College of Science and Technology

AFRICA CENTER OF EXCELLENCE IN ENERGY FOR SUSTAINABLE DEVELOPMENT (ACE-ESD)

P.O.BOX BP 3900, Kigali

Doctor of Philosophy degree by Research In Renewable Energy (PhD-REE)

African Center of Excellence in Energy for Sustainable Development

PROGRAMME SPECIFICATION

(*August 2018)*

1. PROGRAMME DETAILS

The table in this section sets out the programme details. It shows the title, which is also the highest qualification obtainable from the programme, and the exit awards. The title was selected with the aim to make the programme look both academically sound and useful for employment. In addition, in the table specifies the exit awards, the mode of attendance and the resource group.

PhD candidates graduating from this programme will have state-of-the-art research knowledge, skills, and competences within one, or a combination of, the research areas of Smart & Micro-grid Technologies (Wind, Solar, Mini-Hydro, Biomass, Geothermal); Battery management systems (BMS): This involves the renewable energy control, embedded system and power electronics skills; Energy storage system (ESS: This involves the renewable energy control, embedded system and power electronics skills; Renewable energy (bioenergy including bio-fuels, solar energy, wind energy, etc.):

- Energy impact on the environment;
- Energy for socio-economic development;
- Energy system planning and modeling;
- Energy infrastructure optimization;
- Energy efficiency and demand side management;
- Alternative energy

Advanced energy infrastructures for problem solving in renewable energy systems, and techniques for the processing and analysis of massive data sets from scientific experiments.

1.1 Programme Title	**PhD in Renewable Energy**				
1.2 Exit Awards				**Credits**	
	Doctoral of Philosophy in Renewable Energy (PhD-REE)			360	
1.3 Modes of Attendance	Part-time	X	Full-time		X
	Distance Learning		Work-based Learning		
	Other (please specify)		Short course		
1.4 Resource group	1		5		X
	2		6		
	3		Other (write in)		
	4				

1.5 First year of presentation	2018 (1st Presentation)	X
1.6 Programme Leader	Prof. Etienne Ntagwirumugara, Director of ACE-ESD	

1.7 Programme Development Team

Name	**School/Institution**
Prof. Ntagwirumugara Etienne (chair)	ACE-ESD, UR-CST, Rwanda
Prof. Ijumba Nelson	Deputy Vice-chancellor for Academic Affairs/ University of Rwanda
Dr. Ignace Gatare	Principal/College of Science and Technology
Dr. Hakizimana Jean de Dieu	ACE-ESD, UR-CST, Rwanda
Dr. Kabiri Charles	ACE-ESD, UR-CST, Rwanda

1.8 School/Centre Administratively responsible for the Program	Africa Center of Excellence in Energy for Sustainable Development (ACE-ESD)

2. PROGRAMME FUNDING AND NEED FOR RESOURCES

2.1 Programme Development Team

The team is composed of the Programme Leader and two academic staff from UR-CST and working in ACE-ESD supported by Deputy Vice-chancellor for Academic Affairs/University of Rwanda and Principal of College of Science and Technology. The Programme leader who is also the Director of the ACE-ESD will be present throughout the planning process, including the validation meetings.

2.2 Students numbers:

Intake per year into Level 7: 8 students/specialization
Eventual population, all years: 30 students

2.3 Adequacy of Infrastructure

The programme will be resourced from the existing resources of the College of Science and Technology Campuses. The classrooms and computer laboratories are adequate for the program. A special state of the renewable energy laboratory has been set up by the ACE-ESD with World Bank funds to further enhance infrastructure.

Apart from the standard labs Research, students will be supported with special needs to attend international laboratory in collaboration with our partners.
One large equipped PhD student resident room is available with separate desk for each student, a coffee room is available for research students and students working on campus have access to 24-hour access workspace, and ICT facilities. University/College library facilities with access online resources available. The centre has opened or subscribed to journal resources related to Energy area.

2.4 Adequacy of Staff Resource

Here the numbers and level of staff working on the programme in each year are given with the objective to show how the staff resource is adequate in terms of numbers and seniority as well as to cost the programme in financial terms. The staff figures given in the table are full time equivalents.

Year	2017/18	2018/19	2019/20	2020/21	SOURCE OF FUNDS
Academic Staffing					
Full professors	0	1	1	2	UR/ACE-ESD
Associate professors	1	2	3	4	UR/ACE-ESD
Senior lecturers	2	4	5	6	UR/ACE-ESD
Lecturers	3	4	5	6	UR/ACE-ESD
Support Staff	4	4	6	8	UR/ACE-ESD
Technical & Other Staff	2	2	2	2	UR/ACE-ESD

2.5 General accommodation requirements

The figure in this section serves to give an idea on the number and size of rooms that is needed by the programme.

- One classrooms and computer laboratories for at least 30 students are available.
- One Advanced Photovoltaics System (PV) with one phase synchronization, one Small wind power plant System (off-grid) with battery storage and single-phase sinus-converter 230V, one Industrial Photovoltaics with three phase synchronization, one Wind power plant with DFIG and three phase synchronization, one Micro-grid stand-alone with synchronization, one Smart Grid Distribution, one Energy Management lab**,** one Mini Hydro Power, one High voltage transformers lab, one High voltage transmission line Three phase and DC with line protection lab, one Power electronics for renewable energies lab,
- Students will, however, be encouraged to bring their own devices, thus enabling them to access online materials and lectures.

