignment/Group work:** The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 10% towards the final grade for the subject

Assessment 4 - **Quizzes:** These are very short, short answer, or multiple choice questions which are to check if students did understand some of the important components of lectures and collectively weigh 5%.

Assessment 5 **Final written examination:** A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

Thomas Mailund - Beginning Data Science in R Data Analysis, Visualization, and Modelling for the Data Scientist, Apress, 2017

References

1 Ronald Larsen - Engineering with Excel, Pearson, 2012
2 Bill Jelen - VBA and Macros Microsoft Excel 2010, Que Publishing, 2010

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

EN211 Computer Aided Design

Course(s): Mineral Processing Engineering (Honours) (NQF Level 8)

Subject Name: Engineering Practices and Sustainability

Subject Code: EN211

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**3 Lectures + 3Tutorial)

Delivery Mode On campus

Prerequisites: EN 114 Engineering computation

Co-requisites: EN124 Introduction to engineering design

Subject Coordinator: TBA

Synopsis

The subject introduces students to the modern approach of 3D Computer Aided Design for generating and analysing solid models and assemblies related to Civil, Electrical, Mechanical and Mining Engineering systems and structures. The included topics address theoretical and practical aspects encountered in the creation, modification, analysis, and optimization of engineering design. Also included are topics dealing with the creation of technical drawings, generation of bills of materials and basic elements of static, dynamic and thermal analysis.

Subject Topics

1. Characteristics of Digital Engineering Documentation
2. Creation of Fully Defined Sketches
3. Basic 3D Component Modelling
4. Advanced 3D Component Modelling
5. Creation of Assemblies.
6. Creation of Technical Drawings for 3D Parts and 3D Assembly Models

Subject Outline

Topic	Content
7. Characteristics of Digital Engineering Documentation	• Characteristics of feature-based, parametric solid modeler. • Principal components of modern 3D CAD software user interfaces. • Relationships between digitally created sketches, components, assemblies and technical drawingsion

8. Creation of Fully Defined Sketches	• Characteristics of sketch geometry and relationships between geometrical features. Sketch tools. • State of the sketch and the creation of fully defined sketches. • Design intents function of dimensioning methodologies
9. Basic 3D Component Modelling	• Extrusions from sketches. • Boss and cut extrusions. • Hole wizard, fillets, basic drawings, dimension changes. • Associativity between solid models and drawings. • Feature parameter editing
10. Advanced 3D Component Modelling	• Revolved and sweep features. • Shellings and ribs. • Patterns. • Part configurations, repairs and design changes. • Design tables, equations, families of parts. • Selection of materials and calculation of physical properties of solid models: mass, center of gravity, moment of inertia. • 3D printing
11. Creation of Assemblies	• Bottom-up and top-down assemblies. • Import of commercial parts. • Geometrical, mechanical and advanced mating relationships between parts in assembly. • Mass properties and interferences. • Creation of exploded views. • Bills of materials
12. Creation of Technical Drawings for 3D Parts and 3D Assembly Models	• Templates, views, dimensions and tolerances. • Sections and technical notes

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

7. Know the characteristics and requirements of digitally created engineering documentation and the relationships between sketches, parts, assemblies and technical drawings.
8. Create fully defined sketches
9. Perform basic 3D component modelling and understand design intend and associativity between 3D models and technical drawings.
10. Perform advanced 3D component modelling, implement design changes, assign materials to models and calculate physical properties of models. Use design tables and equations and create families of parts.
11. Create 3D assemblies, add mating relationships between parts, evaluate mass properties and implement changes for interference avoidance. Create exploded views and bills of materials.
12. Create technical drawings for parts and assemblies. Add dimensions, tolerances, technical notes, sections and isometric views to created drawings. Prepare parts for 3D printing and 3D print

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%

Students must also refer to the Subject Assessment Details.

Tests **(20 %)**

Laboratory and field work	**(20%)**
Assignments	**(10%)**
Final Examination	**(50%)**

Assessment 1 - **Tests:** There will be three (3) Tests contributing 20% towards the final grade for the subject.

Assessment 2 - **Laboratory and field work (if any)** The Laboratory and field work will contribute 20% towards the final grade for the subject. The case studies will have some problems which will assess the student's ability to think outside the box to consider real design and quality tests.

Assessment 3 - **Assignment/Group work:** The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 10% towards the final grade for the subject

Assessment 4 **Final written examination:** A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. 3D CAD in SolidWorks – Tutorials

References

1. Dassault Systems – *SolidWorks Fundamentals*, Concord, Massachusetts, United States, 2012
2. Leondes, C. - *Systems Techniques and Computational Methods*, CRC Press, Boca Raton, 2001

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

MN211 Introduction to Minerals Engineering

Course(s): Mineral Processing Engineering (Honours) (NQF Level 8)

Subject Name: Introduction to Minerals Engineering

Subject Code: MN211

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**3 Lectures + 3Tutorial)

Delivery Mode On campus

Prerequisites: None

Co-requisites: None

Subject Coordinator: TBA

Synopsis

The subject introduces students to the principals, concepts and science of Geology, Mining Engineering and Mineral Process Engineering. In Geology students comprehend geological processes resulting in the formation of rocks and the process of mineralization and the different resulting earth structures. In Mining Engineering, understanding the different stages in the mining stages, different mining methods and their selection and the design criteria. Surface Mining methods including alluvial mining, strip mining, open cast, leaching and open pit. Underground mining methods include caving, cut and fill, shrinkage, sub-level stoping, avoca. Students to attain clear knowledge of the different production unit operations from ore reserve estimation, grade control, drilling, blasting, loading, hauling and dumping. The students to comprehend the different processing and separation techniques for different ore minerals and the science of physio-chemical properties in designing and selecting processing, separation, concentration and refining the product.

Subject Topics

1. Introduction to Mining Engineering Technology
2. Mineral Deposits and Exploration Technology
3. Surface Mining Engineering Technology
4. Underground Mining Engineering Technology
5. Mineral Processing Engineering Technology
6. Mining Engineering Technology Model Design

Subject Outline

Topic	Content
1. Introduction to Mining Engineering Technology	• Introduction to Mining Engineering Technology
2. Mineral Deposits and Exploration Technology	• Mineral Deposits and Exploration Technology
3. Surface Mining Engineering Technology	• Surface Mining Engineering Technology

4. Underground Mining Engineering Technology	• Underground Mining Engineering Technology
5. Mineral Processing Engineering Technology	• Mineral Processing Engineering Technology
6. Mining Engineering Technology Model Design	• Mining Engineering Technology Model Design

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Review and evaluate mining technology and application and the challenges in contemporary Papua New Guinea environment.
2. Critically examine mineral deposits, ore genesis, mineral appraisal techniques and application; assess exploration program and evaluate mineral resources.
3. Differentiate between and define surface mining terminology; review and apprise surface mining techniques and application, and validate surface mine design.
4. Appraise and differentiate between underground mining terminology; underground mining techniques and design. List related technology and applications.
5. Describe contemporary mineral beneficiation technologies for the economic extraction of minerals and evaluate a processing plant design.
6. List and describe minerals development processes, apply mining techniques and technologies to develop a minerals development plan and communicate those outcomes

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(20 %)**
Laboratory and field work	**(20%)**
Assignments	**(10%)**
Final Examination	**(50%)**

Assessment 1 - **Tests:** There will be three (3) Tests contributing 20% towards the final grade for the subject.

Assessment 2 - **Laboratory and field work (if any)** The Laboratory and field work will contribute 20% towards the final grade for the subject. The case studies will have some problems which will assess the student's ability to think outside the box to consider real design and quality tests.

Assessment 3 -	**Assignment/Group work:** The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 10% towards the final grade for the subject
Assessment 4	**Final written examination:** A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Howard, H.L, Introduction to Mining Engineering, John Wiley & Sons, New York, 1987.
2. B.A. Wills., Introduction to Mineral Technology, 7th ed. 2006

References

- Numerous links are provided within the Subject Topics to research organisations, international universities, YouTube clips, and research databases

Relevant Unitech Policies

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MN212 Thermo-fluids

Course(s): Mineral Processing Engineering (Honours) (NQF Level 8)

Subject Name: Thermo-fluids

Subject Code: MN212

Duration:	13 Teaching weeks
Contact Hours:	6 Hours per week
Credit Points:	**18 (**3 Lectures + 3Tutorial)
Delivery Mode	On campus
Prerequisites:	EN113 Engineering materials & properties, EN122 Engineering mechanics
Co-requisites:	None
Subject Coordinator:	TBA

Synopsis

This course introduces the principles of Thermodynamics and Fluid Mechanics and examines the role of thermodynamics and fluid mechanics in engineering. It covers the basic properties of fluids, fluid statics, analysis of fluid flow through pipes and ducts. The later part of the subject covers the laws of thermodynamics, and the application of control volume techniques to engineering problems.

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Subject Topics

1. Introduction to thermo-fluids
2. Fluid statics
3. Fluid dynamics
4. Basic concept of fluid motion
5. Real fluids
6. Thermodynamics
7. First and second laws of thermodynamics
8. Heat engine cycles

Subject Outline

Topic	Content
1. Introduction to thermo-fluids	• Introduction, fluid mechanics, thermodynamics, heat transfer, energy, forms of energy, energy conversion, dimensions
2. Fluid statics	• Definition, properties of fluid, pressure & pressure measurements, hydrostatic forces on submerged plane and curve surfaces, buoyancy, stability of floating bodies
3. Fluid dynamics	• Definition, types of flows, laminar and turbulent fluid flow
4. Basic concept of fluid motion	Continuity, energy (Bernoulli) and momentum equations and their applications
5. Real fluids	Laminar and turbulent flow – Reynolds number, Head Loss in pipes and open channels, Hagen-Poiseuille equation, Boundary layer
6. Thermodynamics	Definition, Ideal gas laws, Systems: states, processes and properties, properties of pure substance
7. 1st and 2nd Laws of thermodynamics	• Energy analysis of closed systems, mass and energy analysis of controlled volume, 2nd law of thermodynamics, entropy
8. Heat cycles	• Heat engines, energy efficiencies, power cycle

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Describe the basic properties, principles and applications of fluids, fluid statics, fluid flow, fluid boundary layers, fluid power and forces developed by flowing fluids
2. Identify the different types of fluid flows and describe their implications on physical or engineering systems
3. Perform fluid flow calculations
4. Describe the basic concepts and principles and perform relevant calculations with respect to thermodynamic concepts including the forms of energy available, energy transfer, its utilization in engineering applications.
5. Outline the basic applications of thermodynamics in engineering by describing the various aspects and performing relevant basic calculations in terms of heat transfer, combustion and fuels, steam and refrigeration/heat pumps

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(30 %)**
Laboratory and field work	**(10%)**
Assignments	**(10%)**
Final Examination	**(50%)**

Assessment 1 - **Tests:** There will be three (3) Tests contributing 30% towards the final grade for the subject.

Assessment 2 - **Laboratory and field work (if any)** The Laboratory and field work will contribute 10% towards the final grade for the subject. The case studies will have some problems which will assess the student's ability to think outside the box to consider real design and quality tests.

