BEng (Hons) Chemical Engineering (Minor: Energy Engineering) – E403 (Under Review)

1. Introduction

Chemical engineering is a broad based discipline that extends to numerous areas of technology and development. Chemical engineers are responsible for the conception and design of processes for the physico-chemical transformation of raw materials into desired products; it generally begins with laboratory experimentations followed by process and technology development up to implementation of alternative commercial full scale production systems. Modern chemical engineering generally encompasses new elements such as sustainable design, safety, optimal resource use and the environment.

Chemical engineering requires a complete and quantitative understanding of both the engineering and scientific principles underlying technological processes that enables appropriate plant design and practical problem solving in industries. The first three years of this 4-year degree programme provides an in-depth knowledge and understanding of the design, development and operation of chemical processes and plants together with their proper management and optimum resource use; it focuses on specific chemical engineering modules like chemical thermodynamics, heat transfer, mass transfer, unit operations, chemical process design, reaction engineering and process safety. In the third and fourth year, it subsequently provides the learners with the opportunity to apply the knowledge acquired so far in designing a complete commercial chemical processing plant, and to concurrently specialize in energy engineering by acquiring knowledge in specific modules like energy engineering/management and renewable energy technologies, and by opting or linking the bachelor degree project to this area.

This programme thus combines the wide range of core chemical engineering modules including those focusing on multidisciplinary knowledge with complementary specialization electives; it includes the essential academic structure to provide the undergraduates with an excellent foundation for careers in the chemical and/or energy engineering industry. It typically prepares them to meet the challenges in the chemical processing industries such as the sugarcane industry involved in the production of sugar, bioethanol, electricity and other by-products; food and allied industries; textile industry; soap, detergents and paint industries; fertilizer production plants, amongst many others. The specialization option extends opportunities in the energy area, in particular energy management and renewable energy technologies.

The programme has been developed to meet the requirement of Engineering Council of South Africa (ECSA). Graduates from this programme can seek membership with the Council of Registered Professional Engineers (CRPE) and the Institute of Chemical Engineers (IChemE)

2. Objectives

The main educational objectives of the programme are as follows:

- To master the principles of basic scientific and engineering sciences that underlie modern chemical engineering;
- To inculcate and develop analytical skills pertaining to chemical and energy engineering;
- To demonstrate a complete understanding for designing integrated chemical processing systems together with its critical elements of sustainability, safety and optimum resource use;
- To apply critical and creative thinking in solving chemical engineering problems;
- To appreciate and link the broader context of energy, social, safety and economic issues that affect decision making in chemical engineering;
- To communicate effectively, work in multidisciplinary teams and with observance of professional ethics;

- To recognize and commit to the importance of continued self-improvement and the ability to engage in lifelong learning; and
- To understand the implications of chemical processing on energy use and management and apply the use of renewable energy technologies in chemical process industries to promote low carbon development and green productivity.

3. General Entry Requirements

As per General Entry Requirements for admission to the University for Undergraduate Degrees.

4. Programme Requirements

GCE 'A' Level Passes in Mathematics and Chemistry or Physics.
Credit in Chemistry and Physics at SC/'O' Level.

5. Minimum Requirements for Degree Award

For the award of the degree, the following should be met:

- Successfully completion of 600 notional hours credits (150 UoM Credits) as per the programme structure;
- Attendance to at least 12 seminars during the course of the programme (i.e. attendance to at least 3 seminars per year);
- Satisfactory completion of vacation training and industrial training;
- Satisfactory performance in each of the Exit Level Outcomes (ELO) specified against modules in the module specification sheets.

To complete the programme of studies, students are required to perform satisfactorily in the following 11 Exit Level Outcomes (ELOs) which are linked to the modules offered in the programme.

ELO 1: Problem solving
ELO 2: Application of scientific and engineering knowledge
ELO 3: Engineering design
ELO 4: Investigations, experiments and data analysis
ELO 5: Engineering methods, skills and tools, including Information Technology
ELO 6: Professional and technical communication
ELO 7: Sustainability and impact of Engineering activity
ELO 8: Individual, team and multidisciplinary working
ELO 9: Independent learning ability
ELO 10: Engineering Professionalism
ELO 11: Engineering Management

6. Programme Duration

	Normal (Years)	Maximum (Years)
Degree	4	7

7. Classification of Awards

The award classification will be based on the CPA (x) at the end of the Programme of Studies as follows:-

CPA	CLASSIFICATION	
≥ 70	1st Class	with Honours
$60 \leq x < 70$	2nd Class 1st Division	
$50 \leq x < 60$	2nd Class 2nd Division	
< 50	No Award	

8. Pre-requisite (PR)

A student will be allowed to follow module **y** of which module **x** is a pre-requisite (PR) provided the student has passed module **x** with at least a pass grade.