3. PROGRAMME AIMS AND RATIONALE

This program specification has been produced to conform to the Rwandan National Qualifications Framework for Higher Education Institutions. The objective of the program is to prepare students well for leading careers in research and development both in industry and academia.

3.1 Programme Rationale

In order to achieve the National goals vision of the country, University of Rwanda College of Science and Technology (UR-CST) is mandated to achieve Leaning excellence in STI capacity. In line with the above Africa Center of Excellence in Energy for Sustainable Development (ACE-ESD) by the World Bank's ACE II project is mandated to train high-level professionals and academics in the field of Energy for sustainable development both engineers and policy markers through Master's and PhD programmes. Renewable Energy is technical/policy programme that is required for developing innovative energy/policy services, solutions and research outputs. Therefore, ACE-ESD has is offering this PhD programme by Research related to Renewable Energy. We encourage a vibrant, collaborative and interdisciplinary research culture within the Center, based around strategic areas of expertise. Our regional and international community of researchers has an excellent record of research promoting collaboration and impact.

3.2 Research Areas

The research focus of the students could be related to one of these sub-fields but not limited to Smart & Micro-grid Technologies (Wind, Solar, Mini-Hydro, Biomass, Geothermal); Battery management systems (BMS): This involves the renewable energy control, embedded system and power electronics skills; Energy storage system (ESS: This involves the renewable energy control, embedded system and power electronics skills; Renewable energy (bioenergy including bio-fuels, solar energy, wind energy, etc.): Energy impact on the environment; Energy for socio-economic development; Energy system planning and modeling; Energy infrastructure optimization; Energy efficiency and demand side management; Alternative energy.

The ACE-ESD has budgeted for about 2 million USD to set up world-class high tech laboratories for Energy Research. ACE-ESD graduates are expected to work towards the development of new innovative approaches and solutions with relevance to the (East and South Africa) ESA priority domains related to energy engineering/ technology and policy solutions.

3. 3 Educational Aims

PhD degrees by Research are different from taught degrees because the programme is an independent research project, rather than a programme of assessed coursework. The

programme is aimed at candidates who want to qualify for research and scientific work at a high international level. The programme enables the graduates to pursue a research career in academia as well as in industry linked to the application related to renewable energy.
The programme has the following educational aims:

3.3. 1 Making an original contribution

The essential requirement of a PhD is the creation of new knowledge. The research work has to inevitably build on the work and ideas of others, but as a research student they are expected to make an original contribution (novelty though it can be an applied research) to knowledge related to renewable energy discipline by choosing a problem of development priority and find a solution to it by means of developing new ideas through the creation of new knowledge.

3.3.1 Leading a research

The students will lead the research project, but they will also have support from a Supervisory Team (ST) who are there to provide guidance and read and comment on draft work - but the ultimate responsibility for planning and managing the research will rest with the research students.

In general all research students will be able to,

1. Identify new problems arising from recent developments in and related to the renewable energy domain the ability to assess the likely impact of such developments on society.
2. Conduct ethically and scientifically sound research in renewable energy, within the bounds of the law and given due consideration of ethical and moral constraints
3. Successfully conduct and manage research undertakings, which may include aspects not only from renewable energy domain but also from other domains within the discipline of energy materials science, energy environmental.
4. Capability to apply current abstract research and methods within the chosen research domain to specific problems in creative and innovative ways.
5. Critically apply theories, methodologies, and knowledge to address fundamental questions in their primary area of study. (Research, Critical Thinking, Content Knowledge)
6. Ability to organize and participate in research and development through established national and regional research frameworks.

4. PROGRAMME LEARNING OUTCOMES

Graduates from this PhD programme by research will be able to:

A. Knowledge and Understanding

At the end of the research students should possess skills to
A1. Critically examine the background literature relevant to the renewable energy field;
A2. Develop skills in making and testing hypotheses, in developing new theories, and in planning and conducting experiments in renewable energy field;

A3. Develop or design renewable energy solutions to remote areas;
A4. Formulate Mathematical methods connected to renewable energy and their impact on the theory of algorithms.

B. Cognitive/ Intellectual Skills/ Application of Knowledge

At the end of the programme students should be able to:
B1. Engineer in renewable energy systems by applying state-of-the-art of energy technologies and validation techniques in conjunction with simulation and experimental methodology;
B2. Review research work within renewable energy domain, relate it to the forefront of knowledge, and assess its applicability for energy solutions;
B3. Perform research that challenges established concepts, theory, methods and technology within the renewable energy systems field;
B4. Handle Relevant ethical issues pertinent to renewable energy systems research and its application on off-grid solutions.

C. Communication/ICT/Numeracy/Analytic Techniques/Practical Skills

At the end of the programme students should be able to:
C1. Develop practical research skills and learn new state of the art techniques used in renewable energy research;
C2. Carry out research work of high international standards that advances the forefront of knowledge and application related to renewable energy within area of off-grid solutions techniques;
C3. Identify and assess the need for innovation, and initiate and contribute to innovative energy projects that involve micro-grid in the society;
C4. Critically analyze complex system like micro-grid or smart grid technologies and give a specific problem based solutions;
C5. Use software development environment to simulate energy systems solutions.

