



MAASAI MARA UNIVERSITY

SCHOOL OF NATURAL RESOURCES, ENVIRONMENTAL STUDIES

AND AGRICULTURE

DEPARTMENT OF ENVIRONMENTAL STUDIES, GEOGRAPHY AND

PLANNING

DOCUMENT: Master of Science in Environmental Science (Studies)	
TITLE: Master of Science in Environmental Science (Studies)	EFFECTIVE DATE: SEPTEMBER, 2018
PREPARED BY: Department of Environmental Studies, Geography and Planning Chair of Department: (Sign) _____ Dean: School of Natural Resources, Environmental Studies and Agriculture (Sign) _____	APPROVED BY: _____ DVC(A&SA) _____ VICE CHANCELLOR (CHAIR OF SENATE)

MAY 2018

FOREWARD

The environment is one of the pillars of sustainable development, and therefore the need to produce post-graduates who understand the intimate relationship of human development and economic growth of a nation, with the sustainable use of the environment. Maasai Mara University is taking on the challenge of training and conducting research that promotes achievement of sustainable development. Maasai Mara University whose driving vision is to become an excellent university committed to academic excellence for sustainable development in providing quality University education through innovative teaching, research and consultancy services for sustainable development strives to be part of the global force to drive development towards sustainable use and management of environmental resources by mounting a programme in Master of Science in Environmental Science (Studies).

The overall objective of M.Sc. Environmental Science (Studies) is to broaden the knowledge of students in the field of Environmental Science (Studies), and its interfaces with other multiple disciplines. This curriculum has been developed and revised by experts in the environment industry and is based on the idea that environment includes all physical elements in the wealth of a nation bestowed by nature such as climate, forests, wetlands, fields, rangelands, minerals, mountains, lakes, streams, seas, plants and animals and is critical to the economic, social and cultural development of a nation.

The curriculum therefore is focused towards understanding in details the various aspects of the physical environment which will be attained through specific areas of specializations. Since the environment experiences changes as a consequence various anthropogenic activity, this programmes therefore emphasize on research on trend and various issues revolving around environment through the use of technology such as Geographic Information Systems.

Prof. Mary K. Walingo, PhD, MBS, MKNAS, EBS.

Vice-Chancellor

Maasai Mara University

Narok, Kenya

November, 2017

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Masters of Science in Environmental Science (Studies) curriculum was developed in 2015 and brought together team of environmental experts, curriculum experts and stakeholders who contributed valuable experience and knowledge in order to produce a document that meets regulatory and accreditation requirements.

Maasai Mara University wishes to sincerely thank and acknowledge the following individuals for their invaluable contribution, tireless efforts, devotion and active participation in the various stages of development and revision of this curriculum.

1. **Prof. Aggrey Thuo (PhD, MKIP) (Environmental Planning and Management):**
Associate Professor, Department of Environmental Studies, Geography and Planning, Maasai Mara University
2. **Prof. Romulus Abila (PhD, Aquatic Ecology and Conservation Biology):** Associate Professor, Department of Department of Environmental Studies, Geography and Planning, Maasai Mara University
3. **Dr. Samson Mabwoga (PhD, Remote Sensing):** Lecturer, Department of Environmental Studies, Geography and Planning, Maasai Mara University
4. **Prof. Charles N. Mundia, PhD, MISK, LS(K):** Associate Professor, Dedan Kimathi University of Technology.
5. **Ms. Jedidah Nankaya (MSc, Conservation Biology):** Tutorial Fellow, Department of Environmental Studies, Geography and Planning, Maasai Mara University
6. **Ms. Mary Wambui Mwangi (MSc):** Tutorial Fellow, Department of Environmental Studies, Geography and Planning, Maasai Mara University
7. **Mr. Joshua Kuria (MSc, Hydrology)-** Lecturer, Department of Environmental Studies, Geography and Planning, Maasai Mara University
8. **Dr. Waweru Kamundia (MSc, MKVA)-** Chairperson, Department of Environmental Studies, Geography and Planning, Maasai Mara University
9. **Mr. Moses Okombo -** Office of the Director, Quality Assurance and Performance Contracting

1.0 GENERAL INFORMATION

1.1 Vision and Mission of Maasai Mara University

VISION

To be a world-class university committed to academic excellence for sustainable development.

