

NATIONAL DIPLOMA: ENGINEERING: METALLURGY

Qualification code: NDMY03 - NQF Level 6

Campus where offered: Pretoria Campus (day classes)

Last year of new intake: 2019

Teach-out (phase-out) date: 31 December 2024

Students registered for this qualification should complete their studies according to the teach-out date prescribed for the qualification, subject to the stipulations of Regulation 3.1.11 and 3.1.13 in the Students' Rules and Regulations.

Information on phased-out programmes can be obtained from the TUT website, www.tut.ac.za.

Key to asterisks:

* Information does not correspond to information in Report 151.

(Deviations approved by the Senate in November 2008.)

** Students may choose to take Management Skills I or Entrepreneurial Skills I.

CURRICULUM

Consult the 2019 Faculty Prospectus for the full contents of the qualification.

SUBJECTS ARE ONLY OFFERED IN THE SEMESTER AS INDICATED BELOW. SUBJECTS PRINTED IN BOLD ARE NOT FOR REGISTRATION PURPOSES.

FIRST YEAR

| CODE | SUBJECT | CREDIT | PREREQUISITE SUBJECT(S) |
|-----------------------------------|---|--------------|---|
| FIRST SEMESTER | | | |
| CHE141B | Chemistry IA (offered in both semesters) | (0,083) | |
| CSK101B | Computer Skills I | (0,042) | |
| MAT171T | Mathematics I | (0,083) | |
| MEY101T | Metallurgy I | (0,084) | |
| MNP201T | Mineral Processing II | | |
| MNP20XT | Mineral Processing: Chemical Principles II | (0,041) | |
| PHU161B | Physics IA | (0,083) | |
| TOTAL CREDITS FOR THE SEMESTER: | | 0,416 | |
| SECOND SEMESTER | | | |
| COS101T | Communication Skills I | (0,042) | |
| MAT271B | Mathematics II | (0,083) | Mathematics I |
| MCI201T | Metallurgical Chemistry II | (0,083) | Chemistry IA |
| MDR101C | Mechanical Engineering Drawing I | (0,083) | |
| MNP201T | Mineral Processing II | | |
| MNP20YT | Mineral Processing: Metallurgical Principles II | (0,042) | Chemistry IA Mathematics I Mineral Processing: Chemical Principles II |
| PML101T | Physical Metallurgy I | (0,085) | Metallurgy I |
| SMM201T | Strength of Materials II | (0,083) | Mathematics I Physics IA |
| TOTAL CREDITS FOR THE SEMESTER: | | 0,501 | |
| TOTAL CREDITS FOR THE FIRST YEAR: | | 0,917 | |



SECOND YEAR

| CODE | SUBJECT | CREDIT | PREREQUISITE SUBJECT(S) |
|------------------------------------|--------------------------------------|--------------|---------------------------------------|
| FIRST SEMESTER | | | |
| ANP201T | Applied Mineral Processing II | (0,068)* | Metallurgy I |
| ENF201T | Extraction of Non-Ferrous Metals II | (0,067)* | Metallurgical Chemistry II |
| FAT201T | Ferro-Alloy Technology II | (0,067)* | Physical Metallurgy I |
| MGH201T | Metallurgical Thermodynamics II | (0,068)* | Metallurgical Chemistry II |
| MSK121T | Management Skills I** | (0,083) | |
| PMU201T | Practical Metallurgy II | (0,080)* | Metallurgy I Physical Metallurgy I |
| RFC201T | Refractories II | (0,067)* | |
| TOTAL CREDITS FOR THE SEMESTER: | | 0,500 | |
| SECOND SEMESTER | | | |
| ANP301T | Applied Mineral Processing III | (0,100)* | Applied Mineral Processing II |
| CRS301T | Corrosion III | (0,100)* | Chemistry IA |
| ENF311T | Extraction of Non-Ferrous Metals III | (0,100)* | Extraction of Non-Ferrous Metals II |
| EPS101T | Entrepreneurial Skills** | (0,083) | |
| FAT311T | Ferro-Alloy Technology III | (0,100)* | Ferro-Alloy Technology II |
| QCL221T | Quality Control II | (0,083) | Mathematics I |
| RFC321T | Refractories III | (0,100)* | Refractories II |
| TOTAL CREDITS FOR THE SEMESTER: | | 0,583 | |
| TOTAL CREDITS FOR THE SECOND YEAR: | | 1,083 | |

