MAKERERE UNIVERSITY

FACULTY OF TECHNOLOGY

DEPARTMENT OF MECHANICAL ENGINEERING

PROGRAM
FOR
MASTER OF SCIENCE
IN TECHNOLOGY INNOVATION AND INDUSTRIAL DEVELOPMENT

DECEMBER 2010

EXECUTIVE SUMMARY

Uganda, like many developing countries, experiences a net "brain drain" due to highly educated people pursuing better paid and more interesting careers abroad. By offering an education in close collaboration with the industry and with a strong focus on technology innovation and business development, it should be possible to create more interesting jobs for some of the graduates, thereby reducing the net outflow of competence. At the same time there is an outcry from the local industry for trained engineers with an entrepreneurial outlook. Indeed, many local and foreign industries have had no choice but to employ foreign nationals with such skilled resources.

The Faculty of Technology, Makerere University therefore, has designed this graduate programme in Technology Innovation and Industrial Development to bridge this gap. Initially, it is to be run in collaboration with the Norwegian University of Science and Technology's Department of Industrial Economics and Technology Management. The two institutions applied and received a grant of 4,500,000 Norwegian Kroner from the Norwegian Government to facilitate this collaboration for four years. The M.Sc. in Technology Innovation and Industrial Development aims at developing the capacity of the graduates to identify opportunities for technological innovation and offer specialized knowledge and skills for implementation of innovation and commercialization projects in industry.

The purposes of this programme are to:

1) Establish, develop and maintain strong problem-solving and research-based links between university and industry.
2) Develop graduates who have a strong foundation in technology as well as business management, with special emphasis on product, service and process innovations.
3) Produce graduates with an innovation oriented mindset
4) Develop the capacity of graduate engineers in utilizing technology to accelerate entrepreneurship and intra-preneurship
5) Facilitate industry's access to potential innovative solutions to their problems through projects and research undertaken at the university.
6) Create a framework for joint business ventures between university, public institutions and industry.

The program will admit at least 50% of the students from industry that, by following a structured set of courses, industrial-based projects and theses, will attain knowledge,

skills and experiences needed to help industry become more competitive, better at adding value through improved products and services.

The programme duration is two years comprising of two semesters of taught courses, followed by one semester of both taught courses and industry-based project work and then a fourth semester devoted to research work leading to a dissertation. The course is designed in such away that it will follow both Plan A and Plan B is per the Graduate hand book 2009.

The main taught (core) courses will include: Technology Innovation and Research and Development Principles, Engineering Economics, Strategic Management, Logistics Engineering, Engineering Project Management and Quality Management. Students will also study Venture Business Strategy, Value Engineering, Process Improvement as well as Safety, Health and Environment Management. These will provide the fundamental theories, principles and practical ways that employees need to create and run dynamic and growth-oriented industrial businesses the world over. The programme will also offer elective courses tailored to the needs of Ugandan industry. These will be aligned to engineering project-based activities like construction, maintenance and new product launching as well as manufacturing industry.

In order to ensure the industry-based focus of the course, a programme advisory board composed of the leadership of the Faculty of Technology and a number of prominent entrepreneurs from industry, will be constituted. This group will ensure that the collaboration between the university and industry is developed, and used, to provide students opportunity to work on real-life problems faced by industry.

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ACRONYMS

CU: Credit Units

ERB: Engineers Registration Board

FEMA: Faculty of Economics and Management

FOT: Faculty of Technology

M.Sc. TIID: Masters of Science in Technology Innovation and Industrial Development

MSEs: Micro and Small Enterprises

MTTI: Ministry of Tourism, Trade and Industry

NTNU: Norwegian University of Science and Technology

PSFU: Private Sector Foundation Uganda

UACE: Uganda Association of Consulting Engineers

UIPE: Uganda Institute of Professional Engineers

UIRI: Uganda Industrial Research Institute

UMA: Uganda Manufacturers Association

UNBS: Uganda National Bureau of Standards

UNRA: Uganda National Roads Authority

1.0 INTRODUCTION

1.1 BACKGROUND

The Faculty of Technology has been running graduate programmes since 1996. Currently, the master's degree programmes being offered include; both Master of Engineering and Master of Science in each of the fields of Mechanical Engineering, Electrical Engineering and Civil Engineering. There are also more specialized programmes of Master of Architecture, Master of Physical Planning and Master of Science in Renewable Energy. The graduates from these programmes are employed at the top levels of the professional department of government, established companies and agencies. While these programmes deliver the graduates as planned, a major gap has been identified in the area of innovation and industrial development. Global changes, liberalization of economies and opening of trade barriers now call for engineers who can take industrial organizations to a higher level. This is particularly so for a growing economy like Uganda. The country aspires to eradicate poverty principally by exploiting her immense natural resources through rapid industrialization.

The country's agricultural and mineral output has continued to be exported in raw form. This has to be stopped. The President of Uganda, His Excellency Yoweri K Museveni, has on numerous occasions admonished Ugandans to add value to their products before exporting or selling them. This strategy requires that today's graduates are equipped with the right knowledge and skills to enable them come up with means to do so and that Ugandan industries be more innovative and entrepreneurial than they are. The Faculty of Technology has followed the path taken by many internationally renowned universities by offering a programme where students, at the graduate level, are taught the relevant theories, principles and methodologies. Such training is accompanied with challenging problems from the industries where the trainees are employed or new business possibilities are developed. The Master of Science in Technology Innovation and Industrial Development (M. Sc. TIID) is the answer, this can be realized not only to help Ugandans come up with new business ventures but also be able to sustain those industrial ventures.

According to the Global Entrepreneurship Monitor 2004, over one in three adult Ugandans is engaged in some form of entrepreneurial activity, resulting in Uganda being the second most entrepreneurial country in the world. However, the study also showed that the rate of failure of businesses in Uganda was one of the highest in the world, citing that for every business that was started nearly one other closed. Mostly, these are micro and small enterprises (MSEs). The major causes of failure are lack of entrepreneurial skills, lack of access to affordable business development services, limited access to finance, lack of adequate technical and management support services,

limited access to information on market opportunities and limited access to financing - as well as the high cost of financing.

Although there are currently several undergraduate, graduate and even PhD programmes in Makerere University that address many aspects of the country's capacity needs, the M.Sc. TIID programme will focus on aspects of innovation, technology transfer and industrial development as well as supplement these existing programmes. This will make it possible to offer a more comprehensive capacity building effort necessary for Uganda's industrialization.

1.2 TITLE

The title of the programme is: "**Master of Science in Technology Innovation and Industrial Development (M.Sc. TIID)**"

2.0 THE PROGRAMME

The M.Sc. TIID programme is a new programme in the Faculty of Technology. The programme has been developed by key personnel that have extensive experience in different projects and programmes financed by NORAD and other Agencies. Following several years of collaboration between the Faculty of Technology and the Norwegian University of Science and Technology, a team was established to spearhead the establishment of the M.Sc. TIID. Thus, the programme will initially be run in collaboration with the Norwegian University of Science and Technology's Department of Industrial Economics and Technology Management. The two institutions applied and received a grant of 4,500,000 Norwegian Kroner to facilitate this collaboration for four years within the NORAD Master Studies Programme (NOMA).

The Norwegian University of Science and Technology's Department of Industrial Economics and Technology Management has several programmes in related fields. The Master of Industrial Economics and Technology Management is considered very successful, based on criteria like the number of applications, academic ranking and industrial attractiveness. In addition, the International Master of Project Management has become the second largest international master's degree programme at the university with students applying from all over the world. The Faculty of Technology has drawn experiences from this programme and contextualized it to the Ugandan situation. This was possible by drawing on experiences and collaboration with Ugandan industry through the various professional organizations like the Uganda Institution of Professional Engineers, the Uganda Association of Architects, the Uganda National Association of Building and Civil Engineering Contractors, the Uganda Manufacturers Association and the Uganda Small Scale Industries Association.

2.1.1 PROGRAMME OBJECTIVES

This programme is in line with the Makerere University mission which is; "**To provide innovative teaching, learning, research and services responsive to national and global needs**", the main aim of the Master of Science in Technology Innovation and Industrial Development is:

> **To enhance the national capacity for academia and industry to innovate and improve national competitiveness by offering specialized knowledge and skills for implementation of innovation and commercialization projects in industry.**

In addition, the programme aims at developing the necessary capacity for the national goal of rapid industrialization of the country's economy and modernization.

The specific objectives of the programme are:

i. To enhance cooperation between the university, Government and the industrial sector in the country by addressing the challenges faced by industry through training employees from industry, carrying out relevant research projects and sharing expertise, capacities and competence for the benefit of stimulating innovation in industry.
ii. To provide students with knowledge in industrial development, innovations and running of organizations in an efficient and effective way.
iii. To train students in product research and development, and project management methodologies.
iv. To produce graduates who have the technical and analytical expertise and the keen understanding of the business environment needed to succeed in entrepreneurial activities.
v. To enhance capacity of engineering graduates to offer expert professional services in the form of consultancy to industries.

2.1.2 MODE OF LEARNING AND TEACHING

The programme will be conducted through lectures, industrial visits, assignments, seminars, project work and research.

2.1.3 SUPERVISION DURING COURSE AND FIELD WORK/FIELD ATTACHEMENT

Studies in each course will be guided by a senior member of academic staff supervised by a Course coordinator overseen by the Head of Department.

The thesis or project fieldwork will be guided by a supervisor assigned to each student. Where the work involves working with industry, an advisory committee including academia and industry will supervise the work. Oversight on the course will be by the Faculty Research and Graduate Studies Committee.

2.1.4 PROGRAMME IMPLEMENTATION

The M.Sc. TIID Program is to be based on 2 plans, Plan A and Plan B, as follows;

Plan A: Coursework and Dissertation

Plan B: Extended Coursework and Project Report

For any student to graduate in this Programme, the following requirements will have to be fulfilled;

i. A student's progression under Plan A is dependent on whether he/she has a Research Proposal by second week of the 3rd Semester.
ii. A student's progression under Plan B is dependent on whether he/she has project Proposal by second week of the 4th Semester.

iii. The Pass Mark for all Courses shall be 60%.
iv. Credited Entrepreneurship Seminar Series conducted by students are mandatory.
v. All Coursework for this Programmes are examined externally.
vi. The Title of the Thesis/Dissertation/Project Report appears on the Academic Transcript with respective grades indicated.
vii. The Dissertation is in Partial Fulfillment of the Degree.

2.1.4.1 PLAN A: COURSE WORK AND DISSERTATION

i. A student on this Plan must complete an approved program of Coursework consisting of a minimum of 18 Credit Units during the year.
ii. A student must submit a Dissertation.
iii. A Thesis/Dissertation carries a credit 15Credit Units per Semester. External examination of Thesis/Dissertation is mandatory.
iv. Entrepreneurship Seminar Series are mandatory for all registered students.
v. Departments will select topics for students and that a student is required to make presentations during the Seminars Series.
vi. The minimum Graduation load is 60 Credit Units.

2.1.4.2 PLAN B: COURSE WORK AND PROJECT (FIELD) REPORT

i. A student on Plan B must complete an approved programme of Coursework that constitutes 75% of the entire workload for the Degree.
ii. A student must submit a Report on a supervised Short Project/Field Attachment/Industrial Training carried out.
iii. The Project/Field Report should involve a combined total of 450 hours (equivalent to 8 weeks of full time work) and carries 15 Credit Units (CU).
iv. Entrepreneurship Seminar Series are mandatory for all registered students and are conducted every Semester of the second year. The Entrepreneurship Seminar Series have 2 Credit Units per Semester.
v. External examinations of Projects/Reports are mandatory

2.2 LEARNINNG OUTCOMES /PROFILE OF M.Sc. TIID GRADUATE

- The M.Sc. TIID graduate will on top of executing all the engineering work, be able to have other skills making him/her interdisciplinary since they will have been taught entrepreneurship, logistics, strategic management and other courses which are not taught to other engineering masters discipline.
- The M.Sc. TIID graduate will be having an intra-preneurial mindset by seeing things differently from the rest of the employees by being creative and

innovative, this due to the fact that they will be exposed to real industrial problems to provide a solution, and their exposure to the best in the industry like business men, entrepreneurs and managers makes them unique.

- The M.Sc. TIID graduate will be able to take calculated risks with their jobs with "I can do spirit" thus revitalizing their jobs, this is due to the fact that such scenarios may have been found in the seminar series they participate in.
- The M.Sc. TIID graduate will be able to come up with new processes that get the products to the market. Unlike other engineers who are only maintaining systems in an established organizations, these graduates will be able to come up with new and better processes that increase the competitiveness of the company.
- The M.Sc. TIID graduate will use innovative approaches to become more efficient and effective in production and sales, this is due to the entrepreneurial spirit honed in the line of study.
- The M.Sc. TIID graduate will Increase the speed and cost-effectiveness of technology transfer from R&D to the market place in record time since he/she will be contented with product design and development.

The career development opportunities for the graduates of M. Sc. TIID are;

i. Engineer/Start up their professional careers and establish their own businesses, work as business advisors in industries, manage new ventures, companies and organizations at both national and international level.
ii. Work in research and development, design or manufacturing organizations.
iii. Thrive in a small startup company or large industrial complex.
iv. Balance marketing demands with product feasibility and ethical considerations.
v. Apply the focus points of managerial analysis

The following are some of positions the graduates will aspire to hold:
Technology and Innovation Consultants, Engineering Team Leaders, Optimization Engineers, Business Development Consultants, Business Analyst, Product/Process Project Engineer and Entrepreneurs

3.0 JUSTIFICATION OF THE MASTERS' PROGRAMME

The Faculty of Technology has been running graduate programmes since 1996. Currently, the master's degree programmes being offered include; both Master of Engineering and Master of Science in each of the fields of Mechanical Engineering, Electrical Engineering and Civil Engineering. There are also more specialized programmes of Master of Architecture, Master of Physical Planning and Master of Science in Renewable Energy. The graduates from these programmes are employed at the top levels of the professional department of government, established companies and agencies. While these programmes deliver the graduates as planned, a major gap has been identified in the area of innovation and industrial development.

The gap can be justifiable by the following; in terms of a comparison between the current M. Eng., M.Sc. and M.Sc. TIID

- The M. Eng. provides refresher knowledge to engineers from industry to update them with modern engineering practices while the M. Sc. Eng. provides a deeper understanding of subjects in a discipline of engineering and is usually for those graduates who want to pursue a career in academia and for research. The graduates of current M.Sc. /M. Eng. programmes will improve their performances in their respective disciplines because of the acquired knowledge and skills. The course structure of the M.Sc. Eng. Degrees in the Faculty of Technology is given in Annex IV.

The case for the M. Sc. TIID

At some point an entrepreneurial venture reaches a point of being an established business. While reaching this point is an achievement a real concern for most businesses is that somehow becoming an established business means that the entrepreneurial spirit has been lost. Dynamic corporations should simultaneously be trying alternative ways of doing things in competition within themselves. This has given rise to what has been called "intra-preneurship" with an intra-preneur being defined as a person within a large organization who takes direct responsibility for turning an idea into a profitable finished product through assertive risk taking and innovation.

Developing countries have not industrialized and are not competitive because there is little innovation within the organizations. Human resource is deployed usually in a straight jacket manner; an engineer is production and maintenance, while an accountant exclusively deals with accounting records and books. Over 90% of workers have an employee mindset. What is needed are intra-preneurs who can increase the speed and cost effectiveness of technology transfer from R&D to market place.