Assessment 3 - **Assignment/Group work:** The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 10% towards the final grade for the subject

Assessment 4 **Final written examination:** A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Fundamentals of thermos-fluid sciences, Y.A. Cengel, J.M.Cimbala, R.H. Turner, (2017) 5th Eddition
2. Thermodynamics and Statistical Mechanics: An intermediate Level Course by Richard Fitzpatrick (2007).
3. Basics of Fluid Mechanics. Genick Bar-Meir, 2014

References

- Numerous links are provided within the Subject Topics to research organisations, international universities, YouTube clips, and research databases

Relevant Unitech Policies

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EN212 Engineering Maths III

Course(s): Mineral Processing Engineering (Honours) (NQF Level 8)

Subject Name: Engineering Maths III

Subject Code: MN211

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**3 Lectures + 3Tutorial)

Delivery Mode On campus

Prerequisites: EN121 Engineering Maths II

Co-requisites: None

Subject Coordinator: TBA

Synopsis

To enable students to acquire further basic mathematical concepts, principles and analytical processes needed for degree studies in Engineering. On completion of this subject students should be able to use the advanced mathematical method such as Fourier transforms and Laplace transform to solve ordinary and partial differential equations of the 1st and 2nd order.

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Subject Topics

1. Numerical Methods
2. Multivariable Calculus
3. Partial Differential Equations
4. Vector Calculus

Subject Outline

Topic	Content
1. Numerical Methods	• Solution of equations - bisection, Newton -Raphson. Numerical methods of integration using trapezoidal Rule and Simpson's Rule. Numerical solutions of differential equations using Runge-Kutta technique
2. Multivariable Calculus	• Double integrals over rectangular and non-rectangular regions. Triple integrals. Applications including surface areas, centroids, and centre of gravity
3. Partial Differential Equations	• Partial differentiation. Applications including tangent planes, total derivatives, directional derivatives, gradient, maxima/minima. Introduction to partial differential equations. • Fourier's series, The One Dimensional Wave Equation: The Heat Equation: The Two Dimensional Wave equation:

4. Vector Calculus	• Inverse square fields, Divergence and curl, The del operator, The Laplacian operator. • Evaluation of line integrals in 2D and in 3D space, Change of parameter, Applications to the evaluation of a mass of a wire, arc length and work. • The Fundamental theorem of work Integrals, Independence of path, Recognition of conservative vector fields in 2 and 3 dimensional spaces. • Finding work using Green's Theorem, Greens Theorem for multiply connected regions. • Evaluation of surface integrals, Applications to the evaluation of a mass of a curved lamina, surface area and to vector fields associated with fluid flow and electrostatic forces. • Oriented surfaces, using the Divergence Theorem to find flux, Sources and sinks, Gauss's Law for inverse square fields. Relative orientation of curves and surfaces, using Stokes' Law to calculate work, Relationship between Green's Theorem and Stokes' Theorem, Curl viewed as circulation

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Use numerical techniques to solve equations, calculate definite integrals, and solve differential equations.
2. Find the integral of a function of several variables,
3. Apply Fourier series to solve Ordinary Differential equations and Partial Differential equations.
4. Evaluate line integrals in two and three dimensional space

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(20 %)**
Laboratory and field work	**(20%)**
Assignments	**(10%)**
Final Examination	**(50%)**

Assessment 1 - **Tests:** There will be three (3) Tests contributing 20% towards the final grade for the subject.

Assessment 2 - **Laboratory and field work (if any)** The Laboratory and field work will contribute 20% towards the final grade for the subject. The case studies will have some problems which will assess the student's ability to think outside the box to consider real design and quality tests.

Assessment 3 - **Assignment/Group work:** The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 10% towards the final grade for the subject

Assessment 4 **Final written examination:** A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Kreyszig E. Advanced Engineering Mathematics, 7th ed. (Wiley, 1993).
2. Anton H, Calculus with Analytical Geometry, 6th Edition (Wiley 1999

References

1. Stroud K.A .Engineering Mathematics: Programmes and Problems. 6th Edition (ELBS/Macmillan 2000)

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

EN221Engineering Modelling

Course(s): Mineral Processing Engineering (Honours) (NQF Level 8)

Subject Name: Engineering Modelling

Subject Code: EN221

Duration:	13 Teaching weeks
Contact Hours:	6 Hours per week
Credit Points:	**18 (**3 Lectures + 3Tutorial)
Delivery Mode	On campus
Prerequisites:	EN211 Computer Aided Design
Co-requisites:	None
Subject Coordinator:	TBA

Synopsis

The subject introduces students to Engineering Modeling and Simulation and offers solutions for engineering analysis and design problems using physics-based computational models. The applications relate to Civil, Electrical, Mechanical and Mining Engineering systems and structures. The included topics address theoretical and practical aspects encountered in model creation, analysis, and optimization of virtual prototypes, with significant cost reduction of the development cycle. Also included are topics dealing with advanced static, dynamic, fluid flow and thermal analysis applied to all fields of engineering and verification problems.

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Subject Topics

1. Specific Features of Engineering Modeling and Simulation
2. Fundamental Concepts in Modeling and Simulation
3. Static Simulations.
4. Dynamic and Non-Linear Simulations.
5. Engineering Modeling and Simulations for Thermo-Fluidic Applications.
6. Validation Applications in Engineering Modeling

Subject Outline

Topic	Content
1. Specific Features of Engineering Modeling and Simulation	• Engineering modeling and computer simulations as substitutes for prototyping and experiments. The benefits of evaluating the behaviour of engineering systems by virtual prototyping and simulation. The need for verification problems. Main components of software user interfaces for virtual prototyping and simulation. Steps in creating engineering models from 3D geometric models
2. Fundamental Concepts in Modeling and Simulation	• Stress and strain matrices. Finite Element Method. Vibration modes and buckling of structures. Variational statement and equations of heat transfer. Solutions of transient heat conduction governing equations. Physical capabilities of flow simulations and governing partial differential equations for laminar and turbulent flows. Conjugate and radiation heat transfer. Multi-flows. Boundary conditions
3. Static Simulations	• Static analysis of parts, sheet metal and assemblies. Displacement contacts, bolt connectors, remote loads, non-uniform pressure distributions and shrink fits. Beam diagrams and static analysis of trusses. Analysis of systems under bearing loads. Composite shells
4. Dynamic and Non-Linear Simulations	• Modal and harmonic analysis. Buckling, drop test and fatigue analysis. Modeling and optimization of systems under combined pressure, thermal and earthquake loads. Non-linear analysis of contacts. Elasto-plasticity modeling and analysis. Random vibrations, thermal contact and thermal stress analysis. Steady-state and transient thermal analysis of electronic components
5. Engineering Modeling and Simulations for	• Structure and interface of flow simulation applied to ball valve design, flow in porous media and conjugate heat transfer. Computational fluid dynamics with mesh optimization in evaluation of hydraulic losses, drag coefficients, non-Newtonian flows and heat exchanger efficiency. Building and electronic cooling simulations
6. Validation Applications in Engineering Modeling	• Static, buckling and vibrations verification problems. Unsteady heat conduction and thermoelectric cooling verification problems. Laminar and turbulent flows in pipes

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Know the benefits of engineering modeling and simulation, the need for verification problems, the modeling software interfaces and the steps in creating engineering models.
2. Know the fundamental theoretical concepts in engineering modeling and computer simulation related to the fields of statics, dynamics, fluid mechanics and thermodynamics.
3. Perform modeling and static simulation for components and systems encountered in all fields of engineering.
4. Perform advanced modeling and simulation for components and systems under dynamic and non-linear loading conditions. The gained skills and abilities should cover the large spectrum of all engineering fields.

5. Know the structure and interface of computational thermo-fluidic applications and perform advanced simulations related to the fields of civil, electrical, mechanical and mining engineering.
   Perform simulations for engineering models with known analytical solutions, compare the results, discuss the accuracy of computer modeling and understand its limitations

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(20 %)**
Laboratory and field work	**(20%)**
Assignments	**(10%)**
Final Examination	**(50%)**

Assessment 1 - **Tests:** There will be three (3) Tests contributing 20% towards the final grade for the subject.

Assessment 2 - **Laboratory and field work (if any)** The Laboratory and field work will contribute 20% towards the final grade for the subject. The case studies will have some problems which will assess the student's ability to think outside the box to consider real design and quality tests.

Assessment 3 - **Assignment/Group work:** The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 10% towards the final grade for the subject

Assessment 4 **Final written examination:** A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Engineering Modeling and Simulation in SolidWorks – Tutorials

References

1. Dassault Systems – *SolidWorks Simulation*, Concord, Massachusetts, United States, 2014
2. Dassault Systems – *SolidWorks Flow Simulation*, Concord, Massachusetts, United States, 2014

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

MN222 Economic Geology and Mineralogy

Course(s): Mineral Processing Engineering (Honours) (NQF Level 8)

Subject Name: Economic Geology and Mineralogy

Subject Code: MN222

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**3 Lectures + 3Tutorial)

Delivery Mode On campus

Prerequisites: MN211 Introduction to Minerals Engineering

Co-requisites: None

Subject Coordinator: TBA

Synopsis

The subject covers concepts of geology, geological earth materials and processes, rock forming minerals and their physical properties; rock classification. Form clear understanding of history of the earth, plate tectonics, volcanoes, earth quakes and the resulting geological structures as well as weathering products and profile, and tectonic settings of PNG. Enhance students to differentiate between a mineral, rock forming minerals and ore mineralogy and the associated crystalogy, crystal structure and optic mineralogy. Students acquire clear concepts on classification of mineral deposits; hydrothermal, metasomatic, sedimentary, geothermal and hydrothermal system, epithermal and porphyry mineral deposit systems and mineralization. Students apply modern advanced mineral exploration techniques based on classification of mineral deposit.

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Subject Topics

- Concepts of Geology, Rock forming minerals and Physical Properties
- Rock classification system; Igneous, Metamorphic & Sedimentary
- History of Earth, plate Tectonics, Volcanoes and Earth Quake
- Minerals, Rock forming Minerals and Ore Mineralogy
- Crystalogy,
- Classification of Mineral Deposits
- Modern Mineral Exploration Technology and Techniques

Subject Outline

Topic	Content
1. Concepts of Geology	• Concepts of Geology, Rock forming minerals and Physical Properties
2. Rock classification system	• Igneous, Metamorphic & Sedimentary
3. History of Earth, plate Tectonics, Volcanoes and Earth Quake	• History of Earth, plate Tectonics, Volcanoes and Earth Quake
4. Minerals, Rock forming Minerals and Ore Mineralogy	• Minerals, Rock forming Minerals and Ore Mineralogy

5. Crystalogy	• Crystal System and Optic Mineralogy
6. Classification of Mineral Deposits	• Magmatic, Hydrothermal, Metasomatic, Sedimentary, Geothermal & Hydrothermal System, Epithermal & Porphyry Mineral Deposits
7. Modern Mineral Exploration Technology and Techniques	• Modern Mineral Exploration Technology and Techniques

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Describe the Earth's Physical structures and composition, earth's geological process including plate tectonics, volcano crustal deformation and magmatism volcanism, mineral and rock formation, rock-cycle and mineral/ore deposition
2. Identify and distinguish rock forming from ore forming minerals based on crystalline structure, microscopic and physical properties. Distinguish the three rock types; igneous, metamorphic and sedimentary rocks using classification based on genesis, mineral composition, physical and chemical properties.
3. Identify and differentiate between alteration, mineralization, mineral deposit and ore deposit and classify different styles and types of mineral and ore deposits.
4. Differentiate between rock and ore forming minerals based on crystalline structure, microscopic and physical properties. Identify correctly the style of mineral deposits and the type of ore bodies to enable students to critically apply appropriate mining method and mine design.
5. Explain appropriate exploration techniques with respect to objective mineral commodity and application of current exploration technology

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(20 %)**
Laboratory and field work	**(20%)**
Assignments	**(10%)**
Final Examination	**(50%)**

Assessment 1 - **Tests:** There will be three (3) Tests contributing 20% towards the final grade for the subject.

