DEPARTMENT OF MINING ENGINEERING

Head of Department
Dr Arpa, G., PhD(Kyushu, Japan), MSc(Akita, Japan), B.Eng. Mining(PNGUOT)

Deputy Head
Dr Lem, J.P., PhD (UniSA, Australia), M.Phil (PNGUOT), BEng (PNGUOT)

Mining Section
Senior Lecturer
Dr Arpa, G., PhD(Kyushu, Japan), MSc(Akita, Japan), B.Eng. Mining(PNGUOT)

Lecturers
Pakne, D., MSc(NSW), B.Eng. Mining(PNGUOT), Cert.(Japan)
Ail, K. MSc(Curtain), B.Eng. Mining(PNGUOT) (Study Leave)

Mineral Processing Section
Lecturers
Lem, J.P., PhD (UniSA, Australia), MPhil.(PNGUOT), B. Eng. Mineral Processing(PNGUOT)
Witne, J., PhD (Camborne, UK), MSc (Japan), BSc (PNGUOT)
Kobal, W., MPhil.(PNGUOT), B. Eng. Mineral Processing (PNGUOT)

Senior Technical Instructors:
Saki, M., BSc. Mineral Processing (PNGUOT),
Kama, M., M.Phil. (Mineral Processing), BSc. Mineral Processing(PNGUOT), PGDip. Science Education(Curtain)

Senior Technical/Technical Instructors
Yawa, G., B.Eng (PNGUOT)
Kau, C., B.Eng (PNGUOT)
Matarab, Han., BEng (PNGUOT)

Geology Section
Senior Technical Instructor:
Yawas, D., BSc Geology (UPNG) (PNGUOT).

Laboratory Manager:
Kotera, J, Dipl. Lab Sci (Lae Tech)

Principal Technical officer
Pirah, P., Dipl. Lab Sci (Lae Tech)

Senior Technical Officers:
Robert, R.
Daniels, J., Bach. Management (DWU) Dipl. IT

Technical Officers:
Mosbi, J., Dip App Science (PolyTech)

Secretaries:
Rapula, J. PETT Cert.(HTechCol)
Nongur, S.

Administrative Officer:
Vauta. D.

UNDERGRADUATE PROGRAMME

The Department of Mining Engineering was established in 1988 at this University to train graduates for the Extractive Industry. In January 1990, the Mineral Technology Section then in the Department of Chemical Technology (now known as Applied Science) was transferred to the Department of Mining Engineering.

The Department offers the following programmes:

- Bachelor of Engineering in Mining Engineering - 4 years.
- Bachelor of Engineering in Mineral Processing Engineering - 4 years.

The Department admits students to the first year of these two programmes on merit basis from Grade 12 School Certificate (or equivalent) level. Strictly minimum requirements for admission are all Bs in Physics, Chemistry, Mathematics (A) and English.

The undergraduate teaching in the Department aims at producing quality engineers for the extractive industries and other related fields with basic technical, managerial and data handling skill and up-to-date information required for economic exploitation of mineral resources maintaining high standard of safety and environment.

The teaching-learning and research infrastructure and environment in the Department is being updated in the laboratories housed in Moseley Moramoro Mining Building and Kaindi building. The Department is proud of having world class facilities that include Mineral Processing Laboratory with XRD and XRF analyzers,
Cyclosizer, Autoclave and UV-Visible Spectrophotometer, laboratory-size crushing, grinding, sizing and flotation machinery. Besides there are Rock Mechanics Laboratory, Geology Laboratory, Computer and Mine Planning Laboratories.

Students are required to undergo about 12 weeks of industrial training during the vacation. This industrial training must be approved by the Head of Department and every student is required to submit a report at the end of each training period.

Graduates in Mining Engineering and Mineral Process Engineering are employed in various areas in the community; examples of Government associated employers are:
- Department of Minerals and Energy
- National Works Authority
- Electricity Commission
- Bureau of Water Resources
- Provincial Governments
- Local Governments
- Universities
- Technical Colleges

In addition, they are employed in the private sector in large and small mines, consulting companies, equipment sales companies and manufacturing companies. The alumni of this Department are serving in many prestigious industries like PJV, OTML, Lihir Gold, Oil Search Ltd, Pilbara Iron Pty Ltd etc.

**POSTGRADUATE PROGRAMME**

The Department currently runs Master of Philosophy (M Phil) programme. This is a research based post graduate degree programme to be undertaken for minimum two years full time.

The M.Phil programme is open to the following candidates:
1. A good Bachelor of Engineering or equivalent degree
2. A M.Sc. degree in Earth Sciences

The University offers Post Graduate scholarship through its Graduate Assistance Programme. Eligible post graduate students may also obtain Assistant Lectureship to carry out research oriented post graduate studies.

The research areas that the Department offers supervision include Geotechnology, Mine Planning and Design, Geostatistics, Remote Sensing and GIS Applications, Maintenance Management in Mining Industry, Geo Environmental Engineering, Environmental Management in Mineral industry, Gravity Separation, Mineral Processing Techniques, Tailing Management, Safety Engineering, Bulk Material Handling, Acid Mine Drainage, Drilling and Blasting, Under Sea Prospecting, Mineral Economics.

**MINING INDUSTRY ADVISORY COMMITTEE**

The Department keeps close interaction with the mining industry of PNG through its contacts with the Mining Industry Advisory Committee comprising of the representatives of different mining and petroleum companies operating in PNG, Department of Mines and Department of Petroleum of Government of PNG, PNG Chamber of Mines and Petroleum and Academics. The courses offered by the Department are reviewed periodically to accommodate changes required as per the needs of the academic developments and the industrial requirement.

**BACHELOR OF ENGINEERING IN MINING ENGINEERING**

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# Bachelor of Engineering in Mining Process Engineering

## Year 1
### First Semester
- **MA167** Engineering Mathematics I 5 4
- **PH141** Principles of Physics I 5 22

## Year 2
### First Semester
- **ME261** Statics 3 14
- **ME291** Thermodynamics I 3 14
- **CE221** Engineering Materials I 3 16
- **CE241** Engineering Drawing I 3 -
- **MA233** Engineering Mathematics IIA 4 -
- **MP251** Introduction to Mineral Processing 3 -
- **MN233** Exploration and Structural Geology 4 19
- **SV291** Surveying for Engineers I 3 7

### Second Semester
- **CE242** Engineering Drawing II 3 -
- **MA236** Engineering Mathematics IIB 4 3
- **ME252** Fluid Mechanics I 4 18
- **MN212** Introduction to Mining Engineering 3 11
- **MP236** Economic Geology and Mineralogy 4 15
- **LA201** Advanced Academic and Research Skills 2 11
- **SV292** Surveying for Engineers II 3 7
- **SV252** Survey Camp 10 days

## Year 3
### First Semester
- **MA339** Engineering Statistics 3 14
- **MN313** Geomechanics-I 4 15
- **MN315** Surface Mining 3 15
- **MN319** Mine Ventilation and sub surface environment 3 15
- **MN331** Engineering Geology & Geological Mapping 4 15
- **SV399** Mine Surveying 4 9
- **MP341** Hydrometallurgy I 4 13

### Second Semester
- **EE398** Electrical Engineering for Mining 4 15
- **MN324** Material Handling in Mines 3 11
- **MN314** Geomechanics II 4 15
- **MN316** Underground Mining 3 12

## Year 4
### First Semester
- **MN401** Project 4 11
- **MN411** Mineral Economics 4 13
- **MN413** Environmental Engineering 3 11
- **MN415** Mine Design I: Open Pit 6 17
- **MN417** Computer Applications in Mining 3 9
- **MN419** Resource Evaluation and Geostatistics 4 15

### Second Semester
- **MN402** Project 8 18
- **MN418** Industrial Engineering and Management 3 15
- **MN414** Mining Legislation and Safety 3 14
- **MN416** Mine Design II: Underground 6 17
- **Elective** Any one of the following 4 24

- **MN456** Industrial Training 12 weeks 100

## Electives
- **MN422** Alluvial Mining 4 15
- **MN424** Underground Metalliferous Mining 4 15
- **MN426** Raise, Tunnel Boring and Shaft Sinking 4 15
- **MN428** Mine System Engineering 4 15
- **MN432** Introduction to Petroleum Engineering 4 15
- **MN434** Remote Sensing, GIS & GPS 4 15
- **MN436** Mining Machinery 4 15

## BACHELOR OF ENGINEERING IN MINERAL PROCESS ENGINEERING

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- **MA167** Engineering Mathematics I 5 4
- **PH141** Principles of Physics I 5 22
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**Total Credits:**

- **Year 1:** 23
- **Year 2:** 24
- **Year 3:** 26
- **Year 4:** 25

**Total:** 96
### SUBJECTS TAUGHT BY THE DEPARTMENT

**Electives**

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SUBJECT DETAILS

MN122 GEOLOGY, MINING AND MINERAL PROCESSING

Hours per week: 3 (3 lectures)
Credit: 15 core

Learning Outcomes:
To provide students with an introduction of geology, mining and mineral processing.
On completion of the course the student should be able to:

LO 1. Comprehension of geological history of the earth, Classify various rock formations and understand various types of earth materials and mineral deposits.
LO 2. Ability to differentiate rocks from minerals and ore specimen
LO 3. Ability to analyze the basic techniques involved in mining and processing of minerals.
LO 4. Comprehension of the relevance of basic sciences and engineering disciplines to the mining industry.

Syllabus:
Earth Material and Processes:

Text Books:

Assessment:
Continuous - 50%
Written Exam - 50% (1 × 3 hours)

MN212 MINE DEVELOPMENT AND CONSTRUCTION

Hours per week: 3
Credit: 15

Learning Outcomes:
To provide students with a basic understanding of development and construction of a mine as well as rock fragmentation.

LO 1: Comprehension of basic stages involved in a mining enterprise;
LO 2. Comprehension of principles of rock Fragmentation and design drilling, blasting patterns.
LO 3. Ability to select and use different mode of access to a mineral deposit
LO 4. Ability to select a mining method for different ore bodies based on depth and geometry.
LO 5. Comprehension of explosives properties and its use to overcome rock strain energy to achieve fragmentation.

