MBARARA UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF COMPUTING AND INFORMATICS

DOCTOR OF PHILOSOPHY IN COMPUTING BY RESEARCH

(PhD Computing by Research)

THREE YEARS

CURRICULUM

May 2019

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Preamble

The PhD Computing by Research will enrich the researcher with fundamentals of theoretical Computer Science, software Engineering, Information Systems, Health information Technology, Computer Networks, Algorithms Design and Implementation. The programme will provide knowledge to both people in academic institutions and industrial sector who want to improve their research capabilities to solve real problems in academics, industries and communities. The PhD Computing is enriched with a variety of cross cutting and faculty specific courses that will be covered by students.

1 Introduction

1.1 Mbarara University of Science and Technology

Mbarara University of Science and Technology (MUST) is located within Mbarara Municipality 267 km along Kampala-Kabale highway, in Mbarara district Southwestern Uganda. Mbarara University of Science and Technology is accredited by the country's National Council for Higher Education (NCHE). Since the inception of Mbarara University of Science and Technology, a good level of infrastructural growth and program expansion has been registered. The university is currently running Certificate, Diploma, Undergraduate, Post Graduate Diploma, Masters and PhD by research programs.

The university vision is "To provide quality and relevant education at national and international level with particular emphasis on Science and Technology, and its application to community development".

Since its establishment in 1989, MUST has grown to a multi-disciplinary university with more than 500 academic/research staff and 3,000 students. At present, MUST has two major campuses; the town campus and the Kihumuro campus. There are six academic faculties namely Faculty of Medicine, Faculty of Science, Faculty of Computing and Informatics, Faculty of Applied Sciences and Technology, Faculty of Inter-disciplinary Training and Research, and the Faculty of Management Sciences

The University also has the following well-established satellite training centres:

1. The Institute of Tropical Forest Conservation (ITFC) in Bwindi Impenetrable National forest for educational purposes and research in areas of tropical forest conservation and herbal medicine under the Faculty of Science.
2. The Rugazi and Bughoye Teaching Health Centres under Faculty of Medicine which are community-based centre for training third and fourth year Medical students.

The University academic year consists of two semesters, each comprising of 17 weeks; the first from August to December and the second from January to May. Out of these 17 weeks, 15 weeks are usually for teaching and 2 weeks for examinations. The University has a recess term which commences in June till August to allow the students go for practical work, for example, the Faculty of Computing and Informatics Sciences students go to various firms and companies for industrial training during this period.

1.2 Faculty of Computing and Informatics (FCI)

FCI was first established in 1997 as a department of Computer Science under the Faculty of Science. It was later shifted to the Faculty of Development Studies to run courses in Computer Science to meet the increasing demand of ICT in the country. The Faculty started as a Department of Computer Science running a Bachelor of Computer Science Course. In September 2006, the Department of Computer Science was then elevated to the status of the Institute of Computer Science and in 2016 the Institute became a faculty of Computing and Informatics.

The Faculty aspires to be a great Computer Science and Information Technology centre recognized nationally and internationally for excellence in teaching and community outreach with multi-disciplinary dimensions and research. The Faculty now offers undergraduate degree programmes, Postgraduate Degree programmes and technical short courses to meet the demand for Computer and IT basic skills. The programs offered include:

1. Short Technical Courses: Certificate in Computer Applications (CCA), Cisco Certified Network Associate (CCNA), Cisco Certified Network Professional (CCNP), Cisco

Networking Academy Program (CNAP), Information Technology Essentials (ITE) I & II and International Computer Driving License (ICDL) Certification.

2. Undergraduate Degree Programmes: Bachelor of Computer Science (BCS), Bachelor of Information Technology (BIT). Bachelor of Science in Software Engineering (BSc. SE)
3. Postgraduate Degree Programmes: MSc. Information Systems, MSc. Health Informatics ,MSc. Business Informatics and PhD Computing by Research

1.2.1 Infrastructure at FCI

The Faculty of Computing and Informatics is currently located on the main campus. It has three computer laboratories, which include a Computer Science Lab, An information technology laboratory and a Multimedia Laboratory, Computer Engineering Lab and Software Incubation Laboratories. The Faculty has a Computing services Unit that provides all IT support and faster servers where PhD students can set and carry out their experiments. The Faculty has sufficient offices for staff and PhD students, lecture rooms, seminar rooms.

1.2.2 Research Area in the Faculty

Staff members in the faculty of computing and Informatics carry out research in the following areas/fields:

i. Software Engineering and Computer Systems Engineering
ii. Information Systems
iii. Health Information Technology
iv. Algorithmic Design and Modelling
v. Computer Security
vi. Distributed Systems
vii. Embedded Systems
viii. Computer, Network and Information Security for large distributed Systems
ix. Grid and Cloud Computing
x. High Performance Computing / parallel computing
xi. Distributed Pervasive Systems/ Ubiquitous Computing: Mobile computing, and Sensor Networks
xii. Artificial Intelligence
xiii. Data Science and Machine Learning
xiv. Computer Vision and Image processing
xv. Natural Language processing
xvi. Information and Communication Technologies for Development (ICT4D)

2 PhD in Computing by Research Programme

2.1 Programme Overview

In many ways, the PhD program is the cornerstone of Computing at Mbarara University of Science and Technology. Our PhD students serve some of the most central roles of our faculty from pursuing sponsored research together with supervising master's students as Research Assistants, to serving as Teaching Fellows in support of our undergraduate and graduate curriculum.

Pursuing the PhD degree in Computing enables you to become an expert in a technical subfield of Computing and advance the state of the art by contributing original research in that discipline. Most PhD students also gain practical experience in the classroom, as well as becoming a visible member of the research community, by publishing research and through oral presentations at conferences and research seminars.

Upon completing your PhD degree, you will be able to set your own research direction, teach and advise students, and work at the forefront of the cutting-edge research in academia or industry.

2.2 Programme Justification/ Rationale.

There is a need to train professionals who are experts in carrying out both basic and applied research in computing discipline. Applied research involves solving community based problems like in the education, health, Agriculture and industry sectors whereas basic research involves designing theories, algorithms, and concepts for advancing both current and future innovation technology in computing field e.g. Abstraction for data structures for handling big data, block chains, robotics, software architectures/ frameworks. There is also need to provide students with the research skills and techniques to advance computing as well as equip candidates with knowledge on the state of the art in their areas of research so as to ease the process of research.

At Mbarara University, the faculty of Computing, there is an upcoming culture of innovation that attracts learners from all corners of the world to solve real life community problems that can be

solved using ICT. Further, the rate of growth of Information and Communication Technology (ICT) in Uganda in particular and the African region in general is enormous. This has been witnessed by introduction of computing systems like e-passport, system at national registration center and system in all government ministry and private sectors. In order to sustain the high growth useful to the economy, there is need for highly skilled and specialized ICT labor force to cater for the sophisticated ICT-jobs and also carry out research. Due to the number of mushrooming private university in Uganda, there is a need to train more staff in these private universities such that they can provide quality education. The Faculty of Computing and Informatics has the capacity to carry out this training.