Assessment 2 - **Laboratory and field work (if any)** The Laboratory and field work will contribute 20% towards the final grade for the subject. The case studies will have some problems which will assess the student's ability to think outside the box to consider real design and quality tests.

Assessment 3 -	**Assignment/Group work:** The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 10% towards the final grade for the subject
Assessment 4	**Final written examination:** A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Blyth, F.G.H. & De Freitas, M.H., A Geology for Engineers, 7th Edition, ELBS with Edward Arnold, 1994

References

1. Sedra A S, Smith K C - Microelectronic Circuits, Fourth Edition, Oxford University Press, New York, 2009.
2. W. G. Shackleton, *Economic and Applied Geology*, Croom Helm Ltd, Provident House, 1986

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

MP225 Mineral Technology I

Course(s): Mineral Processing Engineering (Honours) (NQF Level 8)

Subject Name: Mining Technology

Subject Code: MP225

Duration:	13 Teaching weeks
Contact Hours:	6 Hours per week
Credit Points:	**18 (**3 Lectures + 3Tutorial)
Delivery Mode	On campus
Prerequisites:	MN211 Introduction to Minerals Engineering
Co-requisites:	None
Subject Coordinator:	TBA

Synopsis

The subject introduces to students the unit operations and technologies employed in mineral beneficiation. At the start of the course, students are shown the importance of mineralogy and how mineralogy influences processing of minerals. This is followed by sample types and sampling techniques. The stages of screening and size analyses are then examined in detail. In the later stages of the subject deals with analytical and mineralogical analyses techniques. Principles and application of various analytical tools as is applicable to the mineral industry are covered.

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Subject Topics

1. Applied mineralogy
2. Sampling
3. Particle Sizing
4. Chemical analyses
5. Analytical Technique
6. Fire Assaying
7. Mineralogical analyses

Subject Outline

Topic	Content
1. Applied mineralogy	• mineral classification, physical properties, mineral texture, mineral liberation assessment, value of mineralogy
2. Sampling	• Theory of Sampling; Laboratory and industrial Sampling Equipment
3. Particle Sizing	• Properties of particles: sizes, shapes and comminution size distribution functions; Laboratory size measurements: wet and dry sieving, sub-sieve size analysis; interpretation and presentation of sizing data; performance evaluation • Industrial Screening
4. Chemical analyses	• General principles of analytical chemistry, errors and handling small data sets; Sensitivity and detection limits; Sample Preparation Techniques
5. Analytical Technique	• X-Ray fluorescence (XRF); Absorption Spectroscopy; UV-Visible absorption spectroscopy of molecules, and Infra-Red absorption Spectroscopy
6. Fire Assaying	• Principles and Practice
7. Mineralogical analyses	• Optical reflected light microscope, X-ray diffraction (XRD), automated mineralogy (MLA, QEMSCAN)

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Define and carry out mineralogical analyses of ores
2. Apply the theory and concept of sampling and understand the values of samples and/or sample types used for assaying
3. Plan and carry out sampling in laboratory, metallurgical plants or in the field in a team environment
4. Describe and explain the properties of particles (e.g. size, shape) and how they influence screening and/or classification in mineral processing operations
5. Select and apply suitable sizing method(s) and perform size analyses in a team environment
6. Plan and develop chemical and/or mineralogical analyses program and also carry out both chemical and mineralogical analyses in a team environment

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(20 %)**
Laboratory and field work	**(20%)**
Assignments	**(10%)**
Final Examination	**(50%)**

Assessment 1 - **Tests:** There will be three (3) Tests contributing 20% towards the final grade for the subject.

Assessment 2 - **Laboratory and field work (if any)** The Laboratory and field work will contribute 20% towards the final grade for the subject. The case studies will have some problems which will assess the student's ability to think outside the box to consider real design and quality tests.

Assessment 3 - **Assignment/Group work:** The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 10% towards the final grade for the subject

Assessment 4 **Final written examination:** A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

3. Mineral Processing Technology, 7th Eds, Barry Wills, 2005
4. Principle of Instrumental analyses, Skoog, D.A.; West, D.M.; 1980

References

- Numerous links are provided within the Subject Topics to research organisations, international universities, YouTube clips, and research databases

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

MP213 Physical Chemistry for Chemical Engineers

Course(s): Mineral Processing Engineering (Honours) (NQF Level 8)

Subject Name: Physical chemistry for chemical engineers

Subject Code: MP213

Duration: 13 Lecturing weeks, plus 1 Examination Week, 1 Mid-Semester Week

Contact Hours: 6 Hours per week

Credit Points: **18** (3 hour lecture, 3 hours Laboratory)

Delivery Mode On campus

Prerequisites: None

Co-requisites: None

Subject Coordinator: TBA

Synopsis

Physical chemistry for engineers is an introductory physical chemistry subject for mineral processing engineering students. The subject covers the laws of thermodynamics, chemical equilibrium, kinetics of chemical reactions, solutions and phases, electrochemistry and surface chemistry. These topics are prerequisite for later and more advanced subjects such as surface chemical processing, pyrometallurgy and hydrometallurgy in the mineral processing engineering degree program.

Subject Topics

1. Chemical Kinetics
2. Thermochemistry and the First Law of Chemical Thermodynamics
3. Homogeneous and Heterogeneous Chemical Equilibria, and the Van't Hoff Equation
4. Spontaneity, Entropy, and the Second and Third Laws of Chemical Thermodynamics
5. Spontaneity and Gibbs Free Energy, and Ellingham Diagrams
6. Electrochemistry and Allied Phenomena

Subject Outline

Topic	Content
1. Chemical kinetics	• Chemical kinetics
2. Thermochemistry	• Thermochemistry and the First Law of Chemical Thermodynamics.
3. Chemical Equilibria	• Homogeneous and Heterogeneous Chemical Equilibria, and the Van't Hoff Equation
4. 2^{nd} & 3^{rd} Law of chemical thermodynamics	• Spontaneity, Entropy, and the Second and Third Laws of Chemical Thermodynamics
5. Gibbs free energy	• Spontaneity and Gibbs Free Energy, and Ellingham Diagrams
6. Electrochemistry	• Electrochemistry and Allied Phenomena

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Describe and explain the basic principles in chemical kinetics, chemical equilibrium in gaseous and aqueous states to engineering applications
2. List and outline the general principles of Thermochemistry including the use of standard enthalpies of formation to calculate heat of reactions, and Hess's Law of constant heat summation
3. Apply spontaneity, entropy, and Gibbs Free Energy; and relations between Gibbs free energy, equilibrium constant, and temperature to the processing of minerals;
4. Use standard thermodynamic data to perform thermodynamic calculations for a given chemical reaction;
5. Apply the fundamental principles in Electrochemistry as related to electrode potentials and their measurement, standard electrode potentials, and perform calculations involving Ecell, ΔG, and equilibrium constant K
6. Distinguish between galvanic and electrolytic cells and explain the differences

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests and quizes	**(30 %)**
Laboratory and field work	**(20%)**
Final Examination	**(50%)**

Assessment 1 - There will be three (3) short Tests and quizzes contributing 30% towards the final grade for the subject.

Assessment 2 - **Laboratory and field work (if any)** The Laboratory and field work will contribute 20% towards the final grade for the subject. The case studies will have some problems which will assess the student's ability to think outside the box to consider real design and quality tests.

Assessment 4 **Final written examination:** A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Elements of Physical Chemistry, 6th Eds., Atkins, P.; Paula, J.; 2012

References

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

MN311 Bulk Materials Handling in Mines

Course(s): Mining Engineering (Honours) (NQF Level 8)

Subject Name: Bulk Material Handling in Mines

Subject Code: MN311

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**3 Lectures + 3Tutorial)

Delivery Mode On campus

Prerequisites: None

Co-requisites: None

Subject Coordinator: TBA

Synopsis

Bulk materials handling in mines enables the students to; review, assess, and formulate a bulk material handling system design by applying contemporary bulk materials handling technology. The students will apply their cognitive ability to critically assess, evaluate, formulate and apply engineering technology to design; storage facilities; stockpile, bins/hopper storage; bulk materials transportation system; haulage trucks, belt conveyor, slurry/ pipe transportation; placing and reclaiming technology and review and assess bulk material properties and apply quality control techniques and technology.

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Subject Topics

1. Introduction
2. Storage of bulk materials in mines (Stockpile and bin storage design)
3. Placing and reclaiming technology and bulk material quality control
4. Belt conveyor technology and application in mines
5. Slurry/ pipe transporting technology and application in mines

Subject Outline

Topic	Content
• Introduction	• Review and assessment of a bulk material handling system and review of bulk materials properties.
• Storage of bulk materials in mines	• Storage of bulk materials in mines - Stockpile and bin storage design
• Placing and reclaiming technology and bulk material quality control	• Placing and reclaiming technology and bulk material quality control

• Belt conveyor technology and application in mines	• Belt conveyor technology and application in mines
• Slurry/ pipe transporting technology and application in mines	Slurry/ pipe transporting technology and application in mines

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

6. Critically review and explain aspects of bulk materials handling condition and application, and, name and define bulk materials properties, discuss how they affect materials handling systems designs, and be able to calculate and demonstrate how to determine their values.

7. Name, differentiate, appraise, and apply contemporary technology in the design of bulk materials storage and their suitability and application in mines; critically assess and evaluate; stockpile techniques and formulate a stock piles system and assess its suitability, and formulate and design bins/hopper as surge storage facility in mines and assess its suitability.

8. Identify, and explain bulk material quality control techniques and demonstrate their application in mines, and review, appraise placing and reclaiming technology, and formulate and validate material placing and reclaiming design.

9. Explain the operating principles of a belt conveyor system and demonstrate applicability of belt conveyors. Examine, formulate, and validate a belt conveyor design.

10. Define and evaluate rheology of various types of fluids and explain the flow behaviour of various fluids and demonstrate their applications. Examine, formulate, and validate a slurry transport design.

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(20 %)**
Laboratory and field work	**(20%)**
Assignments	**(10%)**
Final Examination	**(50%)**

Assessment 1 - **Tests:** There will be three (3) Tests contributing 20% towards the final grade for the subject.

Assessment 2 - **Laboratory and field work (if any)** The Laboratory and field work will contribute 20% towards the final grade for the subject. The case studies will have some problems which will assess the student's ability to think outside the box to consider real design and quality tests.

Assessment 3 - **Assignment/Group work:** The assignments and group work encourage students to work as a team, to research and to communicate the research appropriately and effectively in both written and oral forms. Contributes 10% towards the final grade for the subject

Assessment 4 **Final written examination:** A 3 hour written examination weighs 50%

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

3. Howard, H.L, Introduction to Mining Engineering, John Wiley & Sons, New York, 1987.
4. B.A. Wills., Introduction to Mineral Technology, 7th ed. 2006.

