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A SYLLABUS IN FISHING TECHNOLOGY FOR MAKERERE UNIVERSITY STUDENTS

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ABSTRACT

The project's objective is to develop a syllabus in fishing technology for Makerere University students. Objectives, topics, practical and theoretical teaching methods and techniques have been outlined. Changes in management objectives of the fisheries sector and the rapid development of the aquaculture industry in Uganda in recent decades have warranted development of the syllabus. It therefore has relevance in the curriculum of the Bachelor of Science in Fisheries and Aquaculture programme of Makerere University given the future destinations of our graduated students. Focus has been placed on development of a broad range of relevant topics that cover fishing technology aspects that are relevant to Uganda's fisheries and aquaculture industries. Emphasis has been placed on improvement of the quality of practical knowledge and skills. The content of this syllabus deals with the fundamentals of fishing gear and techniques, design and construction of fishing gear, gear selectivity, fish behaviour, environmental impacts of fishing gears, fishing methods and fish quality, acoustics, naval architecture and fishing gear research and development. Main topics are further subdivided into sub-topics and subjects. The project also includes classroom lecture notes, students' assessments, lesson planning, schemes and records of work.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF ABBREVIATIONS

BScFA	Bachelor of Science in Fisheries and Aquaculture
BMUs	Beach Management Units
CH	Contact Hour
CONAS	College of Natural Sciences
FTI	Fisheries Training Institute
GDP	Gross Domestic Product
SDGs	Sustainable Development Goals
MAAIF	Ministry of Agriculture Animal Industry and Fisheries
NaFIRRI	National Fisheries Resources Research Institute
LH	Lecture Hour
PH	Practical Hour
USD	United States Dollar

1 INTRODUCTION

1.1 A brief overview of the fisheries sectors in sub-Saharan Africa

Fisheries is one of the most important economic sectors of the countries in sub-Saharan Africa, as the region is endowed with vast inland and marine water resources. The inland water resources cover an estimated 520,000 km^2 of which large lakes account for 41%, river floodplains 34% and larger reservoirs 8% while total river cover stands at about 35,000 km^2 (Chirwa, 2003).

The total marine and fresh water fisheries production in sub-Saharan Africa stood at 6.6 million metric tons in 2014 (FAO, 2016). This represented an economic contribution of 24 billion USD to African economies, representing 1.3% of the total GDP of the region (Prince & Vincent, 2015). Fish is also a major source of protein in sub-Saharan Africa accounting for 18% of animal protein intake. The sector provides livelihoods to over 12 million people with 58% in the fishing and 42% in the processing sector (Prince & Vincent, 2015).

Sub-Saharan Africa however lacks a trained work force to sustainably manage such an important economic sector. An assessment of higher education learning outcomes indicated that Sub-Saharan Africa is still lagging behind other regions in the world in the area of training although the growth in tertiary enrolments has increased over the past four decades (8.4% average annual growth) (Tremblay *et al.*, 2012).

Courses in fisheries and aquaculture have been introduced in many universities and technical institutions to train and produce individuals that are competent enough to manage the different aspects of the fisheries and aquaculture industries including fishing gear technology. However, underdeveloped syllabi and curricula threaten to hinder progress in capacity building and development (Chirwa, 2003).

1.2 The fisheries sector in Uganda

Uganda is a landlocked country in East Africa. It is bordered by Kenya to the east, South Sudan to the north, the Democratic Republic of Congo to the west, Rwanda to the southwest and Tanzania to the south. (Infoplease, 2016)**.** It has a total surface area of 241,000 km^2, with approximately 44,000 km^2 (about 18%) of the total area being covered by fresh water (Golub & Varma, 2014).

The capture fisheries are dominated by five major lakes: Victoria, Kyoga, Albert, Edward and George, with Lake Victoria alone contributing about half of the total annual catch while the other lakes contribute varying amounts to the total production but are all of high local importance. The total capture fishery production in 2014 was 461,000 metric tonnes (FAO, 2016) contributing about 3% to the total GDP of the country.

The major species caught in these lakes are Nile perch (*Lates niloticus*), tilapia (*Oreochromis niloticus*) and silver fish *(Rastrineobola argentea)* with the former two accounting for the majority of fish exports to international and regional markets whilst the latter is generally traded in the immediate Great Lakes region, mostly unrecorded (Golub & Varma, 2014). The fisheries industry can largely be described as artisanal operating on small-scale at all stages of production – catching, processing and marketing (Keizire, 2006). A considerable number of

people however are also involved in industrial fish processing and export to international markets.

1.3 Makerere University and its role in the fisheries and aquaculture development of Uganda

Makerere University is Uganda's largest public university and one of the most prestigious universities in Africa (Bailey *et al.,* 2010). It was established in 1922 as a technical college to serve students from the East African territories of Kenya, Tanzania and Uganda. The university currently has a total of 9 colleges and one school that are semi-autonomous in administrative operations (Bailey *et al.,* 2010).

The strategic direction of the University under the current strategic plan (2008/2009-2018/2019) includes a learner-centred problem-based instruction providing experiential and flexible learning, a research-driven university where research and teaching/learning are mutually reinforcing, knowledge transfer partnerships and networking. The institution currently focuses on strategic research, individual and institutional public relations contributing to the national, regional and global development agenda, and strives to become a research-driven university that addresses national and international development needs (Makerere University, 2013).

In 2001, Makerere University introduced a three-year Bachelor's degree programme called Bachelor of Science in Fisheries and Aquaculture (BScFA) in response to demand for capacity building of professionals that could manage the different aspects of the fisheries and aquaculture industries. The programme addresses capture fisheries which depends on wild fish stocks and aquaculture which is the production of aquatic organisms under controlled conditions (FAO, 2016). Today, Makerere University forms an important link in knowledge generation and dissemination through research and teaching to both fisheries and aquaculture industries in partnership with the National Fisheries Resources Research Institute (NaFIRRI), the Ministry of Agriculture Animal Industry and Fisheries (MAAIF) and other development partners (Makerere University, 2015).

Fishing gear technology is one of the course units taught as part of the degree programme. It has been part of the curriculum since the inception of the degree programme. It is taught in the second semester of the final year of the programme and is intended to offer competitive training of fishing gear technology used in Uganda's fisheries and aquaculture sectors. The course unit has no existing syllabus and currently lacks personnel with expertise in the field to effectively conduct the required teaching and research.

This project therefore aims at developing a syllabus for the course unit of fishing technology under the Bachelors of Science in Fisheries and Aquaculture Degree programme at the College of Natural Sciences (CONAS), Department of Zoology, Entomology and Fisheries Sciences, Makerere University, Uganda. Developing a syllabus in fishing technology is also in line with the university's strategic direction of producing well trained and skilled persons that have an all-round understanding of fisheries and aquaculture. Collaborators in the implementation of this syllabus will be the College of Agricultural and Environmental Sciences while the external partners will be the Fisheries Training Institute (FTI), NaFIRRI, fish gear manufacturing industries and landing sites Beach Management Units (BMUs).

1.4 Status of fishing gear technology education

There has never been a standard syllabus for the course unit of fish gear technology for Makerere University for the Bachelor of Science in Fisheries and Aquaculture programme. The current teaching guide which consists of a series of listed topics is the closest there is to a syllabus. While this guide was important and useful in the early days of the course unit, the changes that have occurred in the last 10 years in the fields of fisheries and aquaculture in Uganda warrant the development of a standard syllabus in fishing technology for Makerere University. The teaching guide is limited in scope and biased to only a list of topics related to fishing gear design, construction and fishing methods (Table 1). This only covers a portion of the fishing technology and ignores other equally important aspects like fish quality in relation to fishing, aquaculture, fish behaviour, naval architecture, fishing gear and the environment, acoustics and emerging technological advances in the field of fishing technology.

It also lacks a practical element in implementation even though it is catered for in the time allocation (30 practical hours). Therefore, development of a comprehensive syllabus is needed.

Table 1: Outline of existing teaching guide

Number	Topic title
1	Concept of fishing gear technology, history and trends of development
2	Types of fishing gear and fishing craft
3	Properties of the material used in the construction of hooks, traps and nets
4	Floats, sinkers and their characteristics and properties
5	Assessment of efficiency of fishing gear
6	Net webbing classification and use, knots and hitches
7	Design and construction of different types of fishing gear and their maintenance
8	Repair and general maintenance of fishing gear

1.5 Objectives of syllabus development

The overall objective of the project is to develop a comprehensive syllabus outlining the objectives, topics, practical and theoretical teaching methods and techniques in fishing gear technology for Makerere University. The developed syllabus will aim to provide a transition from teacher to learner centred academic provision as the most effective preparation of students so that they are competent and relevant in the field of fishing gear technology and able to meet their job responsibilities and requirements. It will be designed to provide appropriate knowledge and practical skills thereby, enhancing their participation in sustainable fisheries resource management programmes. This syllabus will also help train already practising professionals in aspects of the sustainable management of fisheries resources thus contributing to Uganda's development efforts as well as fulfilling the United Nations Sustainable Development Goals (SDGs) number 1 (No poverty) and number 14 (Life below water) which will ensure elimination of extreme poverty and ensuring food security especially the animal protein from fish (FAO, 2015).

2 PROPOSED SYLLABUS STRUCTURE

From the existing teaching guide (Table 1), there is a need to propose a syllabus, one with new topics that capture a holistic picture of fishing technology. The proposed syllabus (Table 2) must include important and emerging aspects relevant to the fishing and aquaculture industry in Uganda. The proposed syllabus must capture aspects such as fishing gear and techniques, design and construction of fishing gear, fish behaviour, fishing gear selectivity, environmental impacts of fishing gear, fishing methods and fish quality, fisheries acoustics, naval architecture, fishing gear research and development. The teaching guide will be integrated and assimilated in the developed syllabus. The syllabus proposed should meet the demands of a modern and dynamic fisheries and aquaculture industry. It will be continuously monitored and evaluated for the effectiveness and efficiency of outputs (students).

Table 2: Topics and subtopics in the proposed syllabus structure

Topics	Subtopics
Fishing gear and techniques	1. An overview of fishing gear technology 2. Classification of fishing gear 3. Main fishing gear and methods in use today 4. Factors that influence choice of fishing gears and fishing methods
Design and construction of fishing gear	1. The design process 2. Fishing gear design (calculations) 3. Blue print drawing of fishing gear designs 4. Aquaculture (cage designs) 5. Practical and field excursions
Fish behaviour	1. Fish Swimming 2. Fish vision 3. Fish behaviour in capture processes
Fishing gear selectivity	1. What is selectivity and why is it important to understand selectivity? 2. Gear selectivity and how it is measured 3. Factors that affect selectivity 4. Selectivity of gill nets
Environmental impacts of fishing gear	1. Over fishing, bycatch and discards 2. Ecological impacts of fishing on aquatic ecosystems and communities 3. Effects on benthic habitats 4. Sustainable/rational exploitation of fisheries resources
Fishing methods and fish quality	1. What can fishermen do to increase quality of the catch? 2. Fishing gear/methods and fish quality 3. On board handling of fish: procedures and techniques
Fisheries Acoustics	1. Underwater acoustics, general overview and basic physics 2. Fish finding equipment design and operation 3. Acoustics in fisheries research
Naval architecture	1. The principles of naval architecture 2. The fishing vessel: main parameters, general arrangement, machinery and equipment 3. The design, construction and operation of fishing vessels
Fishing gear research and development	1. Current research in fishing gear technology 2. Discussion of possible research projects with students

2.1 Target group(s)

The syllabus aims at providing quality fisheries technology training to students studying for a Bachelors' Degree in Fisheries and Aquaculture at University level in Uganda. Since the syllabus is topic/module based, it can be adopted as a series of refresher courses for professionals working in the fisheries and aquaculture sector like district and sub-county fisheries officers and extension workers, policymakers and researchers, and can also be used to generate tailor made courses for people working directly with fishing gear for example net makers who are able to read and write English.

2.2 Entry requirements

For students at the university who are the main targets of this syllabus, the entry level requirements are provided by Makerere University which alone reserves the right to admit or reject students for the Bachelor of Science in Fisheries and Aquaculture programme. For professionals working in the fisheries and aquaculture sector like district and sub-county fisheries officers, fish net making companies and researchers who would want their fishing technology knowledge refreshed, the entry requirements will be:

- Must be literate (read and write) in English
- Must have passed Ordinary Level (O-Level) with at least a Credit 4 in English, Mathematics and Physics
- Must be of good sight
- Must be 18 years or older

2.3 Resources

For any syllabus to be successfully implemented, it has to utilise a number of certain resources in order to capture its essence and core objectives. These resources should be available both in the theoretical and practical sessions. Since hands-on practicals are a very important part of teaching fishing technology, efforts will be made to use real materials where necessary in order to ensure effective and efficient delivery of the syllabus.

2.4 Teaching methods

Teaching methods that will be used in this syllabus are the most suitable for the delivery of the set objectives in this course unit. The methods of delivery that will be used in the syllabus are adopted from: Practical Teaching Skills for Maritime Instructors a book by Muirhead and Fisher (2001). The teaching guide paid a lot of attention to the first two methods explained below (lecture and individual study) while completely ignoring the last three. This made the delivery of the course unit not effective and efficient in terms of content and understanding. The lecturing method will contribute 50% of the total allocated time and the other four methods will share the rest of the time. The teaching methods will include:

2.4.1 Lectures/Demonstrations

Lecturing will be the main point of delivery for the theoretical sessions and mostly used to introduce a concept or a task. Depending on the topic and subtopic, lecturing will involve demonstration by teacher or by another instructor(s) from a special field (guest speaker). The lectures will be specifically organized to meet the needs of the students. Lecturing is an

effective teaching method because it helps the lecturer to present large amounts of information to a large audience, allows the instructor maximum control of the learning experience and appeals to those who learn by listening (Kwek, 2011). All lectures for this syllabus will be prepared as part of a syllabus supplement.

