

## NATIONAL DIPLOMA: ENGINEERING: MECHATRONICS (Extended curriculum programme with foundation provision) Qualification code: NDMRF0 - NQF Level 6

Campus where offered: Pretoria Campus (day classes)  
Last year of new intake: 2017  
Teach-out (phase-out) date: 31 December 2023

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](http://www.tut.ac.za).

### CURRICULUM

Consult the 2017 Faculty Prospectus for the full contents of the qualification.

#### FIRST YEAR

**Students who repeat a subject must register for a different subject code. Even though the credits are published as 0,000, the correct credit will reflect on the academic record once the subject is passed.**

CODE	SUBJECT	CREDIT	PREREQUISITE SUBJECT(S)
FPEGN02	Engineering Communication (Extended)	(0,050)	
FPEGNR2	Engineering Communication (Extended) (for repeaters)	(0,000)	
FPETT01	Electrotechnology (Extended) I	(0,100)	
FPETTR1	Electrotechnology (Extended) I (for repeaters)	(0,000)	
FPMAT04	Mathematics (Extended) I	(0,100)	
FPMATR4	Mathematics (Extended) I (for repeaters)	(0,000)	
FPMDR02	Mechanical Engineering Drawing (Extended)	(0,100)	
FPMDRR2	Mechanical Engineering Drawing (Extended) (for repeaters)	(0,000)	
FPMFE01	Manufacturing Engineering (Extended)	(0,150)	
FPMFER1	Manufacturing Engineering (Extended) (for repeaters)	(0,000)	
FPMHC01	Mechanics (Extended) I	(0,100)	
FPMHCR1	Mechanics (Extended) I (for repeaters)	(0,000)	
TOTAL CREDITS FOR THE FIRST YEAR:		<b>0,600</b>	

#### SECOND YEAR

CODE	SUBJECT	CREDIT	PREREQUISITE SUBJECT(S)
<b>FIRST SEMESTER</b>			
<b>After completion of all the extended subjects (see paragraph f of the remarks in the 2017 Prospectus).</b>			
CDD101T	Computer-Aided Design	(0,100)	
ENY101T	Electronic Technology	(0,100)	
ETT211T	Electrotechnology II	(0,100)	
MAT271B	Mathematics II	(0,100)	
MSS201T	Materials and Processing II*	(0,150)	
TOTAL CREDITS FOR THE SEMESTER:		0,550	



## SECOND SEMESTER

DIT101T	Digital Technology I	(0,100)	Mathematics (Extended) I
MAT351T	Mathematics III	(0,100)	Mathematics II
MHC201T	Mechanics II	(0,100)	Mathematics (Extended) I
SMT201B	Strength of Materials II*	(0,100)	Mechanics (Extended) I
THF201T	Thermo-Flow	(0,100)	Mathematics (Extended) I
			Mechanics (Extended) I
TOTAL CREDITS FOR THE SEMESTER:		0,500	
TOTAL CREDIT FOR THE SECOND YEAR:		<b>1,050</b>	

## THIRD YEAR

CODE	SUBJECT	CREDIT	PREREQUISITE SUBJECT(S)
<b>FIRST SEMESTER</b>			
CNF301T	Control of Machines	(0,100)	Electronic Technology
CSD201T	Computer Studies	(0,100)	Mathematics II
DIT201T	Digital Technology II	(0,100)	Digital Technology I
EIE301T	Electric Machines	(0,100)	Electronic Technology
MED202B	Mechanical Engineering Design II*	(0,100)	Mathematics II
			Digital Technology I
			Electrotechnology II
			Computer-Aided Design
			Engineering Communication (Extended)
			Manufacturing Engineering (Extended)
			Mechanical Engineering Drawing (Extended)
			Mechanics (Extended) I
			Strength of Materials II
TOTAL CREDITS FOR THE SEMESTER:		0,500	
<b>SECOND SEMESTER</b>			
MCD301T	Mechatronic Engineering Design	(0,100)	Control of Machines
MHC301T	Mechanics III	(0,100)	Mechanical Engineering Design II
NUA301T	Networks and Communication	(0,100)	Engineering Communication (Extended)
SMT301B	Strength of Materials III*	(0,100)	Mechanics II
SOA301T	Sensors and Process Control	(0,100)	Engineering Communication (Extended)
			Strength of Materials II
			Digital Technology II
			Thermo-Flow
TOTAL CREDITS FOR THE SEMESTER:		0,500	
TOTAL CREDITS FOR THE THIRD YEAR:		<b>1,000</b>	