2.3 Learning Objectives

The objectives of the PhD in Computing by Research programme are to: -

1) Build human resource capacity in the area of Computing fields in both the public and private sectors, especially in universities; Address the increasing demand for PhD holders in the area of Computing fields; Strengthen capacity and institutional building in the area of computer science in tertiary institutions, private and public sectors.
2) Provide those masters holders with potential for PhD with opportunities to develop skills in formulating, conducting and presenting their own scholarly research through the production of a research-based dissertations and publications.
3) Foster initiative and potential for independent self-study that will develop the students' motivation and ability to continue updating their knowledge and skills after completion of the course of study in relation to scholarship and research.
4) Enable the students to be able to demonstrate a critical awareness and reflection on research-based information as a basis for problem solving and practice in professional contexts.
5) Enable students to be able to demonstrate ability to interpret and report research findings in areas relevant to their field of study.
6) Enable students to be able to demonstrate the ability to formulate research questions and problems, design and carry out their own small scale research projects and present their findings orally and in writing.

7) Equip students with research and publication skills to enable them publish research from high quality dissertations in reputable journals and/ or presentation of their research findings at academic conferences.

2.4 Learning Outcomes

1) Produce and defend original research in the field of Computing
2) Master broad knowledge of Computing, across theory, software, systems, and applications.
3) Demonstrate in-depth knowledge of a particular subject area within computing fields.
4) Actively participate in the Computing research community, for example by attending academic conferences and submitting research results for publication in professional conferences and journals.
5) Be able to effectively communicate the results of research.

2.5 Admission Requirements

To qualify for admission on the program, the candidate should have

i. A good Master's degree in Computing Fields or a closely related field
ii. Any Master's degree with evidence of acquisition of sufficient advanced knowledge in computering by virtue of research or work.
iii. PhD applicant must present research concept paper.

2.6 Programme Duration

PhD studies by research shall last for a minimum of three and maximum five years. A Doctoral student who cannot complete his/her studies within the prescribed time may apply for an initial extension of one academic year.

2.7 Regulations

The PhD by research in Computing will be governed by MUST post graduate rules found in the postgraduate Hand book. Studies and Examinations for the degree of will be governed by the general University regulations for postgraduate studies as well as by these regulations.

2.7 Grading System

Each course will be graded out of a maximum of 100 marks and assigned an appropriate letter grade and a grade point as shown in Table 1.

Marks	Letter Grade	Grade Point
80-100	A	5.0
75-79.9	B+	4.5
70-74.9	B	4.0
65-69.9	C+	3.5
60-64.9	C	3.0
55-59.9	D+	2.5
50-54.9	D	2.0
0-49.9	F	0

Table 1: Grading of courses showing marks and their corresponding grade points.

2.8 Minimum Pass Mark

A minimum pass mark for each course shall be 60%.

2.9 Calculation of Cumulative Grade Point Average (CGPA)

The Grade Point Average shall be achieved by weighting each course, i.e., multiplying the grade point of the course by the number of its credit unit's value. The total of the grade points shall be divided by the total credit unit value as shown:

$$CGPA = \frac{\sum_{i=1}^{n}(GP_i * CU_i)}{\sum_{i=1}^{n} CU_i}$$

Where:

- GP_i is the Grade Point score of a particular course

i; CU_i is the number of Credit Units of course i; and

n is the number of courses so far done.

2.8 Weighting and Semester Load

The weighting unit is a Credit Unit (CU). The credit unit is a contact hour per week per semester. A contact hour is equal to (i) one lecture hour (LH) (ii) two practical hours (PH) (iii) two tutorial hours (TH). The semester load is between 12 and 15 credit units. The minimum graduation load is 18 credit units done in the first year of the program

2.9 Assessment

Assessment will be in form of writing technical reports, writing short papers, reviewing literature, critiquing papers or any other approach a student can use to demonstrate in-depth understanding and synthesis of academic matter. The approach used will depend on the course unit being studied. Each course unit shall be assessed on the basis of pass or Fail and a certificate of attendance shall be awarded to the student.

2.10 Graduation Requirements

To qualify for the award of the degree of Doctor of Philosophy (Computing), a candidate is required to obtain a minimum of 30 credit units for all taught courses passed including all the compulsory courses, must have PhD thesis and must have published at least two peer-reviewed journal or conference papers.

3 Program structure

3.1 Studying Cross Cutting Courses

Although a good number of the PhD students come from academia, they still require value addition in form of gaining knowledge through proper guidance and teaching them. However, competencies are lacking in some units to impart knowledge and needed skills to the student to enable them formulate a research problem, write a proposal, implement it and later on publish. Therefore, identification and utilizing existing highly skilled staff from across the university including visiting professors to teach the cross-cutting courses will be quite valuable to the PhD students in their research processes.

The cross-cutting courses shall run on a modular basis with each course offered each year. Delivery of each course shall be in form of didactic lectures, with the major part devoted to practical/labs, tutorials and problem based seminars. The core courses are a requirement for all PhD students. The maximum semester load is 18 CU while the minimum program load is 30 CU. The program shall be run on a semester system and the structure is summarized below:

LH =Lecture hours, PH = Practical hours, TH = Tutorial

CH =Contact hours, CU= Credit units

YEAR ONE SEMESTER I – Core Courses

Code	**Course name**	**LH**	**PH**	**TH**	**CH**	**CU**
CSC 10101	Philosophy of Computing	40	10	-	45	3
CMH 10101	Advanced Research Methods	40	10	-	45	3
FIS 10101	Scholarly Writing and Communication Skills	40	10	-	45	3
CSC 10102	Logic and Computational Thinking	40	10	-	45	3
CSC 10103	Requirements Engineering and System Design	40	10	-	45	3

YEAR ONE SEMESTER II– Core Courses

Code	**Course name**	**LH**	**PH**	**TH**	**CH**	**CU**
CMH 10203	Research Ethics	40	10	-	45	3
CSC 10201	Computer application in research	40	10	-	45	3
EDU 10202	Institutional Pedagogy	40	10	-	45	3
CSC 10202	Informatics	40	10	-	45	3
CSC 10203	Cloud Computing	40	10	-	45	3

YEAR TWO SEMESTER I &II

Code	**Course name**	**CU**
CSC 11101	PhD Research Proposal	60

YEAR THREE SEMESTER I

Code	**Course name**	**CU**
CSC 12101	Research Paper Publication	60

YEAR THREE SEMESTER-II

Code	**Course name**	**CU**
CSC 12201	PhD Thesis	90

3.2 Detailed Course Description For Taught Courses

Course Name :Philosophy of Computing

Course Code: CSC 10101

Credit Units: 3

Credit Hours: 45

Course Facilitators

Dr. Fred Kaggwa and Dr. John Businge

Course Description

This course explorer the philosophical foundations of the computing field. It explores the computational understanding of the major parameters that make up and support the computing field. It explores their foundations and philosophical underpinnings.

