

# NATIONAL DIPLOMA: ENGINEERING: MECHATRONICS

Qualification code: NDMR06 - NQF Level 6

Campus where offered: Pretoria Campus (day classes)  
Last year of new intake: 2017  
Teach-out (phase-out) date: 31 December 2022

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).

Key to asterisks:

\* Information does not correspond to information on AA72.

(Deviations approved by the Senate in September 2011 and September 2015.)

## CURRICULUM

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

### FIRST YEAR

CODE	SUBJECT	CREDIT	PREREQUISITE SUBJECT(S)
<b>FIRST SEMESTER</b>			
EGN101B	Engineering Communication	(0,050)	
ETT101T	Electrotechnology I	(0,100)	
MAT171T	Mathematics I	(0,100)	
MDR111T	Mechanical Engineering Drawing	(0,100)	
MFE101C	Manufacturing Engineering	(0,150)	
MHC101C	Mechanics I	(0,100)	
TOTAL CREDITS FOR THE SEMESTER:		0,600	
<b>SECOND SEMESTER</b>			
CDD101T	Computer-Aided Design	(0,100)	
ENY101T	Electronic Technology	(0,100)	Mathematics I
ETT211T	Electrotechnology II	(0,100)	Electrotechnology I
MAT271B	Mathematics II	(0,100)	Mathematics I
MSS201T	Materials and Processing II*	(0,150)	Manufacturing Engineering
TOTAL CREDITS FOR THE SEMESTER:		0,550	
TOTAL CREDITS FOR THE FIRST YEAR:		<b>1,150</b>	

### SECOND YEAR

CODE	SUBJECT	CREDIT	PREREQUISITE SUBJECT(S)
<b>FIRST SEMESTER</b>			
DIT101T	Digital Technology I	(0,100)	Mathematics I
MAT351T	Mathematics III	(0,100)	Mathematics II
MHC201T	Mechanics II	(0,100)	Mathematics I Mechanics I
SMT201B	Strength of Materials II*	(0,100)	Mathematics I Mechanics I



THF201T	Thermo-Flow	(0,100)	Mathematics I Mechanics I
TOTAL CREDITS FOR THE SEMESTER:		0,500	
<b>SECOND SEMESTER</b>			
CNF301T	Control of Machines	(0,100)	Electronic Technology Mathematics II
CSD201T	Computer Studies	(0,100)	Digital Technology I Electronic Technology Mathematics II
DIT201T	Digital Technology II	(0,100)	Digital Technology I
EIE301T	Electric Machines	(0,100)	Electrotechnology II
MED202B	Mechanical Engineering Design II*	(0,100)	Computer-Aided Design Engineering Communication Manufacturing Engineering Mechanical Engineering Drawing Mechanics I Strength of Materials II
TOTAL CREDITS FOR THE SEMESTER:		0,500	
TOTAL CREDITS FOR THE SECOND YEAR:		<b>1,000</b>	

### THIRD YEAR

CODE	SUBJECT	CREDIT	PREREQUISITE SUBJECT(S)
<b>FIRST SEMESTER</b>			
MCD301T	Mechatronic Engineering Design	(0,100)	Control of Machines Mechanical Engineering Design II
MHC301T	Mechanics III	(0,100)	Engineering Communication Mechanics II
NUA301T	Networks and Communication	(0,100)	
SMT301B	Strength of Materials III*	(0,100)	Engineering Communication Strength of Materials II
SOA301T	Sensors and Process Control	(0,100)	Digital Technology II Thermo-Flow
TOTAL CREDITS FOR THE SEMESTER:		0,500	
<b>SECOND SEMESTER</b>			
EXP1MEC	Mechatronic Engineering Practice (Work-Integrated Learning*)	(0,350)	
TOTAL CREDITS FOR THE SEMESTER:		0,350	
TOTAL CREDITS FOR THE THIRD YEAR:		<b>0,850</b>	
TOTAL CREDITS FOR THE QUALIFICATION:		<b>3,000</b>	



## 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:

### C

#### COMPUTER-AIDED DESIGN (CDD101T)

CONTINUOUS ASSESSMENT

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

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 and Mechatronics Engineering)*

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 I (ETT101T)****1 X 3-HOUR PAPER****(Subject custodian: Department of Electrical Engineering)**

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: ± 70 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 (EGN101B)****CONTINUOUS ASSESSMENT****(Subject custodian: Department of Applied Languages)**

Basics of technical English, verbal communication ethics, technical report writing, general business documents, presentation skills, meetings and interpersonal skills. (Total tuition time: ± 60 hours)

**M****MANUFACTURING ENGINEERING (MFE101C)****1 X 3-HOUR PAPER****(Subject custodian: Department of Mechanical and Mechatronics Engineering)**

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: ± 180 hours)

**MATERIALS AND PROCESSING II (MSS201T)****1 X 3-HOUR PAPER****(Subject custodian: Department of Mechanical and Mechatronics Engineering)**

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 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)

**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 and Mechatronics Engineering)**

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 (MDR111T)****CONTINUOUS ASSESSMENT****(Subject custodian: Department of Mechanical and Mechatronics Engineering)**

Printing, freehand sketches. Construction of scales, ellipse, square screw thread. Isometric drawing. Oblique drawings. Development of pipes. Curve of interpenetration of T-ends and pipe connections. Projections of prisms and pyramids. Drawing language; for example, of machining symbols. First-angle and third-angle orthographic projection drawings of single objects, assembly drawings and detail drawings. (Total tuition time: ± 68 hours)

**MECHANICS I (MHC101C)****1 X 3-HOUR PAPER****(Subject custodian: Department of Mechanical and Mechatronics Engineering)**

Moments, centroids, kinematics, forces and Newton's laws, momentum and impulse, work and energy, circular motion, statics. (Total tuition time: not available)

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

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 and Mechatronics Engineering)**

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 and Mechatronics Engineering)**

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 and Mechatronics Engineering)**

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 and Mechatronics Engineering)**

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 and Mechatronics Engineering)**

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 and Mechatronics Engineering)**

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 and Mechatronics Engineering)**

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)

