ANNEXURE A

Name of qualification: **Master of Engineering (Energy Efficiency)**

Abbreviation: **MEng EE**

Faculty	Engineering and Technology
Department	Electronic Engineering
Contact details for Department	Department of Electronic Engineering S-Block Pvt Bag X021 Vanderbijlpark 1900
Contact details for programme co-ordinator	Prof HCvZ Pienaar S314 Pvt Bag X021 Vanderbijlpark 1900
Site(s) of delivery	Vanderbijlpark

- **Rationale**
- To cope with the changing needs, markets and the latest technology, this programme focuses on equipping students with the skills to manage and optimize energy needs and energy supply scenarios.
- This programme prepares students to become energy effiency practitioners
- Through benchmarking with national and international higher education institutions as well as consultation with relevant stakeholders it became clear that a research component should be included in the qualification to prepare students for further studies. Students with an bachelor's in the relevant discipline will be able to articulate into the Master of Engineering, thereafter and eventually into a Doctorate
- Benchmarking (Annexure I) has been carried out at a global level. This programme compares favourably with international universities. Inputs were received from the advisory committee/board (Annexure B) and other stakeholders in the discipline, therefor meeting the needs of industry.
- Students completing this qualification will have an advantage in the discipline of energy effiency as its could also hold international accreditation.

- VUT students meet the needs of the surrounding community – the Vaal Triangle has many enterprises that employ graduates from VUT. The skills offered by this qualification are sought after in related and relevant disciplines.
- This program specific to the region is to provide skills to better the usage of energy and energy practises due to the fact that the Vaal Triangle area has been identified as industrial polluted environment.

Purpose of the qualification

The purpose of the structured Master of Engineering (Energy Efficiency) degree is to educate students qualifying from undergraduate programmes with specialised knowledge and skills in the field of Energy Efficiency to enable them to engage at a high level in personal intellectual growth, gainful economic activity and contributions beneficial to local society and the international society as the qualification will be aligned with European- and Namibian Universities via the EDULINK PEESA project. This program is unique in the field of energy efficiency for the social economic area and that it is a structured masters and promotes the social constructivist approach to teaching, learning, assessment and research which is embedded in VUT's approach to higher education studies. Students will learn to manage, analyse problems and determine different scenario outcomes and gain experience in energy efficiency. These advanced skills will prepare students for applying these skills in industry to better our community nationally and internationally. After the completion of this qualification the students can articulate vertically into a Doctorate in the same or relevant field.

Exit level outcomes (ELO's)

After the completion of this qualification the student will be able to demonstrate:

1. Apply specialist knowledge to enable engagement with and critique of current research or practices; and an advanced scholarship or research in a discipline of Energy Efficiency engineering.
2. The ability to design, select and apply appropriate and creative methods, techniques, processes or technologies to complex practical and theoretical problems related to Energy Efficiency engineering.
3. The ability to:
    - Evaluate current processes of knowledge production and to choose an appropriate process of enquiry for energy efficiency engineering.
    - Understand the consequences of solutions or insights generated within the specialised context of energy efficiency engineering.
    - Utilise resources to communicate and defend substantial ideas that are the products of research or development in to energy efficiency engineering.
    - Determine interventions within a system, based on an understanding of hierarchical relations within the energy system
4. An ability to make autonomous ethical decisions which affect knowledge production.

5. Engage in independent research and lifelong learning through specialised developed skills. To conduct a comprehensive review of leading and current research in an area of Energy Efficiency engineering to produce significant insights.

Module alignment with ELO's

	ELO 1	ELO 2	ELO 3	ELO 4	ELO 5
Modules	Critical understanding & Application	Problem-solving & Design	Evaluation & Analysis (Independent & teamwork)	Professionalism (Ethics)	Research
Energy Accounting and Economics	X	X	X	X	
Process Energy Management	X	X	X	X	
Electrical Systems	X	X	X	X	
Renewable Energy	X	X	X	X	
Research Project		X			X

- **Programme Design:**

MODULE STRUCTURE FOR: Master of Engineering (Energy Effiency)

Module name	CESM	SAQA Credits	NQF Level	Core/ Fundamental/ Elective	Sem 1/ Sem 2/ Year
1. Energy Accounting and Economics	080901	20	9	Core	Sem1/Sem2
2. Process Energy Management	082201	25	9	Core	Sem1/Sem2
3. Electrical Systems	080901	20	9	Core	Sem1/Sem2
4. Renewable Energy	080901	25	9	Core	Sem1/Sem2
5. Research Project	080901	90	9	Core	Sem1/Sem2
Total		**180**			

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The following table should be completed for each module as indicated in the module structure above

MODULE:	Energy Accounting and Economics
Module description:	The module will include topics of Energy usage, Energy economics, Energy auditing, Energy rates and electrical systems management.