D. General transferable skills

At the end of the programme students should be able to:
D1. Disseminate and publish research results through recognized channels, including scientific workshops, conferences, and journals within renewable energy field.
D2. Participate in research discussions and research collaboration internationally on scientific topics within the renewable energy field of specialization.
D3. Efficiently disseminate scientific research findings within the community and outside, to the research sphere for inter-disciplinary cooperation for increased visibility;
D4. Communicate scientific research outputs among the relevant stakeholders and energy research community;
D5. Contribute to the development of scientific knowledge, scientific methods, and energy based technologies and their application in society;

5. PROGRAMME STRUCTURE

5.1 DURATION

i. The duration of the programme and the time for submission of thesis are counted from the date of provisional registration.
ii. The duration of the Program is minimum 3 to 4 years maximum, Full Time.
iii. The duration of the Program is 6 years, Part Time

The students have to use form (ACEForm-SLF) to apply for leave and the form (ACEForm-ALRF) to report back after leave.

5.2 ENTRY REQUIREMENTS

Applicants must have a Master of Science (or equivalent) degree in field related to energy, electrical engineering, mechanical, electrical and electronics engineering, physics and material sciences. The applicant must demonstrate the ability to think and work independently and in a team environment.

5.3 APPLICATION REQUIREMENTS

Prospective student who wish to do their PhD by research in ACE-ESD need to send the following documents when apply for admission:

- A cover letter indicating for which program of study the application is being made and description of the motivation to join the program
- A curriculum vitae (CV)
- Notarized Master's and Bachelor's degrees and transcripts
- Recommendation letters from at least two academic referees who are knowledgeable about the applicant.
- Support letter from employer (if any).
- Copies of valid identification card and/or passport.
- Sponsorship letter from an organization (if any).
- Applicants from countries where English is not the medium of instruction must provide an English proficiency proof from a relevant and accredited body or institution in their respective countries.
- Research Concept Note relevant to the PhD degree sought.
- Master's Thesis abstract

5.4 ADMISSION PROCEDURE

Implicit in the admission process is the following: on the applicant's part, that there has been an indication of at least a general area of interest and, preferably, provision of some form of proposal, particularly if the program is at the doctoral level; on the ACE-ESD's part, that the application has been reviewed, the area of interest examined, academic expectations and

potential performance considered, and that the ACE-ESD accepts its obligation to provide appropriate supervision for the applicant in the specified subject area.

i. ACE-ESD will send the applications received for appropriate academic judgment to the Expert Committee set up by the ACE-ESD Director. The Expert Committee shall screen the applications and shortlist the candidates based on their proposal leading to a scholarly research and the academic record.
ii. ACE-ESD Director shall forward the list of shortlisted candidates to experts from at least two Partner Institutions for a blind evaluation and ranking.
iii. The prescribed number of candidates to be admitted by the ACE-ESD shall be selected based on the ranking.
iv. ACE-ESD Director shall forward the list of selected candidates along with their allocated Supervisory Team (ST) to the Director UR- Post Graduate Studies (PGS) upon approval by the College Academic Council.
v. The Director UR-PGS shall provide admission to the candidates whose registration has been approved by the CAC in to the Ph.D. Programme with intimation to Head PhD Studies of ACE-ESD, the Supervisory Team (ST) and the candidate.
vi. The admitted candidates should register with the University following the normal procedure. The Form-RDARG should be used for Registration.
vii. On receipt of the registration of the candidates, the *ACE-ESD Expert Team* (Director, Head PhD/Research Studies) along with the main Supervisor shall recommend a panel of Five names for forming the Doctoral Committee (DC) for their respective students and forward the same to the Principal for approval and giving appointment letters.
viii. The date of registration shall be considered as the start date of the PhD study programme of that candidate.

5.5 PROGRAMME DESCRIPTION

As per the UR-CST academic regulations, a doctoral degree by research is awarded only after the student has successfully completed a study programme of 360 credits of which come from the doctoral research thesis and has presented and defended a thesis in oral examination to the satisfaction of the examiners in accordance with the regulations for the award of Doctorate Degree. But, the PhD students have to take some postgraduate modules related to their proposal if needed after consultation with main supervisor or co-supervisor. They should successfully complete a Research Methodology Course.

These modules are non-credited and shall be assessed on a PASS/FAIL basis. The students register for the course and are done under the guidance of the Resident Co-Supervisor.

These modules are related to the research project of the student and taught in the MSc in Renewable Energy and are recommended by Doctoral committee (DC).