## FOURTH YEAR

CODE	SUBJECT	CREDIT	PREREQUISITE SUBJECT(S)
<b>FIRST SEMESTER</b>			
EXP1MEC	Mechatronic Engineering Practice (Work-Integrated Learning*)	(0,350)	
TOTAL CREDITS FOR THE SEMESTER:		0,350	
TOTAL CREDITS FOR THE FOURTH YEAR:		<b>0,350</b>	
TOTAL CREDITS FOR THE QUALIFICATION:		<b>3,000</b>	

### SUBJECT/MODULE 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. On 13 October 2017, the syllabus content was defined as follows:

#### C

##### COMPUTER-AIDED DESIGN (CDD101T)

##### CONTINUOUS ASSESSMENT

*(Subject custodian: Department of Mechanical Engineering, Mechatronics and Industrial Design)*

Introduction to computer-aided design (CAD), various software application packages, component and assembly modeling. Students operate CAD software in order to produce three-dimensional models, providing a basis for more advanced CAD applications and compound drawings. (Total tuition time: ± 80 hours)

##### COMPUTER STUDIES (CSD201T)

##### CONTINUOUS ASSESSMENT

*(Subject custodian: Department of Electrical Engineering)*

The basic principles of computer hardware (A+) and programming. The hardware component teaches students how to assemble and commission a PC. The programming component teaches them the C programming language. The following topics are covered: data types and conversions, program actions and loop control, functions and parameters, data structures. The subject is practice-orientated and assessment is based on a number of programming tasks completed during the semester. Mechatronics technology practicals covering EB101 and EB190. (Total tuition time: ± 120 hours)

##### CONTROL OF MACHINES (CNF301T)

##### 1 X 3-HOUR PAPER

*(Subject custodian: Department of Mechanical Engineering, Mechatronics and Industrial Design)*

The use of electropneumatics and electrohydraulics in the control of machines and systems. An introduction to the use of a PLC to control machines and systems, as well as fundamental robot programming. (Total tuition time: ± 120 hours)

#### D

##### DIGITAL TECHNOLOGY I (DIT101T)

##### 1 X 3-HOUR PAPER

*(Subject custodian: Department of Electrical Engineering)*

Basic components of digital circuits, namely NOT, AND and NOR gates. It is subsequently shown how more complex gates and logic functions can be built from the basic gates. Boolean algebra and Karnaugh maps are used to simplify functions. Combinational logic circuits, including adders, comparators, decoders, encoders, multiplexers, demultiplexers and error control circuits are covered. Binary, octal, decimal and hexadecimal numbers and operations are also included. (Total tuition time: ± 70 hours)



**DIGITAL TECHNOLOGY II (DIT201T)****1 X 3-HOUR PAPER****(Subject custodian: Department of Electrical Engineering)**

Basic components of sequential circuits, namely latches and flip-flops. It is subsequently shown how more complex memory components, such as counters and registers, can be built from the basic components. Different analogue-to-digital and digital-to-analogue converters are covered, and during the introduction to microprocessor systems, the programmable interface control devices (PICs) are presented. TTL and CMOS-integrated circuit technologies and electronic display units are included. The subject ends with the introduction of programmable logic devices (PLD, EPLD, FPGA). (Total tuition time: ± 120 hours)