2.4.2 Individual studies

This method of study is important because it enables students to work independently to solve a certain problem. It is often linked with other approaches to learning such as 'personalisation', 'student-centred learning' and 'ownership' of learning (Meyer *et al.,* 2008). This gives the students confidence, increased motivation, greater awareness of their limitations and their ability to manage them and a deeper understanding of the subject matter (Meyer *et al.,* 2008). Individual study includes project reports, course work and tests which are constituents of progressive assessment indicators of the student.

2.4.3 Group work

This method is important especially in fostering interaction, cohesion and teamwork among students. Numerous studies have shown that thoughtful use of group work brings about benefits to learners including: higher academic achievement, long term retention, higher level of reasoning, critical thinking teamwork skills, interpersonal communication, group problem-solving and decision-making, conflict resolution, improved racial/ethnic relations, improved sexual difference relations, higher self-esteem and individual empowerment (British Columbia Institute of Technology, 2005).

The students (class) will be broken up into small discussion groups conducted by the lecturer. The assignments may include group course work for presentations, a visit report, a practical task where the students will have to produce a report etc. It is important that in formulating the tasks, the students know their role and the expected outcomes of a particular task.

2.4.4 Practical work

A particular emphasis will be placed on practical work in the syllabus. Fishing technology is a practical course unit and therefore students should be exposed to practical work throughout the whole duration of the course unit. It's been observed by educators over the centuries that students learn and comprehend more by doing (Muirhead & Fisher, 2001). The main purpose of including practical work is to develop applied and problem-solving skills which further improves student's understanding of the theoretical concepts. One of the external partners of the syllabus implementation (FTI) will provide the practical training sessions.

Practical work is an essential part of science education. It helps students develop their knowledge of the natural world and their understanding of some of the main ideas, theories and models, learn how to use pieces of scientific apparatus and to develop this understanding of scientific approach to inquiry (Millar & Abrahams, 2009).

2.4.5 Visits

Two study visits are being proposed in the syllabus. One is to a gear manufacturing company and the other is to a landing site. Students will have the opportunity to observe and understand the industrial processes of net making and other accessories plus the real world application of

the different gear used in lake fisheries. As an indicator of whether they learnt from these visits or not, students will be required to submit written reports of the visit individually or as groups.

2.5 Assessment criteria and competence evaluation

Student assessment drives their learning. It does more than allocate grades, it also focuses their learning (Sainsbury, 2009). It helps capture the student's attention, generating appropriate student learning activity and helps students to internalise the course unit's subject matter (Surgenor, 2010). The assessment criterion should be able to reflect how well a student has achieved the learning outcomes.

Competence evaluation of students should continuously be assessed by the instructor throughout the semester. This is done through progressive assessment tests and assignments. A grade in an assignment (coursework, test, presentation, practical examination report) and written examination, will contribute 40% and 60% respectively to the final grade (100%) in a semester.

2.5.1 Grading system

Makerere University has its own letter-based grading system (Table 3) that has been approved by the University council and has been in use from the academic year 2008/2009. It is a standard used to grade marks for all undergraduate degrees. The same grading system will be used for the course unit.

Table 3: Grading system format

Marks	Letter Grade	Grade Point	Interpretation
90-100	A+	5	Exceptional
80-89	A	5	Excellent
75-79	B+	4.5	Very Good
70-74	B	4	Good
65-69	C+	3.5	Fairly Good
60-64	C	3	Fair
55-59	D+	2.5	Pass
50-54	D	2	Marginal Pass
45-49	E	1.5	Marginal Fail
40-45	E-	1	Clear Fail
Below 40 F	F	0	Bad Fail

Source: Makerere University Transcript (Page 2)

2.6 Time allocation/course unit length

Makerere University follows a semester-based system. Each academic year consists of two semesters each 17-week long. Teaching however is done for the first 15 weeks and the last two weeks are for end of semester examinations. In terms of Credit Units, the course unit of fishing technology is a 3 Credit Unit course. This means that the time allocated for this course unit is 60 hours in a semester, 30 Lecture Hours and 30 Practical Hours. The 60 hours make up a composite of 45 Contact Hours.

Therefore, for a 3 Credit Unit course, per week, students have to receive 2 lectures one hour each (making 2 Lecture Hours), 1 practical of 2 hours (1 Practical Hour) meaning the same as 3 Credit Hours OR 3 Credit Units. Time allocation is important for syllabus development because it will determine the amount of material to give to students over the course of the

semester. It is also important in developing effective lesson plans plus schemes and records of work. As mentioned earlier, the other 30 hours will be practical hours and will be divided into three main field activities as shown in Table 4.

Table 4: Time allocation for the practical part

Site	Time Allocation	Activities
Fisheries Training Institute (FTI)	Two days (15hours)	1. Inspection and examination of gill nets, beach seines and other local gear 2. Net cutting, joining and mending exercise 3. Practical design & construction of a local fishing gear
Landing site visit	Two days (12hours)	1. The practical operation of the different gear types and methods used 2. How the fishing gear are designed and constructed locally using local knowledge. 3. To experience a typical fishing operation 4. To observe how fish is handled during a fishing operation 5. To observe the possible environmental effects of the various fishing gear and techniques used
Net making company visit	One day (3 hours)	1. See how different fishing gear and accessories are manufactured on an industrial scale
TOTAL	**30 practical hours**	

3 SYLLABUS DEVELOPMENT

3.1 Review of fishing gear technology in Uganda

Fishing in Uganda dates back for centuries when it was done in small groups using traditional fishing gear such as spears, traps, fishing by hand and poisoning using local herbs. Most materials used were of natural origin and the boats were small dug-out canoes. There were no significant landing sites at that time (Graham, 1929). The beginning of the 20th century saw an emergence of better skills, better gear (synthetic materials) and improved fishing methods leading to increased catchability.

The need to improve research and manage the fisheries led to the establishment of research centres such as NaFIRRI, MAAIF and Makerere University that teach and carry out research and development in fishing gear technology, the results of which are important in policy formulation and effective fisheries management.

3.1.1 Fishing fleet structure

The active fishing fleet in Uganda's fisheries sector is entirely artisanal consisting of mostly wooden fishing craft of varying design and shapes (Appendix 1). These fishing craft are classified into six groups, namely parachute, Sesse pointed at one side, Sesse pointed at both ends, dugout canoes, mechanised catamarans and rafts (MAAIF, 2012). Frame surveys carried out on the major lakes indicated a total of 37,502 boats (Table 5), distributed as follows: Sesse flat at one end (68%), parachute (19%), Sesse pointed at both ends (9.7%), dugout (2.3%) and the rest 1% (NaFIRRI, 2012). Lake Victoria, the biggest fishery accounted for 74% of the total number of boats followed by Lake Albert (16.4%), Lake Kyoga (6.5%), Lake George and Lake Albert (3.2%). Dugout and parachute are flat bottomed in construction and lack a keel. They

are therefore operated exclusively in the littoral areas targeting Nile tilapia. The Sesse flat at one end and Sesse pointed at both ends are V-shaped and have a keel making them the crafts of choice for offshore fishing areas targeting Nile perch (Appendix 1).

Table 5: Total number of boats/crafts used on the five major lakes in Uganda

YEAR	2012			2013		
FISHING CRAFTS BY TYPE	L. VICTORIA	L. KYOGA	L. EDWARD	L. ALBERT	L. GEORGE	TOTAL
Mechanized catamarans	18	0	0	0	0	18
Dug out	116	687	0	80	0	883
Parachute	4,798	1730	0	28	729	7,285
Rafts	92	1	0	41	0	134
Sesse flat at one end	18,974	2	496	6029	0	25,501
Sesse pointed at both ends	3,598	45	0	38	0	3,681
TOTAL						**37,502**

Source: NaFIRRI, frame survey reports 2012 and 2013

The fishing craft are propelled by inboard motor engines, outboard motor engines, saddle and towed (NaFIRRI, 2012; NaFIRRI, 2013). The most common method of boat propulsion is the paddle mode (71%) followed by the use of outboard motor engine (25%) while inboard motor, sailing and towing are the least used modes of propulsion (Table 6). The mode of propulsion is linked to the target fish species. Lake Victoria has the biggest Nile perch fishery which occupies the deeper parts of the lake and thus has the highest number of motor engines to propel the boats to offshore fishing grounds (Mpomwenda, 2015).

Table 6: Total number of boats/crafts using different propulsion modes

YEAR	2012			2013	
MODE OR PROPULSION	L. VICTORIA	L. KYOGA	L. ALBERT	L. EDWARD & L. GEORGE	TOTAL
Inboard motor	369	0	0	0	369
Outboard motor	9,053	0	311	39	9,403
Paddle	17,039	2,463	5887	1258	26,647
Towed	17	0	0	0	17
TOTAL	27,603	2,463	6,198	1297	37,436

Source: NaFIRRI, frame surveys reports 2012 and 2013

3.1.2 Types of gear used

The main gear types used include gillnets, small seines, scoop nets, beach seines, lift nets, traps, cast nets, long line hooks, hand line hooks and mosquito nets for *Rastriniobola argentae* and others (MAAIF, 2012). Certain fishing gear are used to target specific species for example on Lake Edward and George, the two commercial species i.e *Protopterus aethiopicus and Bagrus. docmac* are harvested using gillnets and long lines (Table 7).

Gillnets and longlines are also the commonest gear types used in the Nile perch fishery of Lake Victoria because they are easily operated in deep offshore waters while seines are used for Nile tilapia in shallow waters and lift nets for the *Rastriniobola argentae* fishery. These gears are therefore distributed in relation to where the target species is located and abundant (Table 7). Longlines and gillnets are the most abundant gear type used in the fishery accounting for 88% and 10% respectively. Lake Victoria accounts for the most number of gear used (Table 7).

Table 7: Total number of gear types used on the five major lakes

YEAR	2012			2013		
GEAR TYPE	L. VICTORIA	L. KYOGA	L. ALBERT	L. EDWARD	L. GEORGE	TOTAL
Gillnets	497,888	97,764	8,798	27,390	28,047	659,878
Small seines	7,343		2,297			9,640
Scoop nets	893					893
Beach seines	1,233	613				1,846
Lift nets	2,864	344				3,208
Traps	7,082	344				7,426
Cast nets	1,372	191				1,563
Long line hooks[1]	4,403,137		750,000	100,600	215,320	5,469,057
Hand line hooks	27,780	81,980				109,760
Total	**4,949,592**	**181,236**	**761,095**	**127,990**	**243,367**	**6,251,280**

Source: NaFIRRI, frame survey reports 2012 and 2013

3.1.3 Gear use and regulation

The fisheries of Uganda follow an open access policy which has brought about problems of enforcement, regulation and control of fishing effort. Measures to prevent overfishing have focused on limiting gear types and mesh sizes but the overall fishing effort has continuously increased. Gear restrictions imposed have been ineffective due to difficulty in surveillance and monitoring (Taabu, 2004).

There has been an increase in the number of illegal fishing gear especially gillnets used on the lakes. The use of small mesh sizes of gill nets is rampant. This has resulted in over fishing and decline of fish stocks of species like Nile perch in Lake Victoria (L.V.F.O, 2015).

A concerted effort by the government through education, research and development is needed to reverse this trend. This should mainly focus on designing and construction of gear that are efficient, selective and affordable to the fishers, studies of fish behaviour around the gear to improve catches as well as issues of environmental protection and sustainable fishing should be addressed.

On top of the research, the ability of universities to provide training in different aspects of fishing technology that promote the implementation of policies derived from the research should be enhanced. One of the starting points to achieve this is development of a syllabus that can be used to train university students offering Bachelors and Masters programmes in fisheries and aquaculture sciences, and also used to train professionals already working in the industry like fisheries officers, fishermen and researchers.

3.2 Review of existing teaching guide

The existing teaching guide of fishing gear technology currently used for teaching at Makerere University was reviewed by the fellow in consultation with the supervisor. The main reason for the review was to find out whether the current material and content was sufficient in providing the necessary theoretical and practical aspects of fishing gear technology to the students.

[1] The figures that appear in the table is the number of hooks not the number of handlines or longlines

The factors considered during the review were the number of contact hours that the course unit of fishing gear technology is offered with in the whole curriculum of Bachelor of Science in Fisheries and Aquaculture in relation to the content that was in the guide. It was discovered that the list of topics in the guide was limited to only a few aspects of fishing gear technology which were the design and construction. A syllabus had to be developed in order to produce students that have a holistic understanding of fishing technology. Apart from developing a syllabus, the important aspects of those prospective topics were highlighted and will form the basis of the teaching.

The developed syllabus will put emphasis on field work for the students outside of class demonstrations. The practical part of the syllabus has been designed to be learner centred and not teacher centred. This means that the practical sessions will be done with full hands on participation from the students themselves and not being led along by an instructor demonstrating. It is understandable that this new practical approach will come with a bigger budget because of increased logistics and time. The other aspects of the practical part include two field excursions to a landing site and a fishing gear factory, all intended to give students an over view of the real world practical applications of the different theories they learn in class. After thorough review of the guide and the fishing gear technology in Uganda, a syllabus was developed using resources such as the lecture notes from the specialisation course of fishing technology for the United Nations University Fisheries Training Programme, articles from journals in fisheries science and text books as recommended by the supervisor (Appendix 2).