MISSION

To provide quality University education through innovative teaching, research and consultancy services for sustainable development.

1.2. Philosophy of Maasai Mara University

The University is guided by a philosophical statement, "*eng'eno e puuan*", which is a Maasai name for "*knowledge is prosperity*". As the University seeks creation of knowledge for prosperity through research, innovation and technology, it is further guided by its core values of **excellence, professionalism, teamwork, creativity & innovativeness, transparency & accountability, equity and socio-justice**. The University's Philosophy Statements and Mission are complementary, focused on ensuring a genuine need for quality and relevant curricula for promotion of higher education, training, research and innovation. While the Mission Statement focuses on why the University exists, the Philosophy Statement addresses how Maasai Mara University fulfils its educational, research, **innovativeness** and technological mission as an institution for higher learning.

Maasai Mara University offers challenging undergraduate, graduate and professional career programmes that prepare students to remain relevant in the society upon graduation as they prepare to enter the job market to start nurturing their careers. Many students have found Maasai Mara University academic programmes a stepping-stone to further education within their fields of specialization. This has become possible due to a collegial union of academic Schools and Departments, students, staff, administration and business community members who are holistically committed to providing academic programmes, resources, activities and instructional facilities that support excellence in higher education, training, research and innovation. As the University believes and affirms that members of business and industry communities must also share responsibility for developing, establishing, implementing and evaluating educational and any academic programmes for the sake of continued relevance, attractiveness and competitiveness in the society. While primarily concerned with students' intellectual growth and

development, the University also supports their physical, moral and spiritual growth and development, and augments their capacity for leadership through co-curricular programmes and the entire students' leadership fraternity.

At the heart of the mission, vision and goals of academic, research, innovation and students' affairs, is the University's fundamental commitment to a strong general education, training, research and innovative programmes that prepare students for global competitiveness, broadening their knowledge in the arts and sciences, helping them integrate learning and community concerns, and preparing them for success in their major fields of study and life after graduation. In all these academic programmes of study, the University encourages the examination of fundamental questions of human concern, respectful dialogue in the context of diverse points of view and experience, as well as the search for truth and social justice for all.

In an atmosphere of intellectual dogmatism made possible by academic freedom, the University builds up and trains students in courses within their areas of advanced study, extend research and innovation in their fields of specialization, produce highly scientific, innovative, technological, scholarly and creative work, and serve the University as well as the nation and the entire global community.

The University identifies and supports students of diverse talents, experiences, knowledge, interests and cultures who are willing and prepared to learn and to seek excellence in themselves and others. The University believes that career education instruction that a student undertake is an art as well as a science. And that the process of undertaking it is indeed very dynamic and helps develops both the skill and the intellect of career-minded individuals in its community. The University further believes that career education is an interactive process on which the future of society depends as emerging graduates become professionals of all types and critically become the drivers for future socio-economic growth and development in the society.

Vital to the success process of supporting excellence in higher education, training, research and innovation are the dedicated members of variously skilled academic support services and the administrative leadership charged with nurturing strategic planning, institutional assessment, and effective and efficient stewardship and strategic deployment of University resources. This connection and collaboration ensures that the University is offering an education that produces an employable, skilled, responsible and accountable person in the society. The enduring fellowship of alumni, sponsors, trustees, and other friends and contributors in the community at

large demonstrates their continuing faith and trust in the central mission, vision and goal of Maasai Mara University through various acts of giving, prayer and support.

Infusing this community of shared concern are the distinctive qualities and values of Maasai Mara University, including the belief that faith and reason can interact in mutually fruitful and favorable ways. Therefore, the University membership encourages a full search for truth, including religious truth, while respecting freedom of personal expression. It also promotes a vigorous and compassionate dialogue among the various faith traditions, and between them and the academic disciplines. At its foundation, teaching, research and innovation at Maasai Mara University are premised upon and committed to the fundamental dignity and unique worth of each human person present.