Syllabus:
Exploratory drilling and drillbility of rocks; introduction to unit operations in mining; classification and properties of explosives; detonators, detonating cords, and nonel detonators; mechanisms of rock breakage by blasting; blasting practices in underground and surface mines, blasting patterns, storage and handling of explosives; Access to mineral deposit: Choice of mode of
entry - adit, shaft, decline and combined model, their applicability, number and disposition.
Vertical and Inclined Shafts: Location, shape, size, and organisation of shaft sinking, construction of shaft collar, shaft fittings.
Shaft Sinking Operations: Ground breaking and muck disposal - tools and equipment, lining; ventilation, lighting and dewatering; sinking in difficult and water-bearing ground.
Mechanized Sinking: Simultaneous sinking and lining; slip - form method of lining; high speed sinking; Shaft Boring: Methods and equipment.
Special Attributes: Widening and deepening of inclined and vertical shafts; staple shafts, raised shafts.
Main Haulage Drifts and Tunnels: Purpose, shape, size and location; excavation - ground breaking, muck disposal, ventilation and supporting.
High Speed Drifting/Tunnelling: Application of mechanised methods; roadheaders and tunnel boring machines.
Recent Developments in shaft sinking and drifting/tunnelling.

Textbook:

Assessment:
Continuous assessment - 50%
Written examination - 50% (1 x 3 hours)

MN231 INTRODUCTION TO GEOLOGY

Hours per week: 3 (3 lectures)
Credit: 15

Learning Outcomes:
To provide students of other than mining engineering department with basic knowledge of geology and the geology of Papua New Guinea. On completion of the subject the student should be able to:

LO 1. Understand geological history of the earth;

LO 2. Classify various rock formations:

LO 3. Be familiar with geological structures;

LO 4. Be familiar with geological maps;

LO 5. Outline the geology of Papua New Guinea.

Syllabus:
Earth materials and processes; introduction to rock forming minerals; identification of hand specimens; identification and classification of igneous, sedimentary and metamorphic rock; weathering processes and products; plate tectonics; earthquakes and volcanoes; volcanism; structure and history of the earth; fossils and stratigraphic record.
Structural geology and geomorphology; deformation, folding and jointing of rocks; impact of rock type and structure on surface features.
Geology mapping techniques.
Geology of Papua New Guinea.

Textbook:

Assessment:
Continuous assessment - 50%
Written examination - 50% (1 x 3 hours)

MN233 EXPLORATION AND STRUCTURAL GEOLOGY

Hours per week: 3 (3 lectures)
Credit: 15

Learning Outcomes:
To provide students with basic knowledge of exploration and structural geology with special reference to PNG. On completion of the subject the student should be able to:

LO 1. Comprehension of geological Structure and exploration terminology and techniques;

LO 2. Ability to demonstrate understanding of mineral resources and reserves;

LO 3. Ability to interpret and understand different geological maps;

LO 4. Ability to understand and analyze the geology map and domains of
Papua New Guinea.

**Syllabus:**
Minerals and Rocks: Rock and mineral identification and their properties (Rock forming minerals and three types of rock groups) igneous intrusives (dyke, sills, batholith and laccolith).

Exploration Geology: Desk top study for exploration (interpretation of topography, geological structures, soils, ground water regions from aerial photographs and satellite imageries), Site selection (stratigraphic, lithologic, physiographic and structural guides); Exploration techniques (geochemical, geophysical and geobotany); Planning and drilling for resource evaluation (grade, tonnage, classification of resources and reserves); Preparation of prospecting and exploration reports; Environmental baseline studies during mineral exploration; Geological documentation for mine planning and grade control;

Structural Geology: Ductile and Brittle behaviour of rocks; Folds, Faults, Unconformities – their nomenclature, classification and recognition; Determination of dips, strike, thickness, of beds; Effects of folding and faulting on outcrops of strata/orebodies and on mining operations;

Geology of Papua New Guinea

**Textbook:**

**Reference:**
W. G. Shackleton, Economic and Applied Geology, Croom Helm Ltd, Provident House, 1986

**Assessment:**
Continuous assessment - 50%
Written examination - 50% (1 x 3 hours)

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**MP 251 INTRODUCTION TO MINERAL PROCESSING (For Mining Engineering Students only)**

**Hours per week:** 3 (3 lectures)
**Credit:** 15

**Learning Outcomes:**
To provide students with basic knowledge of mineral processing techniques and their use in Papua New Guinea. On completion of the subject the students should be able to:

- **LO 1.** Comprehension of the necessity for mineral beneficiation
- **LO 2.** Comprehension of mineralogical assessments of different ores types
- **LO 3.** Evaluate the different ore types and their comminution and concentration processes
- **LO 4.** Ability to understand the application of these processes in PNG

**Syllabus:**
The necessity for mineral beneficiation; mineralogical assessment; comminution-fracture, liberation, sizing, energy-size relationships, crushing, grinding, screening and classification. Cyclones, concentration processes based on density, electrical properties, magnetic and other physical properties; application of these processes in Papua New Guinea- case studies of mineral processing plants.

**Text Book:**
Wills, B. A. Mineral Processing Technology, Oxford Pergamon

Course Handouts

**Assessment:**
Continuous Assessment : 50%
Written Examination : 50%

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**MN313 GEOMECHANICS-I**

**Hours per week:** 4(2 lect.,1 tutorial, 1 Lab)
**Credits:** 15

**Prerequisites:** PH141, ME261

**Learning Outcomes:**
To provide students with basic aspects of geotechnology and instrumentation techniques. On completion of the subject the student should be able to:

- **LO1:** Comprehension of geotechnical
properties of rock and rock masses;

LO2: Ability to make stress and strain analysis of a rock mass;
LO3: Ability to use laboratory equipment and instruments.
LO4: Comprehension of rock deformation Characteristics
LO5: Analyze field and laboratory data to determine the strength and deformation properties of cohesive and internal friction angle of soils.
LO6: Demonstrate of understanding the fundamental difference in the strength and deformation characteristics of cohesive and cohesionless soils.
LO 7: Analyze failure Criteria for Rock and Rockmass: Theories of rock failure; Coulomb, Mohr and Griffith

Syllabus:
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 elastic constants; parameters influencing strength; abrasivity and of its determination.
Dynamic Properties of Rock and Rockmass : Propagation of elastic wave in rock media; determination of properties and elastic constants.
Time Dependent Properties of Rock : Creep deformation and strength behaviour; creep test and rheological models.
Behaviour of Rockmass : Rockmass structure, in-situ elastic properties and strength determination.
Failure Criteria for Rock and Rockmass: Theories of rock failure; Coulomb, Mohr and Griffith criteria; empirical criteria.
Pre-mining State of Stress : Sources; methods of determination including overcoring and hydro-fracturing methods.

Physico-mechanical Properties of Soil : Physical properties including consistency and gradation; classification of engineering soils; engineering properties of soils - compressibility, consolidation, compaction and strength.

Ground Water : Influence of water on rock and soil behaviour; permeability of rocks; measurement of permeability; ground water flow in rockmass; measurement of water pressure.

Textbook:

Assessment:
Continuous assessment - 50%
Written examination - 50% (1 x 3 hours)

MN314 GEOMECHANICS II

Hours per week: 4(2 lect,1 tutorial, 1 Lab)

Credits: 15
Prerequisites: MN313, ME261

Learning Outcomes:
To provide students with an understanding of stability problems induced by mining excavations. On completion of the subject the student should be able to:

LO 1. Comprehension of principles of soil and rock mechanics;
LO 2. Design and do analytical work on soil and rock slopes of both open pit and underground mine openings.
LO 3. Evaluate and analyze prediction of ground failures and design support techniques to maintain soil/rock stability in mine excavations.
LO 4. Evaluate In-situ stress and stress distribution profile around underground openings and open pit mine spoles
LO 5. Evaluate and assess rock mass Strength.
LO 6. Design open pit mine slope and underground excavation openings for safe and stable extraction of minerals

Syllabus:
Design and Stability of Structures in Rock: In-situ soil and rock mass classification systems; alterations of rock properties by presence of joints, laminations, geological contacts and discontinuities; application of theory of elasticity, elastic properties of rocks and numerical modeling of a real mining geometry;
Mine excavation: energy released by making an
underground excavation; design of single and multiple openings in massive, stratified and jointed rock mass; mine pillars and their classification, pillar stresses, pillar design, stability analysis of pillars.

Subsidence: Causes and impacts of subsidence; mechanics of surface subsidence, discontinuous and continuous subsidence; monitoring, prediction, control and management of subsidence. Caving of Rockmass : Caving characteristics of rocks; cavability index.

Rockburst: Phenomenology of rockbursts; prediction and control of rockbursts; bumps and gas outbursts.

Introduction to Methods of Stress Analysis: Predictive methods for mine design; principles of classical stress analysis - closed form solutions for simple excavation shapes; introduction to computational methods of stress analysis - finite element, boundary element, distinct element methods and hybrid computational schemes.

Monitoring Rockmass Performance: Purpose and nature, monitoring systems including seismic and microseismic methods.

Mechanics of Fragmentation: Mechanism of rock cutting by picks, disc and roller-cutters; mechanics of rock drilling; water-jet cutting; mechanics of blasting; methods of assessing cuttability, drillability and blastability of rocks.

Surface Mine Slope Stability : Types of mine slope; influence of pit slope on mine economics; common modes of slope failure; factors influencing slope stability; slope stability assessment techniques; stability of analysis of slopes; measures to enhance slope stability; protection and monitoring of slopes.

Textbook:
Course handouts.

References:

Assessment:
Continuous assessment - 50%
Written examination - 50% (1 x 3 hours)

MN315 SURFACE MINING

Hours per week: 3(2 lect, 1 tutorial, Lab)

Credits: 15
Prerequisites: MN212, MN122

Learning Outcomes:
To provide students with an understanding of unit operation techniques in surface mining. On completion of the subject the student should be able to:

LO 1. Apply mining techniques to design surface mining production systems.
LO 2. Ability to select surface mining methods and equipment;
LO 3. Comprehension of economic evaluation for different pit design technique
LO 4. Comprehension of waste to ore stripping ratio.
LO 5. Design and evaluate ultimate pit limit based on economics and physical Constraints
LO 6. Design unit production and auxiliary operations of an open pit mine.
LO 7. Design and produce short term and long term mine planning and designs.

