Faculty of Engineering

2025 Yearbook

Postgraduate Diploma

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PLEASE MENTION YOUR UNIVERSITY NUMBER IN ALL CORRESPONDENCE.

The General Academic Rules of the University, to which all students have to subject themselves and which apply to all the qualifications offered by the University, appear in a separate publication and are available on the web page at: http://www.nwu.ac.za/yearbooks.
Please note: Although the information in this Calendar has been compiled with the utmost care and accuracy, the Council and the Senate of the University accept no responsibility whatsoever for errors that may occur. Before students finally decide on the selection of modules, they must consult the class timetable. If a clash occurs in the planned selection of a student, the relevant module combination is not permitted.

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Mrs B Mackenzie

1. FACULTY RULES

ENG.1.1 AUTHORITY OF THE GENERAL ACADEMIC RULES

The faculty rules valid for the different qualifications, programmes and curricula of this faculty and contained in this faculty calendar are subject to the General Academic Rules of the University, as determined from time to time by the Council of the University on recommendation by the Senate. The faculty rules should therefore be read in conjunction with these General Academic Rules.

The Manual for Masters and Doctoral students, with specific guidelines and procedures for master's and doctoral studies, as well as quality measures of research entities also apply.

General Provisions

Please refer to the General Academic Rules for the rules on:

i. Registration

ii. Recognition of Prior learning

iii. Active Enrolment

iv. Protection of personal and education-related information

v. Examination

vi. Maximum duration of study

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ENG 1.2 FACULTY SPECIFIC RULES

ENG 1.2.1 POSTGRADUATE DIPLOMAS

ENG 1.2.1.1
Examination and moderation

For rules regarding moderation of PG programme modules, please refer to General Academic Rule 3.5.1.3.

ENG.1.3 QUALIFICATIONS, PROGRAMMES AND CURRICULA

POSTGRADUATE DIPLOMA				
Qualification	**Qualification Code**	**Mode of delivery**	**Campus**	**NQF level**
Postgraduate Diploma in Nuclear Science and Technology	**7DC D01**	Distance	PC	8
Postgraduate Diploma in Nuclear Science and Technology with Nuclear Technology Management	**7DC D02**	Distance	PC	8
Postgraduate Diploma in Industrial Engineering	**7DB D01**	Distance	PC	8
Postgraduate Diploma in Industrial Engineering with Sustainability	**7DB D02**	Distance	PC	8
Postgraduate Diploma in Industrial Engineering with Sustainable Mining	**7DB D03**	Distance	PC	8

ENG.2 THE POSTGRADUATE DIPLOMA

ENG.2.1 RULES FOR THE POSTGRADUATE DIPLOMA

ENG.2.1.1 Duration

Nuclear Science and Technology / Nuclear Science and Technology with Nuclear Technology Management:
The minimum term of study is one (1) year.

Industrial Engineering:
The minimum term of study is two (2) years.

For the maximum duration refer to General Academic Rule 1.14.

ENG.2.1.2 Minimum Admission requirements for the qualification

Nuclear Science and Technology / Nuclear Science and Technology with Nuclear Technology Management:

- A qualification such as a three-year BSc degree (an appropriate qualification that exit at NQF level 7, with Mathematics or Physics at least at second year level); or
- A qualification such as a BTech (Engineering) (an appropriate qualification that exit at NQF level 7).

Explanatory notes for the above Nuclear Engineering admission requirements are available at the following link:
http://engineering.nwu.ac.za/nuclear-engineering/postgraduate-diploma-nuclear-engineering

Industrial Engineering:

- Diploma (NQF 6) and BTech (NQF 7) in Engineering Technology with working experience, or
- Engineering degrees from other fields and institutions (BEng and BSc (Eng) - NQF 7)
- Recognition of prior learning is considered.

ENG.2.1.3 Method of presentation

Modules in the Postgraduate Diplomas will be presented using distance mode. A learning management system will provide a platform for the modules. Each module will consist of a combination of an interactive site, that will enable students to participate in well-structured self-study learning activities, and live and other interactive sessions.

The Industrial Engineering Postgraduate Diplomas programmes make use of a combination of formative and summative assessment approaches that are designed to provide feedback, evaluate student progress and assess the attainment of the various programmes' outcomes.

The Postgraduate Diplomas for Nuclear Science and Technology and Nuclear Science and Technology with Nuclear Technology Management makes use of a continuous assessment approach.

NOTE: The sub-minimum for all modules in the various Postgraduate Diplomas is 50%.

ENG.2.2 POSTGRADUATE DIPLOMA IN NUCLEAR SCIENCE AND TECHNOLOGY

ENG.2.2.1 Curriculum: I501P

Qualification code: 7DC D01 Delivery mode: Distance

This programme supplies students all the theoretical knowledge required by the NWU's research Master of Science in Engineering Sciences with Nuclear Engineering.

The field of Nuclear Engineering comprises the technical aspects, such as nuclear reactor design, and the nuclear technology management aspects, such as nuclear Project Management, nuclear policy and financial management.

The present programme focuses on the theoretical knowledge underlying the said technical aspects, especially nuclear reactor design, while another programme will focus on the technology management aspects.

This programme provides learners with:

- a broader and more in-depth knowledge of Nuclear Engineering sciences;
- advanced education in the field of Nuclear Engineering;
- problem-solving ability;
- integration of knowledge across fields;
- the ability to execute a project in the field of Nuclear Engineering and to communicate the results orally and in writing.