Finally, as outlined in Kenyan constitution, it is also the philosophy of Maasai Mara University that no person shall be denied admission to any academic programme of any kinds in the University, be excluded from any training whatsoever, be denied the benefits of training, learning and conducting research of any level, or be subjected to discrimination in any recruitment practices or activity of the University because of race, creed, color, handicap, national origin, sex, age, political affiliation, sexual orientation, marital status or religious belief.

1.3 Maasai Mara University Admission Requirements

1.3.1 Minimum Maasai Mara University Entrance Requirements

- A holder of at least a Second-Class Honors (Upper Division) degree having studied Mathematics/Statistics either as a single subject or as one of the two Science subjects at Bachelor's degree level or its equivalent from a University recognized by the Senate.
- A holder of Second Class Honors (Lower Division) with two years relevant experience.

1.3.2 Other admission requirements

- Or any other qualification approved by senate

1.3.3 Procedure of application for admission to the Maasai Mara University

Step 1: Application for admission should be made on Official Application Forms which can be downloaded at <http://www.mmarau.ac.ke/admissions/admission-procedure> OR you can apply directly ONLINE by clicking the link Postgraduate (<https://docs.google.com/a/mmarau.ac.ke/forms/d/e/1FAIpQLSe0GGZeddkU9XazG16MzrciSKDImUbRBkkw5a6G8mknJi-sOA/viewform?c=0&w=1>) / OR you can obtain the forms from any of the following offices:

A. Admissions Office

Maasai Mara University, Main Campus

P.O.Box 861- 20500

NAROK

Tel: 020-8082410/1

Or

B. Nairobi Satellite Campus

Located at the Kenya Education Management

Institute, Parklands

Tel: 041 2002344

Step 2: Duly completed application forms should be returned to any of the offices indicated above, accompanied with a non-refundable fee of Ksh. 2,000/= . Payment can be made through bankers cheque or paid directly to any of the following University accounts:

Co-operative Bank, Narok Branch A/C No.01129337192600

Equity Bank, Narok Branch A/c No. 0360292999764

1.4 Academic Resources

1.4.1 Facilities and Equipment

a) Lecture Rooms

Available Sitting Spaces in Lecture Rooms in MMU

Room	Sitting space	Room	Sitting space
C 001	50	LT 011	30
C 002	50	LT 012	30
C 003	50	LT 013B	130
C 004	50	LT 014	30
C 005	50	LT 015	30
C 006	50	LT 016B	130
C 007	50	LT 017	30
C 008	50	LT 018	30
C 009	50	LT 019B	130
C 010	50	LT 020	30
C 011	50	LT 101	300
C 012	50	LT 103	30
C 013	50	LT 104B	130
C 014	50	LT 105	30
C 015	50	LT 106	30
C 016	50	LT 107B	80
C 017	50	LT 108	30
C 018	50	LT 109	30
C 019	50	LT 110B	130
C 020	50	LT 111	30
B 005	50	LT 112	30
B 006	50	LT 113B	130
B 103	50	LT 114	30
B 104	50	LT 115	30
LT 001	30	LT 116B	130
LT 002	30	LT 201	850
LT 003	30	MH	700
LT 004	30	Phy Lab	40
LT 005	30	CheLab	40
LT 006B	130	ZooLAB	40
LT 007	30	CompLab	40
LT 008	30	JournLab	40
LT 009B	130	HosLab	40
LT 010	30	GISLab	40
	1700	62	3600
<i>SUMMARY</i>		<i>SUMMARY</i>	
	62	Programs	
	5450	Lecturers	
	4470	Units	

b) Library

a. Library mandate

The library is an academic hub for teaching, learning, research and community service to students, staff and other members of the university community.

b. Library facilities

Maasai Mara University library supports teaching, learning and research by providing adequate information materials and conducive reading environment with current reading carrels and workstations. It promotes and provides quality services to support the university programmes in pursuit of scholarly excellence. For research, the library users access more than 34,000 print information sources as well over 10,000 titles electronic journals, databases, catalogues, dictionaries and e-books. It has latest desktop computers for research and access to electronic information resources provided for through fiber optic connectivity.