9. Assessment and Pass Requirements

- The assessment mode for each module will be based on one or a combination of the following:
- Examination.
- Continuous assessment (class tests, assignments, practicals and oral presentations).
- Report assessment (for Design Project, Final Year Project, Vacation Training and Industrial Training).
- Mini design Projects
- Attendance to seminars.

In order to pass a module a student must obtain an examination mark of at least 40% and a final mark of at least 50%.

Calculation of the final mark: The continuous assessment must account for no less than 30% and for no more than 50% of the final mark, with the exception of modules like design and degree projects. Certain modules are assessed on the basis of 100% Continuous Assessment. The specific details and/or formula for the calculation of the final mark are given in the Module Specification Sheet (MSS) of each module.

Students have to retake both continuous assessment and exams in the failed module except in case of Resit Examinations; See provisions for Resit Examinations at Section 10. Students passing failed modules will score maximum marks of 50% in these modules but will have the failed marks not counted in the computation of the CPA.

If the student's CPA is between 40% and 50%, he/she fails the year. However, student will be eligible to repeat the year and will maintain credits and marks for individual modules where the mark scored is 50% or above. If the CPA is less than 40%, the registration will be terminated.

Rules in Cases of Unsatisfactory Performance of ELOs

The ELOs and assessment criteria are specified against modules in the module specification sheets (MSS).

A student must comply with the subminimum requirements in subdivisions of certain modules. For such modules these specific requirements are given in the MSS of the module. These sub-minima include the achievement of ELOs that are assessed in the module. A sub minimum mark of 50% is required for all assessed elements (relevant questions in an assessment, project or assignment) in which the achievement of

exit level outcomes are finally assessed (for the particular module).

The following Rules will apply in cases of unsatisfactory performance of ELOs.

(i) ELOs assessed in the written examination.
A student failing the assessment of an ELO in a written examination will be deemed to have failed the module. The student will have to retake the module next time it is offered. However, a Resit examination may be granted for the module only if a pass mark of at least 50% has been obtained; See the rules for Resit examinations at Section 10(iii).

(ii) ELOs assessed in coursework, e.g., mini-project work.
A student not satisfying an ELO may be given an extension by the lecturer and moderator prior to the written examination to amend and resubmit the coursework for pass mark of 50 % only. In case the student still fails to satisfy the ELO in the re-submission, he/she may be awarded Grade N in the module and will have to do a new coursework in the next academic year, provided he/she has scored a minimum of 50 % in the overall module mark.

In case a student fails the module, that is, scored less than 50 % in the overall module mark, he/she will be awarded Grade F and has to retake the whole module the next time it is offered.

(iii) ELOs (other than ELO 6) assessed in the Final Year Project.
If a candidate fails to obtain a pass mark of 50 % for any ELO (other than ELO 6) in the Final Year Project, the Board of Examiners may consider one of the following:

- For a project/dissertation with possibility of amendments, award the student Grade N in the module and grant the student an extension period of up to 3 months to amend the work related to the ELO, and resubmit for pass mark of 50 % in the ELO;
- For a project/dissertation with recommendations for a new submission, award the student Grade F in the module and student will have to undertake a new project in the following academic year.

(iv) ELO 6 assessed in the Design Project and/or Final Year Project.
For a student failing to obtain the pass mark of 50 % for ELO 6 in the Design Project and/or Final Year Project, the Board of Examiners may consider awarding the student Grade N and granting the student an extension period of up to 3 months to amend the components of the work related to this ELO, and resubmit the Design Project and/or Final Year Project for a pass mark of 50 % in the ELO, provided that the student has scored a minimum of 50 % in the overall module mark.

In case a student fails the module, that is, scored less than 50 % in the overall module mark, he/she will be awarded Grade F and has to retake the Design Project and/or Final Year Project the next time it is offered.