ENG.2.2.1.1 List of modules

Module code	Descriptive name	Credits
NUCL 511	Nuclear Engineering I	16
NUCL 512	Radiation and the Environment	16
NUCI 521	Introduction to Thermal-Fluid Sciences	16
NUCI 578	Nuclear Engineering II	16
NUCL 525	Nuclear Project Management	16
NUCL 526	Nuclear Reactor Safety	16
NUCI 577	Reactor Analysis	16
NUCL528	Research methodology	16

ENG.2.2.2 Curriculum outcomes

On completion of the qualification, the student should be able to demonstrate:

- A comprehensive and systematic knowledge base in nuclear engineering, as well as a depth of knowledge in nuclear physics and thermal fluid sciences.
- A coherent and critical understanding of the principles and theories of nuclear engineering; an ability to critique current research and advanced scholarship in an area of nuclear engineering; an ability to make sound theoretical judgements based on evidence and an ability to think epistemologically (i.e. from a sound knowledge framework).

- An ability to identify, analyse and deal with complex and/or real-world problems and issues using evidence-based solutions and theory-driven arguments in the field of nuclear engineering.
- Efficient and effective information-retrieval and processing skills; the identification, critical analysis, synthesis and independent evaluation of quantitative and/or qualitative data; an ability to conduct research.
- An ability to present and communicate academic professional work effectively.

ENG.2.2.3 Compilation of curriculum

In accordance with General Academic Rule 3.1.1., the postgraduate diploma consists of a number of modules with a total credit value of 128 at NQF level 8.

One credit represents 10 notional study hours, which suggests that a student should expect to spend at least 1280 study hours on the programme.

The curriculum comprises of 8 core modules.

Components	**Composition**	**Credits**
8 x Modules	Core (Compulsory)	16 each
Total credits for the curriculum		**128**

ENG.2.3 POSTGRADUATE DIPLOMA IN NUCLEAR SCIENCE AND TECHNOLOGY WITH NUCLEAR TECHNOLOGY MANAGEMENT

ENG.2.3.1 Curriculum: I501P

Qualification code: 7DC D02 Delivery mode: Distance

This programme supplies students all the theoretical knowledge required by the NWU's new research Master of Science in Engineering Sciences with Nuclear Engineering and **Nuclear Technology Management**, which the International Atomic Energy Agency (IAEA) assisted the NWU in developing and recently endorsed.

The field of Nuclear Engineering comprises the technical aspects, such as nuclear reactor design, and the nuclear technology management aspects, such as Nuclear Project Management, nuclear policy and nuclear economics.

Most of the modules of the present programme overlap with those of the Postgraduate Diploma in Nuclear Science and Technology and, therefore, it supplies similar technical Nuclear Engineering knowledge. Therefore, it also meets the minimum admission requirements of the Master of Science in Engineering Sciences with Nuclear Engineering. However, it focusses more on Nuclear Technology Management, namely: nuclear policy, nuclear technology management and nuclear economics and financial management aspects.

This programme provides learners with:

- a broader and more in-depth knowledge of Nuclear Engineering sciences;
- advanced education in the field of Nuclear Engineering;
- problem-solving ability;
- integration of knowledge across fields;
- the ability to execute a project in the field of Nuclear Engineering and to communicate the results orally and in writing.
- advanced education in the field of Nuclear Technology management, including Nuclear Project Management, nuclear policy and the economics of nuclear projects;

ENG.2.3.1.1 List of modules

Module code	Descriptive name	Credits
NUCL 511	Nuclear Engineering I	16
NUCL 512	Radiation and the Environment	16
NUCL 513	Nuclear Reactor Technology	16
NUCL 514	PWR Technology	16
NUCL 525	Nuclear Project Management	16
NUCL 526	Nuclear Reactor Safety	16
NUCL 527	Nuclear Energy Policy and Business	16
NUCL 528	Research methodology	16

ENG.2.3.2 Curriculum Outcomes

On completion of the qualification, the student should be able to demonstrate:

- A comprehensive and systematic knowledge base in nuclear engineering, as well as a depth of knowledge in nuclear physics and thermal fluid sciences.
- A coherent and critical understanding of the principles and theories of nuclear engineering; an ability to critique current research and advanced scholarship in an area of nuclear engineering; an ability to make sound theoretical judgements based on evidence and an ability to think epistemologically (i.e. from a sound knowledge framework).
- An ability to identify, analyse and deal with complex and/or real-world problems and issues using evidence-based solutions and theory-driven arguments in the field of nuclear engineering.
- Efficient and effective information-retrieval and processing skills; the identification, critical analysis, synthesis and independent evaluation of quantitative and/or qualitative data; an ability to conduct research.
- In depth knowledge of Nuclear Technology Management, namely: nuclear policy, nuclear technology management and nuclear economics and financial management aspects and the ability to apply it to practical problems in this field.
- An ability to present and communicate academic professional work effectively.

ENG.2.3.3 Compilation of curriculum

In accordance with General Academic Rule 3.1.1., the postgraduate diploma consists of a number of modules with a total credit value of 128 at NQF level 8.

One credit represents 10 notional study hours, which suggests that a student should expect to spend at least 1280 study hours on the programme.

The curriculum comprises of 8 core modules.