Course Objectives

By the end of the course, students should:

i. To give students an avenue of exploring the philosophical foundations of computing as an academic field
ii. To give students the historical foundation of computational thinking and interpretation
iii. To expose students to the philosophical thinking of the different areas of computing

Learning Outcomes

By the end of the course, the students should be able to:

i. Explain the philosophical foundations of computing
ii. Explain the foundations of theoretical thinking and interpretations
iii. Explain the philosophical thinking of the different fields of computing

Course Content

Introduction (8 Hours).

i. What is a computer?
ii. How is a computer different from a calculator?

iii. Should we consider the human mind or the universe to be a computer?
iv. What is it for a computational problem to be solvable?
v. What are the practical and theoretical limits on computability?
vi. What is the relationship between hardware and software?
vii. Can a computer realize a human mind? Could a computer ever be conscious?

Philosophy of Computing (7 Hours).

i. Computation, Computational Systems, and Turing Machines
ii. Computability and the Church-Turing Thesis
iii. Computational Complexity
iv. Data, Information and Representation

Philosophy of Computer Science (7 Hours).

i. Computer Science: Its Nature, Scope and Methods
ii. Computer Programming and Software Engineering
iii. Data Modeling and Ontology
iv. Information Systems
v. Computer Simulation
vi. Human-Computer Interaction

Philosophy of Artificial Intelligence (8 Hours).

i. Artificial Intelligence and Philosophy
ii. Symbolic AI
iii. Connectionist AI, Artificial Life and Dynamical Systems
iv. Knowledge Engineering and Expert Systems
v. Robots and Artificial Agents
vi. AI and Ethics

Philosophy of the Internet and New Media (8 Hours).

i. Theories of New Media and the Information Society
ii. Internet Epistemology
iii. The Ontology of Cyberspace and Virtual Reality
iv. Computer-Mediated Communication and Virtual Communities
v. The Internet and Politics
vi. Cyborgs and Virtual Subjects

Computer and Information Ethics (7 Hours).

i. Approaches in Computer and Information ethics
ii. Topics in Computer and Information Ethics
iii. Values and Computer Systems Design

Course Delivery

i. Course is largely built around active participation in group discussions/seminars
ii. Lectures
iii. Mini-field work and report writing
iv. Critical peer review and presentations
v. Assignment and class exercises.

Methods of Assessment: Assessment will be in form of Assignments (40%); and, a final examination (60%).

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Reading List

1. Brey, P. and Søraker, J. (2009). 'Philosophy of Computing and Information Technology' *Philosophy of Technology and Engineering Sciences. Vol. 14 of the Handbook for Philosophy of Science.* (ed. A. Meijers) (gen. ed. D. Gabbay, P. Thagard and J. Woods), Elsevier.

2. Floridi, Luciano (1999) Philosophy and Computing: An Introduction. Routledge: London / New York.
3. Bynum, Terrel Ward; Moor, James H. (2000) The Digital Phoenix: How Computers are Changing Philosophy. Blackwell Publishers: Oxford, UK.
4. Colburn, Timothy R. (2000) Philosophy and Computer Science. M.E. Sharpe: Armonk, NY, USA

Course Name: Advanced Research Methods

Course Code: CMH 10101

Credit Units: 3

Credit Hours: 45

Course Facilitators

Assoc. Prof. Vincent Batwala,

Course Description

Advanced Research Methods is a 3 Credit Units course that builds on a doctoral student's base of knowledge by providing an opportunity to learn about aspects of the research process in more detail. This course offers a unique blend of qualitative and quantitative approaches. Advanced topics in research design and statistical analysis will be discussed and students will be asked to lead discussions, apply their skills in class and in assignments. Students will also gain skills in the design of conceptually cogent and methodologically rigorous proposals, scientific report writing and manuscript preparation.

Learning objectives

Upon completion of this course unit, the students will be able to:

i. Understand the underlying philosophies to research-based methods in their respective disciplines
ii. Make an informed choice of methods from relevant research paradigm correlated to the specified research problem
iii. Develop skills in making effective use of library and e-resources while sourcing literature
iv. Identify and describe validity issues inherent in different types of research designs
v. Understand ethical issues in working with human participants and laboratory animals
vi. Identify and describe various types of quantitative and qualitative research designs
vii. Make citations using EndNote software
viii. Develop a research proposal
ix. Conduct an advanced analysis and interpretation of results

Course content

i. Introduction to the course and philosophy of science **(2 Hours)**.
ii. Building a reference library in EndNote software **(3 Hours)**.

iii. Problem formulation, theoretical/ conceptual framework, setting objectives/research questions and hypothesis **(7 Hours)**.
iv. Evaluating and critiquing research **(2 Hours)**.
v. Observational, ecological, experimental designs and randomization **(4 Hours)**.
vi. Sampling techniques and approaches **(4 Hours)**.
vii. Survey research and different data collection modes **(6 Hours)**.
viii. Qualitative versus quantitative approaches **(2 Hours)**.
ix. Measurement—metrics, reliability, validity, and factor analysis **(4 Hours)**.
x. Units of analysis, variables, mediation, moderation, confounding **(4 Hours)**.
xi. Ethical considerations in research **(2 Hours)**.
xii. Grant proposal development, budgeting and work plans **(5 Hours)**.

Course Delivery

i. Course is largely built around active participation in group discussions/seminars
ii. Lectures
iii. Mini-field work and report writing
iv. Critical peer review and presentations
v. Assignment and class exercises.

Methods of Assessment: Assessment will be in form of Assignments (40%); and, a final examination (60%).

Reading List

1. American Psychological Association (2010). Publication manual of the American Psychological Association. (6th Ed.). Washington, DC: American Psychological Association.
2. Patton, Michael Quinn; Qualitative Evaluation and Research Methods, Beverly Hills, Sage, 2nd Ed,1990.
3. Sieber, J.E. (1993) Planning Ethically Responsible Research. Sage Publishers
4. Cone, J.D. & Foster, S.L. (1993). Dissertations and theses from start to finish. Washington, DC: American Psychological Association.
5. Creswell (2007). Qualitative Inquiry and Research Design: Choosing Among Five Approaches (2nd ed). Thousand Oaks: Sage.
6. Patten, M.L. (2000). Understanding Research Methods. An Overview of the Essentials. Los Angeles: Pyrczak Publishing.
7. Cresswell, J.W. (2009). Research Design: Qualitative, Quantitative and Mixed methods Approaches. 3rd Edition, Sage.

Course Name: Scholarly Writing & Communication Skills

Course Code: FIS 10101

Credit Units: 3

Credit Hours: 45

Course facilitators

Dr. Viola N. Nyakato

Course Description

The course is intended for PhD students to develop skills in writing English in a correct and appropriate manner for scientific publication. Good language is a prerequisite for being accepted in good journals, but learning to write appropriate and correct academic English requires a prolonged effort of writing, correcting, rewriting, studying, rewriting again, etc. over several years. A course is just one element, but an important one in this learning process.