1	Module title	Energy Accounting and Economics
2	Module code	EAEAC9A
3	HEQF level	9
4	HEQF credits	20
5	CESM	080901
6	Semester/Year	Semester
7	WIL (weeks/months)	0
8	Core/ Fundamental/ Elective	Core
9	Total notional hours	200
10	Contact hours	40
11	Pre-requisite module	None
12	Co-requisite module	None
13	Intended learning outcomes of Module X (ILOs)	**At the end of this module students will be able to** Students will be able to: • Evaluate the heat transfer through building structure • Evaluate the types and application of insulation materials • Evaluate the codes standards and protocols • Use the different cash flow methods in determining the life cycle of different types of machines and processes • Do a full energy audit using the audit instruments and do benchmarking of such systems • Evaluate the different energy rate structures

		• Evaluate the electricity management methods and electrical systems	
14	Graduate attributes developed and/or assessed in this module		Doc A and B
15	Module content (Outline of module)	· Building energy use and economic analysis and life cycle costing · Building envelopes and insulation · Energy auditing · Audit instruments · Codes standards and protocols · Energy purchasing · Energy accounting and benchmarking · Energy rates structures · Electrical systems and electricity management	
16	Teaching & Learning	Learning activity	% Learning time
		Lectures (face to face, consultations, supervisory support, simulations, presentations, feedback, limited interaction or technologically mediated)	20%
		Tutorials: individual groups of 30 or less	
		Syndicate groups	
		Practical workplace experience (experiential learning/work-based learning etc.)	
		Independent self-study of standard texts and references (study guides, books, journal articles)	40%
		Independent self-study of specially prepared materials (case studies, multi-media, etc.)	40%
		Other (specify and please give a detailed explanation)	
			Total 100%

17	Assessment & Moderation (Annexure A and H)	Assessment methods: *Portfolio of evidence (Formative & Summative)* *Oral assessment (Formative & Summative)* *Written assignments (Formative & Summative)* *Class presentation (Formative & Summative)* Assessment criteria: (How will the students be assessed to meet the ILO's?) *Portfolio of evidence (Rubrics)* *Oral presentation (Rubrics / Panel)* *Written assignments (Rubrics)* Does assessment include a final examination? N/A	
18	Feedback to students on assessment (time frame)	Once the evaluation has taken place, feedback will be given within 7 days of assessment (Portfolios, assignments, oral presentations) As directed by Faculty	
19	Resources required to offer this module e.g. Lab equipment		Annexure F
20	Student numbers	Minimum:1 Maximum:20 Refer to Annexure D	
21	Quality Assurance	Doc E	
22	Motivation for additional credits (if exceeding 180 credits)	No additional credits: Credits are assigned to align with international engineering programme credits in Europe and Namibia as decided upon in Edulink Project PEESA.	
23	Recommended sources (Library)	Refer to Annexure T	

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MODULE:	Process energy management
Module description:	The module will include topics of Pump systems, Air systems, Boiler fuels, Boiler management, ventilation and air conditioning, Steam systems and waste heat recovery techniques.

1	Module title	Process energy management	
2	Module code	EAPEM9A	
3	HEQF level	9	
4	HEQF credits	25	
5	CESM	082201	
6	Semester/Year	Semester	
7	WIL (weeks/months)	0	
8	Core/ Fundamental/ Elective	Core	
9	Total notional hours	250	
10	Contact hours	40	
11	Pre-requisite module	None	
12	Co-requisite module	None	
13	Intended learning outcomes of Module X (ILOs)	**At the end of this module students will be able to** Students will be able to: • Design fan systems • Evaluate pumps and pump systems • Evaluate Air systems components management. • Design Heating, ventilating and air conditioning systems	
14	Graduate attributes developed and/or assessed in this module		Doc A and B
15	Module content (Outline of module)	· Fan systems · Pumps and pump systems · Air systems components management.	

		· Heating, ventilating and air conditioning Understanding and managing boilers · Operation · Boiler components · Boiler controls and gauges · Boiler fuels · Heat balance for boilers · Boiler efficiency and improvements Steam distribution systems · Introduction · Steam distribution components · Tracer lines · Waste heat recovery · Improving the hot water distribution system · Cogeneration

16	Teaching & Learning	Learning activity	% Learning time
		Lectures (face to face, limited interaction or technologically mediated)	16%
		Tutorials: individual groups of 30 or less	
		Syndicate groups	
		Practical workplace experience (experiential learning/work-based learning etc.)	
		Independent self-study of standard texts and references (study guides, books, journal articles)	42%
		Independent self-study of specially prepared materials (case studies, multi-media, etc.)	42%
		Other (specify and please give a detailed explanation)	
			Total 100%