Components	Composition	Credits
8 x Modules	Core (Compulsory)	16 each
Total credits for the curriculum		**128**

ENG.2.4 POSTGRADUATE DIPLOMA IN INDUSTRIAL ENGINEERING

ENG.2.4.1 Curriculum: I501P

Qualification code: 7DB D01 Delivery mode: Distance

The Postgraduate Diploma in Industrial Engineering is designed to equip individuals with the necessary skills for a modern industrial engineering career.

In today's complex and dynamic world, the skills of industrial engineering are more valuable than ever before. Industrial engineering is uniquely positioned to tackle many of the challenges faced by local and global organisations by improving service delivery, increasing competitiveness and addressing efficiency and capacity constraints.

This programme is targeted at individuals who aspire to advance their career or change direction by gaining specialised knowledge and skills in industrial engineering.

The programme is also designed for individuals without an appropriate undergraduate qualification in industrial engineering to transition to advanced postgraduate studies in industrial engineering.

The programme consists of 10 modules. These modules include a strong foundation of the sciences associated with operations management, quality and process engineering. These skills are then strengthened with quantitative skills by teaching data and decision science and modelling and simulation. This is enriched with strategic skills in business process engineering, operational excellence and supply chain management.

Although the PGDip is a distance learning programme, careful design incorporates practical examples and case studies, group interaction and workplace learning to ensure that the diploma is relevant and practical and deepens engagement and learning.

ENG.2.4.1.1 List of modules

Year and semester	Module code	Descriptive name	Credits	Pre- requisite module
Year 1 Semester 1	INGB 511	Industrial Thinking and Philosophies	12	
	INGB 512	Introduction to Software Engineering	12	
	INGB 513	Operations Excellence	12	
Year 2 Semester 1	INGB 514	Quality Management	12	
	INGB 515	Decision Support Systems	12	INGB 522
Year 1 Semester 2	INGB 521	Business Process Engineering	12	
	INGB 522	Introduction to Data and Decision Sciences	12	INGB 512
Year 2 Semester 2	INGB 523	Operations Management and Supply Chains	12	
	INGB 524	Modelling and Simulation	12	INGB 515
	INGB 525	Engineering Investigation and Problem Solving	12	

ENG.2.4.2 Curriculum outcomes

On completion of the qualification, the student should be able to demonstrate:

- integrated and applied knowledge of and engagement in various sub- disciplines of Industrial Engineering and a critical understanding and application of the theory, methods and techniques relevant to the field of Industrial Engineering and Operations Management;
- the ability to critically interrogate multiple sources of knowledge such as case studies, journal articles and other supplementary sources of knowledge within the discipline of Industrial Engineering, and critically evaluate and review that knowledge and the manner in which the knowledge was produced with a view to address specific problems encountered in the working environment;
- the ability to select, apply and critically judge the effectiveness of the implementation of a range of appropriate industrial analysis, design methodologies and intervention techniques with a view to make workplace improvements;
- advanced ability to effectively implement Industrial Engineering techniques with a view to bring about operational excellence;
- the ability to conduct oneself ethically and professionally in a workplace environment with specific focus on acknowledging one's competencies in a given problematic situation;
- the ability to analyse, select and effectively apply carefully supervised industrial thinking method of enquiry to reflect on and then address complex operational or abstract strategic problems and contribute to positive change within practice;
- the ability to communicate effectively in a variety of formats (oral, written, visual and electronic) to diverse audiences and for various workplace purposes;
- the ability to interact and collaborate effectively with others, and to work as part of a team, in diverse social, cultural and professional contexts;
- the ability to be a self-directed and lifelong learner, who is able to work independently, utilise resources effectively and exercise initiative;
- the strong ability to articulate a clear vision and goals, and to motivate others to achieve them.

ENG.2.4.3 Compilation of curriculum

In accordance with General Academic Rule 3.1.1., the postgraduate diploma consists of a number of modules with a total credit value of 120 at NQF level 8.

One credit represents 10 notional study hours, which suggests that a student should expect to spend at least 1200 study hours on the programme.

The curriculum comprises of 10 core modules.

Components	Composition	Credits
10 x Modules	Core (Compulsory)	12 each
Total credits for the curriculum		**120**

ENG.2.5 POSTGRADUATE DIPLOMA IN INDUSTRIAL ENGINEERING WITH SUSTAINABILITY (NEW)

ENG.2.5.1 Curriculum: I501D

Qualification code: 7DB D02 Delivery mode: Distance

Industrial Engineering is an area of study that prepares individuals to apply scientific and mathematical principles to design, improve, and install integrated systems of people, material, information, and energy. It includes instruction in applied mathematics, physical sciences, the social sciences, engineering analysis, systems design, computer applications, and forecasting and evaluation methodology. Although not linked to a CESM code, Sustainability and Sustainable Engineering emphasises the design, development, and implementation of technologies, systems, and processes that meet the needs of the present generation without compromising the ability of future generations to meet their own needs.

It is increasingly recognised that Engineering Curricula must equip students with the knowledge and skills needed to facilitate sustained change, as framed by the challenges outlined in the United Nations' Sustainable Development Goals (SDGs), wherever they are currently positioned. With this specialisation in Sustainability, Engineers will be equipped to develop and implement such solutions in various industries.