The relentless pressures stemming from globalization, technological changes etc, today are increasingly buffeting organizations. One of the pathways for companies to weather these storms is through unleashing the entrepreneurial spirit latent in its employees to curve out new passages, initiate new ventures, defy the status quo in these organizations and break fresh ground. Unleashing entrepreneurial energy in large organizations, corporate entrepreneurship or intra-preneurship, is a major driver for organizational renewal or reinvention. What is needed is the intra-preneurial mindset as opposed to an employee mindset. The M.Sc. TIID intends to produce engineers with an intra-preneurial mindset so that they will become leaders of innovation groups.

3.1 RELEVANCE OF THE M.Sc. TIID PROGRAMME

The M.Sc. TIID programme has been developed to create increased societal value along two vectors; equipping students with a science and technology background with higher level technology and business management problem-solving capacity, and enhancing research-driven collaboration between the university and industry. In so doing, the programme addresses one of the most critical needs identified in Uganda's industrialization policy; namely: Section 4.2.7 clause (ii) "**Establishment and strengthening entrepreneurship development institutes with a view to nurturing business culture, mentoring innovation and entrepreneurship spirits, especially concerning new products and services.**"

By introducing a graduate programme for graduates and industrial participants with a technological background, the programme plans to create something new and valuable for society. It will help the students and faculty spearhead efforts to develop new products, services and industrial processes while at the same time know how to manage such work and maximize the value of the outcomes.

The Master programme is mainly relevant for;

i. Educating graduates that can help industry and society achieve better competitiveness and increased value creation.
ii. Creating a framework for collaboration between students, faculty and industry
iii. Strengthening the ties between industry, Government and the University
iv. Imparting the necessary skills to enable graduates to start and manage projects of an innovative nature, including skills in planning and executing new projects and start-ups.
v. Creating a core of competent and qualified staff in the Faculty.

Industry and Universities in Uganda do not have a strong history of collaboration. This situation is not desirable, from either's point of view. This Masters programme, with it's

focus on innovation and development, mix of regular students and participants from industry, use of industry focused projects and team work and the establishment of formalized ties between industry and University, is designed to increase the collaboration and the associated value addition for both parties. This will enhance the staff's ability to teach relevant subjects as well as creating a better foundation for doing industrial research and knowledge dissemination in companies and/or organizations.

3.2 UNIQUENESS OF THE MASTERS PROGRAMME

- Unlike other programmes run at the Faculty of Technology, and possibly the whole university, this programme aims to have a closer partnership between university and industry. Several activities will be conducted in close collaboration with industry; making it unique.
- Several courses will utilize guest lecturers from industry, especially entrepreneurs and those engaged in research and development. Students will be assigned topical industrial problems in the practical sessions and a one-half semester session will be devoted to industry-based student group projects. Solutions to these problems that will be arrived at from application of scientific principles taught in the courses will be made available to industry through students reports.
- Industry will thus have an opportunity to try out some of the solutions provided thus building confidence in the partnership and providing them with state-of-the-art analysis of their situations and problems.

In order to ensure this industry focus, a programme advisory board composed of the leadership of the Faculty of Technology and a number of prominent entrepreneurs from industry, will be constituted. This group will ensure that the collaboration between the University and industry is developed, and used, to provide students opportunity to work on real-life problems faced by industry.

- In addition, unlike other programmes where in-take is undertaken every year, this programme aims at completely finalizing a group for the two years, and then another cohort is admitted. This is done to enable lecturers concentrate on the group fully and enable the transfer of skills from the academia to the industry without being overloaded by courses for another in-take.

3.3 GENDER ASPECTS

Uganda has been actively promoting gender balance. Makerere University has a strong affirmative policy. The current female enrollment at graduate level at Faculty of Technology is about 10% compared to 30% and increasing at undergraduate levels.

This programme will specifically target female candidates with a view to increasing the percentage to 25%.

3.4 PREPARATORY ACTIVITIES

The following preparatory activities were undertaken:

- Consulting stakeholders (Uganda Manufacturers Association, Ministry of Tourism, Trade and Industry (MTTI), Uganda Institution of Professional Engineers. (UIPE), Engineers Registration Board (ERB), Uganda Association of Consulting Engineers (UACE), Private Sector Foundation Uganda (PSFU), Uganda National Bureau of Standards (UNBS), Uganda Industrial Research Institute (UIRI), Uganda National Road Agency (UNRA), among others.
- Two M.Sc. students from Norway University of Science and technology (NTNU) did research on the possibility of success of the M.Sc. TIID. (The recommendations are given in Appendix III.
- One day workshop to consult the stakeholders from industries on how the graduates of the M. Sc. TIID would impact on their industries, (the minutes of the workshop in appendix)
- Correspondences from NTNU, UNRA, UACE, UNBS, and UIPE (see Appendix III)
- Two staff from Faculty of Technology travelled to NTNU where they met the 10 professors proposed as visiting Professors and were introduced to the masters programmes which integrate engineering, innovation and management and did some literature search and were able to obtain some 200 books on CD.
- The Proposal was taken through the Faculty of Technology Higher Degree and Research Committee twice.
- Have agreed in principle to collaborate with the Faculty of Economics and management (FEMA).

3.5 PROGRAMME SCHEDULE

The Masters' of Science in Technology Innovation and Industrial Development is the first of its kind in Makerere University with a unique curriculum designed with the support of the Norwegian University of Science and Technology; the programme however has similar core objectives and aims just like other masters' programmes currently being offered by the Faculty of Technology. It focuses on in-depth teaching of the theoretical work, practical work and field studies and research like the other degree

programs being offered. However, much of the emphasis is being put in the field of innovation and product/process development.

At the start, there will be collaboration with industries to recruit the first group of students. At the same time, lecturers will travel to Norway for 2 weeks for course material preparation, and Norwegian academic staffs come to Uganda as a means of transfer of necessary knowledge to the local staff. Courses will be taught by existing specialized lecturers within the Faculty backed up by visiting professors from Norway. The allowances and travel expenses will be catered for by the allocated project fund from NORAD up to end of 2014. The allocated funds will also offer ten scholarships to students in the first cohort beginning in 2011 and fifteen scholarships in the second cohort beginning in 2012. This will fully cover their tuition fees, stipend and all other learning related expenses.

It is planned that by 2014, the program should be sustainable both in terms of finances and human resource. Opportunities for training academic staff at PhD level in areas of specializations under this programme are being earmarked.

The Faculty staff members coordinating this programme are working hard to get this plan moving on schedule. Also, because of the programme's unique structure/design and its relevant curriculum, it provides the Faculty the opportunity of attracting a sizeable number of private students over time from industries and other organizations.

4.0 ENTRY REQUIREMENTS

4.1 TARGET GROUP

The programme is targeted at graduates coming from industry or having extensive industrial background. The rest of the students are to be recruited from among fresh graduates at the Faculty of Technology and related Faculties. All students must have a bachelors degree or higher within a technology related field like Mechanical Engineering, Electrical Engineering, Civil Engineering, Agricultural Engineering, Telecommunication Engineering, Computer Engineering, Computer Science, Food Science And Technology, Construction, Industrial Chemistry, Manufacturing, Mining etc.

4.2 ADMISSION REQUIREMENTS

To qualify for admission for M.Sc. TIID, the candidate must hold a Bachelor's degree in engineering of second class lower division and above in a scientific or technological field, Mechanical Engineering, Electrical Engineering, Civil Engineering, Agricultural Engineering, Telecommunication Engineering, Computer Engineering, Computer Science, Food Science And Technology, Construction, Industrial Chemistry, Manufacturing, Mining. All other admission requirements and regulations of Makerere University shall apply.

5.0 PROGRAMME STRUCTURE AND DETAILED COURSE CONTENT

5.1 PROPOSED PROGRAM STRUCTURE

The M. Sc. TIID programme just like the other programmes in Makerere will be run on semester system. The Tables below outline the courses and their loading to be offered in the programme.

PLAN A PROGRAMME STRUCTURE

Table 1: SEMESTER 1

Semester 1	code	Course name	LH	PH	TH	CH	CU	Type of Course
Core courses	TID7101	Technology Innovation and R&D Principles	45	30	0	60	4	Core
	TID7105	Information Technology Systems	45	30	0	60	4	Core
	TID7103	Strategic Management	45	30	0	60	4	Core
	TID7104	Advanced Research Methods for Science and Engineering	45	30	0	60	4	Core
Elective courses (Choose One)	TID7102	Engineering Economics	45	30	0	60	4	Elective
	TID8101	Process Improvement & Maintenance engineering	45	30	0	60	4	Elective
	TID8104	Life-cycle Analysis and Sustainability	45	30	0	60	4	Elective
	TID8102	Safety, Health & Environment Management	45	30	0	60	4	Elective
	TID7106:	Clusters & Innovation Systems in Industrial Development	45	30	0	60	4	Elective
Total CU		**20**						

Table 2: SEMESTER II

Semester II	code	Course name	LH	PH	TH	CH	CU	Type of Course
	TID7201	Engineering Innovation and Entrepreneurship	45	0	30	60	4	Core
	TID7202	Logistics Engineering	45	0	30	60	4	Core

Core courses	TID7203	Engineering Programme and Project Management	45	30	0	60	4	Core
	TID8105	Advanced Product Design and Development	45	0	30	60	4	Core
Elective course (Choose One)	TID7205	Value Engineering and Value Management	45	15	15	60	4	Elective
	TID7204	Quality Management	45	30	0	60	4	Elective
	TID7207:	New Business Venture Strategy	45	15	15	60	4	Elective
Total CU		**20**						

Table 3: SEMESTER III AND IV

SEMESTER III and IV	**code**	**Course name**	**LH**	**PH**	**TH**	**CH**	**CU**	**Type of Course**
SEMINAR SERIES AND DISSERTATION	TID8106	Seminar series	0	300	0	150	10	Core
	TID7102	Dissertation	0	300	0	150	10	Core
Total CU		**20**						

PLAN B PROGRAMME STRUCTURE

Table 4: SEMESTER I

Semester 1	**code**	**Course name**	**LH**	**PH**	**TH**	**CH**	**CU**	**Type of Course**
Core courses	TID7101	Technology Innovation and R&D Principles	45	30	0	60	4	Core
	TID7102	Engineering Economics	60	0	0	60	4	Core
	TID7103	Strategic Management	60	0	0	60	4	Core
	TID7104	Advanced Research Methods for Science and Engineering	45	0	30	60	4	Core
Elective courses (Choose One)	TID7105	Information Technology Systems	45	0	30	60	4	Elective
	TID7106:	Clusters & Innovation Systems in Industrial Development	45	30	0	60	4	Elective
Total CU		**20**						

Table 5: SEMESTER II

Semester II	code	Course name	LH	PH	TH	CH	CU	Type of Course
Core courses	TID7201	Engineering Innovation and Entrepreneurship	45	0	30	60	4	Core
	TID7202	Logistics Engineering	45	0	30	60	4	Core
	TID7203	Engineering Programme and Project Management	45	30	0	60	4	Core
	TID7204	Quality Management	60	0	0	60	4	Core
Elective course (Choose One)	TID7205	Value Engineering and Value Management	45	15	15	60	4	Elective
	TID7207:	New Business Venture Strategy	45	15	15	60	4	Elective
Total CU		**20**						

Table 6: SEMESTER III

Semester III	Code	Course name	LH	PH	TH	CH	CU	Type of Course
Core Courses	TID8103	Project Work	0	135	30	60	4	Core
Elective Course (Choose Two)	TID8101	Process Improvement & Maintenance engineering	30	0	30	45	3	Elective
	TID8102	Safety, Health & Environment Management	30	0	30	45	3	Elective
	TID8104	Life-cycle Analysis and Sustainability	30	0	30	45	3	Elective
	TID8105	Advanced Product Design and Development	30	30		45	3	Elective
Total CU		**10**						

Table 7: SEMESTER IV

Semester IV	Code	Course name	LH	PH	TH	CH	CU	Type of Course
Core	TID8201	Project Report	0	300	0	150	10	Core
Total CU		**10**						

Total credit units for a student to graduate in this program are **60**

LH-lecture hour, TH-tutorial hour, PH-practical hour, CH-contact hour, CU-credit units

5.2 DETAILED COURSE CONTENT

5.2.1 SEMESTER ONE

TID7101: Technology Innovation and R&D Principles

Short description

Technology innovation and R&D principles is to effectively manage the research, invention, design, development, production, transfer and use of technology within an organization. This subject brings together knowledge from engineering and research disciplines

Course objectives:

The goal of Technology Innovation and R&D principles is to be able apply manufacturing technology to organizations, manage research, invent, develop, produce and sell products in an organisation.

Learning objectives:

By the end of the course the student should be able to;

(i) Understand and apply manufacturing technology to organizations
(ii) Understand marketing strategies for organization development
(iii) Competently apply research and development information to a high tech industry

Methods of course delivery:

The teaching of students will be conducted through;
Lectures, tutorials, short classroom exercises, case studies, group discussions among the students and projects aimed at solving real life problems.

Method of assessment

Assessment will be done through coursework which will include Home assignments, class room and take home tests, project work and presentations and a written examination. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Project Work 25%.

Detailed Course content

The framework of innovation, Models of science, invention and innovation (4 hours). Manufacturing technology of high technology industry (4 hours); Role of research and development in high tech enterprises(4 Hours) practices of research and development organizations in high technology industry (4 hours); alliance and collaboration of research and development organizations (4 hours); core technology of high tech

industry; technology life cycles (4 hours); strategic partnership between university, industrial and governmental research and development organizations (4 hours); macro- and micro- innovation (4 hours); culture and leadership in innovation and innovative organizations (4 hours). Guest Lectures (5 hours). Intellectual Property and Patents. Practical Hours (15)

Basic reading list / references

(1) Robert S. Friedman, Desiree M. Roberts, Jonathan D. Linton; 2008*, Principle Concepts of Technology and Innovation Management: Critical Research Models*, IGI Global, ISBN-13: 9781605660387; ISBN: 1605660388
(2) Tidd, J. Bessant, J. and Pavitt, K 2005, *Managing Innovation: Integrating Technological, Market and Organizational Change*, 3rd, John Wiley and Sons
(3) Sigvald Harryson; 1998, *Japanese Technology and Innovation Management: From Know-How to Know-Who;* Edward Elgar Publishing; 1 Ed edition, ISBN-10: 1858987687, ISBN-13: 978-1858987682.
(4) Margaret A. White and Garry D. Bruton, 2007*, The Management of Technology and Innovation; A strategic Approach;* South-Western Publishing Co., ISBN10: 0324144970, ISBN13: 9780324144970.
(5) *Strategic Management of Technology and Innovation;* Report of the Asian Productivity Organisation Top Management Forum on Strategic Management of Technology and Innovation, ©APO 2007, ISBN: 92-833-7063-5.

TID7102: Engineering Economics

Short description

This course provides knowledge on financial capacity, performance and financing of industry. It covers financial analysis, financial statements and how to analyze risk in an industry.

Course objectives:

This subject develops students' capability to understand and assess financial statements of industrial entities, and to identify and manage risk in the management and practice of engineering and enterprise.

Learning objectives:

By the end of the course the student should be able to;

(i) Prepare a balance statement
(ii) Prepare an income statement from enterprise incurred costs
(iii) Identify the main hazards in an engineering project and design an appropriate risk management strategy
(iv) Interpret financial statements and audited accounts

(v) Understand what figures in accounts mean

Methods of course delivery:

i) lectures and discussions
ii) self study assignments
iii) case studies and group discussions

Method of assessment

Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Practical Work 25%.

Course content

Financial statement analysis (Income, Cash flow statements, Balance Sheet, budgeting and analysis of performance (18 hours), analyzing fixed and variable cost, allocation of indirect costs, analysis of product costs (8 hours), Investment appraisal, Feasibility Studies, Business Plans, net present value, internal rate of return, depreciation and taxation, multi-attribute analysis (12 hours), Measures of investment worth under risk, utility theory, risk analysis, decision tree analysis (7 hours). Case Studies (15 hours).

