FACULTY OF NATURAL RESOURCES AND ENVIRONMENTAL SCIENCES

DEPARTMENT OF ENVIRONMENTAL PLANNING AND MANAGEMENT

MASTER OF SCIENCE IN CLIMATE CHANGE AND DISASTER RISK MANAGEMENT PROGRAMME

MAY 2020

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Executive Summary

The Faculty of Natural Resources and Environmental Sciences was established in 2009 at Busitema University and is currently implementing Graduate Programmes in Climate Change and Disaster Management, and Environmental Economics. The Faculty is also implementing Undergraduate Programmes in Natural Resource Economics, and Fisheries and Water Resources Management. The Faculty is in the process of developing the Bachelor of Science in Environmental Science and Management, Master of Science in Environmental Governance, and Master of Geo-Information Science Programmes. The Master of Science in Climate Change and Disaster Management Programme (MCC) commenced in 2015 and is currently under review. The Curriculum Review Committee proposes that the reviewed MCC Programme is named as Master of Science in Climate Change and Disaster Risk Management but maintains the acronym MCC. The revised MCC Programme focuses on the link between climate change, disaster risk reduction and sustainable development. The justification for this linkage is that weather related events are the major cause of damage in the world (Kreft, *et al*., 2016). At the regional level, Africa holds half of the world's disaster risk prone countries (UNISDR, 2015). At the national level, Uganda is considered one of the high disaster risk countries in the world (INFORM, 2016). The MCC Programme cuts across several disciplines and is foreseen to be on high demand in the country and region. The Programme is designed to impart knowledge and skills, and produce professionals who can design and implement climate change and disaster risk reduction interventions. The Programme duration shall be two years, consisting of four semesters. Coursework shall be covered in the first two semesters while the last two semesters shall be devoted to in-depth research resulting into a dissertation. In addition, students shall attend graduate seminars and workshops as required.

ACRONYMS

CDM	Clean Development Mechanism
CO_2	Carbon dioxide
CGPA	Cumulative Grade Point Average
DBMS	Database Management System
ESIA	Environment and Social Impact Assessment
FAO	Food and Agriculture Organization of the United Nations
GEP	Geo-Information and Physical Land resources
GIS	Geographic Information Systems
GPA	Grade Point Average
GHG	Green House Gases
ICT	Information and Communication Technology
ILWIS	Integrated Land and Water Information System
MEAs	Multilateral Environment Agreements
NDVI	Normalized Difference Vegetation Index
NRM	Natural Resource Management
PCM	Project Cycle Management
RS	Remote Sensing
UNFCCC	United Nations Framework Convention on Climate Change

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1.0 INTRODUCTION

1.1 Background to Busitema University

Busitema University is a public University established by statutory instrument No. 22, 2007. The University was established as a multi-campus model, with Campuses located at Busitema (Faculty of Engineering), Nagongera (Faculty of Science and Education), Namasagali (Faculty of Natural Resources and Environmental Sciences), Arapai (Faculty of Agricultural Sciences), Mbale (Faculty of Health Sciences), and Pallisa (Faculty of Management Sciences). The University is mandated to provide higher education through teaching, research and outreach. The current university enrolment is 3072 students. The University offers Diplomas, Undergraduate Degrees, Postgraduate Diplomas, Masters Degrees and PhDs in various fields. The University is committed to its vision of becoming "*A center of academic and professional excellence in science, technology and innovation*". The University motto is *"Pursuing excellence*". The University mission is *to provide inclusive high standard training, engage in quality research and outreach to support industrialization and sustainable development*. The University Core Values are; Respect, Professionalism, Customer First, Innovativeness and Integrity.

1.1.1 The Faculty of Natural Resources and Environmental Sciences

The vision of the faculty is "rooting in mathematical and geo-informatics applications in Natural Resources and Environmental Sciences". Its mission is to deliver excellent teaching, research and outreach services in Natural Resources and Environmental Sciences. The Faculty of Natural Resources and Environmental Sciences was established in 2009. The Faculty is made up of three academic departments: Department of Natural Resource Economics; Department of Environmental Planning and Management; and Department of Geo-Information Science, Earth Observation and Physical Land Resources. The Faculty is currently implementing the following Graduate Programmes; Master of Science in Climate Change and Disaster Management, and Master of Science in Environmental Economics. The faculty is also implementing the following Undergraduate Programmes; BSc. Natural Resource Economics, and BSc. Fisheries and Water Resources Management. The Faculty is in the process of developing the BSc. Environmental Science and Management, Master of Science in Environmental Governance, and Master of Science in Geo-Information Science Programmes.

1.2 Background to the Programme

Climate change, disaster risk reduction and sustainable development are inter-related (Kelman, 2017). Climate Change and disasters can impede poverty reduction, and affect the poor and vulnerable people most (World Bank, 2012). Climate change has been characterized by increased incidence of weather related events such as droughts, floods and landslides, and is the major cause of damage in the world. For example, 11,000 extreme weather events were recorded between 1996 and 2015, killing 528,000 people and causing economic losses amounting to US$ 3.08 trillion (in Purchasing Power Parity) (Kreft, *et al*., 2016). Africa holds half of the world's disaster risk prone countries and is experiencing an increasing number of disasters due to climate change, poorly planned urbanization, environmental degradation, poverty and inequality, fragility and conflict (UNISDR, 2015). With a risk index of 5.9, Uganda is considered one of the high disaster risk countries in the world. Although Uganda has a medium hazard and exposure index of 5.0, its vulnerability (6.0) and lack of coping capacity (6.9) indices are high (INFORM, 2016). In 2015, Uganda lost US$ 0.986 million (in Purchasing Power Parity) to extreme weather events (Kreft, et al., 2016). From 1980 to 2010, at least 61 disaster events resulting from various geological, hydro-meteorological, socio-natural and technological hazards were reported in the country (CRED, 2014).

In response to the above challenges, the international community is currently implementing several major international agreements; the Paris Agreement (UNFCCC, 2015), the Sustainable Development Goals (UNGA, 2015), and the Sendai Framework for Disaster Risk Reduction (UNISDR, 2015). At continental level, the Africa Union Agenda 2063 (AU, 2015) aspires to achieve a prosperous Africa based on inclusive growth and sustainable development, and identifies action on climate change as one of the critical enablers for Africa's transformation. At regional level, the East African Community Protocol on Environment and Natural Resources Management (2006) provides for common climate and disaster preparedness and management policies, laws and strategies among member states.

Uganda has put in place several formal climate and disaster risk reduction policies, laws and regulations, including the: Constitution of the Republic of Uganda, 1995 (as amended); National Environment Act Cap, 153; National Environment (Mountainous and Hilly Areas Management)

Regulations, 2000; National Environment Management Policy, 1995; National Policy for Disaster Preparedness and Management (NPDPM; 2010); the Uganda National Climate Change Policy, 2015; Second National Development Plan, 2015; and Uganda Vision 2040. The country also implemented the Hyogo Framework for Action [HFA] 2005-2015. Uganda is currently implementing the Sendai Framework for Disaster Risk Reduction [SFDRR] 2015-2030 (Office of the Prime Minister, 2010, 2015; UNISDR, 2015).

1.3 The Programme Review Process

The National Council for Higher Education (NCHE) quality assurance guidelines require that academic programmes be reviewed regularly. The Faculty of Natural Resources and Environmental Sciences led by the Department of Environmental Planning and Management initiated the review process for the MCC Programme. This involved reviewing the courses and entire programme to enhance its relevance. The review process involved two workshops for MCC course instructors and other academic staff in the faculty. A workshop was organized to get feedback from other stakeholders, including the National Environment Management Authority, Uganda National Meteorological Authority, Jinja District Local Government, and MCC Alumni. Other Busitema University Officers, including the Deputy Vice Chancellor, Academic Registrar, Director for Quality Assurance, and Director for Post Graduate Studies, Research and Innovations were consulted. A Survey was also conducted to obtain feedback from the MCC Alumni who did not attend the stakeholders' workshop. The Faculty Higher Degrees Committee considered all the feedback, and forwarded the revised MCC Programme to the Board of Graduate Studies, Senate and University Council for consideration.

1.4 Programme Justification

Climate change will increase the frequency and intensity of disaster risks (Republic of Uganda, 2007). One of the key objectives of Uganda's National Policy for Disaster Preparedness and Management (Office of the Prime Minister, 2010) is to promote research and technology for disaster risk reduction. The policy mandates the Ministry of Education to promote training programmes and mainstream disaster risk management in the curriculum at all levels. The policy also underscores the need for human resource development and building coping capacity in terms of skills and knowledge required for disaster preparedness and management. The National Climate Change Policy on the other hand seeks to inter-alia; promote adaptation and mitigation policy

responses for Uganda (Ministry of Water and Environment, 2013). The proposed Master of Science Programme in climate change and disaster risk management will contribute to the expertise required to address climate change and disaster risk management challenges at the local, national, regional and global levels.

1.4 Programme Name

The name of the Programme is Master of Science in Climate Change and Disaster Risk Management.

1.5 Programme Aim and objectives

1.5.1 Aim

The MCC Programme seeks to contribute to research and development in the field of Climate Change Science and Disaster Risk Management.

1.5.2 Specific Objectives

The specific objectives of the MCC Programme are to enable students:

1. Acquire skills that support localization of tools and methods used to study climate change and disaster risk management.
2. Translate theories and concepts into national and international strategic climate change and disaster risk management interventions.
3. Acquire skills for implementing climate change and disaster risk mitigation interventions.
4. Design and implement climate change and disaster risk policy.

1.6 Learning Outcomes

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

1. Suggest solutions climate change and disaster risk management challenges
2. Apply theories and concepts of climate change and disaster risk management to develop national and international strategic interventions.
3. Demonstrate how climate change and disaster risk management can be mainstreamed in development planning.
4. Translate climate change and disaster risk policy into practice.

2.0 RESOURCES

2.1 Technical and Infrastructural facilities

2.1.1 Teaching and learning facilities

The faculty is equipped with a computer laboratory with internet connection. Computers installed with relevant software are in place to support the programme. The software includes R statistical programme, ArcGIS, Stata, ILWIS, MapInfo and Matlab. Each student will also be required to have a personal laptop as per the University policy. The University library is well stocked with relevant text books, including E-books and journals.

2.1.2 Research, innovation and outreach facilities

The programme will make use of available Climate Change and disaster risk management facilities at the Climate Change Department in the Ministry of Water and Environment, and Department for Disaster Preparedness and Management in the Office of the Prime Minister. The programme will also benefit from established networks in and outside the country including land degradation and disaster risk management projects in Mount Elgon and Rwenzori, National Agricultural Research Organization (NARO), Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), Catholic University of Leuven in Belgium, and Sokoine University of Agriculture in Tanzania.

2.1.3 Programme funding

The source of funding for this programme will be students' fees and donor scholarships. Various other sources of funding will be sought through research grants.

2.2 Human Resources

The faculty has three full time staff with Doctorate Degrees, including one Professor and two senior lecturers. Six other staff are currently pursuing doctoral studies in fields related to climate change and disaster risk management.

Part-time staff from the sister Faculties of Science and Education, Engineering, Agriculture and Animal sciences, and Management Sciences will be involved in implementing the programme. Additional part-time staff will be solicited from collaborating Organizations, including; NARO, NEMA, the Climate Change Department, and Uganda National Meteorology Authority in the

Ministry of Water and Environment, and the Department of Disaster Preparedness and Management in the Office of the Prime Minister. Visiting Professors will be solicited from collaborating Universities like Sokoine University, KU Leuven in Belgium, Makerere University, Gulu University, University of Nairobi, University of Mekelle in Ethiopia, and Free University of Brussels.

The programme will be supported by a computer laboratory technician with skills in Information Technology and Geographic Information Science / Remote Sensing who will guide students through their practical lessons. The programme will also be supported by three staff members, including; an Administrative Assistant, ICT Technician, and Cleaner.