ENG.2.5.1.1 List of modules

Curriculum map for relevant year level(s): NEW

Year and semester	Module code	Descriptive name	Credits	Pre-requisite module
Year 1				
Semester 1	SENG 511	Socio-Technical Systems Thinking & Philosophies	12	
	INGB 512	Introduction to Software Engineering	12	
	INGB 513	Operations Excellence	12	
Semester 2	INGB 521	Business Process Engineering	12	
	INGB 522	Introduction to Data and Decision Sciences	12	INGB 512
Year 2				
Year module	SENG 571	Sustainable Design & Wicked Problem-Solving	12	
Semester 1	SENG 512	Introduction to Expanded Design Thinking	12	
	INGB 515	Decision Support Systems	12	INGB 522
Semester 2	SENG 521	Sustainable Value Chains	12	
	SENG 522	Integrated Planning & Scenario Forecasting	12	

ENG.2.5.2 Curriculum Outcomes

On completion of the qualification, the student should be able to demonstrate:

- integrated and applied knowledge of and engagement in various sub-disciplines of Industrial Engineering and a critical understanding and application of the theory, methods and techniques relevant to the field of Industrial Engineering and Operations Management;
- the ability to critically interrogate multiple sources of knowledge such as case studies, journal articles and other supplementary sources of knowledge within the discipline of Industrial Engineering, and critically evaluate and review that knowledge and the manner in which the knowledge was produced with a view to address specific problems encountered in the working environment;
- the ability to select, apply and critically judge the effectiveness of the implementation of a range of appropriate industrial analysis, design methodologies and intervention techniques with a view to make workplace improvements;
- advanced ability to effectively implement Industrial Engineering techniques with a view to bring about operational excellence;
- the ability to conduct oneself ethically and professionally in a workplace environment with specific focus on acknowledging one's competencies in a given problematic situation;
- the ability to analyse, select and effectively apply carefully supervised industrial thinking method of enquiry to reflect on and then address complex operational or abstract strategic problems and contribute to positive change within practice;
- the ability to communicate effectively in a variety of formats (oral, written, visual and electronic) to diverse audiences and for various workplace purposes;
- the ability to interact and collaborate effectively with others, and to work as part of a team, in diverse social, cultural and professional contexts;
- the ability to be a self-directed and lifelong learner, who is able to work independently, utilise resources effectively and exercise initiative;
- the strong ability to articulate a clear vision and goals, and to motivate others to achieve them.

ENG.2.5.3 Compilation of curriculum

In accordance with General Academic Rule 3.1.1., the postgraduate diploma consists of a number of modules with a total credit value of 120 at NQF level 8.

One credit represents 10 notional study hours, which suggests that a student should expect to spend at least 1200 study hours on the programme.

The curriculum comprises of 10 core modules.

Components	Composition	Credits
10 x Modules	Core (Compulsory)	12 each
Total credits for the curriculum		**120**

ENG.2.6 POSTGRADUATE DIPLOMA IN INDUSTRIAL ENGINEERING WITH SUSTAINABLE MINING (NEW)

ENG.2.6.1 Curriculum: I501D

Qualification code: 7DB D03 Delivery mode: Distance

Industrial Engineering is an area of study which prepares individuals to apply scientific and mathematical principles to the design, improvement, and installation of integrated systems of people, material, information, and energy. It includes instruction in applied mathematics, physical sciences, the social sciences, engineering analysis, systems design, computer applications, and forecasting and evaluation methodology. Although not linked to a CESM code, Sustainable Engineering emphasises the design, development, and implementation of technologies, systems, and processes that meet the needs of the present generation without compromising the ability of future generations to meet their own needs. Sustainable Mining can be seen as a subset of Sustainable Engineering, balancing resource extraction and environmental preservation.

The current NWU Postgraduate Diploma in Industrial Engineering has a focus on decision science, equipping diplomats with skills for the 4th Industrial Revolution. However, it is increasingly recognised that Engineering Curricula must equip students with the knowledge and skills needed to facilitate sustained change in key industries, as framed by the challenges outlined in the United Nations' Sustainable Development Goals (SDGs). In addition to addressing these challenges, this specialisation of Sustainable Mining equips Engineers with relevant expertise to lead change in a context where the mining industry is a key influencer of the environmental, social and governance opportunities for achieving sustainability goals.

ENG.2.6.1.1 List of modules

Curriculum map for relevant year level(s): NEW

Year and semester	Module code	Descriptive name	Credits	Pre-requisite module
Year 1 Semester 1	SENG 511	Socio-Technical Systems Thinking & Philosophies	12	
	INGB 512	Introduction to Software Engineering	12	
	INGB 513	Operations Excellence	12	
Year 1 Semester 2	INGB 521	Business Process Engineering	12	
	INGB 522	Introduction to Data and Decision Sciences	12	INGB 512
Year 2 Semester 1	SMIN 511	Sustainable Mine Planning & Design	12	
	INGB 515	Decision Support Systems	12	INGB 522
Year 2 Semester 2	SMIN 521	Sustainable Mining & Production Practices	12	
	SMIN 522	Ecological Resilience & Rehabilitation	12	
	SENG 571	Sustainable Design & Wicked Problem-Solving	12	

ENG.2.6.2 Curriculum outcomes

On completion of the qualification, the student should be able to demonstrate:

- integrated and applied knowledge of and engagement in various sub-disciplines of Industrial Engineering and a critical understanding and application of the theory, methods and techniques relevant to the field of Industrial Engineering and Operations Management;
- the ability to critically interrogate multiple sources of knowledge such as case studies, journal articles and other supplementary sources of knowledge within the discipline of Industrial Engineering, and critically evaluate and review that knowledge and the manner in which the knowledge was produced with a view to address specific problems encountered in the working environment;
- the ability to select, apply and critically judge the effectiveness of the implementation of a range of appropriate industrial analysis, design methodologies and intervention techniques with a view to make workplace improvements;
- advanced ability to effectively implement Industrial Engineering techniques with a view to bring about operational excellence;
- the ability to conduct oneself ethically and professionally in a workplace environment with specific focus on acknowledging one's competencies in a given problematic situation;
- the ability to analyse, select and effectively apply carefully supervised industrial thinking method of enquiry to reflect on and then address complex operational or abstract strategic problems and contribute to positive change within practice;
- the ability to communicate effectively in a variety of formats (oral, written, visual and electronic) to diverse audiences and for various workplace purposes;
- the ability to interact and collaborate effectively with others, and to work as part of a team, in diverse social, cultural and professional contexts;
- the ability to be a self-directed and lifelong learner, who is able to work independently, utilise resources effectively and exercise initiative;
- the strong ability to articulate a clear vision and goals, and to motivate others to achieve them.

ENG.2.6.3 Compilation of curriculum

In accordance with General Academic Rule 3.1.1., the postgraduate diploma consists of a number of modules with a total credit value of 120 at NQF level 8.

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10 x Modules	Core (Compulsory)	12 each
Total credits for the curriculum		**120**

ENG.3 MODULE OUTCOMES

INGB 511	**NQF level: 8**
Title: Industrial Thinking and Philosophies	
Purpose of the module: The Industrial Engineer's worldview is distinct from most other professions, including other disciplines of engineering. This module serves as the bridge to learn the Industrial Engineering – lens. Students will gain an appreciation for what Industrial Engineers do, how they do it, what value system they have and how Industrial Engineers bring, create, improve and sustain value. Module outcomes: On completion of the module, the student should be able to demonstrate: • Demonstrate the ability to critically differentiate between the sub-disciplines of Industrial Engineering and comprehend their different philosophies • Understand the origins of the Industrial Engineering field and its progression into the modern era • Understand what Industrial Engineering is, and what Industrial Engineers do in industry • Understand the history of industry, traced through the four so-called "revolutions" • Understand the importance of work, efficiency, effectiveness and productivity and the relationship to success • Understand the importance of improvement	
INGB 512	**NQF level: 8**
Title: Introduction to Software Engineering	
Purpose of the module: Being able to create computer code is a key skill of the Industrial Engineer of the future. This module introduces the student to Software Engineering which will serve as the basis for future modules in data science, Simulation and Modelling and Decision Support Systems. Module outcomes: On completion of the module, the student should be able to: • Show familiarity with computers' functionalities, jargon and operations • Display an ability to create problem abstractions and to capture these in common algorithms • Write simple code that makes use of and manipulates variables and data, by using common operators, functions, lists, libraries and dictionaries	

INGB 513	NQF level: 8

Title: Operations Excellence

Purpose of the module:
Improving organisations makes use of well-developed improvement philosophies, including Lean, Six Sigma, Systems Thinking, and Theory of Constraints. This module introduces students to these philosophies, guides students through selection and execution and loops back to human factors for implementation.

Module outcomes:
On completion of the module, the student should be able to:

- Demonstrate familiarity with, and understand the key improvement philosophies
- Plan and execute continuous improvement initiatives
- Understanding of the impact of continuous improvement
- Appreciate an Industrial Engineer's role in positively influencing people
- Understanding leadership, teamwork, and individual behaviours in organisations

INGB 514	NQF level: 8

Title: Quality Management

Purpose of the module:
Quality is a field of importance to all organisations, from primary industries like agriculture and extractive industries like mining, to secondary – processing and manufacturing businesses to tertiary service-oriented businesses. The importance of good quality in systems must be emphasised. This module equips students with a specialised skill set in the theoretical and practical tools necessary to manage quality in organisations and across value chains.

Module outcomes:
On completion of the module, the student should be able to:

- Understand the philosophies related to quality management and be able to systematically select the correct philosophy for an organisation
- Describe and identify costs associated with quality and build business cases for investments in quality-directed programmes
- Design a quality management and control/assurance process
- Suggesting approaches to achieve systematic quality improvements through processes, systems, and other dimensions
- Ensure that customer-focused interventions produce system-wide benefit and that decisions are evidence-based
- Read, interpret and construct statistical process control tools to scientifically manage quality
- Synthesise the elements of the Total Quality Management philosophy as appropriate for the context

INGB 515	NQF level: 8

Title: Decision Support Systems

Purpose of the module:
Making strong, evidence-based decisions is a key competence of engineers broadly. Basing decisions on strong data and analysis allows engineers to make better decisions, with broad impact. In this module, students are introduced to the key philosophies, tools, software and approaches to building strong evidentiary chains to make good decisions, and to back these up scientifically.

Module outcomes:
On completion of the module, the student should be able to:

- Understand the open-ended nature of problems that may be faced in organisations
- Understand the characteristics of user-friendliness of tools to ensure technical competence is no limitation for decision makers
- Identify suitable problems, and propose data collection and processing streams for these
- Design data rationalisation strategies to summarise complex data sets into usable information
- Design and deliver reporting platforms, including dashboards for management decision support

INGB 521	NQF level: 8

Title: Business Process Engineering

Purpose of the module:
Making businesses better is probably the most central role of the Industrial Engineer. Business Process Reengineering is a loosely collected set of philosophies and techniques that can be used to gain efficiency, productivity, profitability and overall business success. This module equips students with a general set of competencies to achieve this aim.

