SOKOINE UNIVERSITY OF AGRICULTURE

COLLEGE OF NATURAL AND APPLIED SCIENCES

DEPARTMENT OF INFORMATICS AND INFORMATION TECHNOLOGY

PROPOSED ALIGNED UQF CURRICULUM FOR BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY INNOVATION (BSc. ITIN)

October, 2022

Table of Contents

List of Tables

Institutional Profile

1.1. Name of Institution: Sokoine University of Agriculture

1.2. Cluster of Institution: Full-fledged University

1.3. Nature of Provider: Public

1.4. Programme Host Department: Department of Informatics and Information Technology

1.5. Head of Department and his/her contacts: Prof. Wulystan Mtega, Sokoine University of Agriculture, Informatics and Information Technology. P.O.BOX 3038, Morogoro. Email: diit@sua.ac.tz Mobile phone number: +255 769 831 893. Landline telephone number:. Website: www.sua.ac.tz.

Programme Details

Proposed Programme Title

Bachelor of Science in Information Technology Innovation

Programme Cluster

Information and Communication Technology

Programme Discipline

Information Technology

UQF Level

Level 8, Academic degree

Programme Duration and Credits

Table 1: ProgrammeDuration and Credits.

Years	No. of Semesters	Minimum Credits Required
3	**6**	**360**

Programme Status

Full time

Mode of Delivery

The delivery of the programme will be by blending e-learning and face-to-face contacts, which will involve lectures, group projects. The mode of delivery of this programme will follow and adopt the Guidelines for Online and Blended Delivery Modes of Courses for University Institutions in Tanzania.

Location of the Delivery

College of Natural and Applied Science, Sokoine University of Agriculture (SUA), Morogoro.

Proposed Intake Number of Students

Table 2: The proposed intake numbers for the programme.

Enrolment year	Year 1	Year 2	Year 3	Year 4
Number of Students	60	75	90	100

General Minimum Entry Requirements for Admission

The general regulations for Undergraduate Degrees of the Sokoine University of Agriculture shall apply. Applicants must have attained at least UQF Level 6 (Ordinary Diploma) or UQF Level 5 (Advanced Certificate of Secondary Education) or recognized equivalent prior learning qualifications.

Programme Specific Entry Requirements for Admission

The minimum requirements for admission of direct entrants into the Bachelor of Science in Information Technology Innovation degree programme shall be at least two principal level passes (4.0 points of NECTA grading system) in Advanced Mathematics and at least one of the following subjects: Physics, Chemistry, Geography, Economics, and Computer Science in the Advanced Certificate of Secondary Education Examination (ACSEE).

An equivalent candidate for admission into this degree programme shall be required to have a Diploma in any of the following disciplines: Information Technology, Computer Science, Computer Engineering, Electronics Engineering, Telecommunication Engineering, and related fields with a minimum GPA of 3.0 or above. In addition, the applicant must have a minimum of "D" in three science subjects in the Certificate of Secondary Education Examination (CSEE).

Candidates seeking admission through Recognition of Prior Learning (RPL) shall be required to have valid RPL certificate obtained after passing RPL examination, relevant to the Bachelor of Science in Information Technology Innovation degree programme, as approved by The Senate of Sokoine University of Agriculture

Practical Project/Training or Fieldwork Attached to the Programme

Each student in their first, second and third year of study, shall be required to undertake Field Practical Training (FPT). The duration of each FPT shall be five (5) weeks. First year, students shall be required to remain at SUA for in-campus training and be exposed to several ICT projects/activities. Second- and third-year students shall be allowed to conduct their FPT to other designated field stations. The objective of FPT is to expose students to actual working environments and enable them to interact with prospective potential employers. The training will specifically focus on familiarizing and exposing students to real life problems that need ICT related solutions facing today's society. It will also provide practical skills and competence on how to solve problems. During the FPT, students shall work under close supervision of local experts of the FTP sites and shall be assessed by visiting academic supervisors from the Department. This assessment shall form a part of the assessment for the respective academic year.

FPT assessments will compose of several units including scores from the field station determined by both site supervisor (local training officer) and the visiting academic staff from the university as well as the final presentation which will be done at the university. The final presentation shall be scheduled soon after the completion of FPT in a departmental panel. The composition of the entire FPT assessment includes an assessment by the local training officer at the FPT station 30%, assessment of the logbook 10% by SUA academic staff, assessment of FPT reports 30%, and the assessment of FPT presentations 30%. The logbooks shall be available at the DIIT and shall be provided to students prior to FPT.

The semester projects will be done in groups of three (3) to four (4) students under the supervision of at least two lecturers/instructors from the department. The practical courses lecturers will, amongst themselves, choose the "semester project convener" who will organize and handle the entire semester project and the related matters including assigning supervisors to students. The main role of supervisors in projects work will be to assist students to ensure that projects are properly designed and that the students carry them out according to the highest academic and professional standards using the competence acquired during the current (and past semesters, if applicable). Lecturers are additionally responsible for assessing the progress of projects on a regular basis and to do whatever else is necessary to ensure successful completion of the projects.

List of other Accredited Programmes in the Host College

Table 3: List of accredited programmes in the host college.

S/N	Programme name	Date Accredited	Number of Continuing Students		Number of Academic Staff Available for the Programme			
					PhD	Master	Bachelor	Total
1	*BSc Environmental Sciences and Management*	*2000*	Year 1	142	5	9	1	15
			Year 2	86	11	9	1	21
			Year 3	62	9	7	0	16

2	*Bachelor of Science with Education (Chemistry & Biology)*	*2008*	Year 1	208	15	5	0	20
			Year 2	149	16	7	1	24
			Year 3	160	13	5	1	
3	*Bachelor of Science with Education (Geography & Biology)*	*2008*	Year 1	75	14	8	0	22
			Year 2	116	14	7	1	22
			Year 3	92	13	4	1	18
4	*Bachelor of Science with Education (Chemistry & Mathematics)*	*2008*	Year 1	22	12	7	0	19
			Year 2	33	10	5	1	16
			Year 3	64	5	6	1	12
5	*Bachelor of Science with Education (Geography & Mathematics)*	*2008*	Year 1	17	13	8	4	25
			Year 2	23	10	7	0	17
			Year 3	40	10	7	0	17
6	*Bachelor of Science with Education (Informatics & Mathematics)*	*2008*	Year 1	30	19	10	1	30
			Year 2	26	11	12	1	24
			Year 3	41	5	11	1	17
7	*Bachelor of Science in Information Technology*	*2019*	Year 1	12	12	4	1	17
8	*Bachelor of Science with Education (Agricultural Science and Biology)*	*2008*	Year 1	162	12	2	0	14
			Year 2	97	13	6	0	19
			Year 3	79	6	4	0	10

Rationale for Programme Development

Justification of the Programme Undertaken

Higher Learning Institutions (HLIs) are required to demonstrate the ways in which they respond to the social and economic needs of society, such as enhancing graduate employability, facilitating social mobility and wider access to higher education, contributing to national economic growth and local development in short and long term, stimulating new enterprises and innovation in existing firms. In addition, HLIs like SUA must continuously adapt and respond to new challenges to maintain standards of excellence and be competitive on international education markets. We live in a world where technological advances and technology related decisions constantly impact society in many ways. A well-rounded higher education must therefore adequately prepare students to understand technology and its implications on society. Being able to critically assess technological claims helps one make better judgments' that could significantly affect the world. Tanzania as a nation that has decided to develop through the industrialization route has a critical need for higher education that produces IT and innovation experts that are essential to our economy. According to the Development Vision 2025, Tanzania should have created a strong, diversified, resilient and competitive economy, which can effectively cope with the challenges of development and, which can also easily and confidently adapt to the changing market and technological conditions in the regional and global economy. It is worth mentioning that the idea of introducing B.Sc. ITIN degree programmeat SUA is in line with the 2025 Tanzania development Vision in developing and driving innovation processes in practice, from problem identification to ideation and finally to

the validation and implementation of a sustainable digital product, design, concept or process in new or existing businesses and organizations. The B.Sc. ITIN degree programme is also conceived as a way of implementing the SUA Corporate Strategic Plan (CSP) 2016-2021 which requires the University to expand through introducing new programs that are demand driven, cost effective, competitive, and sustainable in the ever-changing market. The B.Sc. ITIN degree programme is expected to attract a diverse group of students and train students to develop critical thinking abilities and competence in modern technologies. Also, the programme is proposed to address recommendations made by the 2011 and 2015 Assessment of Quality Assurance systems and Assessment of Needs for Training, Collaborative Research, and Institutional Capacity Building in Tanzania.

The market survey was conducted using a qualitative approach in which the key information from the graduates and employers was collected. The aim of the market survey was to investigate to what extent students who graduate from the University majoring in BSc. Informatics are employable in different sectors. The Market Survey also investigated the need for courses related to **Sustainable Entrepreneurship and Innovation** in the employment sector (see Appendix 8.3)**.** The Tracer Study and Market Survey Report (Appendix 8.3) had revealed deficiencies within the SUA's B.Sc. Informatics and B.Sc. Information Technology programmes which include: *inadequate skills for self-employment, inadequate IT skills, innovation to graduates, inadequate practical orientation of the courses, insufficient time devoted to field practical training*, and poor *communication skills*. It is for these reasons; the B.Sc. ITIN degree programme is proposed to be established at SUA. The proposed B.Sc. ITIN degree programme curriculum is modeled / prepared to address both the observed deficiencies and objectives of the University Qualification Framework. Thus, the need for the establishment of B.Sc. ITIN degree programme at SUA emerged due to various reasons as indicated in the Market Survey Report (Appendix 8.3), including: -

i) There is a large pool of form six leavers and Diploma of Information Technology graduates and related fields at SUA and/or from other institutions who are interested to pursue ITN related degree programs, owing to the increase in their demand in the labor market as indicated in National Information and Communication Technologies Policy (2016) of Tanzania.

ii) The expansion of colleges, universities, secondary schools, non-governmental organization, and community based organizations and various kinds of information centers in the country have currently in great demand of innovative and entrepreneurial technicians, technologists, Systems analysts and designers, Systems developers, Network administrators, Database developers and administrators, Managers of IT departments, IT Project managers, Researchers in IT field and other DISCIPLINES, Trainers in IT field, Computer Service Representative, IT Consultant, Customer Support Coordinator, Data Specialist, Data Processing Manager, Help Desk Analyst, Human Resources Information Specialist, Information Officer, Instructional e-learning Designer, IT Specialist, Systems Consultant, Technical Analyst, Technical Evaluator, Technical Researcher, Technical Writer and Future Chief Executive Officers of organizations. Thus, the proposed degree programme is expected to reduce this gap.

iii) Due to high opportunities for self-employment in Information Technology, BSc ITIN programme is designed to prepare next generation IT entrepreneurs and innovators in Tanzania who will be able to implement relevant methods and tools in connection with managing projects and start-up companies.

iv) Furthermore, B.Sc. ITIN degree programme prepares qualified candidates who can join Postgraduate Degree in Information Technology Innovation at SUA and other institutions.

v) The BSc. ITIN will be aligned with the current and developing environment of the Fourth Industrial Revolution (4th IR), which fundamentally changes the way we live, work, and relate to one another.

vi) It will be the first undergraduate degree curriculum at SUA that is structured in Student Centered Learning (SCL) approach that is believed to enhance employability, self-employment and innovation aspects to graduates on a current and professional basis to own learning and developmental needs in connection with developing, operating and expanding their own company.

This B.Sc. ITIN programme has considered the aforementioned reasons and designed a course structure to take care of the emerging ICT market needs.

Stakeholders Involvement

The development of the curriculum for the BSc. ITIN programme is a result of a series of internal meetings that were done to develop a draft curriculum in early 2020. The draft curriculum benefited from inputs from EEISHEA project experts from European Universities in a joint meeting that was conducted at SUA on 9th to 10th January 2020. This was followed by a Departmental meeting on 26th June 2020 to review and comment on the draft. The consultation process was finalized by a stakeholders' workshop held on 17th May 2021. The workshop involved students, academic members of staff from SUA, Mzumbe University, University of Dodoma, University of Dar es salaam, COSTECH, TCRA, TTCL, e-Government Agency (e-GA)/TRA, ICT business startups (e.g., ZATANA Ltd and Odotech IT solutions) (see Appendix 1). The workshop was also attended by the Coordinator of SUA Quality Assurance Bureau, Director of Undergraduate Studies, the Principal of the then Solomon Mahlangu College of Science and Education, now College of Natural and Applied Sciences and the Head of Department (DMICS). The workshop was organized by the host Department to give input on the draft curriculum. Comments from stakeholders were incorporated and the curriculum was submitted to higher University authorities for and approved review before submission to TCU for accreditation.

Programme Objective and Philosophy

2.1.1. Main Objectives

The main objective of the B.Sc. ITIN programme is to produce IT and innovation experts that can identify, analyze and evaluate opportunities for the start-up of new businesses and growth in already established businesses.

2.1.2. Specific Objectives

The specific objectives of this programme are to enable students to:

i. Integrate and apply a coherent body of theoretical and technical knowledge, including underlying concepts and principles in computer programming and software development, information systems engineering, computer networking, databases, IT security, web systems and technologies, entrepreneurship, and innovation.

ii. Demonstrate broad understanding of technology methods, including design processes, whole system approaches, project management, and decision-making strategies and their application in technology and innovation practice.

iii. Plan and carry out research-based projects on innovative ICT solutions for solving development problems taking into consideration relevant Sustainable Development Goals.

iv. Identify, analyse, and formulate complex real-life problems of any domain that need ICT related solutions.

v. Demonstrate life-long learning and continued professional development to cope up with fast changes in the IT technologies/tools (including e-learning, m-learning, and MOOC).

vi. Produce innovative IT products (services) of the desired quality that suit local and/or international market.

It is expected that graduates from this degree programme can employ themselves, become entrepreneurs or be employed either in private or public sectors.

2.1.3. Programme Philosophy

The programme employs learning through Problem Based Learning (PBL) and project-based solving philosophy. The programme requires students to do project works in each semester. The aim of project works is to enable students to learn through doing that culminates into an examinable presentation and a written report at the end of the semester in which a project is held. Based on this, the courses are structured so that the theoretical work supports the implementation of the project work. The courses offered in the programme are thus organized and tuned to focus on themes in each semester. Thus, each semester will have a project course, course supporting a project and a project (See Appendix 8.3).

Programme Expected Learning Outcomes and the Associated Teaching/Learning Activities and Assessment Criteria

The expected outcomes for this degree programme are categorized into knowledge, skills, and competences. The teaching/learning activities will involve interactive lectures, presentations, group and individual projects and independent studies. The assessment will be done through theory tests, practical tests, practical reports, project reports, special research project and theory assignments, and university examinations.

Table 4: Exit level outcomes and assessment criteria

Qualification Category		**Undergraduate**	**Assessment Criteria**
Qualification Type		Bachelor Degree	
Level		**UQF 8**	
Learning Outcom	Knowledge	Students should be able to: i) Explain fundamental concepts, Principles and theories used in Information Technology Innovation. ii) Identify, and describe risks and threats associated with security in ICT.	The assessment will include: theory tests, practical tests, practical reports, project reports

	Skills	Students should be able to: i) Analyze the local impacts of ICT systems on individuals, organizations, and society in relation to relevant sustainable development goals. ii) Master the most common software and platforms for producing IT solutions iii) Disseminate (Communicate) ICT solutions and research results to professional users, non-professional users as well as local communities. iv) Execute responsibilities and leadership roles including ethical practices in the IT profession.	and presentations, assignments, and university examinations.
es	Competencies	Successful students should be able to: i) Identify, analyse, and formulate complex real-life problems of any domain that need ICT related solutions. ii) Design, implement, evaluate, and manage innovative computer information systems. iii) Engage in life-long learning and continued professional development to cope up with fast changes in the IT technologies/tools (including e-learning) iv) Initiate, assess, and manage innovative ICT projects including executing new projects and start-ups. v) Produce innovative IT products (services) of the desired quality that suit local markets. vi) Plan and carry out research-based projects on ICT solutions for solving development problems taking into consideration relevant sustainable development goals.	

Programme Management

Entry Arrangement

The general regulations for Undergraduate Degrees of the Sokoine University of Agriculture shall apply. Applicants must have attained at least UQF Level 6 (Ordinary Diploma) or NQF Level 5 (Advanced Certificate of Secondary Education) or recognized equivalent prior learning qualifications. Applicants have to send their applications through the SUA online admission system in accordance with TCU guidelines and timeframes.

Confirmation of admission to the University will be subject to satisfactory verification of academic certificates submitted during the application process. The verification will be done during the orientation week and each prospective student will be required to submit original hard copies of their certificates.

Transfer and Progression to Higher Levels of Studies

Transfers of students within SUA and transfers across universities shall be carried out in accordance with TCU and SUA transfer regulations. Horizontal articulation options shall be possible for a candidate to transfer accumulated credits to and from recognized professional institutions offering similar courses to the level similar to that of SUA as guided by guidelines issued by the TCU. After a successful completion of the B.Sc. ITIN programme at SUA, a candidate can proceed to UQF 9 to study a Masters' degree programme.

Learning Assumed to be in Place

To be admitted to the BSc Information Technology Innovation Programme at Sokoine University of Agriculture, a candidate needs to meet the minimum entry requirements stipulated in section 1.10 of this document. It is assumed that any candidate who has met the entry requirements (stipulated in section 1.10 above) will have acquired competencies and knowledge in science subjects and allied fields to undertake the BSc Information Technology Innovation. Where there is deficiency, SUA regulations will apply, and a candidate may be required to undertake remedial courses before being allowed to register for the programme.

Benchmarking and international comparability

The programme is comparable in terms of duration, subject matrix, subject knowledge, skills, and competencies to similar programmes in other universities such as the University of Dar es Salaam (BSc. Computer Science), and Ardhi University (BSc. in Computer Systems and Networks (BSc CSN), BSc. in Information Systems Management (BSc. ISM). Internationally the programme is comparable with the University of Essex in USA (BSc. Computer Science), University of Tasmania in Australia (BSc. ICT, BSc. Computer Science), University of Namibia in Namibia (BSc. Computer Science), University of Rwanda, Makerere

University, Uganda, Moi University in Kenya, University of South Africa in South Africa, and Coventry University in the UK. Likewise, the BSc. ITIN programme was developed by following the Inter-University Council for East Africa (IUCEA) benchmarks for the Bachelor of Computer Science and the Bachelor of Information Technology programmes. The BSc. ITIN curriculum contains requirements/benchmarks concerning Computer Science and IT from: Accreditation Board for Engineering & Technology, Association for Computing Machinery (ACM), Institute of Electrical and Electronics Engineers (IEEE), Accreditation Agency for Engineering, Informatics, Physics and Mathematics, and the Quality Assurance Agency for Higher Education UK. Moreover, the BSc ITIN follows the Software Engineering Body of Knowledge (SWEBOK), ISACA Chapter Tanzania and Tanzania ICT Commission. Tanzania ICT commission has endorsed the curriculum and the endorsement letter is attached (Appendix 4).

Programmes/Disciplines Directly Related to the Proposed Programme

The BSc Information Technology Innovations relates to Information Technology, Computer Science, Information Systems, Informatics, Software Engineering, and Information Systems Management.

Programmes/Disciplines Supporting the Proposed Programme

The supporting disciplines for BSc ITIN include Mathematics, Statistics, Communication Skills, and Entrepreneurship.

Programme Delivery Monitoring and Evaluation Mechanisms

There will be both formative and summative evaluation of the programme, conducted by the host Department. In formative evaluation, data about the programme implementation will be collected regularly from both staff and students and analyzed to ensure that the quality of the programme implementation is maintained throughout. Summative evaluation, in the form of tracer studies, will be conducted every three years, involving staff, students, alumni, and employers, to specify programme status, conditions, and areas for improvement. The information from different stakeholders will be used for accountability purposes.

Normal Learning Matrix and Course Matrix

Table 5: Semester 1 Year 1

Course Code	Course Name	Core or Elective	Scheme of Study (Hours)						
			L*	T/S*	AS*	IS*	P*	Total hours	Credits
ITIN 100	Computer Programming	Core	20	0	10	40	30	100	10
ITIN 106	Introduction to Computer Networking	Core	20	0	10	40	30	100	10
ITIN 101	Introduction to Digital Electronics	Core	30	0	15	45	30	80	8
BMEI 104	Entrepreneurship and Business Development	Core	30	20	15	15	0	80	8
ITIN 103	Semester Project 1 – Problem solving using Computer Programming	Core	0	30	100	20	60	120	12
ITIN 104	Field Practice Training I	Core	0	0	0	0	60	60	6
	Total of Core courses		100	50	60	220	150	540	54
ITIN 102	Computer Troubleshooting and Maintenance	Elective	30	0	15	45	30	120	12
MTH 100	Foundation of Analysis	Elective	30	15	15	15	0	90	9

SC 100**	Communication Skills I	Elective	30	15	15	15	0	75	0
	Total of Elective courses		90	30	45	75	30	285	21
	Total for Semester 1 year 1		190	80	105	295	180	825	75

L= Lectures; S/T= Seminars /Tutorials; AS= Assignments; IS= Independent Study; P= Practical

***** The course must be passed but does not contribute to GPA***

Table 6: Semester 2 Year 1

Course Code	**Course Title**	**Core or Elective**	**Scheme of Study (Hours/Credits)**						
			L*	**T/S***	**AS***	**IS***	**P***	**Total hours**	**Credits**
ITIN 107	Operating Systems and Computer Architecture	Core	30	0	15	45	30	120	12
ITIN 108	Fundamentals of Data Structures	Core	30	0	15	45	30	120	12
ITIN 109	Multimedia, Animation and Graphics	Core	30	0	15	45	30	120	12
SC 101	Communication Skills II	Core	30	15	8	7	0	60	6.0
ITIN 110	Semester Project 2 – Analysis, Design, and Development of Algorithms	Core	0	30	10	20	60	120	12
	Total of Core courses		120	60	63	192	90	540	54
ITIN 105	Introduction to Business Information Technology	Elective	15	15	8	7	30	75	7.5
MTH 106	Introductory Statistics	Elective	30	15	15	15	0	75	7.5
MTH 112	Discrete Mathematics	Elective	30	15	15	15	0	75	7.5
	Total of Elective courses		75	45	38	37	30	175	22.5
	Total for Semester 2 year 1		175	105	101	229	120	715	76.5

L= Lectures; S/T= Seminars /Tutorials; AS= Assignments; IS= Independent Study; P= Practical

Table 7: Semester 1 Year 2

Course Code	Course Title	Core or Elective	Scheme of Study (Hours/Credits)						
			L*	S/T*	AS*	IS*	P*	Total hours	Credits
ITIN 200	Database Design and Development	Core	20	0	10	40	30	100	10
ITIN 202	Object Oriented Programming	Core	20	0	10	40	30	100	10
ITIN 204	Web Apps Design and Development	Core	20	0	10	40	30	100	10
ITIN 207	Introduction to Artificial Intelligence	Core	30	0	15	20	15	80	8
ITIN 205	Semester Project 3- Interactive Information Systems Development	Core	0	30	10	20	60	120	12
ITIN 213	Field Practice Training II	Core	0	0	0	0	80	80	8
Total of Core courses			90	30	55	220	185	580	58
ITIN 201	Human-Centered Computing	Elective	30	0	15	20	15	80	8
MTH 210	Mathematical Logic and Formal Semantics	Elective	30	15	15	15	0	75	7.5
Total of Elective courses			60	15	30	35	15	155	15.5
Total for Semester 3 year 2			150	45	85	255	200	735	73.5

L= Lectures; S/T= Seminars /Tutorials; AS= Assignments; IS= Independent Study; P= Practical

Table 8: Semester 2 Year 2

Course Code	Course Title	Core or Elective	Scheme of Study (Hours/Credits)						
			L*	S/T*	AS*	IS*	P*	Total hours	Credits
ITIN 208	Python Programming	Core	30	0	15	45	30	120	12
ITIN 209	Systems Engineering and Project Management	Core	30	0	15	45	30	120	12
ITIN 210	IT innovation and entrepreneurship	Core	30	0	15	20	15	80	8
ITIN 203	Information Security	Core	30	0	15	45	30	120	12

ITIN 211	Semester Project 4 –Innovative Digital Solutions Development	Core	0	30	10	20	60	120	12
	Total of Core courses		90	30	55	215	90	480	56
ITIN 206	Fundamentals of Geographic Information System	Elective	30	0	15	45	30	120	12
ITIN 212	Introduction to Modeling and Simulation in MATLAB	Elective	30	N/A	15	20	15	80	8
	Total of Elective courses		60	15	23	27	30	155	20
	Total for Semester 4 year 2		150	45	78	242	120	635	76

L= Lectures; S/T= Seminars /Tutorials; AS= Assignments; IS= Independent Study; P= Practical

Table 9: Semester 1 Year 3

Course Code	**Course Title**	**Core or Elective**	**Scheme of Study (Hours/Credits)**						
			L*	**S/T***	**AS***	**IS***	**P***	**Total hours**	**Credits**
ITIN 300	Database Implementation and Tuning	Core	20	0	10	40	30	100	10
ITIN 301	Mobile Apps Design and Development	Core	20	0	10	40	30	100	10
ITIN 302	Network Design and Management	Core	20	0	10	40	30	100	10
ITIN 303	ICT Innovations for Sustainable Development	Core	30	0	15	20	15	80	8
ITIN 304	Final Research Project Phase I & Phase II	Core	0	15	0	105	0	120	12
ITIN 306	Field Practice Training III	Core	0	0	0	0	100	100	10
	Total of Core courses		90	15	45	245	205	600	60
ITIN 305	Knowledge based Expert System	Elective	30	0	15	20	15	80	8
MTH 303	Numerical Analysis II	Elective	30	15	15	20	0	80	8.0
	Total of Elective courses		60	15	30	40	15	160	16

Total for Semester 5 year 3	150	30	75	285	220	760	76

L= Lectures; S/T= Seminars /Tutorials; AS= Assignments; IS= Independent Study; P= Practical

Table 10: Semester 2 Year 3

Course Code	**Course Title**	**Core or Elective**	**Scheme of Study (Hours/Credits)**						
			L*	**S/T***	**AS***	**IS***	**P***	**Total hours**	**Credits**
ITIN 307	Computer Network Security	Core	30	0	15	45	30	120	12
ITIN 308	Machine Learning	Core	30	0	15	45	30	120	12
ITIN 310	Big Data Analytics	Core	30	0	15	45	30	120	12
ITIN 311	Final Research Project Phase II	Core	0	10	0	80	30	120	12
	Total of Core courses		90	10	45	215	120	480	48
ITIN 309	Distributed Computing	Elective	30	0	15	45	30	120	12
ITIN 313	IT Innovation and entrepreneurship execution	Elective	30	N/A	15	45	30	120	12
	Total of Elective courses		60	0	30	90	60	240	24
	Total for Semester 6 year 3		150	10	75	305	180	720	72

L= Lectures; S/T= Seminars /Tutorials; AS= Assignments; IS= Independent Study; P= Practical

Assessment Details

Programme Assessment Strategy

Except for Semester Projects, the programme assessment will involve coursework and end of semester University Examinations for each course. The coursework for each course will include tests, assignments, projects, practical, and presentation that will constitute 60% of the total score while the University Examination will constitute the remaining 40%. FPT assessments will compose of several units including scores from the field station determined by both site supervisor (local training officer) and the visiting academic staff from the university as well as the final presentation, which will be done at the university. The final presentation shall be scheduled soon after the completion of FPT in a departmental panel. The composition of the entire FPT assessment includes an assessment by the local training officer at the FPT station 30%, assessment of the log-book 10% by SUA academic staff, assessment of FPT reports 30%, and the assessment of FPT presentations 30%. The log-books shall be available at the Department and shall be provided to students prior to FPT. Assessment of the Semester Projects will follow the Final Research Project as per SUA examination guidelines and regulations (2021)

Examination general format and examination regulations

The examinations shall be prepared as per SUA examinations regulations and guidelines as approved by the Senate. General examination regulations are stipulated in the Sokoine University of Agriculture examination guidelines and regulations (2021). The guidelines are expected to carter for checks and balances with the view of ensuring SUA academic excellence and integrity in line with the Quality Assurance requirements and objectives. The guidelines address general principles of good practice, and procedures that shall be applied to ensure efficient and effective administration of examination paper setting at SUA.

Examination moderations

The Departmental Examination Moderation Committee will be responsible for moderating all end of semester examinations**.** The team will scrutinize all draft examination papers with a view of ascertaining their quality. Feedback from the moderation team will be used to revise the draft examinations before the final versions are produced. External Examiners shall be invited to examine marking and overall assessment at the end of the academic unit**.**

Condition for continuation and discontinuation

Abscondment from examinations, or absence from FPT, or failure to meet minimum examination pass mark or examination cheating or any irregularities as stipulated in the general University examinations regulations and guidelines (2021), can lead to discontinuation from studies.

Weight of each component in the final assessment of the programme

The assessment for each course in this degree programme will have two components: Coursework which will carry 60% and 40% for courses with practical and non-practical courses respectively. End of semester University Examination will carry 40% and 60% for courses with practical and non-practical components respectively. Specific assessment procedures for different courses are as indicated in the appended course outlines. The overall pass mark for each of the courses shall be 50%. A student failing in one course of the examination will have a probation status and shall be required to sit for a probation examination.

Courses Description

Semester 1 Year 1

i) **Course title: ITIN 100 - Computer Programming**

ii) **Course aim:**

The aim of this course is introducing the student to the fundamental concepts of programming, algorithm design along with their respective applications.

iii) **Course expected learning outcomes:**

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

1. Describe concepts related to procedural programming.
2. Comprehend simple problems that require computer programming solutions.
3. Design algorithms (pseudocode and flowchart) to solve simple problems
4. Develop computer program for the designed algorithms.

iv) **Course status:** Core

v) **Credits rating:** 10.0

vi) **Total hours spent:** 100 hours

vii) **Course contents:**

An overview of computers and programming languages: Understanding the issues pertaining computers, hardware and software, software code, interpreter, compiler, linker, executable code, object code; structured and object oriented programming; understanding issues pertinent to programming languages; **Algorithms and problem-solving**: Problem-solving strategies; the role of algorithms in the problem-solving process; implementation strategies for algorithms; debugging strategies; the concept and properties of algorithms; **Fundamental programming constructs:** Syntax and semantics of a higher-level language; variables, types, expressions, and assignment; simple I/O; conditional and iterative control structures; functions and parameter passing; structured decomposition; **Fundamental data structures:** Primitive types; arrays; records; strings and string processing - Software development methodology; **Fundamental design:** Concepts and principles; testing and debugging strategies; test-case design (black box testing and requirements testing); unit testing; programming environments.

viii) **Teaching and learning activities:**

Lectures 20 hours, practical 30 hours, assignments 10 hours and independent study 40 hours.

ix) **Assessment methods:**

Coursework: Theory test(s) and/or quizzes (15 marks), Assignment (5 marks), Practical assignments/tests/projects (40 marks), all together, contributing 60% of the total score.