Course objectives

After completing this course, each student should be able to:

i. Identify what is meant by a technically good writing style.
ii. Critically examine own written work as well as that of others.
iii. Recognize and apply the rhetorical styles that are typical of academic writing.
iv. Select the English vocabulary and grammar that is appropriate for academic papers in their own field
v. Identify and analyse their own language strengths and weaknesses and develop and apply strategies for self-improvement
vi. Register clear improvements in his/her own writing in terms of clarity, precision and correct language use, and articulate a personal agenda for further improvement.
vii. Design a personalized editing guide to improve the writing skill
viii. Learn about various resources available to assist with editing, refining and citation
ix. Gain the fundamentals required for coherent and logical argumentation and composition
x. Avoid plagiarism and write original work

Course Content

i. Basic writing rules and strategies including grammar work that is based on the first assignment. The aim is to increase students' awareness of the writing process in general order to help them to develop a writing style that is clear and reader friendly as well as to identify individual problem areas **(4 Hours)**.

ii. Analysis of typical sections of academic texts from the perspectives of content, style, grammatical constructions and vocabulary **(3 Hours)**.
iii. Paired and small group discussions to provide critical feedback with suggestions for improving the readability of different texts. Students are required to provide much of the material that will be used during the sessions **(4 Hours)**.
iv. Individual teacher feedback on written assignments and suggestions for identifying and improving particular weaknesses **(8 Hours)**.
v. Formulating a doctoral question and identifying a research gap **(4 Hours)**.
vi. Conceptualization and Chapter Writing **(4 Hours)**.
    - Synthesizing Theory in Research
    - Critical thinking

vii. The Art of academic and scholarly writing **(4 Hours)**.
viii. The publication and journal submission process **(4 Hours)**.
ix. Writing for Peer Review and determining the Right Journals **(2 Hours)**.
x. Logical flow and comprehension **(2 Hours)**.
xi. Addressing omissions and errors in writing **(2 Hours)**.
xii. Writing Grant Winning Proposals **(2 Hours)**.
xiii. Pursuing an Academic Career Path **(2 Hours)**.

Course Delivery

i. Course is largely built around active participation in group discussions/seminars
ii. Lectures
iii. Mini-field work and report writing
iv. Critical peer review and presentations
v. Assignment and class exercises.

Methods of Assessment: Assessment will be in form of Assignments (40%); and, a final examination (60%).

Reading List

1. Corbett, J. (2003). Review of Translation and Nation. Towards a Cultural Politics of Englishness. *Translation and Literature.* 12(2), pp 85-90
2. Soule, D.P.J., Whiteley, L., & McIntosh, S. (2007). *Writing for Scholarly Journals. Publishing in Arts, Humanities and Social Sciences.* University of Glasgow.
3. Huff S.A.(1998): *Writing for Scholarly Publication.* SAGE Publications. 200p
4. Hyland, K., (2000). *Disciplinary Discourses: Social Interactions in Academic Writing.* New York. Longman

5. Modern Language Association of America. (2010). *MLA handbook for writers of research papers*. Modern Language Association of America.
6. Swales, J. (1990). *Genre Analysis: English in Academic and Research Settings.* Cambridge. Cambridge University Press.
7. Swales, J. (2004). *Research Genres: Explorations and Applications*. Cambridge. Cambridge University Press.
8. Pecorari, D. (2003). Good and original: Plagiarism and patch writing in academic second-language writing. *Journal of second language writing*, *12*(4), 317-345.
9. Huff S.A.(1998): Writing for Scholarly Publication. SAGE Publications. 200p

Course Name: Logic and Computational Thinking

Course Code: CSC 10102

Credit Units: 3

Credit Hours: 45

Course facilitators
Dr. Fred Kagwa and Dr. John Businge

Course Description

Understanding how a computer "thinks" is one of the first steps to becoming an excellent PhD computing candidate. A foundation in logic is crucial in developing this understanding. Mastering logic is more than learning a set of rules. It involves learning how to break problems into smaller chunks, figuring out how repeatable processes can save time and improves quality, and understanding how to organize problems into the right size.

In this module, you'll learn how to do all those things and use computers to make them easier. After all, logical tasks are what computers are best at doing! This is not a programming course, but it will teach you how to approach critical thinking as both a lifestyle and an aide to better programming and testing as a PhD candidate. You will be able to critically think and break down computing problems into smaller chunks for easier interpretation and solving.

Course Objectives

The goals of this course are to:

i. Introduce you to computational thinking — using computational models to describe and reason about systems, including systems that change through time.
ii. To provide students with experience of theory in a practical context.
iii. To introduce a variety of 'professional issues' including software IP, verification, correctness, best practice and liability

Learning Outcomes

By the end of this module, the PhD candidate will be equipped in the following areas:

i. Logical form and how to construct arguments
ii. Deductive and inductive argument forms
iii. The basics of critical thinking
iv. How to break down problems into simpler tasks
v. Recognizing patterns and understanding why this is important

vi. How to use an algorithm to solve problems
vii. The relation of logic to fundamentals in computer science

Course Content

1. Module 1: Introduction to the course (9 hours)

i. What this course is about
ii. Analytic logic and its relation to computer science
iii. Critical thinking as both a lifestyle and aide to better programming and testing
iv. Let's get started: critical thinking and logical reasoning
v. What does it mean to think critically?
vi. An overview of definition, induction, and deduction
vii. Computer programming and logical thinking

2. Module 2: Logic and Computer Science (9 hours)

i. Formal Logic and Computer Science

- Introduction and prolegomena
- What is a Turing Machine?
- Bits and Bytes
- Algorithms
- Logic and Computer Science

ii. Introduction to Formal Logic

- Introduction to Logic
- Arguments
- Statements
- Propositions
- Truth Value
- Review Questions

iii. Symbolizing and Logical Operators

- Symbolization
- Introduction to Operators
- Negation Operator
- Conjunction Operator
- Disjunction Operator
- Conditional Operator

- Sidebar: Operator of the largest scope
- Truth Tables
- Review Questions

3. Module 3: Deductive and Inductive Arguments (9 hours)

i. Types of arguments

- Arguments again
- Review Questions

ii.Deductive Arguments

- Valid and invalid arguments
- Soundness
- Sound deductive arguments
- First two deductive syllogisms
- Sidebar: formal fallacies
- Two more deductive argument forms
- Deductive arguments and computer programs
- Review questions

iii. Inductive Arguments

- Introduction to inductive arguments
- Strong and weak arguments
- Cogency
- Determining strength
- Review questions

4. Module 4: Categorical Logic (9 hours)

i. Introduction to Categorical Logic

- What is categorical logic?
- Aristotle's theory of forms
- Some, all, and none
- Quantity and quality
- Review questions

ii. Categorical form and syllogisms

- Standard categorical form
- The categorical syllogism
- Forms of categorical syllogisms
- Review questions

iii.Venn Diagrams

- Categorical statements and validity
- Venn diagrams: I and O statements

- Venn diagrams: A and E statements
- Using Venn diagrams with categorical syllogisms
- Venn diagrams: testing categorical syllogism for validity
- Review questions

5. Module 5: Introduction to Critical Thinking (9 hours)

i. What is Critical Thinking?