Module outcomes:
On completion of the module, the student should be able to:

- Observe, record and interpret a current state in a business
- Design alternative approaches to improve operational behaviour
- Innovate and propose alternative strategies on the macro and the micro level
- Communicate improvement initiatives up and down the chain of command

INGB 522	NQF level: 8

Title: Introduction to Data and Decision Sciences

Purpose of the module:
Evidence-based decisions are better decisions. In the abundance of data and the overwhelming amount of information and opinion, gathering suitable data, processing it correctly to build valid evidence is a key skill of modern Engineers. This module equips students with the basic skills to start rigorously analysing data and communicating supported findings.
Module outcomes:
On completion of the module, the student should be able to demonstrate:

- Understand the nature of data, the different types and classifications of data
- Suggest an appropriate method for data analysis based on this
- Prepare data analytic models
- Prepare suitable visualisations and communicate the findings of the analysis
- Apply the human touch to data and interpret the findings appropriately

INGB 523	NQF level: 8

Title: Operations Management and Supply Chain

Purpose of the module:
Understanding operations and supply chains scientifically is one of the most important areas in which the Industrial Engineering skill set is of importance. This module equips students with the important skills that are used to deliver product to customer demand in an optimised, efficient, and high-quality way.

Module outcomes:
On completion of the module, the student should be able to:

- Differentiate between “operations” and “supply chain” management
- Plan, schedule and balance the production and distribution of goods
- Design interventions to improve efficiency of processes and relating this to system-cost
- Choose a suitable forecasting technique and apply it in practice
- Design supply networks based on underlying best-practice first principles
- Manage stock holding philosophies to maximise system efficiency
- Manage purchasing, inventory control and warehousing

INGB 524	NQF level: 8

Title: Modelling and Simulation

Purpose of the module:
Complex systems can rarely be solved exactly - only optimised. Given the almost unlimited number of variables and conditions, making use of models, representative tools that simplify reality, and simulations – approaches that reduce the need to run experiments in practice. This leads to lower cost, higher impact decisions in shorter time with the ability to test solutions through simulation before taking the high-risk steps of practical experimentation. In this module, students will be equipped with specific skills in model development, simulation coding and being able to apply these to understand and drive real- world problems.

Module outcomes:
On completion of the module, the student should be able to:

- Understand the purpose of modelling and identifying a suitable scenario that will benefit from being modelled
- Show insight in selecting the details and characteristics that can be simplified
- Produce a model that will be a useful tool for understanding real-world problems
- Create a simulation of a complex problem using suitable software
- Select suitable simulation strategies, choosing agent-based, discrete event or System Dynamic simulations
- Interpret the results from simulations to advise leadership in decision-making

INGB 525	NQF level: 8

Title: Engineering Investigation and Problem Solving

Purpose of the module:
This course is the capstone project for this qualification. In this course, the student will have to identify and solve a problem in their working environment, making use of the skills gained in the other courses of this qualification to deliver an Industrial Engineering solution to a complex, real-world problem.

Module outcomes:
On completion of the module, the student should be able to demonstrate:

- The ability to identify and demarcate an Industrial Engineering related problem and use theory driven tools to analyse and effectively address complex problems –The ability to critically judge ethical and professional aspects of a problem within different environments and contexts and conduct oneself in a way that upholds the values of the Industrial Engineering profession
- The ability to work with others when deploying Industrial Engineering solutions and judge the effectiveness of the implementation against a range of relevant key performance indicators and qualitative criteria

NUCL 511	NQF level: 8

Title: Nuclear Engineering I

Module outcomes:
Students are provided with a broad overview of nuclear power systems to provide them with the basic knowledge they need to function in the nuclear reactor industry. The student should be able to demonstrate an understanding of and the ability to apply and evaluate key terms, concepts, facts, principles, rule and theories of the nuclear field. The student should also have detailed knowledge of the specialization area and how that knowledge relates to other fields. The student's problem-solving skills should include the ability to identify, analyse, evaluate, critically reflect on and address complex problems. Therefore, the following topics in nuclear engineering are covered:

- The history of nuclear engineering
- Basics of atomic and nuclear physics for engineers
- Interaction of neutrons and nuclear radiation with matter
- Basic types of nuclear power plants
- Neutron diffusion and moderation
- Nuclear reactor theory
- Time-dependent behaviour

NUCI 521	NQF level: 8

Title: Introduction to Thermal-Fluid Sciences

Module outcomes:
To provide students with the technical and theoretical knowledge regarding thermal fluid sciences which he/she will need to solve the thermal-flow problems in the modules that will follow.