References

Numerous links are provided within the Subject Topics to research organisations, international universities, YouTube clips, and research databases

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

MP311 Mineral Technology II

Course(s): Mineral Processing Engineering (Honours) (NQF Level 8)

Subject Name: Mineral Technology II

Subject Code: MP311

Duration:	13 Teaching weeks
Contact Hours:	6 Hours per week
Credit Points:	**18 (**3 Lectures + 3Tutorial)
Delivery Mode	On campus
Prerequisites:	MP225 Mineral Technology I
Co-requisites:	None
Subject Coordinator:	TBA

Synopsis

This is an advanced level subject that deals with processing of fine particles and industrial minerals. As a foundation to the various industrial processes such as grinding, sedimentation or classification, laws governing fluid motion and movement of solids in fluids are covered. Slurry rheology is covered in some detail due to its vital contributions to processing operations such as grinding, froth flotation and leaching. Filtration and drying is also covered as part of the subject. The later part of the subject deals with the processing and application of industrial minerals. The students will design or develop process flowsheets for treatment of specific industrial minerals.

Subject Topics

1. Fine particles characterization
2. Important unit operations in mineral and coal processing
3. Rheology
4. Sedimentation
5. Filtration
6. Drying

7. Industrial minerals
8. Processing of industrial minerals
9. Application of industrial minerals in high tech industries

Subject Outline

Topic	Content
1. Fine particles characterization	• Definition of fine and ultra-fine particulates • Particle size, density and their distribution.
2. Important unit operations in mineral and coal processing	• Unit operations such as grinding, gravity concentration, froth flotation, etc in processing of mineral including coal
3. Rheology	• governing laws of fluid motion; movement of solids in fluids and settling velocity calculations; • suspension rheology • practical example of slurry flow in industrial grinding mills
4. Sedimentation	• batch sedimentation settling velocity calculations, elements of transport theory, sedimentation of non-spherical particles • thickener
5. Filtration	• Darcy's Law, Carmen-Kozeny Equation, Streamline and turbulent flows • Filtration principles and theories, filter media and equipment
6. Drying	• Humidity, relative humidity, psychometric chart, Drying mechanism, Drying time (falling period) – Fick's Second Law • Classification of drying process
7. Industrial minerals	• Types of industrial minerals: aggregates for construction, clays, industrial minerals for agriculture, and chemical industry, refractory minerals, minerals for the glass, cement and plastic industries
8. Processing of industrial minerals	• manufacture of Portland cement, clays for ceramics, bricks, paper etc., • production of silica for bricks and glass; the manufacture of silica, magnesia, aluminosilicate for the refractory industry
9. Application	• Application of industrial minerals in high tech industries

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Describe the fundamentals of particle technology and the unit operations involving fine particle processing.
2. Demonstrate a proficient use of mathematics and scientific skills in solving mineral processing engineering problems associated with particulate processes.
3. Examine, synthesis and apply slurry rheology to industrial processes such as grinding, froth flotation, leaching, smelting
4. Describe and apply the fundamental particle processing concepts and unit operations to a range of industrially important processes such as sedimentation, filtration and drying
5. Evaluate the uses and importance of the common industrial minerals

6. Conceptualize and design process flowsheet for specific industrial minerals including the PNG industrial minerals.

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(20 %)**
Assignments	**(15%)**
Laboratories	**(15%)**
Final Examination	**(50%)**

Assessment Task 1: Assignments – A total of 3 assignments to be given in this subject. *Assignment 1* will cover fundamentals on fine particles processing, settling velocity calculations and slurry rheology. *Assignment 2* will be on sedimentation, filtration and drying. *Assignment 3* will cover industrial minerals and their industrial applications. This assessment task is worth 15% of the total marks for the subject.

Assessment Task 2: Laboratories – The practical sessions will enable students to apply classroom theory to demonstrate real life applications in a hands on team environment. A. Experiment 1 is on viscosity measurement of grinding mill slurry. Experiment 2 involves sedimentation and Experiment 3 is on filtering .Students will analyse the experimental data, explain the findings and prepare technical reports. The labs are worth 15% of the total marks for the Subject.

Assessment Task 3: Tests – Class Tests carry a weight of 20%. This assessment component should cover all aspects of the subject.

Assessment Task 4: Examination- this component covers all the topics in this subject. The duration of exam is 3 hours and constitutes 50% of the total mark of this subject

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Mineral Processing Technology, 7th Eds, Barry Wills, 2006
2. Process Principles in minerals & materials production, Hayes Pub Co. 1993. 3
3. Fluid mechanics by J.F. Douglas, J.M. Gasiorek, J.A. Swaffield (3rd Ed); 1995

References

1. Non-Newtonian Flow and applied rheology: Engineering Application; *R.P. Chhabra, J.F. Richardson;* 2008
2. Introduction to mineral processing, Kelly, E.G.; Spottiswood, D.J.; 1982

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

MP312 Hydrometallurgy I

Course(s): Mineral Processing Engineering (Honours) (NQF Level 8)

Subject Name: Hydrometallurgy I

Subject Code: MP312

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**3 Lectures + 3Tutorial)

Delivery Mode On campus

Prerequisites: MP225 Mineral Technology I

Co-requisites: None

Subject Coordinator: TBA

Synopsis

The subject covers Principles of Leaching, Solution Concentration and Purification, Metal precipitation and Electrolytic Metal recovery from solution. It begins with a general introduction to the subject, followed by calculation and plot of the pourbaix Eh/pH phase diagram. This is followed by the application of stoichiometric equations in hydrometallurgical leaching of minerals and kinetics of leaching reactions. Subsequently solution concentration and purification, metal precipitation from solution and electrolytic metal recovery is covered in that order.

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Subject Topics

1. Introduction of hydrometallurgical processes.
2. Thermodynamics of Aqueous systems and leaching kinetics
3. Leaching processes and methods
4. Solution concentration and purification processes.
5. Precipitation processes for metal separation and recovery from solution
6. Electrolytic Processes for the recovery and purification of metals
7. Industrial practices of metal extraction of metals

Subject Outline

Topic	Content
1. Introduction of hydrometallurgy	• Introduction; application of hydrometallurgy, leaching and leaching lixiviates, chemical basis of mineral dissolution and leaching methods
2. Thermodynamics of Aqueous systems	• Thermodynamics of Aqueous systems; Stoichiometric equations, Nernst equation, chemical potentials, construction and interpretation of pH-Potential or pourbaix diagrams, interpretation of metal-water system
3. Methods of Leaching	• Leaching processes and methods, heap, agitation leach, VAT leaching
4. Solution concentration & purification	• Solution concentration and purification; adsorption processes using activated charcoal, Ion exchange processes utilizing solid resins, liquid-liquid solvent extraction processes

5. Metal Precipitation	• Precipitation processes for metal separation and recovery from solution; chemical precipitation processes, reductive precipitation processes
6. Electrolytic processes	• Electrolytic Processes for the recovery and purification of metals; electro winning of metals, electro refining of metals
7. Industrial practice of metal extraction 8.	• Industrial extraction of metals (with flowsheets) including the extraction of Cu, Au, Ag and Ni and Al from their ores

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Construct and interpret Eh/pH or pourbaix phase diagrams for various metal-water systems.
2. Explain the theory and concept of leaching processes and the methods of leaching
3. Describe solution concentration and purification using activated charcoal, ion solid resins, and solvent extraction processes.
4. Outline and explain chemical and reductive precipitation processes.
5. Describe electrolytic processes of electro winning and electro refining.
6. Plan, design and carry out hydrometallurgical extraction of metals such as gold, copper, aluminum, nickel or cobalt in a team environment

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(20 %)**
Assignments	**(15%)**
Laboratories	**(15%)**
Final Examination	**(50%)**

Assessment task 1: Assignments – Assignments are given in this subject to reinforce learning outcomes. *Assignment 1* covers the thermodynamic aspects of leaching, electrochemical considerations, kinetics of leaching, leaching of gold. As*signment 2* covers solution concentration and purification, electrolytical refining of metals. *Assignment 3* covers hydrometallurgical extraction of gold, copper, nickel, cobalt, aluminum, such metals that are important to Papua New Guinea economy. This AT is worth a total of 15% of the total marks for the subject.

Assessment task 2: Laboratories – The practical sessions will enable students to apply classroom theory to demonstrate real life applications in hands on team environment. Practical experiments cover leaching methods and kinetic models, solvent extraction, use of ion exchangers and activated carbon for solution concentration and purification. Metal recovery processes: Cementation, gaseous reduction, compound precipitation and electro winning. Students will analyze the experimental data, explain the findings and prepare technical reports. The labs are overall worth 15% of the total marks for the Subject.

Assessment task 3: Tests – The short Tests carry a weight of 20%. This assessment component covers all aspects of the subject.

Assessment task 4: Examination- this component covers all the topics in the subject. The duration of exam is 3 hours and constitutes 50% of the total mark of this subject

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Biswas, A.K. & Davenport, W.G., Extractive Metallurgy of Copper, Oxford, Pergamon, 1980.2. Marsden, J. & House, I.
2. The Chemistry of Gold Extraction, Chischester, Ellis Horwood, 1992.
3. Jackson, E., Hydrometallurgical Extraction and Reclamation. (John Wiley & Sons, 1986.)
4. The Chemistry of Gold Extraction. (John O. Marsden and C. Iain House. 2nd edition

References

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

MP313 Physical Processing & Metallurgical Accounting

Course(s): Mineral Processing Engineering (Honours) (NQF Level 8)

Subject Name: Physical Processing & metallurgical accounting

Subject Code: MP311

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**3 Lectures + 3Tutorial)

Delivery Mode On campus

Prerequisites: MP225 Mineral Technology I

Co-requisites: None

Subject Coordinator: TBA

Synopsis

This course covers all the aspects of physical mineral processing. It begins with size reduction or comminution. As prerequisite or fundamental course for classification including gravity concentration of minerals, physical laws of Stokes and Newton on settling of particles in fluids are covered first. This is then followed by classification including various industrial classifiers employed in mineral processing operations. Various mineral recovery techniques which utilize physical properties of minerals such as gravity, magnetic, electrical or colour & reflectivity are covered. As an important metallurgical management tool, metallurgical accounting is extensively covered in the later part of the course. To provide greater insight into metallurgical balance, full circuit balance including size-by-size metallurgical balance is included.
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Subject Topics

1. Size Reduction (Comminution)
2. Classification
3. Gravity concentration of minerals
4. Ore sorting -
5. Magnetic and Electrical Concentration of Minerals.
6. Metallurgical accounting

Subject Outline

Topic	Content
1. Comminution	• Theory and Practice of comminution; Energy-size Relationships; Crushers: primary, secondary and tertiary; Grinding: industrial machines, liners, media, grinding/classification circuits • Industrial plant practice (Ball milling, rod milling, fully-Autogenous Grinding, Semi-Autogenous grinding)
2. Classification and classifiers	• Free and hindered settling theory • Classifier types: cyclones, rakes, cones and hydrosizers; Recent developments in hydrocyclone design and application
3. Gravity concentration	• Sluices, spiral, tables, jigs, cones, and the Knelson concentrator, dense media separation
4. Ore sorting	• mechanized sorting of ores, types of ores
5. Magnetic & electrostatic separation of minerals	• Magnetic: Low intensity and high intensity separation; application to beach sand separation; Industrial circuits. Electrical: High tension separations; Electrostatic separations; Industrial applications
6. Metallurgical accounting	• Metal and Material Balances in typical Mineral Processing Circuits; Computation of Grade/Recovery Relationships in typical mineral concentration unit operations; Matrix methods of determining flows • Circuit balance

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Describe the principles of pre-smelting processes (e.g. drying, calcination, roasting & sintering)
2. Perform complex heat and material balances.
3. Describe and explain the roasting of ores or concentrates.
4. Provide a detailed description the smelting of various types of ores or concentrates and the melt and slag chemistry
5. Explain the fire and electro-refining of metals
6. Undertake the role of a team member and develop team work attributes and abilities.