Basic reading list / references:

1) D.G. Newman, T.G. Eschenbach, and J. LaVelle 2009, *Engineering Economic Analysis,* 10th, Oxford University Press.
2) Chan S Park, *Adanced Engineering Economics*, John Wiley & Sons Inc.
3) Sepalveda J. A Sounder, W.E, Gottfried, B.S. *Schaums Outline of Engineering Economics*; Mcgraw-Hill, 1984.
4) Blank L.T, Tarquin A.J., *Basics of Engineering Economy, 2007,* Mcgraw-Hill.

<u>TID7103: Strategic Management</u>

Short description

This course presents different perspectives of strategic management. Students should master the different framework of analysis and be able to master strategic processes within a firm as a whole and its transaction with its environment.

Course objectives:

To identify, assess, improve and limit risk in the management, be able to make decisions, plans, and come up with concepts for now and the future of the organisation.

Learning outcomes:

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

i. Address managerial decision-making at both the formulation and implementation phases of strategic planning
ii. Integrate concepts from both traditional and non-traditional business disciplines.
iii. Make strategic decisions without possessing all the relevant information, the focus is on decision-making under uncertainty.
iv. Scan the environment of any organization and identify key aspects of the environmental factors having an impact on the performance of the overall industry and the company being analyzed.
v. To develop a frame work to enable students to identify central issues and problems in complex, comprehensive case; to suggest alternative course of action, and present well supported recommendations for the future.

Methods of course delivery:

The teaching of students will be conducted through lectures, tutorials, short classroom exercises, case studies, group discussions among the students and projects aimed at solving real life problems. The lecture material will be availed to the students in advance to enable them have prior reading. Solving real life problems in each theme or a number of topics will enhance the students' understanding of the problem based learning techniques

Method of assessment

Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Project Work 25%.

Course content

Overview of 'schools of thought' within strategic management (4 hours), the mind of the strategist, Forming, implementing, managing, and changing strategy (12 hours), Tools and methods for strategic management at the business unit level versus the corporate level (9 hours), Managing formal, respectively, informal strategic collaboration (8 hours). Managerial and organizational issues when adopting new strategies, Strategy and globalization Company mission (12 hours). Case Studies (15 hours)

Basic reading list / references

1. De Witt, B. , Ronn Meyer 2010. Strategy: Process, Content and Context. An International Perspective. 4th Edition. Cengage Learning EMEA, London.
2. Thomas L. Wheelen and J. David Huger. *Strategic Management and Business Policy*, 8th edition ,prentice Hall
3. Fred R. David. *Strategic Management*, 7th edition.
4. Ned Ritson, 2008, *Strategic Management,* Ventus Publishing APS.
5. Anders Drejer, *Strategic Management and Core Competences: Theory and Applications*, 2002, Greenwood Publishing Group. Inc

TID7104: Advanced Research Methods in Science and Engineering

Short description:

The course is intended to provide graduate students with a thorough knowledge and practice in conducting research and development projects and to serve as preparation for carrying out studies in projects and theses.

Course objective:

The main objective of this course is to prepare the students so that they are capable of carrying individual or team research work according to scientific requirements.

Learning objectives:

At the end of the course the student should be able;

i) To identify and describe researchable ideas, projects and themes.

ii) To design and specify methods for carrying out a scientific research and demonstrate possession of skills and attitudes to conduct such research

iii) To be able to analyze data using scientific methodologies.

iv) To present research results in a systematic and objective way

Methods of course delivery:

i) lectures and discussions

ii) self study assignments

iii) case studies and group discussions

Method of assessment

Assessment will be done through coursework which will include assignments, class room tests and a written research project plan, study and report. Assignments and tests will carry a total of 40% and short research project will carry 60%.

Course content:

i) Introduction to the scientific method and research methodology (5 hours)

ii) Selection and definition of a research problem; searching and evaluation of relevant literature. R&D Case studies (8 hours)

iii) Preparation and evaluation of a research plan. Analysis. Constructs, Models and variables. Hypothesis. R&D and experimental designs and methods. (12 hours)

iv) Statistical analysis of research data. Exploratory, descriptive, inferential and regression methods. Mathematical and spatial data representation (12 hours)

v) Preparation and evaluation of research reports and theses. (12 hours)

vi) Case Studies (15 hours)

Basic reading list / references

1. Peter Bock. 2007. Getting it Right: R&D Methods for Science and Engineering. Academic Press
2. Uma Sekara. 2009. Research Methods for Business: A Skill Building Approach. John Wiley
3. Bordens, Kenneth H. Research Design and Methods: A Process Approach. 2008. Mac Graw-Hill, 8th edition.
4. Robson, C. *Real World Research*. 2009. 2nd Edition. Blackwell Publishing.
5. Turabian, Kate L. 1996. *A Manual for Writers of Term Papers, Theses, and Dissertations*. 6th edition. Chicago: University of Chicago Press.
6. Jay L. Devore, "*Probability and Statistics for Engineering and the Sciences*", Cole Publishing Company, Latest edition
7. Poutledge Taylor & Francis Group, 1985 Brenda Laurel (ed.), "*Design Research: Methods and Perspectives*", MIT Press, 2004
8. Douglas C. Montgomery, George C. Runger: "*Applied Statistics and Probability for Engineers*," 4th Edition, Wiley; ISBN: 978-0-471-74589-1, June 2006.
9. William DeCoursey, "*Statistics and Probability for Engineering Applications*" Newnes 2003-01, ISBN: 0750676183

TID7105: Information Technology Systems

Short description

Information technology systems are becoming ever more central to society, especially in business and industry. As society and technology develop in parallel, the most important skills for the future lie in the development of individuals with the ability to both understand and manage these complex and interrelated systems. Consequently, aspects of business that were once seen in isolation (e.g., people, organisation, process, information and technology) are now expected to operate as part of a seamless whole - both within and across enterprises. This places stringent new

demands on the knowledge, skills and technologies required to develop and control (manage) such systems.

The effective use of information technology is critical for organizations to achieve their operational and strategic goals. This course provides a platform for students to appreciate and understand the appropriate use of information technology systems in business decision making.

Course objectives:

Information technology systems focuses on integrating information technology solutions and business processes to meet the information needs of businesses and other enterprises, enabling them to achieve their objectives in an effective, efficient way.

Learning objectives:

At the end of the course the student should be able to;

i. Explore issues relevant to information systems development in the context of modern business environments and needs.
ii. Express a rounded awareness of the state-of-the-art in relation to the role of information systems in the enterprise environment and the importance of strategic alignment.
iii. Understand the changing nature of information systems and the implications of this for the requisite dynamic socio-technical balancing.
iv. Reflect, critically, on the state-of-the art of both the practice and theory of organizational-level systems development and critically understand information systems and their role in organizational effectiveness.
v. Understand both technical and organizational factors and must be able to help an organisation determine how information and technology enabled business processes can provide a competitive advantage.

Methods of course delivery:

i) lectures and discussions
ii) self study assignments
iii) case studies and group discussions

Method of assessment

Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Practical Work 25%.

Course Content:

Systems in Context: concepts of 'information' and 'information systems', information revolutions and their impact, approaches to the implementation and use of information systems in modern working environments. (4 Hours)

ICTs and Strategic Change which aims to develop a critical awareness of the central issues and challenges in strategic approaches to information systems. (4 Hours)

Data Management and Business Intelligence, data/information/knowledge management, approaches to information integration and business analytics. (12 hours)

Data, Information and Knowledge in Business: current and emerging approaches to data, information and knowledge in business (e.g., resource-based and cybernetic perspectives, business intelligence); social and technical issues associated with the concepts, capture, storage, retrieval and use of data, information and knowledge in business (e.g., legitimacy, trust, regulation); organizational learning and innovation (e.g., communities, innovation models); business semantics and technology (e.g., ontology); business performance management; data, information and knowledge visualization (e.g., dashboards). (12 hours)

Business and IT Strategy: Main topics of study include: introduction to developing a business strategy; application of ICT to the delivery of a business strategy; is innovation required to build a strategic advantage?; methods to align the business and ICT strategies (e.g., managing real options and formulating dynamic competitive strategies); maintaining focus on strategic initiatives while under the pressures of day-to-day maintenance; can strategic advantage be achieved and maintained from the deployment of ICT? (14 hours)

Information Systems Development: Main topics of study include: current approaches and challenges for the development of software systems; requirements engineering (e.g., use cases); iterative and agile life cycles (e.g., DSDM and Extreme Programming); designing flexible software architecture including enterprise architectures and SOA; semantic frameworks and business integration (e.g., OWL and RDF); evaluating software systems (e.g., execution based testing, process conformance); new and future developments (e.g., component-based development). (14 Hours)

Basic reading list/references

1. Wim Van Gremberg, Steven De Haes; **Enterprise Governance of Information Technology: Achieving Strategic Alignment and Value;** Springer Science Business Media, LLC 2009, ISBN 978-0-378-84882-2
2. Alexander Lidèn; 1995; **How to manage Software Systems in Telecommunications;** © Alexander Lidèn and Student Litteratur, ISBN 0-86238-274-2
3. Jean-Paul Van Belle, Mike Eccles and Jane Nash **(2003) Discovering Information Systems An Exploratory Approach**; South African Universities Press.

4. Hartmut Wiehr; (2009) **Storage Basics - An Introduction To The Fundamentals Of Storage Technology**; Fujitsu Siemens Computers GmbH.

TID7106: Clusters & Innovation Systems in Industrial Development

Short description

Clusters are a prominent feature on the landscape of every advanced economy, and cluster formation is an essential ingredient of economic development. Clusters offer a new way to think about economies and economic development; new roles for business, government and institutions; and new ways to structure the business-government or business-institution relationship. Dozens of cluster initiatives have sprung up in many parts of the world, and this course outlines some of the learning gleaned from both advanced and developing economies.

Course objectives:

The overall aim of the course is to improve an understanding of how local clusters can be transformed into local systems of innovation and how local clusters can be better connected to global actors. The students are supposed to draw out implications for policy and practice and provide guidance to governments, private sector associations, and non-governmental organizations like companies and business entities. It presents the science and facts behind industrial clusters and innovation systems as away of fostering high levels of production and innovation for competitiveness.

Learning objectives:

By the end of this course the student should be able;

i. To learn that increasing levels of specialization, ongoing technological development and growing number of links between technologies have led to greater importance for inter-organizational collaboration in the creation and realization of innovations.
ii. To deepen their knowledge, insights and skills with regard to design and governance of clusters, chain and innovation networks to improve competitiveness.
iii. Examine the incidence and role of clusters as a viable and increasingly important form of industrial organization.
iv. To draw out implications for policy and practice and provide guidance to governments, private sector associations, and non-governmental organizations like companies and business entities.
v. To reveal important insights about the microeconomics of competition and the role of location in competitive advantage.

Methods of course delivery:

i) lectures and discussions
ii) self study assignments
iii) case studies and group discussions

Method of assessment

Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Practical Work 25%.

Course outline:

The theory of clusters and innovation system, clusters as geographically and sectored bounded entity (8 hours); cluster location and competitive advantage relationship, the role of clusters in competition, and their implications for government policy, company and institutional behavior (8 hours), cluster formation as an essential ingredient of economic development (4 hours). Clusters relationship with economies and economic development; new roles for business, government and institutions and new ways to structure the business-government or business-institution relationship (8 hours). Cluster's effect on competition, Case studies of cluster initiatives in many parts of the world, and some of the learning learnt from both advanced and developing economies (7 hours). Firms possessing different knowledge bases which create synergy; idiosyncratic depositions of knowledge, skills and experiences, clustering emphasizing collective efficiency through joint action by firms and associations to realize productive efficiency, industrial clusters as a forum of industrial organization (10 hours), Case Studies of the world successive clusters (15 hours)

Basic reading list / references

1. Banji Oyelaran-oyeyinka, Dorothy McCormick *Industrial Clusters and Innovation Systems in Africa: Institutions, Markets and Policy* (Paperback) Publisher: United Nations University (June 15, 2007), ISBN-10: 9280811371, ISBN-13: 978-9280811377
2. Örjan Sölvell, Göran Lindqvist, Christian Ketels *The Cluster Initiative Greenbook,* September 2003
3. G. Clark, M. Gertler, and M. Feldman, eds *Oxford Handbook of Economic Geography*. Oxford: Oxford University Press, 2000
4. Christian Ketels, Göran Lindqvist, Örjan Sölvell May 2006, *Cluster Initiatives in Developing Transition Economies.*
5. Michael E. Porter*." "Location, Competition and Economic Development: Local Clusters in a Global Economy. Location, Clusters, and Company Strategy Clusters and the New Economics of Competition"*

5.2.2 SEMESTER TWO

TID7201: Engineering Innovation and Entrepreneurship

Short description

This course will equip students with the knowledge and tools to understand both the role of technical innovation and entrepreneurship in the growth of industries.

Course objectives:

To give the students an introduction to different ways of understanding and conducting innovative work and how it contributes to revitalization of existing and/or establishment of new enterprises.

Learning objectives:

After taking the course the students should understand the role of innovation and knowledge transfer within organizations.

Methods of course delivery:

i) lectures and discussions
ii) self study assignments
iii) case studies and group discussions

Method of assessment

Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Project Work 25%.

Course content

Investment in knowledge for the firm (4 hours), Innovation with a firm (4 hours), Technology diffusion and transfer from labs to market (8 hours). Innovation in global economy(4 hours). Marketing strategies of R&D Organizations (4 hours). Technology and business growth (4 hours). Culture and leadership in innovation and innovative organizations (8 hours). Innovation and entrepreneurship (4 hours). Non Disclosure Agreements, Trade Marks, Service Marks, Copyright.(8 hours). Business plan for a spin-off company.(12 hours) (Assignment and Seminar series)

Basic reading list / references

1. David O'Sullivan and Lawrence Doley. *Applying Innovation*. 2009. Sage Publishers.
2. Paul Trott. *Innovation Management and New product Development*. 2008 4th Edition. Prentice Hall.
3. Edward Lumsdaine and Martin Baules. *Entrepreneurship from creativity to innovation; effective thinking skills of a changing world.* 2006, , ISBN: 9781425104726, Trafford Publishing.
4. Micheal J.C. Martin. *Managing innovation and Entrepreneurship in Technology based focus*, John Wiley & sons 1994
5. Joetidd, John Bessand. *Innovation and entrepreneurship*. 2007, John Wiley & sons ISBN-13:9780470032695
6. Rowan Gibson and Peter Skarzynski, *Innovation to the core; a blueprint for transforming the way your company innovates*, ISBN 13: 978-1-4221-0251-0, Howard Business School Publishing.

TID7202: Logistics Engineering

Short description

Logistics is about the purchasing, transport, storage, distribution, warehousing of raw materials, semi-finished/work-in-process goods and finished goods. This course will provide knowledge to students on the fundamentals, modeling and practice of this function in an organization.

Course objectives:

To show an overview of the general area of logistics, its nature, scope, and process; a critical examination of logistics management functions and the interrelationships among strategic support and operational logistics

Learning objectives:

By the end of this course the students should be able to;

i) To manage the flow of goods, information and other resources, including energy and people, between the point of origin and the point of consumption in order to meet the requirements of consumers (frequently, and originally for military organizations).

ii) To involve the integration of information, transportation, inventory, warehousing, material-handling, and packaging.

Methods of course delivery:

The teaching of students will be conducted through lectures, tutorials, short classroom exercises, case studies, group discussions among the students and projects aimed at solving real life problems. The lecture material will be availed to the students in advance to enable them have prior reading. Solving real life problems in each theme or a number of topics will enhance the students' understanding of the problem based learning techniques

Method of assessment

Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Practical Work 25%.