End of semester examination: constitute 40% of the total score

x) **Reading list**

1. Bjarne, S. (2022). Tour of C++, A (C++ In-Depth Series) 3rd Edition
2. Mike M. (2022). C++ Programming in Easy Steps, 6th Edition
3. Rainer, G. (2022). C++ Core Guidelines Explained: Best Practices for Modern
4. Richard L. H. (2015). *Fundamentals of Programming C++,* Southern Adventist University- School of Computing
5. Rafał Ś. (2022). Modern CMake for C++: Discover a Better Approach to Building.
6. Stephen, R Davies (2014). *C++ for Dummies,* John Wiley & Sons, Inc.

i) **Course title: ITIN 106 - Introduction to Computer Networking**

ii) **Course aim:**

To provide students with an overview of the concepts and fundamentals of computer networks.

iii) **Course expected learning outcomes:**

Upon successful completion of this course the student will be expected to:

i. Explain the fundamentals of computer networks, their types, transmission modes, and different reference models.
ii. Analyze behaviors of networking protocols using computer networking tools.
iii. Design new network protocols for network services to meet certain requirements.
iv. Construct and debug a small-medium IP network using both on hand and computer software.

iv) **Course status:** Core

v) **Credits rating:** 10

vi) **Total hours spent:** 100 hours

vii) **Course contents:**

Networking Fundamentals: Network classification – LAN, WAN, Intranet, Internet, Extranet, peer-to-peer, client server, hybrid models, and network topologies; **Layered Model:** Introduction to layered models, Benefits of Using a Layered Model; Open Systems Interconnection (OSI/ISO) reference Model: The seven (7) layers of the OSI model Application, Presentation, Session, Transport, Network, Data link, Physical; TCP/IP Model: 4/5 layers Application, Transport, Internetwork, Network Interface, TCP/IP Data Encapsulation, OSI vs. TCP/IP, IPv4 and IPv6 addressing, MAC addressing, port addressing, IP addressing, Sub netting, Super netting; **Networking Media:** Overview of LAN cabling – coaxial, UTP, STP, Fibre; Coaxial cables –10base5, 10base2, UTP/STP standards, different types of connectors; Fiber optic cabling: types of fibers, mode of transmission, splicing, connectors and termination, structured cabling; Cable testing: UTP, Fiber; **Local Area Networks Technologies:** Ethernet, Token Ring, ARCnet, FDDI, LANs extension and Internetworking Devices; **Ethernet**

Fundamentals: NIC, MAC address (unicast, multicast, broadcast), old Ethernet standards, recent Ethernet standards – fast Ethernet, Gigabit Ethernet; **Wireless Networks and Technologies:** WPAN-Bluetooth - Zigbee, NFC, Infrared, RFID, etc, WLAN- WiFi, WMAN-WiMAX, Internet; **Media Access Methods:** CSMA/CD, CSMA/CA, Data Link Control, performance limitation, methods to reduce collisions, Congestions, Error Detection and Correction; **Internet architecture:** TCP/IP Protocol Suite, IPv6, Domain Name servers, Routing and routing tables;

viii) **Teaching and learning activities:**

Lectures 20 hours, practical 30 hours, assignments 10 hours and independent study 40 hours.

ix) **Assessment methods:**

Coursework: Theory test (s) and/or quizzes (15 marks), Assignment (5 marks), Practical assignments/tests/projects (40 marks), all together, contributing 60% of the total score.

End of semester examination: constitute 40% of the total score

x) **Reading list**

1. Kewei, S, Aaron. S, Min. S. (2017). Advances in Computer Communications and Networks From Green, Mobile, Pervasive Networking to Big Data Computing, 1st Edition, CRC Press.
2. Wu, C. H. J., and Irwin, J. D. (2016). *Introduction to computer networks and cybersecurity*. 2nd Edition, CRC Press.
3. White, C. (2015). *Data communications and computer networks: a business user's approach*. 8th Edition, Cengage Learning.
4. Anuj Singal, Sandeep Kumar, Sajjan Singh, Ashish Kr. Luhach. *(2017).* Wireless Communication with Artificial Intelligence Emerging Trends and Applications.
5. Mahbub. H. (2022). Wireless and Mobile Networking, CRC Press.
6. Comer, D. (2015). *Computer networks and the Internet*. 6th Edition, Pearson.
7. Beard, C., Stallings, W., and Tahiliani, M. P. (2016). *Wireless communication networks and systems*. Pearson Education Limited.

i) **Course title: ITIN 101 - Fundamentals of Digital Electronics**

ii) **Course aim:**

To introduce students to fundamental concepts of electronics and basics in circuitry and give them an insight into modern design of digital systems.

iii) **Course expected learning outcomes:**

By the end of the course a student should be able to:

1. Describe the basic components of electronic systems
2. Create the design specifications of a digital circuit for a given problem.
3. Examine principles behind the design of logic circuits systems.
4. Design logic circuit systems using computer software and programmable devices.
5. Apply structured methods for analysis and synthesis of combinational and sequential circuits.

iv) **Course status**: Core

v) **Credits rating:** 10.0

vi) **Total hours spent:** 100 hours

vii) **Course contents:**

Introduction to Electronics: analog vs digital signals, Elementary physics of semiconductor materials, P-N junction diodes, Zener diodes, Types of transistors, equivalent circuits of diode, bipolar transistor and FET, switching characteristics of diodes and Transistors, components of electronic circuits, amplifiers, power supplies and signal generators; **Introduction digital logics:** Number systems, arithmetic operations, conversion between bases, representation of number systems, and Binary codes; **Switching Algebra and Logic Circuits:** Boolean algebra and logic gates, standard forms, circuit optimization using K-maps; **Logic Families:** Logic families significance and types, types and characteristics of logic families, comparison of logic families, guidelines to handling logic families, interfacing with different logic families and classification of digital IC's; **Combinational Circuits:** Combinational logic and building blocks, delays, binary

arithmetic, arithmetic circuits, decoders, encoders, multiplexers, demultiplexers, ROMs, PALs and PLAs; **Design and Analysis of Sequential Systems:** Flip-Flop design techniques, asynchronous and synchronous counters, registers, derivation of state tables and state diagrams.

Data Conversion Circuits: D/A and A/D converter, types, and applications; **Troubleshooting Digitals Circuits and Test Equipment:** general troubleshooting guidelines, test and measuring equipment, computer instrument interfacing standards.

viii) **Teaching and learning activities:**

Lectures 20 hours, practical 30 hours, assignments 10 hours and independent study 40 hours.

ix) **Assessment methods:**

Coursework: Theory test (s) and/or quizzes (15 marks), Assignment (5 marks), Practical assignments/tests/projects (40 marks), all together, contributing 60% of the total score.

End of semester examination: constitute 40% of the total score.

x) **Reading list:**

1. Taan S, ElAli. (2022). Systems and Signal Processing with MATLAB, CRC Press
2. Farzin. A. (2022). Electric and Electronic Circuit Simulation using TINA-TI, 1st Edition, River Publishers
3. Kumar, A (2014). *Fundamentals of Digital Circuits.* Nangewer Mekar Bogor, Indonesia.
4. Ndjountche, T (2016). *Digital Electronics 2: Sequential and Arithmetic Logic Circuits*. Wiley Publishers

i) **Course title: BMEI 104 -Entrepreneurship and Business Development**

ii) **Course aim:**

To acquaint and equip students with fundamental knowledge and skills in entrepreneurship; specifically, students will learn on how entrepreneurship can apply at corporate, social, and commercial perspectives.

iii) **Course Expected Learning Outcomes:**

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

1. Explain the historical background of entrepreneurship.
2. Describe how entrepreneurship can be a tool towards organizational success.
3. Identify different areas where entrepreneurship can apply.
4. Develop creativity and innovation in initiating winning business ideas.
5. Apply entrepreneurship in initiating high growth entrepreneurial firms.

iv) **Course Status**: Core

v) **Credit Rating:** 8.0

vi) **Total hours spent**: 80

vii) **Course Contents:**

Anatomy of entrepreneurship: The meaning and historical background of entrepreneurship, Myths of entrepreneurship, Entrepreneurship versus small business management, Importance of entrepreneurship to an economy, Characteristics of successful entrepreneurs (Africa entrepreneurs), Challenges facing today's entrepreneurs; Entrepreneurship theories; **Theories of entrepreneurship:** Sociological theories, Psychological theories, Economic theories, Social capital theories, Cultural based theories, Network based theories; **Entrepreneurship in practice:** Entrepreneurship at corporate bodies (Entrepreneurship), Enablers and Inhibitors of Entrepreneurship, Social entrepreneurship and transformation of people's lives, Commercial entrepreneurship and management of small business, Misconception of application of entrepreneurship, Challenges in applying entrepreneurship at social, corporate and commercial grounds; **Creativity and innovation:** The meaning of creativity and innovation, Creative and innovative thinking, The role of creativity in building successful innovation, Skills and behavior that enhance creativity and innovation within individuals, Challenges in building creativity and innovation within individuals and organizations; **Creating entrepreneurial organization:** The meaning of entrepreneurial organization, Fostering entrepreneurial thinking within organizations, The role of

entrepreneurship in today's organizations, Inhibitors and enablers of entrepreneurial organizations, Challenges in building entrepreneurial organization; Evaluation of a new business opportunity, Critical Factors for Success, Sources of ideas for new ventures, Researching the opportunities, Sources of funding.

viii) **Teaching and Learning Activities:**

Lectures 30 hours, assignments 15 hours, seminar 20 and independent study 15 hours.

ix) **Assessment Methods**

Coursework: Theory test (s) and/or quizzes (30 marks), Assignment (10 marks), all together, contributing 40% of the total score.

End of semester examination: constitute 60% of the total score.

x) **Reading List:**

1. Anthony Abiodun Eniola, Chux Gervase Iwu, Abdullah Promise Opute. (2022). The Future of Entrepreneurship in Africa: Challenges and Opportunities Post-pandemic, 1st Edition, Routledge
2. Morgan R. Clevenger and Michael W-P Fortunato. (2022). Empowering Entrepreneurial Communities and Ecosystems: Case Study Insights, 1st Edition. Routledge
3. Morgan R. Clevenger and Michael W-P Fortunato. (2022). Entrepreneurial Communities and Ecosystems: Theories in Culture, Empowerment, and Leadership, 1st Edition
4. Kuratko, D. F. (2007). *Corporate Entrepreneurship*. Now Publishers Inc, USA.

i) **Course title: ITIN 103 - Semester Project: Problem Solving Using Computer Programming**

ii) **Course aim:**

To enable students to put into practice the knowledge acquired, showcase, and apply skills and competencies acquired in current semester courses, showing their mastery in communication skills, problem-solving abilities while practicing team working and organizational skills.

iii) **Course expected learning outcomes:**

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

1. Use skills for formulating problems and analysing that require computer programming solution.
2. Investigate and propose solution.
3. Develop computer programs that solve problems in the society
4. Apply programming skills as a means of implementing an algorithmic solution.
5. Implement and validate a working prototype.

iv) **Course status:** Core

v) **Credits rating:** 12.0

vi) **Total hours spent**: 120 hours

vii) **Course contents:**

Ideation: Student groups will brainstorm about real-world problems. This might include students visiting the industry for real-world problems; **Create and analyse a problem:** Students will work on their teams to identify, analyse and design solutions to the identified problem(s). Formulate and analyze problems and write its procedures; **Develop prototype:** Write the corresponding computer program; perform program testing and debugging; **Full project implementation:** Perform system testing, deploy system, write report, and perform presentation or communicate the project results.

viii) **Teaching and learning activities:**

During the course students are required to complete a small programming project. Learning is based on class guidance; guided project based learning and individual and group project assignments. Seminars 30 hours, Assignment 10 hours, independent study 20 hours, and practical 60 hours.

ix) **Assessment methods:**

Coursework: Project proposal (10%), Team Project Assignments #1-9 (30%), Sprint Reports (10%), Individual Homework Assignments (5%), all together, contributing 55% of the total score.

End of semester examination: Final Deliverables and Project Review (project presentation and system demonstration (20%) and Final project report (20%)), and Individual Reflection (5%), all together, contributing 45% of the total score.

x) **Reading list**

1. Kochan, S. (2014). *Programming in C*. Addison-Wesley Professional.
2. Rafał Ś. (2022). Modern CMake for C++: Discover a Better Approach to Building.
3. McAllister, W., and Fritz J. S. (2014). *Programming Fundamentals Using Java: A Game Application Approach (Computer Science)*. Prentice Hall Professional.
4. Mike M. (2022). C++ Programming in Easy Steps, 6th Edition
5. Harper, R. (2014). Practical Foundations for Programming Languages> Carnegie Mellon University.
6. Bjarne, S. (2022). Tour of C++, A (C++ In-Depth Series) 3rd Edition
7. Richard L. H. (2015). Fundamentals of Programming C++. Southern Adventist University School of Computing.
8. Rainer, G. (2022). C++ Core Guidelines Explained: Best Practices for Modern
9. Richard L. H. (2015). *Fundamentals of Programming C++,* Southern Adventist University- School of Computing

i) **Course title: ITIN 102 -Computer Troubleshooting and Maintenance**

ii) **Course aim:**

The aim of this course is to provide to a student essential competency on troubleshooting various computer problems and solving them.

iii) **Course expected learning outcomes**

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

1. Describe key concepts related to computer hardware, computer software, computer troubleshooting and maintenance.
2. Install and configure PC hardware and software system components.
3. Troubleshoot to detect problems with PC hardware and software.
4. Upgrade and repair PC and computer systems.
5. Plan for PC preventive Maintenance.

iv) **Course status:** Elective

v) **Credits rating:** 12.0

vi) **Total hours spent:** 120 hours

vii) **Course contents:**

An overview of a computer: Understanding the meaning of computer, major components of the computer, characteristics of the computer, computer operations, computer generations and types of computers; **An overview of a computer hardware and software**: Understanding the meaning of computer hardware and software, input, output, storage and processing units, system unit, system software, application software, word processing software, electronic spreadsheet software; **Computer hardware**: The system case; the Motherboard; CPU/MCP; Clock; Memory; I/O Expansion Bus, Speaker, I/O Ports and Cables, PS2 Ports, Lasers and High-Power Light Sources, High Voltage Equipment, Printer Technologies, Printer Connections and Configurations; **PC troubleshooting and Maintenance**: tools and equipment, procedures for PC troubleshooting, and maintenance, identifying problem to documenting the solution, power problems, Internet access problems, network access problems, Problems with Laptops and Personal Digital Assistants (PDAs), installing, upgrading and troubleshooting of motherboards, hardware and software components and Troubleshooting of Printers; **Safety and preventive maintenance**: Preventive maintenance plan, Preventive maintenance schedule, Preventive Maintenance tools and equipment, Environmental Issues, Storage of PC Components and CRT Servicing and Handling.

viii) **Teaching and learning activities:**

Lectures 30 hours, Practical 30 hours, assignments 15 hours and independent study 45 hours.

ix) **Assessment methods:**

Coursework: Theory test (s) and/or quizzes (15 marks), Assignment (5 marks), Practical assignments/tests/projects (40 marks), all together, contributing 60% of the total score.

End of semester examination: constitute 40% of the total score.

x) **Reading list**

1. Beckerman, J. (2014). *How to Build a computer: Learn, Select Parts, Assemble and Install.*
2. *Dan Gookin. (2021). Troubleshooting and Maintenance PCs. Wiley*
3. Enrico, S (2014). *How to Become a Computer Peripheral Equipment Operator*.
4. *Tanios. S* (2021). Maintenance Therapy for Metastatic CRC
5. Lown, H (2018). *Computer Hardware Repair Guide Pc and Hidden Design of Computer Hardware and Software: Upgrading and Troubleshooting Your own computer comptia Guide*. Independently published
6. Mueller, S (2015). *Upgrading and Repairing PCs. Que Publishing.*

i) **Course title: MTH 100- Foundations of Analysis**

ii) **Course aim:**

The aim of this course Foundations of Analysis is to provide students with knowledge of mathematical abstraction, the development of mathematical proofs to stimulate critical thinking ability, and the use of the language of mathematics.

iii) **Course expected learning outcomes:**

By the end of the course, students are expected to be able to:

1. Perform set operations and apply knowledge of sets to solve various mathematical problems.
2. Construct direct and indirect proofs by induction.
3. Work with functions in particular bijections, direct and inverse images, and inverse functions.
4. Use mathematical logic and reasoning in solving various mathematical problems.
5. Apply the logical structure of the proofs and work symbolically with connectives and quantifiers to produce logically valid, correct, and clear arguments.

iv) **Course status:** Elective

v) **Credits rating:** 7.5

vi) **Total hours spent:** 75 hours

vii) **Course contents:**

Sets: Sets, subsets, set operations, Venn diagrams, algebra of sets, Countable and uncountable sets, cardinality; **Logic**: Propositions, local connectives (negation, conjunction, disjunction, conditional, biconditional, parentheses). Truth tables, tautologies, contradictions, logical, equivalences. Algebra of propositions, inferences, formal arguments, quantifiers; ***Proofs****:* Mathematical statements, general and particular statements, converse and contrapositive of a statement. Methods of proof, direct proof, proof by contradiction, contrapositive, and mathematical induction; **Number Systems:** Natural, integer, rational, real and complex numbers. Peano postulates for the natural numbers, ordering and well ordering. Formal development of the integers from the natural numbers, the rational numbers from the integers, the real numbers from the rational and the complex numbers from the real numbers. The rational numbers as an ordered field. The supremum and infimum and the completeness axiom of the real numbers. Dedeking cuts. Rational exponents of positive real numbers; intervals, inequalities, and absolute values. Complex plane, De Moivre's theorem, nth roots, complex roots of real polynomials; **Relations:** Set products, ordered pairs, relations, inverse relations, equivalence relations, partitions; **Functions of One Variable**: Definition, domain, range, and graph of a function. Arithmetic operations on functions, composition of functions, polynomial and rational functions. Injective surjective and bijective functions: inverse functions; monotone, bounded and unbounded functions.

viii) **Teaching and learning activities**

This course relies on lectures as the primary delivery mechanism for the material. Tutorials supplement the lectures by providing exercises and example problems to enhance the understanding obtained through lectures. A sequence of take-home group and individual assignments, independent reading provides assessment opportunities for students to gauge their progress and understanding.

ix) **Assessment methods:**

Assessment methods for this course will include assignments, quizzes, timed tests and the end-of-semester examinations.

x) **Reading list**

1. Achayrja, D. P. & Sreekumar, D. P. (2005). *Fundamental approach to Discrete Mathematics*, New Age International (P) Limited: New Delhi.
2. Sergei Ovchinnikov. (2021). Real Analysis: Foundations, Springer Nature
3. *Steven G. Krantz*. (2019). Foundations of Analysis, Chapman and Hall/CRC
4. Hammack, R. (2013). *Book of Proof*. Virginia Commonwealth University, Virginia
5. *Ming Cheng, Chi Wai Law, Leilei Liu. (2021).* Analysis, Design and Construction of Foundations. 1st Edition, CRC Press

i) **Course title: SC 100-Communication Skills**

ii) **Course aim:**

This course aims at giving students active listening and responding skills.

iii) **Course expected learning outcomes:**

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

1. Demonstrate an understanding of English tense.
2. Use appropriately finite and non-finite verb forms in sentences.
3. Use English articles appropriately.
4. Demonstrate the understanding of subject verb agreement.
5. Develop competence in using different linking words in indicating relationship of ideas between and within the sentence and paragraph.
6. Apply different elements of basic sentence structure in a sentence.

iv) **Course status:** Elective

v) **Credits rating:** 7.5

vi) **Total hours spent:** 75 hours

vii) **Course content:**

Basic sentence structure: elements of structure in a sentence (e.g., subjects, verbs, objects, adverbials, etc.); **Subject verb agreement:** the concept of agreement, ordering of items in the subject; **Non-Finite Verb Forms:** the forms and functions of non-finite verbs. Noun classes; mass versus count nouns, mass and count nouns with quantifiers; **Uses of the article**: definite and indefinite articles; **The English tense system:** (i.e. tense versus time, aspect versus tense, uses of the tense); **The verb phrase:** (simple versus compound verbs, forms of compound verbs, main verbs versus auxiliary verbs, uses of auxiliary verbs); **Formation of passive forms of verbs**: the process of passive formations, participants' roles in active and passive sentences; **Conjunctions in signaling and linking ideas**: the use of conjunctions (also known as connectors) in joining sentences and indicating relationship of ideas between and within sentences and paragraph. Other connectors in contextual reference

viii) **Teaching and learning activities:**

The course shall be delivered mainly through interactive lectures**,** seminar presentations**,** classroom discussions**,** role plays

ix) **Assessment method:**

The course shall be accessed through Term paper; written tests; Group and individual assignments and Final University Examination.

x) **Reading list**

1. Mohamed, H.I. (2010). *Communication Skills in Higher Education*, Mzumbe, Morogoro: Mzumbe Book Project.
2. Mafu, S.T.A., Mohamed, H.I and Neke, S.M. (2003). *Improve your Communication,* Morogoro, SUA.
3. Martin, J.R. and David, R. (2003). *Working with Discourse*: *Meaning beyond the clause*, London: Continuum.
4. Mohamed, H.I. (2002). *Learn to Communicate Effectively,* Mzumbe –Morogoro: Mzumbe Book Project.
5. Forrest, R. (1998). *Revision English,* (2nd Ed), London, Longman

Semester 2 Year 1

i) **Course title: ITIN 107 - Operating Systems and Computer Architecture**

ii) **Course aim:**

This course aims to provide students with an in-depth understanding of modern operating system technology, implementation techniques, and research issues.

iii) **Course expected learning outcomes:**

By the end of the course candidates should be able to: -

1. Describe the role of the operating system as a high-level interface to the hardware.
2. Developing low-level operating system code.
3. Use of profiling tools to evaluate the performance of operating systems and applications by reviewing the performance of various algorithms.
4. Analyze the relationship between the operating system and the hardware environment in which it runs.

iv) **Subject status:** Core

v) **Credit rating:** 12.0

vi) **Total hours spent:** 120 hours

vii) **Prerequisites**: ITIN 100, ITIN 106, ITIN 101

viii) **Course contents:**

Operating Systems Overview: The fundamental concepts of operating systems; operating system services, file systems and file systems organization, techniques used for processes, disk and CPU scheduling, threads and concurrent processing, Distributed systems; **Processes, Threads, Scheduling:** Process Management: The process concept - Programs, Processes & Threads – Process Control Block – PCB as a data structure in contemporary operating systems - Process Hierarchy - System Calls - CPU Scheduling & algorithms metrics – Examples, Uniprocessor-Multiprocessor and Real-Time Scheduling, Case Study: Unix and its related System Calls; **Interprocess Synchronization & Communication:** Concurrent Processes - The Critical Section & Mutual Exclusion problem - Algorithms - Semaphores, Critical Region, Conditional Critical Region, Monitors, Messages - Examples in Contemporary OS - Classical Process Co-ordination Problems. Deadlocks: Characterization - Prevention - Avoidance - Detection - Recovery - Combined Approach to Deadlock handling & Deadlock Handling in contemporary OS, Case Study: Unix and its related System Calls; **Memory Management:** Memory Hierarchy, Static and Dynamic Memory Allocation, Overview of Swapping, Multiple Partitions Contiguous and Non-Contiguous Memory Allocation, Concepts of Paging, Segmentation, Case Study: Unix and its related System Calls; **Virtual Memory:** Virtual Memory Concepts - Demand paging - Performance - Fragmentation & Compaction. Page replacement and Allocation algorithms –Resident Set Management- Cleaning Policy -Memory Protection - System Calls – Linux/Windows Virtual Memory Techniques, Case Study: Unix and its related System Calls; **Device Management:** Terminals & Capability Databases - Emulators - Virtual Terminals - Disk Devices - Device Independence - Free space management - Performance and Reliability - Storage hierarchy, Case Study: Unix and its related System Calls; **File Systems And Protection Mechanism:** Levels - File Systems in Disk Partitions - File-naming & File Access - Allocation strategies - Directory systems & their implementations - File Systems to device drivers - File Systems Reliability – Examples of fsck() and fsdb() utilities - File protection - Implementation issues, Case Study: Unix and its related System Calls; Computer architecture fundamentals, trends, measuring performance, quantitative principles. Instruction set architectures and the role of compilers. Instruction-level parallelism, branch prediction, thread-level parallelism, VLIW and examples. Memory hierarchy design and caches. Multiprocessors, thread-level parallelism, shared memory architectures, distributed shared memory, synchronization, and multithreading. On-chip interconnection networks and clusters, parallel processing, the memory hierarchy.

ix) **Teaching and learning activities:**

Lectures 30 hours, practical 30 hours, assignments 15 hours and independent study 45 hours**.**

x) **Assessment methods:**

Coursework: Theory test (s) and/or quizzes (15 marks), Assignment (5 marks), Practical assignments/tests/projects/reports (40 marks), all together, contributing 60% of the total score.

End of semester examination**:** constitute 40% of the total score

xi) **Reading list:**

1. Remzi H. et al. (2016). *Operating Systems: Three Easy Pieces*, University of Wisconsin–Madison.
2. Anderson T. and Dahlin M. (2015). *Operating Systems: Principles and Practice*, Kindle Edition.
3. Jean-Loup Baer, J-L., Silberschatz, A. Galvin P. B, and Gagne G. (2012). *Operating System Concepts*, 9th edition. Wiley.

i) **Course title: ITIN 108 - Fundamentals of Data Structures**

ii) **Course aim:**

To enable students to use data structures as tools to algorithmically design efficient computer programs that will cope with the complexity of actual applications and develop and implement efficient algorithms.

iii) **Course expected learning outcomes:**

Upon successful completion of this course students should be able to:

1. Define basic static and dynamic data structures and relevant standard algorithms for them: stack, queue, dynamically linked lists, trees, graphs, heap, priority queue, hash tables, sorting algorithms, min-max algorithm.
2. Determine and demonstrate bugs in the program, recognise needed basic operations with data structures.
3. Construct new solutions for programming problems or improve existing code using learned algorithms and data structures.
4. Assess algorithms and data structures in terms of time and memory complexity of basic operations.

iv) **Course Status:** Core

v) **Credits Rating:** 12.0

vi) **Total hours spent:** 120

vii) **Pre-requisite:** ITIN 100, ITIN 103

viii) **Course contents:**

Introductory concepts: Understanding algorithms, How to write algorithms, Optimizing algorithms, Finding time complexity of an Algorithm, Understanding Data types, What is Data Structure, Need of Data Structure, The Mathematical model.

Lists: What is List and what is it's need, Sequential lists (Arrays), Advantages, Limitations, implementing sequential lists, Linked Lists; The LinkedList structure, Advantages, Limitations, Singly Linked List, Doubly Linked List, Circular Linked List, Time complexity of Linked List and Sequential lists; **Stacks:** Understanding stacks, Stack usage, Implementing Stack; Sequential implementation, Linked implementation. Double stack and its implementation; **Tree;** Introduction to Tree data structure, Tree usage, Types of Trees, Understanding General Tree, Understanding Binary Tree, Understanding Binary Search Tree (BST) , BST usage, Understanding BST algorithms, Insertion and deletion, Inorder, Preorder, Postorder, BFS and DFS, Time complexity of BST algorithms, Implementing BST using arrays, Constructing BST back using the tree traversals, Threaded BST, Why Threaded BST, Threaded BST Algorithms, Insertion and deletion, Inorder, Preorder, Postorder, Time Complexity of Threaded BST. Height Balanced Trees (AVL Trees), Balance factor, right heavy and left heavy tree, Height balancing algorithm, Insertion and deletion algorithms, few other types of trees, Strictly binary tree, Symmetric tree, Red Black Tree, B Tree and B+ Tree; **Queues:** Understanding Queue usage, Implementing Queues, Sequential implementation, Linked implementation, Circular Queue, Usage and implementation, Types of Queue, Priority queue, Double ended queue.

Graphs: Introduction to Graphs, Types of Graph, Directed Graph, Undirected Graph, Implementing Graphs, Sequential implementation, Linked implementation, Graph Algorithms, BFS, DFS, Shortest Path Algorithm; **Minimal Spanning Tree**: creating minimal spanning tree from a graph using, Kruskal's algorithms, Prim's algorithm; **Hash Tables:** The hashing technique, Time complexity of operations on Hash Table, Collision resolution algorithms, Rehashing, Improving performance using Hash Table, Infix, Prefix and Postfix Expression, Infix to prefix conversion and it's evaluation, Infix to postfix conversion and it's evaluation; **Searching Algorithms:** Linear Search, Binary Search, Indexed sequential search, Fibonacci Search; **Sorting Algorithm:** Bubble Sort, Selection Sort, Insertion Sort, Radix Sort, Merge Sort, Quick Sort, Heap Sort; **Finding Time and Space Complexity of Algorithms;** Omega notation, Big O notation.

ix) Teaching and learning activities:

Lectures 30 hours, practical 30 hours, assignments 15 hours and independent study 45 hours.

x) Assessment methods:

Coursework: Theory test (s) and/or quizzes (15 marks), Assignment (5 marks), Practical assignments/tests/projects/reports (40 marks), all together, contributing 60% of the total score.

End of semester examination: constitute 40% of the total score.

xi) Reading list:

1. Chase, J., Lewis, J., and DePasquale, P. (2020). *Introduction to program design & data structures.* (5th ed.) Toronto, ON, Pearson: Addison-Wesley. ISBN: 978-0-13-520597-6
2. Jena, S. R., and Patro, S. (2018). *Design And Analysis Of Algorithms*- (2nd Edition) ISBN-10 : 9352743113
3. Karumanchi N. (2016). *Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles,* 5th Edition, ISBN-13 : 978-819324527
4. Shaffer C. A. (2012). *Data Structures and Algorithm Analysis in C++.* Dover Publications; Computer Science at Virginia Tech.

i) Course Title: ITIN 109 - Multimedia, Animation and Graphics

ii) Course aim:

To expose students to the contemporary software packages used in the fields of Multimedia, Animation and computer graphics as well as enabling the students to learn basic design principles required for daily presentation of work.

iii) Course expected learning outcomes:

Upon successful completion of this course students should be able to:

1. Explain computer operations as they relate to graphic and multimedia applications, and techniques of animation to a creative end.
2. Demonstrate the ability to use these technical skills by successfully completing a variety of assigned projects.
3. Create original works of graphic, multimedia and animation that explore a variety of formal and conceptual challenges, demonstrate a visual vocabulary, and the ability to make effective aesthetic judgments.
4. Assess the effectiveness of personal artwork and the work of others by visual narratives and storyboarding through critique.

iv) Course status- core

v) Credit rating: 12.0

vi) Total hours spent: 120

vii) Course Content:

Introduction: Introduction to Computer Graphic, animation and multimedia, operation of computer graphics, graphics software packages, requirements of graphical systems, graphical user interface; **Computer File Management Techniques**: File format, File Format Types, Software/Hardware Requirements, Digital Sound/Music File Creation & Editing Techniques, hypertext and hypermedia, algorithms for segment table, display file and segment; **Digital Scanning conversion:** scan conversion of solid, Hardware Requirements, Multimedia Imaging Software Programs, Digital Photo Touch-up Techniques, Multimedia Presentation, Enhancement Techniques, Analogue & Digital Editing Techniques, areas or polygon, DDA Algorithms, Bresenhams algorithms, midpoints

methods, problems of scanning conversion, filling algorithms; **Development Digital Photo**: geometric transformation, 3D translation, scaling and rotation, Movie Development, Computer Graphic Development, Student Portfolio Development**,** , 2D and 3D animation and multimedia , Computer Animation Development, Principles of animation,2D and 3D animation, Morphing, Image formation inside camera, windows and view ports, clipping algorithms, Video Streaming, Internet Telephony-Virtual Reality-Artificial intelligence; **Publishing projects:** Action Script, Navigating the Timeline Code, Snippets Events and Functions Creating Animation, External Files Action Script and Components to Load Content Pre loaders Using Arrays and Loops Controlling Text Controlling Sound Working with XMLAction Script and Components to Control, Video Advanced Graphics and Animation, Printing and Sending Email, Adobe Air; **Industry standards:** Real world applications.

viii) **Teaching and learning activities**:

Lectures 30 hours, practical 30 hours, assignments 15 hours and independent study 45 hours.

ix) **Assessment Methods:**

Coursework: Theory test (s) and/or quizzes (15 marks), Assignment (5 marks), Practical assignments/tests/projects/reports (40 marks), all together, contributing 60% of the total score.