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(20 %)**
Assignments	**(15%)**
Laboratories	**(15%)**
Final Examination	**(50%)**

Assessment Task 1: Assignments – There will be 3 assignments in this subject. Assignment 1 should be on comminution, Assignment 2 on classification and physical processing techniques and Assignment 3 on metallurgical accounting. Overall they task is worth 15% of the total marks for the subject.

Assessment Task 2: Laboratories – There are 3 group based experiments which will provide hands on experience. Experiment 1 will involve crushing and grinding. Experiment 2 will be on classification using hydrocyclone and Experiment 3 on gravity concentration. Students will analyze the experimental data and create laboratory reports. The labs are worth 20% of the total marks for the Subject.

Assessment Task 3: Tests – There will be a series of short class tests that will reinforce subject learning outcome. They are overall worth 15% of the marls for the Subject.

Assessment Task 4: Examination- The exam covers all the topics in this subject. The duration of exam is 3 hours and constitutes 50% of the total mark of this subject

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Wills BA, Napier-Munn TJ. 2006. Wills' mineral processing technology. 7th Ed. New York: Elsevier. 444 p.
2. Darling P. 2011. SME mining engineering handbook. 3rd ed. United States of America: Society for Mining, Metallurgy, and Exploration, Inc. 1839 p.
3. Fuerstenau MC, Han KN (eds.). 2003. Principles of mineral processing. United States of America: Society for Mining, Metallurgy, and Exploration, Inc. 573 p

References

1. Introduction to mineral processing, Kelly, E.G.; Spottiswood, D.J.; 1982
2. Society of Mining Engineers SME Mineral Processing Handbook, AIME, 19851982

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

MP314 Pyrometallurgy

Course(s): Mineral Processing Engineering (Honours) (NQF Level 8)

Subject Name: Pyrometallurgy

Subject Code: MP314

Duration:	13 Teaching weeks
Contact Hours:	6 Hours per week
Credit Points:	**18 (**3 Lectures + 3Tutorial)
Delivery Mode	On campus
Prerequisites:	MP213 Physical chemistry for engineers
Co-requisites:	None
Subject Coordinator:	TBA

Synopsis

The subject deals with high temperature processes such roasting, smelting and refining of metals. As a prerequisite to the subject, the students have covered the principles of thermodynamics and reaction kinetics of high temperature processes. This subject provides detailed coverage of drying and calcination, roasting, sintering and smelting of ores/concentrates, converting, fire

refining, smelting processes, practices and equipment (furnace types), roasting, smelting and fire refining of ores/concentrates of metals such as Cu, Ni or Au.

Subject Topics

1. Principals of metallurgical thermodynamics and thermochemistry:.
2. Drying and calcination processes
3. Roasting of ores/concentrates
4. Partial smelting process
5. Physics and chemistry of melts and slags
6. Smelting and Melting of sulfide/oxide concentrate
7. Converting and reduction
8. Fire Refining: principles of fire refining of metals

Subject Outline

Topic	Content
1. Principals of metallurgical thermodynamics and thermochemistry	• Different properties of heat energy (enthalpy & entropy), heat capacities, chemical equilibrium, effects of temperature, pressure and chemical concentration, free energy and predominance diagrams for oxidation, reduction, chlorination, sulphation etc
2. Drying and calcination processes	• Production of lime & alumina, chemical factors affecting yield & purity, effects of temperature, rock types, particle size, porosity, crystallinity, time, atmosphere on calcination rate, practices and equipment used for drying and calcination
3. Roasting ore or concentrates	• Thermodynamics of roasting of sulfides, sulfates and oxides, reaction kinetics of roasting - predominance diagram, heat and material balances in a roasting process, practices and equipment used for roasting as a pre-smelting process
4. Partial smelting processes	• sintering and roasting processes, practice and equipment used in sintering and roasting as partial melting processes, advantages & disadvantages of practice and furnace types
5. physics and chemistry of melts and slags	• phase diagrams-simple and complex, predicting slag characteristics by use of phase diagrams
6. smelting & melting or sulphides/oxide concentrates	• slag structure, silicate bonding, melt compounds, valence variation in slags, reactions between phases and detailed calculations of melts and slags in example Ok Tedi copper concentrate, practice and equipment
7. Converting & reduction	• converting reactions, mass balance, heats of reactions and influence on cycle, reduction of solids and molten materials, thermodynamics, reaction kinetics, practice and equipment
8. Fire refining	• Principle of fire refining • practice and equipment, furnace types, factors affecting furnace efficiencies, oxygen enrichment, fuel, feed preparation and calculations, advantages and limitations of fire refining practices

9. Application	• Application of industrial minerals in high tech industries

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Describe the fundamentals of particle technology and the unit operations involving fine particle processing.
2. Demonstrate a proficient use of mathematics and scientific skills in solving mineral processing engineering problems associated with particulate processes.
3. Examine, synthesis and apply slurry rheology to industrial processes such as grinding, froth flotation, leaching, smelting
4. Describe and apply the fundamental particle processing concepts and unit operations to a range of industrially important processes such as sedimentation, filtration and drying
5. Evaluate the uses and importance of the common industrial minerals
6. Conceptualize and design process flowsheet for specific industrial minerals including the PNG industrial minerals.

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(20 %)**
Assignments	**(15%)**
Laboratories	**(15%)**
Final Examination	**(50%)**

Assessment Task 1: Assignments – A total of 3 assignments to be given in this subject. *Assignment 1* will cover fundamentals on fine particles processing, settling velocity calculations and slurry rheology. *Assignment 2* will be on sedimentation, filtration and drying. *Assignment 3* will cover industrial minerals and their industrial applications. This assessment task is worth 15% of the total marks for the subject.

Assessment Task 2: Laboratories – The practical sessions will enable students to apply classroom theory to demonstrate real life applications in a hands on team environment. A. Experiment 1 is on viscosity measurement of grinding mill slurry. Experiment 2 involves sedimentation and Experiment 3 is on filtering .Students will analyse the experimental data, explain the findings and prepare technical reports. The labs are worth 15% of the total marks for the Subject.

Assessment Task 3: Tests – Class Tests carry a weight of 20%. This assessment component should cover all aspects of the subject.

Assessment Task 4: Examination- this component covers all the topics in this subject. The duration of exam is 3 hours and constitutes 50% of the total mark of this subject

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

4. Mineral Processing Technology, 7th Eds, Barry Wills, 2006
5. Process Principles in minerals & materials production, Hayes Pub Co. 1993. 3
6. Fluid mechanics by J.F. Douglas, J.M. Gasiorek, J.A. Swaffield (3rd Ed); 1995

References

3. Non-Newtonian Flow and applied rheology: Engineering Application; *R.P. Chhabra, J.F. Richardson;* 2008
4. Introduction to mineral processing, Kelly, E.G.; Spottiswood, D.J.; 1982

Relevant Unitech Policies

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MP311 Mineral Technology II

Course(s): Mineral Processing Engineering (Honours) (NQF Level 8)

Subject Name: Mineral Technology II

Subject Code: MP311

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**3 Lectures + 3Tutorial)

Delivery Mode On campus

Prerequisites: MP225 Mineral Technology I

Co-requisites: None

Subject Coordinator: TBA

Synopsis

This is an advanced level subject that deals with processing of fine particles and industrial minerals. As a foundation to the various industrial processes such as grinding, sedimentation or classification, laws governing fluid motion and movement of solids in fluids are covered. Slurry rheology is covered in some detail due to its vital contributions to processing operations such as grinding, froth flotation and leaching. Filtration and drying is also covered as part of the subject. The later part of the subject deals with the processing and application of industrial minerals. The students will design or develop process flowsheets for treatment of specific industrial minerals.

Subject Topics

1. Fine particles characterization
2. Important unit operations in mineral and coal processing
3. Rheology
4. Sedimentation
5. Filtration
6. Drying
7. Industrial minerals
8. Processing of industrial minerals
9. Application of industrial minerals in high tech industries

Subject Outline

Topic	Content
1. Fine particles characterization	• Definition of fine and ultra-fine particulates • Particle size, density and their distribution.

2. Important unit operations in mineral and coal processing	• Unit operations such as grinding, gravity concentration, froth flotation, etc in processing of mineral including coal
3. Rheology	• governing laws of fluid motion; movement of solids in fluids and settling velocity calculations; • suspension rheology • practical example of slurry flow in industrial grinding mills
4. Sedimentation	• batch sedimentation settling velocity calculations, elements of transport theory, sedimentation of non-spherical particles • thickener
5. Filtration	• Darcy's Law, Carmen-Kozeny Equation, Streamline and turbulent flows • Filtration principles and theories, filter media and equipment
6. Drying	• Humidity, relative humidity, psychometric chart, Drying mechanism, Drying time (falling period) – Fick's Second Law • Classification of drying process
7. Industrial minerals	• Types of industrial minerals: aggregates for construction, clays, industrial minerals for agriculture, and chemical industry, refractory minerals, minerals for the glass, cement and plastic industries
8. Processing of industrial minerals	• manufacture of Portland cement, clays for ceramics, bricks, paper etc., • production of silica for bricks and glass; the manufacture of silica, magnesia, aluminosilicate for the refractory industry
9. Application	• Application of industrial minerals in high tech industries

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Describe the fundamentals of particle technology and the unit operations involving fine particle processing.
2. Demonstrate a proficient use of mathematics and scientific skills in solving mineral processing engineering problems associated with particulate processes.
3. Examine, synthesis and apply slurry rheology to industrial processes such as grinding, froth flotation, leaching, smelting
4. Describe and apply the fundamental particle processing concepts and unit operations to a range of industrially important processes such as sedimentation, filtration and drying
5. Evaluate the uses and importance of the common industrial minerals
6. Conceptualize and design process flowsheet for specific industrial minerals including the PNG industrial minerals.

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests **(20 %)**
Assignments **(15%)**

Laboratories	**(15%)**
Final Examination	**(50%)**

Assessment Task 1: Assignments – A total of 3 assignments to be given in this subject. *Assignment 1* will cover fundamentals on fine particles processing, settling velocity calculations and slurry rheology. *Assignment 2* will be on sedimentation, filtration and drying. *Assignment 3* will cover industrial minerals and their industrial applications. This assessment task is worth 15% of the total marks for the subject.

Assessment Task 2: Laboratories – The practical sessions will enable students to apply classroom theory to demonstrate real life applications in a hands on team environment. A. Experiment 1 is on viscosity measurement of grinding mill slurry. Experiment 2 involves sedimentation and Experiment 3 is on filtering .Students will analyse the experimental data, explain the findings and prepare technical reports. The labs are worth 15% of the total marks for the Subject.

Assessment Task 3: Tests – Class Tests carry a weight of 20%. This assessment component should cover all aspects of the subject.