Course content

Scope and elements in logistics, logistics planning, logistics in the system life cycle, logistics engineering (8 hours); measures of logistics; system feasibility analysis, chain supply management, Procurement systems, system operational requirements (12 hours), maintenance and support concept, technical performance measures, functional analysis, allocation of requirements, synthesis, analysis and design optimization (12 hours); supportability analysis process, methods, tools and applications (9 hours); logistics in design, manufacturing and support (4 hours). Tutorials (15 hours)

Basic reading list / references

1. Blanchard, Benjamin S 2004, *Logistics Engineering and Management,* 6th – International Edition, Prentice Hall Inc.
2. Paul Cousins and Richard Lamming and Ben Lawson Brian Square. 2008. Trentice Hall.
3. Martin Christopher. Logistics and Supply Chain Management. Creating Value Adding Networks. 2005 Prentice Hall.
4. Leutz Prauss, *The Green Multiplier. A Study of Environmental Protection and Supply Chain.* 2005. Antonn Rauss Limited, Palgrave Macmillan.
5. *Logistics Engineering handbook*, G Don Taylor Editor, CRC Press 2008, ISBN 13: 978-0-8493-3053-7, Amazon.com

TID7203: Engineering Programme and Project Management

Short description

This course covers aspects of the conceptualization, planning and management of complex technical work typically performed by engineers. These include development of

products, construction and other developmental undertakings of a limited duration often grouped into programmes or presented as individual projects.

Course objectives:

The aims of this course are to:

- Enable students appreciate the role of projects in any industrial setting.
- Give students and understanding of the conduct of projects in all its various aspects such as project planning and management, tendering and procurement.

Learning objectives:

At the end of this course, a student should be able to:

- Distinguish between a programme, project and a routine activity
- Demonstrate knowledge and skills of processes, techniques, standards, empirical guidelines, computer software, team building used in project
- Develop project requirements especially human and financial
- Explain the various project monitoring and control techniques

Methods of course delivery:

The teaching of students will be conducted through lectures, tutorials, short classroom exercises, case studies, group discussions among the students and projects aimed at solving real life problems. The lecture material will be availed to the students in advance to enable them have prior reading. Solving real life problems in each theme or a number of topics will enhance the students' understanding of the problem based learning techniques

Method of assessment

Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Project Work 25%.

Course content:

The course will be taught for 14 weeks in a semester.

i. **Integration management:** The systems approach to programmes and projects. Programme and project structures and organization. (4 hrs).
ii. **Scope management:** Engineering Programme/Project Initiation and Project Planning (4hrs).
iii. **Time management:** Estimating, scheduling, time tracking, and performance and progress measurement (project administration) (4 hrs).
iv. **Cost management:** Estimating, budgeting, performance and progress measurement. Project earned value analysis (4 hrs);

v. **Contract management:** This shall include legal aspects of contracts and discussion of standard contracts for procurement of professional services, goods and works (4 hrs)
vi. **Human resources management**: definition of roles and responsibilities, joint reviews, performance evaluations and reviews (4 hrs);
vii. **Communications management**: Principles, structure and means of communicating project status, success, and process improvement ideas. (4 hrs);
viii. **Risk management** addressed in Project Initiation, Project Planning, and Project Execution. It is also specifically identified within the Project Approval Process (5 hrs); and
ix. **Procurement Strategies and Management** is discussed within the Project Initiation Stage (under the business case - options analysis section) (8 hrs).
x. **Project Evaluation** will be presented from the project managers' point of view and also from an independent reviewer's point of view (8 hrs);
xi. **Management of Project Teams;** provision of the skills required to successfully manage project teams successful team culture, assess team members' abilities and make appropriate assignments, then define authorities and accountabilities, including rewards and consequences (8 hrs).

Basic reading list / references

Core References

1. Jack Gido and James P. *Clements Successful Project Management* An International Thompson Publishing Company ISBM 0-538-88152-6
2. Frederick L. Harrison, Dennis Lock, *Advanced Project Management: A Structured Approach,* Gower Publishing, Ltd., ISBN 0566078228, 2003
3. Scott Berkun, *The Art of Project Management*, O'Reilly, ISBN 0596007868, 2005.
4. Harrold Kerzner. *Project management. A systems Approach to Planning, Building, Scheduling and Planning.* 10th Edition. John Wiley & Sons.
5. Project Management Institute. 2004. *A Guide to the Project Management Body of Knowledge.*
6. David I. Cleland, Ronald Gareis. *Global Project Management Handbook. Planning, Organizing and Controlling International Projects.* 2006. McGraw Hill.

Optional Reading

7. Eric Verzuh, *The Portable MBA in Project Management*, John Wiley and Sons, SBN 0471268992, 2003.

Background Reading

8. James P Lewis, *Fundamentals of Project Management: developing core competencies to help outperform the competition.* AMACOM Div American Mgmt Assn, 2007.

TID7204: Quality Management

Short description

This course is designed to present the concept of total quality control through the study of techniques presently used by industry.

Course objectives:

Students will learn to view quality from a variety of functional perspectives and in the process, gain a better understanding of the problems associated with improving quality, also quality tools utilized in service and international/environments.

Learning objectives:

Upon completion of this course the student should be able to do the following;

1. Compare and contrast the key elements of total quality.
2. Explain the rationale for the total quality approach to doing business.
3. Identification and assessment of the steps in the strategic planning processing.
4. Examine and describe the relationship between quality and competitiveness.
5. Compare and contrast leadership and management.
6. Formulate procedures to promote diversity in teams.
7. Explain the total quality philosophy of training distinguish how it differs from education.
8. Compare and contrast the tools used in the total quality setting.
9. Define decision making and examine problem solving as it relates to total quality.
10. List and explain the requirements for total quality implementation

Methods of course delivery:

i) lectures and discussions
ii) self study assignments
iii) case studies and group discussions

Method of assessment

Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Practical Work 25%.

Course content:

Introduction, evolution and integration of total quality management in organizations (8 hours); Quality Management Philosophies And Frameworks (4 hours); Leadership And Strategic Planning (4 hours); Process Management And Performance Measurement (4 hours); Quality In Product And Process Design (4 hours); Six Sigma (4 hours); Statistical Process Control (4 hours); Process Improvement (5 Hours); Building and Sustaining Total Quality Organizations (8 hours). Case Studies (15 hours).

Basic reading list / references

1. Evans. J.R. and Lindsay, W.M 2008, *Management for Quality and Performance Excellence,* 7th Edition HARD BOUND, Thomson South-Western Publishing
2. Jiju Antony and David Preece; Editors, 2002, *Understanding, Managing and Implementing Quality Frameworks, techniques and cases*, Routledge, London.
3. James Fairfield Sonn , 2001, *Corporate Culture and the Quality Organisation,* Quorum Books., Westport, CT. ISBN 0-89930-903-8
4. Greg Bounds, Lyle Yorks, Mel Adams, Gipsie Ranney, 1994, *Beyond Total Quality Management: Toward The Emerging Paradigm,* Irwin/McGraw-Hill, ISBN-10: 0070066787, ISBN-13: 978-0070066786

TID7205: Value Engineering and Value Management

Short description

Value engineering is a structured process which seeks to remove unnecessary cost without impairing function (or value). Value management is a holistic process that seeks to understand and define what constitutes value within a project. This procedure does not set out to replicate the considerable body of knowledge related to this field. Value Management key outputs are a series of value objectives that must be achieved.

Course objectives:

To be able to relate the value engineering concept to cost, process, machinery and price, this will help students make decisions accordingly for a cost effective product

Learning objectives:

At the end of the course the student should be able to;

i) Be able to relate value engineering to costs, and its application to decision making.

ii) Be able to use value engineering as an economic analysis tool.

iii) Be able to apply SMART methodology in group decision environment.

Methods of course delivery:

i) lectures and discussions
ii) self study assignments
iii) case studies and group discussions

Method of assessment

Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Practical Work 25%.

Course content

i) Definition of value engineering and how it relates to cost and function of a product, facility, process, Applications of value engineering as a decision support tool. (8 hours)
ii) Value engineering as an economic analysis tool, the definition of value management and how it relates to the concept of utility. The differentiation between value engineering and value management. (8 hours)
iii) Introduction to multi-criteria decision making and multi-criteria decision support tools. Description of multi-attribute utility theory and multi-attribute rating techniques. (8 hours)
iv) Description of the simple multi-attribute rating technique (SMART) methodology for value management and how it relates to the concept of group decision support. (9 hours)
v) Application of SMART methodology in group design-decision environment. (12 hours)
vi) Case Studies (15 hours)

Basic reading list / references

1. Connaughton, J. N. and Green, S. D. (1996) *Value Management in Construction: A Client's Guide*, Special Publication 129, CIRIA, London, 73 pgs. ISBN 0 86016 452 2.
2. Green, S. D. (1992) *A SMART Methodology for Value Management*, Occasional Paper No. 53 Chartered Institute of Building, Ascot, 46+vi pgs. ISBN 1-85380-0554.

<u>TID7206: New Business Venture Strategy</u>

Short description

This course concentrates on the study of launching of new business enterprises. It covers identification of the business idea, preparation of business plans, methods for evaluating new venture ideas, formulation and implementation of business strategies for new ventures, and the financing of new ventures. The course utilizes lecture, discussion, exercise, videotape, and case study as methods of learning. It integrates knowledge gained from the prior core business courses to sharpen the student's ability to "think entrepreneurially" and form new ventures.

Course objectives:

i) To prepare students to become competent in the traditional areas of management: accounting, finance, marketing, economics, and production by developing the capability and capacity to "think entrepreneurially" about a venture;
ii) To build entrepreneurial and new venture formation skills;
iii) To offer opportunities in planning and evaluating new business ventures;
iv) To develop effective team work skills;
v) To develop and present a comprehensive business plan;
vi) To reflect on new learning attained through this course and how this learning can assist in personal growth.

Learning outcomes:

At the end of the course the students are expected to;

i) Individual scholastic excellence demonstrated, through preparation and presentation of concepts and techniques of entrepreneurship and new venture formation, in case studies, class participation, and the individual project.
ii) Outstanding team performance demonstrated, through preparation and presentation of concepts and techniques of entrepreneurship and new venture formation, in case studies and the team project.
iii) Personal growth through the setting of objectives and clarifying expectations at the beginning of the course, as well as, through reflective analysis at the end of the course.

Methods of course delivery:

i) lectures and discussions
ii) self study assignments
iii) case studies and group discussions

Method of assessment

Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Practical Work 25%.

Course content

The topics to be covered include;

i) Entrepreneurship (8 hours),
ii) Business Planning (8 hours),
iii) Opportunity Recognition and Venture Evaluation (8 hours),
iv) The Entrepreneur and Entrepreneurial Team (8 hours),
v) Financing of Ventures (8 hours),
vi) New venture marketing (5 hours).
vii) Case Studies (15 hours)

Basic reading list / references

1. *New venture strategy: Timing, Environmental uncertainty and performance*, shepherd, D.A and Shanley M. (1998) Publisher Sage ISBN 0-7619-1354-8
2. Bruce R. Barringer and R. D. Duanne Ireland. 2010. *Entrepreneurship, Successfully Launching New ventures*. 3rd Edition. Pearson Prentice Hall
3. *The future of management*, Gary Hamel, Bill Green, 2007, Howard business school Publishing, ISBN 13:978-1-422-1-0250-3
4. Clustensen C.M, Roth E.A, Scott D. *Seeing what is next using theories of innovation to product industry changes*, 2004, Harvard Business School Publishing.
5. Vadin Kotelmkov, High Growth Business Development, Venturepreneurs Stage By Stage Guide To Venture Formation, 2009.
6. Carland, J.C, Carland J W. *A new venture creation model,* Western Carolina University, 2001.
7. W. Chan Kim. And Renee Mauborgne. *Blue Ocean Strategy. How to Create Uncontested Market Space and make the Competition Irrelevant.* 2005. Harvard Business Press.

5.2.3 SEMESTER THREE

TID8101: Process Improvement and Maintenance Engineering

Short description

The aim of the course is to present a comprehensive overview of methodologies and analyses in the fields of process improvement and reliability / maintenance engineering.

The challenge for process improvement and maintenance engineering is to develop the most effective and at the same time efficient strategy for managing the performance, capability and condition of plant & equipment so as to meet or exceed commercial and operational requirements.

Course objectives:

i. To give students a comprehensive overview of the field of maintenance and process improvement, from a management as well as technical perspective.
ii. To give students the confidence and capability to conduct further work or research in this important field.
iii. Enable students to work in groups to improve problem-solving skills using computation, and to apply fact-based analyses to design maintenance and process improvement strategies and plans.

Learning objectives:

At the end of the course the students are required to know the following;

i. Understand the steps involved in specifying equipment at the time of purchase and the importance of an ongoing reliability and condition monitoring program to ensure that performance is maintained and both condition and risk are appropriately identified and managed.
ii. Understand the various methodologies used in industry to estimate the level of reliability and remaining life of a critical component at a certain point in time, using statistical and mathematical techniques where appropriate.
iii. Understand the principle of Reliability-centered Maintenance (RCM), TPM, CMMS, and FMECA.
iv. Understand the major mechanisms involved in component and system degradation.
v. Be able to conduct a reliability study and to make recommendations with respect to the maintenance plan and ongoing reliability program.

Methods of course delivery:

i) lectures and discussions
ii) self study assignments
iii) case studies and group discussions

Method of assessment

Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination.

Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Practical Work 25%.

Course Content:

The meaning and value of maintenance (3 hours), Overview of damage mechanisms and their maintenance burden, evaluation of equipment function reduction loss (6 hours); failure modes, effects and critical analysis and failure prevention (6 hours). Maintenance planning (planned preventive, and planned corrective maintenance). Condition based maintenance, condition monitoring techniques (6 hours). Maintainability and reliability assessment, organizing for maintenance records: equipment record, inspection report check lists (6 hours). Inspection schedules and maintenance cost records (6 hours). Machine tools maintenance; general recommendations, insulation maintenance, bearing maintenance, commutator and brushes maintenance (3 hours). Maintenance and repair of electronic equipment techniques and procedures (3 hours). Computerization of the maintenance system (6 hours).

Basic reading list / references

1. Larry Bush, *Maintenance Policy and Procedures Manual* 2nd Edition Published by www.BIN95.com 2008 ESBN: E43-851B-1b34-10Q5
2. Carlo Scodanibbio *World Class OEE calculation use to meet your Total Productive Maintenance Objectives*, *World Class OEE* - A TPM Tool, Published by www.bin95.com 2008/09
3. Mike Sondalini. *From Preventive Maintenance to Root Cause*.
4. Mike Sondalini. *The Japanese Path to Maintenance Excellence.* The e-book that tells you how the Japanese destroy maintenance
5. Mike Sondalini *CMMS Secrets*,

TID 8102 Safety, Health and Environment Management

Course Description

This multidisciplinary course provides specialized advanced training for graduates or occupational health and safety practitioners with an emphasis on risk and safety management and occupational injury, disease prevention and environmental protection. This course has an emphasis on practical and theoretical occupational health and safety (OHS) skills with a strong mix of science and technical practical and theoretical knowledge in the core discipline areas of risk management and accident prevention, ergonomics, occupational hygiene, health and safety economics and management, and compensation and injury management. There is an emphasis on industry based assessment and the development of practical skills.

Course Objectives

This unit covers legislative concepts underpinning contemporary occupational health and safety in occupational health and safety management systems by the application of key managerial principles, functions and skills within an organization. The unit also covers accident investigation, safety management plans and environment protection.

Learning Objectives

The course on Occupational Health, Safety and Environment prepares graduates for work in the preparation and implementation of occupational health and safety programs at the workplace. In many cases, students will be in positions of managerial or professional responsibility, through which they are required to develop policies and strategies in response to the occupational health and safety needs of their organizations.