c. Library policy

The library policy emphasizes on current, relevant acquisition of information materials and use ICT to deliver information to library users.

d. Library staff

The library staff members are trained information professionals and para-professionals with library skills

c) Information communication and Technology

		Quantity	Capacity	Usage
Software	Matlab	60	60	Shared
	R program	60	60	Open source
	MS Office 2016	60	60	Shared
	Windows 10	60	60	Shared
	Adobe Acrobat Professional	60	60	Shared
	Adobe Design and Web Premium CS6	60	60	Shared

	Adobe Reader	60	60	Shared
	Java Runtime Env 32bit (Oracle) Java Runtime Env 64bit	60	60	Shared
	Java Development Kit	60	60	Shared
	Packet Tracer*	60	60	Shared
	SPSS*	60	60	Shared
	SAS	60	60	Shared
	STATA	60	60	Shared
	Python*	60	60	Shared
	Microsoft Visual Studio	60	60	Shared
	Microsoft SQL Server	60	60	Shared
	Oracle 12c database	60	60	Shared
	Corel Draw	60	60	Shared
Computer	Desktops	60	60	Shared
	Laptops	10	10	Shared
Audio Visual Aid	Projectors	10	10	Shared
Internet	Access Point	8	500 (conOLD access)	Shared

1.4.2 References Materials

a) Core-texts in terms of numbers

Over 18,000 texts available in the library.

b) E-books, e-journals and accessible databases in terms of subscriptions

Annual subscription of Ksh. 47,000 over 10,000 articles and journals from 28 publishers

c) Print journals in terms of subscriptions

One hundred and five (105) print journals

1.4.3 Academic Staff

a) Teaching Staff

Maasai Mara University has 164 teaching staff employed by the University council based on competency and merit. The University followed the CUE standards and guidelines *INST/STD/04* 2014 on University Human Resources to hire adequate and competent human resources to carry out its mandate in accordance to its human resource policy. The teaching staff are ranked as shown in the table below.

Sn	Rank	Number
1	Professors	5
2	Associate Professors	8
3	Senior Lecturers	13
4	Assistant Lecturers	51
5	Tutorial Fellows	43
6	Graduate Assistants	28
7	Chief Technicians	13
8	Senior Technicians	3
TOTAL		164

In addition to the above teaching staff employed on full time basis, the university also hires part time academic staff members from time to time as the need arise to complement the full-time teaching staff.

1.5 Programmes offered by Maasai Mara University

1.5.1 List of all academic programmes offered in Maasai Mara University

PROGRAMME
Bachelor of Science (Mathematics)
Bachelor of Science (Physics)
Bachelor of Science (Chemistry)
Master of Science in Chemistry
Doctorate of Philosophy in Chemistry
Bachelor of Science in Applied Statistics with Computing
Bachelor of Science (Computer Science)
Bachelor of Science (Information Science)
Bachelor of Science (Zoology)
Bachelor of Science (Botany)
Bachelor of Science in Agribusiness Management
Bachelor of Science in Agricultural Economics and Resource Management
Bachelor of Science in Economics
Bachelor of Science in Economics and Statistics
Bachelor of Science in Financial Economics
Bachelor of Science in Entrepreneurship
Bachelor of Science in Human Resource Management
Bachelor of Science in Project Planning Management
Bachelor of Commerce
Bachelor of Business Management
Master of Science in human resource Management
Master of Business Management
Master of Business Administration
Doctor of Philosophy in Business Administration
Bachelor of Communication and Public Relations