3.3 Theoretical framework and objectives of the developed topics

The theoretical background or framework of the topics in the syllabus is intended to provide the rationale for the choice of the particular aspects of fishing technology to be addressed. It will provide the background that supports the syllabus and offers the reader a justification for its development.

3.3.1 Fishing gear and techniques

Currently, the study of fishing gear and fishing methods is an integral part of fishery science. Biologists and gear technologists are interested in the effect of fishing gear on the living resources of the waters as well as their mode of capture during the fishing process (Brandt, 2005).

The purpose of this topic is to explore a selection of fishing gear methods and techniques used in the world today. It describes gear in a logical sequence from the most primitive gathering methods to the possible use of fully-automated harvesting machines totally operated by computers. It also consists of a rational classification system for the multitude of fish devices and techniques used today. It is intended to give students a global perspective of fishing gear and the basic operation of different methods of fishing in relation to future management strategies for effective and sustainable fisheries. This will be important in helping the students understand global fishing in relation to what is happening in Uganda. It is therefore an important component of the syllabus. The topic is divided into four subtopics which include: an overview of fishing gear technology, classification of fishing gear, main fishing gear and methods in use today (artisanal and industrial) and factors that influence choice of fishing gear and fishing methods.

The course will be delivered mainly through lectures (power point format and enclosed notes) during which demonstrations and visual aids like videos and still pictures will be used. During the field trip to the landing site, the principles learned in class will be further reinforced as students will be able to see and touch the different types of gear and also observe their modes of action in the real world.

After the topic presentation, the student should be able to understand to some degree the following aspects: developments of fishing and the fishing gear industry, fisheries and gear technology in Uganda, different fishing methods and techniques in the world, how the different methods are employed in capturing fish, differences between the fish capturing methods, the advantages and disadvantages of using the methods, classification of the different fishing gear and methods and factors that influence choice of fishing gear and fishing methods.

3.3.2 Design and construction of fishing gear

Development of the various fishing gear has been on a trial and error basis throughout history until only recently. Experimental approaches have been used to determine design limitations rather than practical approaches (Boopendranath, 2012). However, there has been a growth in design and development efforts of fishing gear based on fish behavior, engineering studies, system analysis and model studies keeping in mind resource conservation, ecological and economic issues[2]. Changes have taken place in the design, fabrication, operation and catching capacity of modern fishing gear such as trawls, purse seines and long lines. Knowledge in gear design and construction is important for fisheries managers, researchers and academics (Hreinsson, 2016).

This topic therefore examines the current knowledge in the design and construction of fishing gear. It introduces students to the basic principles of the design and construction of fishing gear and how these principles can be used in real life applications[3]. The first part of the topic examines the theoretical concepts of design and construction such as the basis of design and development efforts of the different gear types, development phases involved in gear design and factors that determine the design and development of fish gear.

The second part covers the applied aspects of design which include: netting panel features, twine numbering system, mesh diameter and mesh sizes determination, hanging ratio, cutting ratio, net shaping and cage netting designs.

The mode of delivery will be lectures while demonstrations and visual aids like videos and still pictures will be frequently used. This topic is the basis of the practical component of the syllabus. During the hands-on practical sessions at the Fisheries Training Institute, the theoretical aspects of this topic will be applied as the following activities will be done: practical design of a fishing gear (calculations), net panel cutting, net joining, mending, gear inspection and model construction of a fishing gear.

After delivery, the students are expected to understand fully the concept behind the theoretical and applied/practical aspects of fish gear design and construction.

[2] Information collected from the specialisation lecture notes of Einar Hreinsson (Gear design)
[3] Information collected from the specialisation lecture notes of Einar Hreinsson (Gear design)

3.3.3 Fish behaviour

Understanding fish behaviour in relation to capture processes in fisheries is of fundamental importance to reduce bycatch, discards and enhancing conservation efforts. A thorough understanding of fish behaviour allows commercial fishers to more effectively capture target species while reducing the catch of unwanted species (He, 2010). This topic examines the role of vision and swimming in fish capture, principles, patterns, characteristics of fish behaviour and fish capture processes using gillnet as an example of a commercial fishing gear.

Delivery will be mainly through lectures (power point format and enclosed notes) during which demonstrations and visual aids like videos and still pictures will be used.

The students at the end should be able to describe the various behaviour patterns that fish use around fishing gear and the relationship between these behaviours and fish capture. They should also be able to apply the principles of fish behaviours to the design and construction of fishing gear for the target species.

3.3.4 Fishing gear selectivity

The topic highlights the importance of gear selectivity and its applications in fisheries management and research. Results from research on selectivity of fishing gear are vital in policy formulations for both fish sizes and species with the aim of lowering unwanted bycatch and prevent discards (Einarsson, 2016). Measures to prevent overfishing in Uganda's fisheries have always targeted limiting gear types and mesh sizes (Taabu, 2004). Therefore, understanding the basic principles of gear selectivity is important in regulating fishing and improving fish capture efficiency. The topic gives special attention to how fishing gear can be altered or designed so as to target more efficiently those species and sizes of fish that are most valuable and marketable, whilst reducing the catch of undersized specimen or unwanted species.

Together with the lectures in fish behaviour, this topic will equip students with the basic knowledge on research on selectivity and its importance for the further development of technical measures and regulations designed to minimise mortality rates of juveniles and non-target species.

3.3.5 Environmental impacts of fishing gear

The environmental impact of fishing is an important component of fisheries and fisheries management. It includes aspects such as overfishing as well as the impact of fishing on other elements of the environment, such as by-catch. These issues are part of conservation, and should be addressed in fisheries programmes (Hreinsson, 2016). Overfishing and declining stocks is perhaps the most predominant problem facing the fisheries sector in Uganda (Sarnowski, 2004). This topic therefore is an in-depth interdisciplinary examination of the impacts of fishing on the fisheries of Uganda. It addresses issues such as over fishing and bycatch, ecological impacts on aquatic communities, effects on benthic habitats and an in-depth look at sustainable/rational exploitation of the fisheries resources from a global and local perspective. The main delivery will be during lectures where demonstrations and visual aids like videos and still pictures will be used. Further demonstrations will be done during the field trip to the landing site as part of the practical part where the principles learned in class will be further reinforced through observations of the gear used and techniques of fishing.

At the end of the topic presentation, students are expected to be able to link fishing and the environment, ecosystem consequences of overfishing and how the fisheries can be best managed to reduce its impact on the environment.

3.3.6 Fishing methods and fish quality

On and off board handling of fish catch remains a large area of food safety concern in the artisanal fisheries of the developing world (Þórðarson, 2016). Improving quality and sanitation issues is critical to improving marketing opportunities locally, regionally and internationally, as quality standards are becoming an important requirement for trading fish across borders (Ward & Beyens, 2015).

This topic focuses mainly on the on-board fish handling from the time fish is caught in the gear until the time it´s offloaded to the market or for processing. It examines the relationship between fish gear and final fish quality and on-board fish handling and how it affects the final fish quality.

Lectures will be delivered and supplemented with videos and still pictures. As part of the field work to the landing site, students will be able to observe how fish is handled by the fishermen. This will enhance their understanding and help them formulate ideas of how to solve the problem of poor fish handling. This topic is interdisciplinary and can be taught as part of another course unit called fish processing technology and quality assurance that is taught in the same semester.

After the lecture and field work, students will have an overview of the current onboard handling practices and improvements that can be made and what fishermen can do to increase quality of catch.

3.3.7 Fisheries acoustics

Aquatic foods from the sea and fresh water have long been and are still an important source of food and economic activity. With both marine and freshwater fish stocks continuously being over-exploited, there is a clear focus on fisheries management, to which acoustic methods can and do make an important contribution (Reynisson, 2016).

Acoustic methods are vital in stock assessment exercises and for behavioural studies, starting from freshwater rivers and extending from inland lakes, estuaries and open ocean. At the moment, fisheries acoustics is not only being used for fishing and assessment studies, but also for ecological and management studies (Simmonds & MacLennan, 2005).

Therefore, the objective is to give the students a basic knowledge of the principles of hydro acoustics and how these are utilized in various equipment for fish finding and monitoring of fishing gear. A brief description of the various equipment will be given and of how hydro acoustics are used in monitoring the distribution and abundance of fish stocks. The main material of the course will be presented on a PowerPoint format and enclosed notes.

After the course, the student should have a rudimentary knowledge of the principles of underwater sound and how acoustics are utilized in fish finding and fishing gear monitoring. The student should be able understand to some extent the potential as well as limitations of

these equipment and how they are used both in commercial fishing and research. The intent is also to give the student an idea on how to choose equipment for different fisheries situations.

3.3.8 Naval architecture

The essential characteristics of a ship's design and how they affect its behaviour in the water are of obvious interest to a wide range of people. Fisheries students need an in depth understanding of the principles and a good general grasp of the basics of ship design and construction (Ragnarsson, 2016).

This topic looks at the basic theory of boats/ships plus the fishing vessel design, construction and operation. As mentioned earlier, Uganda's active fishing fleet is entirely artisanal consisting of mostly wooden fishing crafts of varying design and shape. It will introduce students to the basic definition of boats, their design, construction and operation.

Besides lectures, students will gain more insight from the field trip to the landing site and will interact with the boat owners and makers during the trip.

3.4 Lesson planning (theory and practical)

A lesson plan can best be defined as an instructor's road map of what students need to learn and how it will be done effectively during the class time (University of Michigan, 2016). Lesson planning is very important for effective teaching, producing of unified lessons by the teacher and also gives the teacher an opportunity to select the best lesson objectives and the type of strategies that would have to be employed in order to meet the set objectives, the materials needed, how long the activity might take and how the students should be grouped (Jensen, 2001). Detailed lesson plans (Table 8) and practical plans (Table 9) were developed for every lesson of every topic as guide for the systematic implementation of the syllabus.

Some of the factors that were taken into account when planning for a specific lesson included:

3.4.1 Aim(s) of the lesson

This is a general statement of intent indicating the main goal that the lesson is trying to achieve. Ideally, one aim is adequate for a lesson.

3.4.2 Objectives

These should be primarily learner centred and should include what you expect the students to have achieved by the end of the lesson (Chirwa, 2003).

3.4.3 Students' previous knowledge and experience of the subject matter

This is important especially in a diverse group of individuals with varying backgrounds. It gives the teacher a chance to include material that will help bring everyone to the same level. To plan an effective lesson, it's important to know who your students are especially taking into account their prior knowledge (what they know and how well they know it) of the subject matter (Carnegie Mellon University, 2015).

3.4.4 Classroom organisation

This can be individual, paired, group or whole class. For this syllabus, the main class room organisation is the whole class but for some lectures, the class will be made to split into groups or pairs to accomplish a given task. Also during practical hands-on exercises, the organisation will be in groups. The importance of the different teaching methods has been covered in section 2.4.

3.4.5 Assessment of student learning

This is intended to clarify on how the students learning will be assessed (in relation to the lesson objectives). Assessment is meant to provide immediate feedback about the entire class's level of understanding, not individual students' (Carnegie Mellon University, 2015). Classroom assessment techniques may vary with the type of lesson being delivered but the commonest ones' like asking students during intervals if they are still following the lecture flow and also letting them ask the teacher any question at any time during the lecture (The University of Texas at Austin, 2017).

3.4.6 Resources

In this section, the teaching and learning aids to be used by teacher and/or students are outlined. The teaching materials selected must be appropriate and of motivational value. This is important as it makes the lesson more interesting hence drawing the attention and full participation of the students.

3.4.7 Introduction

Outlines the main aim of the lecture or what the teacher will teach. It helps the teacher to access the prior knowledge and information of the students with regards to the topic at hand. It also helps the students know their expected role during the lecture period. With a proper introduction, the teacher will have an idea of which areas to focus on during the lecture and how to motivate the students during the lecture.

3.4.8 Development

Lesson development involves dividing the lecture into a series of steps to be followed during the presentation. It involves a systematic arrangement of the subjects to give students a clear progression of the presentation. It also indicates the different delivery methods and strategies that will be used in the presentation of the lesson e.g. an explanation followed by a demonstration and practice by the students (Gurirab, 2006).

3.4.9 Conclusion

A brief summary of the work that has been covered. Gives the teacher a chance to round up the lesson in an orderly manner. He/she might choose to conclude the lecture through a number of ways or a combination of them. These include: asking questions as a way of getting feedback from students, talk briefly about what is going to be covered in the next session, and giving an assignment with focused objectives. Conclusion is also an opportunity for the teacher to assess the students and himself in relation to whether the set objectives of the lecture have been met.

A table containing the detailed lecture and practical plans of all topics and practical sessions is shown in Appendix 3.