- Introduction to critical thinking
- Socrates and critical thinking
- Socrates's definition of truth
- The Socratic Method
- Two Socratic questions
- Applying the Socratic Method to computer science

ii. Inductive Reasoning Applied

- Forms of inductive reasoning
- The logic of science
- Confirmation and disconfirmation
- Mill's Method
- Mill's method: agreement
- Mill's method: difference
- Mill's method: variation

Course Delivery

i. Course is largely built around active participation in group discussions/seminars
ii. Lectures
iii. Mini-field work and report writing
iv. Critical peer review and presentations
v. Assignment and class exercises.

Methods of Assessment: Assessment will be in form of Assignments (40%); and, a final examination (60%).

Reading List

1. Kowalski R. Computational logic and human thinking: how to be artificially intelligent. Cambridge University Press; 2011 Jul 21.

2. Grover, S. and Pea, R., 2013. Computational thinking in K–12: A review of the state of the field. Educational researcher, 42(1), pp.38-43.

Course Name: Requirement Engineering and System Design

Course Code: CSC 10103

Credit Units: 3

Contact Hours: 45

Instructors
Dr. John Busing and Dr. Evarist Nabaasa

Course Description:

This course is designed to give students an introduction to software engineering approach in the development of high quality software systems. The course will discuss concepts for systematically establishing, defining and managing the requirements for large, complex, changing and software-intensive systems, from technical, organizational and management perspectives. It will discuss the important software engineering concepts in the various types of common software process models. The students will also learn the concepts and techniques used in each software development phase including requirements engineering, software design and software testing. This course will also expose the students to utilizing object-oriented method (e.g. UML) and tools in analyzing and designing the software. At the end of this course, students are expected to be able to appreciate most of the common software engineering concepts and techniques as well as producing various software artifacts, documentations, and deliverables.

Course objectives

i. Understand the need for requirements for large-scale systems.
ii. Understand the stakeholders involved in requirements engineering.
iii. Understand requirements engineering processes.
iv. Understand models of requirements.
v. Understand functional requirements.
vi. Understand non-functional requirements.
vii. Understand object-oriented and goal-oriented requirements engineering.

Learning Outcome

Upon completion of this course unit, the students will be able to:

i. Ability to define the key terminologies related to Requirement Engineering and System Design principles and approaches.

ii. Gather data to analyze and specify the requirements of a system.

iii. Ability to build and compare the main software artifacts for the software requirements specification, software design, and software testing documents based on the given problem description.

iv. Ability to use the state-of-the-art method and tools in requirement engineering and software design.

v. Ability to work effectively in a team and present technical solutions to range of audience.

Course Content

Introduction to Software Engineering (6 hours)

i. Software Engineering definition

ii. Difference between computer science and software engineering

iii. Classification of software quality

iv. Software Engineering Case Studies

Software Process Model (6 hours)

i. Common Process Activities

ii. Generic Software Process Models

iii. Process Iteration

iv. The Rational Unified Process

v. Computer-Aided Software Engineering

Requirements Engineering (5 hours)

i. Requirement Specification

ii. Functional and non-functional requirements User & system requirements

iii. Requirement specification techniques

iv. Requirements Engineering Process

Requirement Modeling and Specification (5 hours)

i. Requirements Specification with SRS

ii. Requirement Modeling Concept

- Use Case Modeling & Specification
- Sequence Diagram
- Activity Diagram

Requirements Engineering Case Study and Modeling (6 hours)

Case Tool: Enterprise Architect or any other open source UML software

Architectural Design (5 hours)

i. Architectural design decisions

ii. System organization

iii. Decomposition styles

iv. Control styles

v. Reference architectures

Object Oriented Design (OOD) (6 hours)

i. OOD Concepts

- Principles of OOD
- Object Oriented Concepts
- Advantages of OOD

ii. OOD Using UML

- Enhancing Sequence Diagram
- Architectural Design using Package Diagram
- Class Diagram

Software Verification and Validation (V&V) & Testing (6 hours)

i. Introduction to Verification and Validation

- Verification and validation planning
- Software inspections
- Automated static analysis

ii. Software Testing

- System testing
- Component testing
- Test case design
- Test automation

Course Delivery

i. didactic lectures to stimulate discussion
ii. group work
iii. practical demonstration and hands on sessions
iv. assignments
v. writing short research papers (4-6 pages)

Methods of Assessment: Assessment will be in form of Assignments (40%); and, a final examination (60%).

Reading List

1. J. W. Satzinger, R. B. Jackson and S. D. Burd. *Systems Analysis and Design in a Changing World,* 6th ed. Boston, USA: Thomson Course Technology, 2012. (ISBN-10: 1-111-53415-2 ISBN-13: 978-1-111-53415-8)

2. Sommerville, 2010. "Software Engineering", 9th Edition, Addison Wesley

3. Pfleeger, Shari Lawrence, Software Engineering Theory and Practice, second edition. Prentice- Hall 2001.

Course Name: Research Ethics

Course Code: CMH 10203

Credit Units: 3

Contact Hours: 45

Instructors

Assoc. Prof. Gertrude Kiwanuka

Course Description:

This course is intended to promote integrity in research. It is centered on professionalism and integrity in research right from planning, conducting, reporting, and reviewing of research. The content is organized in two parts: Part I has the introduction covering the history of research ethics and shared values for responsible conduct of research; international and local rules, regulations, and professional practices that define the responsible conduct of research regulations. The main sections forming part II cover topics around nine core instructional areas: research misconduct, research involving human participants, welfare of laboratory animals, conflict of interest, data management practices, mentor and mentee responsibilities, collaborative research, reporting and reviewing research, and peer review. Rules/Regulations/Guidelines and institutional policies, when applicable, and relevant to the issue will be provided.

Course Objective

The overall goal of the course is to provide a guide meant to foster research that protects the interests of the public, the subjects of research, and the researchers themselves. It focuses on the main ethical standards, and outlines the operations and review process that research ethics committees follow. Scholars will gain a better understanding of the need to demonstrate integrity in research and in the mentoring of others. The course will also help trainees identify other ethical challenges in many dimensions of research and learn how to address them.

Learning Outcomes

At completion of this course, learners will be able to:

i. Recognize the centrality of voluntary consent in human research; identify and assess the risk to potential benefit ratio
ii. Appraise responsible relationships between researchers and those that will be affected by their research
iii. Examine and appraise research activities that must be reviewed by Research Ethics Committees
iv. Identify research misconduct and describe the procedures for reporting and investigating it
v. Analyze violation of research regulations including abuse of confidentiality, authorship and publication violations
vi. Recognize actual, perceived or potential conflicts of interest and develop strategies to avoid or manage such conflicts
vii. Appraise data ownership and access to data; formulate strategies to maintain data integrity, validity and accuracy
viii. Describe researchers responsibilities in sharing research results with others
ix. Appraise the importance of mentoring in career development and describe basic mentor-mentee responsibilities
x. Assess and conduct responsible peer review of projects and manuscripts
xi. Identify potential collaborations and describe aspects that require formal agreements

Course Content

1) Part I

Introduction

Definitions of research ethics, responsible conduct of research (RCR), rationales and goals for teaching research ethics. History of research ethics; Shared values: honesty, accuracy, efficiency, objectivity; professional codes; government regulations, institutional policies, and personal convictions **(6 Hours)**.