End of semester examination: constitute 40% of the total score.

x) **Reading list:**

1. *Ranjan Parekh*. (2021). Fundamentals of Image, Audio, and Video Processing Using MATLAB, With Applications to Pattern Recognition, CRC Press.
2. Bloomenthal, J. (2019). *Computer Graphics Implementation and Explanation.* Independently published ISBN-10: 1687550271.
3. Lee, L. (2019). *Animation for Beginners; Basic Principles of Animation for Motion Graphics, Volume 1 of Beginners Guide to Learning Computer Graphic Series.* Independently Published, 2019, ISBN 1686282702.
4. Parekh, R. (2013). *Principles of Multimedia*, 2nd Edition, McGraw Hill Education.

i) **Course title: SC 101-Communication Skills II**

ii) **Course aim:**

To provide an opportunity for students to learn communication techniques and practice them in real life settings.

iii) **Course expected learning outcomes:**

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

1. Develop critical thinking skills through analyzing a problem in their discipline, evaluating sources, and creating a solution.
2. Develop academic literacy skills to read and write in an academic manner about content in their discipline in various academic forms.
3. Produce different forms of academic writing, including term papers, paragraphs of various types, literature reviews, resource lists, abstracts, and essay question responses.
4. Listen to lectures and discussions about content in their academic discipline and take notes effectively.
5. Speak in an academic manner (presentations, discussions, debates) about content in their academic discipline.
6. Read and comprehend content in their academic discipline using strategies such as skimming, scanning, SQ4R, affix awareness.

iv) **Course status:** Core

v) **Course credits rating:** 6.0

vi) **Total hours spent:** 60 hours

vii) **Course content:**

Critical thinking skills: Analyzing, evaluating, and creating; **Listening and Speaking skills**: Analyzing purposes and forms of presentations, features of effective oral presentations, developing active listening, listening to lectures and note taking, using argumentative language and logic to express opinions, making oral presentations and giving peer feedback; **Reading skills**: Recognizing and examining different types of academic writing for their purposes and elements (i.e. research proposal, term papers, research report, project report, experiments, abstracts), recognizing affixes (prefixes, suffixes) which change word form,

skimming and scanning through texts, using SQ4R strategy for retention, identifying and evaluating sources of information, reading extensively and intensively in appropriate contexts, interpreting components of essay questions; **Writing skills**: Characteristics of effective academic writing (i.e. formal language, logical flow of ideas and sentences - simple, compound & complex), paragraph structure and organization in various patterns (i.e. cause effect, descriptive, narrative, argumentative), essay planning and writing in response to essay questions from students' disciplines, referencing and citing sources in APA format (in-text citation and end-text citation), paraphrasing to avoid plagiarism, writing in academic forms (i.e. literature review, reference list, abstract, term paper), revising academic writing, argumentative language and logic to express opinions in writing.

viii) **Teaching and learning activities:**

The course shall be delivered mainly through interactive lectures, seminar presentations, classroom discussions, role plays.

ix) **Assessment method:**

Coursework: Theory test (s) and/or quizzes (20 marks), Assignment, presentation (10 marks), all together, contributing 40% of the total score.

End of semester examination: constitute 60% of the total score.

x) **Reading list:**

1. Folse, K.S., Muchmore-Vokoun A. and Solomon, E.V. (2010). *Great Writing 2: Great Paragraphs,* Boston:Heinle Cengage.
2. Kioko, A., Bukenya, A. and Njoroge, M. (2012). *Spot on Writing Skills,* Nairobi: Oxford University Press.
3. Mohamed, H. I. (2010). *Communication Skills in Higher Education,* Mzumbe, Morogoro: Mzumbe Book Project.
4. Mohamed, H.I. (2008). *Grammar and Mechanics of Writing in academics: a University Handbook,* Mzumbe –Morogoro: Mzumbe Book Project.
5. Paiz, J. M. et al. (2013). *Purdue OWL Online Writing Lab APA Style,* https://owl.english.purdue.edu/owl/section/2/10/

i) **Course title: ITIN 110 - Semester Project 2 – Analysis, Design, and Development of Algorithms**

ii) **Course aim:**

1. To enable students to analyse, design and develop efficient algorithms by looking at the real-world problems motivating them and thus put into practice the knowledge and skills acquired in current semester and the earlier courses, showcase, and apply skills acquired in earlier courses to solve real problems through implementation of effectively and efficient algorithm, improve communication skills and problem-solving abilities.

iii) **Course expected learning outcomes:**

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

1. Work in a team and communicate effectively with a client.
2. Formulate and analyze a problem.
3. Explore and propose a solution.
4. Present to an audience in various forms, oral and written.
5. Implement and validate a working prototype of the proposed algorithm
6. Design and implement a solution for a given problem and algorithm in high-level programming languages.
7. Assess and model complex problems in terms of graphs.

iv) **Course status: Core**

v) **Credits rating:** 12.0

vi) **Total hours spent:** 120 hours

vii) **Course contents:**

Ideation: Student groups will brainstorm about real-world problems from the gathered requirements. The requirements may be gathered from students' visits to the industry for real-world problems; **Create and analyse a problem**: Students will work on their teams to identify, analyse, and design and refine solutions to the identified problem(s). Formulate and analyze problem and write its procedures; **Develop prototype**: Write the corresponding computer programs/prototypes;

perform program testing and debugging; **Full project implementation**: Perform system testing, deploy system addressing real-world problems or opportunity in some innovative way and meet stakeholder requirements, capabilities, and constraints, write report, and perform presentation or communicate the project results.

viii) **Teaching and learning activities:**

During the course students is required to complete a small system project. Seminars/Tutorials 30 hours, assignment 10 hours and independent study 20 hours, and practical 60 hours.

ix) **Assessment methods:**

Coursework: Project proposal (10%), Team Project Assignments #1-9 (30%), Sprint Reports (10%), Individual Homework Assignments (5%), all together, contributing 55% of the total score.

End of semester examination: Final Deliverables and Project Review (project presentation and system demonstration (20%) and Final project report (20%)), and Individual Reflection (5%), all together, contributing 45% of the total score.

x) **Reading list:**

1. Aziz, A. (2012). Elements *of Programming Interviews: The Insiders' Guide.* 2nd Edition. ISBN-10: 1479274836
2. Steven S, and Skiena, S. (2010). *The Algorithm Design Manual,* 2nd Edition. Springer.
3. Amrinder Arora (2014). Analysis and Design of Algorithms (2nd Edition). ISBN-13:978-1634870214.
4. Anuj Bhardwaj and Paraj Verma (2017). Design and Analysis of Algorithm. ISBN-13:978-1842658987.

i) **Course title: ITIN 105-Introduction to Business Information Technologies**

ii) **Course aims:**

To enable students to learn the role of information technology and systems in business, and how these can be leveraged to create and sustain competitive advantage while gaining practical skills in online collaboration tools and web site development.

iii) **Course expected learning outcomes**

By the end of the course, students are expected to be able to:

1. Explain the social impact of information technology, both locally and globally, and the need for security, privacy, and ethical implications in information systems usage.
2. Demonstrate problem-solving skills by identifying and resolving issues relating to information technology systems and their components.
3. Demonstrate the application of online collaboration and website development tools to support productivity and communication in business contexts.
4. Describe current information and communication, how they are selected, developed, and used by organizations to produce goods and services, and to cooperate and/or compete with other organizations.

iv) **Course status:** Elective

v) **Credits rating:** 7.5

vi) **Total hours spent:** 75 hours

vii) **Course contents:**

Integration of business and Information technology in a sector context: Business IT value linkage skills; Cost & benefits analysis skills; Business software solution impact analysis skills; **IT architecture, design, and development skills**: System requirements specification skills; Software and IT architecture analysis and design skills; Implementation skills; Technology application skills; **Project management skills:** Scope management skills; Risks management skills; Project integration and time management skills; Configuration management skills; Quality management skill; **E-business models**: Internet Search skills: Skills for developing a methodology for learning; Skills to improve the effectiveness of distant group processes and work products; **Security, privacy and ethical issues**: how business information systems are utilized in organizations, including transaction processing systems, enterprise resource planning systems, management information systems and decision support systems; **Specialized business computing systems**, including artificial intelligence, expert systems and virtual reality; and information systems project management.

viii) **Teaching and learning activities**

Lecture 30 hours, Assignment 15 hours, Individual Studies 20hours and practical 15 hours

ix) **Assessment methods:**

Coursework: Theory test (s) and/or quizzes (15 marks), Assignment (5 marks), Practical assignments/tests/projects (40 marks), all together, contributing 60% of the total score.

End of semester examination: constitute 40% of the total score.

x) **Reading List**

1. Manzoor, A. (2017). *Information Technology in Business,* 2nd Edition, ISBN: 978-1974503049.
2. Bourgeois D. T., (2014). *Information Systems for Business and Beyond.*Saylor Foundation.
3. Geoffrey, E. and Wesley, P. A. (2004). *Global Business Information Technology, An Integrated Systems Approach*, 503 pages.
4. Turban E. (2003). *Introduction to Business Information Technology 2nd Edition* John Wiley & Sons, Inc.

i) **Course title: MTH 106-Introductory Statistics**

ii) **Course aim:**

To introduce students to basic statistical concepts, theory, and practice of statistics.

iii) **Course expected learning outcomes:**

By the end of the course, students are expected to be able to:

1. Explain the meaning of basic statistical terminologies; identify types and sources of data and their methods of collection.
2. Use measures of location and dispersion, and graphical methods to explore, summarise and describe both numerical and non-numerical data.
3. Use sampling techniques to determine samples from populations.
4. Produce mathematical characterization of relationships between explanatory and outcome variables and make predictions.
5. Compute simple probabilities, expected value and variances for both discrete and continuous random variables.
6. Generalize from small group to large group using statistical inference procedures, i.e., estimation of population parameters and testing hypotheses.

iv) **Course status:** Elective

v) **Credits rating:** 7.5

vi) **Total hours spent**: 75 hours

vii) **Course contents:**

Descriptive statistics: Definition of basic statistical terminologies, application of statistics in real world, types and sources of data, scales of measurement of data, variables, methods and tools of data collection, organization and presentation of data, sample statistics and population parameters, summary statistics (numeric and graphical) for continuous and categorical data, measures of symmetry and skewness. Sampling and sampling techniques: Definition of terms, probability sampling techniques: simple random sampling, systematic sampling, stratified sampling and cluster and non-probability sampling: convenience/accidental sampling, judgmental/purposeful sampling, and quota sampling; **Simple linear regression and correlation**: Concepts and assumptions of linear regression, fitting least-squares regression line and interpretation of regression coefficients, coefficient of determination, adjusted coefficient of determination; correlation analysis; **Elementary probability theory**: Definition of key terms, applications of probability in real world, axioms of probability, rules of probability: law of total probability, Bayes' rule, additional rule, multiplication rule, independent and mutually exclusive events, permutations and combinations; **Random variables and probability distributions**: Random variables, types of random variables, expected and variance of random variables, probability distributions of discrete random variables and its properties e.g., Poisson, Binomial; probability distribution of continuous random variables e.g., normal; applications of probability distributions of random variables.

Sampling distributions: Sampling distributions of sample statistics e.g., z-distribution, t-distribution, Chi-square distribution and F-distribution; **Statistical Inference**: Estimation theory: Point and interval estimators, point and interval estimates, confidence intervals for single, and two population means, proportions and variance, interpretation of confidence interval; **Hypothesis testing**: Elements of hypothesis testing; null and alternative hypotheses, significance level, test

statistics, construct critical region or decision rule, conclusion, Type I and Type II errors, one-tailed and two-tailed tests, Tests of means, e.g., one sample t-test, independent samples t-test, and paired samples t-test.

viii) **Teaching and learning activities:**

Lecture 30 hours, Assignment 15 hours, Individual Studies 15 hours and Tutorials 15 hours.

ix) **Assessment methods**

Coursework: Theory test (s) and/or quizzes (30 marks), Assignment (10 marks), , all together, contributing 40% of the total score.

End of semester examination: constitute 60% of the total score.

x) **Reading list:**

1. Sancheti, D.C. and Kapoor, V.K. (2007). *STATISTICS: Theory, Methods and Application*, Sultan Chand and Sons, New Delhi.
2. Gupta S.P (2005*). Statistical Methods*, Sultan Chand and Sons, New Delhi.
3. *Murray, Aitkin*. (2021). Introduction to Statistical Modelling and Inference,
4. *A. John Bailer, Rosemary Pennington*. (2022). Statistics Behind the Headlines, CRC Press, **1st Edition**
5. *Ioannis S. Trianntafyllou, Mangey Ram*. (2022) Statistical Modeling of Reliability Structures and Industrial Processes
6. McClave, J.T. and Sincich, T. (2000). *A First course in Statistics,* 7th Ed. Prentice-Hall, Inc.

i) **Course title: MTH 112-Discrete Mathematics**

ii) **Course aim:**

To stimulate critical thinking and its application with emphasis on Information Technology, enhancing a student's ability to reason and to present a logical and mathematically accurate argument.

iii) **Course expected learning outcomes**

By the end of the course, students are expected to be able to:

1. Develop fundamental entities and concepts in discrete mathematics and determine when they will be useful in solving real-world problems.
2. Describe and apply the basic concepts and algorithms of number theory, including the Euclidean algorithm.
3. Recognize basic methods of proof, particularly induction, and apply them to solve problems in mathematics and computer science.
4. Work confidently with sets, relations, functions, and their associated concepts, and apply these to solve problems in mathematics and computer science.
5. Analyze simple first and second order recurrence relations.

iv) **Course status:** Elective

v) **Credits rating:** 7.5

vi) **Total hours spent:** 75 hours

vii) **Course contents:**

Boolean Algebra: Introduction, AND OR, and NOT operators, Boolean Functions, Laws of Boolean Algebra, Duality, Abstract definition of A Boolean Algebra, Representing Boolean Functions, sum of Product (SOP) AND Product of sums (POS) forms of Boolean functions NAND, NOR, XOR, AND XNOR operators; Functional completeness; **Logic gates**: simplification of Boolean functions, Karnough maps of up to 4 variables; **Enumerative Analysis:** Introduction, Recurrence relations solving homogeneous and inhomogeneous recurrence relations; Principle of inclusion - exclusion. Generating functions; **Elementary Graph Theory and Networks**: Introduction, Basic definitions, Euler and Hamiltonian paths and circuits. Trees, spanning trees and co-trees, shortest path problems.

viii) **Teaching and learning activities**

Lecture 30 hours, Assignment 15 hours, Individual Studies 15 hours and Tutorials 15 hours.

ix) **Assessment methods**

Coursework: Theory test (s) and/or quizzes (30 marks), Assignment (10 marks), all together, contributing 40% of the total score.

End of semester examination: constitute 60% of the total score.

x) **Reading list**

1. *Pierre, Fortney*. (2022).Discrete Mathematics for Computer Science : An Example-Based Introduction, Chapman and Hall/CRC
2. Albertson M. O. (2008). *Discrete Mathematics with Algorithms, John*, Wiley & Sons Publishing House.
3. Hein, J. L. (2009). *Prolog Experiments in Discrete Mathematics, Logic, and Computability*, Portland State University.
4. B. V. Senthil Kumar, Hemen Dutta. (2022). Discrete Mathematical Structures: A Succinct Foundation, CRC Press
5. Smid M. (2013). *Discrete Structures for Computer Science: Counting, Recursion, and Probability,* Carleton University, Ottawa Canada.
6. Gary Chartrand, Ping Zhang. (2022). Chromatic Graph Theory, CRC Press

Semester 1 Year 2

i) **Course title: ITIN 200-Database Design and Development**

ii) **Course aim:**

To introduce students on the design and implementation of relational databases, including data modeling with ER or UML diagrams, relational schema, SQL queries, relational algebra, user interfaces, and administration.

iii) **Course expected learning outcomes:**

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

1. Describe concepts, elements, and principles of database development.
2. Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra, and SQL.
3. Design and build a simple database system with the fundamental tasks involved with modeling, designing, and implementing a DBMS.
4. Apply the Entity-Relationship (E-R) Model for building information systems' data models.

iv) **Course status:** Core

v) **Credits rating:** 10.0

vi) **Total hours spent:** 100 hours

vii) **Pre-requisite:** ITIN 100, ITIN 106

viii) **Course contents:**

Introduction to database: File Based Systems and their limitations, Database, need for database systems, Types of databases: (Relational databases, object-oriented databases, spatial databases, document-based databases etc.; **Basic DBMS concepts:** Database Management System (DBMS), DBMS vs RDBMS, DBMS Functionality, Advantages and disadvantages of DBMS, DBMS Architectures: Teleprocessing, File-server, Client-server, 3-tier and Web-DBMS. DBMS Data Models -network, hierarchical, relational, object-oriented, and object-relational; **Data Model:** ER model, ER Notation and Design, Mapping Constraints, DBMS Keys (Primary Key, Foreign Key, Candidate Key, Super Key), Referential Integrity; **Relational data model:** Relational Operators**,** Relational Algebra, Integrity constraints and Relational Calculus*:* Unary relational operations; Set theory on relational algebra; Binary relational operations; Queries in relational algebra; Domain relational calculus; **Structured Query Language (SQL)***:* SQL Introduction, SQL Data Types, Characteristics of SQL, SQL advantages, SQL Commands, SQL Operators, Creating Database structure and relationships with SQL scripts, Retrieving Data with SELECT statement, Updating Data with UPDATE statement, Inserting Data with INSERT statements, Deleting Data with DELETE statement, SQL view, SQL Index, SQL Sub-queries, Inner Joins, Outer Joins, Aggregate functions, Grouping and sorting; **Database Application Design:** Methodology for the analysis, specification, design and implementation of database applications; **Database Security: Security and Integrity constrains of database;** General password policy; Privilege type and role.

ix) **Teaching and learning activities:**

Lectures 20 hours, practical 30 hours, assignments 10 hours and independent study 40 hours.

x) **Assessment methods:**

Coursework: Theory test (s) and/or quizzes (15 marks), Assignment (5 marks), Practical assignments/tests/projects (40 marks), all together, contributing 60% of the total score.

End of semester examination: constitute 40% of the total score.

xi) **Reading list**

1. West, A. and Prettyman, S. (2018). *Practical PHP 7, MySQL 8, and MariaDB Website Databases: A Simplified Approach to Developing Database-Driven Websites*, 2nd Edition, Berkeley, CA Apress, United States.
2. Navathe, E. (2016). *Fundamentals of Database Systems*, 7th Edition, Addison-Wesley Publishing Company, United States.
3. Alvaro, F. (2016). *SQL: Easy SQL Programming & Database Management for Beginners, Your Step-By-Step Guide To Learning The SQL Database, CreateSpace.* Independent Publishing Platform.
4. Fedel A. C., (2013). *Six-Step Relational Database Design and Development,* 2nd Edition.
5. ***Elvis C. Foster, Shripad V. Godbole***. (2022). Database Systems. A Pragmatic Approach, 3rd edition, CRC Press.
6. *Sikha Saha Bagui, Richard Walsh Earp*. (2022). Database Design Using Entity-Relationship Diagrams, Auerbach Publications
7. Gavin P., (2006). Designing *Database Design*, Wesley Indianapolis, Indiana. ISBN-13; 978-0-7645-7490-0.
8. Korth S. A., (2002). *Database systems Concepts*, 4th edition, McGraw Hill.
9. Oracle Database Programming with Java
10. *Ying Bai*. (2022). Ideas, Designs, and Implementations, Auerbach PublicationS
11. Connolly. T., (2005). *Database Systems: A practical approach to design, implementation and Management*, 4th edition, Addison-Wesley.

i) **Course title: ITIN 202- Object Oriented Programming**

ii) **Course aim:**

To enable the students to be familiar with advanced concepts of Object-Oriented design paradigm and programming, specifically using Java.

iii) **Course expected learning outcome(s):**

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

1. Describe the Java Virtual Machine architecture and behavior.
2. Classify OO programming from declarative and procedural ones.
3. Develop applets that interact abundantly with the client environment and deploy on the server.
4. Apply object-oriented programming concepts to solve real world problems.

iv) **Course status:** Core

v) **Credit rating:** 10

vi) **Total hours spent:** 100 hours

vii) **Prerequisites:** ITIN 100, ITIN 108

viii) **Course contents:**

Introduction to Java Programming: Java/JVM, Java Applications, Development Tools, Sample Program, Compilation; **Basics of Java**: Program Structures, Variables, Constants Data Types & Type Conversions, Comments, Input/output, Arithmetic/Relational Operators, Formatting Output etc.; **Control structures**: Selective statements (IF, IF Else, Nested IFs), Repetition/Iterative statements (FOR loops, WHILE loops, DO-WHILE loops), Switch Selection statements; **Strings**: Creating Strings, String Operations & Methods, String Class, String Builder/String Buffer Class, Character Class; **Arrays**: Array Basics, Array Parameters, Variable Length Array Parameters, Searching Arrays, Array Class, Multi-dimensional Arrays; **O.O.P Concepts**: Classes, Methods & Objects, Constructors, Access Specifiers static Keyword, this Keyword; **O.O.P Principles**: Inheritance: (Inheritance (IS-A), Aggregation (HAS-A)), Encapsulation

(Package, Access Modifiers), Abstraction (Abstract Class, Interface, Abstract vs. Interface), Polymorphism (Method Overloading, Method Overriding, Covariant return Type, Super Keyword, Final keyword, Runtime Polymorphism, Dynamic Binding)**; File processing**: File Class, Reading & Writing Text Files; I/O Streams – File Streams – Applets – String Objects – String Buffer – Char Array – Java Utilities – Code Documentation; **Exception handling**: Overview, Benefits, Exception Types, try….catch…. Block, Throwing Exceptions; **Introduction to Java GUI**: Overview & Java IDEs, Swings vs AWT, Swing Controls, Event Handling; **Packages:** – Access Protection – Importing Packages – Interfaces – Exception Handling –Throw and Throws – Thread – Synchronization – Messaging – Runnable Interface – Interthread Communication – Deadlock – Suspending, Resuming, and stopping threads –Multithreading.

ix) Teaching and learning activities

Lectures 20 hours, practical 30 hours, assignments 10 hours and independent study 40 hours.

x) Assessment methods

Coursework: Theory test (s) and/or quizzes (15 marks), Assignment (5 marks), Practical assignments/tests/projects (40 marks), all together, contributing 60% of the total score.

University Examination: constitute 40% of the total score.

xi) Reading list

1. Sciore, E. (2019). *Java Program Design: Principles, Polymorphism and Patterns*, Apress, MA, USA
2. Baldwin, R. G. (2016). *Object-Oriented Programming (OOP) with Java*, OpenStax-CNX
3. Deitel H. M. and Deitel P. J. (2007). *Java how to program, 7th Edition,* Prentice Hall.
4. John Rodley, 2008, *Writing Java Applets*, The Coriolis group, New Delhi.
5. *Adair Dingle*. (2022). Object-Oriented Design Choices, Chapman and Hall/CRC
6. Herbert Schildt, H (2007), *Java - The complete Reference Books*, Tata Mcgraw Hill, New Delhi.
7. Adair Dingle**. (2022). Object-Oriented Design Choices 1st Edition, Routledge; 1st edition**
8. Niemeyer P. and Daniel L. (2013). *Media's Learning Java*, 4th Edition, O'Reilly Media, Inc.

i) Course title: ITIN 204 - Web Apps Design and Development

ii) Course aim:

To enhance students with practical knowledge of Web Application Development using web programming languages e.g., PHP, web server features, configuration, and administration, cover web technologies and requirements of web application development and cover server-side programming and dynamic content and online database development and management.

iii) Course expected learning outcome(s):

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

1. Describe the technology required to build and implement an internet web-based system.
2. Use a structured approach to identifying needs, interests, and functionality of an internet web-based system.
3. Apply critical thinking and problem-solving skills required to successfully design and implement an internet web-based system.
4. Design and develop interactive, and responsive client-side, server-side and executable web applications which can run on multiple platforms.

iv) Course Status: Core

v) Credit rating: 10.0

vi) Total hours spent: 100 hours

vii) Course contents:

Introduction to Basic Web Technologies Concepts: Browser, Mark-up-Languages, Client-side Scripting, Server-side Scripting, Dynamic web, Dynamic Server Concepts, Web Application Servers; **Dynamic Web Applications:** 3 tier architecture for web application, MVC (Model-View-Controller) model, Hypertext, Tags & elements and text formatting, Lists, hyperlinks and images, Table, and frames, Cascading style sheets: inline, document, external, HTML Forms. Usability and accessibility principles and practices; **Client Side-Programming:** Scripts vs Programs, Common tasks for client side , Data types and expressions,

Control statements, Functions and libraries, Strings and Arrays, Objects: Document, Navigator, Date, Arrays, User defined Classes, Event Driven Programming and HTML Form elements, Document object model; **Server Side-Programming;** Server side programming languages i.e. python, PHP/MYSQL, Environments for server side programming and syntax, User defined functions, Variables scope, and including files, Some inbuilt functions and Server variables, Working with Files: Opening and manipulating files, Form handling, Cookies, Sessions, Time and Date functions, Database Connection and processing. SQL statements for data manipulations, how to use PHP to access data in database; **Functions Advanced Web Programming:** secure communication and encryption/decryption; Regular expression; session management and timeout; pushing data to client; asynchronous communications with JSON, XML and AJAX; Server-Sent Event (SSE); Development of API using classes and objects; **Application Areas**; E-Commerce, E-government, E-learning etc.
Security Considerations in Web applications.

viii) **Teaching and learning activities**

Lectures 20 hours, practical 30 hours, assignments 10 hours and independent study 40 hours**.**

ix) **Assessment methods**

Coursework: Theory test (s) and/or quizzes (15 marks), assignment (5 marks), practical assignments/tests/projects (40 marks), all together, contributing 60% of the total score.
University Examination: constitute 40% of the total score.

x) **Reading list**

1. Luke Welling and Laura. (2009). *PHP and MySQL Web Development*, Thomson. Addison-Wesley, Fourth Edition**.**
2. Bryan Basham, B, Sierra, K, Bates, B. (2008). *Head First Servlets and JSP,* O'Reilly Media, 2nd Edition.
3. Barrell, Dylan. Agile Accessibility Explained: A practical guide to sustainable accessible software development, Amazon Digital Services, 2019.
4. Digital Education Strategies, The Chang School. What You Can Do to Remove Barriers on the Web, The Chang School, 2020.
5. Kevin P. (2007). *Web Design and Marketing Solutions for Business Websites, Apress.*
6. IBM Redbooks. (2006). *IBM Workplace Web Content Management for Portal 5.1 And IBM Workplace Web Content Management 2.5,* IBM.Com/Redbooks.
7. Gay, Greg et al.Introduction to Web Accessibility, Ryerson University Pressbooks, 2019.
8. Gay, Greg et al.Professional Web Accessibility Auditing Made Easy, Ryerson University Pressbooks, 2016.
9. Gay, Greg et al.Web Accessibility for Developers, Ryerson University Pressbooks, 2019.
10. Gilbert, Regine M. Inclusive Design for a Digital World: Designing with Accessibility in Mind (Design Thinking) , Apress, 2020.

i) **Course title: ITIN 207- Introduction to Artificial Intelligence**

ii) **Course aim:**

To enable the student to have a basic exposition to the goals and methods of Artificial Intelligence and apply these techniques in applications that involve perception, reasoning, and learning.

iii) **Course expected learning outcome(s):**

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

1. Describe various models for machine learning and use it appropriately.
2. Compare and contrast artificial intelligent agents, machine learning methods, and select for appropriate real problems.
3. Implement a set of practical methods or algorithms and be able to program solutions to some given real world machine learning problems, using one of the programming languages.
4. Analyze and criticize the arguments that have been advanced both for and against the possibility of artificial intelligence.

iv) **Course Status:** Core

v) **Credit rating:** 8

vi) **Total hours spent:** 80 hours

vii) **Course contents:**

Introduction: Introduction to AI, AI Goals, Applications of AI, Types of AI, Introduction to Machine learning, Introduction Natural language processing; **Intelligent Agents**: Agent structure, Agent types, Agent environments, Turing Test; **Problem-solving:** Search Algorithms, Uninformed Search Algorithms, Informed Search Algorithms, Hill Climbing algorithm, Means-Ends Analysis, Adversarial Search (Minimax Algorithm, Alpha-Beta Pruning), Predicate Calculus etc.; **Knowledge Representation and Expert System**: Knowledge Based Agent, Knowledge Representation techniques, Propositional Logic, Rules of Inference, Backward Chaining, Forward Chaining, Expert systems (Various stages in developing expert system, Knowledge representation using sematicness, predicate calculus, frames, scripts, knowledge acquisition techniques – factors to be considered while expert systems; **Data and Models**: Introducing Data, Probability and Bayesian Presumptions. Simple Distributions, Maximum Likelihood and Bayesian Estimation. Bayesian Sets, Dimensionality Reduction Techniques. Linear Models, Neural Networks, Naïve Bayes, Bayesian Decision Theory.

viii) **Teaching and learning activities**

Lectures (30 hours), assignment (15 hours), independent study (20 hours) and practical (15 hours).

ix) **Assessment methods**

Coursework: Theory test (s) and/or quizzes (15 marks), assignment (5 marks), practical assignments/tests/projects (40 marks), all together, contributing 60% of the total score.

University Examination: constitute 40% of the total score.

x) **Reading list:**

1. Lee, K.F (2018). *AI Superpowers,* Houghton Mifflin Harcourt, USA.
2. Castrounis, A. (2020). AI for People and Business, InnoArchiTech.
3. Russell and Norvig (2009). *Artificial Intelligence: A Modern Approach,* 3rd Edition
4. Bishop, C.M. (2006). *Pattern Recognition and Machine Learning,* Springer. ISBN: 978-0387 31073-2.
5. *Shikha Agarwal, Manish Gupta, Jitendra Agrawal, Dac-Nhuong Le*. (2022). Swarm Intelligence and Machine Learning: Applications in Healthcare, CRC Press
6. *Seyedeh, Leili Mirtaheri* and *Reza Shahbazian*. (2021). Machine Learning: Theory to Applications, CRC Press

i) **Course title: ITIN 205 Semester Project 3 Interactive Information Systems Development**

ii) **Course aim:**

To enable students to put into practice the knowledge acquired in the current semester or earlier courses by showcase/pilot/prototype and solve real problems while practicing disciplined and professional project methods, according to the project plan, monitoring and estimating the project process, progress, and quality.

iii) **Course expected outcomes:**

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

1. Develop operational research models from the verbal description of the real system by client.
2. Prepare the software requirement specification according to the identified problem in any chosen organization for developing of the innovative information system
3. Design, implement, and evaluate a computer-based system, process, database, component, or program using emerging technologies to meet desired needs and apply them to today's organizations.
4. Work effectively in project teams to implement information technology- based solutions.
5. Communicate with a range of audiences in various forms, oral and written.

iv) **Course status:** Core

v) **Credits rating**: 12.0

vi) **Total hours spent:** 120 hours

vii) **Course Contents:**

Ideation: Student groups will brainstorm about real-world problems, focusng on interactive information systems. This might include students visiting the industry for real-world problems; **Create and analyze a problem**: Students will work on their teams to identify, analyse, design solutions to the identified problem(s). Formulate and analyze problem and write its procedures; **Develop prototype**: Plan prototypes, write the corresponding computer program; perform program testing and debugging; refine the prototypes in some innovative ways to meet their stakeholders' requirements and constraints; **Full project implementation**: Perform system testing, deploy system, write report; quality assurance reviews and performs presentation or communicates the project results.

viii) **Teaching and learning activities**

Seminars/Tutorials 30 hours, Assignment 10 hours and independent study 80 hours.

ix) **Assessment methods:**

Coursework: Project proposal (10%), Team Project Assignments #1-9 (30%), Sprint Reports (10%), Individual Homework Assignments (5%), all together, contributing 55% of the total score.