THIRD YEAR

| CODE | SUBJECT | CREDIT | PREREQUISITE SUBJECT(S) |
|--------------------------------------|-----------------------------|--------------|----------------------------|
| FIRST OR SECOND SEMESTER | | | |
| EXP1MET | Work-Integrated Learning I | (0,500) | |
| EXP2MET | Work-Integrated Learning II | (0,500) | Work-Integrated Learning I |
| TOTAL CREDITS FOR THE THIRD YEAR: | | 1,000 | |
| TOTAL CREDITS FOR THE QUALIFICATION: | | 3,000 | |

SUBJECT INFORMATION (OVERVIEW OF SYLLABUS)

The syllabus content is subject to change to accommodate industry changes. Please note that a more detailed syllabus is available at the Department or in the study guide that is applicable to a particular subject. At time of publication, the syllabus content was defined as follows:

A**APPLIED MINERAL PROCESSING II (ANP201T)****1 X 3-HOUR PAPER***(Subject custodian: Department of Chemical, Metallurgical and Materials Engineering)*

Introduction to ore preparation, mineralogy, economic characteristics of deposit, minerals processing accounting, particle size estimation and analysis, comminution. (Total tuition time: ± 60 hours)



APPLIED MINERAL PROCESSING III (ANP301T)**1 X 3-HOUR PAPER****(Subject custodian: Department of Chemical, Metallurgical and Materials Engineering)**

Concentration techniques, physical separation of ores, industrial flow sheets, equipment sizing, power consumption and environment impact. (Total tuition time: ± 60 hours)

C**CHEMISTRY IA (CHE141B)****1 X 3-HOUR PAPER****(Subject custodian: Department of Chemistry)**

Matter and energy: atomic structure, chemical bonding, periodic table and nomenclature of inorganic compounds. Chemical equations and stoichiometry. Solutions. Acids, bases and salts. Chemical reactions. Chemical equilibrium. Electrochemistry and redox theory. Introduction to inorganic and organic chemistry. Practical: experiments based on the theory, with the emphasis on basic laboratory techniques. (Total tuition time: ± 60 hours)

COMMUNICATION SKILLS I (COS101T)**CONTINUOUS ASSESSMENT****(Subject custodian: Department of Applied Languages)**

Communication theory, non-verbal communication (body language). Oral presentations, interviews, developing leadership and participation skills. Technical reports and correspondence. (Total tuition time: ± 64 hours)

COMPUTER SKILLS I (CSK101B)**CONTINUOUS ASSESSMENT****(Subject custodian: End User Computing Unit)**

Students have to acquire theoretical knowledge (computing fundamentals) and practical skills as an end-user in operating systems and MS Office Suite applications (MS Word, MS Excel and MS PowerPoint) on an introductory level. Students will do online and computer-based tests. The modules are mapped with SAQA and IC3 Essential Skills for Digital Literacy (International certification). Open labs are available for additional practice time. (Total tuition time: ± 40 hours)

CORROSION III (CRS301T)**1 X 3-HOUR PAPER****(Subject custodian: Department of Chemical, Metallurgical and Materials Engineering)**

Corrosion processes and corrosion testing. Electrochemistry of corrosion. Passivity. Corrosion of iron and steel. Protection against corrosion. Alloying against corrosion. Non-ferrous alloys and polymers. (Total tuition time: ± 60 hours)

E**ENTREPRENEURIAL SKILLS (EPS101T)****1 X 3-HOUR PAPER****(Subject custodian: Department of Management and Entrepreneurship)**

Types of businesses. Management functions. Planning, organising, guidance, control. Budgeting. Accounting. Administration. Banking. Personnel management. Customer relations. (Total tuition time: ± 60 hours)

EXTRACTION OF NON-FERROUS METALS II (ENF201T)**1 X 3-HOUR PAPER****(Subject custodian: Department of Chemical, Metallurgical and Materials Engineering)**

Applied thermodynamics, reaction thermodynamics and kinetics calculations. Material sources for hydro-metallurgical processing, leaching of ores and concentrates. Separation, purification and enrichment processes for treatment of leach solutions. Precipitation processes for metal separation and recovery. Electrolytic processes for the recovery and purification of metals. (Total tuition time: ± 60 hours)

EXTRACTION OF NON-FERROUS METALS III (ENF311T)**1 X 3-HOUR PAPER****(Subject custodian: Department of Chemical, Metallurgical and Materials Engineering)**

Copper, gold, aluminium, lead, tin and zinc. Calculations. Laboratory practice. Casting of non-ferrous metals. (Total tuition time: ± 60 hours)