2) Part II

i. Research Misconduct

Fabrication, falsification, plagiarism or other practices that seriously deviate from accepted practices in proposing, performing, or reporting. Self-policing with Quality Research Practices: strict adherence to the scientific method, clear, detailed recordkeeping; Policies for handling misconduct: Dispute resolution; Whistle blowing: roles and perspective, necessity and obligation, consequences **(6 Hours)**.

ii. Research Involving Human Participants

Definitions, Rights and welfare of human research participants and their communities; Policies regarding human research participants; Role of regulatory oversight committees; operations of Research Ethics Committees (RECs); basic ethical issues considerations for approval of research protocols. Ethical issues associated with biomedical science research taught via a case study approach. Content structured to meet NIH requirements for RCR training and review process; additional protection of vulnerable groups **(11 Hours)**.

iii. Welfare of live laboratory animals

Rules, policies and guidelines: Definitions, Animal Welfare Act and its amendment, Guide for the Care and Use of Laboratory Animals (1966); institutional organization: Animal Care and Use Committee (IACUC); Principles for the responsible use of animals in research; "three Rs of alternatives." **(6 Hours)**

iv. Conflict of interest

Definition and overview of conflict of interest; personal and intellectual conflicts, professional, and financial; authorship conflicts; reporting and managing significant conflicts **(2 Hours)**.

v. Data acquisition and management practices

Data ownership and access to data; Data collection; Data protection; Data Sharing (publication practices) **(4 Hours).**

vi. Mentor and mentee responsibilities

Basic responsibilities of roles of an advisor, supervisor, and mentor; strategies for managing conflicts between mentors and trainees; Research environment; Supervision and review; Transition to independent researcher **(4 Hours)**.

vii. Collaborative research

Roles and Relationships; Management; Collaborations with Industry **(2 Hours)**.

viii. Reporting and reviewing research

Responsible authorship and publication. Practices that should be avoided **(2 Hours)**.

ix. Peer review

Meeting deadlines; Assessing quality of project or manuscript; Judging importance; Preserving confidentiality **(2 Hours)**.

Mode of Course Delivery

i. Didactic lectures
ii. Case studies and group discussions
iii. Videos and documentaries
iv. Excursion to research sites and REC office

Methods of Assessment: Assessment will be in form of Assignments (40%); and, a final examination (60%).

Reading List

1. On Being a Scientist: A Guide to Responsible Conduct in Research: Third Edition, ISBN: 0-309-11971-5, http://www.nap.edu/catalog/12192.html
2. https://oir.nih.gov/sourcebook/ethical-conduct/responsible-conduct-research-training
3. Gluck, JP, DiPasquale, T, Orlans, FB. Applied Ethics in Animal Research: Philosophy, Regulation, and Laboratory Applications, West Lafayette, IN: Purdue University Press, 2002.
4. The National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research. The Belmont Report: Ethical Principles and Guidelines for the Protection of Human Subjects of Research, Washington, DC: DHHS, 1979. (available at: http://www.hhs.gov/ohrp/humansubjects/guidance/belmont.htm)
5. World Medical Association. Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects, Helsinki, Finland: World Medical Association, 1964, 2002. (available at: http://www.wma.net/e/policy/b3.htm)

Other RCR Resources

6. Online Ethics Center for Engineering and Science (National Academy of Engineering).
7. AAAS-National Academies Compilation of Resources on Scientific Misconduct and Research Integrity.

Course Name: Computer Application in Research

Course Code: CSC 10201

Credit Units: 3

Contact Hours: 45

Course facilitators

Dr. Nabaasa Evarist, Dr. Musiimenta Angella, Dr. Businge John

Course Description

Information competency and management cross-cutting course is a three credit unit course. Aware that today information handling is at the heart of the research process across all disciplines, the three credit unit course focuses on the identification and use of information sources and resources, and the management and effective presentation of the research results. In this course, students are introduced to a range of facilities available at MUST and beyond, that can support their research. These include electronic database and e-journals as well as literature searching and information retrieval from the various printed and electronic resources, word processing, power point presentation, and file management. The course also focuses on computer application in qualitative research, the techniques of storage, retrieval and processing/handling of various types of information/data, citation methods and the academic publication process.

Course Objectives

The major objective of this cross-cutting course is to impart knowledge and skills in the effective information seeking and management by postgraduate students/researchers. The course focuses on an individual's course/research topic to provide information seeking competency and support to the student.

Learning Objectives

After undertaking this course, students are expected to:

i. Identify and use of information resources (print and electronic) relevant to the researcher's individual research topic
ii. Professional citing and quoting of authors versus interviewees/respondents
iii. Improved scholarly writing (writing skills)
iv. File management of the many versions of electronic files researchers work on/with
v. Creation and management of simple databases for the bibliographic data/references, e.g. using Endnote software, and their subsequent updating
vi. Computer applications in qualitative research e.g. using Atals.ti software.

Course Content

i. Literature searches, information retrieval and literature review: identification of relevant bibliographic sources, primary versus secondary sources of information, identification of subject keywords, synonyms, etc, role of thesauri **(12 Hours)**.

ii. Citations: footnote, reference or bibliography, printed and the Internet publication. Quotations - authors versus interviewees/informants/respondents **(10 Hours)**.

iii. Outline a systematic way of storing, use and updating of multiple versions of files **(6 Hours)**.

iv. Creation, management and updating simple database for the bibliographic data/references using Endnote software **(4 Hours)**.

v. Introduction to the use of Atlas.ti in analyzing qualitative data **(11 Hours)**.

vi. The use of power point to present a summary of research work, and the academic publication process **(2 Hours)**.

Mode of Course Delivery Lectures

i. In-class Practical work/Demonstrations
ii. Mini-field work and report writing
iii. Students' research presentations

Methods of Assessment: Assessment will be in form of Assignments (40%); and, a final examination (60%).

Reading list

1. Defining the process to literature searching in systematic reviews: a literature review of guidance and supporting studies, by Chris Cooper, 2017
2. Improving Student Information Search by Barbara Blummer, Jeffrey M. Kenton, 2014
3. Process of information retrieval for systematic reviews and health technology assessments on clinical effectiveness, Version 1.1, December 2016
4. ATLAS.ti 7User Guide and Reference by Dr. Susanne Friese, 2013

1. Course Name: Institutional Pedagogy

Course Code: **EDU 10202**

Credit Units: **3**

Contact Hours: **45**

Course Facilitators

Dr. Sudi Balimutajjo

Course Description

The course is intended to improve teaching strategies, teacher actions, and teacher judgments and decisions by taking into consideration theories of learning, understandings of students and their needs, and the backgrounds and interests of individual students. The students enrolled for the course will be equipped with knowledge and skills to teach courses designed for tertiary level education, since many PhD candidates end up as academic staff in tertiary institutions due to the growing demand for quality tertiary level education.