Syllabus:
Introduction : Basic concepts; role of surface mining in mineral production; deposits amenable to surface mining vis-a-vis excavation characteristics; types of surface mining systems - applicability, limitations, advantages, disadvantages, classification and choice vis-a-vis equipment system;

Elements of surface mine planning; concept of stripping ratios, different mining costs and preliminary evaluation of surface mining prospects;

Opening up of Deposits: Site preparation; box cut; formation of benches and overburden stripping.

Simple analysis of different equipment system, selection and matching; operation, productivity,
application and limitation of dozer, ripper, shovels, hydraulic excavators, draglines, front-end-loaders, scrapers, bucket wheel excavators and continuous surface miners.

Haulage systems and design: Transport systems; operation, application and limitations of dumpers, conveyors (shaftable and high-angle); in-pit crushing and conveying. Haul Road Design.

Extraction Methods : Extraction of subsurface deposits - bedded deposits, massive deposits, pipe type, cap type and vein type deposits; placer deposits.

Mining of beach sands, dimensional stone mining, mining of industrial minerals

Dump Formation : Types of waste dump designs - internal and external; dump formation methods and equipment.

Textbook:
Kennedy, B.A. (Ed), Surface Mining, SME, 1990.
Rzhevsky, V.V., Surface mining Unit operations, Mir Publication, Moscow, 1985

Reference

Assessment:
Continuous assessment - 50%
Written examination - 50% (1 x 3 hours)

MN316: UNDERGROUND MINING

Hours per week: 4 Hours
(2 Lectures + 1 Tutorial + 1 Field work)

Credits: 12
4.5(Lect.) + 2.25(Tut.) + 1.5(Field)
Prerequisite: MN212, MN313, MN319

Learning Outcomes:
At the end of the course, the student should be able to:

LO1: Ability to understand the different underground mining methods and their variations and their application on appropriate geological and geotechnical conditions.

LO2: Understand the mining methods applied in the mines in PNG including Tolukuma, Porgera, Irumafimpa and Wafi-Golpu Project.

LO3: Design drill and blast pattern for the different mining methods.

LO4: Evaluate the rock mass characteristics and design excavations of development and stopes using RMR, Q-Index and Stability (N) Number.

LO5: Design size of opening and pillar using beam theory and area tributary theory.

LO6: Evaluate resource block model to produce reserve, analyse dilution and recovery from stope reconciliation and determine the cut-off grade (COG).

LO7: Comprehend the primary and secondary ventilation set up for each mining methods.

Syllabus
Introduction: Current status of underground metalliferous mining in PNG and abroad; elements of underground mine planning- size, production capacity and life.

Review of categorizing orebody geometry and spatial characteristics: ore strength, host rock strengths, deposit shape, deposit dip, deposit size, ore grade, uniformity, physical and environment assessments

Deposits amenable to underground mining, comparison of underground and surface mining.

Minning Methods - Supported Methods: cut and fill stopping, still stoping and square set stoping, caving methods. Variations in designs of methods such as, Avoca and Vertical Crater Retreat (VCR, Blasthole and Longhole stoping Unsupported methods: Caving Methods

Mine Design: underground adit and opening developments, facing drilling and production drilling, stope design and details of stope layouts, mine opening support systems, mucking, haulage and dumping. Top slicing, sub-level caving and block caving methods; stope layouts, stope preparation and production operations; design and construction of draw points; mechanics of draw and draw control procedure; recovery and dilution.
Combined Systems: Combined open-room, shrinkage, and cut-and-fill systems; combined systems with subsequent filling of rooms.

Deep Mining: Problems of deep mining and the remedial measures; design and layout of stopes in rockburst prone mines.

Special Methods: Hydraulic, thermal, hydrochemical and biochemical methods; nuclear device mining system - scope of application for mining of deep seated low grade mineral deposits; underwater/sea-bed mining - current status; different methods of winning manganese, gold and copper nodules from the ocean-floor. Recent developments in underground metal mining.

Text Book

Reference


Course handouts

Assessment
Continuous 50%
Exam 50%

MN319 MINE VENTILATION AND SUB SURFACE ENVIRONMENT

Hours per week: 4(3 lect,1 tutorial, Lab)
Credits: 15

Prerequisites: MN212, ME291, ME252

Learning Outcomes:
To provide students with an understanding of fundamental principles involved in mine ventilation and management of subsurface environment.

On completion of the subject the student should be able to:

LO 1. Comprehension of sources of mine heat, gas and dust in subsurface environment

LO 2. Design layout of ventilation systems in a mine

LO 3. Ability to solve air-flow and ventilation network problems;


LO 5. Analysis of fan and system characteristics for ventilation optimization

Syllabus:
Composition of Mine Atmosphere in non-metallic and metallic mines: Mine gases - production, properties and effects; sampling and analysis of mine air; methane content; methane drainage; flame safety lamp and its uses; methanometers; methane layering; radon gas and its daughter products; monitoring of gases.

Heat and Humidity: Sources of heat in mines; effects of heat and humidity; psychrometry, kata thermometer; air-conditioning. Introduction to heat and mass transfer.

Air Flow through Mine Openings and distribution: Laws of flow, resistance of air ways, equivalent orifice, distribution of air; flow control devices; permissible air velocities in different types of workings.

Natural Ventilation: Seasonal variations, calculation from air densities and thermodynamic principles.

Mechanical Ventilation: Types of mine fans; theory, characteristics and suitability of fans; selection, testing and output control; fans in series and parallel; forcing and exhaust configurations; reversal of flow; fan drifts, diffusers, evasees; booster and auxiliary ventilation; venturi blowers; standards of ventilation; ventilation cost calculations.

Ventilation Planning: Planning of ventilation systems and economic considerations; ventilation layouts for mining of ore deposits; ventilation of
workings/stopes using heavy blasting; calculation of air quantity required for ventilating a mine; calculation of total mine head;
Network analysis principles and computer applications; automation and remote control of ventilation installations; ventilation surveys.
Recent Developments in mine ventilation.

Textbook:
Course handouts.

Reference:

Assessment:
Continuous assessment - 50%
Written examination - 50% (1 x 3 hours)

MN 324 MATERIAL HANDLING IN MINES

Hours per week: 3(2 lect, 1 tutorial, Lab)

Credits: 11
Prerequisites: MN212, CE221, ME252

Learning Outcomes:
Introduce the students to material handling involved in mines with special reference to the mineral industry in Papua New Guinea.
On completion of this subject the student should be able to:

LO 1. Ability to classify various bulk material handling operations involved in mining and mineral processing.

LO 2. Ability to perform calculations involved in design of belt conveyors, slurry transport, underground mine transport

LO 3. Evaluate the methods and equipment for stacking, blending and reclaiming of bulk materials

LO 4. Design basic construction and operation of basic bulk material handling equipment

Syllabus:
Bulk material handling systems in mines: classification and description.
Conveyors: types and components, basic design calculations, feeders, protection and safety features, drive arrangements.
Storage of bulk material, bin, bunker and silo.
Stackers and reclaimers.
Hydraulic and pneumatic transport basic principles and operation, Introduction to slurry handling systems.
Rope haulage, locomotive haulage, winding of bulk material through vertical and inclined shaft.
Trends of development in material handling in mines.

References:
SME Handbook.
Course handouts.

Assessment:
Continuous assessment - 50%
Written examination - 50%

MN331 ENGINEERING GEOLOGY AND GEOLOGICAL MAPPING

Hours per week: 4(3 lect, 1 tutorial, Lab)

Credits: 15
Prerequisites: MN212, MN236

Learning Outcomes:
To provide students with an understanding of practical engineering geological techniques applied to mining activities. On completion of the subject the student should be able to:

LO 1. Ability to recognise the effects of rock discontinuity on the stability of rock slopes;

LO 2. Analyze geological hazards and provide solutions for remediation;

LO 3. Evaluate and participate in mining operation management when associated with geological problems.

Syllabus:
Engineering Geology: natural slopes and slope
failure mechanisms; mine batter slopes and main types of batter failures; 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.

Geological Mapping: use and familiarity and mining and engineering geology mapping techniques, practice and symbols; face mapping of geology, ore/waste boundaries; defect orientation and spacing; practical exercises including stereographic projection of self collected data. Aerial photography and remote sensing.

Textbook:
Beavis, F.C., Engineering Geology, Blackwell, Melbourne, Australia.

Assessment:
Continuous assessment - 50%
Written examination - 50%

MN332 MINING GEOLOGY AND HYDROGEOLOGY

Hours per week: 4(3 lect,1 tutorial, Lab)

Credits: 15
Prerequisites: MN236, MN331

Learning Outcomes:
To provide students with an understanding of mine geology of various ores deposits and hydrogeology as well as their practical applications in the mining industry. On completion of the subject the students should be able to:

LO 1. Comprehension of ore genesis, classification and mineralogy;
LO 2. Evaluate and produce meaningful geological logs;
LO 3. Comprehend and understand concept of grade control;
LO 4. Comprehend the concepts of hydrogeology and their application in water management techniques in open pits and underground mines.

Syllabus:
Mine Geology: Forms of ore bodies and their impact on mining methods; mineralogy of ore deposits, factors controlling form and location of orebodies, Manner of ore emplacement, Genesis of ores and genetic classification; principles and practices of grade control in opencast and underground mines.

Hydrogeology: introduction to hydrogeology; hydrological properties of rocks; origin of surface and ground water management as well as its control in opencast and underground mines; mine water inflow predictions and drainage calculation techniques; importance of ground water in mine stability. Elements of petroleum geology.

Textbook:
Shakleton, W.G., Economic and Applied Geology.

Reference:

Assessment:
Continuous assessment - 50%
Written examination - 50% (1 x 3 hours)

MN336 MINING GEOLOGY FIELD TRIP

Period: 5 days field trip (8 hours, 5 days)
Credits: 12

Learning Outcomes:
To provide students with field experience in geological investigations. On completion of the subject the student should be able to:

LO 1. Comprehend regional geological formations and rock types;
LO 2. Ability to prepare a face mapping sheet and collect geotechnical information from a rock face;
LO 3. Comprehend the influence of geology
and geological processes on the geomorphic evolution of the landscape.