End of semester examination: Final Deliverables and Project Review (project presentation and system demonstration (20%) and Final project report (20%)), and Individual Reflection (5%), all together, contributing 45% of the total score.

x) **Reading list:**

1. Andersson, B., Johansson, B., Barry, C., Linger, H., Lang, M. and Schneider, C. (Eds.) (2019). *Advances in Information Systems Development: Designing Digitalisation*. Cham: Springer.
2. Johansson, B. (2011). *Diffusion of Open Source ERP Systems Development: How Users Are Involved*. In M. Nuttgens, A. Gadatsch, K. Kautz, I. Schirmer, & N. Blinn (Eds.), IFIP Advances in Information and Communication Technology (pp. 188-203). Springer. https://doi.org/10.1007/978-3-642-24148-2_12.
3. Fang Z. (2008). *Information Technology Entrepreneurship and Innovation. Information Science Reference.* IGI Publishing 701 E. Chocolate Avenue, Suite 200 Hershey PA ISBN:978-1-59904-901-4.
4. Patton, R. (2006). *Software Testing*, 2nd Edition, Sams Publishing.

i) **Course title: ITIN 201 - Human-Centered Computing**

ii) **Course aim:**

To introduce to students the principles, techniques, and tools of designing and developing interactive applications and cover practical experience for incorporating user requirements and experience in computer interface and system designs.

iii) **Expected course outcomes**

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

1. Describe human computer interaction design concepts and related methodologies.
2. Illustrate the fundamental design and evaluation methodologies of human computer interaction.
3. Apply theories and concepts associated with effective work design to real-world application.
4. Assess HCI paradigms, technologies and devices for particular user and task requirements, including the application of standardized interface styles in appropriate and insightful ways.

iv) **Course status:** Core

v) **Credits rating:** 8.0

vi) **Total hours spent:** 80 hours

vii) **Course contents:**

Introduction to Human-Computer Interaction: Includes the difference between good and poor interaction design, what interaction design is and how it relates to human-computer interaction and other fields, what is involved in the process of interaction design, the different forms of guidance used in interaction design, etc.; **Interaction Design**: Involves communication and collaboration, the main kinds of social mechanisms that are used by people to communicate and collaborate, the range of collaborative systems that have been developed to support this kind of social behavior, how field studies and socially based theories can inform the design of collaborative systems, etc.; **Understanding Users, Cognitive and Affective Factors:** Involves what cognition and affection is and why it is important for interaction design, the main ways cognition and affection has been applied to interaction design, a number of examples in which cognitive research has led to the design of more effective interactive products, mental models, conceptual frameworks that are useful for interaction design, etc.; **The Computer and Human-Computer Interaction**: Involves the various devices and implementation beds as well as technological constraints and opportunities, the problem space, how to conceptualize interaction, the pros and cons of using interface metaphors as conceptual models, the relationship between conceptual design and physical design, etc.; **Web Interfaces**: Concerns an introduction of the notion of a paradigm and set the scene for how the various interfaces have developed in interaction design, overview of the many different kinds of interfaces, highlight of the main design and research issues for each of the different interfaces, considerations which interface is best for a given application or activity, etc.; **Introduction to Interactive System Design**: Includes what 'doing' interaction design involves, some advantages of involving users in development, the main principles of a user-centered approach, etc.; **Discuss Data Gathering and Requirements Analysis with focus in HCI aspects**: Discusses how to plan, run and analyze successful data gathering schemes based on previous knowledge, which could include tools and methods as interviews, questionnaires, observations, etc. taking into consideration the HCI influential aspects taught in previous chapters; **Interfaces Design and Prototyping**: Includes prototyping and different types of prototyping activities with regards to systems interfaces design, production of simple prototypes from the models developed during the requirements activity, production of a conceptual model for a product, use of scenarios and prototypes in design, a range of tool support available for interaction design, etc.; **Usability Testing & Analytic Evaluation:** Involves usability testing through examples, the basics of experimental design, the methods used in usability testing, the role of field studies in evaluation, the important concepts associated with inspection methods, how heuristic evaluation can be adapted to evaluate different types of interactive products, what is involved in doing heuristic evaluation and various kinds of walkthrough, how to perform predictive technique, and when to use them, the advantages and disadvantages of using analytical evaluation, etc.; **Evaluation:** Includes the conceptual, practical, and ethical issues involved in evaluation, how observation, interviews, and questionnaires are used in evaluation, the key concepts and terms used in evaluation, the three main evaluation approaches and key evaluation methods within the context of real evaluation studies, how the approaches and methods are used for different purposes at different stages of the design process, the practical challenges that evaluators have to consider when doing evaluation, etc.; Theories of visual perception and cognition, visualization models, visual analytics, and data graphics. User and task-centered design for developing and evaluating visualization-based tools for various types of datA, HCI and interaction design, information visualization, interactive system design. Designing, and evaluating user experiences, understanding the role of user experience in the design of digital products, virtual environments, and physical spaces, and the roles of psychology, sociology, and psychometrics in user experience design.

viii) **Teaching and learning activities:**

Lectures 30 hours, Practical 15 hours, assignments 15 hours and independent study 20 hours.

ix) **Assessment methods:**

Coursework: Theory test (s) and/or quizzes (15 marks), Assignment (5 marks), Practical assignments/tests/projects (40 marks), all together, contributing 60% of the total score.

End of semester examination: constitute 40% of the total score.

x) **Reading list:**

1. DovTe'eni, J. (2007). *Human Computer Interaction: developing effective organizational information systems,* Hoboken: Wiley,2007.
2. Rogers S. P, (2011). *Interaction Design: Beyond Human Computer Interaction, 3rd ed,* John Wiley ISB 978-0-470-66576-3.
3. *Hassan Ugail*. (2022). Deep Learning in Visual Computing: Explanations and Examples, CRC Press
4. *Bert Bongers*. (2022) Understanding Interaction: The Relationships Between People, Technology, Culture, and the Environment: Evolution, Technology, Language and Culture, CRC Press
5. Zaphiris P. (2007). *Human Computer Interaction research in Web design and evaluation,* Hershey: Idea Group.
6. Handbook of Usability and User-Experience
7. *Marcelo M. Soares, Francisco Rebelo, Tareq Z. Ahram*. (2022). Methods and Techniques, CRC Press
8. Addison P. et al (2009). *Designing the User Interface: Strategies for Effective Human-Computer Interaction (5th Edition),* 5th ed., -Wesley.

i) **Course title: MTH 210-Mathematical Logic and Formal Semantics**

ii) **Course aim:**

To provide students with knowledge of fundamental concepts in mathematical logic and formal semantics and be able to use them correctly in other fields of study including computer science.

iii) **Course expected learning outcomes:**

By the end of the course, students are expected to be able to:

1. Define the basic terminologies in mathematical logic.
2. Explain the basic concepts in mathematical logic and formal semantic and use them appropriately in other fields.
3. Describe the methods of Fitch and Tableau to the proposition and predicate logic.
4. Apply the Hoare semantics in proving whether a program meets its specification or not.

iv) **Course status:** Elective

v) **Credits rating:** 7.5

vi) **Total hours spent**: 75 hours

vii) **Course contents:**

Propositional logic, predicate logic, syntax, semantics, natural deduction, tableaux, theories, logic programming, axiomatic semantics. Applications are to be found in the field of philosophy, linguistics, mathematics, and computer science. Two methods are dealt with here. The method of Fitch: herewith the form (the syntax) of the logical formulas plays the main part. This method reflects mathematical reasoning. The Tableau method: now the meaning (the semantics) of the formulas is focused upon. The notion "opposite example" is important here. Both methods are just as powerful (consistency and completeness) and will be applied to the proposition and predicate logic.

viii) **Teaching and learning activities**

Lecture 30 hours, Assignment 15 hours, Individual Studies 15 hours and Tutorials 15 hours.

ix) **Assessment methods**

Coursework: Theory test (s) and/or quizzes (30 marks), Assignment (10 marks), all together, contributing 60% of the total score.

End of semester examination: constitute 60% of the total score.

x) **Reading list:**

1. *Peter Alexander*. (2022). An Introduction to Logic: The Criticism of Arguments, Routledge
2. Rosen, K. H. (2007). *Discrete Mathematics: And it's Applications,* McGraw-Hill College. ISBN 978-0-07-288008-3.
3. *P. H. Nidditch*. (2022). The Development of Mathematical Logic, Routledge
4. Huth, M. & Ryan, M. (2004). *Logic in Computer Science: Modelling and Reasoning about Systems,* Cambridge University Press. ISBN 0-521-54310-X.
5. *Steven G. Krantz*. (2022). The Elements of Advanced Mathematics, Chapman and Hall/CRC

Semester 2 Year 2

i) **Course title: ITIN 203 Information Security**

ii) **Course aim:**

To cover basic concepts and practices in computer and network security such as cryptography, authentication, authorization, secure protocols, and principles for developing secure software. Applications will include using security frameworks to develop software and configuring security support systems

iii) **Course Expected course outcomes:**

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

1. Define how to apply standard responses in the case spyware and malware occurs.
2. Explain the fundamentals concepts of computer security apply to different components of computing systems.
3. Identify the basic cryptographic techniques using existing software in maintaining information security.
4. Describe how malicious attacks, threats, and protocols for security vulnerabilities impact a systems infrastructure.
5. Describe the importance of network principles and architecture to security operations.
6. Assess information security standards, compliance laws, and security policy to real-world implementation in both the private and public sector.

iv) **Course Status:** Core

v) **Credit rating:** 12

vi) **Total hours spent:** 120 hours

vii) **Prerequisites:** ITIN 107, ITIN 200

viii) **Course contents:**

Introduction to Information security: Basic concepts in cyber security; Threats, Vulnerabilities, Attacks, Major security goals; Availability, Confidentiality, Integrity; **Introduction to Cryptography**: History of cryptography, Basic concepts and terminologies in cryptography (Cryptology, Cryptanalysis, Cryptosystems, etc.,) Types of cryptography; Introduction to data/information encryption; **Data Encryption:** Encryption vs Decryption process, Types of data encryption, Encryption algorithms, Tools for data encryption, Symmetric and Asymmetric key Encryption, Public Key Encryption, Block Ciphers and Feistel Block Cipher; Data Encryption Standard (DES), Triple DES (3-DES), Advanced Encryption Standard (AES), RSA, Diffie-Hellman(), IDEA, Twofish, Serpent, Message Authentication, Cryptography Digital Signatures, Public Key Infrastructure; **Data Integrity:** Introduction to Hash Functions, Applications of Hash Functions, Implementation of Hash Algorithms; MD4, MD5, SHA-1, RIPEMD, Whirlpool, etc.; **Enterprise Network Security:** Issues, Concepts, est practices to secure an organization facility, Techniques, Ensuring Network Integrity and Availability, Intruders, Viruses, Worms, firewall design, Trusted systems, antivirus techniques, and digital Immune systems; **Cyber Law:** What is cyber-crime**,** Fundamentals of cyber security law, legal issues in cyber security.

ix) **Teaching and learning activities:**

Lecture 30 hours, Assignment 15 hours, Individual Studies 45 hours and Practical 30 hours.

x) **Assessment methods:**

Coursework: Theory test (s) and/or quizzes (15 marks), Assignment (5 marks), Practical assignments/tests/projects (40 marks), all together, contributing 60% of the total score.

End of semester examination: constitute 40% of the total score

xi) **Reading List:**

1. Seymour G. et al. (2016). *Information Security Policy, Processes, and Practices*, Taylors and Francis Publishers
2. Edward W et al. (2018). *Information Risk and Security Preventing and Investigating Workplace Computer Crime*, Taylors and Francis Publishers
3. Gupta B. B. (2019). *Computer and Cyber Security Principles, Algorithm, Applications, and Perspectives*, Taylors and Francis Publishers
4. Walden, I. (2007). *Computer crimes and digital investigations,* Oxford University Press.
5. Adam S. et al. (2008). *The New School of Information Security,* Addison-Wesley Professional.

6. Brij B. Gupta, Quan Z. Sheng. (2021). Machine Learning for Computer and Cyber Security: Principle, Algorithms, and Practices, aylors and Francis Publishers

7. Douglas R. Stinson. (2022). Techniques for Designing and Analyzing Algorithms, CRC Press

8. Michael E. W. et al. (2007). *Principles of Information Security*, Third Edition, Course Technology.

i) **Course Title: ITIN 208-Python Programming**

ii) **Course aim:**

To introduce core programming basics, principles of Object-Oriented Programming, as well as in-depth data and information processing techniques using Python programming language, where students will solve problems, explore real-world software development challenges, and create practical and contemporary applications.

iii) **Expected course outcomes:**

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

1. Install and run the Python interpreter.
2. Create and execute Python programs.
3. Describe the concepts of file I/O.
4. Read data from a text file using Python.
5. Plot data using appropriate Python visualization libraries.

iv) **Status:** Core

v) **Credit rating:** 12

vi) **Total hours spent:** 120 hours

vii) **Prerequisites:** ITIN 100, ITIN 108, ITIN 202

viii) **Course contents:**

Introduction to Python: Define python, Characteristics of python, History of python, Real world Python Applications; **Python download, Installation and environmental setup**: Python to Download and Install Python, Python environment testing, How to create, compile and run your first python program; **Python Programming Basics**: Python Variables declaration, Python Local and global variables, Python variables concatenation, How to display/print in python; **Numbers, Data Types and Operators**: Data Types, Arithmetic Operators, Logical Operators, Assignment Operators, Bitwise Operators; **Python Data structures**: Array, Tuple, List , Dictionary; **Python Conditional Statements** : If Statements, If Else Statements, ELIF statements, Nested If Statements, Switch statements; **Python Repetition statements (Python Loops)**: For Loop, While Loop, Enumerate, Break, Continue; **Python Functions**: Main Function, User defined function, Return Values, Function calling; **Python O.O.P (Follow regular O.O.P guidelines)**: Objects, Methods, Inheritance, Polymorphism, Encapsulation, Abstraction; **Python Strings**: Lowercase, Uppercase, Join, Split, Reverse, Replace String len(), strip(), format(), count(), find() etc.; **Python File Handling**: Create, Open, Append, Read and Write, Checking If The file exists, File COPY using shutil.copy() and shutil.copystat(), File and Directory handling, Python Zip files, Python Exception handling; **Python library/tool for Data Science**: Numpy, Scipy, Pandas, Matplotlib, Seaborn, Reading and Writing in CSV files, Python Matrix Transposition, Multiplications etc.; **Python Project:** Design and develop a particular algorithm from any of the real life applications; Data science, Python Web Application, Computer Security etc.

ix) **Teaching and learning activities:**

Lectures (30 hours), assignment (15 hours), independent study (20 hours) and practical (15 hours).

x) **Assessment methods:**

Coursework: Theory test (s) and/or quizzes (15 marks), Assignment (5 marks), Practical assignments/tests/projects (40 marks), all together, contributing 60% of the total score.

University Examination: constitute 40% of the total score.

xi) **Reading List**

1. Lutz, M. (2011). *Programming Python: Powerful Object-Oriented Programming,* 4th Edition, O'Reilly Media ISBN-13: 978-0596158101
2. Gowrishankar S. and Veena A. (2020). *Introduction to Python Programming,* ISBN 9780815394372, Chapman and Hall/CRC
3. Vijay Kumar, Sharma and Vimal Kumar and Swati Sharma, Shashwat Pathak. (2022). Python Programming: A Practical Approach 1st Edition, *Chapman and Hall/CRC; 1st edition*

i) **Course Title: ITIN 209 - Systems Engineering and Project Management**

ii) **Course aim:**

To provide the understanding of software development life cycle models, Requirement dictation process, Analysis modelling and specification, Architectural and detailed design methods, Implementation and testing strategies, Verification and validation techniques, Project planning and management as well as the use of CASE tools and techniques for planning, scheduling, and tracking.

iii) **Expected course outcomes:**

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

1. Explain basic concepts and principles of components of software engineering, e.g., of requirements engineering, system design, software implementation, testing and maintenance, and how these components contribute to the software process.
2. Describe the major elements of the Software Development process.
3. Plan software projects, including risk and quality management
4. Develop a simple program specification of a typical formal specification method.
5. Develop Use Case and Activity Diagram analysis for a given problem of limited size.
6. Use available tools for program specification and design.
7. Apply the requirements and domain analysis methods of the Unified Modeling Language (UML).

iv) **Status:** Core

v) **Credit rating:** 12

vi) **Total hours spent:** 120 hours

vii) **Course contents:**

Introduction to Software Engineering: Definitions – Size Factors – Quality and Productivity Factors – Managerial Issues; **The Software Life-cycle:** Introduction to the software life-cycle, Review of historical models, the spiral model and interactive approaches, Prototyping and Incremental models, The Rational Unified Process; **System Specification:** Requirements Elicitation, Requirements Analysis, Requirements Specification document, Design, Implementation, Testing, Deployment & Maintenance; **Project Management Processes and life cycle:** Initiation, Planning Processes, Execution processes, Control processes, Close-up processes; **Software Cost Estimation:** Software cost factors – Software Cost Estimation Techniques – Staffing-level Estimation – Estimating Software Maintenance Costs – The Software Requirements Specification – Formal Specification Techniques – Languages and Processors for Requirements Specification; **Project Integration through Case Study:** Scope Management, Project Time Management, and Resource management, Cost Management, Human Resources Management, Quality Management, Project Communication Management, Risk Management and Procurement Management.

viii) **Teaching and learning activities:**

Lectures (30 hours), assignment (15 hours), independent study (45 hours) and practical (30 hours).

ix) **Assessment methods:**

Coursework: Theory test (s) and/or quizzes (15 marks), Assignment (5 marks), Practical assignments/tests/projects (40 marks), all together, contributing 60% of the total score.

University Examination: constitute 40% of the total score.

x) **Reading List:**

1. Seelam VSV Prabhu Deva Kumar, Shyam Akashe, Hee-Je Kim, Chinmay Chakraborty. (2022). Hybrid Intelligence for Smart Grid Systems, CRC Press, 1st Edition

2. Sommerville I. (2004). *Software Engineering*, 8th Edition, Adson –Wesley.
3. Ronald J. Leach. (2020). *Introduction to Software Engineering*, Chapman and Hall/CRC.
4. Henry J. (2010). *Software Project Management, A Real World Guide to Success*, International edition, Pearson Prentice Hall 978-0-13606-169-4.
5. O'connell, F. (2001). *How to run successful projects III*, Addison Wesley.
6. Jayakrishna Kandasamy, Kamalakanta Muduli, V.P. Kommula, Purushottam L. Meena. (2022). Smart Manufacturing Technologies for Industry 4.0: Integration, Benefits, and Operational Activities , 1st Edition,

7. Foster E. C. et al. (2021). *Software Engineering: A Methodical Approach*, 2nd Edition.

i) **Course title: ITIN 210-IT Innovation and Entrepreneurship**

ii) **Course aim:**

To help students understand the hidden value of their ideas by highlighting the impact of various types of innovation in driving the development of industries and technological fields by helping them identify opportunities and creatively solve problems.

iii) **Expected course outcomes:**

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

1. Effectively combine the understanding of technology and entrepreneurship in a cross-disciplinary way to identify problems worth solving and develop attractive opportunities within the field of experience.
2. Plan, organize, and execute a project or new venture with the goal of bringing new products and services to the market.
3. Apply the acquired entrepreneurial skills to run IT related businesses successfully.
4. Assess the commercial viability of new technologies, business opportunities and existing companies.

iv) **Status:** Core

v) **Credit rating:** 8

vi) **Total hours spent:** 80 hours

vii) **Course contents:**

Innovation: IT Innovation, Innovative entrepreneurship, the relationship of IT innovation and entrepreneurship, Entrepreneurial Mind, Ideas and Opportunities, Creativity, Invention, Disruption and Innovation, Entrepreneurial Strategy, Creation of competitive advantage based on IT innovation and entrepreneurship; **IT Innovative models**: Product, process, organization and marketing, Selling and marketing innovative entrepreneurial products; **IT innovation and their role in business and industrial development:** Sources of IT innovation, transfer of technology, Creative methods and approaches used in IT innovation management; **Approaches to management of IT innovation process**: Project approach to IT innovation management, Adaptation of access to selected business models, In-house business development of the IT innovation process in the company; **Open IT Innovation as a modern concept:** the limits of this method and its benefits for business and industrial development; The **strategy of IT innovation process:** types and selection of appropriate strategies, Measurement and evaluation of the benefits of it innovation for business and industries, Barriers to IT innovation in business and industries, IT innovation failure and its causes, post-audits of IT innovative projects; **ICT Ventures**: Strategy, Organization and Technology: Strategy, Organization and Technology, Disruptive Technology; **Innovation policy**: copyright, trademark and patenting of IS products/processes.

viii) **Teaching and learning activities**

Lectures (30 hours), assignment (15 hours), independent study (20 hours) and practical (15 hours).

ix) **Assessment methods**

Coursework: Theory test (s) and/or quizzes (15 marks), Assignment (5 marks), Practical assignments/tests/projects (40 marks), all together, contributing 60% of the total score.

University Examination: constitute 40% of the total score.

x) **Reading list**

1. Izabela Kowalik. (2021). Entrepreneurial Marketing and International New Ventures: Antecedents, Elements and Outcomes,
2. Ndemo, B., & Weiss, T. (Eds.). (2016). *Digital Kenya: An entrepreneurial revolution in the making*. Springer.
3. Evgueni. V, Birgit, L, Djamchid. A. (2021). Digital Entrepreneurship and the Sharing Economy, Routledge
4. Szirmai, A., Naudé, W., & Goedhuys, M. (Eds.). (2011). Entrepreneurship, innovation, and economic development. Oxford University Press.
5. Audretsch, D. B., Falck, O., & Heblich, S. (Eds.). (2011). Handbook of research on innovation and entrepreneurship. Edward Elgar Publishing.
6. Ndemo, B. (2017). The Paradigm Shift: Disruption, Creativity, and Innovation in Kenya. In Digital Kenya (pp. 1-23). Palgrave Macmillan, London.

i) **Course title: ITIN 211 - Semester project 4: Innovative Information Systems Development**

ii) **Course aim:**

To capture the challenge and excitement of creating a solution that adds value whether a process, product, or service and to provide students with an opportunity to experience the innovation process while exploring various types of innovation (e.g., design thinking, business innovation, etc.).

iii) **Expected course outcomes:**

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

1. Identify and involve users, stakeholders, industry mentors and faculty advisors in the innovation.
2. Describe the building blocks of innovation including the drivers, sources, methods, types, and benefits.
3. Create innovative solutions (products or systems) to address real world situations that meet user needs.
4. Apply best practices in agile project management to make plans, organize projects, align resources, monitor obstacles to success and strategies to overcome and achieve desired outcomes.

iv) **Status:** Core

v) **Credit rating:** 12

vi) **Total hours spent**: 120 hours

vii) **Course Contents:**

Ideation: Student groups will brainstorm about real-world problems, focusing on innovative information systems or applications. This might include students visiting the industry for real-world problems; **Create and analyze a problem:** Students will work on their teams to identify, analyse, design solutions to the identified problem(s). Formulate and analyze problem and write its procedures; **Develop prototype:** Plan prototypes, write the corresponding computer program; perform program testing and debugging; refine the prototypes in some innovative ways to meet their stakeholders' requirements and constraints; **Full project implementation:** Perform system testing, deploy system, write report; quality assurances reviews and perform presentation or communicate the project results. **Introduction to Blockchain technologies for agriculture, health and education sectors.**

viii) **Teaching and learning activities:**

Seminars/Tutorials 30 hours, Assignment 10 hours and independent study 80 hours.

ix) **Assessment methods:**

Coursework: Project proposal (10%), Team Project Assignments #1-9 (30%), Sprint Reports (10%), Individual Homework Assignments (5%), all together, contributing 55% of the total score.

End of semester examination: Final Deliverables and Project Review (project presentation and system demonstration (20%) and Final project report (20%)), and Individual Reflection (5%), all together, contributing 45% of the total score.

x) **Reading List:**

1. *Business Model Generation* by Osterwalder and Pigneur. https://www.strategyzer.com/books/business-model-generation
2. *The Lean Startup* by Eric Ries. http://theleanstartup.com/principles
3. *Rework!* by the 37 Signals team. https://basecamp.com/books/rework
4. *The Startup Owner's Manual* by Steve Blank. https://steveblank.com/startup-owners-manual-1in/
5. *Value Proposition Design* by Osterwalder and Pigneur. https://strategyzer.com/books/value-proposition-design

i) **Course title: ITIN 206-Fundamentals of Geographical Information System**

ii) **Course Aim:**

To introduce concepts of Geographical Information Systems and Science, how to apply GI System modelling and spatial analysis skills to solve geospatial problems and competence in the use of GI System tools for data management, processing, analysis, and visualization.

iii) **Course expected learning outcome(s):**

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

1. Describe fundamental concepts and practices of Geographic Information Systems and Science.
2. Use Geographic Information System modelling, spatial analysis skills and critical thinking in solving geospatial problems using GIS tools.
3. Examine organizational skills in file and database management by presenting examples of interdisciplinary applications of Geospatial Information Science and Technology.
4. Design and implement a complete GIS project from the start using either ArcGIS or QGIS, R and Python software in data collection, processing, analysis and visualization.

iv) **Course status:** Elective

v) **Credits rating:** 12 Credits

vi) **Total hours spent:** 120 hours

vii) **Course Content:**

Introduction: Definitions and Terminologies, history of GIS, functional components of GIS, GISystems, GIScience and GIStudies, GIS data rypes, characteristics of spatial data, point data, line data, Area data and Volume data; **Data modeling, data models and data structures:** Geographic phenomena and their abstractions, Spatial Data and Information, the real world, its Models and their representation, maps, Topology and Spatial Relationships, databases, attribute data models; **Spatial data models and data structures:** Field-based Models, Object-based Models, Spatio-temporal Data Models; **Spatial temporal data models and data structures:** Data modeling, extension standards, Multi-spectral imagery extension; **Spatial Data: Acquisition (Direct and indirect):** Metadata, data quality, sources of errors; **Reference and Coordinate Systems:** Choice of the Ellipsoid, Horizontal and Vertical Datum, Map Projection, Coordinate Systems; **Spatial Analysis:** Data Organization, measurement and Spatial Queries: Maintenance and Analysis of the Spatial Data, Maintenance and analysis of the attribute data, Integrated analysis of Spatial and attribute data; classification and (re)Classification, overlay operations, Neighborhood operations, Connectivity operations; **Digital mapping:** introduction of digital cartography**,** Principles of digital mapping, hardware and software aspects of digital mapping, operating principles of input and output devices, computer assisted cartographic packages/software. Data capture and preparation, editing, processing and output, applications of digital mapping; **GIS Applications:** Land Information Management, Environmental applications, Natural Resources, Public health, and spatial planning (Urban and rural); **Open Geospatial (OGS) data standards:** Data modeling, extension standards, multi-spectral imagery extension; **Spatial data transfer protocol; Getting Started with GIS Software:** ArcGIS and QGIS; An Overview and functionality of ArcGIS and QGIS software.

viii) **Teaching and learning activities:**

Lectures 30 hours, practical 15 hours, assignments 15 hours and independent study 20 hours.

ix) **Assessment methods:**

Coursework: Theory test (s) and/or quizzes (15 marks), Assignment (5 marks), Practical assignments/tests/projects (40 marks), all together, contributing 60% of the total score.

University Examination: constitute 40% of the total score.

x) **Reading list**:

1. de Smith, M. J., Goodchild, M. F., Longley, P. A. (2015) *Geospatial Analysis: A Comprehensive Guide to Principles, Techniques and Software Tools*, 5Ed., Winchelsea, The Winchelsea Press.
2. Jay Gao. (2021). Fundamentals of Spatial Analysis and Modelling 1st Edition,
3. Longley, P. A., Goodchild, M. F., Maguire, D. J., Rhind D. W. (2015). *Geographic Information Systems and Science*, 4th Eds, London, Wiley & Sons, Inc.
4. Chang, Kang-tsung. 2018. *Introduction to Geographic Information Systems*, 9th ed., McGraw-Hill Higher Education, Toronto.
5. Law, Michael, and Amy Collins. 2018. *Getting to Know ArcGIS Desktop*, 5th ed., Esri Press, Redlands, California.

i) **Course title: ITIN 212-Introduction to Computer Modelling and Simulation in MATLAB**

ii) **Course aim:**

To equip students with necessary skills and tools to model and simulate real-world systems.

iii) **Expected course outcomes:**

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

5. Identify fundamental concepts and tools of Computer Simulation.
6. Explain the role of Computer Simulation in research.
7. Use MATLAB tools for various simulation purposes.
8. Apply simulation modeling techniques to solve different production scheduling problems.
9. Build relevant factory models and simulate using the MATLAB.
10. Analyze the simulated results, interpret, and recommend creditable solutions.

iv) **Status:** Elective

v) **Credit rating:** 8

vi) **Total hours spent:** 80 hours

vii) **Course Contents:**

Introduction to Computational: Modeling: Importance of Computational Modeling, Steps in the modeling process, Mathematical modeling terminology and approaches to simulation, Modeling and simulation Terminology; Basic concepts and definitions of models and simulation and their applications, Simulation process flow; Modeling with Difference/Differential Equations, Graphical Models, Modeling and Simulation Examples; Proportionality and Geographic Similarity, Interpolation and Extrapolation, Regression Analysis; Experimental Modeling, Linear and Non-Linear Models, Deterministic and probabilistic (stochastic) models; Spatio-temporal modeling and simulation; Markov Models and Neural Networks.

viii) **Teaching and learning activities**

Lectures (30 hours), assignment (15 hours), independent study (20 hours) and practical (15 hours).

ix) **Assessment methods**

Coursework: Theory test (s) and/or quizzes (15 marks), Assignment (5 marks), Practical assignments/tests/projects (40 marks), all together, contributing 60% of the total score.

University Examination: constitutes 40% of the total marks.

x) **Reading list**

1. Maki, (2006). *Mathematical modeling and computer simulation, Belmont,* CA: Thomson Brooks/Cole.

2. Leonard J. Ledger. (2022). Python Programming For Beginners: The Ultimate Crash Course to Learn Python Coding Quickly and Easily | Step-by-Step Guide With Hands-on Exercises & Beginners Projects Paperback,

3. Kent D. Lee and Steve Hubbard (2015). Data Structures and Algorithms with Python (Undergraduate Topics in Computer Science) 2015th Edition

4. Steven I. G, Brian G. (2021). Introduction to Modeling and Simulation with MATLAB® and Python (Chapman & Hall/CRC Computational Science) 1st Edition, Chapman and Hall/CRC; 1st edition

5. Codeone Publishing. (2021). Python Programming for Beginners: The #1 Python Programming Crash Course for Beginners to Learn Python Coding Well & Fast (with Hands-On Exercises), Independently published

Semester 1 year 3

i) **Course title: ITIN 300 - Database Implementation and Tuning**

ii) **Course aim:**

To enable students to understand essential concepts in relational database implementation and how to ensure databases are running as smoothly and efficiently as possible.

iii) **Course expected learning outcome(s):**

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

1. Describe fundamentals of database concepts and architecture when developing database systems.
2. Discuss the transaction management and concurrency control techniques for ensuring data integrity.
3. Use different DBMS software (e.g., Access, MySQL, Oracle) to support the practical case assignments in the course unit.
4. Develop a database using the concepts of client server architecture and/or distributed architecture.
5. Practice the hands-on skills on database performance tuning.
6. Apply relational algebra and relational calculus when developing applications for querying data using query languages.

iv) **Course status:** Core

v) **Credit rating:** 10

vi) **Total hours spent:** 100 hours

vii) **Prerequisite:** ITIN 200

viii) **Course content:**

Query Processing: Basic concepts, Query Optimization methods; **Normalization**: Introduction to DBMS normalization, First Normal Forms (1NF), Second Normal Forms (2NF), Third Normal Forms (3NF), Boyce-Codd Normal Form (BCNF), Fourth Normal Forms (4NF) and Fifth Normal Form (5NF), Multi-Valued Dependency (MVD), Join dependency, Canonical Cover; **Transactions:** Introduction to DBMS transactions, Transaction (ACID) properties, States of transaction, Testing of Serializability, View of Serializability, Log-Based recovery; **Concurrency control**: Introduction to concurrency control, Lock Based Protocols, Time Stamp Based Protocols, Validation Based protocols, Thomas Write Rule, Multiple Granularity, Deadlock Handling, Recovery Concurrent Transaction, (Recovery Systems – Log Based Recovery – Advanced Recovery Techniques); **File Organization**: Introduction to file organization, Sequential file organization, Heap file organization, Hash File organization; **Hashing**: Static hashing and dynamic hashing; **Database Security:** Authentication, Authorization, Database permissions, Roles and privileges, Access level control; **RAID**: Standard RAID levels, Pros and Cons for each RAID level; **Web as a database application:** Web databases architecture and systems, 3-tier database architectures design and development; **Performance tuning overview:** apply tuning methodology, balance performance and safety trade-offs, identify common tuning problems; **Metrics, alerts, and baselines:** view metrics, create metric thresholds, view alerts, create metric baselines, and enable adaptive thresholds.

ix) **Teaching and learning activities:**

Lectures (20 hours), assignment (10 hours), practicals (40 hours) and independent study (30 hours).

x) **Assessment methods**

Coursework: Theory test (s) and/or quizzes (15 marks), Assignment (5 marks), Practical assignments/tests/projects (40 marks), all together, contributing 60% of the total score.