Course Objectives

After completion of the course the students or participants should demonstrate ability to

i. Identify and critically reflect upon learning and skills needs of their students.
ii. Develop appropriate curricula and organize course(s) and training programs conforming to principles recommended by National Council of Higher Education (NCHE)
iii. Appreciate the diversity of/among students and plan appropriate learning experiences that support the growth and enhancement of their abilities
iv. To employ an array of teaching methods suitable to existing situations, environments, and content of learning
v. Conduct assessment and evaluation of learning processes and use the outcomes to mentor and address learning/teaching deficiencies.

Detailed Course Content

i. Orientation to Teaching **(2 Hours)**
ii. Roles of Teachers in Higher Education (**3 Hours)**
iii. The Learning Theories and Processes (**5 Hours)**
iv. Learning Styles **(3 Hours)**
v. Teaching Approaches **(6 Hours)**
vi. Curriculum Design and Development **(7 Hours)**
vii. Teaching and Learning Resources **(3 Hours)**
viii. Assessment and Evaluation **(5 Hours)**
ix. Socio-cultural Issues in Education **(3 Hours)**
x. Peer-teaching (Practice) **(8 Hours)**

Course Delivery

i. Course is largely built around active participation in group discussions/seminars
ii. Lectures
iii. Mini-field work and report writing
iv. Critical peer review and presentations
v. Assignment and class exercises.

Methods of Assessment: Assessment will be in form of Assignments (40%); and, a final examination (60%).

Reading list

1. Bain, K. (2004). *What the Best Colege Teachers Do.* NY: Havard UNiversity Press.
2. Daniel F. Chambliss, C. G. (2014). *How College Works.* NY: Havard.
3. James Bellanca, R. B. (2010). *21st Century Skills: Rethinking How Students Learn.* Bloomington, IN: Solution Tree Press.
4. Jon Saphier, M. A.-S. (2008). *The Skillfull Teacher: Building Your Teaching Skills* (6th ed.). NJ: Research for Better Teaching.
5. Louis Cohen, L. M. (2004). *A Guide to Teaching Practice* (5 ed.). NY: Taylor & Francis.
6. Russel, S. (2017, 10 23). The Essential Teaching Skills: An introduction to Teaching for Early Careers Lecturers. London, UK, UK.
7. Susan A. Ambrose, M. W. (2010). *How Learning Works: 7 Research-Based Principles for Smart Teaching.* NY: The Jossey-Bass higher and adult education series

Course Name : Informatics

Course Code: CSC 10202

Credit Units: 3

Credit Hours: 45

Course Facilitators

Dr. Theodora Mwebesa Twongyirwe and Dr. Evarist Nabaasa

Course Description

The course deals with foundational *Informatics* concepts such as Information, Knowledge, Modeling, and Uncertainty. We introduce all the conceptual building blocks necessary to understand the basics of Information Theory. We introduce those building blocks hand in hand with the practical dimension of Informatics, which focuses on solving real problems with information technology. We present informatics tools in various human domains, and discuss their implications for the practice of science, engineering, art, and society in general.

Course Objectives

i. Students will be introduced to fundamental topics in Informatics while developing a basic understanding of Information Theory.

ii. Students will build up their proficiency in Information Technology as detailed in the course syllabus, emphasizing its use in the modeling of nature and technology.

Learning Objectives

i. Use software tools to perform daily business-related tasks.

ii. Explain and apply principles of informatics as applied in business

iii. Understand the concepts of data visualization techniques

Course Content

Introduction to Informatics (6 hours)

- The Nature of Information
- From Information to Informatics

- What is Technology and Information Technology?
- Cyborgs and the History of Computers

Modeling and Problem Solving (6 hours)

- Modeling the World
- The Hertz Modeling Relation
- Example Problems: L-systems, boyds, bio-inspired computing, consumer behavior, etc.
- First Individual Project

Data and Knowledge Representation (6 hours)

- Digital Number representation
- Text Encoding
- Multimedia
- Real World examples
- Second Individual Project

Deductive Model Building (4 hours)

- Propositional Logic: Formalizing Natural Language
- Sets

Inductive Model Building (6 hours)

- First group project
- Measuring the World
- Summarizing data
- Centrality and Dispersion
- Fitting Data with regression
- Real World Problems: Cryptography, text frequency analysis, "Freakonomics"
- Third Individual Project

Information and Uncertainty (5 hours)

- Probability
- Second Group Project
- Information and Uncertainty: Hartley, Shannon

Computing Models: Algorithms (6 hours)

- Fourth Individual Project
- Heuristics and algorithms
- Flow chart representation
- Examples: Sorting, Hanoi Problem, Artificial Intelligence, Human-computer interaction, robots, and cyborgs
- Limits of Computation and Complexity of algorithms
- Testing Models against reality: the individual project unfolded

Storing Data (6 hours)

- Databases
- Relational Databases and SQL
- Third Group Project

Course Delivery

i. didactic lectures to stimulate discussion
ii. group work
iii. practical demonstration and hands on sessions
iv. assignments

Methods of Assessment: Assessment will be in form of Assignments (40%); and, a final examination (60%).

Reading list

1. Stair, R. and Reynolds, G., 2012. *Fundamentals of information systems*. Cengage Learning.

2. Von Baeyer, H.C. [2010]. Information: The New Language of Science. Harvard University Press, Chapters 1, 4, 10

3. Clark, A. [2003]. Natural-Born Cyborgs: Minds, technologies and the Future of Human Intelligence. Oxford University Press. Chapters 2 and 6

4. Englander, I [2003]. The Architecture of Computer Hardware and Systems Hardware. Wiley, Chapters 2 and 3

5. Norman, G.R. and D.L. Streinrt [2008]. Biostatistics: The Bare Essentials. Chapters 1-5 and 13.

Course Name : Cloud Computing

Course Code: CSC 10203

Credit Units: 3

Credit Hours: 45

Course Facilitators

Dr. Ssembatya Richard

Course Description

Cloud Computing is considered one of the top five emerging technologies that will have a major impact on the quality of science and society over next 20 years. It provides a way to centralize the setup, implementation, maintenance, and management of integrated computation services to individual and corporate end users. This course provides a comprehensive introduction to cloud computing with an emphasis on advanced topics. It is designed in a workshop format with three workshops focusing on key topics. Each workshop includes a call for papers corresponding to the main theme of the workshop, a keynote presentation to provide a conceptual background on the topic, and your paper submission and online presentation. You will develop a final paper on cloud computing to submit to a related international conference as one of the outcomes of this course. The first workshop focuses on cloud computing concepts, technological foundations, infrastructure, and architecture. The second workshop targets security and technology challenges. The third workshop concentrates on applications, implementation issues, and management and governance. The goal of the final paper is to present a new idea or innovation using cloud computing.