**E****ELECTRIC MACHINES (EIE301T)****1 X 3-HOUR PAPER****(Subject custodian: Department of Electrical Engineering)**

A variety of electrical motors and generators are used on a large scale in the industry. This subject serves as an introduction to electrical machines and provides exposure to the principles on which such machines operate. Single-phase transformers, induction machines and direct-current machines are discussed in this subject. (Total tuition time: ± 70 hours)

**ELECTRONIC TECHNOLOGY (ENY101T)****1 X 3-HOUR PAPER****(Subject custodian: Department of Electrical Engineering)**

The basic principles of electronics: the use of measuring instruments, semiconductor theory, the P-N junction, diodes and rectification, simple power supplies, the bipolar junction transistor, the field effect transistor and operational amplifiers. On completion of this subject, the student should be able to do circuit analysis and design in respect of simple power supplies without smoothing, the direct-current operation of single-stage transistor amplifiers and simple operational amplifier functions. Theoretical presentation is supported by practical experiments in a laboratory, which are taken into account during evaluation. (Total tuition time: ± 70 hours)

**ELECTROTECHNOLOGY (EXTENDED) I (FPETT01, FPETTR1)****1 X 3-HOUR PAPER****(Subject custodian: Department of Electrical Engineering)**

Atom theory, electricity, magnetism and electromagnetism, inductors, capacitors, RLC networks. The correct use of SI units and their applications. Construction and care of batteries. WS theory and different measuring instruments. The influence of magnetic lines, the application and use of magnetic fields, inductance and the factors that influence it. Capacitors and their functioning. (Total tuition time: ± 140 hours)

**ELECTROTECHNOLOGY II (ETT211T)****1 X 3-HOUR PAPER****(Subject custodian: Department of Electrical Engineering)**

Students acquire sound knowledge of systems, machines and equipment used in the field of electrical engineering for the conversion of energy, which mechanical engineers may encounter during their careers. In practical work, students learn to handle and connect equipment. Presentation, alternating current circuit theory, electrical measurements, direct-current machines and single-phase transformers are also dealt with. (Total tuition time: ± 68 hours)

**ENGINEERING COMMUNICATION (EXTENDED) (FPEGN02, FPEGNR2) CONTINUOUS ASSESSMENT****(Subject custodian: Department of Applied Languages)**

Speaking and communication skills, listening skills, reading for academic understanding, academic vocabulary, learning strategies and information gathering, writing, business and life skills. These skills are acquired in an e-learning environment which would also include the following topics: 1. Operating systems (Windows environment). 2. Basic word-processing skills (MS-Word). 3. Spreadsheets (MS-Excel) Presentations tools (PowerPoint). 4. Communications, connectivity, the internet and the Web. Students will be assessed on their language, presentation and report-writing skills. Basics of technical English, verbal communication ethics, technical report writing, general business documents, presentation skills, meetings and interpersonal skills. (Total tuition time: ± 136 hours)

**M****MANUFACTURING ENGINEERING (EXTENDED) (FPMFE01, FPMFER1)****1 X 3-HOUR PAPER****(Subject custodian: Department of Mechanical Engineering, Mechatronics and Industrial Design)**

Introduction to engineering (chemical, metallurgical, civil, surveying, electrical, clinical, digital technology, high-frequency technology, power engineering, process instrumentation, mechanical, industrial, mechatronics),



factory safety, measurements, engineering materials, projects. Safety and safety legislation, identification and application of various types of steel, measuring equipment, measuring and comparators, hand and machine tools, metal cutting and machining, CNC machining, industrial robots, welding, sheet metal work, with a significant component of practical work. (Total tuition time: ± 360 hours)

#### **MATERIALS AND PROCESSING II (MSS201T)**

**1 X 3-HOUR PAPER**

**(Subject custodian: Department of Mechanical Engineering, Mechatronics and Industrial Design)**

A study of the properties and applications of non-ferrous metals, polymers, composites, an overview of processing techniques and machinery, such as laser cutting and welding, spark erosion, plasma cutting, water jet cutting, plastic welding, composite product development, polymer product development, injection moulding and rapid proto-typing with a significant practical component. (Total tuition time: ± 120 hours)