Bachelor of Communication and Journalism
Bachelor of Arts in Kiswahili and Journalism
Bachelor of Arts (Language and Communication Studies)
Bachelor of Arts in Literature, Theatre and Film
Master of Arts in Linguistics
Master of Arts in Kiswahili
Master of Arts in Literature
Doctor of Philosophy in Linguistics
Doctor of Philosophy in Literature
Doctor of Philosophy in Kiswahili
Bachelor of Arts in Community Development
Bachelor of Arts in social Work
Bachelor of Arts in Religion
Bachelor of Arts in Political Science and Public Administration
Bachelor of Arts in Criminology and Penology
Bachelor of Arts in Sociology
Bachelor of Arts in History
Bachelor of Arts in Philosophy
Bachelor of Hotels and Hospitality Management.
Bachelor of Tourism Management
Bachelor of Science in Forest Ecosystems Management
Bachelor of Science in Wildlife Management
Bachelor of Science in Parks, Recreation and Leisure Management
Bachelor of Environmental Studies (Biology and Health)
Bachelor of Environmental Management
Bachelor of Environmental Studies (Environmental Earth Sciences)
Bachelor of Arts (Geography)
Bachelor of Urban and Regional Planning
Bachelor of Science in Leather Production and Processing
Bachelor of Science in Animal Health and Production

Master of science in Environmental Science (Studies)
Master of Science in Land Resource Management
Master of Arts in Geography
Doctor of philosophy in Land Resource Management
Doctor of Philosophy in Environmental Planning Management
Doctor of Philosophy in Environmental Science (Studies)
Bachelor of Education Science
Bachelor of Education Arts
Bachelor of Education Primary Option
Master of Education (Educational Administration)
Executive Master of Education (Educational Leadership and policy Studies)
Master of Education (Curriculum Studies)
Master of Education (Curriculum, instruction and Educational Media)
Doctor of Philosophy in Education (Educational administration)
Doctor of Philosophy in Education (Curriculum Studies)
Doctor of Philosophy in Education (Curriculum, instruction and Educational Media)
Bachelor of Education in Early Childhood Education
Bachelor of Education Science with Special Needs Education
Bachelor of Education Arts with Special Needs Education
Bachelor of Education Science with Guidance and Counseling
Bachelor of Education Arts with Guidance and Counseling
Bachelor of Education with Guidance and Counseling
Bachelor of education Special Needs Education
Bachelor of Education Primary option with Special Needs Education
Master of Education (History of Education)
Master of Education (Sociology of Education)
Master of Education (Guidance and Counseling)
Master of education (Early Childhood Development)
Master of education (Philosophy of Education)
Master of Education (Special Needs Education)

Master of Education (Educational Psychology)
Doctor of Philosophy in Guidance and Counseling
Doctor of Philosophy in Early Childhood Development Education
Doctor of Philosophy in Educational Psychology

1.5.2 Duration of each programme including total lecture/instructional hours

SCHOOL	DEPARTMENT	PROGRAMME	Duration	Total lecture/instructional hours	
ANDSCIENCE	Mathematics and Physical sciences (MPS)	Bachelor of Science (Mathematics)	4years	2314	
		Bachelor of Science (Physics)	4years	2392	
		Bachelor of Science (Chemistry)	4years	2301	
		Master of Science in Chemistry	2years	754	
		Doctor of Philosophy in Chemistry	3years	468	
			Bachelor of Science in Applied Statistics with Computing	4years	2262
			Bachelor of Science (Computer Science)	4years	2379
			Bachelor of Science (Information Science)	4years	2496
			Bachelor of Science (Zoology)	4years	2184
	BUSINESS ECONOMICS	Economics	Bachelor of Science in Agribusiness Management	4years	2184
Bachelor of Science in Agricultural Economics and Resource Management			4years	2184	
Bachelor of Science in Economics			4years	2184	
Bachelor of Science in Economics			4years	2184	