University Examination: constitutes 40% of the total marks.

xi) **Reading list:**

1. West, A & Prettyman, S. (2018). *Practical PHP 7, MySQL 8, and MariaDB Website Databases: A Simplified Approach to Developing Database-Driven Websites, Second Edition*, Berkeley, CA Apress, United States
2. Navathe, E. (2016). *Fundamentals of Database Systems, Seventh Edition,* Addison-Wesley Publishing Company, United States
3. Alvaro, F. (2016). *SQL: Easy SQL Programming & Database Management For Beginners, Your Step-By-Step Guide To Learning The SQL Database*, CreateSpace Independent Publishing Platform
4. Ciro Fiorillo. (2021). Oracle Database 11gR2 Performance Tuning Cookbook, Packt Publishing
5. Lightstone S. (2006). *Database modeling &design: logical design*, Morgan Kaufmann Publishers.
6. Allen G. Taylor. (2021). Database Development For Dummies 1st Edition, Kindle Edition, For Dummies; 1st edition
7. Chad R, Jon, S. (2021). Beginning MySQL Database Design and Optimization: From Novice to Professional Softcover reprint of the original 1st ed. Edition, Apress; Softcover reprint of the original 1st ed. edition

i) **Course title: ITIN 301 - Mobile Apps Design and Development**

ii) **Course aim:**

To provide students with a comprehensive understanding of the tasks related to the development of enterprise-level mobile applications.

iii) **Course expected learning outcome(s):**

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

1. Describe the capabilities and limitations of mobile platforms that affect application development and deployment.
2. Explain the technology and business trends impacting mobile application development.
3. Develop enterprise-level mobile solutions, by taking full advantage of the capabilities of the adopted platform/framework.
4. Use software/hardware tools to develop, test and debug mobile applications.
5. Develop mobile application using a range of software development methods
6. Evaluate alternative mobile frameworks and contrast different programming platforms.

iv) **Course status:** Core

v) **Credit rating:** 10 credits

vi) **Total hours spent:** 100 hours

vii) **Course Contents:**

i. **Overview of Mobile Application Development:** - Why Mobile Apps? - Choice of Implementation Technology - Native Application Implementation - Mobile Web Applications - Hybrid Mobile Application Implementation; **App Design Issues and Considerations:** - Mobile Development Lifecycle Overview - Form Factors and User Input Technology - Architecture, Design and Engineering Considerations - Usability and User Interaction Design - Mobile Navigation and Interface Design - Overarching Design Principles and Guidelines; **Android Overview:** Why Android?, History of Android? Android vs. The Rest**,** Basic Android Features; **Android Environment:** Basic Overview, Environmental Setup, Installation and path setting, Testing Environment, Android IDEs; **Android Architecture:** Linux kernels, Libraries, Android Runtime, Application framework and Applications; **Application Components:** Activities, Services, Broadcast receivers, Content providers; **Developing the Mobile App:** - Techniques, Methodologies for Mobile Application Development - Mobile Application Development Frameworks - Persistent Data in Mobile Apps - Maps and Location in Mobile Apps - Access to Hardware and Sensors - Building Mobile Apps

Powered by Enterprise Backend - Secured Data Store and Synchronization; **Testing and Publishing Apps:** - Mobile Application Build and Delivery - Testing Mobile Applications - Automated versus Manual Testing - App Distribution Through App Stores - App Distribution for the Enterprise - Monetizing Apps.

viii) **Teaching and learning activities:**

Lectures (20 hours), assignment (10 hours), practical (30 hours) and independent study (40 hours).

ix) **Assessment methods:**

Coursework: Theory test (s) and/or quizzes (15 marks), Assignment (5 marks), Practical assignments/tests/projects (40 marks), all together, contributing 60% of the total score.

University Examination: constitutes 40% of the total marks.

x) **Reading List:**

1. Sachin, D. (2015). *An Illustrated Guide to Mobile Technology*, CreateSpace Independent Publishing Platform.
2. Williamson, L. et. al. (2015). *Enterprise Class Mobile Application Development: A Complete Lifecycle Approach for Producing Mobile Apps*, IBM Press
3. Iversen, J. and Eierman M. (2013). *Learning Mobile App Development: A Hands-on Guide to Building Apps with iOS and Android*, Addison-Wesley Professional.

i) **Course title: ITIN 302- Network Design and Management**

ii) **Course aim:**

To introduce to students the application of computer network design and implementation issues for designing and implementing network topologies, network problem diagnosis, network configurations, switching and routing configurations, developing measures to ensure network security as well as to understand the trends of the rapidly evolving communication and networking technologies.

iii) **Course expected learning outcome(s):**

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

1. Explain key networking protocols, and their hierarchical relationship in the context of a conceptual model, such as the OSI and TCP/IP framework.
2. Identify and remedy problems occurring in a network after troubleshooting.
3. Design a LAN using a given topology or combination of topologies.
4. Examine the diagnostics of the networks, using the specialized Hardware and Software.
5. Recommend appropriate measures for improvement of the network security
6. Construct switching and routing tables suitable for the Windows-based OS for network applications.

iv) **Course Status:** Core

v) **Credit rating:** 10

vi) **Total hours spent:** 100 hours

vii) **Course contents:**

Local and Wide Area Network Topologies and Hardware: Physical and Logical Topologies - LANs cabling infrastructure design - Network Switching - Ethernet Local Area Networks - Networking Hardware - Wide Area Networking Technologies -WAN Topologies – WAN and WAN Transmission Methods - WAN Implementation and Remote Connectivity; **Configuring Internet Services**: WWW, FTP, E-mail, Telnet, DNS, Client and Server parts; **Network Security**: Firewalls, web security, IP Security IP security Architecture, authentication Header, Security payload, security associations, Key Management-Malicious Logic, Vulnerability Analysis, Auditing and Intrusion Detection, Protocols, Sockets filtering, Proxy servers, and troubleshooting Network Problems; **Computer Networks Administration**: Network management model, Performance management, Configuration management, accounting management, Fault management, Network management tools, remote monitoring, Upgrading Computer Networks, Managing Network Design, and Implementation.

viii) **Teaching and learning activities:**

Lectures (20 hours), assignment (10 hours), practical (30 hours) and independent study (40 hours).

ix) **Assessment methods:**

Coursework: Theory test (s) and/or quizzes (15 marks), Assignment (5 marks), Practical assignments/tests/projects (40 marks), all together, contributing 60% of the total score.

University Examination: constitutes theory test 40% of the total marks.

x) **Reading List:**

1. Satapathy, S. C (2017). *Computer Communication, Networking and Internet Security, Proceedings of IC3T 2016,* Springer.
2. Comer, D. (2014). *Fundamentals of Computer Networking and Internetworking*, Prentice Hall.
3. Tanenbaum A.S. (2011). *Computer Networks, 5th edition*, Prentice-Hall International.
4. Cheng Sheng, Jie Bai, Qi Sun. (2021). Software-Defined Wide Area Network Architectures and Technologies, 1st Edition, CRC Press
5. Lei Zhang, Le Chen. (2021). Cloud Data Center Network Architectures and Technologies, 1st Edition, CRC Press
6. Rihai Wu, Xun Yang, Xia Zhou, Yibo Wang. (2021). Enterprise Wireless Local Area Network Architectures and Technologies, CRC Press, 1st Edition

i) **Course title: ITIN 303- ICT for Sustainable Development**

ii) **Course aim:**

To give students basic knowledge of society's sustainability challenges (with a focus on the environment and social sustainability), and to give understanding of and practical experience in how they can contribute solutions to sustainability challenges in their future professional role.

iii) **Expected course outcomes:**

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

1. Explain main theories and conceptual frameworks in the field of ICT for development
2. Describe potential of both ICTs in different areas such as health, education, agriculture, finance, gender equality and climate change.
3. Determine existing innovative business models and other applications in the above-mentioned areas with reference to Tanzania and other developing countries.
4. Compare and contrast various business models (public, private sector, PPP, civil society) with respect to technology, infrastructure, capacity building, human resource etc.
5. Assess how ICT models can be successfully implemented in the field and understand critical success factors and constraints in adoption.

iv) **Course Status:** Core

v) **Credit rating:** 8

vi) **Total hours spent:** 80 hours

vii) **Course contents:**

Introduction to ICTs for sustainable Development: Introduction to Information and Communication Technology (ICT); Role of ICTs in Sustainable Development; Current Status of ICTs in Sustainable Development-Global and India Scenario. Potential of ICTs in various fields, impact of information Technologies on GDP growth; **Building Knowledge Societies:** The concept of Knowledge Society; identifying stakeholders and target communities; Understanding information needs, Traditional vs. contemporary knowledge systems, information processing and retrieval; Understanding means of communication in different areas, developing an effective communication strategy; **Information and Communication Technologies:**

The hardware and software, the physical infrastructure, satellite, wireless solutions, telecommunication technologies, mobiles, fixed line, internet and world wide web, community radio, technology-user interface, design of relevant ICT products and services; **ICT Applications:** Applications of ICT in education, Health (telehealth, telemedicine and health informatics), Gender Equality, Agriculture (e-Governance, telecentres, Mobiles for development, climate change and disaster management, ICT Networks for water management; **ICT for Development in Tanzania:** Policy and Institutional Framework in Tanzania, e governance, ICT

Models in health, education , agriculture, finance, gender equality, Mobiles for Development Experience sharing by ICT for Development practitioners; **ICT4D Implementation:** Developing an ICT4D Project, Critical Success factors for technology diffusion and use, Constraints in adoption, The role of national policies, Institutional Policy framework, multi-stakeholder partnerships, Role of Private Sector. **Introduction to Blockchain technologies for agriculture, health and education sectors:** the importance of blockchain technology in implementing abnd achieving SDGs.

viii) **Teaching and learning activities:**

Lectures (20 hours), assignment (10 hours), practical (30 hours) and independent study (20 hours)

ix) **Assessment methods:**

Coursework: Theory test (s) and/or quizzes (15 marks), Assignment (5 marks), Practical assignments/tests/projects (40 marks), all together, contributing 60% of the total score.

University Examination: constitutes theory test 40% of the total marks.

x) **Reading list**

1. Hilty L. M. et al. (2015). *ICT Innovations for Sustainability (Advances in Intelligent Systems and Computing)*, 488 pages Springer; ISBN-10: 3319092278
2. Arthur T. et al (2019). *Sustainable ICT, Education and Learning, IFIP Advances in Information and Communication Technology book series (IFIPAICT, volume 564)* Conference proceedings SUZA 2019
3. Vikram Bali, Rajni Mohana, Ahmed A. Elngar, Sunil Kumar Chawla, Gurpreet Singh. (2022). Handbook of Sustainable Development Through Green Engineering and Technology, 1st Edition, CRC Press
4. Bass, S., & Dalal-Clayton, B. (2012). *Sustainable development strategies: a resource book*. Routledge.
5. Johansson, B., Karlsson, C., & Stough, R. (Eds.). (2006). *The emerging digital economy: entrepreneurship, clusters, and policy*. Springer Science & Business Media.
6. Marullo, C., Casprini, E., Di Minin, A., & Piccaluga, A. (2018). '*Ready for Take-off': How Open Innovation influences startup success*. Creativity and Innovation Management, 27(4), 476-488.
7. Archana Singh, Vinod Kumar Shukla, Ashish Seth, Sai Sabitha. (2022). ICT and Data Sciences, 1st Edition, CRC Press
8. Online learning resources: https://www.routledge.com/Information-and-Communication-Technology-for-Development-ICT4D/Heeks/p/book/9781138101814

i) **Course title: ITIN 304- Final Research Project Phase I**

ii) **Course aim:**

To reinforce students' learning on the aspects of research processes and enable them to produce a research proposal ready for implementation as a final year special research project. Students will develop research proposals, focusing on literature searching and critical appraisal; reference management; framing the research question and determining research methodologies, methods, and approaches; and research ethical issues.

iii) **Course expected learning outcome(s):**

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

1. Describe research principles and methods applicable to any selected topic in ICT.
2. Explain the background and literature review relating to a practical problem involving the researchable problem in Information Technology.
3. Develop a synthesis of literature review relating to a practical problem involving the researchable problem in Information Technology.
4. Develop a formal research proposal which clearly defines the scope and objectives of the research project and includes a plan for its completion.
5. Prepare an oral presentation and answer questions about the research proposal.

iv) **Course Status:** Core

v) **Credit rating:** 12.0

vi) **Total hours spent:** 120 hours

vii) **Course contents:**

Introduction: meaning of research, objectives, motivation of research, types of research, research approaches, significance of research, research process and criteria of good research; **Identifying the research problem**: what is a research problem? selecting the problem, necessity of defining a problem and techniques involved in defining a problem, choosing topic of the research, idea pitching, and preparation of research concept note, matching the title, objectives and research questions; **Research design and Methods**: meaning of research design, need for research design, features of good research design, important concepts relating to research design, research methods; **Components of a research proposal:** title of the research, background of the study, statement of the problem, objectives, justification of the research, research questions/hypothesis, literature review, methodology, budget preparation and scheduling of activities; **Literature review:** Searching the literature, Interpreting and assessing the quality of the literature in the context of the topic; **Scientific Writing and presentations:** citing techniques, referencing; different referencing styles reference and management software i.e. Endnote and Mendeley, Scientific presentation preparations, good and bad presentations and best practices; **Collecting and managing data;** Data collection methodologies, Questionnaires, interviews, Observations, brainstorming etc. Data collection process and tools, Data analysis

Ethical considerations and processes; Acknowledgment v/s Plagiarism, possible consequences.

viii) **Teaching and learning activities:**

Students, under the supervision of a member of staff, carries out a practical Information Technology research project using appropriate scientific, engineering and project management techniques. Thus, the contents to be used in the project will depend on the topic that a student selects in consultation with the supervisor. During the entire course, a student will be provided with guidance on: Developing a literature review, responding to ethical requirements, Clarifying the methodology, Conducting the data gathering, Correct use of text style and referencing, developing platform/tools, how to give presentations of a research project report.

Teaching and learning activities will include readings, group discussions, exercises and research supervision.

ix) **Assessment methods:**

Proposal writing (70 marks), Proposal presentation, Research project report (30 marks).

x) **Reading list:**

1. Jessica Decuir-Gunby and Paul A. Schutz. (2022). Developing a Mixed Methods Proposal: A Practical Guide for Beginning Researchers (Mixed Methods Research Series), SAGE Publications, Inc; 1st edition
2. *Mangey Ram, Om Prakash Nautiyal, Durgesh Pant*. (2022). Scientific Methods Used in Research and Writing,
3. Keith F. P. (2006*). Developing Effective Research Proposals,* University of Western Australia, SAGE Publications Ltd.
4. Barbara Walker and Holly Unruh. (2021). Funding Your Research in the Humanities and Social Sciences: A Practical Guide to Grant and Fellowship Proposals, CRC Press
5. Tayie, S. (2005). Research Methods and Writing Research Proposals*,* Cairo University.

i) **Course title: ITIN 305- Knowledge Based Expert Systems**

ii) **Course aim:**

To enable students to understand principles, techniques, and tools of developing and managing expert systems and understand theories and practices of logic programming.

iii) **Course expected learning outcome(s):**

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

1. Explain problems, challenges, concepts, and techniques from the field of Knowledge-Based Systems.
2. Discuss methodological and project management approaches to developing knowledge-based systems.
3. Compare and contrast various knowledge representation systems.
4. Develop programs and systems of varying complexities from the field of Knowledge – Based Systems and expert system.

iv) **Course Status:** Elective

v) **Credit rating:** 8

vi) **Total hours spent**: 80 hours

vii) **Course contents:**

Introduction: Knowledge-Based Systems (KBS), Expert Systems (ES) Data/Information/Knowledge; **Knowledge Representation:** Definition & importance of Knowledge, Approaches & issues, predicate logic, production rules, semantic networks, frames, conceptual graphs, Object Oriented representation; **Reasoning and Inference:** Predicate Logic, Description Logics, Inference Methods, Resolution, Inference Methods, Resolution; **Methodologies for developing knowledge based systems:** The KBS Development Life Cycles; Knowledge acquisition/elicitation Management of KBS projects Prototyping; Implementation; Development environments; **An overview of AI Programming Languages:** Features of LISP, PROLOG, C++; **Expert System:** Basic concepts of Expert Systems, Comparison of conventional & Expert Systems, Structure of Expert Systems, Expert system Shells, expert system Architectures, Knowledge Acquisition, Case Study MYCIN

viii) **Teaching and learning activities**

Lectures (20 hours), assignment (10 hours), practical (30 hours) and independent study (20 hours)

ix) **Assessment methods**

Coursework: Theory test (s) and/or quizzes (15 marks), Assignment (5 marks), Practical assignments/tests/projects (40 marks), all together, contributing 60% of the total score.

University Examination: constitutes theory test 40% of the total marks.

x) **Reading list**

1. Rajendra A. Akerkar and Priti S. Sajja (2009). *Knowledge-Based Systems;* Jones & Bartlett Publishers, 1st Edition
2. Charu C. Aggarwal. (2021). Recommender Systems: The Textbook: The Textbook, Springer International Publishing AG
3. Sajja & Akerkar Ed (2010). *Advanced Knowledge Based Systems: Model, Applications & Research*, Vol. 1.
4. Stanislas Chaillou. (2022). Artificial Intelligence and Architecture : From Research to Practice, **Birkhauser**
5. Dan W. Patterson (2006). *Introduction to Artificial Intelligence and Expert System*s, PHI, New Delhi.
6. Ronald M. (2007). *Knowledge Management Systems: Information and Communication Technologies for Knowledge Management*, Springer/
7. Henry A Kissinger , Eric Schmidt, III, Daniel Huttenlocher. (2021). The Age of AI : And Our Human Future, John Murray Press

Semester 2 Year 3

i) **Course title: ITIN 307-Computer Network Security**

ii) **Course aim:**

To guide the students in learning the fundamental principles of computer and network security by studying attacks on computer systems, network, and the Web, how they work and how to prevent and detect them.

iii) **Course expected learning outcome(s):**

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

1. Identify security issues and objectives in computer systems and networks.
2. Outline the importance of cryptographic algorithms used in information security in the context of the overall Information Technology (IT) industry.
3. Explain public-key based asymmetric algorithms for encryption-based security of information.
4. Categorize the symmetric algorithms for encryption-based security of information.
5. Apply various security mechanisms derived from cryptography to computers and computer networks using underlying theory and working on a computer security infrastructure.

iv) **Course Status:** Core

v) **Credit rating:** 12

vi) **Total hours spent:** 120 hours

vii) **Prerequisite:** ITIN 106, ITIN 203

viii) **Course contents:**

Introduction: Basic concepts of computer Networks and Networks security, Types of Security attacks (active and passive attacks), Understand real life problems (review network attacks scenario), Principles of Network Security, Network Security Terminologies: Threats, risks, vulnerabilities, etc, Components of Network Security, Network Security Policies; **Secure Vs. Insecure Network Protocols**: What are insecure network protocols?; HTTP, Telnet, FTP, SNMP etc, Why are they vulnerable?, What is a substitute?,; HTTPs, SFTP, SSH etc.; **Cryptography Fundamentals**: What is Cryptography, History of Encryption, Symmetric versus Asymmetric Encryption, Combined Solutions, Private Key versus Public Key, Data Encryption Standard (DES), Advanced Encryption Standard (AES),RSA, Diffie-Hellman, MD4, MD5, SHA-1; **Web Security**: Vulnerabilities, Attacks, and Countermeasures: Secure vs Insecure web protocols, SSL vs TLS, Cross-Site Scripting Attack, Cross-Site Request Forgery Attack, SQL-Injection Attack, Click-Jacking Attack, Web Tracking, Web Proxy , VPNs, IDS and Firewalls; **Wireless Network Security**; WPA, WEP, Configuring WEP Access point, Bypassing WEP encryption , Brute-forcing WPA encryption; **Attack Techniques (Tools)**: Introduction to Wireshark, Network Reconnaissance, Mapping and sweeping the Network, Scanning the Network, Viruses, Worms and Trojan Horses, Gaining Control on Systems, Record Keystrokes, Crack Encrypted Passwords, Reveal Hidden Passwords; **Mobile Devices Security**: Access control in Android operating system, Rooting Android devices, Repackaging attacks, Attacks on app, Whole-disk encryption, Hardware protection: TrustZone; **Securing Linux**: Key Concepts, Linux Administration and Security, Key Linux Network Files, Key Linux Network Process, Key Linux Network Commands, Hardening Linux, Network File System and Linux, Network Information Service and Lin; **Biometrics Fundamentals**: Fingerprint Scanning, Facial Scanning, Iris Scanning, Hand Scanning, Retina Scanning; **Digital Signatures**: Definition and Characteristics, How Digital Signatures function, Message Digest Functions, Digital Signatures with Message Digest, E-Signature Law and Legal Issues, Key Length (56, 112, and 128 bit), RSA and DSS Signature Standards; **Physical security**: Facility Requirements, Technical Controls, Environment/Life Safety, Physical Security Threats, Elements of Physical Security; **Creating a Security Policy**: Concepts of Security Policy, Policy Design & Standards i.e. BS 7799, Various Policies, Sample Policy, Incident Handling and Escalation Procedures, Partner Policies, FW Implementation Practices, Installing and Configuring FW., Monitor FW.

ix) **Teaching and learning activities:**

Lectures (30 hours), assignment (15 hours), practical (30 hours) and independent study (45 hours).

x) **Assessment methods**

Coursework: Theory test (s) and/or quizzes (15 marks), Assignment (5 marks), Practical assignments/tests/projects (40 marks), all together, contributing 60% of the total score.

University Examination: constitutes theory test 40% of the total marks.

xi) **Reading list:**

1. Sanders, C and Smith, J. (2021). *Applied Network Security Monitoring Collection, Detection, and Analysis,* 1st Edition
2. Aggarwal*, M. (2018). Network Security With pfSense: Architect, deploy, and operate enterprise-grade firewalls,* Packt Publishing
3. Stallings, W. (2016) *Cryptography and Network Security, Seventh Edition,* Pearson
4. Stallings, W. (2016). *Network Security Essentials, Sixth Edition,* Pearson India Education*,* India
5. Ian Walden (2007). *Computer crimes and digital investigations,* Oxford University Press.
6. Adam S. et al. (2008). *The New School of Information Security,* Addison-Wesley Professional.
7. Chris M. (2007). Network Security Assessment: Know Your Network, O'Reilly Media, Inc.
8. Michael E. W. et al (2007). Principles of Information Security, Third Edition, Course Technology.

i) **Course title: ITIN 308-Machine Learning**

ii) **Course aim:**

To provide the students with the concepts and applications of machine learning technology, while solving real world problems using such technology.

iii) **Course expected learning outcome(s):**

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

1. Gain knowledge about basic of Machine Learning concepts and Principles
2. Identify machine learning techniques suitable for a given problem
3. Solve the problems using various machine learning techniques
4. Apply Dimensionality reduction techniques.
5. Design application using machine learning techniques.

iv) **Course Status:** Core

v) **Credit rating:** 12

vi) **Total hours spent:** 120 hours

vii) **Prerequisite:** ITIN 202, ITIN 207, ITIN 208

viii) **Course contents:**

Introduction to Machine learning and applications: Meaning of AI, ML, Data Science, deep learning, and their relationship, Types of Machine learning, Supervised Learning, Unsupervised Learning, Semi-Supervised Learning, Reinforcement Learning, Traditional AI tools and techniques (Statistical tools), Statistics Vs Machine learning; **Datasets and Machine learning tools**: Introduction to datasets. What is data in ML? Why data? Data pre-processing and feature selections (Use any online datasets like Kaggle or any well reputed datasets for learning purposes), Introduction to Scikit-learn, Numpy, Scipy, Matplotlib and other python ML tools; **Supervised Learning**: Regression Algorithms, Linear Regression, Random Forest, Classification Algorithms, k-Nearest Neighbors (k-NN), Decision Trees, Naive Bayes, Logistic Regression, Support Vector Machines; **Performance Metrics**: Confusion matrix: Accuracy, Precision, Recall and F-Score, Bias and Variance tradeoff, Overfitting, Under-Fittings problems and regularization; **Unsupervised Learning**: Clustering Algorithm, K-means clustering, Hierarchical Clustering/ Agglomerative clustering; **Artificial Neural Networks**: Biological Neuron, Perceptron, Multi-layer Perceptron; **Introduction to Deep Learning**: Learn the differences between ML and deep learning, Implement CNN algorithm; **Machine Learning Project**: The instructor should design a real life application of machine learning problem based scenario.

ix) **Teaching and learning activities:**

Teaching methodology will include lectures, seminar presentations, tutorials, field visits, and excursions, take home group and individual assignments, independent reading assignments, weekly Practical Laboratory.

x) **Assessment methods:**

Coursework: Theory test (s) and/or quizzes (15 marks), Assignment (5 marks), Practical assignments/tests/projects (40 marks), all together, contributing 60% of the total score.

University Examination: constitutes theory test 40% of the total marks.

xi) **Reading list:**

1. Hack, S. (2021). *Python Machine Learning*, Samule Hack.
2. Russell and Norvig (2009). *Artificial Intelligence: A Modern Approach, 3nd Edition.*
3. Bishop, C.M. (2006). *Pattern Recognition and Machine Learning,* Springer. ISBN: 978-0387 31073-2.
4. *Mark Stamp*. (2022). Introduction to Machine Learning with Applications in Information Security, Chapman and Hall/CRC
5. Hart,D & Stork, G, Peter, E. Hart & Richard O.Duda.(2001). Pattern Classification, Wiley.
6. **Marco Scutari, Mauro Malvestio. (2023).** The Pragmatic Programmer for Machine Learning: Engineering Analytics and Data Science Solutions, Chapman and Hall/CRC

i) **Course title: ITIN 311-Final Project Phase II**

ii) **Course aim:**

To orient students to skills and techniques of undertaking independent research and reporting research results.

iii) **Course expected learning outcome(s):**

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

1. Design, implement and test a solution to the research problem according to appropriate scientific and engineering principles.
2. Develop a full research report about the project.
3. Produce an oral presentation and answer questions about the project.
4. Demonstrate the implemented research solution.
5. Demonstrate the use of appropriate project management tools to organise and prioritise the various tasks involved in producing both the solution and the research report.

iv) **Course Status:** Core

v) **Credit rating:** 12.0

vi) **Total hours spent:** 120 hours

vii) **Course Contents:**

Students undertake independent research project in Information Technology, computer sciences or network fields. Students should apply the skills learnt in the previous study, undertake independent review of literature, collect, analyse data, and write a research report according to university guidelines. Thus, contents will differ from one student to another.

viii) **Teaching and learning activities:**

Teaching and learning activities will include seminar presentations, individual assignments, independent reading and writing assignments.

ix) **Assessment methods:**

Project implementation and documentation (70 marks), Project presentation (30 marks).

x) **Reading list:**

1. *Seyedeh Leili Mirtaheri, Reza Shahbazian*. (2022).Machine Learning: Theory to Applications
2. Jessica Decuir-Gunby and Paul A. Schutz. (2022). Developing a Mixed Methods Proposal: A Practical Guide for Beginning Researchers (Mixed Methods Research Series), SAGE Publications, Inc; 1st edition
3. *Mangey Ram, Om Prakash Nautiyal, Durgesh Pant*. (2022). Scientific Methods Used in Research and Writing,
4. Keith F. P. (2006*). Developing Effective Research Proposals,* University of Western Australia, SAGE Publications Ltd.
5. Barbara Walker and Holly Unruh. (2021). Funding Your Research in the Humanities and Social Sciences: A Practical Guide to Grant and Fellowship Proposals, CRC Press

i) **Course title: ITIN 309-Distributed Computing**

ii) **Course aim:**

To introduce to students the paradigms of distributed systems and computing, for evaluating its scopes and limitations, familiarize current design trend and philosophy seen from software, hardware, and applications.

iii) **Course expected learning outcome(s):**

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

1. Discuss various architecture models and middleware of distributed systems.
2. Explain the design and implementation of distributed systems.
3. Outline the advantages and disadvantages of deploying distributed technologies in a business context.
4. Learn the design issues for distributed computing in Cloud computing.
5. Design and implement distributed applications using a middleware.

6. Create a model or a middleware for a particular situation by comparing the attributes of each type in a critical way for a range of typical applications.

iv) **Status:** Elective

v) **Credit rating:** 12

vi) **Total hours spent:** 120 hours

vii) **Prerequisite:** ITIN 100, ITIN 107, ITIN 200, ITIN 202, ITIN 300, ITIN302

viii) **Course contents:**

Overview and Characterization of distributed systems: Examples of distributed systems, resource sharing, characteristics of distributed systems, distributed systems architecture models and design challenges, interconnections, distributed system taxonomy; **Distributed systems Architecture**: Hardware and Software Systems.

File Service: File Service components, characteristics of distributed file systems, design issues, interfaces, implementation techniques and a network file system case study, and distributed file system case studies: Coda, DFS, SMB/CIFS, Google FS (GFS), GmailFS, xFS; **Distributed Operating Systems**: The Kernel, Naming and Protection, communication and invocation, a distributed operating system case study; **Middleware programming:** Introduction to middleware programming, socket programming, RMI, RPC, local and remote objects implementation. Web-services programming concepts and implementation such as XML-RPC, SOAP and RESTful web services. Data serialization and standard serialization formats e.g., JSON, XML, and YAML. Middleware documentation standards, Middleware programming security concept such as: Transport and Application-level security, Authentication protocols, digital certificates, Kerberos, SSL implementation; **Coordination and concurrency:** Synchronizing physical clocks, logical time, logical clocks, and distributed coordination; **Distributed Data:** Client/Server Communication (Remote Procedure Call), Transaction, Fault Tolerance and Locking.

ix) **Teaching and learning activities:**

Teaching methodology will include lectures, field visits, and excursions, take home group and individual assignments, independent reading assignments, weekly Practical Laboratory.

x) **Assessment methods:**

Coursework: Theory test (s) and/or quizzes (15 marks), Assignment (5 marks), Practical assignments/tests/projects (40 marks), all together, contributing 60% of the total score.

University Examination: constitutes 40% of the total marks.

xi) **Reading list:**

1. Vitillo, R. (2021). *Understanding Distributed Systems: What every developer should know about large distributed applications,* CreateSpace Independent.
2. Ghosh, S. (2020). D*istributed Systems: An Algorithmic Approach, Second Edition*, CBC Press.
3. Steen, M & Tanenbaum, A. (2017), *Distributed Systems,* 3rd Edition, CreateSpace Independent.
4. Andrew, S. T. (2006). *Distributed Systems: Principles and Paradigms* (2nd Ed), Prentice Hall.
5. Sukumar, G. (2006). *Distributed Systems: An Algorithmic Approach (Computer and Information Sciences),* Chapman & Hall/CRC.
6. Kenneth, P. B. (2005). *Reliable Distributed Systems: Technologies, Web Services, and Application*s, Springer.

i) **Course title: ITIN 310-Big Data Analytics**

ii) **Course aim:**

To help students develop the understanding and informed decision-making using data and communicate the results effectively.

iii) **Course expected learning outcome(s):**

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

1. Demonstrate knowledge of big data analytics.
2. Demonstrate the ability to think critically in making decisions based on data and deep analytics.