As well as extending students' skills in raising awareness of occupational health and safety issues and dealing with risks and dangers in the workplace, the program also aims to encourage the desire to promote the health, safety and well-being of others and to help students develop a problem-solving approach to occupational health and safety issues.

Methods of course delivery:

i) lectures and discussions
ii) self study assignments
iii) case studies and group discussions

Method of Assessment

Class topics cover the basics of managing workplace health and safety. Students learn how to design, evaluate and implement programs that promote safer work environments. They are also taught how to handle emergency situations and, when possible, how to prevent them from occurring.

Course Content

Examines health issues, scientific understanding of causes, and possible future approaches to control of the major environmental health problems in industrialized and developing countries **(12 hours)**. Topics include how the body reacts to environmental pollutants; physical, chemical, and biological agents of environmental contamination; vectors for dissemination (air, water, soil); solid and hazardous waste; susceptible populations; biomarkers and risk analysis; the scientific basis for policy decisions; and emerging global environmental health problems. (12 **hours)**

Human-environment interactions: specifically, environmental factors that influence health i.e. physical, chemical and biological stressors and pollutants that affect the health and wellbeing of individuals and populations. The role of government in environmental health management. Science of environmental health, hazards and pollutants. Air pollution, water, and waste management. Industrial pollution management. Noise, built environments, indoor air and global climate issues. (12 hours)

Hazard identification, dose-response assessment, exposure assessment and risk characterization. Risk assessment and evaluation of hazards; selected examples. Hazard analysis and risk criteria. Principles and conduct of environmental health risk assessments. Concepts of risk management. Risk evaluation, Factors affecting perceptions and acceptance of risk. Prevention, control measures and public safety. Uses and limitations of risk assessment and risk management in decision making. Principles of public participation and risk communication. **(12** hours)

Occupational health and safety. Liability of the legislation and regulations, and the role of safety policy and organisation. Other topics include equal opportunity laws, workers compensation, common law liability, and specific legal aspects relating to women in the paid workforce. **(**9 hours)

Basic reading list / references

1. Richard Welford, Editor, 2007, Corporate Environmental Management Systems and Strategies, Earth Scan, 2nd Edition.
2. William Martin, James Walters, Safety and Health Essentials for Small Businesses, Butterworth Heinemann, Updated 2010.
3. Ken Whitelaw, ISO 14001, Environmental Systems Handbook, Butterworth Heinemann, 2004.
4. A. Edwards, 2003, ISO 14001, Environmental Certification Step by Step, Butterworth Heinemann.
5. William Martin and James Walters. 2001. *Safety and Health Essentials: Compliance for Small Businesses.* Butterworth and Heinemann.
6. James Roughton and James Mercurio. 2002. *Developing an Effective Safety Culture: A Leadership Approach.* Butterworth and Heinemann.
7. Sarkis, Joseph; Cordeiro, James J.; Vazquez Brust, Diego (Eds.). 2010. *Facilitating Sustainable Innovation through Collaboration: A Multi-Stakeholder Perspective.* Springer
8. Krozer, Yoram. 2008. *Innovations and the Environment*. Springer

TID8103: Project Work

Short description

This course provides students with the opportunity to build upon the knowledge and skills he/she has acquired during the basic and advanced course in an industrial setting. The project work is conducted in collaboration with companies and industry.

Course objectives:

The objective of the course is to further collaboration between the university and industry and in so doing enable the application of the principles and practices of innovation and entrepreneurship to industry.

Learning outcomes:

By the end of this course the student should be able to;

i) Identify different opportunities to apply theoretical knowledge and principles to a given problem faced by industry
ii) Carry out an analysis of problems faced by industry or group of industries using well-known techniques
iii) Propose and analyze the impact of different solutions to problems faced by industry
iv) Produce a detailed report of the project work

Methods of course delivery:

The project work will carried out in groups of three to five students. Students will be expected to assemble into a group which has to be approved by the course coordinator. The project must be connected to the student's specialization and must of direct interest to an industry or group of industries.

The steps to be followed in the conduct of project work will in general take the following form (135 hours).

- Step 1: Proposals of projects are prepared by the course academic staff in consultation with industry
- Step 2: Students assemble into groups and select a project from the list of provided projects
- Step 3: Projects are assigned to students by the course coordinator
- Step 4: Students undertake the project under the supervision of academic staff
- Step 5: Students prepare a report and a PowerPoint presentation of their findings

Method of assessment

The students' work will be assessed on the basis of the innovativeness of the proposals made in respect of the industry that is interested in the project. The project report will be assessed as follows: Internal Examiner 40%, External Examiner 60%.

Basic reading list / references

This will depend on the topic of the chosen research project.

TID8104: Lifecycle Analysis and Sustainability

Short description

This is the investigation and valuation of the environmental impacts of a given product or service caused or necessitated by its existence or the total cost of ownership over the life of an asset, also commonly referred to as "cradle to grave" or "womb to tomb"

Course objectives:

This course offers understanding in life cycle analysis for cradle to grave of products, and how sustainable this tool can be.

Learning outcomes:

By the end of this course the student should be able;

i) Analyze the sustainability of product and service developments.
ii) To apply life cycle analysis tool to any product and service.
iii) To make an impact analysis of the products lifecycle of products to the environment.
iv) To cost the product or services at every process, and be able to make decisions using lifecycle tools and management strategies.

Methods of course delivery:

The teaching of students will be conducted through lectures, tutorials, short classroom exercises, case studies, group discussions among the students and projects aimed at solving real life problems. The lecture material will be availed to the students in advance to enable them have prior reading. Solving real life problems in each theme or a number of topics will enhance the students' understanding of the problem based learning techniques

Method of assessment

Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Practical Work 25%.

Course content

The content of this course covers the topics of sustainability in product and service development (6 hours), eco-efficiency, resource efficiency, life-cycle processes and modeling, input-output analysis (9 hours), life-cycle environmental assessment (6 hours), value chains, life-cycle costs, activity-based costing, risks and uncertainties (9 hours), decision making tools, and product life-cycle management strategies and cases (9 hours). Seminars (6 hours)

Basic reading list / references

1. Wolter J. Fabrycky, Benjamin S. Blachard; (2005) *Life-Cycle Cost and Economic Analysis.* Prentice Hall International Series in Industrial and Systems Engineering)
2. Takata, Shozo; Umeda, Yasushi (Eds.). 2007. *Advances in Life Cycle Engineering for Sustainable Manufacturing Businesses.* Springer.
3. Brissaud, Daniel; Tichkiewitch, Serge; Zwolinski, Peggy (Eds.). 2006. *Innovation in Life Cycle Engineering and Sustainable Development.* Springer

TID 8105: Advanced Product Design and Development

Course description

This course requires that students get to know the basic procedure of designing products and services. This entails that students learn methods of transforming clients' wants into specifications to enable the design of products, taking into mind restrictions of costs and space.

Course objectives:

After completing this course the students should understand and be able to plan and implement the technical aspects of product development within a company.

Learning outcomes:

The students should be able to know clearly the following;

i) Be able to get product specifications after discussions with the customers

ii) Be able to get concepts from scratch and design a product using the specified procedures of product development.

iii) Be able to cost for every stage of the product development, and look out for ways of minimizing them.

Methods of course delivery:

i) lectures and discussions
ii) self study assignments
iii) case studies and group discussions

Method of assessment

Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Case studies and product design challenges will be used in the course. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Practical Work 25%.

Course content

Introduction to product design (6 hours), the product design and development process (9 hours), product life-cycle. Product specifications, Concept generation, selection and testing (9ours), Product architecture, Industrial Design and modeling (9 hours), Prototyping, Product development economics (6 hours) Design Assignment (6 Hours)

Basic reading list / references

1. Grossman I. E, global optimization in Engineering Design (non convex Optimization and its application), Springer, 1st Edition, 1996
2. Industrial Engineering Book; Jorcad.com 2006-2009
3. Process oriented analysis; Design and optimization of industrial production systems, Meyer. Urs B, Creux Simone E. Weber Mann, Audrea K. 2006.

5.2.4 SEMESTER FOUR

TID 8201: RESEARCH AND PROJECT REPORT

Brief Description

After completing all coursework, each student commences with a Research project on which he/she typically works over a period of 5-6 months (10 CU)). The Research project should deal with a clearly defined topic from the domain of **Industrial innovation and development** and under the condition that competent guidance/supervision is available to the student throughout the project period. The

project may be carried out either in an academic environment (university, research institute, or equivalent) or in an industrial setting (production plant, construction company, or other industry/business).

TID8106/TID8202: SEMINAR SERIES AND DISSERTATION

Brief Description

After completing all coursework, each student following Plan A studies commences with a research project on which he/she typically works over a period of 2 SEMESTERS (20 CU)). The research project should deal with a clearly defined topic from the domain of **Industrial innovation and development** and under the condition that competent guidance/supervision is available to the student throughout the thesis project period. The project may be carried out either in an academic environment (university, research institute, or equivalent) or in an industrial setting (production plant, construction company, or other industry/business).

6.0 DURATION

Masters of Science in Technology Innovation and Industrial Development (M. Sc. TIID) will be for two year-four semesters just like any other masters programme in Makerere University, this degree will follow the two plans, Plan A and Plan B as mentioned earlier.

6.1 PROGRAMME REGULATIONS

6.1.1 General Regulations

The general Master's degree regulations of Makerere University shall apply.

6.1.2 COURSE ASSESSMENT

The courses offered in the programme will be assessed on a course by course basis and will comprise coursework and project assignments, tests and examinations. The details are specified for each course in Section 11.

6.1.3 GRADING OF COURSES

Each course shall be graded out of a maximum of 100 marks and assigned appropriate letter grades and grade points as follows:

Table 8: COURSE GRADING

Marks%	Letter Grade	Grade points	Interpretation
90-100	A+	5.0	Exceptional
80-89	A	5.0	Excellent
75-79	B+	4.5	Very good
70-74	B	4.0	good
65-69	C+	3.5	Fairy good
60-64	C	3.0	pass
55-59	D+	2.5	Marginal pass
50-54	D	2.0	Clear fail
45-49	E	1.5	Bad fail
40-45	E-	1.0	Qualified fail
Below 40	F	0	Qualified fail

6.2 CALCULATION OF THE CUMULATIVE GRADE POINT AVERAGE (CGPA)

The Cumulative Grade Point Average at a given time shall be obtained by:

i) Multiplying the grade point obtained in each Course by the Credit Units assigned to the Course to arrive at the Weighted Score for the Course.
ii) Adding together the Weighted Scores for all the Courses taken up to that time.
iii) Dividing the Total Weighted Score by the total number of Credit Units taken up to that time.

6.3 RETAKING A COURSE OR COURSES

i) A student shall retake a Course or Courses when next offered again in order to obtain at least the Pass Mark (60%) if he/she had failed during the First Assessment in the Course or Courses.

ii) A student who has failed to obtain at least the Pass Mark (60%) during the Second Assessment in the same Course or Courses he/she has retaken shall receive a warning.

iii) A student may retake a Course or Courses when next offered again in order to improve his/her Pass Grade(s) if the Pass Grade(s) got at the first Assessment in the Course or Courses were low. A student who fails to attain higher marks after retaking to improve, the examination results of the first sitting are recorded on the transcript and should not be recorded as ***Retake.***

iv) Where students miss to sit examinations for justified reasons; they should not be recorded as those who retake when they sit the examinations when next offered.

While retaking a Course or Courses, a student shall: -

a. Attend all the prescribed lectures/ tutorials/ Practical's/Fieldwork in the Course or Courses;
b. Satisfy all the requirements for the Coursework Component in the Course or Courses; and
c. Sit for the University Examinations in the Course or Courses.
d. A student shall not be allowed to accumulate more than five (5) Retake Courses at a time. Students are required to register for retake course(s) first before registering for new courses offered in that semester and the retake courses should fit into the approved normal load so as to avoid timetable clashes.
e. A final year student whose final Examination Results has already been approved by the Faculty Board and has qualified for the Award of a Degree in M.Sc. TIID, shall not be permitted to retake any Course or Courses.
f. When a student has retaken a course the better of the two Grades he/she has obtained in that course shall be used in the computation of his/her cumulative Grade Average (CGPA).
g. Whenever a Course or Courses has/have been retaken, the Academic Transcript shall indicate so, accordingly.
h. Students who have a course(s) to retake and these Course(s) fall beyond the set normal semester load for their Academic Programmes shall pay tuition fees for any Course/Courses to be retaken. Besides, such students also pay the reexamination fees per Course retaken as well as the Registration Fees.

6.4 PROGRESSION

6.4.1 NORMAL PROGRESS

Normal Progress shall occur when a student has passed the Assessments in all the Courses he/she had registered for in a particular Semester and not when he/she has passed the Assessments in the Core Courses only.

6.4.2 PROBATIONARY PROGRESS

A student who has obtained the Cumulative Grade Point Average (CGPA) of less than 3.0 shall be placed on Probation. Such a student shall be allowed to progress to the next Semester/Academic Year but shall still retake the Course(s) he/she had failed later on and obtain at least the Pass Mark (60%).

6.4.3 CERTIFICATE OF DUE PERFORMANCE

(i) A student who fails to honour the deadline set for handing in an assignment without justifiable reasons shall receive a score of a zero or fail grade in that assignment.

(ii) A student who does not have coursework marks shall be denied the Certificate of Due Performance and will not be allowed to sit the University Examinations.

6.4.4 CONCEDED PASS

A "Conceded Pass" will be granted for a course in which a final year candidate is within five marks of a pass mark in the course assessment. The pass is conceded on the basis that the student's overall performance in other courses for the programme has been sufficiently strong to counter the deficient percentage in that particular course.

The circumstances warranting a conceded pass shall avail as stipulated in the graduate training and research handbook 2009.

6.5 DISCONTINUATION

When a student accumulates three consecutive probations based on CGPA he/she shall be discontinued.

i) A student who has failed to obtain at least the Pass Mark (60%) during the Third Assessment in the same Course or Courses he/she had retaken shall be discontinued from his/her studies at the University.

ii) A student who has overstayed in an Academic Programme by more than Two (2) Years shall be discontinued from his/her studies at the University.

6.6 DISSERTATION

The dissertations shall conform to the standing guidelines and regulations of the University on higher degrees. In addition, the following shall also apply:

i) A candidate shall not be allowed to formally start on research work unless he/she has passed at least 10 courses.
ii) A candidate shall submit a research proposal to the Faculty Higher Degrees Committee before the end of first semester of second year of study.
iii) The candidate shall conduct research during the second semester of the second year of study.
iv) The candidate shall hand in three hard copies and one soft copy of the dissertation by the end of the second year.

6.6.1 PASSING DISSERTATION

To pass a dissertation, the candidate shall satisfy the examiners in both the written report and viva voce.

6.6.2 REVISED DISSERTATION

A candidate who fails to satisfy examiners shall re-submit a revised dissertation within six months after notification.

6.6.3 GRADUATION REQUIREMENTS

The degree of M.Sc. (Technology Innovation and Industrial Development) shall be awarded to a candidate who fulfils both conditions below:-

i) Accumulated a minimum of 60 credit units.
ii) Passed the dissertation.

6.6.4 QUALITY ASSURANCE

The quality assurance practices like the other programmes in the Faculty of Technology in particular and Makerere University in general shall apply. A student will be required to attend at least 70% of the lectures given in a course, do and pass all the coursework assignments, tests and laboratory exercises before he/she can sit for a written examination. Also the performance of the assigned lecturers to teach these students shall be monitored closely to ensure they comply with the curriculum requirements. This will be partly achieved through giving the students assessment forms to assess their lecturers on the content taught, mode of delivery, self explanation and appearing for lectures.