**LO 4.** Ability to relate geology to slope stability and strength of geological materials.

**Syllabus:**
Field practice and experience in the examination of rocks, minerals; geological exposures in general.

**Assessment:**
Assessment of field report - 100%

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**MN 340 COMPUTER PROGRAMMING**

**Hours per week:** 2 (2 lect)

**Credits:** 9

**Prerequisites:** EE 102

**Learning Outcomes:**
On completion of the subject, students should be able to:

**LO1.** Ability to use the Turbo-C application.

**LO2.** Ability to construct algorithms and implement them in computer program.

**LO3.** Ability to write computer programme in i.e. on the IBM compatible PC, and to solve engineering problems.

**LO4.** Design and write programme in C for laboratory use with AD system.

**LO5.** Ability to use C language to Construct computer programmes for specific engineering problems

**LO6.** Comprehend the applications and relevance of programming in engineering design and management.

**Syllabus:**
The “C” programming language. The Turbo-C computer programming tool. Compiling and linking programmer, data types, formatted input/output, variable names, arrays, string handling, reading from a file and writing to a file, loop structure, decision, header files, pointers, standard functions, language structure. Writing algorithms. Solving numerical problems using computer programs, solution of some engineering problems through C programs, write simple programs to be used in laboratories to control experiment and record data.

**Textbook:**

**Reference Books:**

**Assessment:**
Continuous assessment - 100%

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**MN356/MN456 INDUSTRIAL TRAINING**

**Period:** 12 weeks training in mines during 2nd and 3rd year long vacations.

**Credits:** 480

**Learning Outcomes:**
To allow students to gain field experiences to visualize classroom orientated conceptual learning and field exposure will better equip them as mining engineer. On completion of the subject the student should be able to:

**LO1.** Comprehension of field operational aspects of mining activities with respect to what is learnt from text books;

**LO 2.** Ability to self motivate student to learning and to understand the course;
LO 3. Ability to use technical language to communicate by a written training report.

**Syllabus:**
Training at a mine in all aspects mining including geology, surveying, mine planning, material handling, mineral processing, community services, supervision and administrations. Writing Training Report: writing of technical report on training experience.

**Assessment:**
Continuous assessment - 100%

**MN 391 MINING TECHNIQUES AND MINING ECONOMICS**

**Hours per week:** 4 (2le, 1tut, 1lab)
**Credits:** 12

**Learning Outcomes:**
To provide students with a detailed summary of the processes of mineral exploration, mine development and mineral processing, and an appreciation of the economic factors inherent in the mine investment decision-making process. On completion of this subject the student should be able to:

- **LO1.** Ability to describe the process and outline the principle techniques of mineral exploration;
- **LO2.** Ability to understand and describe the principal ore deposit types and the mineral commodities associated with each ore deposit;
- **LO3.** Comprehension of main surface and underground mining methods;
- **LO4.** Ability to describe the major processes and components used in mineral processing plants;
- **LO5.** Evaluate the primary economic factors affecting mine development;
- **LO6.** Comprehension of the main capital and operating costs of a mining operation;
- **LO7.** Evaluate the taxation and royalty system as applied to the mining industry in Papua New Guinea.

**Syllabus:**
Exploration methods, preliminary, geophysical and geochemical, drilling and providing up of ore bodies types. Statements of reserves. Selection of mining techniques to suit orebody size, shape and rock strength. Surface mining methods, alluvial and bedded deposits, vein deposits and massive deposits. Mining equipment and factors affecting choice of methods. Underground mining methods and equipment. Activities undertaken by mining companies the structure of the industry. Mineral resources as diminishing assets. General factors affecting the supply and demand for minerals, mineral pricing. The feasibility study and prediction of project costs. Evaluation of capital costs for mine and processing plant. Evaluation of operating costs for mining and processing plant. The Papua New Guinea taxation and royalty system. Overall valuation of project worth by various criteria, such as present value, discounted cash flow, internal rate of return, break even point. Sensitivity analysis. Sources of finance.

**Reference:**

**Assessment:**
Continuous assessment - 50%
Written Examination - 50% (1x3hrs)

**MN401/MN402 PROJECT**

**Hours per week:**
5 hours first semester, 8 Hours second semester
**Credits:** 11 & 18

**Learning Outcomes:**
To train students with basic skills to initiate and fulfill a design or research project. On completion of the subject the student should be able to:

- **LO 1.** Ability to search for information and literature required for the research project;
Department of Mining Engineering

LO2. Ability to design and create research Plan, organize sequential works and tests involved;

LO 3. Ability to write a project report;

LO 4. Ability to present research results in a structured way.

LO 5. Ability to aquire skills by seminar presentation on their projects.

Syllabus:
The topics for each student are assigned by the Department and supervised by a staff member. Review of related literature; organisation of works involved; experimentation and analysis of results; writing of project report; presentation of project seminars.

Assessment:
Continuous assessment - 100%

MN411 MINERAL ECONOMICS

Hours per week: 4 (3 hr lect, 1 hour tut)
Credits: 13

Learning Outcomes:
To provide students with a basic understanding of economics of mining industry, mine operational economics, risks, and project evaluations. On completion of the subject the student should be able to:

LO 1. Ability to understand basic principles of mineral economics;

LO 2. Evaluate mineral projects by financial modeling of mining projects;

LO 3. Evaluate and predict financial risks/profits by applying market information and company’s financial statements

LO 4. Ability to evaluate, assess and apply different taxation laws and rates in cash flow modeling of mineral resources industry

Syllabus:
Introduction: Economic importance of the mineral industry; mining economy, risky nature of the mining industry; State and the mining industry; Mineral resource - concept, classification and estimation. Economics of mineral exploration and production. Mineral price and pricing, price index. royalties and compensation; Mineral consumption and substitution; market survey and demand analysis. Market structure, market conduct and performance


Optimization: financial modeling, economics of equipment selection, cost and benefit calculations,

Financial risks analysis, use of Monte Carlo Simulation and Scenario Analysis, Depreciation and taxation, accounting terminologies in analyzing company financial statements.

Mineral market analysis: Various market structures and competitive forces of mining industry, supply and demand, introduction of supply chain management

Textbook:

Reference:

Assessment:
Continuous assessment - 50%
Written Examination - 50%(1x3 hours)

MN413 ENVIRONMENTAL ENGINEERING

Hours per week: 3 (2 hrs lect, 1 hr Tut/lab)
Credits: 11

Learning Outcomes:
To provide students with an understanding of the impacts of mining, mineral processing activities on the surrounding environment, the disposal of mineral wastes, and the rehabilitation and reclamation of mineral waste impoundments.

On completion of the subject the student should be able to:

LO1. Ability to understand basic aspect of the socio-economic and environmental conditions in which mineral extraction is normally undertaken, and the methods of managing these conditions;

LO 2. Evaluate and assess possible environmental impacts of mineral workings and determine the strategies to minimise these impacts;

LO 3. Design the rehabilitation and reclamation methods for mine wastes and tailings impoundments;

LO 4. Ability to understand the procedures for monitoring and sampling mine wastes and tailings impoundments;

LO 5. Analyse the factors influencing environmental management strategies in Papua New Guinea.

Syllabus:
Introduction : Environmental issues in mineral industry - national and global; ambient environment in mining complexes; environmental impacts of mineral exploitation - underground and opencast mining and associated activities, pollution aspects of mineral and metal extraction. 6

Societal Environment: Societal environment and its management including resettlement and rehabilitation; socio-economic impacts; sustainable development; concept of carrying capacity based planning.

Ecological Environment: Ecological environment and its management including biological reclamation.

Land Environment : Visual impacts; landscape analysis; land use; landscape planning; physical reclamation and subsidence management.

Water Regime: Availability; water quality; water pollution and water management.

Air Pollution: Air pollution - sources, monitoring and control.

Waste Management : Liquid effluents - quality, treatment and disposal; solid wastes - generation, treatment and disposal.

Noise and Vibrations: Causes, precautions, prevention and reduction.

Blasting: Environmental aspects of blasting.

Administration and Management: Environmental administration in PNG; preparation of environmental management plan. EIA, Environmental Laws and Standards, ISO 14000.

Textbooks:
Masters, Gilbert M., Introduction to environmental engineering and science Prentice Hall India, 2000
Rao, C.S., Environmental Pollution Control Engineering, New Age International(P Ltd, New Delhi, 1998.

Assessment:
Continuous assessment - 50%
Written examination - 50% (1 x 3 hours)

MN414 MINING LEGISLATION AND SAFETY

Hours per week: 4 (3 Hrs Lect, 1 hr tut)
Credits: 14

Learning Outcomes:
To provide students with an understanding of legislation relating to mining industry.
On completion of the subject the student should be able to:

LO 1. Ability to broadly understand mining industrial laws including mining safety and environment regulations;

LO 2. Ability to understand Mining Act relating to exploration and mining leases;

LO 3. Evaluate the effect of mining policy affecting international competitiveness

Syllabus:
PNG Mining Act and its components which are: Regulations governing operations, Exploration or Tenement Administration, Mine Safety Act and Environmental Act. Mining Policy and international competitiveness.
Mine rescue and first aid. Safety management systems in PNG mining industry; engineering aspects of safety management.
Risk Assessment: Basic concept of risk, reliability and hazard potential; elements of risk assessment; statistical methods; control charts; appraisal of advanced techniques - fault tree analysis, failure mode and effect analysis, quantitative structure - activity relationship analysis; fuzzy model for risk assessment.

Safety in Mines: Occupational hazards of mining; accidents and their classification; statistics of fatal and serious accidents; frequency rates and severity rates of accidents; cause-wise analysis; basic causes of accident occurrence; investigations into accidents and accident reports; in-depth study of accidents due to various causes; measures for improving safety in mines.

Cost of Accidents Inundation: Causes and prevention; precautions and techniques of approaching old workings; safety boring apparatus, pattern of holes; design and construction of water dams.
Rescue and Recovery: Rescue equipment and their uses; rescue stations and rescue rooms; organisation of, measurement and control. Illumination rescue work.
Airborne Respirable Dust: Generation, dispersion: Cap lamps; layout and organisation of lamp rooms; standards of illumination; photometry and illumination survey.

Textbook:
PNG Mining (Safety) Act, (1980) Revised DME.

Reference:
Mining Act, 1992.

Assessment:
Continuous assessment - 50%
Written examination - 50% (1 x 3 hours)

MN415 MINE DESIGN I: OPEN PIT

Hours per week: 6(4hr lect, 2 hrs tut )
Credits: 17

Learning Outcomes:
To provide students with basic knowledge of surface mine design principles. On completion of the subject the student should be able to:

LO 1. Ability to interpret geological data, log results and synthesize exploration information.