Table 8: An example of a 115 minutes' detailed lesson plan

Date	Length of lesson	Course	Topic	Subtopic
---/--/20---	115 minutes	BScFA	Fishing gear and techniques	Main fishing gear and methods in use today

	Aim	To introduce students to the different fishing gear, methods and techniques used today in world capture fisheries
	Objectives	**At the end of the lesson students should be able to:** i. Differentiate between artisanal and industrial fishing ii. Identify the different fishing methods and techniques in the world iii. Explain how the different methods are employed in capturing fish iv. Discuss the advantages and disadvantages of using the methods
	Assumed prior knowledge:	Some students have diplomas from the fisheries training institute and may have some knowledge and prior field exposure about the subject Students that have had their internships at fish landing sites may have prior knowledge about the fishing methods and techniques
	Classroom organisation	The class room will be taught as a whole
	Assessment of student learning	Student learning will be assessed by vigorous interaction and engagement between the pupils and teachers in terms of asking questions as the lecture goes on and tutor observation
	Resources	The teaching and learning aids will include: Lecture presentation, videos, pictures, computer, overhead projector, flip charts and markers, copy of power point as handout
	ORGANISATION OF LESSON	
Time	**Teacher Activity**	**Student Activity**
5 Minutes **105 Minutes** **5 Minutes**	**Introduction** Tell the students the lecture aim Ask students if they have heard of any fishing method or technique or if they have been involved with any method before. **Development** Explain the difference between artisanal and commercial fishing Explain the different fishing methods and techniques available, their mode of action using a prepared power point Demonstration with pictures and videos of each method **Conclusion** Recap of the day's session ask clarification on anything that has been taught Talk briefly about what we are going to cover in the next session	• Attentively listening and watching • Asking the teacher questions for clarification • Answering questions from the teacher during and after the lesson
Homework:		Tell the students to read about factors that influence choice of gear and fishing methods

Table 9: An example of a 6 hours' detailed practical plan

Date	Length of lesson	Course	Topic
---/---/20---	330 minutes	BScFA	Design and construction of a gillnet

	Aim	To introduce students to the practical aspects of gear design and model construction
	Objectives	**At the end of the practical students should be able to:** i. Know the practical factors to be considered before constructing a gear ii. Know the calculations needed for that particular gear to fit design specifications iii. Know the construction materials iv. Be able to make net, step by step v. Be able to build a model fish gear
	Assumed prior knowledge:	Some students have diplomas from the fisheries training institute and may have some knowledge and prior field exposure about the subject
	Practical organisation	The students will be first taught as a whole in the introductory part and later divided into groups of individuals for the hands on practical work.
	Assessment of student learning	Application of skills very well demonstrated as outlined in the practical objectives
	Resources	The teaching and learning aids will include: Lecture presentation, videos, pictures, computer, overhead projector, flip charts and markers, needle, knives, twine material, netting material, rope, plastic floats, sinkers
	ORGANISATION OF LESSON	
Time	**Teacher Activity**	**Student Activity**
20 Minutes **150 Minutes** **180 minutes**	**Introduction** Tell the students the practical aim Tell students what exactly will be done in the practical session, how it will be carried out and the expected outcome **Development** • A recap from the lectures about the calculations involved in gear design • Introduce students to the materials used in construction of the model gear • Ask the students to practically do the necessary calculations for the gear. **These will include:** • Mesh size determination • Rope length • Horizontal and vertical hanging ratios • Number of meshes in the T and P directions • Resultant Tex • Twine area • Net and rope weights • Buoyancy and ballast calculations • Model construction by the students Students will be divided into groups and each group will construct a model of the selected gear	• Attentively listening and watching • Asking and answering questions • Hands on with the practical • Working in groups to figure out the calculations and other net specifications

20 minutes	**Conclusion** Recap of the day's session- ask each one thing they have learnt Talk briefly about what we are going to cover in the next session	

3.5 Development of schemes and records of work

The notes from the specialisation lectures and other references were the building blocks for the syllabus. The main topics and subtopics were derived from different sources, mainly from lecture notes, articles, text books and were essential in lesson planning and development of schemes and records of work. A scheme of work is a written, modifiable document that guides the overall direction of any teaching activity with each group of students and provides a context and resource for the development of detailed lesson plans (Murchan & Johnston, 2013).

It is always important and necessary to scrupulously plan what should be taught during the course of the semester. Planning has to take into account: the amount of time allocated for the course unit in a semester, the amount of information/work contained in a syllabus, number of periods per week, the different strategies of delivering the information, references, semester and academic year (Chirwa, 2003).

An outline of the schemes of work for the syllabus includes the following:

3.5.1 Work planned

This basically indicates an outline the total number of work/lectures that have been planned to be delivered to students on a weekly basis throughout the semester.

4.3.2 Methods/strategies

To ensure a successful delivery of the lectures to the students, specific methods/strategies are employed. These methods are what the lecturer deems relevant and fit to employ for the specific topics.

3.5.2 Accomplishment

What has been successfully delivered to the students out of what was planned before is indicated in this section. It's important that this section be filled after every lecture. It is very important in course evaluation later on when assessing the degree of effectiveness of the course (Gurirab, 2006).

3.5.3 Remarks/comments

This indicates what has been done and what has not been done after delivery of the lecture. This part includes comments such as whether the lesson was clear or for any other reasons it was not properly delivered. In cases where there were problems in delivery, it should be indicated whether it is necessary to repeat the lesson or not.

A detailed template for scheme and records of work is shown in Appendix 4.

3.6 Designing and development of lecture slides, notes and assignments

Detailed lecture notes in form of power point presentations were developed by the fellow on topics and subtopics. This was supplemented with reading material for the students which included articles and text books. The lecture presentation development followed the lesson plans and took into consideration factors like time limitations, logistics required and level of importance of the topic. In total, fourteen presentations were developed from the eight topics. This will form the backbone of the theoretical part of the syllabus. A question bank consisting of possible questions from the topics was prepared by the fellow. The questions developed were in form of multiple choice questions, short answer questions and long answer questions (essays) and will be used for assessment as take-home exercises, coursework assignments and end of semester examinations. The question bank is a guide and questions will be added or removed during the implementation of the syllabus.

The questions were set in accordance with the Makerere University examination setting system. The Department of Zoology, Entomology and Fisheries Sciences of Makerere University has a standard examination format for course units of different credits units. Since the course unit of fishing technology is a 3CUs course, the following format was used (Table 10). It would be noted that the same format is used for all 3CU courses in the Degree Programme of Fisheries and Aquaculture.

Table 10: Examination setting format for a 3 credit course unit

	Multiple Choice Questions (MCQs)	Short Answer Questions (SAQs)	Long Answer Questions (LAQs)	Total
Number of questions	15	10	2 out of 4	27
Marks	15	50	50	115
Time allocated (minutes)	15	40	80	135

Source: Makerere University examination setting guidelines (unpublished)

4 CONCLUSION AND RECOMMENDATIONS

In a nutshell, the developed syllabus should be able to provide a broad overview of fishing technology to the students from a global and local perspective and should be able to achieve the learning outcomes of each topic. It should also be able to support in the design, preparation and provision of demand driven tailor made short courses thereby supporting the different stakeholders like net makers, fishermen, researchers and extension workers. By training students to improve their knowledge and skills in fishing technology, this syllabus will be directly participating in the fisheries management programmes that aim at maximising the benefits derived from fisheries resources of Uganda.

4.1 General recommendations

The following recommendations are offered for further improvement of the efficiency and effectiveness of the syllabus implementation:

Refresher courses tailor made for the industry: modification of the topics in the syllabus into demand related modules to train professionals working in the fisheries and aquaculture

industry like researchers and fisheries officers. Courses can be sponsored by Makerere University, the Government of Uganda or external funding from partner donor organisations. The duration of the courses may vary depending on the need of the group to be trained.

Introduction in the Masters of Zoology programme: with the increased need for knowledge of fishing technology among fisheries and aquaculture professionals in Uganda, it is recommended that this new syllabus be incorporated into the curriculum of the Master in Zoology (fisheries and aquaculture) curriculum since it doesn't exist at the moment.

Give more time to the practical aspects of the course: more time and resources should be focused on the practical training of the course for the students to improve its effectiveness in imparting knowledge to the recipients. This doesn't in anyway mean that the class room theory part be neglected or reduced. In order to strike a balance between providing more practical training and maintain a good theoretical background, it´s recommended that the credit units of the course unit of fishing technology be increased from three (3CUs) to four (4Cus). This will mean that the practical hours will be increased from fifteen to forty-five without changing the lecture hours. This can be done by removing a credit from other course units such as the field attachment which currently has 5CUs and adding it to the fishing technology course unit.

Integration with other course units: The syllabus has the potential to be integrated in terms of teaching with other course units in the course of fisheries and aquaculture to create an interdisciplinary approach to the course. Topics such as fishing methods and fish quality, fish behaviour and selectivity can be integrated in fish processing and quality, fish biology, bio-math and stock assessment course units respectively.

Name change: the current official course unit name is design and construction of fishing gear. Its recommended that this name be changed effective immediately to reflect the content of the developed syllabus, its scope and importance in the fisheries and aquaculture industries of Uganda. The new names suggested here are fishing gear technology, fishing technology or fishing and gear technology.

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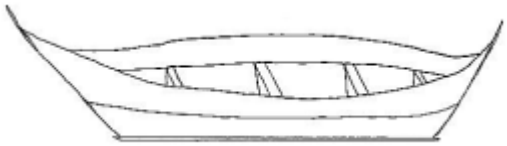
APPENDIX 1: DESCRIPTION OF FISHING CRAFT CATEGORIES

Vessel type	Description
1. Dugout boat 	▪ Curved out of a whole log of a tree. ▪ Common size, 4 to 5 m long ▪ Entirely propelled by paddle ▪ Operated exclusively in the littoral areas targeting Nile tilapia ▪ The main fishing gear types used are gillnets and basket traps
2. Parachute 	▪ Constructed from planks of timber ▪ Flat bottomed ▪ Common size, 4 to 6 m long ▪ Entirely propelled by paddle ▪ Operated exclusively in the littoral areas targeting Nile tilapia ▪ The main gear types used are gillnets, cast nets and basket traps
3. Sesse pointed at both ends 	▪ Constructed from planks of timber ▪ V-shaped bottom with a keel ▪ Common size, 6 to 10 m long ▪ Propelled by paddle or sails ▪ Operated in the littoral and sublittoral areas, up to about 3 km from the shore ▪ Largely unspecialised, i.e. used in the Mukene/Dagaa /Omena fishery with small seines; in the Nile tilapia fishery with gillnets, cast nets and basket traps; and in the Nile perch fishery with gillnets, beach seines, long lines and hand lines
4. Sesse flat at one end 	▪ Constructed from planks of timber ▪ V-shaped bottom with a keel ▪ Common size, 5 to 12 m long ▪ Propelled by paddle, sail or out board motor ▪ Largely unspecialised, i.e. used in the Mukene/Dagaa /Omena fishery with small seines; in the Nile tilapia fishery with gillnets, cast nets and basket traps; and in the Nile perch fishery with gillnets, beach seines, long lines and hand lines

Source: modified from Muhoozi, (2002)

APPENDIX 2: DETAILED SYLLABUS FOR FISHING GEAR TECHNOLOGY

Theory

Course Name Ref: BScFA	**Course unit Name:** Fishing Gear Technology	**Prepared by:** Drake Ssempijja	**Edition date:** March, 2017
Course Unit Ref: 3105	**Time frame/Semester:** 30LH	**Type of document:** Syllabus	**Approved by:**

Topic	Sub-Topics and subjects	Topic Objectives	Reference to Books	Class Hours
Fishing gear methods and techniques	▪ **An overview of fishing gear technology** i. A short history of fishing ii. Trends of development of fishing gear and systems iii. Fishing technology of Uganda ▪ **Classification of fishing gear** i. Passive and active gear ii. Behaviour control and capture mechanics iii. International standard statistical classification (FAO) ▪ **Main fishing gear and methods in use today (artisanal and industrial)** i.Hook and line ii.Seining (purse, beach and Danish seining) iii.Gillnets iv.Lift nets v.Traps and pots vi.Trawling (bottom and mid water) ▪ **Factors that influence choice of fishing gear and fishing methods** i.Technical factors ii.Social consideration iii.Economic considerations	Give a background on the fish capturing process and exploited stocks and identify fishing gears and methods in relation to future management strategies for effective and sustainable fisheries.	Definition and classification of fishing gear categories. (Nédélec & Prado, 1999). Modern fishing gear of the world fourth Edition (Brandt, 2005) Fish Catching Methods of the World (Brandt, 1984) Fisherman's workbook (Prado, 1990)	6 hrs
Design and construction of fishing gear	▪ **Design process** i. Basis of design and development efforts ii. Development Phases involved in gear design iii. Factors that determine the design and development ▪ **Fishing gear design (calculations)** i. Netting, how is it made and the main features	To introduce students to the basic principles of the design and construction of fishing gear and how these principles can be used in real life applications	Calculations for Fishing Gear Designs-(Fridman, 1992) FAO Catalogue of Fishing Gear Designs (FAO, 1978) Fisherman workbook (Prado, 1990)	9hrs

	ii. Twine Numbering system iii. Mesh size determination and measurement iv. Twine diameter determination v. Horizontal hanging ratio (E1) vi. Vertical hanging ratio (E2) vii. Length of stretched netting viii. Height of stretched netting ix. Number of meshes in length x. Number of meshes in height xi. Cutting ratios xii. Cutting combinations xiii. Calculating the twine surface area xiv. Estimating the weight of netting (practical) ▪ **Blue prints drawing of fishing gear** i. Paper based blue print drawings of fishing gear designs ii. Computer based modelling of fishing gear (Design CAD software) ▪ **Aquaculture** i. Determination of net type to use ii. Design and construction of the cage parameters iii. Determine the amount of twine net to be used	Design and construction of cages in different shapes and how gear is used to enhance the effectiveness and maintenance of these designs	Lecture notes (Hreinsson, 2016)	
Fish behaviour	▪ **Swimming in fish** i. Swimming behaviour ii. Swimming speed iii. Swimming speed and fish capture ▪ **Fish vision and its role in fish capture** i. Light ii. Fish vision iii. Fish vision and its application in fish capture iv. Fishing with light v. Fish and artificial light ▪ **Fish behaviour near gillnets: capture process, and influencing factors** i. Net visibility and fish avoidance	Describe the various behaviour patterns that fish use around fishing gear and the relationship between these behaviour and fish and capture	Fish Behaviour and Fishing Gear. (Wardle, C. S, 1986) Behaviour of marine fishes: Capture Processes and Conservation Challenges. (He, 2010) Lecture notes (Hreinsson, 2016) Fishing with light (Yami, 1976)	3 hrs