Table 1 ***Teaching Staff for the Master of Science in Climate Change and Disaster Risk Management Programme***

Name	Highest Qualification	Awarding Institution	Year	Specialization	Course Unit
Full Time Staff					
Prof. Moses Isabirye	PhD	KU Leuven, Belgium	2005	Resource surveys	GIS and Spatial Analysis; Research Methods; Environment and Social Impact Assessment
Dr. Alice. Nakiyemba	PhD	KU Leuven, Belgium	2013	Applied Biological Sciences-Environmental Sociology	Environmental Sociology; Research Methods; Environmental Law, Policy and Governance
Dr. Sowedi Masaba	PhD	University of Nairobi	2018	Disaster Risk Management, and Environmental Governance	Hazard and Risk Assessment, Early Warning Systems; Disaster Risk Planning and Coordination; Environmental Law, Policy and Governance
Mr. Kakungulu Moses	MA Economic Policy and Planning	Makerere University	2007	Resource and Environmental Economics	Applied Statistics; Resource and Environmental Economics; Mathematical Modeling and Econometrics
Mr. Kifumba David	MSc. Environment and Natural Resource Management	Makerere University	2002	Environment and Natural Resources	Industrial Ecology
Mr. G. Taako,	MA. Economic Policy and Planning	Makerere University	2007	Resource Economics	Environment and Social Impact Assessment

Mr. Henry Kisu Kisira	MSc. Forestry; MBA	Makerere University	2007	Resource Economics, Forestry	Environmental Law, Policy and Governance
Mr. James Ssuuna	MSc. Statistics	Makerere University		Applied Statistics	Applied Statistics
Part Time Staff					
Dr. Saul Daniel Ddumba	PhD	Michigan State University	2018	Climate Change, Environmental Science & Policy	Climatology and Climate Change; Climate Change Mitigation, Adaptation and Assessment
Dr. Twaib Ssemwogerere	PhD	Makerere University	2016	Mathematical Modelling	Mathematical Modeling and Econometrics
Dr. Basil Mugonola	PhD	KU Leuven, Belgium	2012	Resource and Environmental Economics	Resource and Environmental Economics
Dr. Isaac Kiyingi	PhD	Lilongwe University of Agriculture and Natural Resources, Malawi	2016	Resource and Environmental Economics	Resource and Environmental Economics
Dr. Bob Ogwang	PhD	Nanjing University of Information Science and Technology, China	2015	Climate Science and Modelling	Climatology and Climate Change
Dr. Magolo John Faith	PhD	Mbarara University	2017	Disaster Risk Management	Disaster Risk Planning, Coordination and Communication; Project Planning and Management
Visiting Professors					
Prof. Miet Maertens	PhD	Georg-August University Gottingen, Germany	2005	Agricultural Sciences	Resource and Environmental Economics

Prof. Liesbet Vranken	PhD	KU Leuven	2005	Environmental Economics	Resource and Environmental Economics
Prof. Matthieu Kervyn De Meerendre	PhD	Free University of Brussels, Belgium	2005	Geomorphology	Hazard and Risk Assessment
Prof. Didas Kimaro	PhD	Sokoine University of Agriculture, Tanzania	2003	Soil and water conservation	Land Use Planning

3.0 PROGRAMME REGULATIONS

3.1 Programme Duration

The Master of Science in Climate Change and Disaster Risk Management shall be a two year programme, conducted under coursework and dissertation mode (Plan A). Coursework and research shall each constitute 50% of the total workload. During the first year, a student shall complete approved courses totaling to 42 Credit Units. During the second year, a student shall develop a research proposal (5 Credit Units), carry out in-depth research resulting in a Dissertation (15 Credit Units), and attend seminars (3 Credit Units). The minimum Graduation load for the programme shall be 60 Credit Units.

3.2 Admission Requirements

To be admitted to the Master of Science in Climate Change and Disaster Risk Management programme, a student should have obtained at least a lower second class Degree in Bio-Physical, Agricultural, Health, Earth and Atmospheric, Managerial, Social or Educational Sciences from a recognized institution. The general admission requirements of Busitema University shall apply.

3.3 Examination Regulations

3.3.1 General regulations

The general Master's Degree regulations of Busitema University shall apply.

3.3.2 Method of Assessment

Assessment will be done through coursework which will include take home assignments, tests, field study trips reports, project work and class presentations, and a written end of semester examination. Course work will constitute 40% and the written end of semester examination 60% of the total marks. The overall pass mark shall be 60%. To sit for the end of semester examination, a student must have attended at least 75% of the scheduled classes and practical work.

3.3.3 Grading of Courses

Each course shall be graded out of 100 marks and assigned appropriate letter grades and grade points as shown in Table 2. To pass a course, a student must have obtained at least 60% in written examination.

Table 2 Course Grading

Marks %	Letter Grade	Grade Points	Interpretation
75 – 100	A	5.0	Excellent
70 – 74	B	4.0	Very good
65 – 69	C	3.5	Good
60 – 64	D	3.0	Satisfactory
< 60	E	2.0	Fail (Poor)

3.3.4 Calculation of Cumulative Grade Point Average (CGPA)

The grade point average (GPA) shall be calculated using the following formula:

$$GPA = \frac{\sum_{i=1}^{n}(PG_i \times CU_i)}{\sum_{i=1}^{n} CU_i}$$

Where GP_i is the Grade Point Score in Course *i*; CU_i is the number of Credit Units of course *i*; and n is the number of courses taken in that semester or recess term. CGPA is calculated using a formula similar to the above, but *n* is the number of course taken from the beginning of the programme up to the time when the CGPA is being calculated less courses that do not count towards the CGPA by:

a) 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.
b) Adding together the Weighted Scores for all the Courses taken up to that time.
c) Dividing the Total Weighted Score by the total number of Credit Units taken up to that time.

3.3.5 Course Retaking

a) A student shall retake a Course or Courses when next offered in order to obtain the Pass Mark if he/she had failed during the First Assessment in the Course or Courses.
b) A student who has not done course work will not be allowed to sit for end of semester examinations
c) A student who has failed to obtain at least the Pass Mark during the Second Assessment in the same Course or Courses retaken shall receive a warning.

d) A student may retake a Course or Courses when next offered in order to improve his/her Pass Grade(s) if the Pass Grade(s) obtained at the first Assessment in the Course or Courses were low. In case a student fails to attain a higher mark after retaking a course to improve his/her pass grade, the examination results of the first sitting will be recorded on the transcript and shall not be recorded as Retake**.**

e) Where student misses to sit an examination for justified reasons, his/her results shall not be recorded as Retake when the examination is next offered.

While retaking a Course or Courses:

a) A student shall attend all the prescribed lectures/tutorials/practicals /fieldwork in the Course or Courses

b) A student shall satisfy all the requirements for the Coursework component in the Course or Courses

c) A student shall sit for the University Examinations in the Course or Courses.

d) A student shall not be allowed to accumulate more than five Retake Courses at a time.

e) A student shall be 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.

f) A final year student whose final examination results have already been approved by the Higher Degrees Committee and has qualified for the Award of the Master of Science in Climate Change and Disaster Management Degree, shall not be permitted to retake any Course(s).

g) The better of the two Grades obtained in that course shall be used in the computation of his/her Cumulative Grade Average (CGPA).

h) The Academic Transcript shall accordingly indicate so.

i) A student shall pay for retaken courses

3.3.6 Academic Progress

3.3.6.1 Normal progress

Normal Progress shall occur when a student has passed the assessments in all the Courses registered for in a particular Semester.

3.3.6.2 Probationary progress

A student who obtains the Cumulative Grade Point Average (CGPA) of less than 2.0 shall be placed on Probation. Such a student shall be allowed to progress to the next Semester or Academic Year but shall retake the Course(s) he/she had failed till she/he scores at least the Pass Mark.

3.3.6.3 Certificate of due performance

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

3.3.6.4 Discontinuation

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

b) A student who fails to obtain at least the Pass Mark during the Third Assessment in the same Course or Courses retaken shall be discontinued from his/her studies at the University.

c) A student who has overstayed on the Academic Programme by more than two years shall be discontinued from his/her studies at the University

3.3.6.5 Dissertation

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

b) A candidate shall submit a research proposal before the end of first semester of second year of study.

c) A candidate shall conduct research on an approved topic during the second semester of the second year of study.

d) A candidate shall hand in three hard copies and one soft copy of the dissertation by the end of the second year.

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

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

3.3.7 Graduation Requirements

The Master of Science in Climate Change and Disaster Risk Management Degree shall be awarded to a candidate who fulfils the following conditions:

a) Has a minimum of 60 CUs

b) Has passed the dissertation research

3.3.8 Quality Assurance

The quality assurance practices for Busitema University shall apply. A student shall be required to attend at least 75% of the lectures in a course, do and pass all the coursework assignments, tests and laboratory/field practical exercises before he/she can sit for the written examinations. Performance of each of the academic staff shall be monitored to ensure that they comply with the curriculum requirements. At the end of each course, students will be required to fill assessment forms to evaluate teaching staff on the content taught, mode of delivery, attendance of lectures, tutorials and practical/field work.

3.3.9 Classification of Award

The Master of Science in Climate Change and Disaster Risk Management Degree will be awarded to a student who fulfills all the requirements for the programme. The Master of Science in Climate Change and Disaster Risk Management Degree shall not be classified.

4.0. PROGRAMME STRUCTURE

4.1 Programme Structure

The MSc in Climate Change and Disaster Risk Management will be run on a semester system.

4.2 Course Codes, Titles and Credit Units

The detailed course structure with respective course loads is shown in Table 3. The respective acronyms are explained as follows: LH-Lecture Hours, TH-Tutorial Hours, PH-Practical Hours, CH-Contact Hours and CU-Credit Units. According to the Universities and Other Tertiary Institutions Act, 2003, **one** contact hour is equivalent to; **one lecture** hour, **two** tutorial hours, or **three** laboratory/field practical hours. Contact hours for a course unit represent the sum of the "weighted" lecture, tutorial and practical hours. One credit unit is equal to 15 contact hours. These ratios have been used to calculate the CUs for the various courses under the MCC programme.

Table 3 ***Detailed course structure for the Master of Science in Programme in Climate Change and Disaster Risk Management***

First Year , First Semester, Course Code and Name		**LH**	**TH**	**PH**	**CH**	**CU**
Core Courses						
MCC 8101	Climatology and Climate Change	30	20	15	45	3
MCC 8103	Geographical Information Systems and Spatial Analysis	30		90	60	4
MCC 8104	Environmental Sociology	30	20	15	45	3
MCC 8105	Applied Statistics	45	20	15	60	4
MCC 8106	Hazard and Risk Assessment	45	20	15	60	4
Elective Courses (Choose one)						
MCC 8102	Industrial Ecology	30	20	15	45	3
MCC 8107	Resource and Environmental Economics	30	20	15	45	3
MCC 8108	Early Warning Systems	30	20	15	45	3
Total Credit Units						**21**
First Year Second Semester, Course Code and Name		**LH**	**TH**	**PH**	**CH**	**CU**
Core Courses						
MCC 8202	Research Methods	45	20	15	60	4
MCC 8203	Climate Change Mitigation, Adaptation and Assessment	30	20	15	45	3
MCC 8204	Disaster Risk Planning and Coordination	45	20	15	45	4
MCC 8205	Environment and Social Impact Assessment	30	20	15	45	3
MCC 8206	Project Planning and Management	30	20	15	45	3
Elective Courses (Choose one)						
MCC 8201	Mathematical Modeling and Econometrics	30	30		45	4
MCC 8207	Environmental Law, Policy and Governance	45	20	15	60	4
Total Credit Units						**21**

Second Year, First and Second Semester, Course Code and Name		LH	TH	PH	CH	CU
MCC 9101	Proposal Development	0	0	225	75	5
MCC 9102	Dissertation	0	0	450	150	10
MCC 9103	Graduate Seminars	0	0	45	15	3
Total Credit Units						**60**
Graduation	**Total Teaching Hours and CUs**					**60**

In table 3 above, two courses (13%) fall under the discipline of climate change science i.e. MCC8101 Climatology and Climate Change, and MCC8203 Climate Change Mitigation, Adaptation and Assessment. The content for the two climate change related courses has not significantly changed. Three courses (20%) fall under the discipline of disaster risk management i.e. MCC8106 Hazard and Risk Assessment, MCC8108 Early Warning Systems, and MCC8204 Disaster Risk Planning and Coordination. The first two disaster risk management related courses are new while the third one was originated from the review of the former course MCC8204 Disaster Assessment and Management. Ten courses (67%) are cross cutting courses i.e. MCC8102 Industrial Ecology, MCC8103 Geographical Information Systems and Spatial Analysis, MCC 8104 Environmental Sociology, MCC8105 Applied Statistics, MCC8107 Resource and Environmental Economics, MCC8201 Mathematical Modeling and Econometrics, MCC8202 Research Methods, MCC8205 Environment and Social Impact Assessment, MCC8206 Project Planning and Management, and MCC8207 Environmental Law, Policy and Governance. For the cross cutting courses, the content has not significantly changed except for MCC8207 Environmental Law, Policy and Governance.