- *Thermodynamics*: Properties of pure substances, work and heat, First Law of Thermodynamics, Second Law of Thermodynamics, power cycles
- *Fluid mechanics*: Fluid statics, flow analysis, conservation laws for control volumes, differential forms of basic laws, dimensional analysis, incompressible viscous flow through pipes, one-dimensional compressible flow
- *Turbo machinery*: Basic laws, compressors, turbines
- *Heat transfer*: Conduction, convection and radiation heat transfer, heat exchangers

NUCL 526	NQF level: 8

Title: Nuclear Reactor Safety

Module outcomes:
On completion of the module, the student should be able to demonstrate:

- integrated knowledge of and engagement in aspects related to nuclear reactor safety and critical understanding and application of techniques and practices relevant to nuclear reactor safety
- The ability to critically interrogate multiple sources of knowledge within the field of nuclear reactor safety and critically evaluate and review that knowledge with a view to apply relevant knowledge

NUCI 574	NQF level: 8

Title: Nuclear Engineering Project

Module outcomes:
On completion of the module, the student should be able to demonstrate:

- the ability to execute a research project in the field of nuclear engineering independently
- and to write a concise scientific report on it

NUCL 512	NQF level: 8

Title: Radiation and the Environment

Module outcomes:

Learners should develop a sound understanding of the characteristics of ionizing radiation and radionuclides, interactions of radiation with matter, biological effects, protection of persons and the environments against harmful effects of radiation and detection and measurement of radiation. The module provides the student with baseline knowledge of the use of radiation and radionuclides in various branches of science, technology and medicine, with special emphasis on the monitoring of environmental pollution on nuclear techniques.

The content includes:

- Characteristics of ionizing radiation
- Properties of radionuclides and other sources of radiation
- Basic processes involved in interactions of radiation with matter
- Main radiation quantities and units
- Physical, chemical and biological effects of radiation
- Protection of people and the environment against harmful effects of radiation
- Radiation detection, measurement and spectrometry
- Monitoring of environmental radioactivity
- Applications of radiation and radionuclides in science, industry and medicine
- The use of nuclear techniques in assessing various pollutants in the environment

NUCI 577	NQF level: 8

Title: Reactor Analysis

Module outcomes:

After completion of this module, the student should demonstrate:

- Integrated knowledge of nuclear reactor neutronics analysis, which includes the following topics:
  - Physics of neutron-nuclear interactions and fission chain reaction
  - Neutron transport model and diffusion theory
  - Neutron energy distribution, including slowing down, resonance absorption and group energy method
  - Nuclear reactor dynamics
  - Fuel burn-up

Critical understanding of these underlying physical principles and the ability to apply computational methods to reactor design and analysis, such as using simplified neutron diffusion and slowing down theories to calculate neutronflux distributions in space and energy for simple homogenous geometrics and heterogeneous lattices.

NUCI 578	NQF level: 8
Title: Nuclear Engineering II	
Module outcomes: After completion of this module, the student should demonstrate: • Applied knowledge and integrated understanding regarding the design and operation of nuclear power plants • The ability to solve basic thermal-hydraulic problems related to nuclear reactor engineering • The ability to communicate with the engineering community regarding these issues • Integrated knowledge regarding thermal-hydraulic analysis of nuclear reactors, nuclear fuel and reactor operations in order to enable him/her to work in the nuclear industry	

NUCL 525	NQF level: 8
Title: Nuclear Project Management	
Module outcomes: To provide students with a broad overview of nuclear project management in order to provide them with the basic knowledge they need to function in the nuclear reactor industry. The following topics in nuclear engineering are covered: • System Engineering Process • Scheduling project execution • Nuclear safety • Cost estimation and cost-value analysis • Planning project execution • Project functional management • The ability to apply this knowledge to a typical nuclear industry project After completion of this module, the student should demonstrate: • integrated knowledge of and the ability to apply and evaluate key terms, concepts, facts, principles, rule and theories of the Nuclear Project Management field • critical understanding of the specialization area and how that knowledge relates to other fields • problem-solving skills that encompass the ability to identify, analyse, evaluate, critically reflect on and address complex problems, related to Nuclear Project Management	

NUCI 811	NQF level: 9

Title: Nuclear Engineering I

Module outcomes:

The module provides students with a broad overview of nuclear engineering to provide them with the basic knowledge they need to function in the nuclear reactor industry. The student should be able to demonstrate specialist knowledge to enable engagement with criticism of current nuclear research and nuclear practices. The student's problem-solving skill should be developed to demonstrate the ability to use a wide range of specialist skills in identifying, conceptualizing, designing and implementing methods to address complex practical and theoretical nuclear problems. The student should also demonstrate an understanding of the consequences of any nuclear solution.

Therefore, the following topics in nuclear engineering are covered:

- The history of nuclear engineering
- Basics of anatomic and nuclear physics for engineers
- Interaction of neutrons and nuclear radiation with matter
- Basic types of nuclear power plants, neutron diffusion and moderation
- Nuclear reactor theory
- Time dependent behaviour and effects
- Heat generation in nuclear cores
- Radiation protection
- Radiation shielding
- Reactor safety and licencing

NUCI 879	NQF level: 9

Title: Nuclear Project Management

Module outcomes:

After successful completion of the Nuclear Project Management (NPM) module the student should demonstrate mastery of basic knowledge and skills pertaining to the theory, concepts, processes, tools and techniques of project management. He/she will have applied it to a typical nuclear industry project.

NUCI 883	NQF level: 9

Title: Nuclear Engineering II

Module outcomes:

On completion of this module, the student will have obtained the basic knowledge and understanding of how nuclear power plants are designed and operated.

With the knowledge the student has obtained from the module, he/she should be able to solve basic thermal-hydraulic problems related to nuclear reactor engineering and communicate with the engineering community about these problems.

The student's knowledge in the thermal-hydraulic analysis of nuclear reactors, as well as knowledge of nuclear fuel and reactor operations, will enable him/her to work in the nuclear industry.