3. Interpret computer output and use it to solve problems.
4. Demonstrate effective communication skills that facilitate the effective presentation of analysis results.
5. Apply a variety of statistical techniques, both descriptive and inferential
6. Assess the application and outcomes of statistical techniques.

iv) **Course Status:** Core

v) **Credit rating:** 12

vi) **Total hours spent:** 120 hours

vii) **Course contents:**

Descriptive Statistics: Introduction to the course, Descriptive Statistics, Probability Distributions; **Inferential Statistics**: Inferential Statistics through hypothesis tests, Permutation & Randomization Test; **Regression & ANOVA**: Regression, ANOVA (Analysis of Variance); **Machine Learning:** Introduction and Concepts, differentiating algorithmic and model based frameworks, Regression, Ordinary Least Squares, Ridge Regression, Lasso Regression, K Nearest Neighbours Regression & Classification; **Supervised Learning with Regression and Classification techniques -1**: Bias-Variance Dichotomy, Model Validation Approaches, Logistic Regression, Linear Discriminant Analysis, Quadratic Discriminant Analysis, Regression and Classification, Trees Support Vector Machines; **Supervised Learning with Regression and Classification techniques -2**: Ensemble Methods: Random Forest Neural Networks Deep learning; **Unsupervised Learning and Challenges for Big Data Analytics Clustering**: Associative Rule Mining Challenges for big data analytics; **Prescriptive analytics**: Creating data for analytics through designed experiments, creating data for analytics through Active learning, Creating data for analytics through Reinforcement learning.

viii) **Teaching and learning activities:**

Teaching methodology will include lectures, field visits, and excursions, take home group and individual assignments, independent reading assignments, weekly Practical Laboratory.

ix) **Assessment methods:**

Coursework: Theory test (s) and/or quizzes (15 marks), Assignment (5 marks), Practical assignments/tests/projects (40 marks), all together, contributing 60% of the total score.

University Examination: constitutes 40% of the total marks.

x) **Reading list:**

i. Hastie, Trevor, et al. (2009). The elements of statistical learning. Vol. 2. No. 1. New York: springer.
ii. Mounir, K and Shahira E. A (2021). Data Analytics in Marketing, Entrepreneurship, and Innovation, 1st Edition, Auerbach Publications
iii. Montgomery, Douglas C., and George C. Runger (2010). Applied statistics and probability for engineers, John Wiley & Sons.
iv. *Jay Liebowitz*. (2020). Data Analytics and AI, Auerbach Publications

i) **Course title: ITIN 313- IT Innovation and Entrepreneurship Execution**

ii) **Course aim:**

To provide both a deep grounding to students in the field of technological innovation for managers and entrepreneurs whose goal is to play a leading role in innovation-driven firms; thus, students will have an opportunity to integrate and apply these tools in a practical, business context, and draw from a wide variety of firms and industries.

iii) **Expected course outcomes:**

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

1. Familiarize with current topics in strategic innovation management, such as innovation networks, idea brokering, open innovation.
2. Identify, evaluate, and resolve a variety of issues relating to poor innovative performance in large firms as well as entrepreneurial firms.
3. Develop an understanding of the strategies most effective for exploiting innovations.

4. Critically assess and explain key current issues in our understanding of innovation as a field of study.

5. Apply innovation processes and structures such as research and Development (R&D) team and incentive design, R&D portfolio management, idea generation processes, the pros and cons of various R&D organizational structures, and the challenges of innovation in large and small firms.

iv) **Status:** Elective

v) **Credit rating:** 12

vi) **Total hours spent:** 120 hours

vii) **Course contents:**

Introduction: Dynamics of technological innovation, Industrial implications of technological innovation, Competitive implications of market and technology dynamics; **Exploring innovations:** the processes used to explore innovations along the technology, market and strategy dimensions as the innovation moves from idea to market; **Executing innovations:** the structures and incentives organizations must put into place to effectively allow talented individuals (from different functions) to execute innovation processes; **Exploiting innovations:** the strategies that a firm must consider to most effectively exploit the value of their innovation, including innovation platforms that incorporate multiple product options, portfolios and standards; **Renewing innovations:** the processes, structures and strategies for exploring, executing and exploiting innovations that established firms can use to renew their innovation foundations in the face of potentially disruptive innovations.

viii) **Teaching and learning activities:**

Teaching methodology will include lectures, field visits, and excursions, take home group and individual assignments, independent reading assignments, weekly Practical Laboratory.

ix) **Assessment methods:**

Coursework: Theory test (s) and/or quizzes (15 marks), Assignment (5 marks), Practical assignments/tests/projects (40 marks), all together, contributing 60% of the total score.

University Examination: constitutes 40% of the total marks.

x) **Reading list:**

1. Tidd, J. & Bessant, J. (2015). Managing innovation (5th edition). Wiley: Chichester, United Kingdom. ISBN: 978-1-118-36063-7 See: http://eu.wiley.com/WileyCDA/WileyTitle/productCd-EHEP003053.html

2. *Mike Kennard*. (2021). Innovation and EntrepreneurshiP, Routledge

3. Drucker, P. (2015). Innovation and Entrepreneurship, ISBN 9781138019195.

Facilities and Support Services

Facilities

Both undergraduate and postgraduate students are in two campuses: the Edward Moringe Campus (EMC) and Solomon Mahlangu Campus (SMC), both located within Morogoro Municipality. The EMC has 12 lecture rooms with sitting capacity 15-50 students, 15 lecture rooms with sitting capacity 51-100 students, four lecture rooms with a sitting capacity of 101-150 students and 3 lecture rooms with sitting capacity 151–230 students. In SMC, there are a total of 26 lecture rooms, each with a varied sitting capacity of 40-400 students; 4 computer laboratories, each with 40 – 120 computers Allocation of programmes to lecture rooms and computer laboratories for different courses is managed centrally by the Students' Records Office (SRO), and thus all lecture rooms and computer laboratories are available to all students. In other words, the new programme will not require additional or new teaching space.

Library Facility

The SUA library is designated a national depository for resources on agriculture and other related sciences, hence the name Sokoine National Agricultural Library (SNAL). The main Library is in the Edward Moringe Campus and a branch of the same in Solomon Mahlangu Campus. Given the diversity of programmes currently offered by SUA, including informatics programmes, the library has materials relevant to the degree of Bachelor of Science in Information Technology Innovation which can be accessed electronically or in print forms. Available in the Library are e-resources, including 30 computers, in the EMC library and 32 computers in SMC library, connected to the internet. There are more than 120 e-books relevant to the degree of Bachelor of Science in Information Technology Innovation. Currently, the library has a total of 37 staff. These include 6 staff with PhD qualifications; 13 staff with MA/MSc qualifications; 4 staff with BA/BSc qualifications; and 14 staff with Diploma qualifications.

Equipment

The available equipment for teaching this programme includes computers with Liquid Crystal Displays (LCDs). Most of the teaching rooms are fitted with immovable power point projectors, and at least in all rooms, black and white boards are available. The university has incubator equipped with IT equipment for students to practice their skills and knowledge.

Information and Communications Technology

The SUA Centre of Information and Communication Technology (CICT) coordinates the Information and Communication Technologies (ICT) services at SUA. The Centre trains both teachers and students to use ICT facilities in responsible, efficient and innovative ways and has provided computers in designed computer laboratories for this purpose. In addition, the two campuses have been connected to the national Optic Fibre Cable (OFC), with 100Mbps. Therefore, internet connectivity between SUA students and staff and the outside world is reliable.

Learner Support Services

There are adequate support services to enable students learn effectively. These include one library in Edward Moringe Campus; one library in Solomon Mahlangu Campus; four cafeterias in Edward Moringe Campus; 4 cafeterias in Solomon Mahlangu Campus; various playing grounds in both campuses; and a help desk in the office of the Dean of Students. There are hostels in both Edward Moringe and Solomon Mahlangu campuses which can accommodate 2500 and 1250 students respectively. Private hostels are also available in the neighborhood of both campuses. Other services available in both campuses include banking and postal services, stationeries, and business centres.

Academic Staff Available to Run the Proposed Programme

Table 11: list of academic staff with qualifications directly related to the proposed programme

S/N	Name of Academic Staff	Nationality	Age (yrs)	Academic Rank	Academic Qualification	Duration of Studies (yrs)	Final GPA Attained	Conferring Institution	Year Qualification obtained	TCU Recognition Certificate Number for Foreign Award	Employment Status	Teaching experience	His/her Check Number	List of Teaching Courses by Code	Semester	Year
1	Ayubu Jacob Churi	Tanzanian	45	Senior Lecturer	BSc. In Computer Science	3	4.6	UDSM	2003		Full time	19	11902814	ITIN 309	6	3
					MSc in Computer Science	1	Distinction	Essex University, UK	2005					ITIN 305	5	3
					PhD	4		Sokoine University of Agriculture, TZ	2014							
1.	Consolata Angello	Tanzanian	47	Lecturer	PhD	4	Pass	UDSM	2013		Full time	12	11903143	ITIN 110	2	1
					MSc	2	5	UDSM	2008					CIT 300	5	3
					BVM	5		SUA								
3	Anna Kimaro	Tanzanian	34	Assistant Lecturer	Bachelor of Library and Information Studies	3		Tumaini University	2011		Full time	3		ITIN 303	5	3
					Master of Information Studies	2	4.2	UDSM	2017							
4	Kitindi Edvin Jonathan	Tanzanian	38	Lecturer	BSc. (ICT Management)	3	4.6	MZUMBE	2008		Full time	13	11890023	ITIN 106	2	1
					M.Eng. (Communication Engineering)	2	Unclassified	Chongqing University-CHINA	2012					ITIN 302	6	3
					PhD (Communication &Inf. Systems)	4	Unclassified	Chongqing University-CHINA	2018							
2.	Neema Simon Sumari	Tanzanian	42	Lecturer	BSc (Computer Science)	3	4.3	Alabama Agricultural and Mechanical University (AAMU)	2006		Full time	14	11890034	ITIN 209	4	2

					Master of Science	2	4.4	(AAMU)	2011					ITIN 310	5	3
					PhD Computer Science and Technology	4	unclassified	Wuhan	2020							
6	Shaban Ayubu Mvuyekule	Tanzanian	37	Assistant lecturer	BSc. Information and com. Technology	3		Mzumbe	2008		Full time	13	11890001	ITIN 207	3	2
					MSc. Comp. Science			Osmania University	2012					ITIN 108	2	1
														ITIN 203	3	2
3.	George W. Kibirige	Tanzanian	41	Lecturer	Bachelor ICT Management	3	4.0	Mzumbe	2007		Full time	13	11889999	ITIN 307	5	3
					Master of Computer Sciences (Information Security)	2	3.7	University of Technology Malaysia	2012					ITIN 204	4	2
														ITIN 310	6	3
4.	Neema Nicodemus Lyimo	Tanzanian	38	Lecturer	BSc. (ICT Management)	3	4.4	Mzumbe	2008		Full time	13	11890012	ITIN 206	4	2
					MSc. Computer Science	2	4.0	UDSM	2015					ITIN 202	3	2
					PhD	4		Wuhan University	2021					ITIN 313	6	3
5.	Baraka William Nyamtiga	Tanzanian	36	Lecturer	MSc	2	4.6	NM-AIST	2013		Full time	7	111070443	ITIN 100	1	1
														ITIN 106	2	1
					BSc Computer Science	3	4.5	UDSM	2010					ITIN 212	4	2
10	Michael Pendo John Mahenge	Tanzanian	36	Lecturer	BSc (Informatics)	3	4.3	SUA	2011		Full time	9	110513113	ITIN 300	5	3
					MSc. (Information & Comm. Sci. & Eng.)	2	4.49	NM-AIST	2014					ITIN 202	3	2
					PhD	4		Wuhan University	2021					ITIN 200	6	3
11	Athuman Mgeni	Tanzanian	47	Lecturer	BSc. Information Communication Tech. management	3	4.4	Mzumbe	2009		Full time	14	110512639	ITIN. 108	2	1
														ITIN 102	1	1
					MSc Computer science	2	4.3	UDOM	2015					ITIN. 107	2	1
12	Alcardo Alex Barakabitze	Tanzanian	36	Lecturer	Bsc.in comp. science	3	4.2	UDSM	2010		Full time	11	110512683	ITIN 300	5	3
					MSc. Electronics and Communication Eng.	2	3.7/4.0	Chongqing University, CHINA	2015					ITIN 204	4	2
					PhD	4	Unclassified	HIT – China NAD Plymouth University- UK	2020					ITIN 308	6	3

6.	Joseph Philipo Telemala	Tanzanian	37	Assistant Lecturer	BSc. Computer Science	3	4.0	UDSM	2011		Full time	11	110513179	ITIN 206	4	2
					MSc. Comp. Science	2	8.25/10	Mahatma Gandhi University, India	2015					ITIN 309	6	3
					PhD (Computer Science)	4	Pass	University of Cape Town	2022					ITIN 209	4	2
14	Deus Francis Kandamali	Tanzanian	31	Ass. Lecturer	Bsc. Informatics	3	4.4	SUA	2010		Full time	6	111778113	ITIN 208	4	2
					MSc. Computer science	2	Unclassified	Beijing Institute of Technology	2018					ITIN 210	4	2
														ITIN 308	6	3
15	Catherine Francis Mangare	Tanzanian	32	Assistant Lecturer	BSc. Informatics	3	4.1	SUA	2013		Full time	7	111449316	ITIN 102	1	1
					MSc. Computer Sciences	2	Unclassified	Harbin Institute of Technology	2018					ITIN 110	2	1
														CIT 100	1	1
7.	Bertha Msuliche Lebelwa	Tanzanian	32	Tutorial assistant	BSc. Informatics	3	4.1	SUA	2014		Full time	6	111799479	ITIN 305	5	3
														CIT 100	1	1
17	Hussein Rajabu Mkwazu	Tanzanian	34	Tutorial Assistant	BSc (Computer Science)	3	3.9	IFM	2013		Full time	6	111817893	CIT 100	1	1
														ITIN 208	4	2
					Msc. Maths	2	Unclassified	UDSM	2011							
18	Odoyo Otieno	Tanzanian		Tutorial Assistant	BSc Education (Informatics and Mathematics)	3	3.9	SUA	2017		Full time	3	112167415	ITIN 212	4	2
														ITIN 105	1	1
19	Magesa Mawazo	Tanzanian		Senior Lecturer	BSc in Computer Engineering and Information Technology			UDSM	2004		Full time			ITIN 100	1	1
					MSc in Computer Science			UDSM	2010					ITIN 200	3	2
					PhD (Information and Communication Technologies for Development)			NM-AIST	2018					ITIN 108	2	1

20	Farian Ishengoma	Tanzanian	39	Lecturer	Bachelor of Electronics and Communication Engineering	4	4.4	St. Joseph Engineering College	2009		Full time		111090536	ITIN 302	5	3
					Masters of Telecommunication Engineering	2	4.1	Anna University, India	2013					ITIN 101	1	1
														ITIN 307	6	3
21	Camilius Sanga	Tanzanian		Professor	BSc. In Computer Science	3		University of Dar es Salaam			Full time	20	11906166	ITIN 309	6	3
					MSc. Computer Science	2		Osmania University						ITIN 209	4	2
					PhD. Computer Science	4		University of the Western Cape						ITIN 303	5	3
22	Abdulbastwa Hassan	Tanzanian		Tutorial Assistant	BSc. Information Systems & Network Engineering	4	3.8	St. Joseph College of Engineering and Technology	2012		Full time	6	111397972	ITIN 203	3	2
														CIT 100	2	1
23	Mussa Mussa	Tanzanian		Lecturer	BSc. In Agricultural Engineering	4	4.1	SUA	2007		Full time		11903866	ITIN 201	3	2
					Postgraduate Diploma in Computing Sciences	1	Unclassified	UDSM	2009					CIT 100	2	1
					MSc. In Computer Science	2	4.1	UDSM	2015							
24	Joan Jonathan	Tanzanian		Assistant Lecturer	BSc. Informatics	3	3.9	SUA	2011		Full time	6	111817895	ITIN 107	2	1
					MSc. Information Systems	2	Unclassified	Uppsala University	2019					ITIN 101	1	1
25	Judith Valerian	Tanzanian		Lecturer	BSc. Agricultural Economics and Agribusiness	3		SUA	2009		Full time			ITIN 313	6	3
					MSc. Agribusiness and Food economics			University of Copenhagen, Copenhagen, Denmark	2012					ITIN 210	4	2
														ITIN 105	1	1
26	Jamal Firmat Banzi	Tanzanian		Lecturer	BSc. In Information Systems	3	3.9	UDOM	2011		Full time	6	111816517	ITIN 301	5	3
					MSc. Signal and Information Processing Engineering	3	4.8	Tianjin University of Technology and Education	2015					ITIN 208	4	2
					PhD Information and Communication Engineering	4	3.9	University of Science and Technology of	2019					ITIN 308	6	3

								China								
27	Anna Geofrey	Tanzanian		Assistant Lecturer	BSc. Informatics	3	4.3	SUA	2014		Full time			ITIN 107	2	1
					MSc	2		NM-IST	2021					ITIN 201	3	2
28	Kadeghe Fue	Tanzanian		Lecturer	Bachelor's in computer engineering and Information Technology	4	4.2	UDSM	2011		Full time	9	110513165	ITIN 301	5	2
					Masters in Agric. & Biol Eng (Automation and IS)	2	4.8	The University of Florida	2014					ITIN 308	6	2
					PhD. In Engineering (Machine Vision and Robotics)			University of Georgia	2020					ITIN 207	3	2

Table 12: list of academic staff with other qualifications to teach supporting courses in the proposed programme.

S/N	Name of Academic Staff	Nationality	Age (yrs)	Academic Rank	Academic Qualification	Duration of Studies (yrs)	Final GPA Attained	Conferring Institution	Year Qualification obtained	TCU Recognition Certificate Number for Foreign Award	Employment Status	Teaching experience	His/her Check Number	List of Teaching Courses by Code	Semester	Year
1	Hashim Mohamed	Tanzanian	61	Senior Lecturer	BA. Ed	3	3.6	UDSM	1988		Full time	18	11905631	SC100	1	1
					MA.	2	3.5	UDSM	1998					SC101	2	1
					PhD	3	Unclassfied	UWC, South Africa	2006							

2	Benedicto Bhishikana Kazuzuru	Tanzanian	50	Associate Professor	B.A Statitics (Hons)	3	4.0	UDSM	1997		Full time	21	11902711	MTH 211	3	2
					MSc. Biometry	1	unclassified	University of Reading UK	2004					MTH 106	2	1
					PhD in Economics (Econometrics)	4		UDSM	2013							
3	Juma Samwel Kabote	Tanzanian	47	Senior Lecturer	BSc. ESM	3	4.3	SUA	2003		Full time	14	11903187	DS100	1	1
					MSc. DS	2	4.6	UDSM	2008							
					PhD Rural Development	3		SUA	2015							
4	Alex Xavery Matofali	Tanzanian	49	Senior Lecturer	BSc. (Edu)	4	3.8	University of Dar Es Salaam	2003		Full time	17	11903729	MTH 100	1	1
					MSc. (Maths)	2	Merit	University of Zimbabwe	2007					MTH 207	4	2
					PhD (Maths)	3	Pass	University of Dar Es Salaam	2015							
5	Michael Hamza Mkwizu	Tanzanian	49	Senior Lecturer	Bed Maths	3	4.2	Univeristy of Iringa	2008		Full time	13	11890311	MTH 103	1	1
					MSc Maths	2	Pass	UDSM	2011					MTH 303	5	3
					PhD Applied Maths)	3	4.5	NM-AIST	2016					MTH 112	2	1
6	Aziza Juma Iddi	Tanzanian	47	Senior Lecturer	Bed (Maths)	3	4.2	Univeristy of Iringa	2007		Full time	13	11890263	MTH 207	4	2
					MSc (Maths)	2	unclassified	UDSM	2011							
					PhD (Maths)	3	unclassified	UDSM	2017					MTH 101	1	1
7	Amani Mwakalapuka	Tanzanian	46	Lecturer	BA	3.5		UDSM	2001		Full time	13	11903811	SC 100	1	1
					MA	4		UDSM						SC 101	2	1
8	Edwin Kwayu Daniel	Tanzanian	42	Lecturer	B.A Statistics	3	3.9	UDSM	2007		Full time	13	11890252	MTH. 106	2	1
					M.A Statistics	2	unclassified	UDSM	2011							

9	Job Wilson Mwakapina	Tanzanian	43	Lecturer	BA Ed (Geo & Linguistic)	4	3.9	UDSM	2007		Full time	13	11890241	SC 100	1	1
					Masters in Linguistic	2	4.2	UDSM	2011					SC 101	2	1
10	Abdulkarim Mhandeni	Tanzanian	44	Lecturer	BA. Ed	3	3.9	UDSM	2007		Full time	13	11890159	SC 100	1	1
					MA	2	4	UDSM	2013					SC 101	2	1
11	Nicodamus Robinson	Tanzanian	37	Lecturer	BA Ed	3	4	UDSM	2011		Full time	7	110577075	SC 100	1	1
					MA Ed	2	4	UDSM	2015					SC 101	2	1
					PhD	4		SUA	2020							
12	Onesmo Nyinondi	Tanzanian	40	Lecturer	BA Ed	3	4.1	UDSM	2009		Full time	10	110512694	SC 100	1	1
					MA Ed	2	Unclassified	UDSM	2013							
					PhD			UDSM	2020					SC 101	2	1
13	Nkuba Nyerere	Tanzanian	42	Lecturer	Bed Maths	3	4.2	Univeristy of Iringa	2009		Full time	17	110512645	MTH 100	1	1
					MSc	2	4.33	NM-AIST	2014							
					PhD	3		NM-AIST	2021					MTH 110	2	1
14	Issa Shaban Mfinanga	Tanzanian	41	Lecturer	Bachelor of Arts in Education (Math & Geo)	3	4.4	MUSLIM	2008		Full time	11	111799694	MTH 300	5	3
					Master of Science	2	Unclassified	UDSM	2011					INF. 204	4	2
														MTH 105	2	1
15	Emanuel Mbazi Msemo	Tanzanian	36	Lecturer	B.A. Statistics	3	3.8	UDSM	2009		Full time	11	110503759	MTH 106	2	1
					MSc. Statistics			Virginia Polytechnic Institute and State University	2014							
16	Patrick Nelson	Tanzanian	41	Lecturer	BSc. Applied Statistics	3	4.1	Mzumbe	2008		Full time	10	110503745	MTH 106	2	1

	Malakasuka				M. A. (Statistics)			UDSM	2015							
17	Richard Mlewa Ngaya	Tanzanian	38	Assistant Lecturer	BSc. Education	3	3.9	UDSM	2010		Full time	20	110512814	MTH 106	2	1
					MSc Statistics	2	3.5/4	Virginia	2017							
18	Peter Rabson Mziray	Tanzanian	35	Assistant Lecturer	BA Ed	3	4.2	UDSM	2010		Full time	7	12353579	SC 100	1	1
					MA	4	4.1	UDSM	2015					SC 101	2	1
19	Salum Iddy Khamisi	Tanzanian	39	Assistant Lecturer	BA Language Studies	3	3.9	UDSM	2009		Full time	10	110512632	SC 100	1	1
					MA Linguistic	2	4.0	UDSM	2015					SC 101	2	1
20	Zakile A. Mfumbilwa	Tanzanian	32	Assistant Lecturer	BSc. Statistics	3	4.3	UDOM	2012		Full time	7	111449482	MTH 106	2	1
					MSc.				2018							
21	Kisoma Linus Nyarusanda	Tanzanian	41	Lecturer	B.Ed (Science-Maths)	3	4.1	UDSM	2008		Full time	13	11890218	MTH 207	4	2
					Msc. Maths	2	Unclassified	UDSM	2011							
					PhD				2022							

Table 13: list of technical staff available for the proposed programme.

S/N	Name of Technical Staff	Nationality	Age (yrs)	Rank	Academic Qualification	Duration of Studies (yrs)	Final GPA Attained	Conferring Institution	Year Qualification obtained	TCU Recognition Certificate Number for Foreign Award	Employment Status	Experience	His/her Check Number	List of Courses supported by code	Semester	Year
1	Juma Kilima	Tanzanian	44	Principal ICT Officer	BSc in Electronics Science	3	3.6	UDSM	2003		Full time	19		ITIN 102, ITIN 106	1	1
					Master of Engineering Management	2	3.8	UDSM	2007							
2	Lazaro Luhusa	Tanzanian	45	Principal ICT Officer	Bsc with Computer Science	3	3.3	UDSM	2004		Full time	17		ITIN 109, ITIN 202	2	1,2
					Msc. Computing Science	2	3.6	University of Groningen	2010							
3	Kundaseni Swai	Tanzanian	52	Computer Technologist	Bsc. Computer Science	3	3.6	UDSM	2008			12		ITIN 208	2	2
					Diploma in Computer Science	2		UDSM			Full time					

Table 14: List of academic staff involved in the development of the proposed programme.

S/N	Name of Academic Staff	Nationality	Age (yrs)	Academic Rank	Academic Qualification	Duration of Studies (yrs)	Final GPA Attained	Conferring Institution	Year Qualification obtained	TCU Recognition Certificate Number for Foreign Award	Employment Status	Teaching experience

1	Kitindi Edvin Jonathan	Tanzanian	38	Lecturer	BSc. (ICT Management)	3	4.6	Mzumbe	2008		Full time	14
					M.Eng. (Communication Engineering)	2	Unclassified	Chongqing University- CHINA	2012			
					PhD (Communication &Inf. Systems)	4	Unclassified	Chongqing University - China	2018			
2	Alcardo Alex Barakabitze	Tanzanian	36	Lecturer	Bsc.in comp. science		4.2	UDSM	2010		Full time	11
					MSc. Electronics and Communication Eng.		3.7/4.0	Chongqing University, CHINA	2015			
					PhD	4	Unclassified	HIT – China NAD Plymouth University- UK	2020			
8.	Joseph Philipo Telemala	Tanzanian	37	Assistant Lecturer	BSc. Computer Science	3	4.0	UDSM	2011		Full time	11
					MSc. Computer Science	2	8.25/10	Mahatma Gandhi University, India	2015			
					PhD Computer Science	4	Pass	University of Cape Town	2022			
4	Deus Francis Kandamali	Tanzanian	31	Ass. Lecturer	Bsc. Informatics	3	4.4	SUA	2010		Full time	7
					MSc. Computer science	2	Unclassified	Beijing Institute of Technology	2018			
5	Catherine Francis Mangare	Tanzanian	32	Assistant Lecturer	BSc. Informatics	3	4.1	SUA	2013		Full time	7
					MSc. Computer Sciences	2	Unclassified	Harbin Institute of Technology	2018			
6	Camilius Sanga	Tanzanian		Professor	BSc. In Computer Science	3		University of Dar es Salaam			Full time	20
					MSc. Computer Science	2		Osmania University				
					PhD. Computer Science	4		University of the Western Cape				
7	Judith Valerian	Tanzanian		Lecturer	BSc. Agricultural Economics and Agribusiness	3		SUA	2009		Full time	
					MSc. Agribusiness and Food economics			University of Copenhagen, Copenhagen,	2012			

								Denmark				

List of Appendices

Appendix 1: Stakeholders Panel Workshop

SOKOINE UNIVERSITY OF AGRICULTURE

COLLEGE OF NATURAAL AND APPLIED SCIENCES

DEPARTMENT OF INFORMATICS AND INFORMATION TECHNOLOGY

Stakeholders Panel Workshop to input on the proposed Curriculum for B.Sc Information Technology Innovation (B.Sc ITIN)

May 2021

1. Introduction

Stakeholders Panel Workshop was conducted on 17th May 2021 at Solomon Mahlangu campus of Sokoine University of Agriculture. The workshop involved a total of 28 participants both internal and external ICT stakeholders in Tanzania (list of participants, Appendix 1). The stakeholders' workshop was officiated by the Principal, Solomon Mahlangu College of Science and Education (SMCoSE), Dr. Geofrey Karugila on behalf of Deputy Vice Chancellor (Academic), Prof. Maulid Mwatawala. The workshop was attended by ICT stakeholders from COSTECH, TTCL, UDOM, UDSM, Mzumbe University, ZATANA Co. LTD, e-GA, TRA, EDUCATION-SUA, SNAL-SUA, CICT-SUA, DUS-SUA, QAB-SUA, and ongoing and graduated SUA students. The workshop aimed at

reviewing a new developed curriculum for Bachelor of Science in Information Technology Innovation (B.Sc ITIN). This curriculum was jointly developed between the EEISHEA Project, Center for Information Communication and Technology (CICT) and the Department of Informatics, Mathematics and Computational Sciences (DIMCS). EEISHEA stands for Enhancing Entrepreneurship, Innovation and Sustainability in Higher Education in Africa a 4 years project funded by EU - Erasmus+ programme. The project aims to initiate sustained educational change in higher education study programmes to ensure curricula that are highly relevant to the contemporary economic and social needs of Africa.

The developed curriculum aim to equip graduates with knowledge, skills and competences for employability and self-employment. This is because it is designed to be delivered through Student Centred Learning (SCL) approaches and applying relevant e-learning (E-L) tools. The Curriculum will serve as "best practice" within the HE institutions in Tanzania where relevant elements of entrepreneurship, innovation and sustainability are integrated. The unique features of the curriculum for BSc. ITIN include the use of Student Centred Learning approaches where each semester involves a mini project for students to execute and foster practical skills. The proposed semester project intends to solve existing societal problems emanating from the IT industry. In so doing students will acquire not only skills but also competences.

The external stakeholders appreciated SUA for designing such a curriculum which gives more time for students' experimentation and practical skills through semester projects. Furthermore, the stakeholders' urged the need to introduce a strong collaboration between the Government, IT industry and Academia (GIA) through a Helix Model so that Intended Learning Outcomes (ILOs) of the BSc. ITIN are realized.

The HOD-DMICS Dr. Alex Matofali welcomed the Principle of SMCoSE for opening Remarks and official opening of the meeting. The Welcome note went along with introduction of participants. This was followed by presentation on the EEISHEA project overview which was done by Prof. Camillius Sanga. Project overview was followed by presentation on the draft curriculum on B.Sc ITIN which was done by the subject matter specialist Dr. Edvin Kitindi. The presentation included the Survey (Tracer Study), Rationale of the BSc. Information Technology Innovation, Programme Expected Learning Outcome, Course structure and the Semester projects.