5.0 DETAILED COURSE DESCRIPTION

Course Name: **Climatology and Climate Change**
Course Code: **MCC 8101** **Credit Units: 3**

Course Description:

Climate is a key determinant and conditioner of the state and productivity of land resources. Climate is associated with disasters like landslides and floods often blamed on excessive rains. On

the other hand, excessive dry periods and consequent decline in agricultural productivity are caused by a shortage of rains. Climatic factors are reported to be more variable and less predictable to day- a phenomenon referred to as climate change. Climate change and the related impacts can best be understood by following a course that explores the basics of climate.

Learning Outcomes:

Students will be introduced to climate science and should be able to collect, record and analyze climatic data and make inferences for mitigating adverse climatic effects.

Mode of delivery:

The course will be delivered through lectures, group discussions, self-study assignments, case studies, group and individual research project assignments, and practical work.

Course assessment:

Continuous Assessment	40%
Take home assignment:	20%
Tests:	20%
End of Semester Examinations	60%

Detailed Course Content:

1. Climatology (3 *Hours*): definition, Meteorology and climatology, scales in climatology, subfields of climatology, climatic records and statistics; *climatic data*: data sources-collection agencies, primary versus secondary data.

2. The Atmosphere (*2 Hours*): Origin of the earth and atmosphere, atmospheric composition, Faint young sun paradox, atmospheric structure.

3. Controls on climate (*4 Hours*): Latitude, earth-sun relationships, distance to large bodies of water, circulation- pressure, wind, surface and upper level winds, vertical motion, cyclones and anticyclones, oceanic circulation- , Topography, Local features, spatial and seasonal variations; *Effects on the climate system* : Ocean circulation, El Nino events, Volcanic activity and climate, deforestation and desertification, cryospheric changes.

4. Energy, Matter, Momentum exchange near the surface (*3 Hours*): Troposhere properties, near-surface troposphere, energy in the climate systems, local flux of matter-moisture in atmosphere, Atmospheric statics / stability, Momentum flux.

5. Global hydrologic cycle (*2 Hours*): hydrologic cycle, surface water balance, water balance models, drought indices.

6. Circulation and secondary circulations (*2 Hours*): circulation of a nonrotating earth and a rotating planet, general circulation- observed surface pattern, airflow and secondary circulation.

7. Climatic classification (*2 Hours*): early attempts, age of climatic classification, genetic classifications, local and regional classification, quantitative analysis to derive climatic types.

8. Northern hemisphere climates (*4 Hours*): climatic setting of north America, climatic setting of Europe, climatic setting of Asia, regional climatology; *Tropical and southern hemisphere climates*: Climatic setting of Africa, Climatic setting of Australia and Oceania, Climatic setting of Latin America, Climatic setting of Antarctica, regional climates.

9. Climatic change and variability (*4 Hours*): Climatic changes in geological history, evidence of past climatic changes, natural causes of climatic change and variability; *Anthropogenic Climatic changes*: Global warming, atmospheric pollution, classifying air pollutants, reactions and attitudes to climatic change;

10. Climate impact and responses (*4 Hours*): impacts on natural systems, impact on agriculture, impact on societal systems, impacts on human health and comfort; *Responses to climate change*; Climate change and sustainable development; decision making; mitigation, vulnerability and adaptation relationship

References:

Stern R., Rijks D., Dale I., Knock J., (January 2006). Instat Climatic Guide.

Robert V. Rohli, Anthony J. Vega (2011), Climatology, 2nd edition, Jones and Bartlett learning UK

Raes, D., D. Mallants and Z. Song. (1996). RAINBOW – a software package for analyzing hydrologic data. In W.R. Blain (Ed.) Hydraulic Engineering Software VI. Computational Mechanics Publications, Southampton, Boston: 525 – 534.

Raes, D., (2001) Irrigation agronomy, Lecture notes. Inter University Programme in Water Resources Engineering. Katholieke Universiteit Leuven/Vrije Universiteit Brussel

Halsnæs, K., P. Shukla, D. Ahuja, G. Akumu, R. Beale, J. Edmonds, C. Gollier, A. Grübler, M. Ha Duong, A. Markandya, M. McFarland, E. Nikitina, T. Sugiyama, A. Villavicencio, J. Zou, (2007): Framing issues. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O. R. Davidson, P. R. Bosch, R. Dave, L. A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA

Course Name: **Industrial Ecology**
Course Code: **MCC 8102** **Credit Units: 3**

Brief Course Description:

Industrial ecology studies the flow of material and energy through industrial systems and seeks to quantify the material flows and document the industrial processes that make modern society function. The course focuses on the impacts that industrial activities have on the environment, with use of the earth's supply of natural resources, and with problems of waste disposal. The course imparts an understanding of the emergent behavior of complex integrated human / natural systems through the examination of problems from multiple perspectives, involving aspects of sociology, the environment, economy and technology. It combines aspects of engineering, economics, sociology, toxicology and the natural sciences.

Learning Outcomes:

Students should be able to use the analogy of natural systems to design sustainable industrial systems.

Mode of delivery:

The course will be delivered through lectures, group discussions, self-study assignments, case studies, group and individual research project assignments, and practical work.

Course Assessment:

Continuous Assessment	40%
Take home assignment:	20%
Tests:	20%
End of semester Examination:	60%

Detailed Course Description:

1. Ecology as a Science (*6 Hours*); definition**,** Importance of Ecology, Status **of Ecology, The** science of ecology- Sub disciplines, Emergent Properties and Hierarchy**, The** Scientific Method**,** Data, Theories, and Hypotheses, Observations and Experiments**;**

2. Industrial ecology: goals and definitions; Recent history of industrial ecology; Industrial ecology and cleaner production; Industrial ecosystems;

3. Governance, laws and regulations (*2 Hours*)

4. Material flow analysis (*6 Hours*); Substance flow analysis; Physical input–output accounting; Process analysis approach to industrial ecology; Industrial ecology and life cycle assessment; Impact evaluation in industrial ecology; Environmental accounting and material flow analysis; Materials flow analysis and economic modeling; Energy flows in the economy: efficiency and dematerialization; Transmaterialization; and rematerialization; Optimal resource extraction

5. Industrial ecology and technology policy (*6 Hours*); Material flows due to mining and urbanization; Long-term world metal use; Risks of metal flows and accumulation; Material constraints on technology evolution; Wastes as raw materials; Heavy metals in agrosystems; Industrial ecology and automotive systems

6. The information industry (*6 Hours*); Industrial ecology and green design; Industrial ecology and risk analysis; Industrial ecology and spatial planning; Industrial estates as model ecosystems; Closed-loop supply chains

7. Remanufacturing cases (*4 Hours*); Industrial ecology and producer responsibility; Life cycle assessment as a management tool; Municipal solid waste management; Industrial ecology and integrated assessment; approach for climate change; Earth systems engineering and management.

References:

Robert U. Ayres and Leslie W. Ayres (ed.). 2002. A handbook of industrial ecology

Stanley E. Manahan. Industrial Ecology**:** Environmental Chemistry and Hazardous Wastes, 19

books.google.com/books?isbn=156670381699

Allenby, Brad (2006). The ontologies of industrial ecology Progress in Industrial Ecology. Inderscience Enterprises Ltd.) 3 (1/2): 28–40. doi:10.1504/PIE.2006.010039.

Deanna J Richards (Ed), 1997. The industrial green game: implications for environmental design and management, National Academy Press, Washington DC, USA.

Sangwon Suh (Ed). 2009. Handbook of Input-Output Economics in Industrial Ecology. Springer, 2009

Reid Lifset (ed.). 2012. Industrial Ecology. Online ISSN: 1530-9290

Course Name: **Geographical Information Systems and Spatial Analysis**
Course Code: MCC8103 **Credit Units: 4**

Brief Course Description:

This course unit encompasses a wide variety of operations whose objective is to derive analytical results from geospatial data. In a way, it is an advanced application of geographical information system in spatial data analysis. Spatial statistics and geo-statistics are examined in depth- exploring all skills of studying spatial data variations in spreading phenomenon like the spread of a contaminant in soil, water and air.

Learning Outcomes:

At the end of the course, students should be able to collect and analyze spatial data, and make scientific inferences related to decision making in environment and natural resource management.

Mode of delivery:

The course will be delivered through lectures, group discussions, self-study assignments, case studies, group and individual research project assignments, and practical work.

Course Assessment:

Continuous Assessment 40%

Take home assignment:	20%
Tests:	20%
End of semester Examinations:	60%

Detailed Course description:

1. Spreadsheets (*6 Hours*): Creating a Spreadsheet and integration with other programmes, data manipulation, calculations and automation; Database management systems: Design methodology, conceptual modeling: the entity-relationship approach, logical modeling: relational databases, transforming entity-relationship models into relational models, logical modeling: CODASYL databases, logical modeling.

2. Geographical Information Systems (*2 Hours*): Definition and concept- spatial data and geo-information, modeling, maps, databases, spatial databases; *Geographic information and spatial data types:* Geographic phenomenon, Computer representations of geographic information, spatial data organization.

3. Data processing system (*2 Hours*): Hardware and software trends, Geographic information systems, Database management systems; *Data entry and preparation*: spatial data input, spatial referencing, data preparation, point data transformation, advanced operations on continuous field rasters.

4. Spatial databases (*6 Hours*): Basic data structures; Data retrieval strategies; Database management systems. Coevolution of DBMS and GIS; Relational DBMS; Object-Oriented DBMS; Extensions of the relational model. Tessellation data models: Grid representations; The raster model ; Grid compression methods; The hexagonal model; The triangulated irregular network (TIN) model; Resolution; Hierarchical data models; Vector and object data models: Geometric primitives; The spaghetti model; The topological model; Classic vector data model; The network model; linear referencing; Object based spatial data bases; Modeling 3D, uncertain, and temporal phenomena: Spatial-temporal GIS; modeling uncertainty; Modeling three dimensional entities.

5. Analytical approaches (*6 Hours*): Spatial modeling, geo-statistics, spatial statistics, qualitative analysis, map algebra and network analysis; spatial-temporal analysis; stages in spatial analytical process; Query operations and query languages; Geometric measures: distances and lengths; shape and geometric operations, convex hull and shapes, centroids and polygon boundaries; Area;

Proximity and distance decay; Adjacency and connectivity; Basic analytical operations: Buffers; Overlay; Neighborhoods; Map algebra; Basic analytical methods: point pattern analysis; Kernels and density estimation; Spatial cluster analysis; Spatial interaction; Analyzing multidimensional attributes; Cartographic modeling; Multicriteria evaluation; Spatial process models; Analysis of surfaces: Calculating surface derivatives; Interpolation of surfaces; Surface features; Intervisibility; Fraction surfaces.