17	Assessment & Moderation (Annexure A and H)	Assessment methods: *Portfolio of evidence (Formative & Summative)* *Oral assessment (Formative & Summative)* *Written assignments (Formative & Summative)* *Class presentation (Formative & Summative)* Assessment criteria: (How will the students be assessed to meet the ILO's?) *Portfolio of evidence (Rubrics)* *Oral presentation (Rubrics / Panel)* *Written assignments (Rubrics)* Does assessment include a final examination? N/A	
18	Feedback to students on assessment (time frame)	Once the evaluation has taken place, feedback will be given within 7 days of assessment As directed by Faculty	
19	Resources required to offer this module e.g. Lab equipment		Annexure F
20	Student numbers	Minimum:1 Maximum:20 Refer to Annexure D	
21	Quality Assurance	Doc E	
22	Motivation for additional credits (if exceeding 120 credits)	Credits are assigned to align with international engineering programme credits in Europe and Namibia as decided upon in Edulink Project PEESA.	
23	Recommended sources (Library)	Refer to Annexure T	

ANNEXURE A

MODULE:	Electrical systems
Module description:	The module will include topics of rate structures, energy maintenance systems, automatic controls and web based automation of energy electrical systems.

1	Module title	Electrical systems	
2	Module code	EAESS9A	
3	HEQF level	9	
4	HEQF credits	20	
5	CESM	082201	
6	Semester/Year	Semester	
7	WIL (weeks/months)	Not Applicable	
8	Core/ Fundamental/ Elective	Core	
9	Total notional hours	200	
10	Contact hours	40	
11	Pre-requisite module	None	
12	Co-requisite module	None	
13	Intended learning outcomes of Module X (ILOs)	**At the end of this module students will be able to** Students will be able to: • Evaluate and apply different tariff structures • Evaluate the different electrical systems i.e. single-, two- and three phase • Apply protection principles to electric motors and drives • Do energy systems maintenance • Apply control systems to energy systems in terms of types of controls.	
14	Graduate attributes developed and/or assessed in this module		Doc A and B
15	Module content	· Rate structures	

	(Outline of module)	· Electrical systems · Electric motors and drives · Tariffs and structures · Electrical protection systems · Energy systems maintenance Control systems and computers · Need for controls · Types of controls - Manual systems - Basic automatic controls - Web based building automation systems

16	Teaching & Learning	Learning activity	% Learning time
		Lectures (face to face, limited interaction or technologically mediated)	20%
		Tutorials: individual groups of 30 or less	
		Syndicate groups	
		Practical workplace experience (experiential learning/work-based learning etc.)	
		Independent self-study of standard texts and references (study guides, books, journal articles)	40%
		Independent self-study of specially prepared materials (case studies, multi-media, etc.)	40%
		Other (specify and please give a detailed explanation)	
			Total 100%

17	Assessment & Moderation (Annexure A and H)	Assessment methods: *Portfolio of evidence (Formative & Summative)* *Oral assessment (Formative & Summative)* *Written assignments (Formative & Summative)* *Class presentation (Formative & Summative)* Assessment criteria: (How will the students be assessed to meet the ILO's?) *Portfolio of evidence (Rubrics)* *Oral presentation (Rubrics / Panel)* *Written assignments (Rubrics)* Does assessment include a final examination? N/A	
18	Feedback to students on assessment (time frame)	Once the evaluation has taken place, feedback will be given within 7 days of assessment As directed by Faculty	
19	Resources required to offer this module e.g. Lab equipment		Annexure F
20	Student numbers	Minimum:1 Maximum:20 Refer to Annexure D	
21	Quality Assurance	Doc E	
22	Motivation for additional credits (if exceeding 120 credits)	Credits are assigned to align with international engineering programme credits in Europe and Namibia as decided upon in Edulink Project PEESA.	
23	Recommended sources (Library)	Refer to Annexure T	

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MODULE:	Renewable energy
Module description:	The module will include topics of wind generation, water energy systems, solar energy systems, thermal energy systems and hydrogen/fuel cell systems. Focus will also be given to distributed generation and economics and technologies surrounding these.