7.0 CLASSIFICATION OF AWARD

The degree of Masters of Science in Technology Innovation and Industrial Development (M. Sc. TIID) will be awarded to a student who fulfills all the requirements for the programme or upon attaining a total of 60 credits for graduation and conducts and passes a Dissertation arising out of research work. The 60 credits are equivalent to the EU norm of 120 points where the 3 CU are equivalent to 6 CUs in EU.

8.0 EXTERNAL REVIEW INPUT

The program coordinator was able to arrange for a stakeholder's consultative workshop, the aim of this workshop was to get views from the industry and other stakeholders on how the program should be improved to suit the Ugandan industries, attached in appendix II are the minutes for the stakeholder's workshop.

The program was sent to industries and other stakeholder's to be reviewed by external organizations, among the organizations targeted include Norwegian University of science and technology, Uganda National Roads Authority, Uganda Association of Consulting Engineers, Uganda National Bureau of Standards, and Uganda Institution of Professional Engineers. Check appendix III for the comments made.

9.0 RESOURCES

9.1 HUMAN RESOURCES

The capacity to run the programme exists. Staff from Faculty of Technology together with the Norwegian University of Science and Technology will participate in the teaching, industrial excursions and supervision of students. The Faculty of Technology has 35 staff with PhD's, other required expert inputs have been sourced at the Faculty of Economics and Management (FEMA) in Makerere University.

Table 9: DETAILS OF ACADEMIC STAFF TO PARTICIPATE IN THE PROGRAMME

Local Staff	Qualification/Expertise
1. Prof. J.K. Byaruhanga	Ph.D.; Maintenance and Entrepreneurship
2. Prof. M.A. Okure	Ph.D.; Quality Management and Research Methodology
3. Dr. J.B. Kirabira	Ph.D.; Product Design and Innovation
4. Dr. B. Kariko- Buhwezi	Ph.D.; Industrial Optimization and Design
5. Dr. Umar Kakumba	Ph.D.; Entrepreneurship and Marketing
6. Dr. Thomas Mwebaze	Ph.D.; Industrial Economics
7. Prof. J. Ddumba-Ssentamu/Dr. Eseza Kateregga	Ph.D.; Project Planning and Management
8. Dr. Dan Tindiwensi	Ph.D.; Value Engineering and Management
9. Dr. M. K. Musaazi	Ph.D.; Engineering Innovation And New Venture Business Strategy
10. Dr. P. Lating	Ph.D.; Information Systems
11. Dr. Y. Naku Ziraba	Ph.D.; Industrial Clusters And Innovation
12. Prof. Tickodri Tagboa	Ph.D.; Project Work
13. Prof Lugujjo	Ph.D.; Project Work

14. Prof. Jackson A. Mwakali	Ph.D.; Project Work
15. Prof. G. Ngirane-Katashaya	Ph.D.; Project Work
16. Dr. Adam Sebbit	Ph.D.; Project Work
17. Dr. Israel Da-silva	Ph.D.; Project Work

Table 10: VISITING PROFESSORS FROM NTNU WHO WILL PARTICIPATE IN THE PROGRAMME

Visiting Professors	Qualification / Expertise
1. Prof. Arild Aspelund	Ph.D.; Venture Marketing
2.Prof. Tore Haavaldsen	Ph.D.; Engineering Program and project management
3.Prof. Bjorn Otto	Ph.D.; Engineering Program and project management
4.Prof. Tim Torvatn	Ph.D.; Innovation and Entrepreneurship
5.Prof. Torbjorn H. Netland	Ph.D.; Project Work and Research Methods
6. Prof. Erlend Alfnes	Ph.D.; Operations Management
7. Prof. Jan Hovden	Ph.D.; Safety, Health and Environment
8. Prof. Elsebeth Holmen	Ph.D.; Strategic Management
9. Prof. Luitzen De Boer	Ph.D.; Logistics Engineering
10. Prof. Oystein Moen	Ph.D.; Project Work and Masters Thesis

Table 11: WORK LOAD OF THE LECTURERS WHO WILL TAKE PART IN THE PROGRAMME

SN			SEMESTER ONE					SEMESTER TWO		
	RESOURCE PERSON	STATUS	CURRENT TEACHING LOAD		PROPOSED TEACHING LOAD		TOTAL LOAD	CURRENT TEACHING LOAD		PR LO
			COURSES	CU	COURSES	CU		COURSES	CU	CO
1	Prof. J.K. Byaruhanga	PERMANENT	MEC 4101 MEC7101	4 3	TIID8101	3	10	MEC 4201 MEC3201	4 4	TI
2	Prof. M.A. Okure	PERMANENT	MEC 3105 RET7103	4 3	TIID7104	3	10	TEC 7201 RET 7203	3 3	TI
3	Dr. J.B. Kirabira	PERMANENT	MEC 3102	4				MEC3203	4	TI
4	Dr.B.Kariko Buhwezi	PERMANENT	MEC 4108	4				MEC3202	4	TI
5	Dr. Umar Kakumba	PERMANENT	unknown		TIID7102	3				TI
6	Dr. Thomas Mwebaze	PERMANENT	unknown		TIID7103	3				
7	Prof. J. Ddumba-Ssentamu/Dr. Eseza Kateregga	PERMANENT	unknown							TI
8	Dr.Dan Tindiwensi	PERMANENT	unknown							TI
9	Dr. M. K. Musaazi	PERMANENT			TIID7101	3				
10	Dr. P. Lating	PERMANENT	CIV7101	3	TIID7105	3		NONE		
11	Dr. Y. Naku Ziraba	PERMANENT			TIID7106	3				
12	Prof. Tickodri Tagboa	CONTRACT	EMT 3101 EMT 7103 RET 7105	4 4 3				ELE 7214 ELE 4202 RET 7202	4 3 3	
13	Prof Lugujjo	CONTRACT	UNKNOWN		TIID8104	3				
14	Dr. Adam Sebbit	PERMANENT	MEC4105 RET8101	4 3	TIID8102	3	10	MEC7201 RET7201	4 3	
15	Dr. Israel Da-silva	PERMANENT	ELE3104 ELE7104	4 4				ELE2201 ELE7201 RET 7204	4 4 3	
16	Prof.G. Ngirane-Katashaya	CONTRACT	UNKNOWN		TID8103			UNKNOWN		
17	Prof. Jackson A.	PERMANENT	UNKNOWN		TID 8103			UNKNOWN		

	Mwakali									

9.2 TECHNICAL AND INFRASTRUCTURE FACILITIES

i. Reading room facilities and access to relevant literature

The Faculty of Technology will house the M.Sc. TIID Program, thanks to a recent grant from NORAD that added 4,000 square meters to the Faculty of Technology. The faculty of technology has enough equipments and laboratories which will be used by the master's student. Seminar rooms have been set aside for graduate studies in the programme. Library/reading facilities exist at the Faculty, Faculty Library and University Library, where students can access reading materials freely, including as many as 14,000 online journals, the majority of which are in English.

ii. IT-support, accessibility data network

There is an integrated fiber network, including 24/7 internet access that connects all units of the university, including the library. The facility is fully supported by a Directorate of ICT Support at university level. There is open access to all the students. Within the Faculty of Technology, there is a dedicated facility for graduate students; the Faculty LAN is supported by a system's administrator and several assistants.

iii. Excursions related to the study programme

Arrangements will be made for student's excursions to places of relevance to the course. This is a routine activity in most of the courses in the Faculty of Technology. This will be fully paid by the programme.

iv. Accommodation for the students

The university has accommodation for graduate students in the hall of residence known as Dag, students who will not be able to get space in the hall will be advised to look out for space in the many hostels that are around the university.

9.3 FINANCIAL RESOURCES AND STUDENT SUPPORT

The tuition fees will be Uganda Shillings 3,787,500 (Shillings Three Million Seven Hundred Eighty Seven Thousand, five Hundred Only) per annum for Ugandan students and Uganda shillings 6,666,000 (Shillings Six Million Six Hundred Sixty Six Thousand Only) per annum for international students. All other charges for postgraduate students at Makerere University will apply.

The NORAD programme for Master Studies (NOMA) has agreed to sponsor 10 students in the first cohort of academic year 2011/2012-2010/2012, and 15 students in the academic year 2012/2013-2013/2014; the rest of the additional students who wish to

enroll will be privately sponsored. Private sponsorship for all students will commence when Norwegian support is terminated.

The project is financially sustainable in terms of students support, payment of visiting professors, acquisition of learning materials and equipment and other related expenses. The funds have been released by NOMA through NTNU (Norwegian University of Science and Technology), Norway and part of these funds will be transferred to Makerere University Account. Check appendix 1.

9.4 INSTITUTIONAL ARRANGEMENT

The Norwegian University of Science and Technology (NTNU) will offer technical support in the implementation of this programme through transfer of expertise that exists therein to the staff of the Faculty of Technology. This hence will develop capacity for the Faculty of Technology staff to develop, mount and conduct the Master of Science in Technology Innovation and Industrial Development.

10.0 SUSTAINABILITY

The programme is planned to be sustainable after the Norwegian support is terminated. This will be achieved, as mentioned above, by training and facilitating local staff in planning, preparing and conducting the courses within this programme, including curriculum development, developing teaching materials and cases, mentoring some master students and so on. More sponsors will be invited from industries and other organizations.

With rising demand for University education leading to increase in student numbers, the need for graduate studies will continue to grow into the foreseeable future. Since the programme will cooperate with and deliver tangible benefits to industry, support from government departments, public institutions such as Uganda Industrial Research Institute (UIRI) and Uganda National Bureau of Standards (UNBS) as well as the private sector itself will actively be sought to support and develop the programme. This will make the program more relevant to the industries and organizations which will take part.

11.0 PROGRAM CORDINATOR

The Masters of Science in Technology Innovation and Industrial Development (M.Sc. TIID) is to be coordinated by Associate Professor J.K. Byaruhanga. He has been lecturing in the University for over 20 years in Mechanical Engineering. From the early 1990's he started working with the Small Scale Enterprises Project under Uganda

Gatsby Trust which aimed to assist SMEs business advisory services to help them improve their businesses through managerial and technical skills. He has also assisted them to develop their innovations to marketable levels. This program has enabled the growth of hundreds of SMEs all over Uganda.

Since 2007, He has been taking courses in Business management and Entrepreneurship at both Undergraduate and Graduate level. He is also a Principal Investigator for one of the Sub-Programs (Engineering Materials and Application) under the Sida-funded Makerere Research Collaboration Program.

12.0 CONCLUSION

Today, technical employees in industry are called upon to play key roles in defining the company strategy which often requires changes in the way the company is conducting its business. These professionals often take up leadership roles as well. Their technical background gives them the edge they need to carry out these task with the analytical perspective that is provided in tee engineering and technological undergraduate education. Enhancing this capacity with graduate level knowledge in the principles, practices and the relevant tools of product/process development and/or improvements is a major requirement by industry.

This programme presents an opportunity for the industry-oriented development of these globally demanded competences for Ugandan industry. Consultations with industry over a six-month period and their perusal of the draft programme confirmed the need for such professionals.

APPENDIX I: PROGRAM BUDGET

The budget has been based on Ugandan students and includes recurrent expenditures and the staff costs projected (both academic, administrative/technical and support staff), capital expenditure and other running costs

Table 12: PROGRAM COSTING 2011/2012

	M.Sc. in Technology Innovations and industrial development	
Revenue per semester	Amounts	
Tuition fees	Semester 1	Semester 2
Student fees @ 1,893,750/= per semester (3,787,500/= per annum)		
Fees (10 students) @1,893,750/=	18,937,500/=	18,937,500/=
Total	18,937,500/=	18,937,500/=
expenditure		
University council 25%	4,734,375/=	4,734,375/=
Teaching Expenses 41%	7,764,475/=	7,764,475/=
Administrative Expenses 5%	946,875/=	946,875/=
Office Expenses 3%	568,125/=	568,125/=
Library Materials 2%	378,750/=	378,750/=
Faculty Levy 5%	946,875/=	946,875/=
Utilities/Furniture 1%	189,375/=	189,375/=
Staff Development 2%	378,750/=	378,750/=
Computer Laboratory 4%	757,500/=	757,500/=
Air ticket for visiting professors 10%	1,893,750/=	1,893,750/=
Total 100%	18,937,500/=	18,937,500/=

Table 13: PROGRAM COSTING 2012/2014

	M.Sc. in Technology Innovations and industrial development	
Revenue per semester	Amounts	
Tuition fees	Semester 1	Semester 2
Student fees @ 1,893,750/= per semester (3,787,500/= per annum)		
Fees (15 students) @1,893,750/=	28,406,250/=	28,406,250/=
Total	28,406,250/=	28,406,250/=
expenditure		
University council 25%	7,101,562.5/=	7,101,562.5/=
Teaching Expenses 41%	11,646,712.5/=	11,646,712.5/=
Administrative Expenses 5%	1,420,312.5/=	1,420,312.5/=
Office Expenses 3%	852,187.5/=	852,187.5/=
Library Materials 2%	568,125/=	568,125/=
Faculty Levy 5%	1,420,312.5/=	1,420,312.5/=
Utilities/Furniture 1%	284,062.5/=	284,062.5/=
Staff Development 2%	568,125/=	568,125/=
Computer Laboratory 4%	1,136,250/=	1,136,250/=
Air ticket for visiting professors 10%	2,840,625/=	2,840,625/=
Total 100%	28,406,250/=	28,406,250/=

Note:
Teaching Expenses: Lecturers at 40,000/= per contact hour

Budget narrative:
Programme budget is based on the Ugandan fees structure, all of the 10 graduates in first group are Ugandan, the tuition fees for Ugandan students is 3,787, 500/= per annum.

APPENNDIX II: STAKEHOLDER INPUTS AND COMMENTS

The consultative process used the following methodology.

Phase I: Inception Stage

During inception, key representatives of the relevant industries were interviewed by a team of professors form Makerere University and the Norwegian University of Science and Technology. These included:

1. Uganda Manufacturers Association
2. The Ministry of Tourism, Trade and Industry
3. The Uganda Road Authority
4. Uganda Small Scale Industries Association
5. Engineers Registration Board
6. Uganda Association of Building and Civil engineering Contractors (UNABCEC)

These consultations helped confirm the need for the programme and indicated that the conceived design would receive the backing of the top executives of the target industries.

Phase II: Programme Design Stage

During this stage, a number of researchers were engaged to carry out fieldwork –based research to find usable recommendations and advice for organizing the programme. Interviews of the various stakeholders was done including; undergraduate students and employees in industry who are the target candidates for the programme, the Faculty of Technology staff, executives of Ugandan industries and leaders of industry associations.

The key finds of this research were that:

1. All the organizations interviewed thought that collaboration between the Faculty of Technology is necessary and all were interested in collaboration with the Faculty in various ways.
2. Contact between the university and industry is weak but there is willingness to develop it within a framework of the M. Sc. TIID
3. There is strong motivation for new and employed professional to join the programme
4. Contact with industry during project and thesis work is a motivating factor for students instead of ordinary academic assignments
5. Academic staff are keen to carry out industry-sourced research since it is often applied research and has the potential of immediate implementation

Phase III: Programme Review Stage

Having designed the programme, a serious of consultations were undertaken to seek inputs and comments from the various stakeholders. These included:

1. The Faculty of Technology staff and committees through various meetings whose minutes are available in the Faculty records
2. The Faculty of the Norwegian University of Science and Technology though a visit to Norway by a team from Makerere University. Several modifications were suggested, discussed and incorporated in the revised programme document.
3. Solicitation of written comments from industry and professional associations. Several of these are appended to this document.
4. A stakeholder's workshop. A report of the stakeholder workshop is included below.