6. Spatial statistics (4 *Hours*): Graphical methods; Stochastic processes; The spatial weights matrix; Global measures of spatial association; Local measures of spatial association; Outliers; Bayesian methods. Geostatistics: Spatial sampling for statistical analysis; Principles of semivariogram construction; semivariogram modeling; Principles of kriging; Kriging variants; Spatial regression and econometrics; Principles of spatial econometrics; spatial auto regressive models; Spatial filtering; spatial expansion and geographically weighted regression (GWR).

7.0 Data mining (*2 Hours*): Problems of large spatial databases; Data mining approaches; Knowledge discovery; Pattern recognition and matching. Network analysis: Networks defined; Graph theoretic measures; Least cost (shortest) path; Flow modeling; The classic network application problems; accessibility modeling; Optimization and location-allocation modeling: Operations research modeling and location modeling principles; Linear programming; integer programming; Location-allocation modeling and p-median problems.

8. Data visualization (*2 Hours*): Data quality and metadata: measures of location error on maps, error propagation in spatial data processing, metadata and data sharing; *GIS in Networked Environments***:** Host-based systems, stand-alone, PC-based systems; networking and distributed systems; Application of the network models.

References:

AAG (2003) Geographic Information Science and Technology Body of Knowledge – www.aag.org/bok

ITC (2000) Principles of GIS, Lecture notes, ITC, Enschede, The Netherlands

ITC (2000) Principles of Remote Sensing, Lecture notes, ITC, Enschede, The Netherlands

Webster R., Margaret A. Oliver M.A., (2007) Geostatistics for environmental scientists, John Wiley and Sons Ltd.

Burrough, P.A. and McDonnell, R.A. (1998) Principles of geographical information systems. Oxford University Press, Oxford, 327 pp.

de Smith M J, Goodchild M F, Longley P A (2007). *Geospatial analysis: A comprehensive guide to principles, techniques and software tools* (2nd Ed.). Troubador.

Fu, P., and J. Sun. 2010. *Web GIS: Principles and Applications*. ESRI Press. Redlands.

Worboys, Michael; Duckham, Matt (2004). *GIS: a computing perspective*. Boca Raton: CRC Press.

Chang, K. (2007) *Introduction to Geographic Information System, 4th Edition*. McGraw Hill.

Course Name: **Environmental Sociology**
Course Code: **MCC8104** **Credit Units: 3**

Brief Course Description:

This course looks at environment as a social issue and attempts to explore the interactions between humans and the environment thereby seeking answers to environmental problems and successes from a modern and historical perspective. Reference is made to several published experiences with special focus to developing countries with emphasis on the eastern African region especially Uganda.

Learning Outcomes:

Students should be able to explain the socio-economic factors linked to the current environmental challenges and how these in turn influence human behavior and social structure.

Mode of delivery:

The course will be delivered through lectures, group discussions, self-study assignments, case studies, group and individual research project assignments, and practical work.

Course Assessment:

Continuous Assessment	***40%***
Take home assignment:	20%
Tests:	20%

End of semester Examinations: 60%

Detailed Course Description:

1. Definitions, Issue, Debates (*4 Hours*): Defining Ecological Issues, Population Food and Hunger, Human Progress versus Ecological Collapse; *the Economic Factor*: Industrialization or Capitalism? The Modern Economy and its Ecological Implications, Consumer Society;

2.Modern Environmentalism (*4 Hours*): The Origins of Modern Environmentalism, The Sixties – A New Paradigm Emerges, Mainstream Uganda Environmentalism Since the Sixties, The Limits of the Traditional Debate, Locating Environmentalism in the Context of Social History, Environmentalism as Part of a Larger Social Critique;

3. Social Justice and Environmental Issues (*4 Hours*): Gender, Justice, and Environmental Issues, Race, Justice, and Environmental Issues; Social Class, Justice, and Environmental Issues, Social Class, Justice, and Environmental Issues;

4.Cultural and Religious Factors (*5 Hours*): The Debate on Christianity and Ecology, Christian Environmentalism, Testing the Lynn White Thesis, Ecology and "Postmodern" Religion, Resources for an Ecological Ethic in Native Ugandan Traditions, Culture, Rationality, and Modernity;

5. Environmentalism in the developed World (*5 Hours*): Perspectives from the Developed World; Environmental Movements in the US and Europe; Rational "Self-interest" and Collective Regimes: Rational Choice, Collective Behavior, and Ecology, The Global Ecological Commons, Global Ecological Regimes;

6.0 Democracy, Civil Society, and Ecology (*4 Hours*): Modes of Political Mobilization, Democracy, Civil Society, and Ecology, Local, International, and Global Eco-Social Movements, Ecology and Global Civil Society;

7. Response and Responsibility (*4 Hours*): Alternative Economics, a Second Look at Consumption, Individual Ethics and Public Policy. The University, the Churches, and Civil Society.

References:

Mehta M.D, Ouellet. E (1995) Environmental sociology: theory and practice - 412 pages 1995 Captus press Inc.

Frederick H.B. and Craig R. Humphrey. (2002). "Sociological Theory and the Natural Environment." pp. 33–69 in *Handbook of Environmental Sociology* edited by Riley E. Dunlap and William Michelson, Westport, CT: Greenwood Press.

Jared D. (2005) *Collapse: How Societies Choose to Fail or Succeed*. New York: Viking.

Dunlap, Riley E., Frederick H. Buttel, Peter Dickens, and August Gijswijt (eds.) 2002. *Sociological Theory and the Environment: Classical Foundations, Contemporary Insights* Rowman & Littlefield.

Foster, John Bellamy (1999). "'Marx's Theory of Metabolic Rift: Classical Foundations for Environmental Sociology'". *The American Journal of Sociology* **105** (2): 381.doi: 10.1086/210315.

Pellow, David N.; Hollie Nyseth Brehm (2013). "An Environmental Sociology for the Twenty-First Century". *Annual Review of Sociology* **39**: 229–50. doi: 10.1146/annurev-soc-071312-145558.

Diamond, Jared. (2005) *Collapse: How Societies Choose to Fail or Succeed*. New York: Viking.

Dunlap, Riley E., Frederick H. Buttel, Peter Dickens, and August Gijswijt (eds.)
2002. *Sociological Theory and the Environment: Classical Foundations, Contemporary Insights*, Rowman & Littlefield.

Dunlap, Riley E., and William Michelson (eds.) 2002.*Handbook of Environmental Sociology*. Greenwood Press.

Freudenburg, William R., and Robert Gramling. 1989. "The Emergence of Environmental Sociology: Contributions of Riley E. Dunlap and William R. Catton, Jr.", *Sociological Inquiry* 59(4): 439-452

Harper, Charles. 2004. *Environment and Society: Human Perspectives on Environmental Issues*. Upper Saddle River, New Jersey: Pearson Education, Inc.

Humphrey, Craig R., and Frederick H. Buttel. 1982. *Environment, Energy, and Society*. Belmont, California: Wadsworth Publishing Company.

Humphrey, Craig R., Tammy L. Lewis and Frederick H. Buttel. 2002. *Environment, Energy and Society: A New Synthesis*. Belmont, California: Wadsworth/Thompson Learning.

Mehta, Michael, and Eric Ouellet. 1995. *Environmental Sociology: Theory and Practice*, Toronto: Captus Press.

Redclift, Michael, and Graham Woodgate, eds. 1997.*International Handbook of Environmental Sociology*. Edgar Elgar.

Course Name: **Applied Statistics**
Course Code: **MCC8105** **Credit Units: 4**

Brief course description:

Applied statistics is presented in a manner that motivates students with less mathematical experience but with great interest in the use of statistics in the planning, implementation and evaluation of their research projects. Topics that cover various aspects of experimental design analysis and data types are considered including problematic data. Parametric, nonparametric, randomized and nonrandomized experiments, spatial experiments, regressions and computer experiments among others are explored at length.

Learning Outcomes:

Students should be able to design experiments, and collect and analyze data using various statistical programmes.

Mode of delivery:

The course will be delivered through lectures, group discussions, self-study assignments, case studies, group and individual research project assignments, and practical work.

Course Assessment

Continuous Assessment	40%
Take home assignment:	20%
Tests:	20%
End of semester Examination:	60%

Detailed course description:

1. Introduction (*2 Hours*): Deterministic Data and Random Data, Population, Sample and Statistics, Random Variables, Probabilities and Distributions, Beyond a Reasonable Doubt,

Statistical Significance and Other Significances, Datasets, Software Tools- SPSS, STATA, STATISTICA, MATLAB and R;

2. Presenting and Summarizing the Data (*2 Hours*): Reading and Operating with the Data, Presenting the Data- Counts and Bar Graphs, Frequencies and Histograms, Multivariate Tables, Scatter Plots and 3D Plots, Categorized Plots-, Summarizing the Data-, Measures of Location, Spread, Shape, Association for Continuous, Ordinal and Nominal Variables-;

3. Estimating Data Parameters (*2 Hours*): Point and Interval Estimation, Estimating a Mean, Proportion, Variance, Variance Ratio and Bootstrap Estimation;

4. Parametric Tests of Hypotheses (*4 Hours*): Hypothesis Test Procedure, Test Errors and Power, Inference on One Population, Inference on Two Populations, Inference on More than Two Populations- Analysis of variance (ANOVA), One-Way and Two-Way ANOVA; Non-Parametric Tests of Hypotheses**:** Inference on One Population-, The Runs Test, Binomial Test, Chi-Square Goodness of Fit Test, Kolmogorov-Smirnov Goodness of Fit Test, Lilliefors Test for Normality, Shapiro-Wilk Test for Normality-, Contingency Tables-, 2×2 Table, *r*x*c* Table, Chi-Square Test of Independence, Measures of Association Revisited, Inference on Two Populations, Inference on More Than Two Populations;

5. Statistical Classification (*2 Hours*): Decision Regions and Functions, Linear Discriminants, Bayesian Classification, the ROC Curve, Feature Selection, Classifier Evaluation, Tree Classifiers;

6. Data Regression (*4 Hours*): Simple Linear Regression, Multiple Regression, Building and Evaluating the Regression Model; Regression through the Origin, Ridge Regression, Logit and Probit Models;

7. Data Structure Analysis (*4 Hours*): Principal Components, Dimensional Reduction, Principal Components of Correlation Matrices, Factor Analysis;

8. Survival Analysis (*2 Hours*): Survivor Function and Hazard Function, Non-Parametric Analysis of Survival Data, Comparing Two Groups of Survival Data, Models for Survival Data,

9. Directional Data (*2 Hours*): Representing Directional Data, Descriptive Statistics, The von Mises Distributions, Assessing the Distribution of Directional Data, Tests on von Mises Distributions, Non-Parametric Tests;

10. Experimental design (*6 Hours*): Adaptive Designs for Parametric Models, Observational Studies and Nonrandomized Experiments, Robust Design: Experiments for Improving Quality, Experiments with a Directional Response, Multi response Surface Methodology, Sequential

Assembly of Fractions in Factorial Experiments, Nonlinear and Generalized Linear Models, Spatial Experimental Design, Spatial Experiments: Model Fitting and Prediction, Experiments with Selection and Ranking Goals, Nonparametric Methods in Design and Analysis of Experiments, Optimal Crossover Designs, Block and Other Designs Used in Agriculture, Incomplete Block Designs for Parallel Line Bioassays, Row-Column Designs, Nested Designs, Optimal Design: Exact Theory, Optimal and Efficient Treatment-Control Designs, Model Robust Designs, Optimal Bayes Designs, Polynomial Regression: Invariance, Admissibility, and Optimality, Computer Experiments, Response Surface Designs.

References:

Little M.T and Jackson F., (1980) Agricultural experimentation: design and analysis; John Wiley and Sons.

Joaquim P., Marques de Sá (2007), Applied Statistics Using SPSS, STATISTICA, MATLAB and R Springer.