LO 2. Evaluate and model a hypothetical mineral deposit;

LO 3. Design an open pit mine based on the drill hole data in feasibility stages.

LO 4. Ability to Understand basic principles of open pit mine design and apply analytical tools to design a mine

LO 5. Ability write a conceptual mine design report.

LO 6. Ability to make a present to public
**Department of Mining Engineering**

**Syllabus:**
Review of 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 range and long range mine plans.

Pit limit and Ultimate pit configuration, Calendar plans and scheduling.

Design of open pit mine, waste dumps, haulage systems, face design, bench designs, cost estimations, economic analysis and produce a analytical report.

Environmental and economic assessment of a mine; computer applications in mine design; design exercises on surface and underground mining.

**Textbook:**
Course handouts.

**Reference:**

**Assessment:**
Continuous assessment - 100%

**MN416: MINE DESIGN II: UNDERGROUND MINING**

**Hours per week:** 6 (3hr lect, 3hrs tut)

**Credits:** 17

**Learning Outcomes.**
To train students with basic skills in mine design. On completion of the subject the student should be able to:

- **LO 1.** Ability to interpret geological data, log results and synthesize exploration information.

- **LO 2.** Evaluate and model a hypothetical mineral deposit and design the mine

- **LO 3.** Ability to make economic evaluation of the deposit

**Syllabus:**
Review of Interpretation of geological and log information and model the deposit; Assessment of the ore body and host rock properties, ground water conditions and geometrical orientation of the deposit.

Selection of appropriate underground mining method and conceptual reserve estimations.

Design underground mine openings, design of underground blasts, ventilations systems, rock stability designs, design of roof supports cost estimations and economic analysis and preparation of analytical report.

Design of underground transport system, hoist design-cage and skip winding, design of pit top and pit bottom layout

**Textbook:**
Course handouts and self research sources

**Reference:**

**Assessment:**
Continuous assessment - 50% Final Report
Assignments - 50%

**MN417: COMPUTER APPLICATION IN MINING**

**Hours per week:** 3 Hours
(1 Lecture + 2 Tutorials)

**Credits:** 9

**Prerequisite:** MN316, MN315, MN319, SV399, MN340

**Learning Outcomes:**
At the end of the course, the student should be able to:

- **LO1:** Ability to use MS Excel and design a short term production plan.
LO2: Ability to use MS Access and design a production database for data entry and recording.

LO3: Ability to use design softwares to design ore block using resource block model, drill designs, and development designs.

LO4: Ability to use Mine design softwares to design open pit and underground mine plans.

Syllabus
Database Systems: Overview of file organisation - sequential, direct, indexed, hashed, inverted; introduction to RDBMS; use of DBASE and Microsoft Access.

User Interfaces: Forms, graphics, semi-graphic, spread sheet, natural language. Use of a high level computer language to simulate some mining problems.

Artificial Intelligence Programming: LISP programming; rule based representations; knowledge representation and use of represented knowledge to solve problems.

Geographic Information System: Introduction to GIS package; introduction to software packages for mining industry - SURPAC, FLAC 3.4, 3-DEC, and other FEM/BEM packages. Remote Sensing and Image Processing software and their application in mining.

Text Book
Course handouts

Assessment
Continuous 100%

MN418: MINE AND MINERAL MANAGEMENT

Hours per week: 4 (3hrs lect., 1hr tut)
Credits: 15

Learning Outcomes:
To provide students with an understanding of basic principles of mine management.
On completion of the subject the student should be able to:

LO 1. Ability to understand basic principles applicable to mine management;

LO 2. Ability to participate in short and long term aspects of mine management;

LO 3. Ability to understand basic principles of operation research applicable to mining industry.

Syllabus:
Introduction: Evolution of management theory and practice; principles of scientific management; elements of management functions - planning, organisation and control; structure and design of organisation for mining enterprises.

Company Management Structure: Tall and short management structures, decentralization of functional duties to achieve unified corporate object, and employment, motivation and specialization.

Introduction to Financial management, Personal management and Production Management
Determination of norms and standards of operations by work study; analysis of mine capacities and capabilities; production planning, scheduling and control - short and long term; productivity - its concept and measurement.

Quantitative Managements Tools/Operation Research:

Textbook:


Trench, A. & Judge, T., (2002), Success in Australian Business and Management, McPherson’s Printing Group, Australia

Assessment:
Continuous assessment - 50%
Written examination - 50% (1 x 3 hours)

MN419 RESOURCE EVALUATION AND GEOSTATISTICS

Hours per week: 4 (3 hrs letc, 1 hour tut)

Credits: 15

Learning Outcomes:
To provide students with basic skills in ore reserve estimation. On completion of the subject the student should be able to:

LO 1. Ability to understand theories and methods of ore reserve estimation;
LO 2. Ability to apply sampling and grade control techniques in mine planning and design.
LO 3. Evaluate and carry out mineral deposit resource modeling

Syllabus:
Reserves and resources; drilling programs; theories, methods and applications of estimating ore reserves; Interpretation of geological and log information and model the deposit.

Textbook:

Reference:
A. G. Journal, Ch. J. Huijbregts, Mining Geostatistics.

Assessment:
Continuous assessment - 50%
Written examination - 50% (1 x 3 hours)

MN422 ALLUVIAL MINING (Elective)

Hours per week: 4 (3hrs lect, 1 hr tut)

Credits: 15

Learning Outcomes:
To provide students with an understanding of alluvial mining techniques and their applications in design and management of alluvial mines. On completion of the subject the student should be able to:

LO 1. Design facilities applicable to various alluvial mining systems;
LO 2. Evaluate and select appropriate mining methods for particular deposits;
LO 3. Ability to manage an alluvial mining mine operation.

Syllabus:
Alluvial mineral deposits and their occurrences in Papua New Guinea.
Gravity separation techniques and equipment.
Alluvial mining methods and their selections; planning considerations in alluvial mines; evaluation of alluvial mines.
Marketing of mine outputs.
Textbooks: Course handouts.

Field trip: 1 day field trip to an alluvial mining area.

Assessment: Continuous assessment - 100%

MN424 UNDERGROUND METALLIFEROUS MINING (Elective)

Hours per week: 4 (3 hrs lect, 1 hr tut)
Credits: 15

Learning Outcomes: To provide students with an understanding of advanced underground metalliferous mining techniques in design and management of an underground mine. On completion of the subject the student should be able to:

LO 1. Ability to understand different underground metalliferous mining methods and their selections applicable to deposits;

LO 2. Design and plan an underground metalliferous mines.

Syllabus: Production, development and resource scheduling; mine development; stope development; cyclic and continuous production systems; optimum ore fragmentation; material flow in passes; pillar recovery; optimum fill selection, preparation and placement of mine fills, fill dewatering; ground support during stopping.

Textbook: Course handouts.

Assessment: Continuous assessment - 100%

MN426 RAISE, TUNNEL BORING AND SHAFT SINKING (Elective)

Textbook: Course handouts.

Assessment: Continuous assessment - 100%
**Syllabus:**
Introduction to Systems Engineering: Concept of system, components and system environment; classification of systems; systems analysis; creative aspects of planning and design; factors influencing creativity; techniques for generating alternative ideas/solutions.
Decision Analysis: Decision problems; model formulation; decision analysis based on expected monetary value and utility value.

Mathematical Programming Methods: Linear programming - definition/elements, assumptions and limitations of LPP; graphical solution; geometry and algebra of simplex method; interpretation of simplex table; application of linear programming for solution of mining problems related to production, blending, scheduling.

Transportation and Assignment Problems: Mathematical modelling and solution algorithm; application to mining problems.

Project Management with PERT & CPM: Assumptions of PERT and CPM; art of drawing network; redundancy and identification of redundant jobs; algorithm for calculation of critical path and identification of critical jobs; criticality index; statistics related to PERT; probability of completing a project by a due date; lowest cost schedule; case examples.

Network Models: Introduction and concept; shortest route and minimal spanning tree algorithms; application to mining problems.

Simulation: Introduction and concept; scope and limitation; system type versus simulation technique; generating input data; Monte-Carlo simulation; simulation of equipment maintenance and inventory systems in mines.

Inventory Management: Introduction; components, scope and limitations; nature of inventory; classical E. O. Q. model; E. O. Q. model with quantity discount; an E. O. Q. problem with safety stock; static and dynamic inventory problems for single and multiple items; inventory optimisation under space and budgetary constraints.

**Textbook:**

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**Assessment:**
Continuous assessment - 100%

MN432 INTRODUCTION TO PETROLEUM ENGINEERING (Elective)

**Hours per week:** 4 (3 hrs lect, 1 hr tut)
**Credits:** 15

**Learning Outcomes:**
To provide students with an introduction to petroleum geology and petroleum engineering. On completion of the student should be able to:

- LO 1. Ability to understand basic principles of Petroleum Geology;
- LO 2. Ability to understand basic petroleum engineering processes;
- LO 3. Evaluate location and logistic of prospective and producing oil and gas fields in PNG.

**Syllabus:**
Fundamental principles of petroleum regarding its origin, migration and accumulation; chemical composition; stratigraphy; nature of source rocks; reservoirs and traps.

- Introduction to petroleum industry; petroleum prospecting; drilling operation; formation evaluation, petroleum production system management; reservoir management; oil and gas separation, oil and gas transportation; utilisation of oil and natural gas.
- Location and characteristics of producing gas and oilfields of PNG.

**Textbook:**
McRay and Cole, 1960 Oil Well drilling Technology, English Book Depo, Dehradun

**Reference:**
SPE Handbook

**Assessment:**
Continuous assessment: 100%
MN434  REMOTE SENSING, GIS AND GPS  
(Elective) 

Hours per week:  4 (3 hrs lect, 1 hr tut)  
Credits:  15  

Learning Outcomes:  
To provide students with concepts of remote sensing, GIS and GPS. On completion of the course the students will learn  

LO 1. Ability to understand basic principle of remote sensing, GIS and GPS  
LO 2. Ability to use basic image processing and GIS software  
LO 3. Ability to handle GPS receiver and spatial information  

Syllabus:  
Introduction to remote sensing: sensors, present status of remote sensing satellites, Digital image processing techniques; introduction to digital terrain modelling; 
Introduction to Land and Geographic Information Systems; Different coordinate system, Working principle of GIS, Database associated with GIS, Applications of GIS in surface mining, Applications of GIS in land development, road construction, etc., GPS and its applications 
Hand on exercise on RS and GIS package.  