S.No.	Category	Index	Section	Year 1		Year 2		Year 3		Year 4	
			Admission Confirmation onwards	*Semester-1*	*Semester-2*	*Semester-3*	*Semester-4*	*Semester-5*	*Semester-6*	*Semester-7*	*Semester-8*
1	**Preliminary Activities**	**1.1**	Induction week	First week							
		1.2	Initial Proposal presentation & Allocation of Core Graduate modules by **Doctoral Committee**	Third week							
2	**Research Progress Related Activities**	**2.1**	Core Disciplinary Graduate Module completion -(2)		1 core	1 core					
		2.2	Minor Generic Skills Module - compulsory (2)		1 generic	1 generic					
		2.3	Literature review & Data Collection for PhD Thesis								
		2.4	Comprehensive Exam by **Doctoral Committee** on Extensive Research Proposal & Research Progress at the 4th Semester beginning (REQUIRE a PASS for Doctoral Candidature)				Comprehensive Exam				
		2.5	Continue with PhD Research work								
		2.6	Semester Wise Progress Report Submission (8)- submitted during first week of June and December every year.	1	1	1	1	1	1	1	
		2.7	Presentation of Synopsis at **Doctoral Committee** (during the last three months of 7th semester). APPROVAL GIVEN FOR THESIS WRITING.							PhD Synopsis presentation	
		2.8	Submission of Thesis and Final Viva Voce defense								Final Thesis Defense
3	**Other Mandatory Activities**	**3.1**	Seminar Presentation at Center/School Level (2)			1 seminar		1 seminar			
		3.2	Workshop attendance (2)					1	1		
		3.3	Conference Paper Publications (1)				MAX time limit				
		3.4	Journal Publications (2)							MAX time limit	
		3.5	Industrial Attachment (3 to 4 months) (1)								
		3.6	UR Research and Innovation week attendance (4)		1 week		1 week		1 week		1 week
		3.7	Graduation								1 DAY

PhD maximum Timeline given in Table 1

6. ACDEMIC STAFF (Supervisors and Co-Supervisors)

Sl. No	Name of the Staff/Expert (existing, visiting, new, industry etc.)	Area of Research
	Staff from UR-CST	
1	Prof. Ntagwirumugara Etienne	Electrical Engineering, Energy Policy, Electronics & Telecom
2	Prof. Ijumba Nelson	Electrical Engineering
3	Dr. Ignace Gatare	Electrical Engineering &Telecom
4	Dr. Ernest Mazimpaka	Renewable Energy
5	Dr. Anastase Rwigema	Renewable Energy
6	Dr. Denis Ndanguza	Mathematics
7	Dr. Philibert Nsengiyumva	Control Systems
8	Prof. Bonfis Safari	Physics
9	Dr. Hakizimana Jean	Energy& Economics
10	Dr. Kayibanda Venant	Mechanical
11	Dr. Kabiri Charles	Wireless Telecommunication
Expert Staff from Partners and Volunteers		
12	Prof. Albert Banal, City University (London)	Economic Regulation & Competition
13	Prof. Bruce Krogh (Carnegie Mellon, Rwanda)	Electrical & Computer Engineering
14	Prof. Jonathan Colton, Georgia Tech-USA	Mechanical Engineering
15	Prof. Daniel Ayuk, (Johannes –Austria)	Organic Semi Conducting/Hybrid materials
16	Dr William Gboney, (Ghana)	Economics regulation & competition, Energy
17	Dr. Philippe Goffin (Zurich)	Energy& Building Systems
18	Dr. Jaesung Jung (Korea)	Electrical Engineering
19	Prof. Josiah Munda (South Africa)	Electrical Engineering
20	Dr. Akshay Kumar Saha (South Africa)	Electrical Engineering
21	Dr. Lawrence KIPRONO (Kenya)	Electrical Engineering
22	Prof. Andrea Micangeli (SAPIENZA-Italy)	Renewable Energy
23	Prof. Ignacio Perez (MIT-USA)	Electrical Engineering & Policy
24	Dr. Sameer Hameer (Ethiopia)	Electrical Engineering
25	Dr. Diego Sandoval (Zurich)	Electrical Storage
26	Dr. Andrew Swanson (South Africa)	Electrical Engineering
27	Prof. Valerie Thomas (Georgia Tech-USA)	High Energy Physics
28	Prof. Yanmin Wang (China)	Materials Science & Engineering
29	Dr. Wen, Ya, (China)	Economic & Technology
30	Dan Zimmerle, CSU-USA	Electrical Engineering

7. SUPERVISORY TEAM (ST)

All PhD candidates are required to work under the guidance of the Supervisory Team (ST) comprising not more than three staff.

7.1 Supervisory Team (ST) Profile

i. The ST will have one Main Supervisor and two Co-supervisors of which one shall be a Resident staff of the University. The Main Supervisor is the Chair of the ST.
ii. Main Supervisors and Co-Supervisors are any competent staff from the Host University of ACE-ESD or from any Partner Institutions of ACE-ESD or Research Associates of the ACE-ESD.
iii. Where external supervisors are appointed, it is the responsibility of the Head of PhD Studies of ACE-ESD to ensure that the external supervisors are familiar with the University and programme regulations and expectations for thesis supervision. An information package for supervision at UR will be sent to these supervisors by the Head of PhD studies of ACE-ESD.
iv. Normally, an external supervisor can be allowed as the Main Supervisor for a maximum of two ACE-ESD students and can be Co-Supervisors for any other two students.
v. The Main Supervisors are required to have appropriate qualifications in the relevant field or discipline, have undertaken supervision training, have demonstrated expertise in the field of energy or electrical engineering in which the student research is located and shall be active researchers.
vi. The Main Supervisor is expected to have publications in the relevant areas of research within the past three years to his/her role as Main Supervisor.