Course Objectives

The objective of this course is to provide students with the comprehensive and in-depth knowledge of Cloud Computing concepts, technologies, architecture and applications by introducing and researching state-of-the-art in Cloud Computing fundamental issues, technologies, applications and implementations. Another objective is to expose the students to frontier areas of Cloud Computing and information systems, while providing sufficient foundations to enable further study and research.

Learning Outcomes

After successfully completing of this course, the student should be able to:

i. Articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing
ii. Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.
iii. Explain the core issues of cloud computing such as security, privacy, and interoperability.
iv. Choose the appropriate technologies, algorithms, and approaches for the related issues.
v. Identify problems, and explain, analyze, and evaluate various cloud computing solutions.
vi. Provide the appropriate cloud computing solutions and recommendations according to the applications used.
vii. Attempt to generate new ideas and innovations in cloud computing.
viii. Collaboratively research and write a research paper, and present the research online.
ix. Effectively communicate course work in writing and oral presentation.

Course Content

Part I Understanding Cloud Computing (12 hours)

i. Keynote PowerPoint Presentation: Introduction to the main concepts, issues, and direction for this part of the study.
ii. Workshop 1 Call for Papers: An outline of the Part 1 topics; paper submission and online presentation dates.
iii. Group Research: You will research and write a short paper (4-5 pages) on a selected topic and submit the paper for peer review.
iv. Online Workshop 1: You will present this part of your research paper.

Part II Core Issues of Cloud Computing (11 hours)

i. Keynote PowerPoint Presentation: Introduction to core issues and challenges in cloud computing, and direction for this part of the study.

ii. Workshop 2 Call for Papers: An outline of the Part 2 topics; paper submission and online presentation dates.
iii. Group Research: Research and write a short paper (4-5 pages) on the on a selected topic and submit the paper for peer review.
iv. Online Workshop 2: You will present this part of your research paper.

Part III Cloud Computing Now and Future (12 hours)

i. Keynote PowerPoint Presentation: Introduction to cloud computing applications, and issues, and direction for this part of the study.
ii. Workshop 3 Call for Papers: An outline of the Part 3 topics; paper submission and online presentation dates.
iii. Group Research: You will research and write a short paper (4-5 pages) on a selected topic and submit the paper for peer review.
iv. Online Workshop 3: You will present this part of your research paper.

Part IV Cloud Computing and Innovation (10 hours)

i. You will summarize your research done in parts I-3 and try to identify new ideas and innovations for any aspect of cloud computing.
ii. You will write a full conference paper (8 -10 pages) for peer review.
iii. You will submit the paper for a cloud computing-related international conference.

Course Delivery

i. didactic lectures to stimulate discussion
ii. group work
iii. practical demonstration and hands on sessions
iv. assignments

Methods of Assessment: Assessment will be in form of Assignments (40%); and, a final examination (60%).

Reading List

1. Readings are located on links to papers and articles from IEEE and other journals and proceedings available through the Internet.

2. Keynote PowerPoint Presentations (to be provided during the course).

3.3 Concept Paper approval

The PhD applicant must defend his concept note at the faculty before temporary admission is made by the university.

3.4 Developing Proposal

The PhD candidate shall be given a period of one year to develop a proposal together with his/her assigned supervisors. Proposal development shall take place in the second year. The proposal must follow the guidelines provided in the postgraduate hand book.

3.5 Research and Publication Requirement

In third year semester I, students must continue their research as per their developed proposals in year two and must publish at least 2 peer reviewed journal or conference paper.

3.6 PhD Thesis Writing Requirement

Similarly, in third year, students must write a thesis that will be approved through the relevant university structures and submitted for external examination as guided in the postgraduate handbook.

3.7 PhD programme Staffing

S/N	Names	Qualifications	Course unit	Status at MUST
1	Assoc. Prof. Kiwanuka Gertrude	PhD (Biochemistry) From Mbarara University of Science and Technology, 2007	Research Ethics	Full-time
2	Assoc. Prof. Vincent Batwala	PhD (Public Health) From Makerere University, 2013	Advanced Research Methods	Full-time
3	Dr. Sudi Balimutajjo	PhD (Educational Curriculum) From Reno University Nevada USA, 2010	Institutional pedagogy	Full-time
4	Dr. Viola N Nyakato	PhD (Development Studies)From Mbarara University of Science and Technology, 2014	Scholarly Writing & Communication Skills;	Full-time
5	Dr. Nabaasa Evarist	PhD (Networks & Algorithms) From Mbarara University of Science and Technology 2015	Computer Application in Research	Full-time
6	Dr. Musiimenta Angella	PhD (ICT 4D & Health) Manchester University UK 2013	Computer Application in Research Requirement Engineering and System Design	Full-time
7	Dr. Businge John	PhD (Software Engineering) Eindhoven University of Technology Netherlands 2014	Computer Application in Research	Full-time
8	Dr. Fred Kagwa	PhD (Computer Security) From Mbarara University of Science and Technology 2016	Logic and Computational Thinking Philosophy of Computing	Full-time
9	Dr. Theodora Mwebesa Twongyirwe	PhD (Information System) From Mbarara University of Science and Technology 2018	Informatics	Full-time
10	Dr. Ssembatya Richard	PhD (ICT 4D) From University of Cape Town South Africa 2014	Cloud Computing	Full-time

3.8 Proposed Budget for PhD Computing By Research

Estimated Revenue

Item	No. of student	Tuition fees	Functional Fees	application fees	Year I collection	Year II collection	Year III collection	Subtotal per category
Students on Scholarship (DAAD, ADB etc.)	6	7,000,000	1,270,000	100,000	50,220,000	49,620,000	49,620,000	149,460,000
Students on Staff Development	2	0	1,270,000	100,000	2,740,000	2,540,000	2,540,000	7,820,000
Self-Sponsored Students	2	7,000,000	1,270,000	100,000	16,740,000	16,540,000	16,540,000	49,820,000
				Yearly Total	**69,700,000**	**68,700,000**	**68,700,000**	
				Total Revenue				**207,100,000**

Estimated Expenditure

Budget	Year 1	Year 2	Year 3
Academic staff			
Senior lecturers and lecturers teaching allowances	3,000,000	0	0
Visiting professors teaching allowances	3,000,000	3,000,000	0
Research supervision			
Internal supervisors per student	0	0	6,000,000
Internal Reviewer per student			6,000,000
External Examiner per student	0	0	6,000,000
Other expenses			
Advertising and publicity on radio	3,000,000	0	0
Workshops and seminar series	5,000,000	5,000,000	5,000,000
Text books and E-books	3,750,000	3,750,000	3,750,000
Printing, stationery and photocopy	2,000,000	2,000,000	2,000,000
Equipment - projector each at 3,500,000	3,500,000	0	0
Teaching materials and software license	3,000,000	3,000,000	3,000,000
Support of 3 research groups	4,000,000	4,000,000	4,000,000
Revenue collection per year	69,700,000	68,700,000	68,700,000
Sub Total (Costs)	30,250,000	20,750,000	35,750,000
Contribution to MUST Budget Per year	**39,450,000**	**47,950,000**	**32,950,000**