Textbook:  
Computer processing of remotely sensed Images: An Introduction by Paul M Mather  

Reference  

Assessment:  
Continuous assessment:  100%  

MN436  MINING MACHINERY  

Hours per week:  4 (3 hrs lect, 1 hr tut)  
Credits:  15  

Learning Outcomes:  
To provide students the fundamental concepts for understanding the machinery used in the mining industry. On completion of the course the student should be able to:  

LO 1. Ability to understand functions of the prime movers and power transmission systems for mining machinery  
LO 2. Ability to learn the basic principles of maintenance planning for mining machinery  
LO 3. Ability to undertake and supervise maintenance management job for mining machinery  

Syllabus:  
Classification of mining machinery: basic constructions, operations and maintenance. 
Prime movers for mining machinery: IC engine, hydraulic power, pneumatic power;  
Elements of mechanical power transmission-gears, belt, chain; coupling, clutch and brake. 
Pumps, Fans and compressors for mining 
Productivity and capacity utilization of Mining Machinery 
Introduction to tribology and its importance in machinery management, 
Techniques of maintenance planning and their procedures, Application of PERT and CPM, Network diagrams, Pareto Diagram, Fish Bone Diagram, Control Charts, Queuing in maintenance of mining machinery 
Basic concepts of inventory and inventory control  

Textbook:  
Course handouts.  

Reference:  
SME Handbook  
Handbook of Maintenance Planning
STRUCTURE OF COURSES

BACHELOR OF ENGINEERING IN MINERAL PROCESS ENGINEERING

MN212 INTRODUCTION TO MINING ENGINEERING

Hours per week: 3 (2 Hrs lect, 1 hr tut)
Credits: 11

Learning Outcomes:
To provide students with a basic understanding of development and construction of a mine as well as rock fragmentation.

LO 1: Comprehension of basic stages involved in a mining enterprise;

LO 2. Comprehension of principles of rock Fragmentation and design drilling, blasting patterns.

LO 3. Ability to select and use different modes of access to a mineral deposit

LO 4. Ability to select a mining method for different ore bodies based on depth and geometry.

LO 5. Comprehension of explosives properties and its use to overcome rock strain energy to achieve fragmentation.

Syllabus:
Exploratory drilling and drillbility of rocks; introduction to unit operations in mining; classification and properties of explosives; detonators, detonating cords, and nonel detonators; mechanisms of rock breakage by blasting; blasting practices in underground and surface mines, blasting patterns, storage and handling of explosives;
Access to mineral deposit: Choice of mode of entry - adit, shaft, decline and combined model, their applicability, number and disposition.
Vertical and Inclined Shafts : Location, shape, size, and organisation of shaft sinking, construction of shaft collar, shaft fittings.
Shaft Sinking Operations : Ground breaking and muck disposal - tools and equipment, lining; ventilation, lighting and dewatering; sinking in difficult and water-bearing ground.
Mechanised Sinking : Simultaneous sinking and lining; slip - form method of lining; high speed sinking; Shaft Boring: Methods and equipment.
Special Attributes: Widening and deepening of inclined and vertical shafts; staple shafts, raised shafts.
Main Haulage Drifts and Tunnels : Purpose, shape, size and location; excavation - ground breaking, muck disposal, ventilation and supporting.
High Speed Drifting/Tunnelling: Application of mechanised methods, roadheaders and tunnel boring machines.
Recent Developments in shaft sinking and drifting/tunnelling.

Textbook:

Assessment:
Continuous assessment-50%
Written examination - 50% (1 x 3 hours)

MP224 SAMPLING, SIZE ANALYSIS AND SIZE REDUCTION

Hour per week: 7(4hrs lect, 3hrs lab)
Credits: 19

Learning Outcomes:
To introduce students to the unit operations involved in the concentration of minerals. On completion of this subject, the student should be able to:

LO 1. Ability to determine/calculate the grade/recovery relationships in typical mineral concentration circuits;

LO 2. Ability to understand the basic theories of sampling, and also be able to describe both industrial and laboratory sampling equipment;

LO 3. Ability to understand the properties of particles (e.g. size, shape) and how they influence particle sizing processes in mineral processing
operations;

LO 4. Ability to understand comminution theories, size reduction processes and the industrial equipment used in comminution unit operations.

Syllabus:
Sampling: Theory of Sampling; Laboratory and industrial Sampling Equipment; Industrial Practice. 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: 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, etc.).

Textbook:

References:

Assessment:
Continuous assessment - 50%
Written examination - 50%

MP 236 ECONOMIC GEOLOGY AND MINERALOGY

Hours per week: 4 (3 hrs lect, 1 hr tut)
Credits: 15

Learning Outcomes:
To introduce students to ore minerals and rock-forming minerals and the various techniques of identifying minerals.
On completion of this subject the student should be able to:

LO 1. Ability to know the importance of minerals and identify the common

LO 2. Evaluate and assess the amount of a mineral in an ore;

LO 3. Ability to describe the mineral Properties useful in mineral processing;

LO 4. Ability to describe the origin of ores and the rock types in which they occur.

Syllabus:
Minerals: physical and chemical properties of minerals (chemical structure of minerals e.g. rock-forming minerals and ore minerals), the uses of minerals; classification of minerals: based on chemical composition. Introduction to crystallography: crystal systems, classes, indexing, crystal defects; use of crystallography in mineral identification. Practicals to cover identification of minerals of hand specimens, in thin sections, polished sections and quantitative assessment of minerals. Emphasis to be place on common ore minerals in PNG. Economic Geology: Ore deposits - classifications with emphasis on genetic classification; ores of igneous, sedimentary and metamorphic origin. Geological field trips to study rock types and ore deposits.

Textbook:

Reference:


Assessment:
Continuous assessment - 50%
Written Examination - 50% (1 x 3 hours)
Department of Mining Engineering

MP302 COMPUTER APPLICATIONS IN MINERAL PROCESSING ENGINEERING

Hours per week: 2(1hr lect, 1 hr tut)
Credits: 6

Pre-requisites: EE101/EE102

Learning Outcomes:
To introduce students to the utilisation of software packages in Mineral Processing. On completion, the student should be able to:

LO 1. Ability to competently use various application software packages for word processing, spreadsheet calculation, and database management;

LO 2. Ability to use statistical, modeling and simulation software available to perform material and flow computations in typical Mineral Processing circuits, and computations of Grade/Recovery relationships;

LO 3. Ability to understanding the basic concepts of expert systems and the application of expert systems in the Mineral Industry.

Syllabus:
Review of the basic concepts of computer hardware and software, and their functions. Review of Word processing, Spreadsheet, and Database Management Software packages selected from: Word Perfect (DOS/Windows Version); 5.1 or later; Microsoft Word (DOS/Windows Version 2.0 Or later); Lotus 123 (DOS/windows Version);Microsoft Excel (Windows Version 4 or later); DBASEIV or later; Foxpro Version 2 or later Statistical, Modeling and Simulation Software selected from: MINITAB (Version 7 or later); JKSImMet (version 3.6 or later); JKSIm Float; METSIM (Version 5 or later)

References:

Assessments:
Continuous assessment - 100%

MP321 PROCESS TECHNOLOGY 1

Hours per week: 4 (2 hrs lect, 2 hrs tut)
Credits: 13

Learning Outcomes:
To provide students with an introduction to industrial processes particularly mineral and chemical processes. As an important analytical tool they will be taught material balances and the nature of flow of fluids, raw material and products. On completion of the subject the student should be able to:

LO 1. Ability to identify the flow of raw material and products in processes and/or plant;

LO 2. Design and perform material balances and calculate product tonnages;

LO 3. Ability to calculate flow rates, flow velocities and pressure drops in transporting fluids and slurries through pipes and channels.

Syllabus:
Material Balances in process flows: Component and total mass balances of reactive and non-reactive systems including recycling. Batch and steady state flows.
Fluid Mechanics: Basic fluid properties, Hydrostatics, stability of floating bodies, viscosity, shear stresses and friction in fluid flow, friction factor and pressure drop relationships in pipe and open channel flows. Velocity and shear stress distributions in laminar and turbulent flow.

Textbook:
Webber, N.B., Fluid Mechanics for Civil Engineers, Chapman & Hall
MP322 PROCESS TECHNOLOGY II

Hours per week: 4 (2 hrs lect, 2 hrs tut)
Credits: 13

Learning Outcomes:
To provide students with a knowledge of Behaviour of solid particles in fluids. Mechanisms of heat transfer in industrial process. Calculate the drying periods and psychrometry. On completion of the subject the student should be able to:

LO 1. Evaluate and determine the settling characteristics of particles in fluid;
LO 2. Ability to calculate heat transfer coefficients and the extent of heat transfer during an industrial process;
LO 3. Design drying requirements to meet product specifications.

Syllabus:

Reference:

Assessment:
Continuous assessment - 50%
Written examination - 50% (1 x 3 hours)

MP323 PHYSICAL PROCESSING AND METALLURGICAL ACCOUNTING

Hour per week: 7(4 hrs lect, 3hr lab)
Credits: 21

Learning Outcomes:
To give a thorough understanding of modern mineral processing techniques. On completion of this subject, the student should be able to:

LO 1. Ability to understand the basic theories of classification;
LO 2. Ability to understand and describe the operation of industrial classification equipment such as hydrocyclones, rakes, cones, etc.;
LO 3. Ability to understand the principles of gravity concentration processes including sluices, spirals, shaking tables, jigs and the Knelson concentrator;
LO 4. Ability to understand and describe magnetic and electrical concentration techniques.
LO 5. Design and perform mass balance and metallurgical accounting.

Syllabus:
Classification: Free and hindered settling theory; Classifier types: cyclones, rakes, cones, hydrosizers and elutriators; Recent developments in hydrocyclone design and application. Gravity concentration of minerals: Sluices, spiral, tables, jigs, cones, and the Knelson concentrator; Dense media separation; Recent developments. Magnetic and Electrical Concentration of Minerals: (a) Magnetic: Low intensity and high intensity separation; application to beach sand separation; Industrial circuits. (b) Electrical: High tension separations; Electrostatic separations; Industrial applications.
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.