7.2 Roles & Responsibilities of the ST

i. The ST Chair (Main supervisor) along with the ST shall within two weeks of Student registration have the responsibility of orienting the students and helping the students to revise their initial proposal topic during application into a viable revised research proposal, focusing on solving the development priorities of the Eastern and Southern Africa Region, through the application of energy technologies.
ii. The ST, in consultation with the candidate, shall determine the student's '*Student Learning Plan'*, agree to changes as required, to meet the targets based on the PhD Timeline given in Table 1.
iii. The Main Supervisor shall develop a '*Supervision Plan'* in discussion with the PhD candidate and ST within six weeks of his appointment and sends a copy to the Head of PhD studies of ACE-ESD. This plan shall provide for regular consultations between the Main Supervisor, ST and the candidate, as well as a written report thereof.
iv. Both the *Student Learning Plan* and *Supervision Plan* are filed in the student Folder for any reference during the course of the study.
v. The ST shall meet with the students on a regular basis (e.g. every 2 weeks) to discuss the doctoral programme and review progress. Any member of the ST can

e-meet the students through 'appear.in' or 'Skype' or any other form of video chats.

vi. The ST team can establish other regular consultation approaches through Telegram or any other group chats.

vii. The Main Supervisor/ST shall guide the student in the preparation of the 'Full Research proposal' and comprehensive oral examination.

viii. Main Supervisor/ST shall lead the students to the successful completion of a doctoral level Research Thesis by Publications;

ix. The Co-supervisors assist the Main Supervisor in guiding the PhD candidates.

x. The Main Supervisor and the Co-supervisors shall agree on how the Co-supervisors will be involved in the regular consultations between the Main Supervisor and the PhD candidates.

xi. The Co-supervisor who is a resident staff of the University shall be responsible for monitoring the progress of the candidate and shall act as the Mentor to the student and local coordinator of the ST and the candidate. The Expert Team of ACE-ESD nominates the resident Co-supervisor.

xii. Mentors are expected to provide opportunities for reflection and open communication regarding supervision issues and shall observe part of the supervision process in order to give feedback to the Main Supervisor.

xiii. A supervisory mentor can report on difficulties that arise for either the student or supervisor/s at any time during and supervisory process. This can be to the Director of ACE-ESD or College Director RIPGS.

xiv. The supervisory mentor can initiate discussion of any other issues that may arise during supervision, which may require expert guidance.

Students can assume that:

- They will receive regular supervision by a supervisory team with the requisite knowledge and expertise in their chosen field of study;
- Supervisors will provide regular and timely comment on any work submitted during the course of the doctoral programme;
- They will have access to resources commensurate with the research project being undertaken.

Supervisors shall assume that:

- The students will meet with them on a regular basis;
- Students will draw on their supervisors' expertise and advice as appropriate;
- The students will provide supervisors with copies of papers/drafts/reports for comment during the course of the doctoral programme;
- They will be supported by the ACE-ESD in the course of discharging their responsibilities as supervisors of doctoral students.

More information regarding Supervisor's Code of Conduct and ToR can be accessed from:
http://www.research.ur.ac.rw/sites/default/files/Supervisor%20Code%20of%20Conduct.docx#overlay-context=node/53%3Fq%3Dnode/53 and

http://www.research.ur.ac.rw/sites/default/files/Supervisor%20TOR.docx#overlay-context=node/53%3Fq%3Dnode/53 respectively.

8. DOCTORAL COMMITTEE (DC)

The following members shall constitute the Doctoral Committee as nominated by the Expert Team of ACE-ESD and approved by the College Academic Council on the advice of College Director RIPGS.
The DC shall comprise of the following members:

1. Main Supervisor,
2. Internal/External Expert from Academic Institutions,
3. External expert from Academic/Industry/ Research Institutions
4. Resident Co-Supervisor (Convenor)
5. Director of ACE-ESD / Head of PhD Studies of ACE-ESD.

The External Expert may be within the student's research area and is approved by CAC on the recommendation of the College Director RIPGS based on the basis of qualifications, as evidenced by his/her credentials, and his/her relevance to the student's major field.

The Doctoral committee meets three times during a student's PhD Study period until the student submits the synopsis of his/her thesis.

8.1 Initial PhD Proposal presentation

The students present their revised PhD proposal to the DC during the third week of their registration in to the Programme. The checklist in Proposal submission Form ACEForm-PSF should be completed for the submission of the Proposal. The Students also complete the Key Skills Questionnaire (Form RDSAQ) to Self-assess research competencies (knowledge, skills, and values/attitudes). The DC allocates the *Core disciplinary Graduate* modules related to the Research and the Students' self-assessment and give suggestions to improve on the Proposal. The relevance of the *minor Generic Skills* modules may vary based on the student's experimental learning, disciplinary and professional development needs and therefore, students are allowed to do the selection in discussion with their supervisors.

Meeting Schedule: *During the third week of Semester 1 of the PhD student.*

Note: A Semester is half-year term in which an academic year is divided in to a period of six months.