2. Stakeholders' Comments

The two presentations were followed by a moderated session where stakeholders were given time to give out their comments as summarized below

i. It was advised that, there is a need to prepare instructors who are expected to teach the courses.
ii. It was cautioned that the course may attract many students, how is the department prepared to manage enrolment of students in relation to available resources?
iii. It was advised to integrate the courses from other departments apart from IT area and linking the students with the industry.
iv. The BSc. ITIN curriculum needs to follow the TCU format. The important parts should be included i.e., Human Resources capacity, Physical Resources. It was advised to use 2018 TCU format as an updated version.
v. Section 2.3.5 the word irrelevant is too harsh word, as it is reported that some of the courses are irrelevant and yet they seem to be found in this document to be offered. Needs to be rechecked and advice on using the word the graduate suggested for revision of courses especially in course contents.
vi. Benchmarking needs to be checked if it answers the following questions according to TCU format.
vii. How are other universities doing?
viii. How good do they do?
ix. Which one are the best methodologies?
x. How different are they presenting?
xi. Field Practical Training needs to be revised and being given a course code in the matrix. It is advised that there should be in campus Field Practical Training for first years. This has been practiced at UDOM since 2012 and has given a positive testimony from the industries.
xii. The curriculum should check on how they can handle placement. Students should be assigned to FPT stations where they can get the relevant practice according to the degree programme expected.
xiii. Prepare a guideline for the FPT especially the in campus FPT. The FPT has to be included in GPA grading system to make student being serious in their practical work during FPT.
xiv. The department has planned to have IT innovation week whereby industries experts from different areas are going to be invited to crosscheck the work of our students.
xv. The document format varies in different section (font style, list of tables, list of figures, abbreviations) There are a lot of typo errors; the document needs to be proofread between lines.
xvi. The Helix model needs to be stated exactly i.e. Which Helix model is to be adopted? Which industry does the document present? All terminologies used needs to be well defined to give the better directory.
xvii. Page no 5, the sentence on making payment is not properly written. Needs to be rechecked. Section 1.1 is not matching with main objective of section 1.4. The language presented differs.

xviii. Entry qualification needs to be stated exactly in relation to the degree program. Checking the advanced level and diploma requirements subjects needed for students to be enrolled for BSc. ITIN (Recognizing prior learning and state it in Section 3.3 according to TCU requirement).

xix. The programme should state on how the part time will be handled in those 6 years of their studies. And the matrix should be included.

xx. There should be having a full report of Market Survey and Stakeholders report (include in appendices).

xxi. The document needs to state the extra circular activities to be participated by students both academia and non-academia.

xxii. Teaching methodology is stated in a traditional way. Should check which can be relevant to innovation and entrepreneurship.

xxiii. References used to prepare the document needs to be listed in the document.

xxiv. The list of programmes offered in the department needs to be included. Check the TCU guideline on curriculum development. Section 4.4 stated section 3.9 with no clarification. Section 3.8 should be well checked to address the intended information

xxv. Innovation and entrepreneurship need to start in early semesters. The project management needs to be included to in the teaching.

xxvi. The semester projects need to be realistic, especially those which can solve societal problem. The instructors should encourage students in discovering real life problems from the industries; they can start with the ones available in Morogoro region. We need to make students understand the whole process of solving different problems from the industries, not by imagination.

xxvii. Show well how the innovation and entrepreneurship is integrated with IT especially by putting Innovation related courses as core instead of them being elective. i.e., ITIN 313. At the end of the degree program, all graduates should be employable or can manage to start their own projects.

xxviii. How are the semester projects related to the courses offered through the particular semester? We need to check more semester projects apart from project related to information systems.

xxix. Course code style can follow the format of number of year and number of semesters i.e., for first year semester one the course code could be ITIN 11 followed by a number defining the course.

xxx. Think about delivering professional courses which are certified (competent based professional courses). They can add value to graduates

xxxi. Expose students to online collaborative platforms whereby they can be recruited and work online.

xxxii. Recommended reading list and required needs to follow TCU format. The recommended reading needs to be updated

xxxiii. The course content can follow the format used to prepare ITIN 208. Make the content of all courses to look similar ITIN 208.

xxxiv. Rephrase some of the courses like Computer security to be Information Security, Data analytics to be core instead of being elective. Review computer network security and think about including cyber security. For an IT student, Multimedia and animation would be suitable instead of computer graphics. System analysis and design is a required course in IT so think on how you can include it. Mathematical logic and semantic needs to be placed in a core course.

xxxv. ITIN 203 possesses two names. Needs to be checked. ITIN 313 and ITIN 303 present same thing check the overlapping topics, and what does execution stand for? Database in second year and database in third year should be checked in the redundancies of the topics to be offered.

xxxvi. ITIN 100 and ITIN 202 make it general then instructor can decide the programming language of implementation according to the available market. ITIN 100 some of the topics are not related to computer programming. ITIN 204 has few topics. Needs to be rechecked. ITIN 308 has no course aim and can be renamed as artificial intelligence instead of machine learning.

xxxvii. Prerequisite to be defined in all courses which needs pre-requisite

xxxviii. Check why statistics be placed as an elective course while is a prerequisite in machine learning.

xxxix. The means of assessment should be well stated, especially in number of tests, the assignment and their frequencies, practical's as well as reports and their nature, if it will be individual or groups works.

xl. Think to incorporate introductory courses related to problem-based learning, student cantered learning and innovation and entrepreneurship before students goes for their degree courses.

xli. The tracer study needs to be rechecked. The number of graduate students needs to be stated so that can show the relation to the number of students who were surveyed during tracer study. This can show the actual statistics of number of graduate and number of students who were surveyed for tracer study.

xlii. Are 35% of graduate enough to make a conclusion of the need of BSc. ITIN? Need to be rechecked. 80% of graduate have reported to use the knowledge they gained from Informatics. Why is there a need for new programme while the knowledge is enough to be used in the industry? Tracer study needs to cover all aspect (market survey, industry, and students). The tracer study reported communication skill to be a problem to graduate, why then is communication skill an elective course? The tracer study shows that there is no graduate with ICT based business while the introduction gave examples of students who have their ICT company i.e., ODOTECH IT Solution (the document needs to be rechecked)

xliii. The document present 65% of graduate have been employed. Should check in relevance to the number of graduates for all those mentioned years and number of employed one.

3. Conclusion and way forward

After a long discussion on the comments, the head of department thanked all the participants for reading the draft curriculum for B.Sc. ITIN and finally the contributions made for improving the draft. He appreciated the positive ideas that were given by participants and requested them to spear their time next time

when required to participate in project activities. The head of department further informed participants that the comments raised will be in cooperated and the draft will be presented to the college board meeting and other higher university levels for approval processes.

SUA subject matter specialists incorporating comments to the new curriculum after the stakeholders' workshop

Appendix 2: Market Survey Report

1.0 Introduction

The Bachelor of Science in Informatics programme started in the year 2009 under the custodian of the former Department of Mathematics and Biometry. Since then, eight (8) cohorts of graduates have been produced by the programme from 2012 to 2020. Due to the change of technology, industrial requirements, labour market and government educational policies, the curriculum for the Bachelor of Science in Informatics had to be reviewed in the year 2019 as part of a major university-wide curriculum review exercise. In the curriculum review exercise, the conduct of market survey for collecting vital inputs from the main stakeholders and end-users of the university products is important and inevitable. Therefore, this market survey was carried out. The market survey was conducted with the following objectives:-

i. To keep records of key BSc. Informatics graduates' information and their employment status.
ii. To assess the labour market requirements and the BSc. Informatics graduates' employability.
iii. To investigate the quality of the BSc. Informatics programme in preparing its graduates for self-employment and job creation.
iv. To measure the SUA capability in offering the BSc. Informatics programme in a suitable learning and teaching environment.
v. To identify areas in the BSc. Informatics curriculum which needs improvements to take on board the immediate and prospective requirements of the labour market.

2.0 Methodology

The market survey was conducted using a qualitative approach in which the key information from the graduates and employers was taken. Primary data was collected from graduates and potential employers using questionnaires. There were two sets of questionnaires, one for the graduates' survey and the other for employers' survey. Questionnaires were used as a tool for collecting data since they are easier to respond to, familiar to graduates and employers, large sample of the given population can be contacted at relatively low cost and simple to administer. A total of 23 BSc in Informatics graduates and 43 employers who were randomly selected participated in this study.

3.0 Major Finding of the Graduates' Survey

3.1 Sex of the Graduates

A total of 23 (41%) out of 56 graduates participated in the graduate survey. As shown in figure 3.1, the male graduates who participated in the study were 19(82.6%) and female graduates were 4(17.4%). The results reflect the actual admission trend of students into the BSc Informatics programme. Admission data for the BSc. Informatics show that more than 80% of students admitted into the programme are male

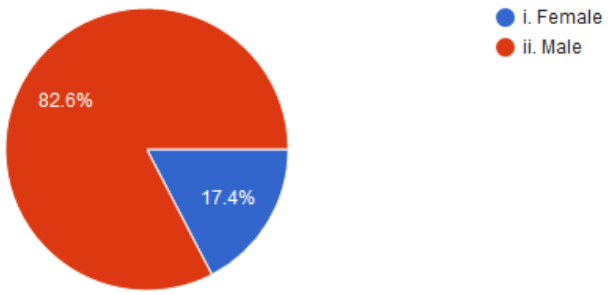


Figure 3.1: Sex of respondents.

3.2 Graduation Year

Graduates involved in this study had graduated from Sokoine University of Agriculture with a Bachelor of Science degree in Informatics between the year 2011 and the year 2019 as shown in Table 3.1.

Table 3.1: Yearly Distribution of Graduates

Graduation Year	Frequency	Percentage
2011-2013	13	56.5
2014-2016	5	21.75
2017-2019	5	21.75
	23	100

The results show that most 13(56.5%) respondents who participated in this study graduated between 2011 and 2013. These graduates are expected to provide more useful information to the study as they are in the labour market for so long.

3.3 Factors for the decision to enroll in the programme

Figure 3.2 clearly shows that area of specialization is the main (39.1%) factor that influenced most students to choose BSc. Informatics. The influences of other factors are as shown in the same figure 3.2. The results indicate that the students had their mission to pursue in joining the programme.

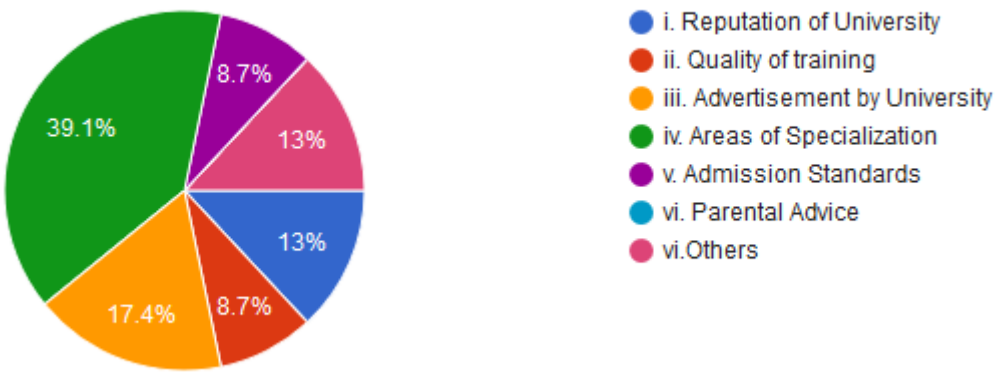


Figure 3.2: Factors that Influenced Graduates to join BSc in Informatics Programme

3.4 Assessment of Study Conditions and Provisions

Graduates were requested to provide their assessment of the programme study provisions and conditions at the Sokoine University of Agriculture (SUA). The study conditions and provisions were specifically assessed on the academic environment, infrastructure provision and social environment.

3.4.1 Academic Environment

In assessing the academic environment, graduates rated ten (10) items from very good to very poor. The items were the structure of the programme, duration of the programme, teaching quality of lecturers, academic advice offered, chances to participate in research projects, grading system of examinations, training on innovation and entrepreneurship, the effectiveness of practical works provided, the effectiveness of assessment method used and competence of the instructors. The results of the study are as indicated in Table 3.3.

Table 3.3: Responses on Academic Environment based on Three-Fold Classification of Responses

	Poor to Very Poor (%)	**Satisfactory (%)**	**Good to Very Good (%)**
Programme Structure	8.70	43.48	47.83
Programme Duration	4.35	43.48	52.17
Teaching Quality	13.04	43.48	43.48
Academic Advice offered	21.74	30.43	47.83
Research Projects Opportunities	30.43	30.43	39.13
Examination Grading System	0.00	39.13	60.87
Training on innovation and entrepreneurship	39.13	39.13	21.74
Effectiveness of practical works provided	34.78	39.13	26.09
Effectiveness of assessment method used	17.39	47.83	34.78
Competence of instructors	13.04	43.48	43.48

Results of the study show that the academic environment at SUA is generally rated as good. However, graduates rose concerns in areas such as training on innovation and entrepreneurship, the effectiveness of practical works provided, and opportunities provided for research projects.

3.4.2 Infrastructure Provision

As regards the assessment of infrastructure provision, graduates were asked to rate eleven (11) items from very poor to very good. Results indicate that infrastructure provision at SUA is generally good but major concerns were raised on the quality of availability of relevant books in the library, chance to influence university policies, availability of relevant books in bookshops, and availability of technical equipment. Table 3.4 shows details of the survey results.

Table 3.4: Responses on Infrastructure Provision Based on a Three-Fold Classification of Responses

	Poor to Very Poor (%)	Satisfactory (%)	Good to Very Good (%)
Chance to influence university policies	34.78	34.78	30.43
Technical Equipment Availability	30.43	39.13	30.43
Quality of Computer laboratories	21.74	34.78	43.48
Quality of Teaching and Learning Materials	17.39	43.48	39.13
Availability of relevant books in Library	43.48	30.43	26.09
Availability of relevant books in Bookshops	26.09	43.48	30.43
Affordability of relevant books in Bookshops	30.43	47.83	21.74
Buildings Quality	13.04	47.83	39.13
Classrooms Quality	8.70	52.17	39.13
Quality for Staff Offices	8.70	52.17	39.13
Quality of Accommodation facilities	21.74	39.13	39.13

3.4.3 Social Environment

Social environment refers to the immediate physical and social settingThe workshop

in which students experience while studying at the university. The study results indicate that the social environment for the students at SUA is very good. It is encouraging that the key aspect of the social environment for university students such as collaboration with their fellow students and students' relationship with teaching staff were rated very high. However, there are some areas such as health care services and recreation facilities which need improvements. Table 3.5 shows details of the survey results.

Table 3.5: Graduates' Responses on Social Environment based on Two-fold Classification

	Poor to Very Poor (%)	Satisfactory (%)	Good to Very Good (%)
Student Administration	0.00	52.17	47.83
Collaboration with Fellow Students	4.35	30.43	65.22
Catering Services	4.35	56.52	39.13
Student Organization	4.35	52.17	43.48
Counselling Services	13.04	43.48	43.48
Health Care Services	13.04	39.13	47.83
Recreation Facilities	13.04	56.52	30.43
Relationship with Teaching Staff	4.35	30.43	65.22
Availability of Worshipping Areas	13.04	21.74	65.22

3.5 Themes and Courses Relevance.

Informatics involves the practice of information processing and the engineering of information systems. In achieving the programme learning outcome, the BSc in Informatics is built of eleven (11) themes namely Enterprise Information Systems, Programming, Software and Hardware Systems, Information Technology, System Analysis and Databases, Artificial Intelligence, Computer Networks, Research Projects and Field Practical Training, Mathematics, Information Science and Entrepreneurship and Business Management. In this study, graduates were requested to rate the relevance of programme themes and their underlying courses from highly relevant to highly irrelevant. The results of the ratings are as described below.

3.5.1 Enterprise Information Systems

The theme of Enterprise Information Systems consisted of two (2) courses which were Organisational Behaviour and Managing Information and Communication Systems. Results, as shown in table 3.6, indicate that both courses are relevant to the programme.

Table 3.6: Graduates' Responses on Enterprise Information Systems theme based on Two-fold Classification

	Irrelevant to Highly irrelevant (%)	Relevant to Highly relevant (%)
Organisation Behaviour	17.39	82.61
Information System Management	8.70	91.30

3.5.2 Programming

The programming theme comprised seven (7) courses. The courses were Web Contents Design and Management, Internet Programming and Web Server Management, Data Structure and Algorithms, Object-Oriented Concepts, Fundamentals of Computer Programing, Programming in Java and Introduction to XML and related technologies. The outcome of the ratings is as indicated in table 3.7. Graduate considered all seven (7) courses as relevant to the programming theme. In addition to that, all courses except the courses Introduction to XML and Related Technologies and Internet Programming and Web Server Management were rated relevant to the theme by more than 90%.

Table 3.7: Graduates' Responses on Programming theme based on Two-fold Classification

	Irrelevant to Highly irrelevant (%)	Relevant to Highly relevant (%)
Web content design and Management	8.70	91.30
Internet Programming and Web Server Management	13.04	86.96
Data structure and Algorithms	4.35	95.65
Object-Oriented Concepts	8.70	91.30
Fundamental of Computer Programming	8.70	91.30
Programming in Java	8.70	91.30
Introduction to XML and related technologies.	13.04	86.96

3.5.3 Software and Hardware Systems

The theme for Software and Hardware Systems was made up of four courses namely Computer Architecture and Operating Systems, Basics in Digital Circuitry, Geo-Informatics and Distributed Systems. Graduates' responses depict that all the courses are relevant to the theme. Table 3.8 shows the results.

Table 3.8: Graduates' Responses on the Software and hardware Systems theme based on Two-fold Classification

	Irrelevant to Highly irrelevant (%)	Relevant to Highly relevant (%)
Architecture and Operating Systems	4.35	95.65
Basics in Digital Circuitry	13.04	86.96
Geo Informatics	17.39	82.61
Distributed Systems	4.35	95.65

3.5.4 Information Technology

Introduction to Microcomputer and Applications, Computer Modelling and Simulation, Computer Graphics and Image Processing, Social and Cultural Impact of ICT and Information Technology Security were courses that form the Information Technology theme. Graduates reacted so positively to the course Introduction to Microcomputer and Applications with 100% rated as highly relevant to the Information Technology theme. Table 3.9 depicts the results.

Table 3.9: Graduates' Responses on the Information Technology theme based on Two-fold Classification

	Irrelevant to Highly irrelevant (%)	Relevant to Highly relevant (%)
Introduction to Microcomputer and Applications	0.00	100.00
Computer Modelling and Simulation	13.04	86.96
Information Technology Security	4.35	95.65
Social and Cultural Impact of ICT	8.70	91.30

Computer Graphics and Image Processing	17.39	82.61

3.5.5 System Analysis and Databases

The courses that made the System Analysis and Databases theme are Introduction to System Analysis and Design, Software Engineering and Project Management, Database Concepts, Database Implementation and Management and Human-Computer Interaction. The outcomes of the ratings indicate that all courses are highly relevant to the theme as all of them were rated above 90%.

Table 3.10: Graduates' Responses on the System Analysis and Database theme based on Two-fold Classification

	Irrelevant to Highly irrelevant (%)	Relevant to Highly relevant (%)
Introduction to System Analysis and Design	0.00	100.00
Software Engineering and Project Management	8.70	91.30
Database Concepts	4.35	95.65
Database Implementation and Management	4.35	95.65
Human Computer Interaction	8.70	91.30

3.5.6 Artificial Intelligence

The Artificial Intelligence theme comprised four (4) courses. The courses were Introduction to Artificial Intelligence, Decision Support Systems, Knowledge-based Systems and Expert Systems. Graduates regarded all four (4) courses as relevant to the theme. Nevertheless, there is a discrepancy in the results as shown in Table 3.10. While the course Artificial Intelligence was rated highly relevant (95.5%), the courses, Knowledge-Based System, Decision Support Systems and Expert Systems were rated quite low with 50.26%, 51.56% and 50.90% respectively. From the graduates' point of view, these courses were rated low because their contents are almost similar. The curriculum reviewers should explore the contents of these courses for the possibility of merging them.

Table 3.10: Graduates' Responses on the Artificial Intelligence theme based on Two-fold Classification

	Irrelevant to Highly irrelevant (%)	**Relevant to Highly relevant (%)**
Introduction to Artificial Intelligence	4.35	95.65
Decision Support Systems	49.74	50.26
Knowledge Based Systems	48.44	51.56
Expert Systems	49.10	50.90

3.5.7 Computer Networks

Computer Networks theme comprised of two (2) courses namely Network Design and Administration and Management of Communication and Computer Networks. Both courses were considered by graduates as highly relevant to the theme at more than 95%. Table 3.11 represents the results.

Table 3.11: Graduates' Responses on the Computer Networks theme based on Two-fold Classification

	Irrelevant to Highly irrelevant (%)	**Relevant to Highly relevant (%)**
Network Design and Administration	4.35	95.65
Management of Communication and Computer Networks.	0.00	100.00

3.5.8 Mathematics

Courses that formed the Mathematics theme were Numerical Analysis I, Numerical Analysis II, Linear Algebra I, Foundation of Analysis, Discrete Mathematics, Linear Programming, Mathematical Logic and Formal Semantics, Introductory Statistics and Advanced Mathematical Statistics. As regards the rating outcomes, all courses were rated relevant to the theme as indicated in Table 3.12. However, graduates were concerned with the course Advanced Mathematical Statistics as its relevance was rated low (39%). Further, only the course Operational Research was rated highly relevant at 95%.

Table 3.12: Graduates' Responses on the Mathematics theme based on Two-fold Classification

	Irrelevant to Highly irrelevant (%)	Relevant to Highly relevant (%)
Numerical Analysis I	17.39	82.61
Numerical Analysis II	17.39	82.61
Linear Algebra I	13.04	86.96
Foundation of Analysis	13.04	86.96
Discrete Mathematics	17.39	82.61
Operational Research	4.35	95.65
Mathematical Logic and Formal Semantics	13.04	86.96
Introductory Statistics	13.04	86.96
Advanced Mathematical Statistics	60.87	39.13

3.5.9 Information Science

In respect to the ratings of courses in the Information Science theme, all courses were rated as relevant to the Information Science theme. The rated courses were Knowledge Management, Information Storage and Retrieval, Records and Archive Management, Information Architecture and Organization of Information. The two courses namely Information Architecture and Information Storage and Retrieval were rated highly relevant to the theme at 95%. Table 3.13 summarizes the results

Table 3.13: Graduates' Responses on the Information Science theme based on Two-fold Classification

	Irrelevant to Highly irrelevant (%)	Relevant to Highly relevant (%)
Knowledge Management	21.74	78.26
Information Storage and Retrieval	4.35	95.65
Records and Archive Management	17.39	82.61
Information Architecture	4.35	95.65
Organization of Information	17.39	82.61

3.5.10 Research Projects and Field Practical Training

Courses in the Research Projects and Field Practical Training theme were all rated highly relevant by the graduates. All courses were rated relevant to the theme by 100%. The results as depicted in Table 3.14 clearly show that graduates regard hands-on skills as a very key attribute of the BSc Informatics graduate.

Table 3.14: Graduates' Responses on the System Analysis and Database theme based on Two-fold Classification

	Irrelevant to Highly irrelevant (%)	Relevant to Highly relevant (%)
Research Methods in Computing and Information Management	0.00	100.00
Research Project	0.00	100.00
Field Practical Training I	0.00	100.00
Field Practical Training II	0.00	100.00

3.5.11 Entrepreneurship, Innovation and Business Management

Unfortunately, the theme Entrepreneurship, Innovation and Business Management have only one course i.e., Policy, Legal and Ethical Issues in ICT. The response of graduates on this course regarding its relevance to the theme was positive. The course is highly relevant to the theme as shown in Table 3.15.

Table 3.15: Graduates' Responses on Entrepreneurship, Innovation and Business Management theme based on Two-fold Classification

	Irrelevant to Highly irrelevant (%)	Relevant to Highly relevant (%)
Policy, Legal and Ethical Issues in ICT.	8.70	91.30

3.6. Graduate Employability

It is the expectation of every graduate to have the means of living after completing studies at the university. The graduates may be employed or employ themselves. As the mismatch between the skills of graduates and the skills required in the labour market widens, it is very important to address the problem in the curriculum review exercise. Graduates were requested to respond to various questions concerning graduate employability. The graduates' responses are presented and discussed in the following sections.

3.6.1 Programme Expectations

Graduates were asked to rate how the programme has met their expectations from a very high extent to not at all. The results as shown in figure 3.3 indicate that the programme met the expectation of more than 65% of the graduates, about 31% of the graduates were satisfied to some extent and it did not meet the expectations of about 4% of the graduate. However, there are some issues to be addressed as about 35% of the graduates claimed to be somehow unsatisfied.

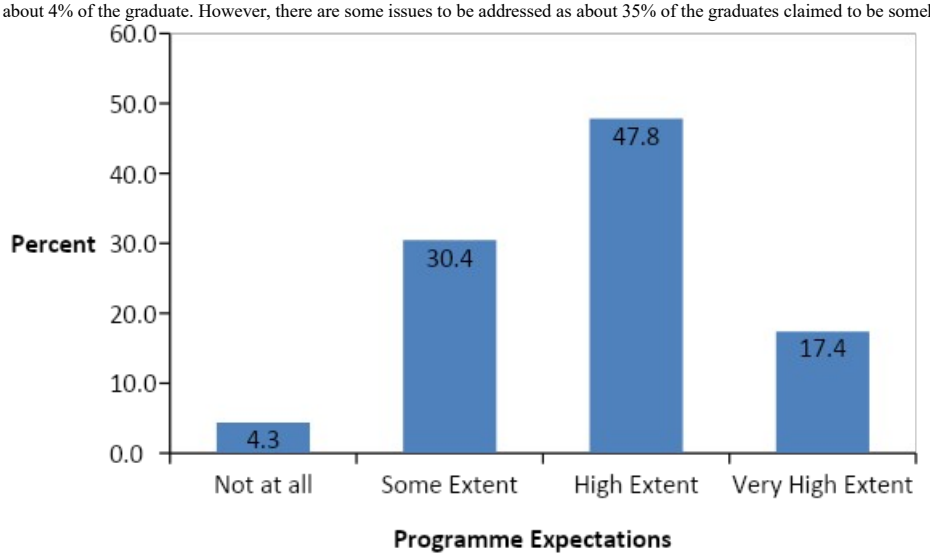


Figure 3.3: Graduates' Responses on Programme expectations

3.6.2 Type of Organization

Results indicate that more than 61% of the graduates have been employed by the government or government organizations. While 18% of the graduates are working in private companies and 17% of graduates are self-employed. Few (4%) graduates have been employed by non-government organizations. The results show obviously that most the graduates rely on the government for their employment. Figure 3.4 summarizes the results.

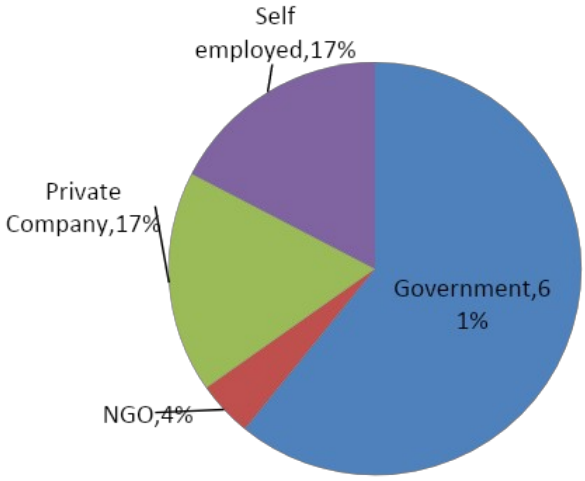


Figure 3.4: Graduates' Responses on the type of organisation

3.6.3 Seeking for Employment

As figure 3.5 indicates, more than half (56.5%) of the graduates started looking for employment one (1) to two (2) years after graduation while 21.7% looked for employment before graduation. Another 4.3% said they did not look for employment and the remaining 17.4% looked for employment more than two (2) years after employment. Generally, the results show that more than 95% of the graduates have no other alternative besides waiting for employment. This situation, therefore, calls for immediate actions to incorporate entrepreneurship and innovation skills into the curriculum to prepare graduates for self-employment and be job creators for others.

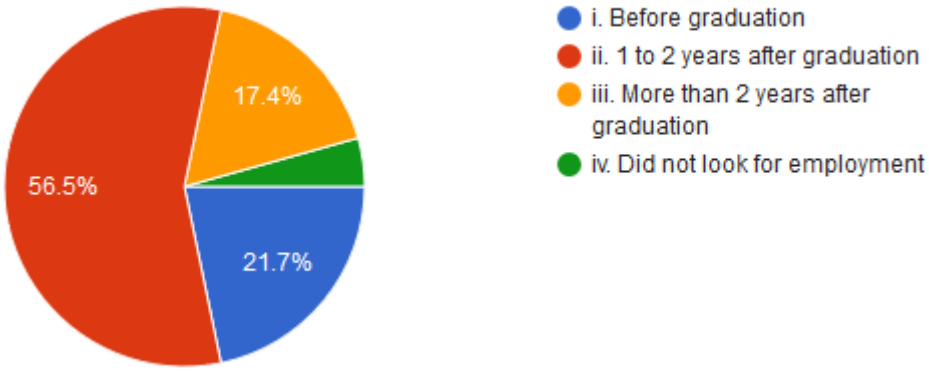


Figure 3.5: Graduates' Responses on Seeking for Employment

3.6.4: Application for the First Employment

Graduates were asked to indicate how they obtained their first employment. As in figure 3.6, the majority (65.2%) of graduates obtained their first employment by applying for advertised vacant positions, 17.4% through personal connections, 8.7% through department staff 4.3% through contacts established during FPT and 4.3% through parents/relatives help. It is unfortunate that no graduate who neither set up his/her own business or being approached by the employers. This indicates that BSc in Informatics graduates do not possess the desired quality to attract a rare situation of being approached by employers or possessing the competence of setting up their own business. In that regard, it is so important to develop a competence-based curriculum that considers issues of entrepreneurship and innovation.

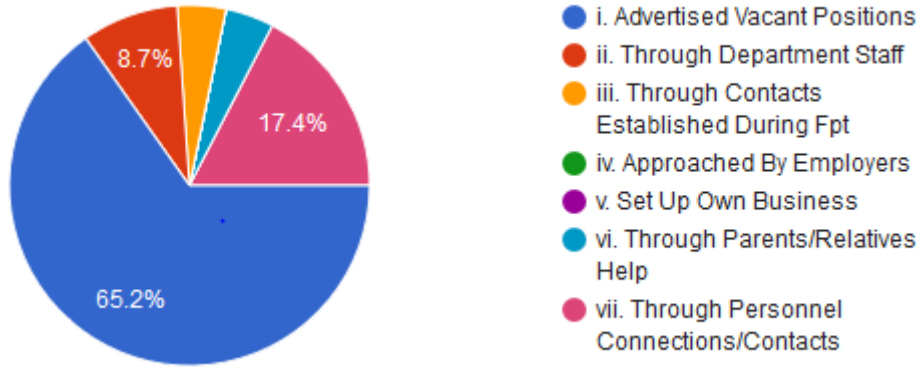


Figure 3.6: Graduates' Responses on the Application for the First Employment

3.6.5 Factors for Employment

Graduates were asked to rate how some factors have contributed to them being employed as Figure 3.7 indicates the results. Performance at the interview was the major (34.8%) factor for their employability. Other greatly contributing factors include the main focus of the subject area (21.7%), previous work experience (17.4%) and the special projects (13%). The results also show that the least contributing factor for the graduates' employability is the grades at the university (3.4%). This result provides further evidence that the competence of the graduates is the major contributing factor to their employability. Hence, the competence-based curriculum that equips graduates with entrepreneurial and innovative skills for employability and self-employment is inevitable if SUA intends to produce market-oriented graduates.

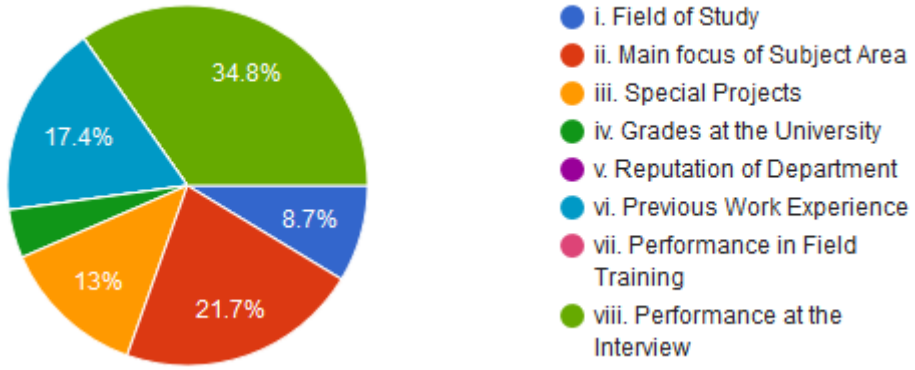


Figure 3.7: Graduates' Responses on the Factors for Employment

3.6.6 Theme Knowledge Usage

Graduates were also asked to specify the extent to which the knowledge acquired at SUA is used in their carrier path. Generally, all knowledge areas are used as Table 3.16 depicts except for Artificial Intelligence, Geoinformatics and Graphics Design. The extent of knowledge usage is almost the same (less than 80%) in all knowledge areas which indicates the lack of specialization in the BSc. Informatics programme. Further, the extent of knowledge usage from field practical training is moderate (69%). Hence, the conduct of field practical training needs to be revised to ensure that students immensely benefit from the field works.