(v) ELO 3 assessed in the Design Project.
A student failing ELO 3 will be awarded Grade F in the design project and will have to retake the module the next time it is offered.

The detailed assessment mode for each module is given in the MSS.

10. Resit Examinations

If a student obtains a CPA of at least 50% but has not passed all the modules, a Resit examination may be granted for failed modules by the Board of Examiners provided that:

(i) A minimum of 40% has been obtained in continuous assessment.

(ii) A Final mark of at least 40% has been achieved in the failed modules which exclude assessment of ELOs;
(iii) A pass mark has been achieved but the required sub minimum for passing an Exit Level Outcome (ELO) has not been obtained.

Resit examinations do not apply to final year Project/Dissertation/Mini-Project Portfolio/Industrial Training and to modules assessed solely by continuous assessment.

11. Duration of examinations

16 NH credits modules shall have 3-hour examination papers. 12 NH credits and 8 NH credits modules shall have 2-hour examination papers.

12. Termination of Registration

Termination of registration will occur in the following circumstances:

- If the CPA is less than 25% at the end of Semester 1, Level 1.
- If the CPA is less than 40% at the end of an academic year.
- If the student fails to obtain credit in a module which he/she is repeating. This excludes Resit examinations.
- If the student does not pass all the modules for 1st, 2nd and 3rd years in a total of five years.

13. Unless otherwise decided by Faculty Board, the following will apply for:

Progression from lower level to higher level

First Year to Second Year
A student should not have failed more than two modules to be able to register for Second Year modules. If any of the failed modules is a Pre-requisite(s) for a Second Year module, then the candidate cannot register for the PR-linked Second Year module until the Pre-requisite(s) is passed.

Second Year to Third Year
A student **must** have passed all prescribed First Year modules. In addition, the student should not have failed more than two modules of the prescribed second year modules to be able to register for Third Year modules. If any of the failed modules is a Pre-requisite(s) for a Third Year module, then the candidate cannot register for the PR-linked Third Year module until the pre-requisite is passed.

Third Year to Fourth Year
A student **must** have passed all prescribed second year modules. In addition, the student should not have failed more than two modules of the prescribed **Third Year** modules to be able to register for Fourth Year modules. If any of the failed modules is a pre-requisite for a Fourth Year module, then the candidate cannot register for the PR-linked Fourth Year module until the pre-requisite is passed.

14. Registration for Modules in a Higher Year of study for Repeating Students

If a student is repeating a year and the CPA is above 45, the student may be allowed to register for a maximum of two modules per semester from the higher year of study. The student will need to make a request to the Dean of Faculty. The student cannot register for a module of a higher year of study if a timetable clash occurs with a module of a previous year which has not yet been passed and which is prescribed for his or her field of study. Moreover, registration for modules is subject to pre-requisites being met.

15. Self-Development

This refers to directly supervised work in terms of hours/week. It includes practicals, tutorials, seminars, visits, mini-projects, oriented-discussion, coached group-work, presentations and other structured activities associated to enhancing the engineering application abilities and professional and personal attributes of the students. Such supervised work is included in the time-table.

16. B.Eng. (Hons.) Chemical Engineering (Minor: Energy Engineering) Programme Structure

Year 1 - Semester 1

Module Code	Module Name	L+T+P/SD	UoM Credits	Notional Hours Credits	Pre-requisites
MATH 1101(1)	Mathematics 1	3+2	4	16	
ELEC 1107(1)	Physics for Engineers 1	3+2	4	16	
CHE 1103(1)	Chemistry for Engineers	3+2	4	16	
CHE 1104(1)	Professional Communication for Chemical Engineers	2+2	3	12	
CHE 1105(1)	Basic Chemical Engineering	3+2	4	16	
TOTAL			**19**	**76**	

Year 1 - Semester 2

Module Code	Module Name	L+T+P/SD	UoM Credits	Notional Hours Credits	Pre-requisites
MATH 1201(1)	Mathematics 2	3+2	4	16	
CHE 1205(1)	Material Science	3+2	4	16	
MECH 1204(1)	Mechanics	3+2	4	16	
CHE 1203(1)	Fluid Mechanics 1	2+2	3	12	
CHE 1208(1)	Thermodynamics 1	2+2	3	12	
CHE 1204(1)	Green Chemistry	2+2	3	12	
CHE 1200	Vacation Training				
TOTAL			**21**	**84**	