Textbook:
Wills, B.A., Introduction to Mineral Processing
**MP324 SURFACE-CHEMICAL PROCESSING**

**Hours per week:** 7 (4 hrs lect, 3 hrs lab)

**Credits:** 21

**Learning Outcomes:**
To enhance the students' understanding of mineral processing unit operations. On completion of this subject, the student should be able to:

**LO 1.** Comprehension of application of surface or interfacial chemistry to the process of froth flotation, coagulation or flocculation of minerals

**LO 2.** Ability to understand the fundamentals and concepts of the flotation of minerals

**LO 3.** Ability to describe and analyze the equipment and circuits commonly employed in industrial flotation operations;

**LO 4.** Ability to identify and analyse factors that govern the process of froth flotation of minerals

**LO 5.** Ability to understand the theories of coagulation, flocculation and dispersion and their application in industrial mineral processing operations

**LO 5.** Ability to describe selective flocculation processes for the separation of a variety of minerals.

**Syllabus:**
Concentration of Minerals by Flotation. Fundamentals of flotation; Surface chemical properties of minerals; Flotation reagents, chemistry of flotation; Flotation of sulphide and non-sulphide metalliferous minerals; Coal flotation; Flotation Machines (including flotation columns); Flotation circuit design and industrial practice; Research Techniques Applied to Flotation; Industrial Practice and Flotation Process Control.


Selective Flocculation in Mineral Extraction. The Surface Chemistry of Minerals; properties of fine mineral particles; colloids and their properties; Surface Phenomena in Coagulation and Flocculation; Inorganic coagulants; Polymeric Flocculants; Separation of minerals by Selective Flocculation processes.

**Textbook:**

**Assessment:**
Continuous assessment: 50%
Written examination: 50% (1 x 3 hours)

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**MP325 INSTRUMENTAL ANALYSIS**

**Hours per week:** 3/2 hr lect, 1 hr tut)

**Credits:** 11

**Learning Outcomes:**
To give the student an understanding of the basic theory of instrumental analysis, and to provide students with practice in using a selection of analytical methods and instruments commonly used in the mineral industry. On completion, the student should be able to:

**LO 1.** Understand the general principles and concepts of analytical chemistry

**LO 2.** Understand and describe the instruments and procedures for chemical analyses;

**LO 3.** Perform chemical analyses
of various ores and concentrates using various instrumental methods of analysis;

**LO 4.** Ability to determine the concentrations of precious metals in ores and concentrates by fire assaying techniques.

**Syllabus:**
Introductory Analytical Chemistry. General principles of Analytical Chemistry; Errors and handling small data sets; Sensitivity and detection limits; Sample Preparation Techniques. Analytical Methods. Titrations; Electrochemical Methods; Chromatographic methods; X-Ray Analytical methods: X-Ray powder Diffraction (XRD) and X-Ray fluorescence (XRF); Absorption Spectroscopy; UV-Visible absorption spectroscopy of molecules, and Infra-Red absorption Spectroscopy. Fire Assaying-Principles and Practice. Slags: bi silicate, mono-silicate and mixed slags; Reducing Fluxes: Reducing power of carbon, flour and various ores. Oxidising Fluxes: Oxidising power of nitrites and ores Calculation of charges in the determination of gold and silver contents of siliceous and sulphide ores and concentrates.

Practicals: Experiments involving instrumental methods will include Atomic Absorption Spectrophotometry; Infra-Red spectrophotometry; Electrochemical techniques including pH, ion-selective electrodes, and Electrogravimetry; Fire assaying.

**Textbook:**

**Assessment:**
Continuous assessment- 50%
Written examination -50% (1 x 3 hours)

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**MP341 HYDROMETALLURGY I**

**Hours per week:** 4 (2 hrs lect, 2 hrs tut)
**Credits:** 13

**Learning Outcomes:**
To introduce students to the principles of hydrometallurgical processes.

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On completion of this subject the student should be able to:

**LO 1.** Know the solution chemistry of the important minerals in PNG;

**LO 2.** Evaluate and assess the thermodynamic aspects of hydrometallurgical processes and plot Eh pH phase diagrams;

**LO 3.** Ability to determine the kinetics of homogeneous and heterogeneous systems in hydrometallurgy;

**LO 4.** Ability to know how to separate leach liquor from residue, concentrate and purify the leach liquor ready for metal extraction;

**LO 5.** Ability to know how to recover metals from leach liquor;

**LO 6.** Ability to know how to refine metals hydrometallurgically.

**Syllabus:**
Solution chemistry; liquid-liquid and solid-liquid interactions, speciation; activity-concentration relationship; thermodynamic feasibility of mineral reactions, equilibrium and Eh-pH diagrams for minerals.

Hydrometallurgical processes relating to the production of metals and compounds. Leaching processes and methods e.g. heap and agitation leaching; leaching kinetics. Solution concentration and purification: thickening, filtration and precipitation; solution concentration and purification with solvents, ion exchange resins and activated carbon.

Practicals to 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, electrowinning. Hydrometallurgical refining of metals. Application of these processes to Cu, Au, Ag, Ni, Al and U.

Industrial extraction of metals (with flowsheets) including the extraction of Cu, Au, Ag and Ni and Al from their ores.
Textbooks:

Reference:

Assessment:
Continuous assessment - 50%
Written examination - 50%

MP342 HYDROMETALLURGY II

Hours per week: 5 (3 hrs lect, 2 hrs lab)
Credits: 16

Learning Outcomes:
To introduce students to the principles and concepts governing reactor design. On completion of the course, the student should be able to:

LO 1. Ability to understand homogenous and heterogenous reaction kinetics.

LO 2. Evaluate and use rate data from Laboratory and Pilot plant test work to design leaching system, solvent extraction, CIP, etc.

LO 3. Design equations for batch, semi-batch, continuous reactors and plug flow reactors.

LO 4. Ability to know how to design equilibrium stages in leaching, solvent extraction, CIP, etc.

LO 5. Ability to design the extraction processes Au, Ag, Cu, Ni, Cr etc. ores.

Syllabus:
Critical study of gold ore treatments, hydrometallurgical processing of Zn, Al, Ni, involving case studies of operating plants; further look at homogenous reaction kinetics, zero order, first order, second order, etc., heterogeneous reaction kinetics, flat plate geometry, spherical geometry, shrinking core model, continuous reaction model, rate determining steps, reactors design, equations of batch, semi-batch, CSTR and plug flow systems, mass balances, flow systems, concept of residence time, residence time distributions, multiple reactor systems, design of equilibrium stages; solvent extraction distribution isotherm, McCabe-Thiele diagram, co-current and counter-current and crossflow system, CIP design, interstage screening, mechanical and air agitation, carbon transport, adsorption kinetics and equilibra.


Reference:

Assessment:
Continuous assessment - 50%
Written examination - 50%

MP343 PYROMETALLURGY I

Hours per week: 4(2 hrs lect, 2 hrs lab)
Credits: 12

Learning Outcomes:
To introduce students to the use of high temperature extracting metals from ores. On completing this subject the student should be able to:

LO 1. Ability to discuss the principles relating to pre-smelting processes (e.g. drying, calcining, roasting, sintering);

LO 2. Ability to understand how to undertake oxidation-reduction roast of various ores/concentrates prior to smelting.

Syllabus:
Operations in extractives metallurgy utilising heat as the prime mover to accomplish chemical and structural changes, as in drying, calcination, roasting, sintering and smelting.
Thermochemistry and thermodynamics review: enthalpy, combustion and heat balances; free energy and predominance diagrams for oxidation, reduction, sulphation (chlorination) processes at high temperatures.
Calcination: Calcination of carbonates, chemical factors affecting yield and purity; effects of rock types, size, porosity, crystallinity, temperature, time, atmosphere etc. on calcination rate.
Sintering: partial smelting process.
Pre-smelting processes, practices and equipment: calcination, roasting and sintering of ores/concentrates and their respective furnace types (vertical and horizontal); advantages and disadvantages of furnace types.

References:

Assessments:
Continuous assessment - 50%
Written examination - 50% (1 x 3 hours)

MP344 PYROMETALLURGY II

Hours per week: 4 (3 hrs lect, 1 lab)
Credits: 15

Learning Outcomes:
To introduce students to the use of heat for smelting ores and refining metals. On completion of this subject the student should be able to:

LO 1. Ability to describe the principles relating to smelting of ores and their reduction/converting to metals;
LO 2. Synthesis the type of fluxes to use for smelting various ores/concentrates;
LO 3. Ability to describe how to smelt ores/concentrates with various fluxes and reducing agents to produce metals;
LO 4. Ability to describe how to fire refine some impure metals.

Syllabus:
Smelting; physics and chemistry of melts and slags. Phase diagrams: simple, complex and their use in prediction of slag characteristics. Smelting and melting of sulphide/oxide concentrates. Slag types, composition and structure. Reactions between phases and detailed calculations of melts and slag composition e.g. for Ok Tedi concentrate. Converting: reactions, mass balance, heats of reactions and influence on cycle. Reduction: solids and molten materials, thermodynamics, kinetics. Fire refining: principles of fire refining of metals. Smelting processes, practices and equipment: smelting processes; converting - oxidation-reduction; furnace types (reverberatory, electric, flash); factors affecting furnace efficiencies and oxygen enrichment, fuel, feed preparation and calculation. Roasting and smelting practices of some common ore types/concentrates including those of Cu, Pb, Zn, Ni and Fe. Fire refining of selected metals including Au, Ag and Cu; advantages and limitations of fire refining. Practicals may cover gold, silver and copper smelting and refining.

Reference:

Assessment:
Continuous assessment - 50%
Written examination - 50% (1 x 3 hours)

MP356/MP456 INDUSTRIAL TRAINING

Period: 12 weeks training in mines during end and 3rd year long vacations.
Credits: 100

Learning Outcomes:
To introduce the student to industrial set up including practice and equipment in mineral processing and extractive metallurgy. On completion of the training the student should be able to:

LO 1. Ability to relate theoretical work to
Department of Mining Engineering

practice in industry;

LO 2. Ability to synthesis and describe some of the industrial processes and equipment.

Syllabus:
Training at a mineral processing plant in all aspects of mineral processing including crushing, grinding, C.I.P. circuits, dewatering and tailings disposal, mining, supervision, and management of plant operations, community services. Training report writing.