J.P. Marques de SA, Applied Statistics using SPSS, STATISTICA, MATLAB and R, Springer publications 2nd Edition.

R Through Excel: A Spreadsheet Interface for Statistics, Data Analysis, and Graphics by Richard M. Heiberger, Erich Neuwirth; Springer.

Dodge, Y. (2006) *the Oxford Dictionary of Statistical Terms*, OUP.

Hays, William Lee, (1973) *Statistics for the Social Sciences*, Holt, Rinehart and Winston.

Moore, David (1992). "Teaching Statistics as a Respectable Subject". In F. Gordon and S. Gordon. *Statistics for the Twenty-First Century*. Washington, DC: The Mathematical Association of America. pp. 14–25.

Chance, Beth L.; Rossman, Allan J. (2005). Preface". Investigating *Statistical Concepts, Applications, and Methods*. Duxbury Press.

Anderson, D.R.; Sweeney, D.J.; Williams, T.A. (1994) *Introduction to Statistics: Concepts and Applications*, pp. 5–9. West Group.

Conniffe, Denis (1990–1991). "R. A. Fisher and the development of statistics—a view in his centenary year". *Journal of the Statistical and Social Inquiry Society of Ireland* XXVI.

Fisher, Ronald A. (1971) [1935]. *The Design of Experiments* (9th Ed.). Macmillan.

Course Name: **Hazard and Risk Assessment**
Course Code: **MCC 8106** **Credit Units:** 4

Brief course description:

Rapid population growth and urbanization combined with extreme climatic events have increased the vulnerability of communities exposed to hazards. As a result, disasters are increasingly taking heavy toll of life and property. Unplanned growth both in urban and non-urban areas calls for adequate preparation to reduce risks and the impact of disasters. The course introduces students to techniques of acquiring and using hazard and disaster risk information to plan for disaster risk reduction.

Learning outcomes:

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

a) Differentiate hazards from risks and disasters

b) Carry out hazard and risk assessment

c) Use hazard and risk information for planning mitigation, preparedness, response and recovery.

Mode of delivery:

Lectures, self-study assignments, case studies, group discussions and individual research project assignments.

Course Assessment:

Continuous Assessment	40%
Take home assignment:	20%
Tests:	20%
End of semester Examinations	60%

Detailed course description:

1. Introduction to hazards and disaster risks: basic concepts, terminology and characterization (6 Hours)

2. Disaster risks: drivers, global trends and impacts (6 Hours)

3. Hazard and risk assessment approaches: probabilistic and deterministic approaches (12 Hours)

4. Hazard and risk assessment steps; risk identification, risk analysis and risk evaluation (9 Hours)

5. Disaster assessment: Post-Disaster Impact and Damage Analysis (6 Hours)

6. Using risk information for risk reduction planning (6 Hours)

References:

DesInventar: The National Disaster Loss Database. Retrieved from http://desinventar.net

EM-DAT: The International Disasters Database. http://www.emdat.be/disaster_trends/index.html

Hou L. and Shi P. (2011). Haiti 2010 Earthquake- How to explain such huge losses? *Int. J. Disaster Risk Sc. 2(1): 25-33.*

INFORM: Index for Risk Management. Retrieved from http://www.inform-index.org/Results/Global

Kreft S., Eckstein D. and Melchior I. (2016). Global Climate Risk Index 2017. Retrieved from http://germanwatch.org/en/download/16411.pdf

Munich RE NatCatService (2013). Loss events worldwide 2013. Geographical overview. Retrieved from http://www.unisdr.org/2005/wcdr/thematic- sessions/presentations/session2-8/munichre.pdf

UNISDR (2017). National Disaster Risk Assessment. Governance system, methodologies and use of results.

Course Name: **Resource and Environmental Economics**
Course Code: **MCC 8107** **Credit Units: 3**

Brief Course Description:

The course provides a comprehensive account of the application of economic analysis to environmental issues. It presents various economic tools and their position in controlling environmental challenges. Its global outlook and links to the determinants of development are covered with a view of exposing the student to emerging issues and proposed mitigation programmes. Therefore the cause is designed to cover the theory and concepts, policy and economics of sustainability.

Learning Outcomes:

Students should be able to link the theory and practice of natural and environmental economics to policy and action.

Mode of Delivery:

The course will be delivered through lectures, group discussions, self-study assignments, case studies, group and individual research project assignments, and practical work.

Course Assessment:

Continuous Assessment	40%
Take home assignment	20%
Tests	20%
End of semester Examinations	60%

Detailed Course Description:

1. Introduction (8 Hours): Concepts, reasons for optimisms and concerns; Values: Ethics-deontological ethics, theological ethics, utilitarianism; positive and normative economics; economics questions. Markets : market capitalism; competitive market conditions; market demand and supply; market equilibrium and efficiency; market failure- monopoly, cartel and market power, externalities, common pool resources and public goods, imperfect information, distributive justice, market failure and government intervention. Externalities: positive and negative externalities, property rights and externalities, social cost and externalities, competitive markets and externalities, policy intervention and externalities, damage cost estimates. Natural resource economics: theory and concepts; allocating nonrenewable resources; allocating recyclable resources; ecosystem services and natural capital; factors affecting future resource scarcity;

2. Policy (**12 Hours**): Benefit / Cost analysis (; The political economy: definition and concepts; Economic models and regulatory space, PE of environmental regulation, PE of locally self-governed common pool resources, PE of international environmental accord; Compliance and deterrence- the economics of crime, EPA enforcement; Incentive regulations: market based regulation, cap and trade, renewable portfolio standard, emission trading, pollution taxes; Global

climate change: GHG emissions and climate change, Evidence regarding climate change, Benefit Cost analysis, Economic policy instruments, Policy implementation- Kyoto protocol, carbon markets, emerging regulatory programmes.

3. Economics of Sustainability (10 Hours): Concept of sustainability; sustainable development, conservation based development; Interdependencies and thinking long term technological advance, the agrarian transition, and human migration, income poverty and economic growth, education, empowerment and justice, international trade, population, taxes and incentives; thinking long term discounting and policy making; Sustainable economic development: economic development strategies, envisioning sustainable development- Earth summit, SDGs, theories of sustainability, sustainability indicators; Sustainable production and consumption: sustainable energy resources, technologies, and processes; policies promoting sustainable production- producer responsibilities, ecolabels, taxes, subsidies, and ecological tax reform, government research and development funding, international environmental certification; Carbon financing and marketing; Carbon projects

References:

Steven C. Hackett, Michael C Moore. 2011. Environmental and Natural Resources Economics: Theory, Policy, and sustainable society. M.E. Sharpe Inc.

Scott J. Callan, Janet M. Thomas. 2009. Natural resource and environmental economics. Pearson Education, Environmental Economics and Management: Theory, Policy and Applications**.** *books.google.com/books?isbn=1439080631*

Allen K. Kneese and Clifford S. Russell (1987). "Environmental economics," *The New Palgrave: A Dictionary of Economics*.

Robert N. Stavins (2008). "Environmental economics," *The New Palgrave Dictionary of Economics*, 2nd Edition.

Maureen L. Cropper and Wallace E. Oates (1992). "Environmental Economics: A Survey," *Journal of Economic Literature*.

David Pearce (2002). "An Intellectual History of Environmental Economics", Annual Review of Energy and the Environment 2002, 27:57–81.

UNEP (2007). Guidelines for Conducting Economic Valuation of Coastal Ecosystem Goods and Services, UNEP/GEF/SCS Technical Publication No. 8.

UNEP (2007). Procedure for Determination of National and Regional Economic Values for Ecotone Goods and Services, and Total Economic Values of Coastal Habitats in the context of the UNEP/GEF Project Entitled: "Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand", South China Sea Knowledge Document No. 3. UNEP/GEF/SCS/Inf.3

Course Name: **Early Warning Systems**
Course Code: **MCC8108** **Credit Units: 3**

Brief Course description:

Early warning is critical for disaster risk reduction. Early action is an essential investment that can minimize disaster risks. This is particularly the case with people-centred early warning systems that ensure information and warnings captured by various technologies reach the most vulnerable communities. The course introduces students to Early Warning Systems (EWS) with a focus on the operational aspects.

Learning Outcomes:

By the end of the course, students should be able to design and implement early warning systems.

Mode of delivery:

The course will be delivered through lectures, group discussions, self-study assignments, case studies, group and individual research project assignments, and practical work.

Course Assessment:

Continuous Assessment	40%
Take home assignment:	20%
Tests:	20%
End of semester Examination:	60%

Detailed Course Description:

1. Understanding early warning systems; basic concepts, myths and facts about EWS (3 Hours)

2. EWS components; risk knowledge, monitoring, response capability and warning communication (6 Hours)

3. EWS guiding principles; Integration within DRR, synergy across scales, multi-hazard, systematic inclusion of vulnerability, components with multiple functions, multiple time scales, etc. (6 Hours)

4. Community involvement in EWS; community based versus community driven EWS. Integration if community and national EWS (6 Hours)

5. Institutional and governance frameworks for EWS at local, national, regional and global levels (6 Hours)

6. EWS; challenges and opportunities in a developing country context (3 Hours)

7. Case studies of best practice EWS; The European Multi-Purpose Meteorological Awareness System (EMMA) Programme, The US Emergency Alert System (15 Hours)

References:

International Federation of the Red Cross and Red Crescent Societies. 2012. Community early warning systems: guiding principles. Geneva, Switzerland.

UNDP 2016. Climate Information and Early Warning Systems Communication Toolkit.

UNDP 2018. Five Approaches to build functional Early Warning Systems.

UNEP 2012. Early Warning Systems. A State of the Art Analysis and Future Directions. Division of Early Warning and Assessment (DEWA), United Nations Environment Programme (UNEP), Nairobi.

Jadoo R. 2013. Community-Based Early Warning Training for the Mayaro Rio Claro Regional Cooperation. Training Manual.

Course Name: **Mathematical Modeling and Econometrics**
Course Code: **MCC 8201** **Credit Units: 4**

Brief Course Description

This course unit focuses on the application of mathematics, statistical methods, and, computer science, to economic data with the aim of giving empirical content to economic relations. More

precisely, it explores the quantitative analysis of actual economic phenomena based on the concurrent development of theory and observation, related by appropriate methods of inference.

Learning Outcomes:

Students should be able to translate theoretical analysis into policy evaluation.

Mode of delivery:

The course will be delivered through lectures, group discussions, self-study assignments, case studies, group and individual research project assignments, and practical work.

Course Assessment

Continuous Assessment	***40%***
Take home assignment:	20%
Tests:	20%
Examination:	***60%***

Detailed Course Description:

1. Mathematical modeling (*4 Hours*): Natural decay and natural growth, differential equations and solutions, mathematical models and mathematical modeling, stages of modeling, classification of models and their limitations; basic concepts and techniques: Mathematical models, First-Order equations, slope fields, existence of unique solutions, Euler's Method, Runge-Kutta Methods;
2. Homogeneous Linear Equations (*4 Hours*): Linear Oscillators, systems of Linear Algebraic equations, theory of homogeneous linear equations; Non homogeneous Linear equations: Linear Oscillator models, solutions for non-homogeneous equations, forced linear Oscillators, First-Order and second order Linear equations;
3. Autonomous Equations and Systems (*4 Hours*): Population models, the phase line, the phase plane, the direction field and critical points, qualitative analysis; Analytical methods for systems: compartment models, eigenvalues and eigen spaces, linear trajectories, homogeneous systems with complex eigen values, qualitative behavior of nonlinear systems;
4. The laplace transformation; Building models (*6 Hours*): Systems analysis, choosing mathematical equations, Solving equations, Studying models, Testing models, Estimating model

parameters, using models; Optimization modeling: linear optimization, linear optimization-sensitivity analysis, integer optimization, nonlinear optimization, unconstrained optimization, nonlinear optimization, using solver for NLP models, the EOQ inventory model, inventory with quantity discounts model, inventory and production; Probabilistic models: decision analysis, monte carlo simulation,, discrete event simulation;

5. Econometrics (2 Hours): definition and concepts, data sources and structures;

6. Conditional Expectation and Projection (*10 Hours*)**:** The Algebra of Least Squares; Least Squares Regression; Large Sample Asymptotics; Asymptotic Theory for Least Squares; Restricted Estimation; Hypothesis Testing; Regression Extensions; The Bootstrap; Non Parametric Regression; Series Estimation; Quantile Regression; Method of Moments; Empirical Likelihood; Endogeneity; Univariate Time Series; Multivariate Time Series; Dependent Variables; Panel Data; Nonparametric Density Estimation; The Logit model: estimation, testing and interpretation; Comparison of the Probit and Logit distributions; Modeling fractions; Forecasting.