8.2 Comprehensive Examination for Doctoral Candidature

In order to confirm the Doctoral Candidature the students have to appear for a comprehensive oral examination conducted by the DC and present their *Extensive Research Proposal* and research progress. The comprehensive exam tests the fitness of the candidate to proceed further with his/her PhD work. If the performance of the candidate in the comprehensive examination is satisfactory, his/her registration shall be

confirmed with Doctoral Candidature. If the performance is unsatisfactory, he/she shall be given one more opportunity to appear for the examination within six months of the first examination. In case, the research student fails to successfully complete the comprehensive examination within the prescribed time limit, the University shall withdraw his/her registration.

Meeting Schedule: *First week of the fourth semester of the PhD student*

i. A PhD student shall take a comprehensive examination after the completion of two semesters of his/her research programme but before the completion of four semesters.
ii. The comprehensive examination is mandatory and is to test his / her background knowledge in the broad area of specialization.
iii. The comprehensive examination shall be in the oral form.
iv. The comprehensive examination will cover the topics of the research focus and all the allied areas. Candidates will be assessed based on their ability to:
    - Identify the core issue/s or problem/s within the case.
    - Seek appropriate and sufficient information to understand the issue/problem.
    - Observe interactions that may complicate the management of the issue/problem.
    - Present a quality, focused review outlining the case, which is articulated clearly.
    - Identify significant solutions/outcomes giving benefits and complications.
    - Understand diverse points of view other than own.
    - Offer alternative suggestions and the basis for alternatives.
    - Present views ethically and with cultural and social sensitivity.
    - Show professionalism and maturity when personal views are challenged.
v. Comprehensive examination shall be conducted by a panel of examiners, which consists of the members of the Doctoral Committee along with one external examiner as recommended by the ACE-ESD Expert Team and approved by the College Director RIPGS.
vi. The Main Supervisor shall intimate the PhD student sufficiently in advance, the scope of the examination and other relevant details.
vii. The presentation should be between 40-60 minutes.
viii. The students shall receive comments, feedback to improve on their Research from the DC.
ix. The report and recommendations from the DC would be sent to the Director RIPGS signed by the DC members (ACEForm-CDC). The recommendations of DC can be:
    A. Confirm Doctoral Candidature or;
    B. Conditional Doctoral Candidature –reappear for comprehensive exam within an agreed period of time or;
    C. Termination of Candidature.
x. Students are notified by the College Director RIPGS of the outcome. Normally, a student will not be able to reappear to the comprehensive exam more than twice.

9. PhD Synopsis presentation

Upon satisfactory completion of the research and publication of at least three research papers (not less than two of which shall be in SCI refereed journals, others can be in Scopus indexed conference proceedings, the research scholar is permitted to submit the synopsis of the PhD work to the Head PhD Studies of ACE-ESD with the approval of the College Director RIPGS for presentation to the Doctoral Committee (ACEForm-SSF). The Synopsis shall be submitted not later than a month before the DC meeting is scheduled.

Meeting Schedule: *During last three months of 7th semester of the PhD scholar*

i. Prior to submission of the synopsis, the research scholar shall get feedback and comments from the ST, which may be suitably incorporated into the synopsis and thesis under the advice of the Main Supervisor.
ii. The DC assesses whether the research work reported in the synopsis of the student has met all the requirements as per the PhD regulations for writing a thesis, and is ready to start the preparation of the thesis. After the approval of the Synopsis, by the DC the students can then proceed with the writing of the thesis.

10. RESEARCH SUPPORT

UR has introduced the system of Researcher Accounts whereby recipients of Research grants will be required to open such an account. It avoids putting funds into University accounts, for which Researchers have no control of, and from which withdrawal involves a lot of bureaucratic procedures. Additionally, in its Research Strategy, UR has approved an incentive scheme to motivate staff to do more research. All academic/research staff will be required to open a Research Account into which the incentives money can be paid.

11. MONITORING THE PROGRESSION THROUGH THE DEGREE

1. *Registration of the Candidate:* Once the candidate satisfies the admission criteria he/she is allowed to register (Form-RDARG). CAC approves the Supervisory Team (ST) for the candidate and the UR Director of PGS appoints the ST for the candidate. The Doctoral Committee (DC) for the student based on the recommendation of the ACE-ESD Expert Team is appointed by the Principal.

2. *Initial Proposal Presentation:* Once the candidate registers, s/he appears before the Doctoral Committee during the third week for the Initial Research Proposal Presentation. The student fills in the Self Assessment Questionnaire (Form RDSAQ). The Doctoral Committee allocates the *Core disciplinary Graduate* modules related to the Research, Self-assessment and give suggestions to improve on the Proposal. The relevance of the *minor Generic Skills* modules may vary based on the student's

experimental learning, disciplinary and professional development needs and therefore, students are allowed to do the selection in discussion with their supervisors.

3. *Course Work: Core disciplinary* PG *Graduate* modules *(if needed after consultation with main supervisor)* and *Research Methodology* modules will be recorded in the *Student Learning Plan* and they are required to complete the module, including all elements of assessment and examination based on the timeline. The modules will be assessed on a PASS/FAIL basis and are not credit bearing.