	ii. Fish behaviour and gillnet fishing			
Fishing gear selectivity	▪ **What is Selectivity and why is it important to understand selectivity?** i. Drivers of research on fishing gear ii. Types of selectivity iii. Importance/use of gear selectivity iv. Factors that affect selectivity v. Selectivity of different gear ▪ **Gear selectivity and how its measured** i. Selectivity properties of gillnets ii. Selectivity of gear attracting devices	Highlight the importance of gear selectivity and its applications in fisheries management and research	Lecture notes (Einarsson, 2016) ICES-CIEM, (2016) FAO (2000)	3 hrs
Environmental impacts of fishing gear	▪ Over fishing and bycatch ▪ Ecological impacts to aquatic communities ▪ Effects on benthic habitats ▪ **Sustainable/rational exploitation of all water resources** i. Policy and regulatory framework on fishing gear ii. Relevant management strategies in relation to sustainable fish capture methods iii. Responsible fisheries practices	To introduce students to the environmental aspects of fishing including impacts and possible solutions		2 hrs
Fishing methods and fish quality	▪ **What can fishermen do to increase quality of catch?** i. Fishing gear and fish quality ii. On board fish handling of fish: procedures and techniques	Describe the relationship between fish gear, on board fish handling and how these two factors affect the final fish quality	Lecture Notes (Þórðarson, 2016)	2hrs
Acoustics	▪ **Acoustics, general overview and basic physics** i. Acoustics and importance in fisheries management ii. Waves in elastic materials iii. Pressure, intensity and energy of sound iv. Sound scattering and attenuation ▪ **Fish finding equipment design and operation** i. Theory of Scientific Echo sounders ii. Types of Transducers iii. Target strength and how its measured iv. Gear monitoring devices	Give students a basic knowledge of the principles of underwater acoustics and how these are utilized in various equipment for fish finding and monitoring of fishing gear	Fisheries Acoustics: Theory and Practice 2nd Ed. (Simmonds & MacLennan , 2005) Fisheries acoustics (Reynisson, 2016)	2 hrs

	v. Fish abundance estimation using echo sounders and echo Integration			
Naval architecture	▪ **The principles of naval architecture, basic theory** i. Main dimensions ii. Lines drawings iii. Displacement iv. Stability v. Resistance and propulsion vi. Hull and its elements ▪ **The fishing vessel** i. Main parameters, general arrangement, machinery and equipment ii. General arrangement, main parameters iii. Main engine, propulsion and auxiliary equipment iv. Accommodation v. Fish handling spaces, fish holds vi. Winches and deck equipment ▪ **Vessel design, construction and operation** i. The design procedure	Introduce students to the basic theory of naval architecture	Naval Architecture (Ragnarsson, 2016)	2 hrs
Fishing gear research and development	▪ Current research in fishing gear technology in Uganda ▪ Discuss possible research projects with the students as their research projects ▪ Assess the overall delivery and perceived impact of the course unit from the students' perspective	Interactive session with students to talk to them about current research happening in the area of fish gear technology Asking them about how they think the course has been relevant to them Finding out if they have any project ideas in fishing gear for their Bachelors thesis, Introduce to them the possible research topics that they could work on under my supervision		1 hr

Practical

Course Name Ref: BScFA	**Course Unit Name:** Fishing Gear Technology	**Prepared by:** Drake Ssempijja	**Edition date:** March, 2017
Course Unit Ref: 3105	**Time frame/Semester:** 30PH	**Type of document**: Syllabus	**Approved by:**

Practical Location	Activities and Tasks	Practical Hours	Practical Objectives
Fisheries Training Institute (FTI)	i. Practical design of a fishing gear (calculations) ii. Model construction of a fishing gear iii. Net panel cutting, joining and mending iv. Practical aspects of boat construction	15hrs	**On completing the practical sessions, student should be able to:** i. Be able to design and construct a fishing gear ii. Demonstrate the ability to cut, mend, repair/rig netting panels iii. Identify material and equipment used to make fishing gear, their characteristics, physical properties and area of use. iv. Capable of measuring and inspecting all parts of a fishing gear, using correct measuring devices, cut netting, wire, rope and chain according to plan
Landing site visit	**The practical operation of the different gear types and methods used** i. How the fishing gear are designed and constructed locally using local knowledge? ii. To experience a typical fishing operation iii. To see how fish is handled during a fishing operation iv. To observe the possible environmental effect of the various fishing gear used	12hrs	**The field trip aims to:** i. Allow students to observe how different fishing gear and techniques are being applied in the real world ii. Classify fishing vessels and know the main methods of fishing used in Ugandan waters iii. Experience a typical fishing operation: setting and hauling operations of fishing gear iv. To compare gear design and construction using the technical way and local knowledge way used by the fishermen
Net making company visit	i. See how different fishing gear and accessories are manufactured on an industrial scale	3hrs	ii. To give students an insight of how nets are manufacture on an industrial scale

APPENDIX 3: DETAILED LESSON PLANS

TOPIC 1: FISHING GEAR AND TECHNIQUES

Date	Length of lesson	Course	Topic	Subtopic
--/--/20--	55 minutes	BScFA	Fishing gear and techniques	An overview of fishing gear technology

Time	**Aim**	To introduce students to the concept of fishing gear technology, history and trends of development in the world and in Uganda
	Objectives	**At the end of the lesson students should be able to:** • Describe the developments of the fishing gear industry from its primitive stages to modernity • Describe the fisheries of Uganda in relation to fishing gear used
	Assumed prior knowledge:	Some students have diploma from the Fisheries Training Institute and may have some knowledge and prior field exposure about the subject. Some students have had internship at fish landing sites and therefore have some knowledge of the subject matter.
	Classroom organisation	The class room will be taught as a whole
	Assessment of student learning	Student learning will be assessed by vigorous interaction and engagement between the pupils and teachers in terms of asking questions as the lecture goes on and tutor observation
	Resources	The teaching and learning aids will include: Lecture presentation, pictures, computer, overhead projector, flip charts and markers, copy of PowerPoint as handout and lecture notes
	ORGANISATION OF LESSON	
	Teacher Activity	**Student Activity**
5 Minutes **45 Minutes** **5 Minutes**	**Introduction** Tell the students the lecture aim Ask students if they know anything about the term fishing gear technology **Development** Explain the history of fishing gear technology including the theory of fishing gear and fishing systems Explain the history of fishing in Uganda. Demonstration with pictures **Conclusion** Recap of the day's session- ask if they have any questions and also ask them what they have learnt Talk briefly about what we are going to cover in the next session and ask the students to read about it	• Attentively listening and watching • Asking questions to the teacher for clarification • Answering questions from the teacher during and after the lesson
Homework:		Read about the classification of fishing gear

Date	Length of lesson	Course	Topic	Subtopic
--/--/20--	115 minutes	BScFA	Fishing gear and techniques	Main fishing gear and methods in use today

Time	**Aim**	To introduce students to the different fishing gear, methods and techniques used today in world capture fisheries
	Objectives	**At the end of the lesson students should be able to:** • Differentiate between artisanal and industrial fishing • Identify the different fishing methods and techniques in the world • Explain how the different methods are employed in capturing fish • Discuss the advantages and disadvantages of using the methods
	Assumed prior knowledge:	Some students have diplomas from the fisheries training institute and may have some knowledge and prior field exposure about the subject Students that have had their internships at fish landing sites may have prior knowledge about the fishing methods and techniques
	Classroom organisation	The class room will be taught as a whole
	Assessment of student learning	Student learning will be assessed by vigorous interaction and engagement between the pupils and teachers in terms of asking questions as the lecture goes on and tutor observation
	Resources	The teaching and learning aids will include: Lecture presentation, videos, pictures, computer, overhead projector, flip charts and markers, Copy of PowerPoint as handout
	ORGANISATION OF LESSON	
	Teacher Activity	**Student Activity**
5 Minutes	**Introduction** Tell the students the lecture aim Ask students if they have heard of any fishing method or technique or if they have been involved with any method before.	• Attentively listening and watching • Asking questions to the teacher for clarification • Answering questions from the teacher during and after the lesson
105 Minutes	**Development** Explain the difference between artisanal and commercial fishing Explain the different fishing methods and techniques available, their mode of action using a prepared power point Demonstration with pictures and videos of each method	
5 Minutes	**Conclusion** Recap of the day's session- ask each 1 thing they have learnt Talk briefly about what we are going to cover in the next session	
Homework:		Tell the students to read about factors that influence choice of gear and fishing methods

Date	Length of lesson	Course	Topic	Subtopic
--/--/20--	55 minutes	BScFA	Fishing gear and techniques	Classification of fishing gear

Time	**Aim**	To introduce students to the concept of fishing gear technology, history and trends of development in the world and in Uganda
	Objectives	**At the end of the lesson students should be able to:** • Discuss the different classification criteria used for the different fishing gear and methods
	Assumed prior knowledge:	Some students have Diploma from the Fisheries Training Institute and may have some knowledge and prior field exposure about the subject. Some students have had internship at fish landing sites and therefore have some knowledge of the subject matter.
	Classroom organisation	The class room will be taught as a whole for the first 30 minutes and then divided into three groups with each group tasked to identify the different gear that fall in each category
	Assessment of student learning	Student learning will be assessed by vigorous interaction and engagement between the students during the grouping session
	Resources	The teaching and learning aids will include: Lecture presentation, pictures, computer, overhead projector, flip charts and markers, copy of PowerPoint as handout and lecture notes.
	ORGANISATION OF LESSON	
	Teacher Activity	**Student Activity**
5 Minutes **45 Minutes** **5 Minutes**	**Introduction** Tell the students the lecture aim Ask students if they know anything about classification of gear **Development** Explain the different classifications used to differentiate between different gear types **Conclusion** Recap of the day's session- ask if they have any questions and also ask them what they have learnt Talk briefly about what we are going to cover in the next session and ask the students to read about it	• Attentively listening and watching • Asking questions to the teacher for clarification • Answering questions from the teacher during and after the lesson • Participate actively in the group exercise
Homework:		Read about main fishing gear and methods in use today (artisanal and industrial)

Date	Length of lesson	Course	Topic	Subtopic
--/--/20--	55 minutes	BScFA	Fishing gear and techniques	Factors for choice of fishing gear

Time	**Aim**	To introduce students to the different factors that determine choice of fishing gear and fishing methods
	Objectives	**At the end of the lesson students should be able to:** • Explain the factors that influence choice of fishing gears and fishing methods
	Assumed prior knowledge:	Some students have diploma from the Fisheries Training Institute and may have some knowledge and prior field exposure about the subject.
	Classroom organisation	The class room will be taught as a whole
	Assessment of student learning	Student learning will be assessed by vigorous interaction and engagement between the students and the lecturer
	Resources	The teaching and learning aids will include: Lecture presentation, pictures, computer, overhead projector, flip charts and markers, copy of PowerPoint as handout and lecture notes.
	ORGANISATION OF LESSON	
	Teacher Activity	**Student Activity**
5 Minutes **45 Minutes** **5 Minutes**	**Introduction** Tell the students the lecture aim Ask students if they know anything about classification of gear **Development** Explain the different factors and how they determine choice of a gear **Conclusion** Recap of the day's session- ask if they have any questions and also ask them what they have learnt Talk briefly about what we are going to cover in the next session and ask the students to read about it	• Attentively listening and watching • Asking questions to the teacher for clarification • Answering questions from the teacher during and after the lesson
Homework:		Read though the first topic and find questions to ask me during the question and answer session.

TOPIC 2: DESIGN AND CONSTRUCTION OF FISHING GEAR

Date	Length of lesson	Course	Topic	Subtopic
--/---/20--	55 minutes	BScFA	Design and construction of fishing gear	Design process

Time	Aim	To introduce students to the general process of fish gear design
	Objectives	**At the end of the lesson students should be able to:** • Explain the basis of design and development efforts of the different gear • Explain the development phases involved in gear design • Discuss the factors that determine the design and development
	Assumed prior knowledge:	Some students have diploma from the Fisheries Training Institute and may have some knowledge and prior field exposure about the subject.
	Classroom organisation	The class room will be taught as a whole
	Assessment of student learning	Student learning will be assessed by vigorous interaction and engagement between the students and the lecturer and answering questions as the lecture goes on
	Resources	The teaching and learning aids will include: Lecture presentation, pictures, computer, overhead projector, flip charts and markers, copy of PowerPoint as handout and lecture notes.
	ORGANISATION OF LESSON	
	Teacher Activity	**Student Activity**
5 Minutes **45 Minutes** **5 Minutes**	**Introduction** Introduce the concept of fish gear design and why it's important **Development** Explain the factors on which design and development efforts are based on The development Phases involved in gear design Factors that determine the design and development of a fish gear Conclusion Ask if there is anything I can clarify to the students about what I has been taught Talk more about the next lecture	• Attentively listening and watching • Asking questions to the teacher for clarification • Answering questions from the teacher during and after the lesson
Homework:		Read about the twine numbering system

Date	Length of lesson	Course	Topic	Subtopic
--/--/20—	115 minutes	BScFA	Design and construction of fishing gear	Gear design (calculations)