References

Bruce E. Hansen. 2013. Econometrics. University of Wisconsin www.ssc.wisc.edu/~bhansen

Greene, William H. (1999, 4th Ed.) *Econometric Analysis*, Prentice Hall.

Hayashi, Fumio. (2000) *Econometrics*, Princeton University Press.

Jagat Narain Kapur Mathematical Modeling: - 1988 - 259 pages 1991 New Age International (P) Ltd, New Delhi, India

Reinhard Illner Mathematical modeling: a case studies approach- 2005 - 196 pages – American Mathematical Society

Jeffrey Hillsman Moore, Lawrence R. Weatherford, Decision modeling with Microsoft Excel 6th edition, Prentice Hall.

Hayashi, Fumio. (2000) *Econometrics*, Princeton University Press.

Kennedy, Peter (2003). *A guide to econometrics*. Cambridge, Mass: MIT Press.

Giovanini, Enrico. 2008. *Understanding Economic Statistics*, OECD Publishing.

MacKay, D.J. 2003. *Information Theory, Inference, and Learning Algorithms*, Cambridge.

Aris, Rutherford. 1994. *Mathematical Modelling Techniques*, New York: Dover.

Bender, E.A. [1978] (2000). *An Introduction to Mathematical Modeling*, New York: Dover.

Lin, C.C. & Segel, L.A. (1988). *Mathematics Applied to Deterministic Problems in the Natural Sciences*, Philadelphia: SIAM.

Gershenfeld, N. (1998). *The Nature of Mathematical Modeling*, Cambridge University Press.

Course Name: **Research Methods**
Course Code: **MCC 8202** **Credit Units: 4**

Brief Course Description:

Learning the principles of experimental design and of reasoning from experimental results are key ingredients in the research agenda and career development. The research enterprise is presented to the maximum benefit of the student who will find this course not only useful in preparation for special project research but also in future career development. Literature review is considered as part of the research project enterprise and has therefore been included in this course.

Learning Outcomes:

At the end of the course, students should be able to plan and implement research projects

Mode of delivery:

The course will be delivered through lectures, group discussions, self-study assignments, case studies, group and individual research project assignments, and practical work.

Course Assessment

Continuous Assessment		40%
Take home assignment:		20%
Tests:		20%
End of semester examinations:	60%	

Detailed Course Description:

1**.** The Research Enterprise (*2 Hours*): A Conflict that is at the Heart of Research, The Merging of Different Insights and Skills, A Framework for a Research Project, The Insights and Methods of Statistical Science, The Data Analyst's Tools, Practicalities.

2**.** The Structure of a Research Project (*2 Hours*): The Different Demands of Different Areas of Research, Eight Steps in a Research Project, Effective Planning.

3**.** Alternative Types of Study Design (*4 Hours*): The Question of Salt, Again, Different Types of Study – The Eberhardt and Thomas Classification- What Type of Study is Appropriate; Experimental Design: Experimental Design Issues, Randomized Controlled Trials, A Simple Taste Experiment, The Principles of Experimental Design, Confounding, Experimental Design; Quasi-Experimental and Observational Studies: Some alternative types of non-experimental study, Studies that rely on regression modelling, Knowledge Discovery in Databases (KDD).

4. Sample Surveys, Questionnaires and Interviews (*4 Hours*): The Planning of Questionnaire Based Sample Surveys, The Language of Sample Surveys, Sample Survey Design, Questionnaire Design, Questionnaires as Instruments, Qualitative Research; Sample Size Calculations**:** Issues for sample size calculation, A Common Form of Sample Size Calculation, Rules of Thumb;

5. The Rationale of Research (*2 Hours*): Balancing Scientific Scepticism with Openness to New Ideas, Data and Theory, Models, Regularities (Law-Like Behaviour), Statistical Regularities, Imaginative Insight, Science as Hypothesis Testing, Strategies for Managing Complexity, Cause and Effect, Computer Modeling, Science as a Human Activity, The Study of Human Nature and Abilities.

6. Critical review of Literature (*2 Hours*): Purpose of a literature review; Types of sources: Journal Article, ISI vs. non-ISI journals, Conference Paper, Book chapter, Textbook, Technical Report, Web access to printed sources- Peer-reviewed non-printed sources Web pages, Judging the reliability of web pages, When to use a web page as a source; Peer review for quality control, Choosing among sources; How to Search; Starting points, Selecting databases, Search strategy for databases, The "spider" approach, Effective use of on-line search, Evaluating the search results, Using Journal Citation Reports to evaluate journals, Using citation counts to evaluate papers; Citations: Purpose of citations, When not to use a reference, Citations must have been read by the author, Citing material you can't read, Non-Latin scripts, Corporate vs. Individual Authorship, Multiple sources for the same fact, Answers to self-test questions; List of references.

7. Presenting and Reporting (*2 Hours*): Keep the End Result in Clear Focus, General Presentation Issues, Statistical Presentation Issues.

8. Data Analysis (*6 Hours*): Exploratory Data Analysis, EDA Displays, What is the Appropriate Scale, Data Mining and Exploratory Data Analysis, Formal Analysis, Inference – Asking the Data

Specific Questions, The Limits of Confidence Intervals and Hypothesis Tests; Statistical Models: Rough and Smooth, Why Models Matter, Model Assumptions, Model Validation Issues, Broad Principles of Model Construction; Types of Data Structure: Example, Fixed Effects, and a Simple Form of Error Structure, Two or More Nested Random Components, Time Series Data, Repeated Measures Data, Data Mining and Data Structure, Outliers; Critical Review – Examples: Inadequate or Faulty use of Data, Probing the Reasons for Differences in Results – An Example, Instructive Examples, Bivariate Time Series, Multiple Papers, and the Task of Overview, Measuring Instrument and Study Type Issues; The Research Process.

References:

D G Rossiter. 2008. MSc Research Skills: Literature review, Citations, and List of references. Version 1.01, ITC, Enschede.

Gorard, S. (2013) Research Design: Robust approaches for the social sciences, London: SAGE.

Gauch, Jr., H.G. (2003). Scientific method in practice. Cambridge, UK: Cambridge University Press.

Creswell, J.W. (2008). Educational research: Planning, conducting, and evaluating quantitative and qualitative research (3rd). Upper Saddle River, NJ: Prentice Hall.

Rocco, T.S., Hatcher, T., & Creswell, J.W. (2011). The handbook of scholarly writing and publishing. San Francisco, CA: John Wiley & Sons.

Course Name: **Climate Change Mitigation, Adaptation and assessment**
Course Code: **MCC 8203** **Credit Units: 3**

Brief course description:

This course looks at interventions aimed at the reduction and stabilization of the greenhouse gas concentrations in the atmosphere in light of Article 2 of the United Nations Framework Convention on Climate Change (UNFCCC). Focus is on the main options and conditions under which it is to be implemented, reflects on past and future GHG emission trends, and highlights the institutional mechanisms currently in place for the implementation of climate change and sustainable development objectives.

Learning Outcomes:

At the end of the course, should be able to plan and implement climate change mitigation and adaptation strategies. .

Mode of delivery:

The course will be delivered through lectures, group discussions, self-study assignments, case studies, group and individual research project assignments, and practical work.

Course Assessment:

Continuous Assessment	40%
Take home assignment:	20%
Tests:	20%
End of semester examination:	60%

Detailed course description:

1. Mitigation (2 Hours): Concept and definition; Mitigation issues- emissions scenarios, baseline scenarios, mitigation scenarios, the role of technologies, mitigation and adaptation.

2. Energy supply (4 Hours): status of sector, Primary energy resource potentials, supply chain and conversion technologies, Mitigation costs and potentials of energy supply, Policies and instruments; Transport and its infrastructure: Current status and future trends, Mitigation technologies and strategies, Mitigation potential, policies and measures.

3. Residential and commercial buildings (4 Hours): Trends in buildings sector emissions, Scenarios of carbon emissions resulting from energy use in buildings, GHG mitigation options in buildings and equipment, Potential for and costs of greenhouse gas mitigation in buildings, Co-benefits of GHG mitigation in the residential and commercial sectors, Barriers to adopting building technologies and practices that reduce GHG emissions, Policies to promote GHG mitigation in buildings, Interactions of mitigation options with vulnerability, adaptation and sustainable development.

4. Industry (4 Hours): status and development trend:, Industrial mitigation matrix, Industrial sector-wide operating procedures and technologies, Process-specific technologies and measures, Short- and medium-term mitigation potential and cost, Barriers to industrial GHG mitigation,

Sustainable Development (SD) implications of industrial GHG mitigation, Interaction of mitigation technologies with vulnerability and adaptation, Effectiveness of and experience with policies, Co-benefits of industrial GHG mitigation, Technology Research, Development, Deployment and Diffusion, Long-term outlook, system transitions, decision-making and inertia.

5. Agriculture (4 Hours): Status of sector, development trends including production and consumption, and implications; Emission trends (global and regional), Description and assessment of mitigation technologies and practices, options and potentials, costs and sustainability; Interactions of mitigation options with adaptation and vulnerability, Effectiveness of, and experience with, climate policies; potentials, barriers and opportunities /implementation issues; Integrated and non-climate policies affecting emissions of GHGs; Co-benefits and trade-offs of mitigation options, Technology research, development, deployment, diffusion and transfer.

6. Waste Management (4 Hours): Status of the waste management sector, Emission trends, Mitigation of post-consumer emissions from waste, Policies and measures: waste management and climate, Long-term considerations and sustainable development; Mitigation from a cross-sectoral perspective: Technological options for cross sectoral mitigation: description and characterization, Overall mitigation potential and costs, including portfolio analysis and crosssectoral modeling, Macro-economic effects, Technology and the costs of mitigation, From medium-term to long-term mitigation costs and potentials, international spillover effects, Synergies and trade-offs with other policy areas, Mitigation and adaptation - synergies and trade-offs.

7. Sustainable Development and Mitigation (2 Hours): sustainable development and climate change, Implications of development choices for climate change mitigation, Implications of mitigation choices for sustainable development goals.

8. Adaptation to Climate Change in the Context of Sustainable Development and Equity (4 Hours): Adaptation and Adaptive Capacity; Adaptation Characteristics and Processes; Future Adaptations; Planned Adaptations and Evaluation of Policy Options; Adaptive Capacity and its Determinants; Enhancing Adaptive Capacity.