#### **MATHEMATICS (EXTENDED) I (FPMAT04, FPMATR4)**

**1 X 3-HOUR PAPER**

**(Subject custodian: Department of Mathematics and Statistics)**

Basic algebra, functions, exponents and logarithm, differential calculus, trigonometry, geometry. Basic mathematics. Differentiation. Integration. Matrices and determinants. Vectors. Data handling. Complex numbers or mensuration. (Total tuition time: ± 120 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)

#### **MATHEMATICS III (MAT351T)**

**1 X 3-HOUR PAPER**

**(Subject custodian: Department of Mathematics and Statistics)**

First-order differential equations. Higher-order differential equations. Basic mathematical modelling. Laplace transforms. Systems of differential equations. Numerical solutions of differential equations. Fourier Series. (Total tuition time: ± 70 hours)

#### **MECHANICAL ENGINEERING DESIGN II (MED202B)**

**1 X 3-HOUR PAPER (PRESCRIBED OPEN BOOK)**

**(Subject custodian: Department of Mechanical Engineering, Mechatronics and Industrial Design)**

General introduction to design. Basic principles of design in respect of knuckle, coffered, rivetted and lozenge joints, thin cylinders, gears, shafts, keys, arms for gears, bearings, shaft couplings, pipes and pipe joints, eccentric loading of connections, welding. Drawing projects. (Total tuition time: ± 68 hours)

#### **MECHANICAL ENGINEERING DRAWING**

**CONTINUOUS ASSESSMENT**

**(EXTENDED) (FPMDR02, FPMDRR2)**

**(Subject custodian: Department of Mechanical Engineering, Mechatronics and Industrial Design)**

Lettering, line work and freehand sketches, geometric constructions, fasteners, dimensioning, methods of projections, sectioning, interpenetration curves and pipe developments, conversions: imperial to metric, terms and abbreviations used in engineering drawing, piping diagrams. Printing, freehand sketches. Construction of scales, ellipse, square screw thread. Isometric drawing. Oblique drawings. Developments of pipes. Curve of interpenetration of T-ends and pipe connections. Projection of prisms and pyramids. Drawing language, e.g. of machining symbols. First-angle and third-angle orthographic projection drawings of single objects, assembly drawings and detail drawings. (Total tuition time: ± 240 hours)

#### **MECHANICS (EXTENDED) I (FPMHC01, FPMHCR1)**

**1 X 3-HOUR PAPER**

**(Subject custodian: Department of Mechanical Engineering, Mechatronics and Industrial Design)**

Module 1: measurements, mechanics, motion in one-dimension kinematics, laws of motion dynamics, kinetic theory of matter and properties of matter. Module 2: atoms, molecules and ions, chemical formulas and equations, the periodic table, chemical bonding, nomenclature of inorganic compounds, phases of matter, solutions, the rate of chemical reactions, equilibrium in chemical reactions, acids and bases, oxidation, reduction and electrochemical cells. Motion in one dimension. Uniform motion. Instantaneous velocity. Motion with constant acceleration. Free fall. Instantaneous acceleration, scalars, vectors, coordinate systems and vector components, vector algebra, force, Newton's first law, Newton's second law, Newton's third law, ropes and pulleys, motion in a circle. Impulse and momentum. Energy. Work. Fluids and elasticity. Thermodynamics. (Total tuition time: ± 180 hours)



**MECHANICS II (MHC201T)****1 X 3-HOUR PAPER****(Subject custodian: Department of Mechanical Engineering, Mechatronics and Industrial Design)**

Dynamics: centrifugal forces, simple harmonic motion and pendulums, moments of inertia, vehicle dynamics, hoisting and hauling machines. Power transmission: bearings and couplings, belt drives. Rolling bodies. (Total tuition time: ± 68 hours)

**MECHANICS III (MHC301T)****1 X 3-HOUR PAPER****(Subject custodian: Department of Mechanical Engineering, Mechatronics and Industrial Design)**