Time	**Aim**	An overview of the basics one needs to know before calculations
	Objectives	**At the end of the lesson students should be able to:** • Describe how a netting panel is made and name the different features • Explain the twine numbering system and its use in design • Determination of mesh diameter and mesh sizes its implications in fisheries management
	Assumed prior knowledge:	Some students have diploma from the Fisheries Training Institute and may have some knowledge and prior field exposure about the subject.
	Classroom organisation	The class room will be taught as a whole
	Assessment of student learning	Student learning will be assessed by vigorous interaction and engagement between the students and the lecturer and answering questions as the lecture goes on and level of responsiveness during the demonstrations
	Resources	The teaching and learning aids will include: Lecture presentation, pictures, netting panels of different sizes, cutting knife, pencil, ruler, calculator, pair of scissors, computer, overhead projector, flip charts and markers, copy of PowerPoint as handout and lecture notes.
	ORGANISATION OF LESSON	
	Teacher Activity	**Student Activity**
5 Minutes **105 Minutes** **5 Minutes**	**Introduction** Introduce the basic calculations used in gear design **Development** Explain the features of a typical netting panel including meshes, twine diameter, twine and rope material, knots, T and P direction Explain mesh size and twine diameter determination Explain the twine numbering system and the resultant twine **Conclusion** Ask if there is anything I can clarify to the students about what I has been taught Talk more about the next lecture	• Attentively listening and watching • Asking questions to the teacher for clarification • Answering questions from the teacher during and after the lesson • Work out the given calculation exercises
Homework:		Read about hanging ratios

Date	Length of lesson	Course	Topic	Subtopic
--/---/20--	115 minutes	BScFA	Design and construction of fishing gear	Gear design (calculations)

Time	**Aim**	How to calculate gear specifics (hanging ratio, meshes and stretched lengths)
	Objectives	**At the end of the lesson students should be able to:** • Define hanging ratio and its importance in gear design • Calculate the horizontal and vertical hanging ratios • Determine the rope length • Calculate the height and length of the stretched netting • Determine the number of meshes in the horizontal and vertical directions
	Assumed prior knowledge:	Some students have diploma from the Fisheries Training Institute and may have some knowledge and prior field exposure about the subject.
	Classroom organisation	The class room will be taught as a whole but individual exercises will be given to the student as the lecture proceeds
	Assessment of student learning	Student learning will be assessed by vigorous interaction and engagement between the students and the lecturer and how much they are participating I the calculation exercises
	Resources	The teaching and learning aids will include: Lecture presentation, pictures, netting panels of different sizes, cutting knife, pencil, ruler, Vernier calliper, calculator, pair of scissors, computer, overhead projector, flip charts and markers, copy of PowerPoint as handout and lecture notes.
	ORGANISATION OF LESSON	
	Teacher Activity	**Student Activity**
5 Minutes	**Introduction** Introduce the basic calculations used in gear design	• Attentively listening and watching • Asking questions to the teacher for clarification • Answering questions from the teacher during and after the lesson • Work out the given calculation exercises
105 Minutes	**Development** Explain hanging ratio, its application and importance in gear design Calculation exercises for hanging ratio, rope length, height and length of the stretched netting and number of meshes in the horizontal and vertical directions	
5 Minutes	**Conclusion** Ask if there is anything I can clarify to the students about what I has been taught Talk more about the next lecture	
Homework:		Practice questions to be done at home

Date	Length of lesson	Course	Topic	Subtopic
--/--/20--	115 minutes	BScFA	Design and construction of fishing gear	Gear design (calculations)

Time	Aim	How to calculate gear specifics (ratios, combinations, weights)
	Objectives	**At the end of the lesson students should be able to:** • Calculate the cutting ratio and combination of a piece of netting • Calculate estimated twine area and area of hung net • Application of gear technology in aquaculture
	Assumed prior knowledge:	Some students have diploma from the Fisheries Training Institute and may have some knowledge and prior field exposure about the subject.
	Classroom organisation	The class room will be taught as a whole but individual calculation exercises will be given to the student as the lecture proceeds
	Assessment of student learning	Student learning will be assessed by vigorous interaction and engagement between the students and the lecturer and how much they are participating I the calculation exercises
	Resources	The teaching and learning aids will include: Lecture presentation, pictures, netting panels of different sizes, cutting knife, pencil, ruler, calculator, pair of scissors, computer, overhead projector, flip charts and markers, copy of PowerPoint as handout and lecture notes.
	ORGANISATION OF LESSON	
	Teacher Activity	**Student Activity**
5 Minutes **105 Minutes** **5 Minutes**	**Introduction** Introduce the basic calculations used in gear design **Development** Explain the cutting ratio and cutting combination of a piece of netting. Calculation exercises for cutting ratios and combinations, twine area and weight **Conclusion** Ask if there is anything I can clarify to the students about what I has been taught	• Attentively listening and watching • Asking questions to the teacher for clarification • Answering questions from the teacher during and after the lesson • Work out the given calculation exercises
Homework:		Practice questions to do at home

Date	Length of lesson	Course	Topic	Subtopic
--/--/20--	115 minutes	BScFA	Design and construction of fishing gear	Blue prints fishing gear

Time	**Aim**	How to draw blue prints for the designed gear on paper and on computer
	Objectives	**At the end of the lesson students should be able to:** • Drawing well labelled blue prints for designed gear • Design computer fish gear blue prints (demonstration)
	Assumed prior knowledge:	Some students have diploma from the Fisheries Training Institute and may have some knowledge and prior field exposure about the subject.
	Classroom organisation	The class room will be taught as a whole but individual calculation exercises will be given to the student as the lecture proceeds
	Assessment of student learning	Student learning will be assessed by vigorous interaction and engagement between the students and the lecturer and how much they are participating I the calculation exercises
	Resources	The teaching and learning aids will include: Lecture presentation, pictures, netting panels of different sizes, cutting knife, pencil, ruler, calculator, pair of scissors, computer, overhead projector, flip charts and markers, copy of PowerPoint as handout and lecture notes.
	ORGANISATION OF LESSON	
	Teacher Activity	**Student Activity**
5 Minutes **105 Minutes** **5 Minutes**	**Introduction** Introduce the basic calculations used in gear design **Development** Explain the principle and practice of blue prints and their use in the net making industry Practical exercise of drawing blue prints **Conclusion** Ask if there is anything I can clarify to the students about what I has been taught	• Attentively listening and watching • Asking questions to the teacher for clarification • Answering questions from the teacher during and after the lesson • Work out the given drawing exercises
Homework:		Practice questions to do at home

TOPIC 3: FISH BEHAVIOUR

Date	Length of lesson	Course	Topic	Subtopic
---/-----/20---	55 minutes	BScFA	Fish behaviour	Swimming in fish

Time	**Aim**	To introduce students to swimming behaviour of fish and its role in fish capture
	Objectives	**At the end of the lesson students should be able to explain:** • Swimming behaviour • Swimming speeds • Swimming speed and fish capture
	Assumed prior knowledge:	Some students have diploma from the Fisheries Training Institute and may have some knowledge and prior field exposure about the subject.
	Classroom organisation	The class room will be taught as a whole
	Assessment of student learning	Student learning will be assessed by vigorous interaction and engagement between the students and the lecturer and how much they are participating in the lecture
	Resources	The teaching and learning aids will include: Lecture presentation, pictures, computer, overhead projector, flip charts and markers, copy of PowerPoint as handout and lecture notes.
	ORGANISATION OF LESSON	
	Teacher Activity	**Student Activity**
5 Minutes **45 Minutes** **5 Minutes**	**Introduction** Brief overview of swimming and its role in a fish's life **Development** Explain in detail swimming behaviour, speed and its role in fish capture **Conclusion** Ask if there is anything I can clarify to the students about what has been taught and answer possible questions that might arise	• Attentively listening and watching • Asking questions to the teacher for clarification • Answering questions from the teacher during and after the lesson
Homework:		Go and read about the fish eye and its function and structure

Date	Length of lesson	Course	Topic	Subtopic
---/---/20---	115 minutes	BScFA	Fish behaviour	Fish vision and its role in fish capture

Time	**Aim**	To introduce students to the different aspects of vision and fish capture
	Objectives	**At the end of the lesson students should be able to explain:** • Fish vision and its application in fish capture • Fish behaviour near gillnets: capture process, and influencing factors
	Assumed prior knowledge:	Some students have diploma from the Fisheries Training Institute and may have some knowledge and prior field exposure about the subject.
	Classroom organisation	The class room will be taught as a whole
	Assessment of student learning	Student learning will be assessed by vigorous interaction and engagement between the students and the lecturer and how much they are participating in the lecture
	Resources	The teaching and learning aids will include: Lecture presentation, pictures, computer, overhead projector, flip charts and markers, copy of PowerPoint as handout and lecture notes.
	ORGANISATION OF LESSON	
	Teacher Activity	**Student Activity**
5 Minutes **105 Minutes** **5 Minutes**	**Introduction** Brief general introduction to light **Development** Explain light in relation to aquatic environments Light and its role in fishing How do fish behave around gillnets? **Conclusion** Ask if there is anything I can clarify to the students about what has been taught and answer possible questions that might arise	• Attentively listening and watching • Asking questions to the teacher for clarification • Answering questions from the teacher during and after the lesson
Homework:		Go read about the definition of selectivity of fishing gear

TOPIC 4: SELECTIVITY OF FISHING GEAR

Date	Length of lesson	Course	Topic	Subtopic
--/--/20--	115 minutes	BScFA	Selectivity of fishing gear	What is Selectivity and why is it important to understand selectivity?

Time	**Aim**	To introduce students to the principles of gear selectivity
	Objectives	**At the end of the lesson students should be able to explain:** • Drivers of research on fishing gear • Types of selectivity • Importance/use of gear selectivity • Factors that affect selectivity • Selectivity of different gear
	Assumed prior knowledge:	Some students have diploma from the Fisheries Training Institute and may have some knowledge and prior field exposure about the subject.
	Classroom organisation	The class room will be taught as a whole
	Assessment of student learning	Student learning will be assessed by vigorous interaction and engagement between the students and the lecturer and how much they are participating in the lecture
	Resources	The teaching and learning aids will include: Lecture presentation, pictures, computer, overhead projector, flip charts and markers, copy of PowerPoint as handout and lecture notes.
	ORGANISATION OF LESSON	
	Teacher Activity	**Student Activity**
5 Minutes **105 Minutes** **5 Minutes**	**Introduction** Define the three important definitions of selectivity **Development** Explain: Research on fishing gear Types of selectivity Importance/use of gear selectivity Factors that affect selectivity **Conclusion** Summary of the lecture and answering any lingering questions from the students	• Attentively listening and watching • Asking questions to the teacher for clarification • Answering questions from the teacher during the lecture
Homework:		Go and read selectivity of fishing gear

Date	Length of lesson	Course	Topic	Subtopic
--/--/20--	55 minutes	BScFA	Selectivity of fishing gear	Gear selectivity and how its measured

Time	**Aim**	To introduce students to the measurements and practical aspects of selectivity
	Objectives	**At the end of the lesson students should be able to explain and discuss:** • Selectivity of gill nets • Selectivity of fish attracting devices
	Assumed prior knowledge:	Some students have diploma from the Fisheries Training Institute and may have some knowledge and prior field exposure about the subject.
	Classroom organisation	The class room will be taught as a whole
	Assessment of student learning	Student learning will be assessed by vigorous interaction and engagement between the students and the lecturer and how much they are participating in the lecture
	Resources	The teaching and learning aids will include: Lecture presentation, pictures, computer, overhead projector, flip charts and markers, copy of PowerPoint as handout and lecture notes.
	ORGANISATION OF LESSON	
	Teacher Activity	**Student Activity**
5 Minutes	**Introduction** Define the three important definitions of selectivity	• Attentively listening and watching • Asking questions to the teacher for clarification • Answering questions from the teacher during the lecture
45 Minutes	**Development** Explain selectivity of gill nets Explain the selectivity of fish attracting devices	
5 Minutes	**Conclusion** Summary of the lecture and answering any lingering questions from the students	
Homework:		Go and read about over fishing

TOPIC 5: ENVIRONMENTAL IMPACTS OF FISHING GEAR

Date	Length of lesson	Course	Topic	Subtopic
--/--/20--	115 minutes	BScFA	Environmental impacts of fishing gear	Environmental impacts of fishing gear

Time	**Aim**	To introduce students to the environmental aspects of fishing including impacts and possible solutions
	Objectives	**At the end of the lesson students should be able to discuss and explain:** • Over fishing, bycatch and discards • Ecological impacts on freshwater communities • Effects on benthic habitats • Sustainable/rational exploitation of the fisheries resources
	Assumed prior knowledge:	Some students have diploma from the Fisheries Training Institute and may have some knowledge and prior field exposure about the subject. Also, the students have undergone some courses relating to environment and natural resources management
	Classroom organisation	The class room will be taught as a whole
	Assessment of student learning	Student learning will be assessed by vigorous interaction and engagement between the students and the lecturer and how much they are participating in the proceedings of the lecture
	Resources	The teaching and learning aids will include: Lecture presentation, pictures, computer, overhead projector, flip charts and markers, copy of PowerPoint as handout and lecture notes.
	ORGANISATION OF LESSON	
	Teacher Activity	**Student Activity**
5 Minutes	**Introduction** Define fishing and the environment	• Attentively listening and watching • Asking questions to the teacher for clarification • Answering questions from the teacher during and after the lesson
105 Minutes	**Development** Explain the overfishing, bycatch, discards they impact the environment Discussing different fishing gear and its impact on the environment (ecology and benthic habitats) Explain the different methods that can be used to ensure less environmental impact and destruction	
5 Minutes	**Conclusion** Ask if there is anything I can clarify to the students about what has been taught and answer possible questions that might arise	

TOPIC 6: FISHING AND FISH QUALITY

Date	Length of lesson	Course	Topic	Subtopic
--/--/20--	115 minutes	BScFA	Fishing and fish quality	What can fishermen do to increase quality of catch?