		and Statistics		
		Bachelor of Science in Financial Economics	4years	2184
	Business Management	Bachelor of Science in Entrepreneurship	4years	2262
		Bachelor of Science in Human Resource Management	4years	2444
		Bachelor of Science in Project Planning Management	4years	2301
		Bachelor of Commerce	4years	2340
		Bachelor of Business Management	4years	2340
		Master of Business Management	3years	702
		Master of Business Administration	3years	702
		Doctor of Philosophy in Business Administration	2years	702
ARTS AND SOCIAL SCIENCE S		Media Film and Communication	Bachelor of Communication and Public Relations	4years
	Bachelor of Communication and Journalism		4years	2184
	Linguistics, Languages and Culture	Bachelor of Arts in Kiswahili and Journalism	4years	2496
		Bachelor of Arts (Language and Communication Studies)	4years	2520
		Bachelor of Arts in Literature, Theatre and Film	4years	2520
		Master of Arts in Linguistics	2years	1326
		Master of Arts in Kiswahili	2years	1326
		Master of Arts in Literature	2years	1326
		Doctor of Philosophy in Linguistics	3years	1624

		Doctor of Philosophy in Literature	3years	1624	
		Doctor of Philosophy in Kiswahili	3years	1624	
	Social Studies		Bachelor of Arts in Community Development O	4years	2184
			Bachelor of Arts in social Work	4years	2379
			Bachelor of Arts in Religion	4years	2379
			Bachelor of Arts in Political Science and Public Administration	4years	2379
			Bachelor of Arts in Criminology and Penology	4years	2340
			Bachelor of Arts in Sociology	4years	2301
			Bachelor of Arts in History	4years	2470
			Bachelor of Arts in Philosophy	4years	2262
Natural Resources, Environmental Studies and Agriculture	Tourism and Hospitality Management	Bachelor of Hotels and Hospitality Management.	4years	2665	
		Bachelor of Tourism Management	4years	2613	
	Forestry and Wildlife Management	Bachelor of Science in Wildlife Management	4years	2288	
		Bachelor of Science in Forest Ecosystems Management	4years	2301	
		Bachelor of Science in Parks, Recreation and Leisure Management	4years	2483	
		Bachelor of Science in Forest Ecosystems Management	4years	2301	
	Environmental Studies, Geography and Agriculture	Bachelor of Environmental Studies (Biology and Health)	4years	2301	
		Bachelor of Arts (Geography)	4years	2315	
		Bachelor of Environmental Management	4years	2496	

		Bachelor of Environmental Studies (Environmental Earth Sciences)	4years	2301
		Bachelor of Environmental Studies (Biology and Health)	4years	2301
		Bachelor of Arts (Geography)	4years	2315
		Bachelor of Environmental Management	4years	2496
		Bachelor of Urban and Regional Planning	4years	2457
		Bachelor of Science in Animal Health and Production	4years	3150
		Master of science in Environmental Studies	2years	754
		Master of Science in Land Resource Management	2years	754
		Master of Arts in Geography	2years	546
		Doctor of philosophy in Land Resource Management	3years	468
		Doctor of Philosophy in Environmental Planning Management	3years	468
		Doctor of Philosophy in Environmental Studies	3years	962
		EDUCATION	Curriculum Instruction and Educational Management	Bachelor of Education Science
Bachelor of Education Arts	4years			2223
Bachelor of Education Primary Option	4years			2184
Master of Education (Educational Administration)	2years			630
Executive Master of Education	1year			630

	(Educational Leadership and policy Studies)		
	Master of Education (Curriculum Studies)	2 years	630
	Master of Education (Curriculum, instruction and Educational Media)	2years	630
	Doctor of Philosophy in Education (Educational administration)	3years	676
	Doctor of Philosophy in Education (Curriculum Studies)	3years	676
	Doctor of Philosophy in Education (Curriculum, instruction and Educational Media)	3years	676
Education Foundations, Psychology/Guidance and Counseling, Special Needs Education & Early Childhood Development Education	Bachelor of Education in Early Childhood Education	4years	2262
	Bachelor of Education Science with Special Needs Education	4years	3042-3276
	Bachelor of Education Arts with Special Needs Education	4years	3042-3120
	Bachelor of Education Science with Guidance and Counseling	4years	2808-3042
	Bachelor of Education Arts with Guidance and Counseling	4years	3120-3042
	Bachelor of Education with Guidance and Counseling	4years	2262
	Bachelor of education Special Needs Education	4years	2262
	Bachelor of Education Primary option with Special Needs Education	4years	2262