Rectilinear motion, plane curvilinear motion, rectangular coordinates (x-y), normal and tangential coordinates (n-t), polar coordinates (r- $\theta$ ), relative motion, constrained motion of connected particles, Newton's second law, equation of motion, rectilinear motion, curvilinear motion, work and kinetic energy, potential energy, impulse and momentum. (Total tuition time: ± 68 hours)

**MECHATRONIC ENGINEERING DESIGN (MCD301T)****1 X 3-HOUR PAPER (PRESCRIBED OPEN BOOK)****(Subject custodian: Department of Mechanical Engineering, Mechatronics and Industrial Design)**

Theory: design of machines and systems, including the design and/or selection of appropriate automation components such as sensors, actuators and controller. The mechanical components include structural design, as well as belt drives, chain drives, gears, clutches, brakes, bearings and lubrication, steel ropes, springs, piping, fittings and valves. Conventional representation of items. Assembly drawings of designed projects. The sensors, actuators and controller(s) need to be incorporated and included in the design of machines and/or systems. (Total tuition time: ± 120 hours)

**MECHATRONIC ENGINEERING PRACTICE****WORK-INTEGRATED LEARNING****(WORK-INTEGRATED LEARNING) (EXP1MEC)****(Subject custodian: Department of Mechanical Engineering, Mechatronics and Industrial Design)**

Industry-related training, as determined and agreed on by training providers in industry and the University. The training should be at technician level, and involve the application of knowledge and skills obtained during the academic studies. Typical topics are investigation, analysis, problem-solving, design and development, commissioning, improvement, optimisation, quality control, etc. (Total tuition time: ± 420 hours)

**N****NETWORKS AND COMMUNICATION (NUA301T)****1 X 3-HOUR PAPER****(Subject custodian: Department of Mechanical Engineering, Mechatronics and Industrial Design)**

An overview of networking and communication in the mechatronic environment, including fundamentals and applications of Bus systems such as R485, Ethernet, Profi-bus and ASI-net, as well as an introduction to the MCS 51 microcontroller, voice recognition, vision systems and GSM. Mechatronic technology practicals. (Total tuition time: ± 120 hours)

**S****SENSORS AND PROCESS CONTROL (SOA301T)****1 X 3-HOUR PAPER****(Subject custodian: Department of Electrical Engineering)**

This subject teaches students the required knowledge and skills to understand and apply the basic principles of all the different types of sensors and instruments for process control (flow, temperature, pressure, level). Electronic detectors, transmitters, actuators and their applications and PLC control systems. The knowledge and skills are required to define, design, construct, commission and maintain a process control system. (Total tuition time: ± 120 hours)

**STRENGTH OF MATERIALS II (SMT201B)****1 X 3-HOUR PAPER****(Subject custodian: Department of Mechanical Engineering, Mechatronics and Industrial Design)**

Analysis of simple structures. Simple stress and strain. Shearing forces and bending moments. Thin cylinders (stationary and rotating). Torsion of circular shafts. Helical springs. Laboratory work. (Total tuition time: ± 68 hours)



**STRENGTH OF MATERIALS III (SMT301B)****1 X 3-HOUR PAPER****(Subject custodian: Department of Mechanical Engineering, Mechatronics and Industrial Design)**

Temperature stresses. Strain energy due to direct stress. Beam sections. Theory of bending. Fatigue and creep. Reinforced concrete beams. Structures. Shear stress in beams. Shearing forces and bending moments. Laboratory work. (Total tuition time: ± 68 hours)

**T****THERMO-FLOW (THF201T)****1 X 3-HOUR PAPER****(Subject custodian: Department of Mechanical Engineering, Mechatronics and Industrial Design)**

Fundamentals of thermodynamic processes and cycles, gas law, internal combustion engines. Properties of fluids. Hydrostatic forces. Flow of fluids - conservation of mass, momentum and energy. Flow in pipes. Flow measurement. Mechatronics technology practical's covering all hand skills. (Total tuition time: ± 68 hours)