Assessment Task 4: Examination- this component covers all the topics in this subject. The duration of exam is 3 hours and constitutes 50% of the total mark of this subject

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Mineral Processing Technology, 7th Eds, Barry Wills, 2006
2. Process Principles in minerals & materials production, Hayes Pub Co. 1993. 3
3. Fluid mechanics by J.F. Douglas, J.M. Gasiorek, J.A. Swaffield (3rd Ed); 1995

References

1. Non-Newtonian Flow and applied rheology: Engineering Application; *R.P. Chhabra, J.F. Richardson;* 2008
2. Introduction to mineral processing, Kelly, E.G.; Spottiswood, D.J.; 1982

Relevant Unitech Policies

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MP322 Hydrometallurgy II

Course(s): Mineral Processing Engineering (Honours) (NQF Level 8)

Subject Name: Hydrometallurgy I

Subject Code: MP312

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**3 Lectures + 3Tutorial)

Delivery Mode On campus

Prerequisites: MP225 Mineral Technology I

Co-requisites: None

Subject Coordinator: TBA

Synopsis

The subject is a continuation of Hydrometallurgy (I) and covers the Fundamentals of Mass Transfer, Homogeneous Kinetics, Heterogeneous Kinetics and Reactor Design. The course begins with Classification of Rate reactions and Definition of Rate Reactions. This is followed by Homogeneous Kinetics and Heterogeneous Kinetics. The second part of the subject looks at Reactor Design and types of reactors including calculations involved in deriving equations for Batch Reactors, Plug Flow Reactors and Mixed Flow Reactors. This followed by Design parameters which cover Kinetics of Fluid Particle Reaction, shrinking core model, Progressive conversion model, Concentration of Lixiviant and design for continuous leaching systems.

Subject Topics

1. **Introduction**; fundamentals of mass transfer.
2. **Classification of Reactions;** kinetics of physical processes, kinetics of chemical reactions and definition of reaction rates.
3. **Homogeneous Kinetics;** law of mass action, rate law, and theories of rate constant and transition state theory.
4. **Heterogeneous Kinetics;** reaction steps and rate controlling steps, transport within phases, kinetics of adsorption reactions, reaction at the interface, electrode kinetics, rate equation for heterogeneous reaction-flat plate geometry, fluid particle reaction-spherical geometry.
5. **Reactor design;** types of reactors – batch, plug flow and mixed flow reactors. Design parameters – kinetics of fluid particle reaction, progressive conversion model, the shrinking core model, and the concentration of lixiviates.
6. **Modelling and design for continuous leaching system;** symbols and notation, descriptions of governing equations, results from computer simulations, design worksheet and examples

Subject Outline

Topic	Content
1. Introduction of hydrometallurgy	fundamentals of mass transfer
2. Classification of reactions	• kinetics of physical processes, kinetics of chemical reactions and definition of reaction rates.
3. Homogenous kinetics	• law of mass action, rate law, and theories of rate constant and transition state theory

4. heterogenous kinetics	• reaction steps and rate controlling steps, transport within phases, kinetics of adsorption reactions, reaction at the interface, electrode kinetics, rate equation for heterogeneous reaction-flat plate geometry, fluid particle reaction-spherical geometry
5. reactor design	• types of reactors – batch, plug flow and mixed flow reactors. Design parameters – kinetics of fluid particle reaction, progressive conversion model, the shrinking core model, and the concentration of lixiviates
6. modelling and design for continuous leaching system	• symbols and notation, descriptions of governing equations, results from computer simulations, design worksheet and examples

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Critically describe the theory and concept of Mass transfer and define the kinetics of physical processes and the kinetics of chemical reactions.
2. Describe and compare homogenous and heterogenous reaction kinetics.
3. Analyze and apply rate data from laboratory or pilot-plant tests to design leaching system, solvent extraction, carbon-in-pulp or carbon-in-leach.
4. Analyze, design and apply equations for batch, semi- batch and continuous reactors for plug flow or mixed flow reactors.
5. Analyze and design process flowsheet for hydrometallurgical extraction of metals such as Au, Ag, Cu, Ni, Co from their ores
6. Function in a team

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(20 %)**
Assignments	**(15%)**
Laboratories	**(15%)**
Final Examination	**(50%)**

Assessment Task 1: Assignments – A number of short assignments to be given in this subject to reinforce student learning. This assessment task is worth 15% of the total marks for the subject.

Assessment Task 2: Laboratories – The practical sessions will enable students to apply classroom theory to demonstrate real life applications in a hands-on team environment. Practical exercises will cover leaching kinetics with an aim to collect kinetic data for reactor design. The labs are worth 15% of the total marks for the Subject.

Assessment Task 3: Tests – Short class tests carry a weight of 20%. This assessment component assists in the evaluation of student learning outcomes

Assessment Task 4: Examination- this component will cover all the topics in this subject. The duration of exam is 3 hours and constitutes 50% of the total mark of this subject

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Biswas, A.K. & Davenport, W.G., Extractive Metallurgy of Copper, Oxford, Pergamon, 1980.2. Marsden, J. & House, I.
2. The Chemistry of Gold Extraction, Chischester, Ellis Horwood, 1992.
3. Jackson, E., Hydrometallurgical Extraction and Reclamation. (John Wiley & Sons, 1986.)
4. The Chemistry of Gold Extraction. (John O. Marsden and C. Iain House. 2nd edition

References

Relevant Unitech Policies

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MP323 Dewatering and Tailings Disposal

Course(s): Mineral Processing Engineering (Honours) (NQF Level 8)

Subject Name: Dewatering and Tailings Disposal

Subject Code: MP323

Duration:	13 Teaching weeks
Contact Hours:	6 Hours per week
Credit Points:	**18 (**3 Lectures + 3Tutorial)
Delivery Mode	On campus
Prerequisites:	MP225 Mineral Technology I
Co-requisites:	None
Subject Coordinator:	TBA

Synopsis

The subject deals with some of the common dewatering techniques and tailings disposal systems used in the mining and mineral processing industries to produce a mineral concentrate or a product for further processing. Also students use empirical data from experiments to design a dewatering device.

Subject Topics

1. **Principles of Dewatering & Dispersions;** Reasons for dewatering in mineral processing operations, Behaviour of dispersions in polar medium.
2. **Coagulation and Flocculation ;** Wetting characteristics, Repulsive forces, Attractive forces, Stability of colloidal systems, Flocculants types**;** Natural & synthetic polymer, Nonionic, anionic & cationic flocculants, Adsorption mechanism, Aggregate formation, Factors affection flocculation, Selective flocculation
3. **Sedimentation Separators;** Thickener, Thickener area calculation, Thickener types, Centrifugal Sedimentation, Sedimentation calculation, Types of centrifuge
4. **Filtration;** Methods of filtration, Mathematical relationship between process variables, Effect of pressure on filter cake properties, Factors affecting filtration operation, Filtration equipment
5. **Thermal Drying;** Principles of thermal drying, Thermal drying equipment
6. **Tailings Disposal;** Tailings dam, Dry stacking, Deep sea tailings placement (DSTP).

Subject Outline

Topic	Content
1. Principle of dewatering and dispersion	• Reasons for dewatering in mineral processing operations, Behaviour of dispersions in polar medium
2. Coagulation & flocculation	• Wetting characteristics, Repulsive forces, Attractive forces, Stability of colloidal systems, Flocculants types**;** Natural & synthetic polymer, Nonionic, anionic & cationic flocculants, Adsorption mechanism, Aggregate formation, Factors affection flocculation, Selective flocculation
3. Sedimentation separators	• Thickener, Thickener area calculation, Thickener types, Centrifugal Sedimentation, Sedimentation calculation, Types of centrifuge
4. filtration	• Methods of filtration, Mathematical relationship between process variables, Effect of pressure on filter cake properties, Factors affecting filtration operation, Filtration equipment
5. Thermal drying	• Principles of thermal drying, Thermal drying equipment
6. Tailings disposal	• Tailings dam, Dry stacking, Deep sea tailings placement (DSTP)

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Identify and select appropriate dewatering systems for a given mineral processing operations
2. Critically describe the general principles and mechanisms of the various depressions used in dewatering systems
3. Describe and apply the various techniques used for dewatering of mineral particles
4. Design a thickener from laboratory or experimental data
   Describe, design and apply mine waste and tailings disposal systems

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests **(20 %)**
Assignments **(15%)**
Laboratories **(15%)**
Final Examination **(50%)**

Assessment Task 1: Assignments – A number of short assignments to be given in this subject to reinforce student learning. This assessment task is worth 15% of the total marks for the subject.

Assessment Task 2: Laboratories – The practical sessions will enable students to apply classroom theory to demonstrate real life applications in a hands-on team environment. Practical exercises will cover leaching kinetics with an aim to collect kinetic data for reactor design. The labs are worth 15% of the total marks for the Subject.

Assessment Task 3: Tests – Short class tests carry a weight of 20%. This assessment component assists in the evaluation of student learning outcomes

Assessment Task 4: Examination- this component will cover all the topics in this subject. The duration of exam is 3 hours and constitutes 50% of the total mark of this subject

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

Wills, B.A. Mineral Processing Technology, 6th Edition, (Oxford, Pergammon, 2005)

References

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

MP324 Surface chemical Processing

Course(s): Mineral Processing Engineering (Honours) (NQF Level 8)

Subject Name: Surface Chemical Processing

Subject Code: MP324

Duration:	13 Teaching weeks
Contact Hours:	6 Hours per week
Credit Points:	**18 (**3 Lectures + 3labs)
Delivery Mode	On campus
Prerequisites:	MP213 Physical chemistry for engineers
Co-requisites:	None
Subject Coordinator:	TBA

Synopsis

This subject deals with the application of surface and interfacial chemistry, thermodynamics, applied physics and electrochemistry to processing of minerals and other particulate materials. The subject covers fundamentals and industrial processes of froth flotation including flotation of gold and base metal ores, industrials minerals as well as coal. Electrokinetics including DLVO theory, zeta potential, thermodynamic aspects to surface chemical processing, 3-phase system, wettability, mineral chemistry are covered first as foundation topics.

Subject Topics

1. **Electro-kinetic properties of minerals** – acquisition of surface charges, DLVO theory, zeta potential, electrophoresis,
2. **Thermodynamic Aspects** - Surface chemical properties of minerals, hydrophobicity, 3-phase system, polarity of minerals & classification, mineral-liquid interface chemistry
3. **Concentration of Minerals by Flotation** - Flotation reagents, chemistry of flotation; Flotation of sulphide and non-sulphide metalliferious minerals; Coal flotation; Flotation Machines (including flotation columns); Flotation circuit design

4. **Kinetics of Flotation -** batch, semi-batch, continuous flotation, factors affecting rate constant, sub-process of flotation, advances in flotation research
5. **Practical examples of flotation circuits –** Ok Tedi Copper Concentrator, K92 Au-Cu Concentrator, Porgera Gold Concentrator, Prominent Hill Cu Concentrator.