Time	**Aim**	To introduce students to the relationship between fishing and fish quality
	Objectives	**At the end of the lesson students should be able to explain:** • Relationship between fish gear and fish quality • On board fish handling: how it affects the final fish quality, procedures and techniques
	Assumed prior knowledge:	Some students have diploma from the Fisheries Training Institute and may have some knowledge and prior field exposure about the subject. Also, the students have undergone a course unit in fish quality management
	Classroom organisation	The class room will be taught as a whole
	Assessment of student learning	Student learning will be assessed by vigorous interaction and engagement between the students and the lecturer
	Resources	The teaching and learning aids will include: Lecture presentation, pictures, computer, overhead projector, flip charts and markers, copy of PowerPoint as handout and lecture notes.
	ORGANISATION OF LESSON	
	Teacher Activity	**Student Activity**
5 Minutes	**Introduction** Define fishing and fish quality and how important it is in the value chain	• Attentively listening and watching • Asking questions to the teacher for clarification • Answering questions from the teacher during and after the lesson
105 Minutes	**Development** Differences between artisanal and industrial fishing in terms of fish handling Catch method and area and how it affects quality On-board fish handling: how its properly done and its impacts on the quality	
5 Minutes	**Conclusion** Ask if there is anything I can clarify to the students about what has been taught and answer possible questions that might arise	

TOPIC 7: ACOUSTICS

Date	Length of lesson	Course	Topic	Subtopic
---/---/20---	55 minutes	BScFA	Acoustics	General overview and basic physics

Time	Aim	Introduce students to the basic theory of acoustics
	Objectives	At the end of the lesson students should be able to: Define acoustics as used in fisheries management Explain the physics behind the principle of acoustics (waves, pressure and sound)
	Assumed prior knowledge:	Some students have Diploma from the Fisheries Training Institute and may have some knowledge and prior field exposure about the subject.
	Classroom organisation	The class room will be taught as a whole
	Assessment of student learning	Student learning will be assessed by vigorous interaction and engagement between the students and the lecturer and how much they are participating in the calculation exercises
	Resources	The teaching and learning aids will include: Lecture presentation, pictures, computer, overhead projector, flip charts and markers, copy of PowerPoint as handout and lecture notes.
	ORGANISATION OF LESSON	
	Teacher Activity	**Student Activity**
5 Minutes	**Introduction** Introduce students to acoustics science and define what it means	• Attentively listening and watching • Asking questions to the teacher for clarification • Answering questions from the teacher during and after the lesson
45 Minutes	**Development** Explain waves, pressure and sound energy and their applications in acoustics	
5 Minutes	**Conclusion** Ask if there is anything I can clarify to the students about what has been taught	
Homework:		Go and read about Eco sounders

Date	Length of lesson	Course	Topic	Subtopic
--/--/20--	55 minutes	BScFA	Acoustics	Fish finding equipment design and operation

Time	Aim	Introduce students to Eco sounders
	Objectives	**At the end of the lesson students should be able to:** • Explain the theory of Scientific Echo sounders • Explain fish abundance estimation using echo sounders and echo Integration
	Assumed prior knowledge:	Some students have diploma from the Fisheries Training Institute and may have some knowledge and prior field exposure about the subject.
	Classroom organisation	The class room will be taught as a whole
	Assessment of student learning	Student learning will be assessed by vigorous interaction and engagement between the students and the lecturer and how much they are participating I the calculation exercises
	Resources	The teaching and learning aids will include: Lecture presentation, pictures, computer, overhead projector, flip charts and markers, copy of PowerPoint as handout and lecture notes.
	ORGANISATION OF LESSON	
	Teacher Activity	**Student Activity**
5 Minutes **45 Minutes** **5 Minutes**	**Introduction** Introduce students to acoustics science and define what it means **Development** Explain waves, pressure and sound energy and their applications in acoustics **Conclusion** Ask if there is anything I can clarify to the students about what has been taught and answer possible questions asked	• Attentively listening and watching • Asking questions to the teacher for clarification • Answering questions from the teacher during and after the lesson
Homework:		Go and read types of boats used in the fisheries of Uganda

8. NAVAL ARCHITECTURE

Date	Length of lesson	Course	Topic	Subtopic
---/---/20--	115 minutes	BScFA	Naval architecture	Principles of naval architecture

Time	Aim	Introduce students to naval architecture
	Objectives	**At the end of the lesson students should be able to explain:** • Basic theory • The fishing vessel: vessel design, construction and operation
	Assumed prior knowledge:	Some students have diploma from the Fisheries Training Institute and may have some knowledge and prior field exposure about the principles of the topic
	Classroom organisation	The class room will be taught as a whole
	Assessment of student learning	Student learning will be assessed by vigorous interaction and engagement between the students and the lecturer and how much they are participating I the calculation exercises
	Resources	The teaching and learning aids will include: Lecture presentation, pictures, computer, overhead projector, flip charts and markers, copy of PowerPoint as handout and lecture notes.
	ORGANISATION OF LESSON	
	Teacher Activity	**Student Activity**
5 Minutes	**Introduction** Introduce students to naval architecture and give the lecture objectives	• Attentively listening and watching • Asking questions to the teacher for clarification • Answering questions from the teacher during and after the lesson
105 Minutes	**Development** Explain the basic theory and the fishing vessel, its design, construction and operation	
5 Minutes	**Conclusion** Ask if there is anything I can clarify to the students about what has been taught	

DETAILED PRACTICAL PLANS

Date	Length of lesson	Course	Topic
---/---/20---	330 minutes (day 1)	BScFA	Design and construction of a model fishing gear

Time		
	Aim	To introduce students to the practical aspects of gear design and model construction
	Objectives	**At the end of the practical students should be able to:** • Explain the practical factors considered before constructing a gear • Calculations needed for that particular gear to fit design specifications • Identify and name the construction materials • Explain the step by step process of net making • How to build a model fish gear
	Assumed prior knowledge:	Some students have diplomas from the fisheries training institute and may have some knowledge and prior field exposure about the subject
	Practical organisation	The students will be first taught as a whole in the introductory part and later divided into groups of individuals for the hands on practical work.
	Assessment of student learning	Application of skills very well demonstrated as outlined in the practical objectives
	Resources	The teaching and learning aids will include: Lecture presentation, videos, pictures, computer, overhead projector, flip charts and markers, needle for knitting, knives, scissors, twine material, netting material, rope, plastic floats, sinkers, hanging pole, Vernier calliper, ruler
	ORGANISATION OF THE PRACTICAL	
	Teacher Activity	**Student Activity**
20 Minutes	**Introduction** Tell the students the practical aims Tell students what exactly will be done in the practical session, how it will be carried out and the expected outcome	• Attentively listening and watching • Asking and answering questions • Hands on with the practical • Working in groups to figure out the calculations and other net specifications
150 Minutes	**Development** A recap from the classroom lectures about the calculations involved in gear design Introduce students to the materials used in construction of the model gear Ask the students to practically do the necessary calculations for the gear.	
180 minutes	**These will include:** • Mesh size determination • Rope length • Horizontal and vertical hanging ratios • Number of meshes in the T and P directions • Resultant Tex • Twine area • Net and rope weights • Buoyancy and ballast calculations Model construction by the students	

20 minutes	Students will be divided into groups and each group will construct a model of the selected gear **Conclusion** Recap of the day's session- ask each 1 thing they have learnt Talk briefly about what we are going to cover in the next session	

Date	Length of lesson	Course	Topic
---/---/20---	330 minutes (day 2)	BScFA	Net panel cutting, joining, mending, inspection and boat construction

Time	**Aim**	To introduce students to the net mending, joining, cutting and to the practical aspects of boat construction
	Objectives	**At the end of the practical students should be able to:** • Cut, join and mend netting panel • Describe the basics of boat construction and the different parts of a boat
	Assumed prior knowledge:	Some students have diplomas from the fisheries training institute and may have some knowledge and prior field exposure about the subject
	Practical organisation	The students will be first taught as a whole in the introductory part and later divided into groups of individuals for the hands on practical work.
	Assessment of student learning	Application of skills very well demonstrated as outlined in the practical objectives
	Resources	The teaching and learning aids will include: Lecture presentation, videos, pictures, computer, overhead projector, flip charts and markers, needle for knitting, knives, scissors, twine material, netting material, rope, plastic floats, sinkers, hanging pole, Vernier calliper, ruler
	ORGANISATION OF THE PRACTICAL	
	Teacher Activity	**Student Activity**
20 Minutes	**Introduction** Tell the students the practical aims Tell students what exactly will be done in the practical session, how it will be carried out and the expected outcome	• Attentively listening and watching • Asking and answering questions • Hands on with the practical • Working in groups to figure out the different activities on the netting panel
180 Minutes	**Development** A recap from the classroom lectures about netting webbing, materials, cutting ratios and cutting combinations Divide students into groups and assign tasks to them. **These assignments will involve:** • Different cutting ratios and combinations • Joining of net panels in the both the T and P directions • Mending of nets with holes and damages	
150 minutes	Recap on class room lectures about naval architecture	

20 minutes	• Practical aspects of boat construction and design **Conclusion** Recap of the day's sessions- ask sample questions to assess whether the students thing they have learnt Give them the outline and expectations from the practical report they have to write as part of the assignment	

APPENDIX 4: SCHEMES AND RECORDS OF WORK TEMPLATE

Number of periods:	Semester:	Academic year:	Approved by:
45 CH	2	20-----/20----	

Week	Work planned	Delivery Methods/ strategies	Accomplishments	Remarks/comments
1	Fishing gear and techniques	Lecture Demonstrations Videos		
2, 3 and 4	Design and construction of fishing gear	Lecture Demonstration Videos Practice (calculation exercises)		
5	Fishing gear selectivity	Lecture		
6	Fish behaviour	Lecture Visual aids like pictures		
7	Environmental impacts of fishing gear	Lecture Demonstration Videos		
8	Fishing methods and fish quality	Lecture Demonstration Videos		
9	Acoustics	Lecture Demonstration Videos, still pictures		
10	Naval architecture	Lecture Demonstration and videos		
11	Fishing gear research and development	Lecture Visual aids like pictures		
12	Field practical (FTI)	Hands on practical exercises Demonstration Interviewing		
13	Landing site visit	Hands on practical exercises Observation and Interviewing		
14	Net making company visit	Observation Interviewing		
15	Preparation for the end of semester examinations			

SYLLABUS SUPPLEMENT

The Syllabus Supplement must be read in conjunction with the syllabus document. It contains well prepared lecture notes for the topics and practical to assist teachers delivering the syllabus and can be modified as required. This syllabus supplement consists of two sections.

1. Prepared lecture presentations of the topics contained in the whole syllabus. The presentations are not attached to this document but they have been prepared by the fellow and approved by the supervisors. They consist of a total of 13 presentations from the different topics and 415 slides

2. Design and model construction of a drift gill net used for Nile perch fishery on Lake Victoria. This will be used as an effective teaching tool and will form the basis of classroom demonstrations as well as practical sessions at FTI.

APPENDIX 5: DESIGN AND MODEL CONSTRUCTION OF A DRIFT GILL NET USED FOR NILE PERCH FISHERY ON LAKE VICTORIA

As part of the practical part of the syllabus, a model of a standard gill net was designed by the fellow. This will be used as an effective teaching tool and will form the basis of classroom demonstrations as well as practical sessions at FTI. It will help students understand the classroom theory and also get the much needed hands on experience. The model developed was based on data provided by NaFIRRI (table below) about gillnet fishery of Nile Perch from Lake Victoria. A model of a drift gillnet was chosen for construction because it's the commonest type of gillnet setting used in the fishery (Msuku *et al.*, 2011). The design developed can also be adopted for use in different species in regard to the specific regulations of the fishery. The designs were done using the latest fish gear design software known as Design CAD 3D 2016 and the model was constructed at the net loft in Isafjordhur, Iceland.

Specifications of the model gillnets to be constructed

Specifications	
Mesh sizes(mm)	180
Twine type	Polyamide multifilament (nylon)
Twine netting specifications	210D*2*3
Twine diameter(mm)	0.5
Number of meshes in-depth	78
Horizontal stretch length (m)	90
Number of meshes horizontally	500
Horizontal hanging ratio (E1)	0.5
Hung length /Rope length (m)	45
Hung depth (m)/ Rope length	12
Head rope material	Polyamide
Head rope diameter(mm)	9
Float materials	PVC/plastic
Float weight (gf)	255
Float dimension (mm)	158
Number of floats per unit	9
Footrope material	Polyamide
Footrope diameter (mm)	9
Sinker weight (g)	225
Sinker material	Sandstone
Number of sinkers per unit	5

Calculations

1. Calculate the rope length given that the:
   Stretched net length = 90m
   $E_1 = 0.5$

$$E_1 = \frac{\text{Line length}}{\text{Stretched net length (\# of meshes x mesh size)}}$$

$$0.5 = \frac{\text{Line length}}{90\text{m}}$$

Line/rope length = 45metres

2. Number of meshes in the horizontal direction

$$E_1 = \frac{\text{Line length}}{\text{Stretched net length (\# of meshes x mesh size)}}$$

E1 = 0.5
Rope length = 45m
Mesh size = 180mm
Number of meshes =?