MAKERERE UNIVERSITY

FACULTY OF TECHNOLOGY

DEPARTMENT OF MECHANICAL ENGINEERING

REPORT OF THE STAKEHOLDER CONSULTATIVE WORKSHOP ON THE

Master of Science in Technology Innovation and Industrial Development

Date of workshop: 13/05/2010 Place: City Royal Resort Hotel

I: ATTENDACE

Participants	Organisation/ Affiliation	Contacts
1. K. Ssebalamu	Muteesa 1 royal university	0772-626210
2. P.O Lating	Makerere university	0782-904042
3. Eng. Jackson Mubangizi	UNBS/ UIPE	O701-404001
4. Dr. M. Kamatenesi Mugisha	Faculty of Science, Makerere university	0772/0702-438905
5. Kirabo Angella	MEYS CONSULT/ UIPE	078-894999
6. Tolbert Okirine	Mantrac Ug Ltd/ Toric Innovations & Design Ltd	0774-128180
7. Bazalaki Stella	Uganda Broadcasting Corporation	0773-058805
8. Kavuma Chris	Busitema University	0782-264023
9. Ndyamuhaki Benon	Makerere/UIPE	0782-341846
10. Ayor Andrew	Omega Construction Ltd	0782-504758
11. Kasisira L.Levi	Agricultural Eng. Makerere university	0752-960146
12. Yasin Naku Ziraba	Innovations Systems and	0772- 862610

	clusters program, Makerere university	
13. Davis Bariho B.	UIRI	0782-016899
14. Wangi Godfrey	Gayaza Technical	0782-304817
15. Ssengendo Lawrence	Sen. ARCH. KCC	0712-419799
16. J.B. Kirabira	Makerere University	jbkirabira@tech.mak.ac.ug
17. Mackay Okure	Makerere University	mokure@tech.mak.ac.ug
18. Ssajja Ssali G	Makerere University	sssajja@tech.mak.ac.ug
19. B. Nawangwe	Makerere University	Nawangwe@tech.mak.ac.ug
20. J.K. Byaruhanga	Makerere university	jbyaruhanga@tech.mak.ac.ug

II: PROCEEDINGS

§1 Agenda

ACTIVITY	TIME
Registration	08:30- 09:00
Welcome and Self introduction	09:00-09:10
Opening remarks: The Dean of the Faculty of Technology, Prof. B. Nawangwe	09:10-09:20
Programme outline: Prof. M.A. Okure	09:20-09:30
Detailed Programme: Prof. J.K.Byaruhanga	09:30-10:30
Break tea	10:30-11:00
Detailed Programme cont'd: Prof. J.K.Byaruhanga	11:00-12:30
General Discussions and Resolutions	12:30-13:00
Lunch	13:00- 14:00
Departure	14:00 -

§2 Opening remarks

The opened with remarks by Dr. Byaruhanga, the Course Coordinator. The workshop was opened by the Dean, Faculty of Technology, Dr. Barnabas Nawangwe with a request for participants to make best of this initiative to start the programme as their inputs and endorsement is a perquisite for approval by the University Senate.

§3 Presentations

A brief background and outline of the Masters of Science in Technology Innovation and Industrial Development was made. These included: the reason for the introduction of this programme; the difference between this programme and others such as the MBA; the objectives, opportunities for the graduates and those eligible to join; and most importantly, how the programme can contribute towards the national development.

The course outlines were then presented. These covered: the brief description, objectives of the courses, expected outcomes, course outlines.

§4 Discussions

The first point of concern was the number of candidates to be admitted. The plan of taking up only 10 applicants in the first cohort of 2010 and then running for two years without admitting another group. It was felt that it would be difficult for the University Senate to accept that arrangement. The team was advised to look for a strong argument for it.

On the overall objectives and motivation for the course, many participants welcomed this introduction of a course on technology innovation and urged the team to work towards its speedy commencement. A number expressed the opinion that the programme will provide the missing in collaboration between the university and industry – that is – establishing and developing businesses through research and entrepreneurship as a major departure from undergraduate internships. The availability of the scholarship was considered a strong incentive for industry to release employees for the programme. The university was cautioned against having the graduate spend more that the specified two years on the programme and to minimize drop-outs.

On each course, a number of useful points were suggested. These were points for inclusion and what could be left out to make it better. A number of participants raised comments and requested clarifications. Some of these were:

1. The subjects of entrepreneurial marketing, certification and market analysis should be included in the programme.
2. 'Total Quality Management' be changed to 'Quality management', and that it should also involve product/service standards.

§5 The Way Forward

The following resolutions were made;

1. The suggested numbers of those to be admitted would be for the pilot project period and the scholarships and that since the need for the masters is critical, admission figures must be increased after the funded period ends to ensure sustainability of the programme.
2. Admission should only be meant for students with a background of science and technology only in order to ensure that the focus of the programme and the projects and research to be done lead to technological advancement of industry and the country. Students from other backgrounds could take the MBA or other suitable alternative.
3. The graduates should be motivated enough so that they stay and finish their studies in time by giving them information that challenges them.

§6 closing of the meeting

The meeting was closed by Dr. Byaruhanga who thanked the participants for coming and promised that their comments would be incorporated in the programme document.

APPENNDIX III: COMMENTS FROM STAKE HOLDER INSTITUTIONS

Norwegian University of Science and Technology NTNU

Department of Civil and Transport Engineering
Faculty of Engineering Science and Technology

Tel: (+47) 73 59 46 38
Fax: (+47) 73 59 70 21
Post: N-7491 Trondheim, Norge
Email: tore.haavaldsen@ntnu.no

The Director
School of Graduate Studies
Makerere University
P.O. Box 7062
KAMPALA, UGANDA

NTNU, 19th July 2010

Dear Sir

COLLABORATION BETWEEN NTNU AND FACULTY OF TECHNOLOGY MAKERERE UNIVERSITY

In early 2009, the Norwegian University of Science and Technology (NTNU) made a successful joint application with the Faculty of Technology to NORAD for a grant to run a Masters Programme, which would foster closer ties between Makerere University and Industry. This would be achieved through training 25 Ugandan graduates of Science and Technology at a Masters level with special emphasis on technology and innovation, which are the drivers of competitiveness of industry. The main requirement is that within four years (by 2014), the Programme will produce 25 Masters graduates with at least 50% coming from industry. Furthermore, we expect that 2 or 3 will of these be going on to do Ph.D. for sustaining the programme.

The Faculty of Technology has developed the programme with input from Ugandan Government and the Norwegian Government. In addition, two staff members of the Faculty of Technology have recently visited NTNU and been thoroughly briefed in our Masters Programmes on Project management, Safety, Health and Environment (SHE), Global Technology Management and the Integrated Masters Programme. They were also introduced to special topics, group work in Projects and masters thesis as well as User Oriented Research.

We also noted that Makerere had about 15 Professors who can participate in the implementation of the Programme, which should be adequate. Also, during the course of the co-operation, several NTNU Professors are expected to provide further input to the Programme as visiting Professors.

We therefore recommend the approval of the Programme of Masters of Science in Technology Innovation and Industrial Development as it will produce highly innovative human resource with background in Science and Technology for Uganda.

Yours faithfully,

(sign.)

Bjørn Otto Elvenes
Project Coordinator

Tore Haavaldsen
Professor

Cc: B. Nawangwe, Dean FOT, and Prof. M. A. Okure

Figure 1: COMMENTS FROM NTNU UNIVERSITY

Uganda National Roads Authority

Plot 11 Yusuf Lule Road
P.O. Box 25467
Kampala Uganda
In any correspondence on this subject
Please quote No:UNRA/10/CT/15

6 July 2010

The Programme Coordinator,
M.Sc. TIID Programme,
Department of Mechanical Engineering
P.O. Box 7062,
Kampala, Uganda.

Attention of: Prof. J.K. Byaruhanga

Dear Sir,

PROPOSED MASTER OF SCIENCE IN TECHNOLOGY INNOVATION AND INDUSTRIAL DEVELOPMENT (M.Sc. TIID)

Reference is made to yours of 4th May 2010 forwarding for our comment a programme on the course for the Master of Science in Technology Innovation and Industrial Development (M.S.c. TIID).

This programme, developed by the Faculty of Technology in collaboration with the Norwegian University of Science and Technology targets among others graduates coming from industry or having extensive industrial background. The course is also built with an outcome oriented focus and a user-industry perspective.

The Uganda National Roads Authority (UNRA), whose mandate is the development and maintenance of road infrastructure, has core functions that are engineering based. We therefore note with satisfaction the focus and perspective of the course and believe that it opens room for appropriate collaboration between institutions such as ours and the University in areas of common interest.

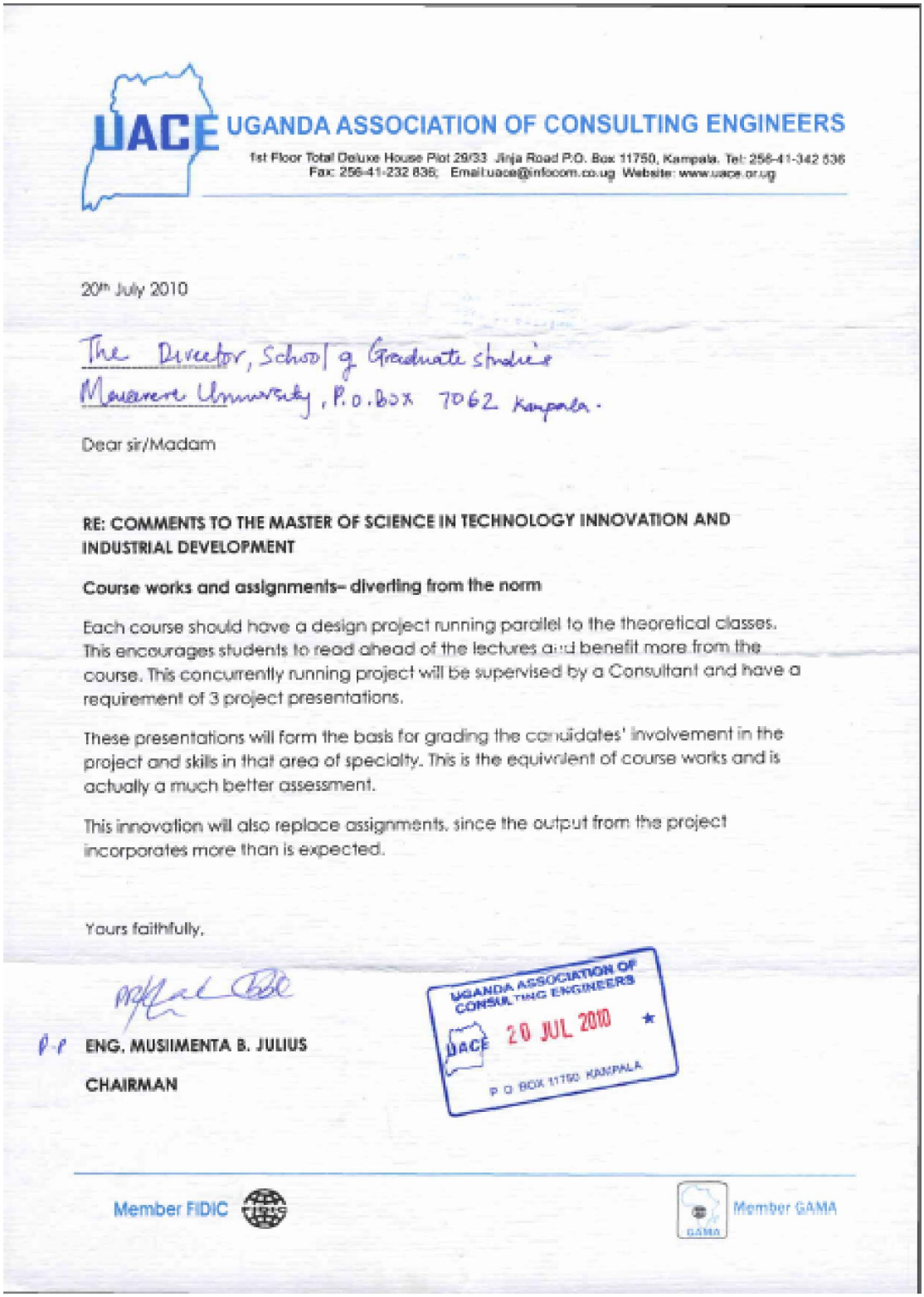
We do find the program well structured and consider the course relevant. Its blend will undoubtedly be attractive to multi-disciplinary participants in the engineering related fields.

We recommend the course to technical persons in our organization, and will encourage and support those who may develop interest.

Yours faithfully,

Peter W. Ssebanakitta
Executive Director

Figure 2: COMMENTS FROM UNRA



UACE UGANDA ASSOCIATION OF CONSULTING ENGINEERS

1st Floor Total Deluxe House Plot 29/33 Jinja Road P.O. Box 11750, Kampala. Tel: 256-41-342 536
Fax: 256-41-232 836; Email:uace@infocom.co.ug Website: www.uace.or.ug

20th July 2010

The Director, School of Graduate studies
Makerere University, P.O.Box 7062 Kampala.

Dear sir/Madam

RE: COMMENTS TO THE MASTER OF SCIENCE IN TECHNOLOGY INNOVATION AND INDUSTRIAL DEVELOPMENT

Course works and assignments– diverting from the norm

Each course should have a design project running parallel to the theoretical classes. This encourages students to read ahead of the lectures and benefit more from the course. This concurrently running project will be supervised by a Consultant and have a requirement of 3 project presentations.

These presentations will form the basis for grading the candidates' involvement in the project and skills in that area of specialty. This is the equivalent of course works and is actually a much better assessment.

This innovation will also replace assignments, since the output from the project incorporates more than is expected.

Yours faithfully,

P.P **ENG. MUSIIMENTA B. JULIUS**

CHAIRMAN

UGANDA ASSOCIATION OF CONSULTING ENGINEERS
UACE 20 JUL 2010
P O BOX 11750 KAMPALA

Member FIDIC

Member GAMA

Figure 3: COMMENTS FROM UACE

UGANDA NATIONAL BUREAU OF STANDARDS

Our Ref: BO/TRN/010 ..... Your Ref: ..... Date 2010-07-20 .....

The Dean Faculty of Technology
Makerere University,
Kampala.

Attn: Prof. J.K. Byaruhanga

RE: PROPOSED MASTER OF SCIENCE IN TECHNOLOGY INNOVATION AND INDUSTRIAL DEVELOPMENT

UNBS received your letter dated May 4, 2010 together with details of the proposed Master of Science in Technology Innovation and Industrial Development (M.Sc. TIID). UNBS finds this course relevant to the Industry and timely more especially in linking up the industry practices with theories. It also comes when the Government is emphasizing the need for Institutions of Higher Learning to produce graduates who are job creators as opposed to job seekers.

It is important to note that the local, regional and global markets are gradually opening up but the standards related barriers are remaining in place. The survival of any business therefore is hinged on its ability to meet requirements of standards. It is therefore necessary to mainstream standards in various courses. It is on basis of this background that we recommend that various courses be enriched to focus on various standardization requirements as follows;

TID7204: Quality Management; may be enriched with aspects of management systems based on relevant requirements such requirements of Quality Management Systems (ISO 9001), Good Manufacturing Practices (GMP), Hazard Analysis Critical Control Points (HACCP).

TID7208: Product Design and Development; enriching Product specifications to include development of product standards, stages of development of standards, product certification, quality assurance regimes, accreditation of quality assurance schemes, packaging and labelling requirements.

TID 8102: Safety Health and Environment Management; may be enriched to include Environmental Management systems, Occupational Health and Safety, Environmental Regulations based on existing standards such ISO 14001.