F**FERRO-ALLOY TECHNOLOGY II (FAT201T)****1 X 3-HOUR PAPER****(Subject custodian: Department of Chemical, Metallurgical and Materials Engineering)**

Iron and steel production, blast furnace iron-making. Steel production. Ferro-alloy technology. Söderberg paste and electrodes. Separation processes. Furnace design. (Total tuition time: ± 60 hours)



FERRO-ALLOY TECHNOLOGY III (FAT311T)**1 X 3-HOUR PAPER****(Subject custodian: Department of Chemical, Metallurgical and Materials Engineering)**

Iron and steel production. Production of alloy steels and stainless steel. Casting of steel. Off-gas systems and pollution. Steel slags. Ferro-alloy technology. Production of ferrosilicon, ferromanganese, ferrochrome and special ferro-alloys. Ferro-alloy furnace equipment. Pollution control and pollution control equipment. (Total tuition time: ± 60 hours)

M**MANAGEMENT SKILLS I (MSK121T)****1 X 3-HOUR PAPER****(Subject custodian: Department of Management and Entrepreneurship)**

Self-management, organisational environment, introduction to leadership and management principles. (Total tuition time: ± 60 hours)

MATHEMATICS I (MAT171T)**1 X 3-HOUR PAPER****(Subject custodian: Department of Mathematics and Statistics)**

Basic mathematics. Differentiation. Integration. Matrices and determinants. Vectors. Data handling. Complex numbers or mensuration. (Total tuition time: ± 60 hours)

MATHEMATICS II (MAT271B)**1 X 3-HOUR PAPER****(Subject custodian: Department of Mathematics and Statistics)**

Revision of differentiation. Differentiation of functions with more than one variable. Further integration. Numerical methods. First-order ordinary differential equations. Matrices (Gauss elimination). (Total tuition time: ± 60 hours)

MECHANICAL ENGINEERING DRAWING I (MDR101C)**1 X 3-HOUR PAPER****(Subject custodian: Department of Mechanical and Mechatronics Engineering)**

Printing, freehand sketches, types of lines, construction of scales. Geometric construction of arcs and tangency, locus applications: i.e. ellipse, parabola, involute, archimedean spiral. Orthographic projections, isometric drawing, sectioning. Surface development, construction of fasteners, and detailed working and assembly drawing. (Total tuition time: ± 60 hours)

METALLURGICAL CHEMISTRY II (MCI201T)**1 X 3-HOUR PAPER****(Subject custodian: Department of Chemistry)**

Physical chemistry: introduction. Gases. Electrochemistry. Chemical equilibrium. Rates and mechanisms of chemical reactions. Colloidal properties of solutions. Colloids. Metallurgical analysis: sampling. Volumetric analysis. Gravimetric analysis. Instruments and analysis in the metal industry. (Total tuition time: ± 60 hours)

METALLURGICAL THERMODYNAMICS II (MGH201T)**1 X 3-HOUR PAPER****(Subject custodian: Department of Chemical, Metallurgical and Materials Engineering)**

Introduction. First and second law of thermodynamics. Heat capacity. Real gases. Thermodynamic relations. Properties of mixtures. Absorption. Enthalpy. Entropy (processes: spontaneous, reversible and irreversible). Free energy. Ellingham diagram for oxides and sulphides. Chemical equilibrium. Principles of phase equilibrium. Construction of phase diagrams: binary, free energy. (Total tuition time: ± 60 hours)

METALLURGY I (MEY101T)**1 X 3-HOUR PAPER****(Subject custodian: Department of Chemical, Metallurgical and Materials Engineering)**

Basic concepts of atomic bonds, crystal structures and material properties. Control over properties by heat treatment, microstructure and phase diagrams. Measuring material properties with mechanical tests like tensile tests, hardness tests, impact tests, etc. General forming processes, plastic strain, strain hardening, hot working, cold working, recrystallisation. Getting acquainted with the well-known non-ferrous alloys. The basic properties and behaviour of ceramics, polymers and compound materials. (Total tuition time: ± 60 hours)

MINERAL PROCESSING: CHEMICAL PRINCIPLES II (MNP20XT)**1 X 3-HOUR PAPER****(Subject custodian: Department of Chemical, Metallurgical and Materials Engineering)**

Understanding the units and dimensions of the British, SI and American engineering systems. Converting one set of units to another. Defining a mole and converting from moles to mass and the reverse for any chemical compound, given the molecular weight. Writing and balancing chemical reaction equations. Calculating the stoichiometric quantities of reactants and products, given the chemical reaction. Understanding the mass conservation law. Calculating material balances for systems without chemical reactions. Calculating material balances for systems with chemical reactions. (Total tuition time: ± 60 hours)