References

Rogner, H.-H., D. Zhou, R. Bradley. P. Crabbé, O. Edenhofer, B.Hare (Australia), L. Kuijpers, M. Yamaguchi, 2007: Introduction. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate

Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (Eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

R.E.H. Sims, R.N. Schock, A. Adegbululgbe, J. Fenhann, I. Konstantinaviciute, W. Moomaw, H.B. Nimir, B. Schlamadinger, J. Torres-Martínez, C. Turner, Y. Uchiyama, S.J.V. Vuori, N. Wamukonya, X. Zhang, 2007: Energy supply. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Kahn Ribeiro, S., S. Kobayashi, M. Beuthe, J. Gasca, D. Greene, D. S. Lee, Y. Muromachi, P. J. Newton, S. Plotkin, D. Sperling, R. Wit, P. J. Zhou, 2007: Transport and its infrastructure. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (Eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Levine, M., D. Ürge-Vorsatz, K. Blok, L. Geng, D. Harvey, S. Lang, G. Levermore, A. Mongameli Mehlwana, S. Mirasgedis, A. Novikova, J. Rilling, H. Yoshino, 2007: Residential and commercial buildings. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Bernstein, L., J. Roy, K. C. Delhotal, J. Harnisch, R. Matsuhashi, L. Price, K. Tanaka, E. Worrell, F. Yamba, Z. Fengqi, 2007: Industry. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA

Smith, P., D. Martino, Z. Cai, D. Gwary, H. Janzen, P. Kumar, B. McCarl, S. Ogle, F. O'Mara, C. Rice, B. Scholes, O. Sirotenko, 2007: Agriculture. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Bogner, J., M. Abdelrafie Ahmed, C. Diaz, A. Faaij, Q. Gao, S. Hashimoto, K. Mareckova, R. Pipatti, T. Zhang, Waste Management, In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Barker, T., I. Bashmakov, A. Alharthi, M. Amann, L. Cifuentes, J. Drexhage, M. Duan, O. Edenhofer, B. Flannery, M. Grubb, M. Hoogwijk, F. I. Ibitoye, C. J. Jepma, W.A. Pizer, K. Yamaji, 2007: Mitigation from a cross-sectoral perspective. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Sathaye, J., A. Najam, C. Cocklin, T. Heller, F. Lecocq, J. Llanes-Regueiro, J. Pan, G. Petschel-Held , S. Rayner, J. Robinson, R. Schaeffer, Y. Sokona, R. Swart, H. Winkler, 2007: Sustainable Development and Mitigation. In Climate Change 2007: Mitigation.Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R.Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Course Name: Disaster Risk Planning and Coordination

Course Code: MCC8204 Credit Units: 4

Brief course description:

Disasters are increasing in frequency, severity and impact, resulting in enormous loss of life and property. Disasters result from an interplay of exposure to hazards, vulnerability and lack of coping capacity. The course examines planning theories and research on disasters to establish best practices, and for the development of mitigation, preparedness, response, and recovery plans.

Learning Outcomes

Upon completion of the course, students should be able to:

a) Propose disaster risk reduction strategies

b) Prepare and implement disaster response and recovery plans

Mode of delivery:

The course will be delivered through lectures, group discussions, self-study assignments, case studies, group and individual research project assignments, and practical work.

Course Assessment:

Continuous Assessment	40%
Take home assignment:	20%
Tests:	20%
End of semester examination:	60%

Detailed course description:

1. Disaster risk management: key concepts, goals and approaches (6 Hours)
2. Planning for disaster risk management: The disaster risk management cycle; mitigation, preparedness, response and recovery (3 Hours)
3. Disaster risk mitigation: hazard identification and vulnerability analysis. Disasters and development. Mitigation strategies (6 Hours)
4. Disaster preparedness and disaster risk reduction (3 Hours)
5. Disaster response: Planning for disaster response (3 Hours)
6. Disaster recovery: Planning for recovery (3 Hours)
7. Education and public awareness in disaster risk management: The role of community based approaches (3 Hours)
8. The Media and disaster risk management (3 Hours)
9. Disaster risk governance: National and international institutions and governance frameworks for disaster risk reduction (12 Hours)

References:

African Union (2004). Africa Regional Strategy for Disaster Risk Reduction. Retrieved from http://www.unisdr.org/files/4038_africaregionalstrategy1.pdf

Ahrens J. and Rudolph PM. (2006). The importance of governance in risk reduction and disaster management. Journal of Contingencies and Crisis Management 14(4):2017-220.

Akera S. (2012). Towards implementation of the Uganda National Disaster Preparedness and Management Policy. In: UNISDR, Disaster risk reduction in Africa. Retrieved from http://www.preventionweb.net/files/26438_isdrafricainformsspecialissuesondro.pdf

DesInventar: The National Disaster Loss Database. Retrieved from http://desinventar.net

Doocy S., Russell E., Gorokhovich Y. and Kirsch T. (2013). Disaster preparedness and humanitarian response in flood and landslide-affected communities in Eastern Uganda. *Disaster Prevention and Management 22 (4): 326-339.*

International Strategy for Disaster Reduction (ISDR). (2007). The Hyogo Framework for Action 2005-2015: Building the resilience of nations and communities to disasters. *Extract from the final report of the world conference on disaster risk reduction (A/CONF.206/6).* Retrieved from *http://www.preventionweb.net/files/1037_hyogoframeworkforactionenglish.pdf*

International Strategy for Disaster Risk Reduction (ISDR). (2009). UNISDR Terminology on disaster risk reduction. Retrieved from http://www.unisdr.org/files/7817_UNISDRTerminologyEnglish.pdf

Kahn M.E. (2005). The death toll from natural disasters: The role of income, geography and institutions. The Review of Economics and Statistics. 87 (2): 271-284.

Lemos M.C., Agrawal A. (2006). Environmental Governance. *Annu. Rev. Environ. Resour. 31:297-325*.

Masaba S., Mungai D.N., Isabirye M. and Nsubuga H. (2017). Implementation of landslide disaster risk reduction policy in Uganda. *International Journal of Disaster Risk Reduction 24:326-331* http://dx.doi.org/10.1016/j.ijdrr.2017.01.019

McEntire D.A. (2001). Triggering agents, vulnerabilities and disaster reduction: towards a holistic paradigm. *Disaster prevention and management. 10 (3):189-196.* Retrieved from https://www.researchgate.net/profile/David_Mcentire/publication/242202837_Triggering_agents_vulnerabilities_and_disaster_reduction_Towards_a_holistic_paradigm/links/53d133900cf228d363e5b1a8.pdf

Office of the Prime Minister (2010). The National policy for disaster preparedness and management. Kampala; Uganda. Retrieved from http://www.preventionweb.net/files/21032_ugandanationalpolicyfordisasterprep.pdf

Okiror S. (2015). Uganda moves on Sendai Framework. Retrieved from http://www.unisdr.org/archive/47105

Oktari R.S., Fahlevi H. & Irawati W. (2017). Disaster budgeting of Banda Aceh's local government: Trends and analysis of post-tsunami Aceh 2004. *IOP Conf. Ser.: Earth and Environ. Sc. 56 012022* http://iopscience.iop.org/1755-1315/56/1/012024

Osuret J., Atuyambe L.M., Mayega R.W., Ssentongo J., Tumuhamye N., Bua G.M., Tuhebwe D. and Bazeyo W. (2016). Coping strategies for landslide and flood disasters: A qualitative study of Mt. Elgon Region, Uganda. *PLoS Currents,* 8 http://doi.org/10.1371/currents.dis.4250a225860babf3601a18e33e172d8b

Palliyaguru R., Amaratunga D., and Baldry D. (2014). Constructing a holistic approach to disaster risk reduction: the significance of focusing on vulnerability reduction. *Disasters 38 (1):* 45-61.

Raschky P.A. (2008). Institutions and the losses from natural disasters. *Nat. Hazards Earth Syst. Sci.* 8:627-634. Retrieved from http://www.nat-hazards-earth-syst-sci.net/8/627/2008/nhess-8-627-2008.pdf

Tierney K. (2012). Disaster governance: social, political and economic dimensions. *Annu. Rev. Environ. Resour. 37*:341-63. http://dx.doi.org/10.1146/annurev-environ-020911-095618

United Nations Office for Disaster Risk Reduction (UNISDR). (2013a). "Disaster impacts/2000-2013". Retrieved from www.preventionweb.net/files/31737_20130312disaster20002012copy.pdf

United Nations Office for Disaster Risk Reduction (UNISDR) (2015a). Disaster Risk Reduction in Africa. Status report - 2015. Retrieved from http://www.unisdr.org/files/51078_drrinafricaexecsummary2015.pdf

United Nations Office for Disaster Risk Reduction (2015b). Sendai Framework for Disaster Risk Reduction 2015-2030. Retrieved from http://www.unisdr.org/files/43291_sendaiframeworkfordrren.pdf

Course Name: **Environment and Social Impact Assessment**
Course Code: **MCC 8205** **Credit Units: 3**

Brief Course Description:

Environmental Impact Assessment and Social Safeguard are assessments of the possible positive or negative impact that a proposed project may have on the environment, together consisting of the natural, social and economic aspects. The purpose of the assessment is to ensure that decision makers consider the ensuing environmental impacts when deciding whether to proceed with a

project. EIAs and Social Safeguards are unique in that they do not require adherence to a predetermined environmental outcome, but rather they require decision makers to account for environmental values in their decisions and to justify those decisions in light of detailed environmental studies and public comments on the potential environmental impacts of the proposal. This course delves into the details of EIA and Social Safeguards with reference to guidelines for Uganda.

Learning Outcomes:

At the end of the course, students should be able conduct environmental impact assessments and audits.

The course will be delivered through lectures, group discussions, self-study assignments, case studies, group and individual research project assignments, and practical work.

Course Assessment:

Continuous Assessment	40%
Take home assignment:	20%
Tests:	20%
End of semester examination:	60%

Detailed Course Description:

1. Role of environmental appraisals (6 Hours): Priority environmental concerns, rational for environmental appraisals, focus of environmental appraisals, authority responsibility and decision making, linking EIA with project appraisals, EIA as part of the project development appraisals, procedures for environmental appraisals, boundaries and scales of sustainability analysis for EIA, limitations of environmental appraisals at project level, special considerations for agricultural and irrigation development, stakeholder involvement and local presentation;
2. Scope of EIA (4 Hours): Activities in various investments projects, planning documents, the database; **Screening**: EIA according to National regulations, project appraisals in development aid, further EIA studies, framework conditions for environmental protection, Alternatives for EIA application; **Scoping**: Alternative EIA studies, focus of scoping, organization, co-ordination;

3. Focus and content of an EIA study (6 Hours): Objectives, Key issues, Environmental quality goals, guiding principles for projects, checklist for environmental components, impact (cause – effect), impact analysis and assessment, prediction of impacts, holistic environmental appraisals, feedback and project design improvement, the environmental management plan; EIA study process: Gathering information and consultations, environmental description, analysis and prognosis of environmental changes, professional impact assessment, recommendation for environmental management;

4. Social safeguards (4 Hours): Safeguard policies, safeguard objective, when to apply safeguards, safeguard triggers- environmental assessment, natural habitats, forests, pest management, safety of dams, involuntary resettlement, indigenous peoples, physical cultural resources-, safeguard challenges;

5. EIA assessment techniques (6 Hours): models on landscape analysis, health risk assessments, water pollution diffusion, spatial data analysis;

6. National EIA regulations and guidelines (4 Hours): Guidelines for environmental impact assessment in Uganda- EIA policies, Basic components of the EIA process, guidelines for developers, guidelines for use by EIA practitioners, guidelines for public participation in the EIA process, guidelines for use by lead agencies and NEMA, guidelines for monitoring

References:

Thomas Petermann, 1996. Environmental Appraisals for Agricultural and Irrigated Land Development, DSE-ZEL, Zschortau, Germany.

John Glasson, Riki Therivel, Andrew Chadwick. 2006. *Introduction **to** environmental impact assessment*. Routledge.

***Introduction** to **environmental impact assessment**:* a guide to principles and practice Bram F. Noble - Oxford University Press.

Carroll, B. and Turpin T. (2009). *Environmental impact assessment handbook,* 2nd ed. Thomas Telford Ltd.

Glasson, J; Therivel, R; Chadwick A. (2005). *Introduction to Environmental Impact Assessment*. London: Routledge

Hanna, K. (2009). *Environmental Impact Assessment: Practice and Participation,* 2nd ed. Oxford.