Table 3.16: Themes Knowledge Usage based on Two-fold Classification

	Not at All to Low Extent (%)	**Some Extent to High Extent (%)**
System Analysis and Design	34.78	65.22
Databases	21.74	78.26
Mathematics	43.48	56.52
Computer Programming	21.74	78.26
Computer Networking	30.43	69.57
Information Security	21.74	78.26
Artificial Intelligence	86.96	13.04
Operating System	21.74	78.26
Geo Informatics	65.22	34.78
Project Management	21.74	78.26
Information Science	34.78	65.22
Software Development	26.09	73.91
Graphics Design	56.52	43.48
Special Projects	26.09	73.91
Website Development	26.09	73.91
Field Practical Training	30.43	69.57

3.6.6 Addition of Relevant Courses

Graduates were also requested to suggest courses to be added to the curriculum based on the advancement of Information Technology and their industrial working experience. As shown in figure 3.8, most (35%) of graduates proposed courses on Entrepreneurship and Innovation to be included in the curriculum, 22% of graduates suggested the addition of data science courses and 18% of graduates recommended that the curriculum should include courses on Android and Mobile Applications. While few (4%) advised that the curriculum should contain courses on wireless technology, machine learning and computer repair

and maintenance. It is evident that skills in entrepreneurship and innovation are highly important for our students to cope with the rapid advancement of technology and the changing demands of the labour market.

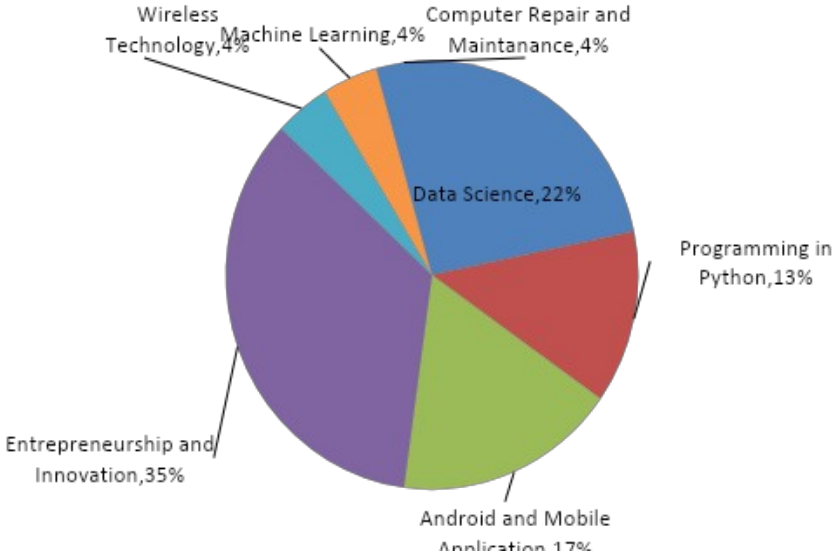


Figure 3.8: Graduates' Responses on Addition of Relevant Courses

3.6.7 Effective Mode of Delivery

When asked about the effective mode of delivery of the programme, most graduates suggested problem-based learning (43.48%) and project-based learning (52.17%). Few graduates (4.35%) recommended student centred learning. Generally, most graduates (95.65%) suggested a delivery mode that will impart to students' real-world skills and competencies. Figure 3.9 depicts the results.

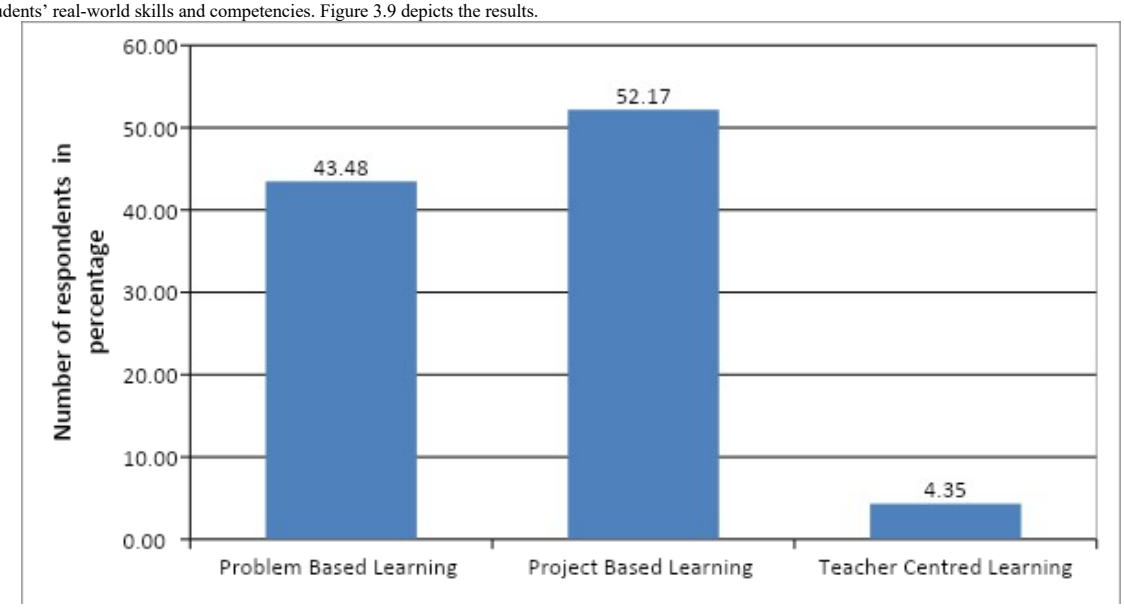


Figure 3.9: Graduates' Responses on Effective Delivery Mode

4.0 Major Finding of the Employers' Survey

4.1 Type of Respondents' Organization

The majority of respondents were private companies consisting 41.9% of the responses which was followed closely by government institutions (including ministries, municipals, and authorities) at 32.6%. The ICT services firms and training institutions consisted of 14% and 11.6% of respondents respectively. The study deliberately involved more private companies because private companies put more emphasis on the practical competencies of the graduate they want to recruit. Figure 4.1 illustrates the results.

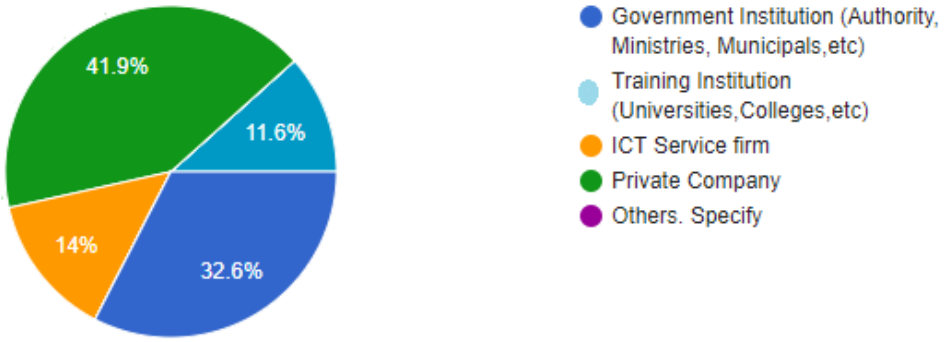


Figure 4.1: Type of Respondents' Organization

4.2 Number of ICT Employees in the Organizations

60.5% of the respondents have less than ten (10) ICT employees in their ICT services departments while 14% of the companies have more than fifty (50) ICT employees in their organizations. This is simply because companies with less than 10 ICT staff are either non ICT based companies or small ICT services firms so they don't have many IT employees. On the contrary, companies with the higher number of ICT employees are either ICT based companies or huge and widely distributed companies. Figure 4.2 detailed the results.

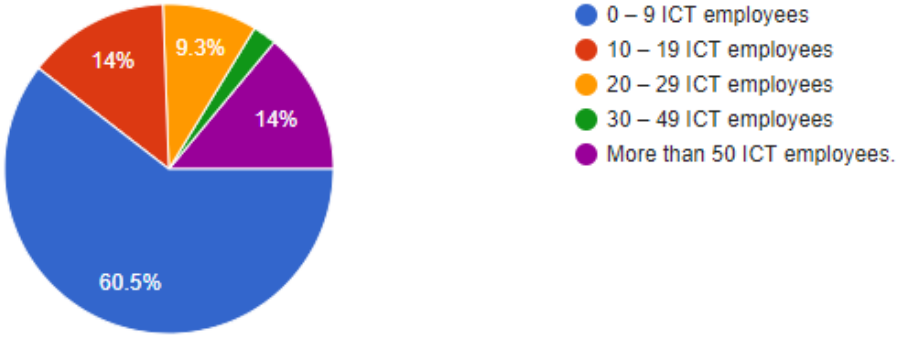


Figure 4.2: Number of ICT employees in the organizations

4.3 ICT employees graduated from SUA

The majority, 81.39% of the organization had SUA BSc in Informatics graduates as their permanent employed staff in their ICT departments or as internships trainees. Few, 18.61 of organizations do not have SUA graduates at any level however they do have similar ICT graduates from other universities, and they were willing to share their experiences regarding what they see from them. As most organizations involved in this study employed SUA BSc. Informatics graduates, their inputs in this study will be pertinent and will be very useful in developing a curriculum that produces IT graduates that meet the demands of the labour market.

4.4 Procedures Used to Recruit ICT Graduates

According to our survey, most, 92% of the government institutions depend on public sector recruitment services and 8% have the autonomy to recruit directly. The private companies conducted their recruitments through advertising the vacancies 42.5%, references through internships and field practical training 37.5%, direct applications from the applicants 15% and 6% comes from other sources like the recommendation of personal contacts and the likes. All respondents indicated that graduates must pass the interview before being employed.

4.5 Important Criteria Considered in Recruiting ICT Graduates

Most employers considered work experience (31%), practical abilities (28%) and innovation skills (26%) as the three most important criteria in the selection of new recruitments. Other criteria were specialization (9%) and academic performance (6%). According to the survey's results, no employer considered University's reputation as the criterion for recruitment. Most employers especially in private sectors and ICT services firms claimed that GPA may be a good indicator of someone's ability but is not an effective factor towards determining someone's practical and creative ability. This indicates that most ICT graduates need to demonstrate practical ability rather than just good grades to be in a position for consideration in a competitive job market. Further, ICT business start-ups consider the practical ability and innovative skills as the best tools required for the success of any ICT firm. Figure 4.3 provides more details.

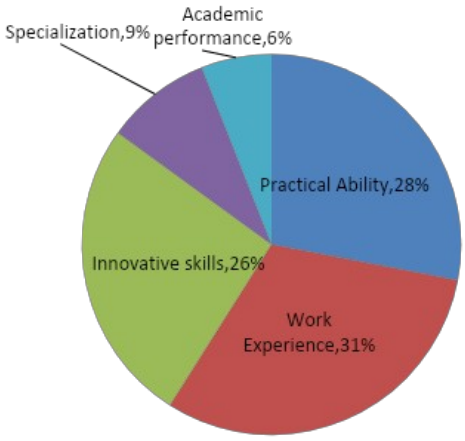


Figure 4.3: Important Criteria Considered in Recruiting ICT Graduates

4.6 Employers Expectation from the Fresh ICT Graduates

The study results indicated that most (66.7%) employers expect ICT graduates to have at least satisfactory knowledge and practical ability in the main areas (subfields) of ICT. However, these graduates have to undergo comprehensive training before assuming their responsibilities. Other (31%) employers believe that there is no need of training newly employed ICT graduates, but they will have to work under the guidance of seniors. While only a few (2.14%) expect ICT graduate to carry out their tasks without any support. Figure 4.4 below shows the results.

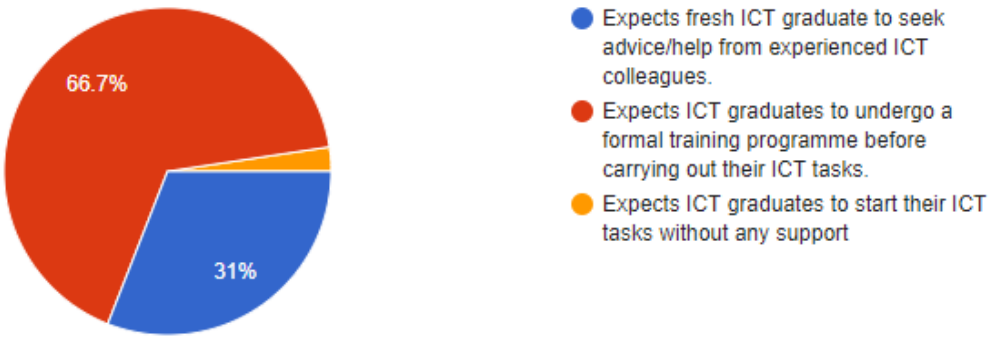


Figure 4.4: Employers Expectation from the Fresh ICT Graduates

4.7 Competences of ICT Graduates When Employed

There are many job titles in the ICT sector with a variety of areas of interest and many levels of expertise. The study results revealed that companies seeking to recruit ICT professionals face difficulties in finding skilled practitioners because of competence mismatches. In the recruitment process, employers found that most ICT graduates are quite competent in graphics design (28%), network administration (25%) and website development (22%). Very few ICT graduates are competent in computer programming (6%) and the development of innovative ICT solutions. The competence mismatches necessitate companies to provide comprehensive training to the newly employed ICT graduates.

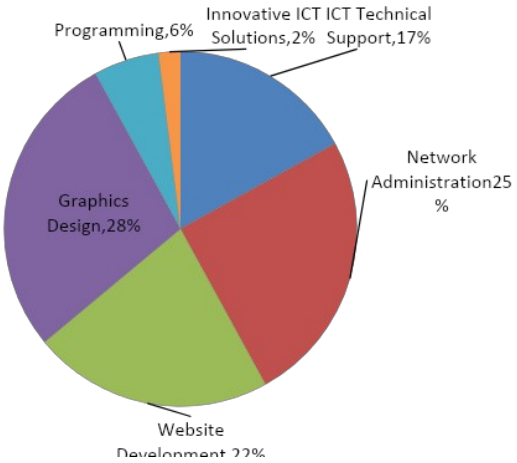


Figure 4.5: Competences of ICT Graduates When Employed

4.8 Graduates' ICT competencies Required by Employers

Most (40%) employers preferred ICT graduates with programming skills. Since most organizations are in high demand of ICT innovative solutions for improving working performance and business efficiency. Other competencies required by employers are website development and management (19%), ICT support (16%), network design and administration (16%), IT security (7%) and graphics design (2%). Figure 4.6 illustrate the results.

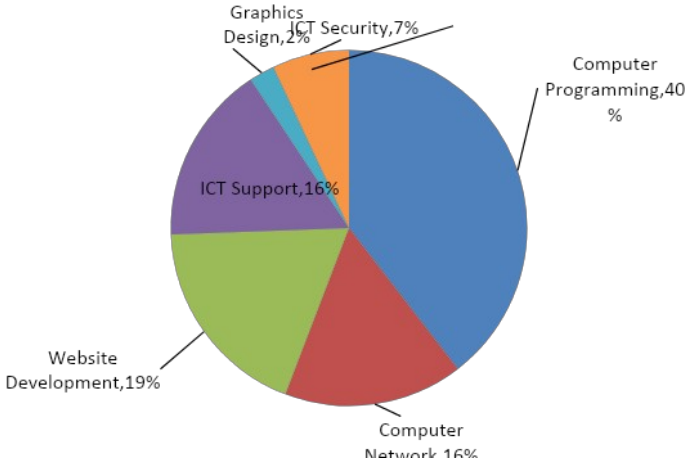


Figure 4.6: Graduates' ICT competencies required by Employers

4.9 Appropriate Mode of the ProgrammeDelivery

All employers (100%) who are participated in this study proposed the teaching approach that makes ICT graduates acquire the necessary knowledge, skills and competencies that are required in the labour market. The approach of implementing competence-based learning can take any path based on the availability of resources. However, most (53%) employers suggested the problem-based approach as it focuses on the student's use of knowledge, skills, and abilities to produce effective solutions to real-life problems. Some employers (32%) proposed the project-based learning which requires students to work on the long task as a project and create a useful product. Other (15%) employers recommended an internship-based approach where students spend a significant amount of time (maybe six or nine months) working in the actual working environment and provide innovative solutions to problems existing at the working place.

5.0 Conclusions and Recommendations

This market survey was conducted by the Department of Mathematics, Informatics and Computational Sciences (DMICS) of Sokoine University of Agriculture (SUA) as part of the BSc in Informatics curriculum review. The findings of this study are based on quantitative data collected from twenty-three (23) students graduating from the BSc in Informatics from 2012 to 2019 and forty three (43) employers. The study outcomes represent the genuine and key observations on the conduct of the academic study in DMICS. Hence, DMICS and SUA, in general, should take appropriate measures to address genuine

matters of concern raised by the graduates and employers. As to ensure that our graduates make a significant contribution to the national development, SUA must prepare its graduates as per the employment needs as well as making them capable enough to create new employment.

BSc in Informatics has been running for almost 11 years and based on the market survey's results it is still relevant since most graduates admitted that the programme has met their expectations and most organizations involved in this study employed BSc in Informatics graduates. However, the programme has not been reviewed since its commencement besides the rapid changes in the IT sector. Thus, producing graduates with skills mismatch with that required in the labour market. Study results show also that majority of graduates were employed in the government, and few were employed in the private sector, NGOs or established their own firms. This trend is because most employers in the private sector prefer to recruit innovative employees, with good work experience and good practical skills. As the private sector is increasingly becoming the main employer. A thorough review of the BSc in Informatics curriculum should be conducted to make sure that graduates acquire the right knowledge and possess the appropriate skills required in the labour market. Further, the graduates regarded the academic and social environment at SUA as good but the identified challenges in areas such as training on innovation and entrepreneurship, the effectiveness of practical works, opportunities for research projects, health care services and recreation facilities need to be addressed.

The programme structure needs also to be overhauled. The course sequence should be re-organized, IT specialization be introduced, irrelevant courses such as Advanced Mathematical Statistics should be removed and merging some courses with contents overlapping such as Knowledge Base Systems, Decision Support Systems and Expert Systems. In addition to that, some new courses in areas such as Data Science, Entrepreneurship and Innovation, Programming in Python and Mobile Applications should be included in the curriculum to cater for changes and advancement in the IT industry. This will make graduates fit well in the labour market.

Study investigation realized that many graduates were recruited due to their excellent performance in the interview and not by good grades that appear on their certificates. It was also found that the graduates are lacking skills due to inadequate practical opportunities. Even the employers expect little from the fresh ICT graduates and are obliged to provide them with comprehensive training to be productive. In addition to that, most employers are in high demand of ICT innovative solutions for solving their business problems. It was therefore recommended to change the teaching approach from conventional teaching methodology and adopt those which put more emphasis on practical training such as problem-based learning and project-based learning. This will increase graduates' competence to suit the market needs.

Lastly, the study results revealed that many graduates obtained their job by applying for advertised vacant posts. Very few obtained their job through the departmental staff, none obtained by being approached by employers and none set up their own business. This situation stands as a wake-up call for the DMICS to establish IT incubators for supporting the development of start-ups. The DMICS staff and other stakeholders will provide technical and administrative support services and hence assist significant graduates in securing jobs or establishing their own businesses.

Appendix 3: A Student-Centred Learning Semester Model

Based on the recent presentations in Kumasi of redesigned curricula from the African universities and on some self-critical reflection, it became clear to me that in the project we have given too little attention to what a Student-Centred Learning (SCL) curriculum could look like. In the typical African curriculum, each semester consists of 5 – 7 courses, with time for lecturing and practicals (in TZ also time for: seminars/tutorials, assignments, independent studies). The problem with these curricula is that SCL elements are not visible, and although such elements may be embedded within an individual course, this course-

based PBL/SCL model is what we did in the BSU project, but is NOT what we are looking for in this EEISHEA project. My main concern is that SCL elements are clearly visible in the curricula once we present them to the EU.

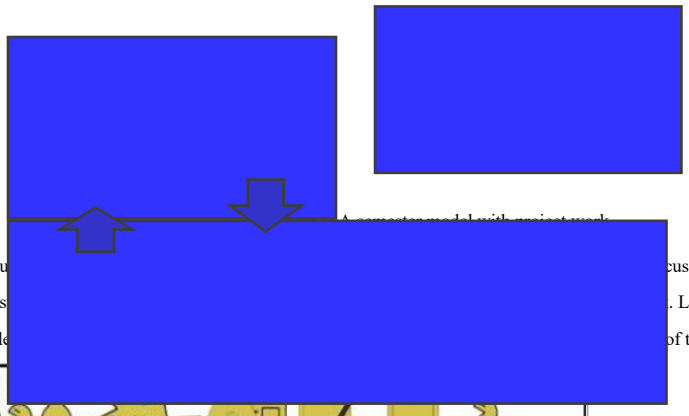
Therefore, I have prepared this short document that describes a possible semester model. The below model is of course not the only model possible, but it may give you a basis for reflecting on a suitable semester model, with clearly visible SCL elements.

This semester model consists of 5 – 6 courses per semester and a semester project, the project clearly and visibly representing the SCL component in the curriculum. The project work is supported by 2 – 4 courses, so-called project supporting courses (P-courses) and the project, and the P-courses together constitute what is called a Project Unit that is closely related to the semester theme, which is mentioned in the Work Packages 6-10. A theme may be defined as "an arena where the subject field explicitly links to and interacts with the human, social, economic and political context". Thus, the theme ensures that the problem-oriented project is seen in a holistic context (for more information about themes and the use of themes in SCL, please see the booklet "Changing the curriculum – changing the balance?", p.12 – 14).

The students apply knowledge achieved in the P-courses in the project. Time for the students to do the project work is taken from the P-courses, for example, assignments, independent studies, and practical work. Thus, lecture time is not necessarily reduced in the P-courses, but assignments, independent studies and practical are replaced by the project work. The P-courses are assessed together with the project. This means that both the project and the P-courses should have clearly formulated Intended Learning Outcomes and assessment methods (or rather combinations of assessment methods) that match learning through project work.

The remaining courses are stand-alone courses (S-courses) that have their own assessment. The S-courses are not (necessarily) related to the semester theme and the knowledge achieved in these courses is not (necessarily) applied in the project work, but the courses are relevant for the study as such.

This semester model is illustrated in figure 1, an original semester model from AAU. The percentage indicated in the figure should of course be adapted to the given semester and to what is realistically achievable in your institution. Thus, I would recommend that project work in 1st semester is around 25% of students' study time, increasing in the following semesters to 50% and 100% in the final semester project.



The below model illu cus is on introducing the semester theme and on teaching the project s . Later on in the semester more time is allocated to project work and le of the students' study time.

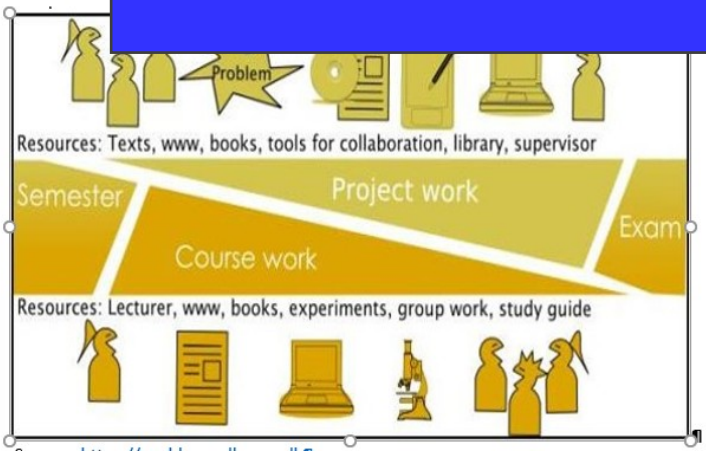


Figure 2: Timing of courses and project work in a semester – a general model.

Figure 2 illustrates a situation where the project work is approximately 50% of the total semester work. As mentioned above this may not be realistic in the first semesters, where the percentage of project work might be reduced to 25 – 35%, while in the later semesters the project work could increase to the 50% - and for the final project, the so-called capstone project, could be 100% of the final semester.

Another, more detailed semester time schedule, week by week, is shown in figure 3 that shows the semester timing of a typical AAU semester in engineering some years ago.

The scheduled semester has a project and 4 P-courses that together constitutes the Project Unit. Furthermore, there are 2 S-courses and one or possibly 2 Elective courses.

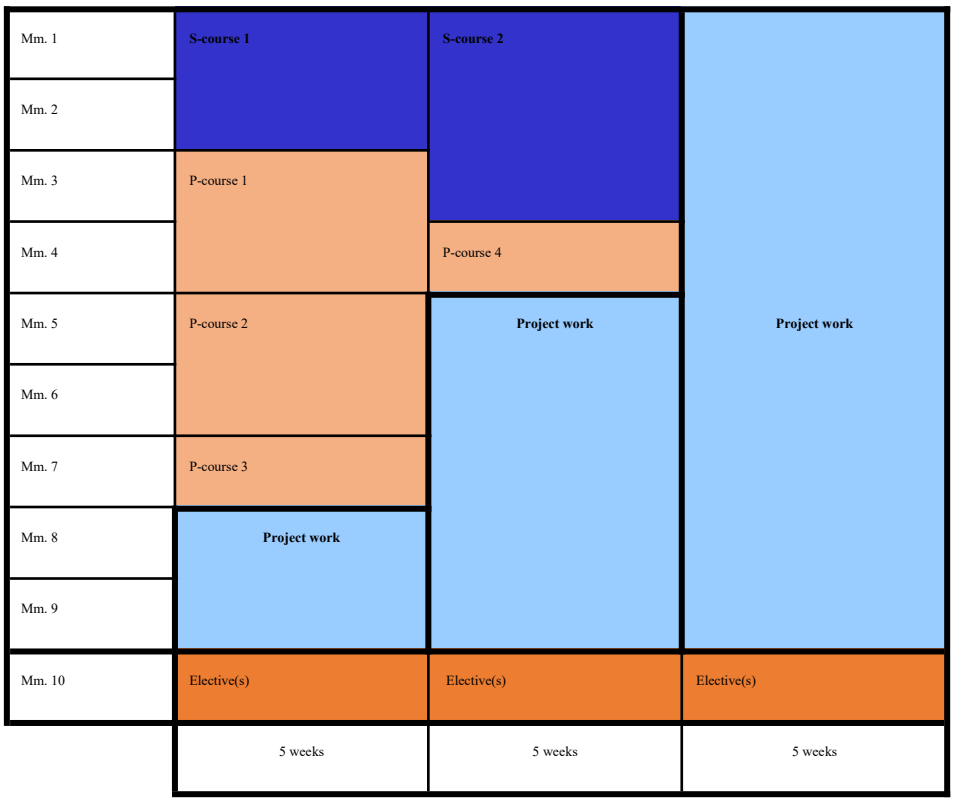


Figure 3: Example of weekly semester timing of AAU semester

A few explanations to figure 3: One Mm (mini-module) is equivalent to half a day (= 4 hours) and is the smallest unit in all time schedules at AAU. A week is 5 days, thus 10 Mm per week. One semester is typically 15 weeks of teaching/learning plus 5 weeks for exams, i.e., a total of 20 weeks. The 15-week period is divided into 3 periods of 5 weeks each, and within a 5-week period the same time schedule is valid for all 5 weeks. P-courses are typically taught in the beginning of the semester because the role of the P-courses is to support the project work. S-course may be taught at any time of the semester, but typically the teaching load, for teachers as well as for students, lies in the first half of the semester.

Appendix 4: Endorsement Letter from the ICT Commission

UNITED REPUBLIC OF TANZANIA

MINISTRY OF INFORMATION, COMMUNICATION AND INFORMATION TECHNOLOGY

ICT COMMISSION

In reply please quote:

Ref. No: BD.83/171/01/5 **05th May 2022**

Head of Department,
Department of Informatics & Information Technology (DIIT), College of Natural and Applied Sciences (CoNAS),
P.O Box 3038,
MOROGORO

RE: **REQUESTING A RECOMMENDATION LETTER TO SUPPORT THE SUBMISSION OF THE INFORMATION TECHNOLOGY INNOVATION (BSC. ITIN) CURRICULUM TO TCU**

Reference is made to your letter with Ref. Number SUA/DIIT/Barakabitze dated 22nd March 2022 on the subject matter above.

2. The National Digital Skills Development Framework provides guidance on digital skills training demands and enables development of occupational standards that satisfy the digital economy demands and the rising fourth industrial revolution. In addition, the ICT Commission uses the National ICT Professionals Registration and Certification Framework as a guiding tool to develop ICT Practitioners in Tanzania.

3. The ICT Professionals Registration and Certification framework sets a minimum of core academic ICT courses credits to be 70% or more under the specified program as a minimum criteria for an individual to be registered by the ICT Commission. Based on evaluation of proposed Bachelor of Science in Information Technology and Innovation, the number of core course's credits related to ICT and courses which support an individual's competence in ICT practice upon graduation exceeds 70%.

Therefore, the ICT Commission **endorses** the proposed new **Bachelor of Science in Information Technology and Innovation (Bsc. ITIN)** program. Graduates of the prospective program will be eligible for professional registration.

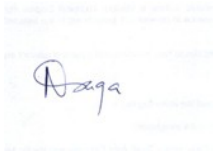
4. However, the evaluation results indicate the need to have the Data Analytics course as a core subject not elective and to increase practical hours on courses in high demand in the current business industry settings.

5. Furthermore, majority of the academic staff delivering core ICT courses are not registered by the ICT Commission. You are encouraged to facilitate their professional registration to ensure the use of competent professionals and promote efficiency in ICT skills development.

Thank you for your cooperation.

NKUNDWE MOSES MWASAGA

DIRECTOR GENERAL



Appendix 5: Incorporating External Stakeholders Comments on BSc. ITIN Curriculum Development Based on External Stakeholders

Subject:	**Minutes of Retreat for Incorporating External Stakeholders Comments on BSc. ITIN Curriculum Development** **18-20/05/2021**
Venue:	**St. THOMAS HALL MOROGORO**
Minutes taken by:	**MANGARE, C. F**

Attendee:	**Department:**	**Signature:**
1. Prof. Camillius Sanga	CICT-SUA- LTF Coordinator	
2. Prof. A. Z. Sangeda	DAARS-SUA-LTF Coordinator	
3. Dr. E. Kitindi	DMICS-SUA	
4. Dr. Alcardo Barakabitze	DMICS-SUA	
5. Mr. Mussa Mussa	CICT-SUA	
6. Ms. Catherine Mangare	DMICS-SUA	
7. Mr. Deus Francis	DMICS-SUA	

Agenda:
Introduction
Discussion and comment clarification
Incorporating External Stakeholders Comments
Closing and Next

Meeting

Topic	Issues
Introduction	The meeting was opened around 8:00 AM by LTF Coordinator Prof. Sangeda at the meeting room St Thomas MB/RM room 12 Hall and welcomed all participants. He presented the agenda of the meeting and objective of the meeting, team, structure and actions,
Discussion and comment clarification	Participants checked all comments of the stakeholders and thought the way on how can be applied in the document and discussed. The comments were grouped into 5 groups ✔ Use TCU template 2018 and arrange the according to the template. ✔ Check sections from Section 1-5, 7-8 in groups then present using projector while reading between lines. ✔ Check section 6 from the course matrix and course descriptions. ✔ Prepare the stakeholders and survey market report. ✔ Combine and Compile the whole document for next step.
Incorporating External Stakeholders Comments	The work took 3 days and the groups of the works were divided into those three days. **In day 1:** Participants were divided into two teams, the first team checked on the document from section 1-4 and the second group checked section 5,7-8. The document was compiled and then proof-read the document between line in relation to the comment. **In day 2:** From 8:00AM to 12:00PM, the compiled document was to be checked in comparison to recent approved curriculums and TCU curriculum submission template. From 13:30PM to 18:00PM the team had to work on the course description from course to course. At the beginning, participants checked on the matrix in relation to what stakeholders advised. It was required to restructure the course matrix which can meet the demand of the industry driven curriculum development. **In day 3**: Each team member (subject matter expects (5 participants)) was required to prepare the course description for at least 4 courses, arrange them according to the TCU template, prepare the course content and the means of assessment. Other 2 members worked on preparing stakeholders report and survey market report. Compile the document for next step
Closing and Next	Send the document to Director of Undergraduate studies for the pre-check before submitting for the next process of University board presentation.