Subject Outline

Topic	Content
1. Electrokinetic properties of minerals	• acquisition of surface charges, DLVO theory, zeta potential, electrophoresis
2. thermodynamics aspects	• Surface chemical properties of minerals, hydrophobicity, 3-phase system, polarity of minerals & classification, mineral-liquid interface chemistry
3. Concentration of minerals by froth flotation	• Flotation reagents, chemistry of flotation; Flotation of sulphide and non-sulphide metalliferious minerals; Coal flotation; Flotation Machines (including flotation columns); Flotation circuit design
4. Kinetics of flotation	• batch, semi-batch, continuous flotation, factors affecting rate constant, sub-process of flotation, advances in flotation research
5. practical examples of flotation circuits	• Ok Tedi Copper Concentrator, K92 Au-Cu Concentrator, Porgera Gold Concentrator, Prominent Hill Cu Concentrator

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Critically review and apply the knowledge of surface or interfacial chemistry, thermodynamics and engineering concepts to flotation of minerals
2. Describe and analyse process flowsheet and equipment employed in industrial flotation operations
3. Critically design, select and conduct froth flotation experiments of wide range of minerals
4. Evaluate and analyse performance of commercial flotation plants and propose corrective measures for plant improvement and optimisation
5. Apply knowledge gained in this subject to other related areas.
6. Function effectively in a professional team of engineers

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(20 %)**
Assignments	**(10%)**
Laboratories or design project	**(20%)**
Final Examination	**(50%)**

Assessment Task 1: Assignments – A number of short assignments to be given in this subject to reinforce student learning. This assessment task is worth 10% of the total marks for the subject.

Assessment Task 2: Laboratories or projects – The practical sessions will enable students to apply classroom theory to demonstrate real life applications in a hands-on team environment. Practical exercises will cover leaching kinetics with an aim to collect kinetic data for reactor design. The labs or design projects are worth 20% of the total marks for the Subject.

Assessment Task 3: Tests – Short class tests carry a weight of 20%. This assessment component assists in the evaluation of student learning outcomes

Assessment Task 4: Examination- this component will cover all the topics in this subject. The duration of exam is 3 hours and constitutes 50% of the total mark of this subject

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Surface Chemistry of Froth Flotation: Volume 1: Fundamentals 2nd Edition; S. Ramachandra Rao; 2003
2. Mineral Processing Technology, 7th Eds, Barry Wills, 2005

References

1. Leja. J., Surface Chemistry of Froth Flotation, (Plenum Press, New York, 1982).

2. King, R.P., (ed) Principles of Flotation, (South Africa Inst., Min & Metall, Johannesburg, 1982).

3. Introduction to mineral processing, Kelly, E.G.; Spottiswood, D.J.; 1982

4. Society of Mining Engineers SME Mineral Processing Handbook, AIME, 1985

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

MN411 Project Management and Economics

Course(s): Mineral Processing Engineering (Honours) (NQF Level 8)

Subject Name: Project Management & Economics

Subject Code: MN411

Duration:	13 Teaching weeks
Contact Hours:	6 Hours per week
Credit Points:	**18 (**1 hour lecture, 5 hours project)
Delivery Mode	On campus
Prerequisites:	Year 2 to Year 4 subjects
Co-requisites:	None
Subject Coordinator:	TBA

Synopsis

The subject covers project management and economics as an interdisciplinary area of management decision-making techniques for imparting management skills required to evaluate plan and scope projects, manage risk and cost budgeting. Conceptual

understanding of business strategies and market structures affect the economic and financial evaluation of mining projects and operation management tools. As such, the subject ensures the students attain the knowledge and hands-on skills that provide the foundation for achieving competency in mining project evaluation and operation management.

Subject Topics

1. Business Management Strategies:
2. Critical Path Method (CPM):
3. Linear Programming (LP):
4. Queuing Models:
5. Economic Order Quantity (EOQ) model:
6. Financial derivatives:
7. Time value of money applications:
8. Discounted Cash Flow (DCF) analysis.

Subject Outline

Topic	Content
1. Business Management Strategies	• Generic strategies, low-cost production strategy, Porter's Five Forces of competition, sustainable competitive advantage, market structure and factors of production and business growth horizons, organisation structures.
2. Critical Path Method (CPM)	• Construct CPM for scheduling time and resource allocations for managing and completing a project under time and cost constraints.
3. Linear Programming (LP)	• Convert descriptive problems into linear models (equations) solve LP problems using graphical technique and Solver in Excel™.
4. Queuing models	• Define different waiting line systems and calling population, and use average time and Poison Distribution to optimise productivity associated with time management and the cost of waiting.
5. Economic order quantity (EOQ) model	• Define ordering and holding costs and ordering cycle (graphical), optimal order size, total inventory costs, number of orders per year, and order cycle time
6. Financial derivatives	• Understanding of price commodity price cycles, the different type of interest rates, inflation, depreciation techniques and mining taxes, including royalties
7. Time value of money applications	• Define present, future and annual worth or values as they apply to complex investment decision-making associated with mutually and non-mutually investment options. It also covers equipment replacement analysis

8. Discounted cash flow (DCF) analysis	• Definition of cash flows, net present value (NPV), internal rate of return (IRR), capital efficiency (KE) and discounted payback period (DPP), construct a linear DCF model (nominal and real) and derive the financial variables (NPV, IRR, KE & DPP) for investment decision-making

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Be able to analyse the market structure, competitive strategies and have the ability to strategize different business outcomes under competitive forces that influence management decisions that are subject to dynamic market structures.

2. Be able to use operation research management tools such as Critical path method (CPM), Linear Programming (LP), and Economic Quantity Order (EQO) and other management tools to analyse problems using numerical data and confidentially provide recommendations for managerial decision-making.

3. Be able to analyse the basic principles of financial derivatives and the time value of money applications and have the ability to construct liner DCF financial model for the economic and financial evaluation of mining projects using economic, fiscal, mineral deposit and market information.

4. Be able to explain, analyse and apply competitive forces that influence management decisions and optimise operation productivity using operation research tools and confidently evaluate a project at the feasibility stage for assessing investment viability, planning, designing and construction of mining investment.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the Research Literature Review Final Report.

Students must also refer to the Subject Assessment Details.

Assignment 1	**(12.5%)**
Assignment 2	**(12.5%)**
Test 1	**(12.5%)**
Test 2	**(12.5%)**
Final exam	**(50%)**

Assessment Task 1: Assignment 1 contributes about 12.5% of the final marks. This designed to ensure the students explain business strategies and principles that are applied to manage the competitive forces that shape business decision-making within a market structure, especially for the mining industry. Also, the students will critically analyse management problems using operation research techniques that will demonstrate their abilities to analyse and interpret the numerical results and recommend suitable win-win solutions for different aspects of business operations.

Assessment Task 2: Assignment 2 contributes about 12.5% of the final marks. This assignment is designed for students to conceptualise the principles of the time value of money and solve application problems for making mutually and non-mutually investment decisions given the market and economic conditions. The students will be able to use spatial (geological), fiscal, economic and incorporate risks into the linear DCF model to derive financial decision-making variables such as the net present value (NPV) that enable them to make financial management decisions for analysing the financial viability of a mining project.

Assessment Task 3: Test 1 contributes to 12.5% of the total marks. This test is designed to assess the students' cognitive ability to apply the principles of business management strategies within different market structures and analyse the problems associated with optimal management decision-making, which

includes construction scheduling, production optimisation and inventory management of material supplies of production.

Assessment Task 4: Test 2 contributes to 12.5% of the total marks. This test is designed to assess students' ability to apply the time value of money applications and use economic, market, financial and spatial data to construct a DCF model of a hypothetical business operation, derive the decision variables and be able to interpret and analyse the results and provide recommendations for investment decision-making.

Assessment Task 5: Final written examination contributes to 50% of the total marks. The final examination covers the entire lectures, assignments and quizzes to assess students' ability to apply business strategies competently and solve management problems using operation research tools and the time value of money problems. Additionally, it tests students' ability to apply geological data, economic, fiscal and market risk conditions to construct a linear DCF and be able to use the results to evaluate the economic and financial viability of a mining project

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Allan Trench and Thomas Judge, (2002), The Insider's Guide to Success in Australian Business Management, Wrightbooks, McPherson's Printing Group, Australia
2. Stermole, F.J. (2000), Economic evaluation and investment decision methods 7th ed. Investment evaluations Corp
3. Thomas F. Torries, (1998), Evaluating mineral projects: Applications and misconceptions, SMME Inc.
   DeGrom, E.P., Sullivan, W.G. & Bontadelli, J.A, (1993), Engineering economy 9th Ed. MacMillan.

References

Numerous links are provided within the Subject Topics to research organisations, international universities, YouTube clips, and research databases

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/

MP411 Plant Design I

Course(s): Mineral Processing Engineering (Honours) (NQF Level 8)

Subject Name: Plant Design I

Subject Code: MP411

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**2 Lectures + 4labs)

Delivery Mode On campus

Prerequisites: All 2nd and 3rd year subjects

Co-requisites: None

Subject Coordinator: TBA

Synopsis

The subject Plant Design is taught in two (2) parts to final year mineral process engineering students. Plant Design (I) is taught in semester 1 and Plant Design (II) in semester 2. The Plant Design subject provides students with the opportunity to undertake integrated design and process selection to process a given orebody of a mine. The subject requires the student to integrate and apply the knowledge and skills acquired in years 1 to year 4 to the complex process flowsheet design and process selection. It builds on the areas of mineral processing engineering such as physical mineral processing, metallurgical accounting, hydrometallurgy, pyrometallurgy, process control, instrumentation & simulation, surface-chemical processing is vital together with their Laboratory skills. The subject covers sample types & sampling, mass or metal balance including use of computer software, ore characterization techniques, geometallurgy (process mineralogy), mineralogical analyses tools, process selection & flowsheet development and simulation and process testing.

Subject Topics

1. **Review of Mineral Processing Computations:** Calculation of Grade/Recovery Relationships, Metal and Material Balance and the use of Computer Software (e.g. JKSimMet, METSIM, Bilmat) as an aid to Process Calculations**.**
2. **Ore Characterisation Techniques:** Sampling and the Statistical Analysis of Sampling Data; Mineralogical Analysis of ores: mineral types, liberation sizes, ore textures; metallurgical test works
3. **Mineralogical analyses tools –** optical or reflected light microscopy, XRD or QXRD, Automated mineralogy – QEMSCAN, MLA
4. **Process selection**, **flowsheet development** and **Process Simulation.**
5. **Process Testing:** Bench-scale and pilot plant process testing, and computer modelling and simulation of processes and economic assessment of the selected processes for minerals or metals recovery**.**
6. **Study of Industrial Mineral Processing Flowsheets,** with particular reference to the Papua New Guinea Mineral Industry.
7. **Group Project** - develop Preliminary Process Design and deliver a group design seminar.