4. *Ethical Approval:* Students may begin their ethics applications (Form RETHC) at any time but normally shall not collect data until their ethics application has been approved. It is incumbent on the student and supervisors to ensure that any requirements for ethical approval are met prior to the commencement of the data gathering, if applicable.

5. *Comprehensive examination:* The confirmation of Doctoral Candidature normally occurs not later than four semesters after commencement in to the doctoral programme. In order to appear for the comprehensive examination, the students should have passed the *core disciplinary graduate* modules. The Main Supervisor guides the student in the preparation of the *Extensive Research Proposal* and oral comprehensive examination. Once the student passes this examination the student is admitted to candidacy and allowed to progress with their research work.
   The *Extensive Research Proposal* includes the following content:
   - A summary of the research proposal;
   - Proposed thesis title;
   - Clearly stated research problem aligned with the developmental priority(s)
   - Rationale and significance of the research;
   - Research aim and objectives;
   - Literature and/or past research review
   - An outline of the research design;
   - Ethical approval (if required);
   - A planned budget for your research and how this will be funded;
   - An indication of where the research will be conducted;
   - Progress and activity to date;
   - A timetable for completion within the prescribed time limit;
   - Publications and Presentations if any to date;
   - References.

6. *Progress Reports:* Progress reports are vital to the Center's overall monitoring of both individual progress and programme issues. Form RDPRS could be adopted for reporting.
   i. All research students are required to supply six monthly reports, which reflect the progress of their work. These should also identify any issues that have arisen and how they are going to be resolved. The timeline table, above, indicates when progress reports for doctoral students are to be submitted to ACE-ESD Head of PhD Studies.

ii. Once a student has completed their section of the report, the supervisor(s) will complete their section and provide comments on the progress. If there are issues around progress, the supervisor should be explicit in any misgivings they have regarding a student's progress. Comments must be discussed with the student and a copy made available for them.
iii. Supervisor(s) are also required to indicate any remedial action to be taken and to implement them to assist the students.
iv. The signed reports are filed by the Head of PhD Studies of ACE-ESD.
v. It is important to note that progress reports should not be the first point at which a supervisor and student identify there is a problem. Issues are expected to be discussed regularly as part of the supervision relationship. If problems do arise, both parties are expected to take active steps to rectify them within the ST and the student the first instance. Failure to do so could be disadvantageous to both students and staff.
vi. Students may seek advice in confidence from the Director ACE-ESD on any aspect of their candidature, including problems. Advice can also be sought from the Director UR-PGS.
vii. If the student progression is not satisfactory, the Main Supervisor shall initiate formal warnings of unsatisfactory progress with a copy to Head PhD Studies and the Director UR-PGS, which will notify the student in writing that their unsatisfactory progress in the programme. The notification shall specify the reasons why the progress is deemed to be unsatisfactory; provide a list of conditions that must be met for improvement. The student shall be given an appropriate timeframe to respond to the notification.
viii. If the student fails to respond within the specified period, the Main Supervisor shall advise the Head of PhD Studies and Director UR-PGS and recommend that the registration of the student be withdrawn.

7. *Publications and Authorship:* Doctoral students are required to publish and disseminate research findings. A Doctoral thesis shall comprise of at least three published papers out of which two articles published in a Scopus indexed peer reviewed journals like Thomson Reuters, Elsevier etc. The time limits for publications are given in the Table 1.

i. Consensus should be reached between the student and research supervisor(s) concerning authorship of publications and acknowledgement of contributions during and after candidature. There should be open and mutual recognition of the student's and supervisors' work arising from the research.
ii. Supervisors also gain/benefit from postgraduate students' work. Where a supervisor draws on and wishes to build on a student-initiated subject, the supervisor must advise the student (and co-supervisors) and through consultation negotiate a fair and equitable arrangement with the student and co-supervisor.
iii. The thesis and the IP out of the research belong to the University;
iv. The supervisor in publications relevant to the research undertaken by the doctoral student, must acknowledge the contribution of the student and

provide them with the opportunity of joint publications and other research outputs.

v. ACE-ESD recommends the following principles as key in determining authorship attribution:
   - Early discussion and agreement on authorship responsibilities and order;
   - Inclusion of all in the ST if fair contribution is done;
   - Exclusion of unacceptable claims to authorship;
   - Adequate acknowledgement of other contributions;
   - Inclusion of web-based publications.

8. PhD Synopsis Submission and Presentation: The Students shall complete one in a Scopus indexed publication in conference proceedings and two in SCI journals, to submit the synopsis of the PhD work –refer checklist (ACEForm-SSC). The Synopsis has to be submitted not later than a month before the DC meeting is scheduled. Prior to submission of the synopsis, the research scholar shall get feedback and comments from the ST, which may be suitably incorporated into the synopsis and thesis under the advice of the Main supervisor. The DC assesses the Synopsis and if satisfied approval to proceed with the Thesis writing will be given.

Format of the Synopsis:
The synopsis is to be considered as a detailed summary of the work with important results highlighting the original contributions in the thesis to be submitted. It should give an outline of the thesis. The review of earlier work (literature review) is to be minimized with just enough to highlight the contributions in the research work to be reported in the thesis. It is expected that at the time of submission of the synopsis no work is yet to be completed except writing the thesis and all other academic requirements such as course work, comprehensive examinations and the suggestions and directions given by members of the Doctoral Committee have been fulfilled. The Synopsis shall not exceed 40 pages. Refer to the ACE-SPM manual, which is providing guidelines in the preparation of the synopsis.