Assessment:
Continuous assessment - 100%

MP401/MP402 PROJECT

Hours per week: 4 (6 in Semester II)
Credits: 13 (20 sem II)

Learning Outcomes:
To give the student the opportunity to utilise the knowledge and skills acquired in carrying out independent research work under a supervisor. On completion of the project the student should be able to:

LO 1. Ability to carry out independent research work, present the results in a logical manner and make appropriate conclusions.

Syllabus:
Students are to take research projects in Mineral Processing or extractive metallurgy. The projects enable students to experience research procedure, handle data and draw together relevant information from various parts of their course work. Students select topics, normally relevant to PNG and carry out the work under staff supervisors who guide them throughout the duration of the projects. At the end of Semester I, students will present literature reports and give a seminar. The project seminar which will be of 10 to 15 minutes duration will be given by every student.

Assessment:
Continuous assessment: 100%

MP421 PROCESS DESIGN

Hours per week: 4 (3 hr lect, 1 hr tut)
Credits: 15

Learning Outcomes:
To enable students to apply the principles of the unit mineral processing operations to efficient design, operations. Upon completion, the student should be able to:

LO 1. Ability to understand and describe the techniques commonly used in the characterisation of ores and concentrates, such as sampling, mineral description, identification and liberation size determination,

LO 2. Design unit concentration processes based on mineralogical assessment, and select process equipment,

LO 3. Design process flowsheets,

LO 4. Ability to perform bench-scale and/or pilot plant process testing, and computer modeling and simulation of processes.

Syllabus:
Review of Mineral Processing Computations: Calculation of Grade/Recovery Relationships, Metal and Material Balance and the use of Computer Software (e.g. JKSimMet, METSIM) as an aid to Process Calculations. Ore Characterisation Techniques: Sampling and the Statistical Analysis of Sampling Data; Mineralogical Analysis of ores: mineral types, liberation sizes, ore textures; process selection, and flowsheet development, Process Simulation.


References:
MP422 PLANT DESIGN

Hours per week: 6 (3hrs lect, 3 hrs tut)
Credits: 20

Learning Outcomes:
On completion, the students should be able to:

LO 1. Ability to understand the concepts involved in flowsheet design, plant engineering, control, and management of Mineral Processing operations.

LO 2. Ability to design projects involving detailed engineering plant design concepts, including costings and economic appraisals.

Syllabus:
Application of Mineral Processing principles in the detailed flowsheet development and optimisation for a specific ore.
Projects will be undertaken by students working in groups which will involve detailed plant design to a level suitable for final construction of a plant.
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. Design and Control of some circuits will be investigated using computer simulation.
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.

Reference:

Assessment:
Continuous assessment -100%

MP423 SOLID/LIQUID SEPARATION
AND FINE PARTICLE PROCESSING

Hours per week: 5 (3 hrs lect, 2 hrs lab)
Credits: 16

Learning Outcomes:
To provide students with principles and techniques of solid/liquid separation and processing of fine particles in the mineral industry.
On completion of this subject the student should be able to:

LO 1. Ability to describe the techniques of dewatering mineral particles;

LO 2. Ability to discuss the need for agglomerating, briquetting and sintering fine mineral particles;

LO 3. Design specific processing techniques for recovering mineral fines.

Syllabus:
Dewatering in mineral processing: principles, techniques and equipment covering screening, thickening, filtering and drying. Agglomeration: balling, briquetting and sintering. Production of fines and ultrafine particles. Small scale beneficiation techniques e.g. for gold and heavy mineral solids.

Textbook:

Assessment:
Continuous assessment - 50%
Written examination - 50% (1 x 3 hours)

MP424 BULK MATERIALS HANDLING

Hours per week: 3 (2 lect, 1 tutorial, Lab)
Credits: 11
Prerequisites: MN212, CE221, ME252

Learning Outcomes:
Introduce the students to material handling involved in mining and mineral processing, with special reference to the mineral industry in Papua New Guinea.
On completion of this subject the student should be able to:

LO 1. Ability to classify various bulk material handling operations involved in mining and mineral processing.

LO 2. Ability to perform calculations involved in design of belt conveyors, slurry transport, underground mine transport.

LO 3. Evaluate the methods and equipment for stacking, blending and reclaiming of bulk materials.

LO 4. Design basic construction and operation of basic bulk material handling equipment.

Syllabus:
Bulk material handling systems in mines: classification and description.
Conveyors: types and components, basic design calculations, feeders, protection and safety features, drive arrangements.
Storage of bulk material, bin, bunker and silo.
Stackers and reclaimers.
Hydraulic and pneumatic transport basic principles and operation, Introduction to slurry handling systems.
Rope haulage, locomotive haulage, winding of bulk material through vertical and inclined shaft.
Trends of development in material handling in mines.

References:
SME Handbook.
Course handouts.

Assessment:
Continuous assessment - 50%
Written examination - 50%

MP426 INDUSTRIAL MINERALS PROCESSING

Hours per week: 4 (3 hrs lect, 1 hr tut)
Credits: 15

Learning Outcomes:
To introduce the student to the use and processing of the common industrial minerals. On completion, the student should be able to:

LO 1. Ability to evaluate the uses and importance of the common industrial minerals.

LO 2. Ability to know how to process specific industrial minerals including the PNG industrial minerals.

LO 3. Ability to realize the increasing use of industrial minerals in modern industries.

Syllabus:
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.
Processing: 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. The use of industrial minerals in high tech industries.

Reference book:

Assessment:
Continuous assessment - 50%
Written examination - (1x3h) 50%

MP427 PROCESS CONTROL AND INSTRUMENTATION

Hours per week: 5 (3 hrs lect, 2 hrs lab)
Credits: 16
Learning Outcomes:
To familiarise the student with technique of process control used in mineral processing plants and the instruments employed.
On completion of the subject the student should be able to:

LO 1. Ability to identify and select a control circuit for a given mineral processing operation.

LO 2. Ability to design a control system by block diagrams.

LO 3. Evaluate and compare difference process controls systems and comment on their advantages and disadvantages.

LO 4. Ability to determine the gain factors, and other characteristics of proportional, derivative and integral controllers.

LO 5. Ability to determine steady-state and unsteady-state response of simple process control circuits.

LO 6. Ability to evaluate and understand the working of various instruments used in mineral processing circuits.

Syllabus:
Purpose of manual and automatic control, block diagrams, control circuits, feedback, feed forward loops and their characteristics. ON-off proportional, integral and derivative control, transfer functions, steady state and unsteady state analysis of simple control loops. Pneumatic and hydraulic controllers; temperature, flow level, density and pH measurements. Modeling and control of Mineral process plant operations.

Reference:

Assessment:
Continuous assessment: - 50%
Written examination: - 50% (1 x 3 hours)

MP428 METALLURGICAL PERFORMANCE EVALUATION AND OPTIMISATION (Elective)

Hours per week: 4 (3hrs lect. 1 hr tut)
Credits: 15

Learning Outcomes:
To give the students a thorough understanding of the tools needed (and used) for the evaluation and optimisation of metallurgical performance. On completion, the student should be able to:

LO1. Understand and explain the general mining and mineral process operating philosophies;

LO 2 Perform quantitative assessments of the performance of the unit processes used in mineral processing operations.

LO 3. Describe the optimisation procedures commonly employed in mineral processing operations.

Syllabus:
Mining and Mineral Process Operating Philosophies.
Quantitative assessment of the performance of unit operations in mineral processing: Process Sampling Methods: Problems & Solutions; Mass balancing and Data Adjustment techniques; Evaluation of Separation efficiency and the influence of ore variability; Modeling Comminution, Screening, Gravity Concentration-ration, Flotation and other Mineral Processing circuits; Reconciliation of Mine Site, Mineral processing plant, concentrate and tailings inventories.

Optimisation Procedures in Mineral Processing Plants.
On-Line Optimisation Techniques, for example: One variable at a time; Grid Search; Steepest Ascent; Evolutionary Operation (EVOP); Simplex Self-Directing Evolutionary Operation (SSDEVOP).

Off-Line Optimisation Techniques, for example: Indirect Methods; Mathematical Programming Methods; Direct Climbing Methods. Applications of Circuit Optimisation.
References:

Assessment:
Continuous Assessment - 50%
Written examination - 50%(1 x 3 hours)

MP430 FEASIBILITY STUDY OF A MINERAL DEPOSIT (Elective)

Hours per week: 4 (3 hrs lect., 1 hr tut)
Credits: 15

Learning Outcomes:
To introduce the student to how to conduct simple feasibility projects.
On completion of the course the student should be able to:

LO 1. Ability to collect information relevant for carrying out a feasibility assessment.

LO 2. Ability to carry out a simple feasibility assessment of a mineral deposit.

LO 3. Ability to economically evaluate a proposed mineral deposit project.

Syllabus:
Collection of information required to carry out a feasibility report, examples of feasibility reports on mineral deposit projects; assignment of a feasibility project.

Reference:

Assessment:
Continuous assessment - 100%

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MP442 ADVANCED EXTRACTIVE METALLURGy (Elective)

Hours per week: 4 (3 hrs lect, 1 hr tut)
Credits: 15

Learning Outcomes:
To bring the student to an advanced stage in understanding and awareness of modern developments in Extractive Metallurgy. On completion of this subject, the student should be able to:

LO 1. Ability to describe the principles and processes employed in the extraction of precious metals in Papua New Guinea.

LO 2. Ability to determine the concentration and fineness of precious metals ores and concentrates and other products.

LO 3. Be familiar with modern developments in hydrometallurgy, pyrometallurgy and electrometallurgy.

Syllabus:
Relevant topics will be selected from the units listed below.
Modern Developments in Extractive Metallurgy Hydrometallurgy: Recent advances including the treatment of simple and refractory gold/silver ores; Developments in CIL/CIP techniques for the recovery of precious metals; Developments in Biohydrometallurgy.
Pyrometallurgy: New and/or recent pyrometallurgical processes such as Continuous Smelting and Refining processes, the ISASMELT Process, etc; Developments in furnace design and refractories.
Electrometallurgy: advances in electrochemical principles and their application to extractive metallurgy; Rectification Systems (e.g. DC and PCR Systems); Recent Developments in Tankhouse
Practice.

References:
Various Extractive Metallurgy Conference Proceedings.

Assessment:
Continuous Assessment - 50%
Written examination - 50% (1 x 3 hours)