From the formula,

$$0.5 = \frac{45}{0.18\text{m} \times \text{Number of meshes}}$$

Number of meshes in the T- Direction = 500

3. Calculation of resultant tex

Rtex PA = 210D
Twine rope specification = 210D x 2 x3

$$\text{Convert Denier to Tex Scale} = 210\text{D} \times \frac{1000\text{Tex}}{9000\text{D}} = 23\text{Tex}$$

23x2x3 = 138Tex

From Prado, we have to add 10% to correct for the structure of the finished twine

10% x 138 = 13.8 + 138 = 152tex

This means that 1000m of the PA twine weighs 152g

4. Calculate the twine area

$$A = \frac{(N+M)}{2} \times H \times 4 \times a \times d \times 10^{-6}$$

$$A = \frac{500+500}{2} \times 78 \times 4 \times 90 \times 0.5 \times 10^{-6}$$

Twine Area (A) = 7.02 M^2

5. Total weight of the net

1000m of PA weighs 152g

1m = 0.152g/m

From the twine area calculation = 14040m

14040m x 0.152g = 2.1kg

Each net twine area weighs 2.1kgs

Each fleet has on average 60 nets and the fishermen carry an average of 2 fleets on their boats. This therefore means that they carry a total weight of

120 x 2.1kg = 252 kg of twine area on a boat of 8metres

6. Calculation of the rope weight

Number: Rope 2
Length: 45m each
Diameter: 9mm

From the factory specifications, 100m of a PA nylon rope of 9mm weighs 4kg
If 100 m weigh 4kg
1metre will weigh 0.04kg
45m of the rope will weigh 45 x 0.04kg = 1.8kg

Since there are 2 ropes, 1.8kg x 2 = 3.6kg

This means that both ropes on the net weigh a total of 3.6kg

7. Calculation of whether the twine diameter is proportional to the mesh size chosen:

This calculation is important is important to determine how strong your net is going to be in the water, it differs between calm and rough waters as wells as between low catches and higher catches.

$$\text{The ratio} = \frac{\text{Twine diameter}}{\text{Stretched mesh size}}$$

$$\frac{0.5\text{mm}}{180\text{mm}}$$

= 0.0027

Since the net is going to be used in Lake Victoria which is calm and low catches, the ratio given by Prado is 0.0025 which is with the margin of error of our net which is 0,0027 so we can safely conclude that the mesh size and diameter are appropriate.

8. Buoyancy and ballast calculations

a) Buoyancy

1 float (PVC) = 255gf spread 5 meters apart

If 1 float occupies 5 meters

9 floats will occupy 45m

Therefore, there are 9 floats each weighing 255gf on a 45m rope

Total buoyancy is therefore 255gf x 9floats = 2300gf OR 2.3kgf

b) Ballast

The ratio of buoyancy to ballast in midwater drifting nets should be 2, this means that the buoyancy force should be 2 times the ballast force in order to allow the net float in water

Therefore, to calculate the ballast, we divide the buoyancy by 2

$$\text{Ballast} = \frac{2300\text{gf}}{2} = 1150\text{g of ballast required}$$

Since 1 sinker weighs 225g
1150g will be the weight of 5 sinkers
Therefore, there are 5 sinkers each weighing 225g on a 45m rope

Total ballast is therefore 255g x 5sinkers = 1150g OR 1.15kg

Weight in freshwater of the rigged gillnet

Component	Weight in air (Kg)	Weight in fresh water (multiply by a factor for freshwater)
Rope 2 x 45m, 9mm	3.6	0.432
Netting	2.1	0.252
Floats	2.3	-6.9
Sinkers	1.15	0.6325
Total	**6.586**	**-5.5835**

-5.5835 means that the type of net we have made is a mid-water drifting gillnet with a floating force of **-5.5835**

Construction of a model gill net

The model gillnet was aimed at producing a good representation of the gillnet specifications for demonstration to the students. In order to improve the understanding and practical skills of the students, it would be beneficial to incorporate gillnet/gear model designing in the new syllabus.

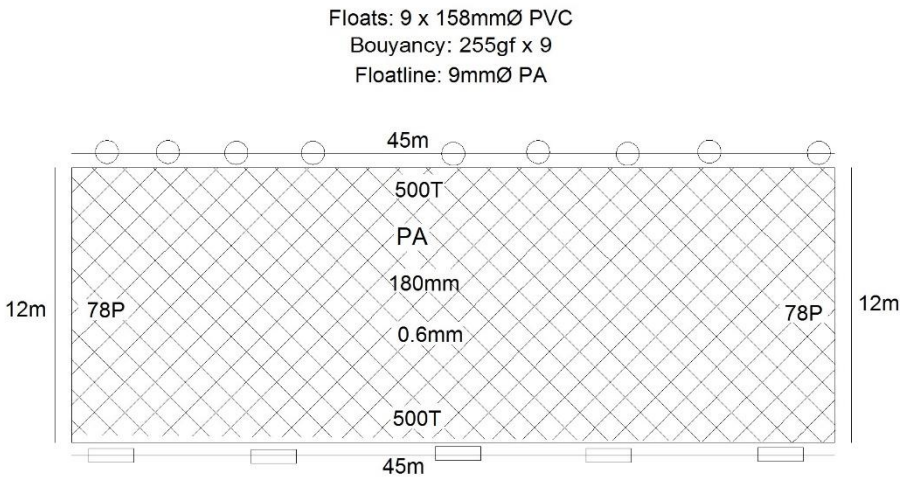
The model design and construction was extracted from the calculations of the gear design and will be a basis for the practical training part of the new syllabus. It will be done by the students themselves with guidance and supervision from the lecturer (the fellow). After this practical, the student should be able to design, construct and build a model for any other gear used in the fisheries of Uganda. The gillnet was chosen for this exercise because it's the most common gear used in Uganda.

Scaling down the model

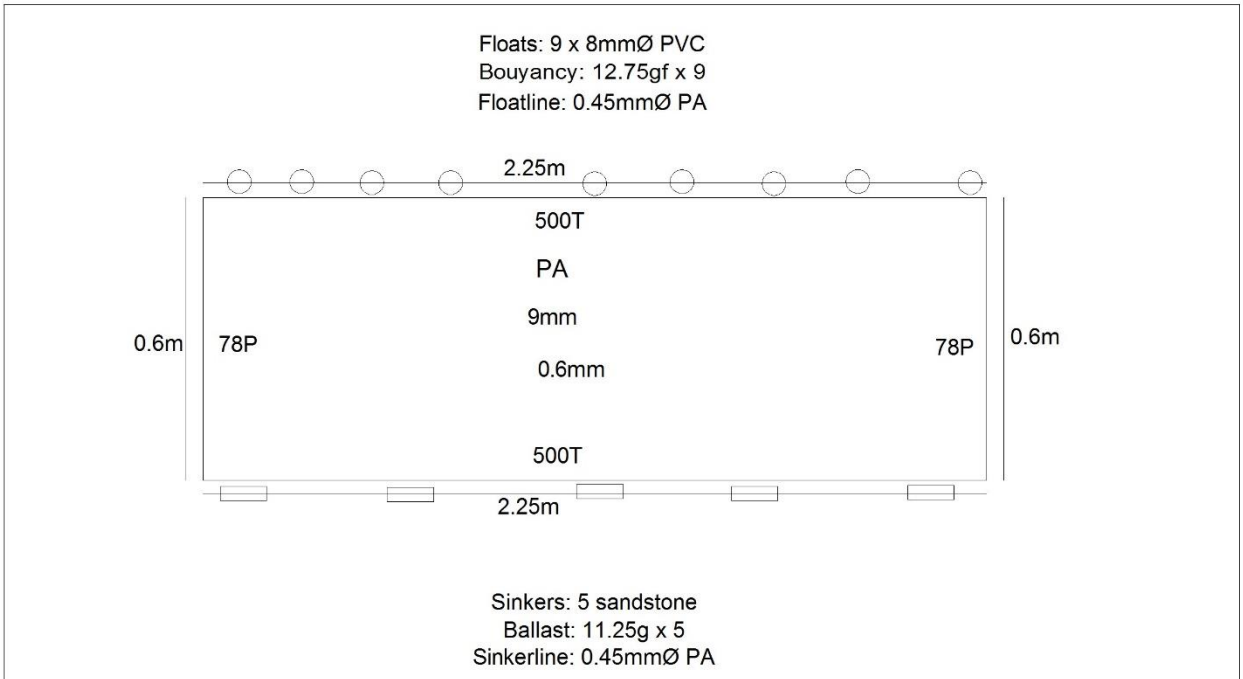
In order for the model to be small, portable and usable for demonstrations, the horizontal rope lengths, mesh size, the floats and sinkers, the vertical depth and were scaled down by a factor of 20. This was from the dimensions used for drawing the net in the design software Design CAD 3D Max 2016.

The model gillnet dimensions after scaling down were as follows.

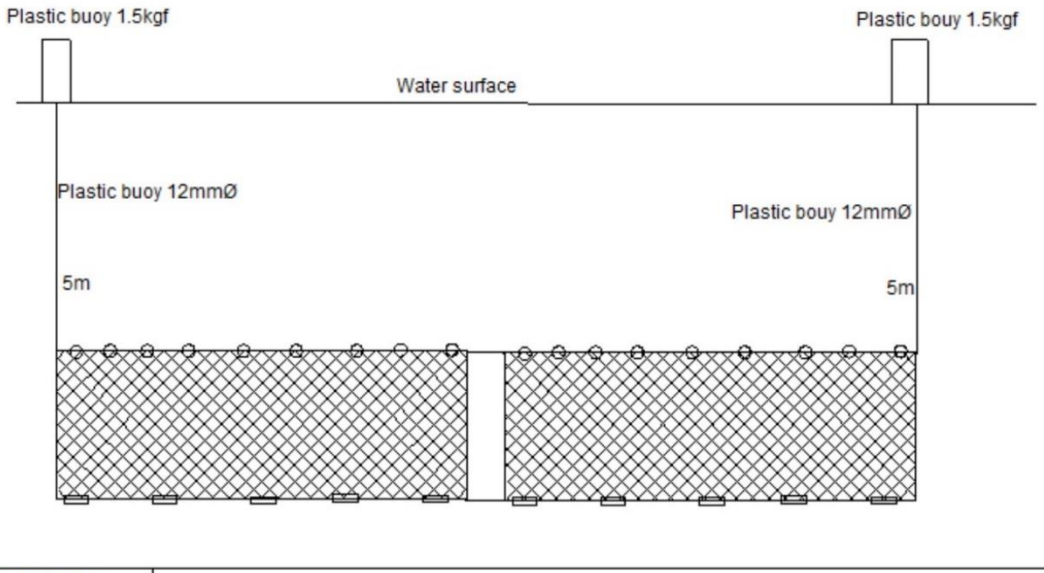
Specifications	Dimension	Scale down factor	New dimensions for model
Rope length	45m	20	2.25m
Floats	158mm	20	8mm
Vertical depth	12m	20	0.6m
Mesh size	180mm	20	9mm



United Nations Fisheries Training Programme P.o Box, 1390, Skulagata 4, Reykjavik, Iceland	Title: Stardand drift gill net used for Nile Perch fishery on Lake Victoria	
	Boat type: Sesse flat at one end, Length overall = 8m, Horse Power = 15-25	
	Drawn by: D. Ssempijja UNU-FTP Fellow, 2017	Date: 12th-02-2017
	Checked by: Einar Hreinsson	



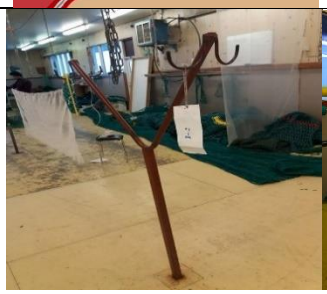
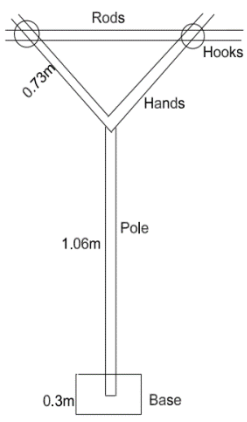
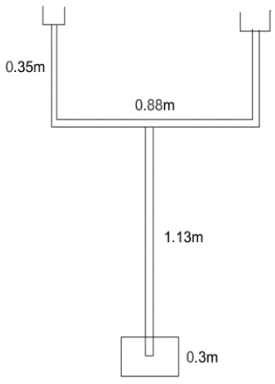
United Nations Fisheries Training Programme P.o Box, 1390, Skulagata 4, Reykjavik, Iceland	Title: Model construction of a stardand drift gill net used for Nile Perch fishery on Lake Victoria Scale down factor: 1:20	
	Drawn by: D. Ssempijja UNU-FTP Fellow, 2017	Date: 12th-02-2017
	Checked by: Einar Hreinsson	



United Nations Fisheries Training Programme P.O BOX 1390, Skulagata, 4 Reykjavik, Iceland	Title: Set drift gillnet	
	Drawn by: D. Ssempijja	12th-02-2017
	Checked by: Einar Hreinsson	

The United Nations University
FISHERIES TRAINING PROGRAMME

PRACTICAL MATERIAL AND GEAR COMPONENTS

Material	Description and use	Image/ picture
Netting panel	Finished product from the twine material. Basic component of any net based fishing gear	 
Needles	Used in mending, joining and net making operations	 
Knife and scissors	Mainly used in cutting and general net repair operation	 
Hanging pole	Used in general net repairs to hung the net in an upright position making it easy to be worked on.	   

This paper should be cited as:
Ssempiia, D. 2018. *Syllabus in fishing technology for Makerere University students.* Nations University Fisheries Training Programme, Iceland [final project]. http://www.unuftp.is/static/fellows/document/drake16prf.pdf

Ropes	Form part of the gear as float and sinker lines, as bridles in trawling and purse seining	 
Sinkers (rubbers and lead)	Helps the gear open during a fishing operation. Attached on the fishing line. Responsible for ballast	 
Floats (rubber and plastic)	Helps the gear open during a fishing operation. Attached on the float line. Responsible for buoyancy	 
Vernier calliper	Determination of twine diameter and mesh size of a netting panel	
Ruler	Used to determine the stretched mesh size