1	Module title	Renewable energy	
2	Module code	EARNE9A	
3	HEQF level	9	
4	HEQF credits	25	
5	CESM	082201	
6	Semester/Year	Semester	
7	WIL (weeks/months)	Not Applicable	
8	Core/ Fundamental/ Elective	Core	
9	Total notional hours	250	
10	Contact hours	40	
11	Pre-requisite module	None	
12	Co-requisite module	None	
13	Intended learning outcomes of Module X (ILOs)	**At the end of this module students will be able to** Students will be able to: • Evaluate the different renewable energy sources for a specific site • Apply the principles of DG in the field in order to save energy.	
14	Graduate attributes developed and/or assessed in this module		Doc A and B

15	Module content (Outline of module)	Renewable energy sources and water management · Wind generation · Water energy systems · Geothermal energy · Solar energy · Thermal energy storage · Hydrogen and Fuel Cells Distributed generation (DG) · Economics of DG · Technologies · Analysing your own facility for possible DG application · A case study

16	Teaching & Learning	Learning activity	% Learning time
		Lectures (face to face, limited interaction or technologically mediated)	16%
		Tutorials: individual groups of 30 or less	
		Syndicate groups	
		Practical workplace experience (experiential learning/work-based learning etc.)	
		Independent self-study of standard texts and references (study guides, books, journal articles)	42%
		Independent self-study of specially prepared materials (case studies, multi-media, etc.)	42%
		Other (specify and please give a detailed explanation)	
			Total 100%

17	Assessment & Moderation (Annexure A and H)	Assessment methods: *Portfolio of evidence (Formative & Summative)* *Oral assessment (Formative & Summative)* *Written assignments (Formative & Summative)* *Class presentation (Formative & Summative)* Assessment criteria: (How will the students be assessed to meet the ILO's?) *Portfolio of evidence (Rubrics)* *Oral presentation (Rubrics / Panel)* *Written assignments (Rubrics)* Does assessment include a final examination? N/A	
18	Feedback to students on assessment (time frame)	Once the evaluation has taken place, feedback will be given within 7 days of assessment As directed by Faculty	
19	Resources required to offer this module e.g. Lab equipment		Annexure F
20	Student numbers	Minimum:1 Maximum:20 Refer to Annexure D	
21	Quality Assurance	Doc E	
22	Motivation for additional credits (if exceeding 120 credits)	Credits are assigned to align with international engineering programme credits in Europe and Namibia as decided upon in Edulink Project PEESA.	
23	Recommended sources (Library)	Refer to Annexure T	

ANNEXURE A

MODULE:	Research Project
Module description:	The module will focus on research in the energy efficiency field with focus relating to topics in modules 1 to 4 and the impact on communities within Southern-Africa.

1	Module title	Research Project	
2	Module code	EARPE9A	
3	HEQF level	9	
4	HEQF credits	90	
5	CESM	082201	
6	Semester/Year	Semester	
7	WIL (weeks/months)	Not Applicable	
8	Core/ Fundamental/ Elective	Core	
9	Total notional hours	900	
10	Contact hours	90	
11	Pre-requisite module	None	
12	Co-requisite module	None	
13	Intended learning outcomes of Module X (ILOs)	**At the end of this module students will be able to** Students will be able to: • Demonstrate ability to do research. • Resolve problems via research in the Energy field	
14	Graduate attributes developed and/or assessed in this module		Doc A and B
15	Module content (Outline of module)	Research Project relating to energy sources and/or water management systems pertaining to: · Wind generation systems and optimization	

		· Water energy systems and optimization · Geothermal energy systems and optimization · Solar energy systems and optimization · Thermal energy storage systems and optimization · Hydrogen and Fuel Cell systems and optimization	
16	Teaching & Learning	Learning activity	% Learning time
		Lectures (face to face, supervision, limited interaction or technologically mediated)	10%
		Tutorials: individual groups of 30 or less	
		Syndicate groups	
		Practical workplace experience (experiential learning/work-based learning etc.)	
		Independent self-study of standard texts and references (study guides, books, journal articles)	80%
		Independent self-study of specially prepared materials (case studies, multi-media, etc.)	10%
		Other (specify and please give a detailed explanation)	
			Total 100%
17	Assessment & Moderation (Annexure A and H)	Assessment methods: *Oral assessment wrt proposals* *Mini Thesis document according to VUT Research guidelines and references* Assessment criteria: (How will the students be assessed to meet the ILO's?) *Oral assessment wrt proposals by internal examiner.* *Mini Thesis document according to VUT Research guidelines and references by internal examiner and by external moderator.*	

		Does assessment include a final examination? NO	
18	Feedback to students on assessment (time frame)	Once the evaluation has taken place, feedback will be given within 7 days of assessment As directed by Faculty	
19	Resources required to offer this module e.g. Lab equipment		Annexure F
20	Student numbers	Minimum:1 Maximum:20 Refer to Annexure D	
21	Quality Assurance	Doc E	
22	Motivation for additional credits (if exceeding 120 credits)	Credits are assigned to align with international engineering programme credits in Europe and Namibia as decided upon in Edulink Project PEESA.	
23	Recommended sources (Library)	Refer to Annexure T	