9. Seminar Presentation: The students have to present two seminars about their research work to the Master's students of IoT and Fourth year Computer Engineering/Electronics and Communication Engineering degree students.

10. Workshop Attendance: The students have to attend any two workshops organised by the ACEIoT or any other Institutions related to their core research or any other generic skills of their interest.

11. Industrial attachment: All students should compulsorily take a 2-4 months of Industrial attachment related to their Research work after confirmation of their Doctoral Candidature.

12. UR Research and Innovation week attendance: The students are encouraged to present their research work at the University Research Conferences

13. Submission of the Thesis

The research scholar shall, within six months of approval of the synopsis, prepare thesis in accordance with the format and specifications prescribed in accordance with the requirements of the University regulations.

i. The PhD candidate shall submit the thesis to the Main Supervisor, either as a whole or in sections as agreed, and the Main Supervisor shall make recommendations for its improvement and/or further research or reading that might be undertaken.
ii. All members of the ST shall read the last draft of the thesis, make suggestions for final amendment and if they are satisfied, sign that they have seen it and consider that it is fit to be submitted.
iii. The Co-supervisors shall submit a summarised assessment of the draft thesis o the Main Supervisor in writing.
iv. The PhD candidate shall attend to all the comments to the draft thesis and resubmit it to the Main Supervisor for approval.
v. After approval of the Thesis by the Main Supervisor, the students submit it to the Director UR-PGS. Use the form RDTSD_Thesis_Submission.
vi. At least one of the supervisors will be required to attend the oral examination, providing points of clarification when necessary

14. Examination for PhD by Research

The examination for the Doctoral Degree by Research shall have two stages: Firstly the submission and external expert assessment of the thesis by examiners, and Secondly its defence by oral or approved alternative examination.

(i) Thesis Submission and external expert assessment: The Doctoral thesis shall be examined by 3 examiners external to the institution, at least one of whom shall be from outside the country. The examiners shall submit their reports to the Director of Director UR-PGS, who shall prepare a recommendation as per External Experts' comments to College Academic Council.

(ii) Oral examination of the Thesis: The candidate must present and defend the Dissertation or Thesis to the satisfaction of examiners in an oral examination, the conduct of which shall be in accordance with the regulations for the award of Doctoral degree by Research.

More details are found at
<http://www.research.ur.ac.rw/sites/default/files/PhD_Procedures_Summary.docx#overlay-context=node/53%3Fq%3Dnode/53>

12. GRADUATION

If the performance of the research scholar in the Oral examination is satisfactory and recommendations of the examiners attended to satisfactorily, s/he shall be deemed to have completed the PhD. The degree shall be awarded on the recommendation of the College Academic Council and approval by Senate. The Student shall have the degree conferred at a UR Graduation Ceremony.

13. POST GRADUATE FORMS THAT WILL BE USED

Sl. No	PURPOSE OF THE FORM	FILE CODE	Available at
1	Application for Registration for Research Higher Degrees	RDARG	http://www.research.ur.ac.rw/sites/default/files/RDARG_Application_for_Registration.docx#overlay-context=node/53%3Fq%3Dnode/53
2	Proposal Submission Form	ACEForm-PSF	http://www.aceesd.ur.ac.rw/?q=content/phd-studies/PSFForm1
3	Key Skills Questionnaire-Self Assessment	RDSAQ	http://www.research.ur.ac.rw/sites/default/files/RDSAQ_KeySkills_Questionnaire.docx#overlay-context=node/53%3Fq%3Dnode/53%3Fq%3Dnode/53
4	Half-Early Student Progress Report	RDPRS	http://www.research.ur.ac.rw/sites/default/files/RDPRS_Student_Progress_Report.docx#overlay-context=node/53%3Fq%3Dnode/53
5	Confirmation of Doctoral Candidature	ACEForm-CDC	http://www.aceesd.ur.ac.rw/?q=content/phd-studies/CDCForm2
6	Synopsis Submission Form	ACEForm-SSC	http://www.aceesd.ur.ac.rw/?q=content/phd-studies/SSCForm3
7	PhD Synopsis Preparation Manual	ACE-SPM	http://www.aceesd.ur.ac.rw/?q=content/phd-studies/SPM
8	Ethical Approval Form	RETHC	http://www.research.ur.ac.rw/sites/default/files/RETHC_Research_Ethical_Approval.docx#overlay-context=node/53%3Fq%3Dnode/53
9	Thesis Submission Form	RDTSD_Thesis_Submission	http://www.research.ur.ac.rw/sites/default/files/RDTSD_Thesis_submission.docx#overlay-context=node/53%3Fq%3Dnode/53
	Student Leave Form	ACEForm-SLF	http://www.aceesd.ur.ac.rw/?q=content/phd-studies/SLFForm4
	Student After Leave Reporting Form	ACEForm-ALRF	http://www.aceesd.ur.ac.rw/?q=content/phd-studies/ALRFForm5

Note: All these forms can be downloaded from the links provided.