UNBS therefore recommends this course to the Industry and I hope the above proposed additions will be of value. We are also more than willing to offer technical and advisory support in mainstreaming standards in your curriculum.

Yours faithfully,

UGANDA NATIONAL BUREAU OF STANDARDS

Dr. Terry Kahuma
EXECUTIVE DIRECTOR

UGANDA NATIONAL BUREAU OF STANDARDS
P. O. BOX 6329, KAMPALA

Postal Address	Office Address	Telephone	256-414-286123	Telefax	256-414-286123
P.O. Box 6329	Plot M217 Nakawa	Executive Director	256-414-222367/505995		
KAMPALA	Industrial Area	General Line	256-31-262688/9	Website	www.unbs.go.ug
		E-mail Address:	unbs@infocom.co.ug		

Figure 4: COMMENTS FROM UNBS

UGANDA INSTITUTION OF PROFESSIONAL ENGINEERS

Management Support Unit Building,
Public Works Training Centre,
Plot 2, Gloucester Avenue, Kyambogo
P. O. Box 1308, KAMPALA
Tel : +256 414 287 292
Fax : +256 414 287 291
E-mail : uipe@infocom.co.ug
Website : www.uipe.co.ug

21 July, 2010

The Dean
Faculty of Technology
Makerere University
P. O. Box 7062
KAMPALA

Attn: Professor J. K. Byaruhanga

RE: PROPOSED MASTER OF SCIENCE IN TECHNOLOGY INNOVATION AND INDUSTRIAL DEVELOPMENT (Msc.TIID).

Reference is made to your request to review the proposed programme mentioned above which the faculty is planning to start in the department of Mechanical Engineering. After a considerable discussion about the issue, the following are our comments:

(a) According to the proposal, the programme was found to be relevant more especially on addressing the practical and real life challenges in the industry.
(b) The proposed catchment area of applicants is intended to cover non-engineering courses such as Food Science Technology. Whereas it's good to widen on the scope, it would be important to focus on students with engineering background since the course is oriented to engineering.
(c) Lastly, it should be emphasized in the background information of the course that it's not aiming at training individuals to become engineers but it's to enable applicants to overcome life challenges faced with engineering graduates.

I wish to commend you for coming up with this course and I pledge to continue working with you in providing good environment for development of engineering profession.

Eng. Jackson Mubangizi
PRESIDENT

Figure 5: COMMENTS FROM UIPE

APPENNDIX IV: ABSTRACTS FROM NTNU M.SC. STUDENT THESES

NORGES TEKNISK-
NATURVITENSKAPELIGE UNIVERSITET
INSTITUTT FOR BYGG, ANLEGG OG TRANSPORT

Title: Start-up of the proposed NOMA M.Sc. program in Technology Innovation and Industrial Development at Makerere University, Uganda - Challenges, needs and possibilities	Date:14.06.2010 Number of pages (included appenices): 87			
	Master thesis	X	Project work	

Name:
Stud.techn. Per Bjørnson Lunke

Supervisor:
Tore Haavaldsen

External supervisors:
Bjørn Otto Elvenes and Arild Aspelund, Institutt for industriell økonomi og teknologiledelse

Abstract:

NTNU and Makerere University has a long history of close collaboration. This collaboration has earlier lead to the start-up and running of different master and Ph.D. programs at Makerere University. Now a new project is started in order to start up and run two cohorts of Master of Science in Technology Innovation and Industrial Development. The project will be economically supported by NOMA for four years.

The contact between Makerere University and the industry and business life in Uganda is weak or non-existent. The goal of the new program at Makerere University is to increase this contact, and establish long-term collaboration between the university and the industry. The students will partly be recruited from companies in the industry, and the companies will be involved in the students' projects and thesis work.

The possibility of scholarships is found to be very attractive among relevant candidates, and seems to attract attention and interest in the program. It will be important to secure the candidates' motivation to complete the program when receiving scholarships. Experiences from similar projects show that students might be more interested in economic assistance and scholarships, than in the program and the education.

Current students tend to express frustration with the help and guidance from their supervisors. It is found to be of great importance to the students that the supervisors and professors take interest in their work and progression. Contact with the industry during project and thesis work is also found to motivate the students more than ordinary academic assignments given by the university.

It will be important to follow up the students and give them guidance during the two years of the program. Problems and challenges need to be dealt with as soon as possible in order to secure a well organized program before enrolling students without scholarships.

Key words:

1. Makerere University
2. Innovation and Industrial Development
3. University-Industry relations
4. Scholarship

Per Bjørnson Lunke
Sign.

NORWEGIAN
UNIVERSITY OF
SCIENCE AND TECHNOLOGY

Title of the assignment:	Date: 14.06.10			
Investigation of the Ugandan Construction Industry's Interests in Industry-University Collaboration in a New Master's Degree Programme at Makerere University: Technology Innovation and Industrial Development	Number of pages (incl. appendices): 195			
	Master's thesis	X	Project work	
Name: Stud. techn. Line Maria Solberg				
Supervisor: Professor Tore Haavaldsen, NTNU				

A new master's degree programme, Master of Science in Innovation and Industrial Development (M.Sc. TIID), will start at Faculty of Technology (FOT) at Makerere University (MU), Kampala, in August 2010. Closer industry-university collaboration through the M.Sc. TIID should be achieved by inviting engineers with bachelor's degrees from different organizations to do the master's degree, and the students in the programme should do their master's theses within an organization in industry.

This thesis describes how different parts of Ugandan construction industry respond to the start-up of the M.Sc. TIID; if they are willing to be involved in collaboration with FOT through the M.Sc. TIID, and in which ways. 20 organizations in the construction industry in the city of Kampala were interviewed. The organizations were chosen by advices given by employees at FOT, and also by *snowball sampling*.

All the organizations that were interviewed thought collaboration between FOT and the construction industry in Kampala is necessary, and all of the organizations were interested in collaboration with FOT. They wanted to be involved in collaboration with FOT in different ways, and they set various conditions for different type of participation. All in all, lack of finances confines the possibility or the willingness for the organizations' fully involvement in the M.Sc. TIID.

Due to lack of understanding of the scope of the M.Sc. TIID, and because of the way the challenges in the construction industry affect the organizations, it is concluded that parts of the construction industry are not developed or mature enough for the M.Sc. TIID. The organizations within the construction industry which should be contacted for collaboration are: DWD, MTTI, UNRA, NWSC, Multi-Konsults Ltd, and MBW Consulting Ltd. Recommendations of how FOT can design the master's degree programme, so that the participating industry will benefit from the collaboration, are given in the final part of the thesis.

Keywords:

1. Continuous education
2. Makerere University
3. Industry-university collaboration
4. Construction industry

Line Solberg

APPENNDIX V: MASTER COURSES CURRENTLY IN FOT

M.Sc. ELECTRICAL ENGINEERING

Semester I

CODE TITTLE		LH	PH	CH	CU
EMT 7102	Advanced Engineering mathematics	45	0	45	3
ELE 7103	Computer Applications and Programming	45	30	60	4
ELE 7102	Experimental Methods and Instrumentation	45	30	60	4
ELE 7103	Information technology and systems	45	30	60	4
ELE 7104	Energy sources and environment	45	30	60	4

Semester II

Compulsory course

TEC7200	Research Methods	45	0	45	3

Elective courses (Choose Four)		LH	PH	CH	CU
ELE 7207	Machines and machine design	45	30	60	4
ELE 7208	Power generation	45	0	45	3
ELE 7209	Power system design, operation and management	45	0	45	3
ELE 7210	Industrial control systems	45	30	60	4
ELE 7211	Signal and systems	45	0	45	3
ELE 7212	Electronic devices: design and fabrication	45	30	60	4
ELE 7213	microprocessors	45	30	60	4
ELE 7214	Computer technology	45	30	60	4
ELE 7215	Communication theory	45	0	45	3
ELE 7216	Telecommunication techniques	45	30	60	4
ELE 7217	Telecom system design, operation and management	45	0	45	3
ELE 7218	Propagation	45	0	45	3
ELE 7219	Radio frequency techniques	45	30	60	4
ELE 7220	Instructional methods	30	0	30	2
ELE 7221	Principle of management	30	0	30	2
ELE 7222	Development studies	30	0	30	2

Year II

Semester I and II

TEC 8101	RESEARCH Work AND DISSERTATION	45	270	135	12

M.Sc. MECHANICAL ENGINEERING

Semester 1

CODE TITTLE		LH	PH	CH	CU
EMT 7102	Advanced Engineering mathematics	45	0	45	3
EMT 7103	Computer Applications	45	30	60	4
MEC 7102	Instrumentation and control	45	30	60	4
MEC 7103	Advanced engineering materials	45	30	60	4
MEC 7104	Quality control and management	45	0	45	3

Semester II

Compulsory course

TEC7200	Research Methods	45	0	45	3

Elective courses (select four)		LH	PH	CH	CU
MEC 7206	Extractive Metallurgy	45	30	60	4
MEC 7207	Advanced manufacturing processes	45	30	60	4
MEC 7208	Welding technology	45	30	60	4
MEC 7209	Plastics engineering	45	30	60	4
MEC 7210	Advanced chemical metallurgy	45	30	60	4
MEC 7211	Mechanics of fracture and fatigue	45	30	60	4
MEC 7212	Fuels, furnace and refractories	45	30	60	4
MEC 7213	Plastic deformation of materials	45	30	60	4
MEC 7214	Operation research and management	45	0	45	3
MEC 7215	Applied statistics	45	30	60	4
MEC 7216	Production planning and control	45	0	45	3
MEC 7217	Facility location and layout	45	0	45	3
MEC 7218	Human resource management	45	0	45	3
MEC 7219	CAD/CAM (advanced manufacturing technology)	45	30	60	4
MEC 7220	Plant engineering	45	30	60	4
MEC 7221	Materials handling and management	45	0	45	3
MEC 7222	Energy planning	45	30	60	4
MEC 7223	Renewable energy technology	45	30	60	4
MEC 7224	Air conditioning and refrigeration	45	30	60	4
MEC 7225	Conduction and radiation heat transfer	45	30	60	4
MEC 7226	Conduction and radiation head transfer	45	30	60	4
MEC 7227	Head exchange design	45	30	60	4
MEC 7228	Combustion engineering	45	30	60	4

Year II

Semester I and II

TEC 8101	RESEARCH WORK AND DISSERTATION	45	270	135	12

M.Sc. Civil Engineering

YEAR I

SEMESTER I

COMPULSORY COURSES

		LH	PH	CH	CU
EMT 7102	Advanced mathematics	45	0	45	3
EMT 7103	Computer application in engineering	45	30	60	4
CIV 7102	Environment studies	45	0	45	3
Compulsory courses from each specification					
Construction management					
CIV7201	Project management and control	45	30	60	4
CIV7204	Construction economics	45	0	45	3
Environmental engineering					
CIV7105	Water treatment	45	30	60	4
CIV7106	Environmental quality management	45	30	60	4
Structural engineering					
CIV7107	Advanced structural mechanics				
CIV7108	Advanced structural design	45	30	60	4
Geotechnical engineering					
CIV7109	Intermediate soil mechanics	45	0	45	3
CIV7110	Advanced foundation design	45	0	45	3
Highway/transportation engineering					
CIV7111	Transportation system analysis	45	0	45	3
CIV7112	Highway geometric design	45	0	45	3
Water resources engineering					
CIV7113	Water resources management	45	0	45	3
CIV7114	Advanced surface hydrology	45	0	45	3

Semester II

Compulsory courses

TEC 7200	Research methods	45	0	45	3

ELECTIVE COURSES (at least four from each specification)

Construction Management		LH	PH	CH	CU
CIV7219	SITE management and practice	45	30	60	4
CIV7220	Advance construction technology				
CIV7221	Contracts law and management	45	30	60	4
CIV7222	Systems engineering	45	30	60	4
CIV7223	Strategic management in construction	45	0	45	3
CIV7224	Construction business management	45	0	45	3
Environmental engineering					
CIV7225	Waste water treatment	45	30	60	4
CIV7226	Water transport and distribution	45	0	45	3
CIV7227	Industrial waste and water treatment	45	0	45	3
CIV7228	Solid waste management	45	0	45	3
CIV7229	Air pollution	45	30	60	4
CIV7230	Wetlands & waste water treatment	45	30	60	4
Structural engineering					
CIV7231	Numerical methods of structural analysis	45	0	45	3
CIV7232	Structural dynamics	45	0	45	3
CIV7233	Stability of structures	45	0	45	3
CIV7234	Plates and shells	45	0	45	3
CIV7235	Applied elasticity	45	0	45	3
CIV7236	Durability and maintenance of structures	45	0	45	3
Geotechnical engineering					
CIV7237	Soil improvement	45	0	45	3
CIV7238	Earth structures	45	0	45	3
CIV7239	Advanced laboratory	30	60	60	4
CIV7240	Soil structure interaction	45	0	45	3
CIV7241	Advanced mechanics of materials	45	0	45	3
CIV7242	Slope stability	45	0	45	3
Highway/transportation engineering					
CIV7243	Structural design of pavements	45	0	45	3
CIV7244	Performance and rehabilitation of pavements	45	30	60	4
CIV7245	Pavement materials	45	30	60	4
CIV7246	Transportation planning &modeling	45	0	45	3
CIV7247	Traffic systems analysis	45	0	45	3
CIV7248	Mix design	45	0	45	3
Water resources engineering					
CIV7249	Hydraulic engineering	45	30	60	4

CIV7250	Ground water investigation and technology	45	0	45	3
CIV7251	Statistical analysis in hydrology	45	0	45	3
CIV7252	Fluid mechanics	45	0	45	3
CIV7253	Water resources planning	45	30	60	4

YEAR II
SEMESTER I & II

CE7200	RESEARCH WORK AND DISERTATION	45	270	135	12

APPENNDIX VI: DEFINITION OF KEY WORDS

INNOVATION

Innovation can be defined as a change in the thought process for doing something, or the useful application of new inventions or discoveries. It may refer to an incremental or radical revolutionary change in thinking, products, processes, or organizations. The distinguishing feature between invention and innovation is that one is done after the other though many do confuse this. Invention, *an idea made manifest* and innovation, *ideas applied successfully in practice*. An innovation must be something new, better than what exists, economically viable and having a widespread appeal.

ENTREPRENEURSHIP

Entrepreneurship is the act of being an entrepreneur, which is a French word meaning "one who undertakes innovations, finance and business acumen in an effort to transform innovations into economic goods". This may result in new organizations or may be part of revitalizing mature organizations in response to a perceived opportunity. The most obvious form of entrepreneurship is that of starting new businesses (referred as Startup Company); however, in recent years, the term has been extended to include social and political forms of entrepreneurial activity. When entrepreneurship is describing activities within a firm or large organization it is referred to as intra-preneurship and may include corporate venturing, when large entities spin-off organizations.

INTRA-PRENEURS

An intra-preneur is a person within a large or small corporation who takes direct responsibility for turning an idea into a profitable finished product through assertive risk-taking and innovation. Intra-preneurs have been credited with increasing the speed and cost-effectiveness of technology transfer from research and development to the marketplace. While intra-preneurs are sometimes considered inventors, inventors come up with new products. Intra-preneurs come up with new processes that get that product to market. Part of the reason they are considered similar to inventors is that they are creative and are risk-takers in the sense that they are stepping out of their traditional role within the business.

INDUSTRIAL DEVELOPMENT/INDUSTRIALIZATION

According to the National Industrial Policy of 2008, “Uganda’s economic transformation will critically hinge upon industrialization and the application of science, technology and innovation as the main drivers and prime agents” The M.Sc. TIID aims to produce graduate who can make a contribution towards industrial development by using science, technology and innovation to contribute to improved competitiveness of Uganda’s industry hence leading to their growth and eventually to industrialization.