Year 2 - Semester 1

Module Code	Module Name	L+T+P/SD	UoM Credits	Notional Hours Credits	Pre-requisites
ENGG 2101(3)	Engineering Mathematics 1	3+2	4	16	
CHE 2105(3)	Fluid Mechanics 2	2+2	3	12	CHE 1203(1)
CHE 2106(3)	Environmental Engineering	2+2	3	12	
CHE 2107(3)	Heat Transfer	2+2	3	12	
CHE 2108(3)	Process Instrumentation	2+2	3	12	MATH1101(1)
CHE 2109(3)	Legal Aspects for Chemical Engineers	1.5+1	2	8	
TOTAL			**18**	**72**	

Year 2 - Semester 2

Module Code	Module Name	L+T+P/SD	UoM Credits	Notional Hours Credits	Pre-requisites
ENGG 2201(3)	Engineering Mathematics 2	3+2	4	16	
CHE 2208(3)	Thermodynamics 2	2+2	3	12	CHE1208(1)
CHE 2209(3)	Renewable Energy Technologies	2+2	3	12	
CHE 2210(3)	Mass Transfer	2+2	3	12	MATH1101(1)
CHE 2211(3)	Process Control	2+2	3	12	
CHE 2212(3)	Research and Statistical Methods	2+2	3	12	
TOTAL			**19**	**76**	

Year 3 - Semester 1

Module Code	Module Name	L+T+P/SD	UoM Credits	Notional Hours Credits	Pre-requisites
CHE 3107(5)	Unit Operations 1	2+2	3	12	CHE2210 (3); CHE2107(3)
CHE 3108(5)	Chemical Engineering Economics	2+2	3	12	
CHE 3109(5)	Chemical Thermodynamics	2+2	3	12	CHE2208(3)
CHE 3110(5)	Chemical Process Safety and Risk Management	2+2	3	12	
CHE 3111(5)	Reaction Engineering 1	2+2	3	12	CHE1208(1)
CHE 3112(5)	Chemical Process Technologies	2+2	3	12	CHE2107(3); CHE2210(3)
CHE 3113(5)	Design Process	1.5+1	2	8	
TOTAL			**20**	**80**	

Year 3 - Semester 2

Module Code	Module Name	L+T+P/SD	UoM Credits	Notional Hours Credits	Pre-requisites
CHE 3212(5)	Unit Operations 2	2+2	3	12	CHE2107(3); CHE2210(3)
CHE 3213(5)	Design Project 1	1+4	3	12	CHE3112(5); CHE 3113(5)
CHE 3214(5)	Quality Systems	3+2	4	16	
CHE 3215(5)	Chemical Process Design and Simulation	2+2	3	12	CHE1105 (1)
CHE 3216(5)	Reaction Engineering 2	2+2	3	12	CHE3111 (5)
CHE 3220	Industrial Training				
TOTAL			**16**	**64**	

Year 4 - Semester 1

Module Code	Module Name	L+T+P/SD	UoM Credits	Notional Hours Credits	Pre-requisites
CHE 4200Y(5)	Degree Project		5	20	
CHE 4100(5)	Design Project 2	1+8	5	20	CHE3213(5)
ENGG 4102(5)	Sociology for Engineers	1.5+1	2	8	
CHE 4108(5)	Energy Engineering	3+2	4	16	CHE2208(3)
CHE 4213(5)	Refrigeration and Air Conditioning	2+2	3	12	CHE2208(3)
TOTAL			**19**	**76**	

Year 4 - Semester 2

Module Code	Module Name	L+T+P/SD	UoM Credits	Notional Hours Credits	Pre-requisites
CHE 4200Y(5)	Degree Project		5	20	
MECH 4201(5)	Engineering Professionalism	2+2	2	8	
CHE 4212(5)	Applied Renewable Energy Technologies	3+2	4	16	CHE2209 (3)
CHE 4110(5)	Energy Management	3+2	4	16	CHE2208 (3)
CHE 4201(5)	Petrochemical Engineering	2+2	3	12	CHE3107 (5)
TOTAL			**18**	**72**	

[L: Lecture; T: Tutorial; P: Practical; SD: Self Development]

Total Notional Hours Credits (NHC): 600
Total UoM Credits: 150