NUCI 887	NQF level: 9
Title: Reactor Analysis	
Module outcomes: Upon successful completion of the module, the student should have acquired basic knowledge of nuclear reactor analysis, which includes the following topics: • Physics of neutron-nuclear interactions and fission chain reaction • Neutron transport model and diffusion theory • Neutron energy distribution, including slowing down, resonance absorption and group energy method • Nuclear reactor dynamics • Fuel burn-up This level of knowledge would enable the student to understand physical principles and apply computational methods for reactor design and analysis such as the calculation of neutron flux distribution in space and energy for simple homogenous geometrics and heterogeneous lattices.	
NUCI 888	**NQF level: 9**
Title: Reactor Safety	
Module outcomes: On completion of this module the student should have developed a basic knowledge of the field of reactor safety. With this knowledge he/she should be able to: • Understand accident situations and the student should have learned the necessary methods to evaluate them • Communicate with the engineering community about these problems • Carry out estimations for important accidents in nuclear plants • Use the basic knowledge to go deeper and to use complex programmes for safety analysis • Use the knowledge to work in the nuclear industry or in safety organizations for supervision of nuclear power plants The methods used in nuclear safety analysis are helpful in other fields of technology.	
SENG 511	**NQF level: 8**
Title: Socio-technical Systems Thinking & Philosophies	
Module outcomes: After completion of module Socio-technical Systems Thinking & Philosophies, the student will demonstrate: • The ability to recognise social aspects, technical aspects, and the relation of the two groupings within the application of engineering science • The ability to convert business processes into evolving socio-technical systems • The ability to manage the complexity of socio-technical systems • The ability to assess & manage varying levels of stability experienced by socio-technical systems • The ability to structure and arrange socio-technical systems in different contexts using descriptions and visual syntax	
SENG 512	**NQF level: 8**
Title: Introduction to Expanded Design Thinking	
Module outcomes: After completion of the module Introduction to Expanded Design Thinking, the student will demonstrate: • The ability to examine & assess business processes against sustainability criteria • The ability to justify the need for sustainability interventions within various contexts	

- The ability to contrast Traditional Design Thinking &Expanded Design Thinking
- The ability to prescribe sustainability interventions basedon Expanded Design Thinking principles

SENG 521	**NQF level: 8**

Title: Sustainable Value Chains

Module outcomes: After completion of module Sustainable Value Chains, the student will demonstrate:

- The ability to construct socio-technical systems that align with circular economy concepts
- The ability to characterise various forms of value within the context of operations management and sustainability
- The ability to contrast various definitions of value within the context of operations management and sustainability
- The ability to examine value streams in various disciplines
- The ability to optimise & design sustainable value stream maps in various disciplines

SENG 522	**NQF level: 8**

Title: Integrated Planning & Scenario Forecasting

Module outcomes: After completion of the module Integrated Planning & Scenario Forecasting, the student will demonstrate:

- The ability to describe strategy development processes in relation to organisational goals and sustainability goals
- The ability to differentiate between operational, tactical and strategic interventions
- The ability to recognise & justify the existence of value chain risks & opportunities and recommend operational, tactical or strategic interventions to address risks & opportunities
- The ability to propose & develop plans for operational, tactical & strategic interventions based on integrated planning principles
- The ability to propose various alternatives for operational, tactical & strategic interventions based on statistical justifications and forecasting principles

SENG 571	**NQF level: 8**

Title: Sustainable Design & Wicked Problem-Solving

Module outcomes: After completion of the module Sustainable Design & Wicked Problem-Solving, the student will demonstrate:

- The ability to recognise the need to apply circular design, participatory design & wicked problem-solving based on contextual factors
- The ability to select, modify, combine & integrate operations management, data & decision science and sustainability knowledge
- The ability to assess and model a socio-technical system in a practical context (organisation or community)
- The ability to justify the existence of a wicked problem within the context of sustainability
- The ability to design an operational, tactical & strategic intervention to address an opportunity that aligns with sustainability goals
- The ability to appreciate and address the ethical, professional and collaborative aspects associated with the practical application of various concepts

SMIN 511	NQF level: 8
Title: Sustainable Mine Planning & Design	
Module outcomes: After completion of module Sustainable Mine Planning & Design, the student will demonstrate: • The ability to examine & assess business processes against sustainability criteria • The ability to justify the need for sustainability interventions within various contexts • The ability to integrate Traditional Mine Planning & Design Goals & 6 dimensions of Expanded Design Thinking • The ability to prescribe sustainability interventions based on 6 dimensions of Expanded Design Thinking	

SMIN 521	NQF level: 8
Title: Sustainable Mining & Production Practices	
Module outcomes: After completion of the module Sustainable Mining Practices & Production Patterns, the student will demonstrate: • The ability to construct sustainable short-term plans that align with optimal production input (energy, water, space, capital) usage/allocation • The ability to outline the role of tailings characterisation in sustainable tailings management practices • The ability to characterise and compare various waste management approaches • The ability to optimise mining practices and production patterns by applying precision and waste elimination concepts	

SMIN 522	NQF level: 8
Title: Ecological Resilience & Rehabilitation	
Module outcomes: After completion of module Ecological Resilience & Rehabilitation, the student will demonstrate: • The ability to characterise ecosystem disturbances within the various mining life cycle phases • The ability to differentiate between engineering resilience and ecological resilience • The ability to recognise & justify the existence of an ecosystem recovery gap • The ability to propose & develop recommendations to change mining designs, mining plan, mining practices and production patterns to minimise the ecosystem recovery gap	