MINERAL PROCESSING: METALLURGICAL PRINCIPLES II (MNP20YT) 1 X 3-HOUR PAPER**(Subject custodian: Department of Chemical, Metallurgical and Materials Engineering)**

Ideal gas equation of state, PVT behaviour and cubic equations of state, energy balances and first law of thermodynamics, steam tables, phase changes and humidification processes, state properties and process changes, mixing and solution processes, effect of reactions on material and energy balances. (Total tuition time: ± 60 hours)

P**PHYSICAL METALLURGY I (PML101T) 1 X 3-HOUR PAPER****(Subject custodian: Department of Chemical, Metallurgical and Materials Engineering)**

Binary phase diagrams and their interpretation, phase reactions, equilibria and non-equilibrium solidification of Fe-Fe₃C, Al-Si and Cu-Zn systems. Strengthening mechanisms, solidification phenomena. Heat treatment: the common processes like annealing, normalising, hardening, martempering, etc. Hardenability and the use of hardenability data. IT diagrams corrosion: an introduction to the eight basic corrosion types. (Total tuition time: ± 60 hours)

PHYSICS IA (PHU161B) 1 X 3-HOUR PAPER**(Subject custodian: Department of Physics)**

Basic mathematics for physics, measurements, kinematics in one and two dimensions, Newton's laws of motion, dynamics of uniform circular motion, work, energy and power, impulse and momentum, rotational kinematics, rotational dynamics, fluids, temperature and heat, the ideal gas law and kinetic theory, thermodynamics, electric forces and electric fields, electric potential energy and the electric potential, electric circuits, geometric optics – reflection of light: mirrors, refraction of light: lenses and optical instruments. Practical work. (Total tuition time: ± 60 hours)

PRACTICAL METALLURGY II (PMU201T) PRACTICAL EXAMINATION**(Subject custodian: Department of Chemical, Metallurgical and Materials Engineering)**

Physical metallurgy: sampling and specimen mounting. Polishing and etching techniques. Macro- and micropreparation. Optical microscopy, qualitative and quantitative metallography. Photography. Introduction to scanning electron microscopy. Pyrometry. Evaluation of material properties. Extraction metallurgy: ore dressing. Hydro-metallurgy. Pyro-metallurgy. Analytical techniques. (Total tuition time: ± 60 hours)

Q**QUALITY CONTROL II (QCL221T) 1 X 3-HOUR PAPER****(Subject custodian: Department of Chemical, Metallurgical and Materials Engineering)**

Fundamentals of statistics. Statistical process control. Product acceptance (sampling). Quality engineering. Quality and economy. Computers and quality. (Total tuition time: ± 60 hours)

R**REFRACTORIES II (RFC201T) 1 X 3-HOUR PAPER****(Subject custodian: Department of Chemical, Metallurgical and Materials Engineering)**

Refractory principles: classification of refractories, the basic principles of refractories. The properties and testing of refractory materials. Refractory materials: the manufacturing of refractory shapes, acid refractory materials, basic refractory materials, non-oxide refractory materials and thermal insulation products. Design and installation: the refractory lining system. The design of a lining: selection of material, mechanical, thermal and physical design. The installation of a refractory lining: pre-fired shapes, castables and other monolithic materials. The commissioning of refractory linings. (Total tuition time: ± 60 hours)

REFRACTORIES III (RFC321T) 1 X 3-HOUR PAPER**(Subject custodian: Department of Chemical, Metallurgical and Materials Engineering)**

Raw materials for monolithic refractories. Manufacture and properties of monolithic refractories. Wear mechanisms of monolithic refractories. Design, applications and installations. (Total tuition time: ± 60 hours)



S**STRENGTH OF MATERIALS II (SMM201T)****1 X 3-HOUR PAPER****(Subject custodian: Department of Mechanical and Automation Engineering)**

Static. Direct stresses. Thermal effects and material combinations. Deformation, Poisson's ratio and Young's modulus. Centroid and second moment of inertia. Shear force diagram. Bending moment diagrams. Torsion. Combined stresses. (Total tuition time: ± 60 hours)

W**WORK-INTEGRATED LEARNING I (EXP1MET)****WORK-INTEGRATED LEARNING****WORK-INTEGRATED LEARNING II (EXP2MET)****WORK-INTEGRATED LEARNING****(Subject custodian: Department of Chemical, Metallurgical and Materials Engineering)**

Practical experience in the industry. (Total tuition time: six months)