Subject Outline

Topic	Content
1. Review of Mineral Processing Computations	• Calculation of Grade/Recovery Relationships, Metal and Material Balance and the use of Computer Software (e.g. JKSimMet, METSIM, Bilmat) as an aid to Process Calculations

2. Ore characterisation techniques	• Sampling and the Statistical Analysis of Sampling Data; Mineralogical Analysis of ores: mineral types, liberation sizes, ore textures; metallurgical test works
3. Mineralogical analysis tools	• optical or reflected light microscopy, XRD or QXRD, Automated mineralogy – QEMSCAN, MLA
4. Process design	• Process selection, flowsheet development and Process Simulation
5. Process testing	• Bench-scale and pilot plant process testing, and computer modelling and simulation of processes and economic assessment of the selected processes for minerals or metals recovery
6. Industrial minerals process flow sheet	• Industrial minerals process flowsheet with particular reference to the Papua New Guinea Mineral Industry
7. Group project	• Develop Preliminary Process Design and deliver a group design seminar

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Critically examine, explain and select ore characterization techniques such as QXRD, QEMSCAN etc for mineralogical analyses for process selection and flow sheet design
2. Critically plan, develop and carry out bench-scale and pilot-scale metallurgical testworks for equipment selection and process design
3. Critically evaluate and design unit concentration processes based on mineralogical assessment and metallurgical testing at laboratory and at plant scale
4. Critically evaluate process options and design process flowsheet for a given ore
5. Plan, schedule and manage projects
6. Undertake complex integrated design of a processing plant through team work and be able to communicate design outcomes via oral and written reports

Assessment Tasks and Weightings

Assessment for the subject is continuous worth 100%, and students are divided in Groups and each group allocated a project. Groups are assessed based on the **laboratory test results** (10%) and apply these test results in a **Preliminary Process Flowsheet in block diagram** (20%) and will do **a group presentation** (20%) of the class audience and the **Final detail process design** (25%) and **oral presentation** (25%) to the class. During the class presentation the Group will have to defend their design to the student cohort and an industry delegate.

Assessment 1 This assessment involves the student working in groups and organising themselves promoting team work, be able to provide leadership during the Laboratory program and obtained and analyse results obtained from the test program. This assessment is worth 10% of the total marks.

Assessment 2 This assessment is divided into two parts, Part A is the Preliminary process design in block diagrams and is worth 20% of the total marks and Part B is the presentation part which requires the group to present and defend their design to their student cohort. Part B is worth 20% of the total marks.

Assessment 3. This assessment involves submission of the final process design report. The process flowsheet should be comprehensive detailing all the unit processes and equipment in the circuit and the reagent addition points in the circuit. This assessment is worth 25% of the total marks in this subject

Assessment 4. The task is the final group presentation, which requires the group to present and defend their design to their student cohort audience and the subject lecturer. This assessment is worth 25% of the total marks

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Mineral processing plant design, practice and control, Vol. (1 &2) 1st Eds., Andrew L. Mular; Derek, J. Barratt; Doug, N. Halbe; 2002
2. Mineral Processing Design and Operations: An Introduction 2nd Edition; Ashok Gupta; Denis S. Yan; 2016

References

1. Process Principles in Minerals and Materials Production, P. Hayes, 1993.
2. Flotation Plant Optimisation: A Metallurgical Guide to Identifying and Solving Problems in Flotation Plants: AusIMM-The Minerals Institute; C. Greet (Eds); 2010

Relevant Unitech Policies

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MP421 Plant Design II

Course(s): Mineral Processing Engineering (Honours) (NQF Level 8)

Subject Name: Plant Design II

Subject Code: MP421

Duration:	13 Teaching weeks
Contact Hours:	6 Hours per week
Credit Points:	**18 (**2 Lectures + 4labs)
Delivery Mode	On campus
Prerequisites:	MP411
Co-requisites:	None
Subject Coordinator:	TBA

Synopsis

Plant Design II provides the opportunity to students to be involved in detailed integrated plant design to a level suitable for final construction of an industrial scale mineral processing plant. In the first semester, under the subject Plant Design (I), students developed a ***process flowsheet*** comprising of number of unit operations and also preliminary selection of equipment.

In this subject, students continue that development and undertake detailed plant design including such as sizing & number of equipment, type of instrumentations, control units, and pumps.

Subject Topics

1. **Overview of plant design –** design criteria, crushing circuit design, grinding circuit design, flotation circuit design, leaching circuit design, gravity circuit design, design of dewatering unit

2. **Control systems** employed in a number of circuits will be studied in order to identify the controllable variables and the sensing instruments used to detect changes in these circuit operations.
3. **Computer Aided design & Control –** computer simulation softwares such as JKSIMET will be used to design and control some circuits, e.g. grinding mill. Full plant material balance will be taught to students to know how to perform full plant material balance on excel spread sheet or with the aid of computer softwres, JKSIMMET, JKSIMFLOAT, BILMAT
4. **Students in a small working group**, are then allocated a **circuit or unit operation to design**. A circuit or unit operation defined in this subject includes; *crushing circuit, grinding circuit, flotation circuit, leaching circuit, gravity circuit* etc. The unit operation allocated will have been incorporated in the process flowsheet developed under subject code Plant Design (I).
5. **The final project reports** will include engineering drawings showing the physical location of pumps, cells, reactors, etc., as well as costing and economic appraisals of each project

Subject Outline

Topic	Content
1. Overview of plant design	• design criteria, crushing circuit design, grinding circuit design, flotation circuit design, leaching circuit design, gravity circuit design, design of dewatering unit
2. control systems	• control systems employed in a number of circuits will be studied in order to identify the controllable variables and the sensing instruments used to detect changes in these circuit operations
3. computed aided design and control	• computer simulation softwares such as JKSIMET will be used to design and control some circuits, e.g. grinding mill. Full plant material balance will be taught to students to know how to perform full plant material balance on excel spread sheet or with the aid of computer softwres, JKSIMMET, JKSIMFLOAT, BILMA
4. Students in a small working group	• Students in a small working group, are then allocated a circuit or unit operation to design. A circuit or unit operation defined in this subject includes; *crushing circuit, grinding circuit, flotation circuit, leaching circuit, gravity circuit* etc. The unit operation allocated will have been incorporated in the process flowsheet developed under subject code Plant Design (I)
5. Final project report	• will include engineering drawings showing the physical location of pumps, cells, reactors, etc., as well as costing and economic appraisals of each project

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Critically assess, evaluate and interpret mineralogical data and metallurgical test results
2. Perform metallurgical balance of both simple and complex metallurgical plants
3. Critically evaluate different design options by examining multiple options
4. Understand and resolve the delicate balance between design effectiveness, economics, environmental impacts while meeting safety constraints
5. Demonstrate proficiency in the use of modelling and simulation
6. Plan and manage a substantial project
7. Undertake the complex integrated design of a mineral processing plant through team work and be able to communicate design outcomes via oral and written reports

Assessment Tasks and Weightings

Assessment for the subject is continuous worth 100%.

To obtain a pass grade in this subject at least 50% overall and at least 45% for the final report must be achieved. This subject is evaluated through continuous assessment and there is no final examination.

Unit assessment consists of reports and presentation or project defense as outlined below. Students must also refer to the Subject Assessment Guide for detail information on each assessment task

Assessment Task One: Project Concept Report: A team based report outlining member roles, project selection, team and member action plan and activity schedule to achieve the final design outcome. The report contributes **10%** towards the final grade for the subject.

Assessment Task Two: Project Defence (oral presentation): The students defend their project design before a panel of experts. This contributes **30%** towards the final grade for the subject.

Assessment Task Three: Final Report: Constitutes **60%.** A comprehensive professional technical report with the completed design with specifications included must be submitted

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Mineral processing plant design, practice and control, Vol. (1 &2) 1st Eds., Andrew L. Mular; Derek, J. Barratt; Doug, N. Halbe; 2002
2. Mineral Processing Design and Operations: An Introduction 2nd Edition; Ashok Gupta; Denis S. Yan; 2016

References

1. Process Principles in Minerals and Materials Production, P. Hayes, 1993.
2. Flotation Plant Optimisation: A Metallurgical Guide to Identifying and Solving Problems in Flotation Plants: AusIMM-The Minerals Institute; C. Greet (Eds); 2010

Relevant Unitech Policies

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MP417 Process control, instrumentation and Simulation

Course(s): Mineral Processing Engineering (Honours) (NQF Level 8)

Subject Name: Process control, instrumentation and simulation

Subject Code: MP417

Duration: 13 Teaching weeks

Contact Hours: 6 Hours per week

Credit Points: **18 (**3 Lectures + 3labs)

Delivery Mode On campus

Prerequisites: All 3rd year subjects

Co-requisites: None

Subject Coordinator: TBA

Synopsis

The subject covers some of the common process control systems and Instruments used in the mining and mineral processing industries to automatize unit operations. Also students will engage with a Software Package for Modeling and Simulation of Mineral Processing Plants to optimize Unit Operations.

Subject Topics

1. Principles of Process Control
2. Block Diagrams & Types of Control Loops
3. Operation Systems & Hardware of a Control System
4. Steady State Analysis & Unsteady State Responses
5. Controller Actions
6. Instrumentation of various Unit Operations
7. Application; Process Control Systems used by Mineral Processing Plants in PNG.
8. Use of Software Package, JKSimMet, JKSim Float, METSIM for Modeling and Simulation of Mineral Processing Plant Unit Operations.

Subject Outline

Topic	Content

1. Principles of Process Control	• Principles of Process Control
2. Block Diagrams & Types of Control Loops	• Block Diagrams & Types of Control Loops
3. Operation Systems & Hardware of a Control System	• Operation Systems & Hardware of a Control System
4. Steady State Analysis & Unsteady State Responses	• Steady State Analysis & Unsteady State Responses
5. Controller Actions	• Controller actions
6. Instrumentation	• Instrumentation of various Unit Operations – grinding, froth flotation, leaching etc
7. Application;	• Process Control Systems used by Mineral Processing Plants in PNG.
8. Software packages	• JKSimMet, JKSim Float, METSIM for Modeling and Simulation of Mineral Processing Plant Unit Operations

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Examine control systems and employ a control unit for a given mineral processing operations.
2. Critically compare different process control systems and comment on their advantages and disadvantages.
3. Calculate and utilise the gain factors and other characteristics of proportional, derivative and integral controllers.
4. Determine steady-state and unsteady-state response of simple process control circuits.
5. Describe the working of various instruments used in mineral processing circuits.
6. Differentiate between and apply Mineral Process Engineering software or tools available to optimize Mineral Processing Operations

Assessment Tasks and Weightings

The summative exam (final examination) will carry 50% and formative assessment (continuous assessment) 50%.

Students must also refer to the Subject Assessment Details.

Tests	**(20 %)**
Assignments	**(15%)**
Laboratories	**(15%)**
Final Examination	**(50%)**

Assessment Task 1: Assignments – A number of short assignments to be given in this subject to reinforce student learning. This assessment task is worth 15% of the total marks for the subject.

Assessment Task 2: Laboratories – The practical sessions will enable students to apply classroom theory to demonstrate real life applications in a hands-on team environment. Practical exercises will cover leaching kinetics with an aim to collect kinetic data for reactor design. The labs are worth 15% of the total marks for the Subject.

Assessment Task 3: Tests – Short class tests carry a weight of 20%. This assessment component assists in the evaluation of student learning outcomes

Assessment Task 4: Examination- this component will cover all the topics in this subject. The duration of exam is 3 hours and constitutes 50% of the total mark of this subject

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism www.unitech

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text book

1. Webber, T., Introduction to Process Dynamics and Control, (Wiley, New York. 1973)

References

1. Leja. J., Surface Chemistry of Froth Flotation, (Plenum Press, New York, 1982).

2. King, R.P., (ed) Principles of Flotation, (South Africa Inst., Min & Metall, Johannesburg, 1982).

3. Introduction to mineral processing, Kelly, E.G.; Spottiswood, D.J.; 1982

4. Society of Mining Engineers SME Mineral Processing Handbook, AIME, 1985

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism which can be accessed at www.unitech.ac.pg/AssessmentGuide/ and www.unitech.ac.pg/Plagiarism/