Petts, J. (ed.), *Handbook of Environmental Impact Assessment*, Vols 1 & 2. Oxford, UK: Blackwell

Ruddy, T. F.; Hilty, L. M. (2008). "Impact assessment and policy learning in the European Commission". *Environmental Impact Assessment Review* **28** (2–3): 90.doi: 10.1016/j.eiar.2007.05.001

Course Name: **Project Planning and Management**
Course Code: **MCC 8206** **Credit Units: 3**

Brief course description:

A project is a business initiative that receives funding because of the impact it will have on society. This is provided in form of a project design document and activity reports validated by an approved third party. This course looks at projects in the context of the traditional project cycle management (PCM).

Learning Outcomes:

Students should be able to plan and implement projects.

Mode of delivery:

The course will be delivered through lectures, group discussions, self-study assignments, case studies, group and individual research project assignments, and practical work.

Course Assessment:

Continuous Assessment	40%
Take home assignment:	20%
Tests:	20%
End of semester examination:	60%

Detailed Course description:

1. Project Cycle Management: the project cycle; project identification, Initial Review, Situational Analysis, Socio-economic and Gender Analysis, Identification of Potential Projects; Project Design- Logical Framework, Work Plans (6 Hours)

2. Project Appraisal**:** Social Appraisal, Gender Appraisal, Social Cost Benefit Analysis; Proposal (6 Hours)

3. Preparation: Understanding Perspectives, key points to address, proposal outline, gathering the evidence, and Writing Style (6 Hours)

4. Project Monitoring and Evaluation: Monitoring, Evaluation, Procedure for Monitoring and Evaluation (6 Hours)

5. Carbon project development: Project identification, preparation and review; Development; Forest Carbon Feasibility Report; Development of Project Design Document; the carbon finance, the project cycle, Verified Carbon Standard (VCS) and Leakage Assessment Reports, Carbon Stock Inventory, Stakeholder Engagement, Biodiversity Assessment and Monitoring, Implementation and initial verification, transfer ERs to participants accounts (6 Hours)

References:

Climate Investment funds: clean technology fund guidelines for investment plans Dec. 1, 2008 http://siteresources.worldbank.org/INTCC/Resources/GuidelinesInvestmentPlansDec1_08.pdf

The Definitive Guide to Project Management.

Paul C. Dinsmore et al (2005) *The right projects done right!* John Wiley and Sons.

Lewis R. Ireland (2006) *Project Management*. McGraw-Hill Professional.

Joseph Phillips (2003). *PMP Project Management Professional Study Guide*. McGraw-Hill Professional.

PMI (2010). *A Guide to the Project Management Body of Knowledge*.

Dennis Lock (2007) *Project Management* (9th ed.) Gower Publishing, Ltd.

Young-Hoon Kwak (2005). "A brief History of Project Management". In: *The story of managing projects*. Elias G. Carayannis et al. (9 eds), Greenwood Publishing Group.

David I. Cleland, Roland Gareis (2006). *Global Project Management Handbook*. "Chapter 1: "The evolution of project management". McGraw-Hill Professional.

Martin Stevens (2002). *Project Management Pathways*. Association for Project Management. APM Publishing Limited.

Morgen Witzel (2003). *Fifty key figures in management*. Routledge.

Course Name: **Environmental Law, Policy and Governance**
Course Code: **MCC8207** **Credit Units: 4**

Course description

Institutions and governance arrangements are critical to achieving climate change and disaster risk reduction goals. Environmental laws and policies regulate human-nature interactions with the aim of minimizing the impact of human activity on the environment. The course examines the application of environmental law and policy at the national, regional and international levels. The course also explores governance processes, systems and structures, as well as collaborative environmental governance approaches

Learning Outcomes

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

a) Explain the role of law in environmental management

b) Appraise environmental management policies

c) Critique environmental governance arrangements

Mode of delivery:

The course will be delivered through lectures, group discussions, self-study assignments, case studies, group and individual research project assignments, and practical work.

Course Assessment:

Continuous Assessment	40%
Take home assignment:	20%
Tests:	20%
End of semester examination:	60%

Course content:

A. Environmental law

1. Nature, evolution and scope of environmental law: laws as formal institutions; tracing environmental law in precolonial, colonial and post-colonial Africa and Uganda (4 Hours)
2. Process of environmental law making: powers of environmental law making; functions and sources of environmental law; process of environmental law making at national, regional and international level. Tradeoffs between socio-economic rights and environmental rights in development discourse. Climate change and disaster risk as emerging issues in environmental law (4 Hours)
3. Principles and Theories in Environmental law: Conservation versus preservation; environmental justice; inter and intra-generational equity; precautionary principle; proportionality; public trust doctrine; Polluter or User Pays Principle; Public Participation; Access to Information. Incorporation of principles into national, regional and international laws (4 Hours).
4. National Environmental Law: Constitutional, legal and institutional context- The 1995 Constitution; framework and sectoral law, and decentralized governance in Uganda (4 Hours)
5. International Environmental Law: Principles and objects of international environmental law. Case studies: The Paris Climate Agreement, 2015 and Sendai Framework for Disaster Risk Reduction (2015-2030) (4 Hours).

B. Environmental Policy

6. The environmental policy making process; the Policy cycle
7. Principles of environmental policy
8. Policy implementation; approaches and challenges
9. Policy analysis: key elements, approaches, features and steps
10. Case studies: The Climate Change Policy for Uganda, 2015, and National Policy for Disaster Preparedness and Management, 2010

C. Environment and Natural Resource Governance

11. Natural Resource Management (2 Hours): Concepts and definitions; levels of natural resource management; Stakeholders and stakeholder analysis: concept, definition and role in natural resource management; stakeholders methodology;

12. Natural Resources Policy Regulations and Strategies (4 Hours): Overview of existing policy and institutions; Policy development processes;- Constitutional principles of importance to natural resource policies, Policy formulation processes in natural resource sectors, New policy tools and concepts-, Policy gaps and implementation shortfalls, The governance context; Natural resource policy implementation;- Rights and entitlements, Land and forest resource allocation procedures, Land delimitation exercises, Private sector entities and forestry, Community forestry and other Community Based NRM initiatives, Decentralization initiatives;

13. MEAS Multilateral Environmental Agreements (4 Hours): Decentralization and NRM: Levels of decision making, - International level, National level, Regional/provincial/state level, District level, Sub-district level, Locality level, community/village level, Group level, Household level, Individual level-, Defining Decentralization, why decentralization? Political Decentralization, Fiscal Decentralization, Institutional Decentralization, Sectoral Decentralization, Decentralized Natural Resource Management, Decentralization and natural resource management in Uganda;

14. Natural Resource Governance (4 Hours): Concepts, definition and dimensions- voice and accountability, political stability, government effectiveness, regulatory quality, control of corruption, rule of law-, governance indicators, governance structures and natural resource management, NRM governance issues;

15. Natural Resources Use and Conflicts (4 Hours): the nature of conflicts, natural resources and civil wars; mechanisms of resolving the conflicts; access to natural resources and user rights; livelihoods and access to natural resources; common property resource management- concepts and methods;

16. Assessing the impact of NRM (4 Hours): Local communities, new institutions, representation and participation; Forms of benefits for local- communities, Social capital, Human capital, Natural capital, Physical capital, financial capital-; Community incentives, rights and management of resources; Social differentiation and marginalization; Conflicts and dispute resolution.

References

1. Douglas M. (1986). *"How institutions think"*. Syracuse University Press.
2. Vatn A. (2005). *Institutions and the Environment*. Edward Elgar Publishing.
3. Faure M. and Du Plessis W. (Eds). (2012). *The balancing of interests in Environmental Law in Africa*. PULP, Pretoria.
4. Hunter D., et al. (2007). *International Environmental Law and Policy*. 3rd edition. Foundation Press, New York.
5. Richardson B., et al. (Eds) (2009). *Climate law and developing countries*. Cheltenham, Edward Elgar.
6. Ball, S. and McGillivray, D. (2005). *Environmental Law*. 6th Edition. Blackstone Press.
7. Ashford N.A and Caldart C.C (2008). *Environmental Law, Policy and Economics. Reclaiming the Environmental Agenda*. The MIT Press.
8. NEMA (2004): *Guide to the Practice of Environmental Law in Uganda: A Hand Book.*
9. Rwakafuuzi L.K. (ed.) (2004). *Environmental Legislation of Uganda.* Vol. 1.
10. Eburn M. (2013). The role of law in disaster management. *J.Geogr Nat Disast 3:2*
11. Parsons W. (1997). *Public policy. An Introduction to the theory and practice of policy analysis*. Cheltenham, Edward Elgar.
12. Howlett M and Ramesh M. (2003). *Studying public policy. Policy cycles and policy subsystems*. Oxford, Oxford University Press.
13. Weimer L. and Vining A. (1999). *Policy analysis. Concepts and Practice*. Englewood Cliffs, Prentice Hall.
14. Simms A. (2009). *Ecological Debt: Global Warming and the Wealth of Nations*.
15. Bainomugisha A. (2006). Political Parties, Political Change and Environmental Governance in Uganda: A Review of Political Parties Manifestos, *ACODE Policy Research Series, No. 16, 2006*
16. Examining access to natural resources and linkages to sustainable livelihoods A case study of Mozambique 2004 Simon Norfolk LSP Working Paper 17 Access to Natural Resources Sub-Programme
17. FAO , Livelihood Support Programme (LSP)
18. Decentralisation in India: Poverty, Politics and *Panchayati Raj*
19. February 2003, Craig Johnson Overseas Development Institute Working Paper 199

20. World Wide Governance indicators 1996 – 2008: Country Data Report for UGANDA, 1996-2008. Governance matters 2009
21. Warner, M and Jones, P. 1998 "Assessing the need to manage conflict in community-based natural resource projects". ODI Natural Resource Perspectives No. 35 July 1998.http://www.odi.org.uk/resources/download/2117.pdf
22. Measham TG (2007) Building capacity for environmental management: local knowledge and rehabilitation on the Gippsland red gum plains, Australian Geographer, Vol 38 issue 2, pp 145–159 doi:10.1080/00049180701392758
23. Shackleton, S, Campbell, B, Wollenberg, E and Edmunds, D. 2002. "Devolution and community-based natural resource management: creating space for local people to participate and benefit?" ODI, Natural Resource Perspectives, No. 76. March 2002.http://dlc.dlib.indiana.edu/dlc/bitstream/handle/10535/3646/76-devolution-community-based-natural-resource-management.pdf
24. Grimble, R. (1998) 'Stakeholder methodologies in natural resource management, Socioeconomic Methodologies,' Chatham: Natural Resources Institute, pp. 1-12 http://www.nri.org/old/publications/bpg/bpg02.pdf
25. Kellert, S, Mehta, J, Ebbin, S and Litchtenfeld, L. 2000"Community natural resource management: promise, rhetoric, and reality". Society and Natural Resources, 13:705-715http://biologicalcapital.com/art/Article%20Community%20Natural%20Resource%20Management.pdf

Course Name: **Research Proposal Development**
Course Code: **MCC9101** **Credit Units: 5**

During the first semester of the second year, each student will develop a research proposal. Proposal development will focus on the following activities:

a) Identification of a research problem and topic of own interest, drawing on the theoretical and practical content of the coursework component of programme.
b) Presentation of research synopsis
c) Appointment of research supervisors
d) Extensive literature review related to the proposed research
e) Development of a full research proposal and research instruments

f) Presentation of the research proposal to the Higher Degrees Committee for approval
g) Development of a research plan with the guidance of the supervisors

Course Name: Dissertation Research
Course Code: MCC 9102 Credit Units: 10

During the first and second semester of the second year, each student will undertake an in-depth research resulting into a dissertation. The dissertation research activities will include:

a) Data collection
b) Data Analysis
c) Presentation of preliminary findings
d) Dissertation writing
e) Submission of Dissertation for examination
f) Dissertation examination
g) Viva voce examination

Course Name: Seminars
Course Code: MCC 9103 Credit Units: 3

Seminars are an important component of the Master of Science in Climate Change and Disaster Risk Management Programme. During the first and second year of study, each student will be required to give at least one seminar per semester. Seminars shall be based on the theoretical and practical content of the coursework component of programme.