		Master of Education (History of Education)	2years	630
		Master of Education (Sociology of Education)	2years	630
		Master of Education (Guidance and Counseling)	2years	630
		Master of education (Early Childhood Development)	2years	630
		Master of education (Philosophy of Education)	2years	630
		Master of Education (Special Needs Education)	2years	630
		Master of Education (Educational Psychology)	2years	630
		Doctor of Philosophy in Guidance and Counseling	3years	676
		Doctor of Philosophy in Early Childhood Development Education	3years	676
		Doctor of Philosophy in Educational Psychology	3years	676

1.5.3 Definitions of Terms

Credit hours

This refers to the total number of hours required to be taught per week which for this program is 4. This translates to 52 credit hours per semester of 13 weeks.

Lecture/instructional hours

Means a period of time equivalent to one hour and representing one such instructional hour in lecture form, two in a tutorial or open learning session, three in a laboratory practical or practicum and five in farm or similar practice.

Contact Hours

Synonymous with Lecture/instructional hours

Course Units

A course unit is a defined curriculum that forms part of an academic programme.

1.5.4 Academic organization of the programmes reflecting academic quarters/trimester/Semesters

Maasai Mara University has adopted a semester system where an academic year runs for two semesters each consisting of 13 weeks of teaching and 2 weeks of end of semester exams.

2.0 THE CURRICULUM

2.1 Program Title:

This is a curriculum for the **MASTER OF SCIENCE IN ENVIRONMENTAL STUDIES**

Introduction

Master of Science in Environmental Science (Studies) is an interdisciplinary graduate program for students who wish to broaden their knowledge in the field of Environmental Science (Studies) or who seek special education in technical, social, or management aspects of the environment. The broad construal of environment in this program is based on the idea that environment includes all physical elements in the wealth of a nation bestowed by nature such as climate, forests, wetlands, fields, rangelands, minerals, mountains, lakes, streams, seas, plants and animals and is critical to the economic, social and cultural development of a nation.

The program provides opportunities for interdisciplinary graduate study and research and its goal is to give students a broad understanding of natural resources as well as knowledge of related scientific, technical, socio-political, legal, and economic issues.

2.2 Philosophy of the Programme

Is to produce graduates with deep knowledge and skills that will enable graduates to either employ themselves or be employed in the private or public sector in environmental management industry.

2.3 Rationale of the Programme

2.3.1 Needs Assessment / Market Survey / Situation Analysis

The Master of Science in Environmental Science (Studies) provide an excellent, practically-based environmental management education that has several distinctive features:

First, Master of Science in Environmental Science (Studies) emphasises the importance of practical experience and builds real-world problem-solving skills through field work, workshops, role-plays, case studies, and close interaction with lecturers and leading practitioners. Students also develop an ethical and theoretical foundation that serves them well for professional practice.

Also, while rooted in the Kenyan context, the Master of Science in Environmental Science

(Studies) draws on international experience and management approaches. Maasai Mara University Master of Science in Environmental Science (Studies) graduates can therefore apply their training locally or overseas in a variety of professional and applied environments.

2.3.2 Stakeholders Involvement

The Masters in Land Resources Management programme was developed with consultation with the National Environmental Management Authority (NEMA- Kenya).

2.3.3 Justification of the Need for the Program

The Master of Science in Environmental Science (Studies) provides an excellent, practically-based training that has several distinctive features:

First, it is unique in that it offers a multi-disciplinary research-led programme in Master of Science in Environmental Science (Studies) is consistent with the changing needs of contemporary environmental issues. The proposed degree emphasizes the integrated nature of management through the delivery of course units from natural, social, economic, political and environmental sciences to understand and evaluate planning processes, policies and tools set within Kenya, and increasingly regional and global, systems. The multi-disciplinary nature of the degree provides students with the opportunities to develop strength in areas of choice.

Second, the Master of Science in Environmental Science (Studies) enables students to develop critical thinking skills, the ability to conduct independent research, and the skills to work with others in an integrated manner on challenging projects. Students develop interpersonal, communication, and conflict resolution skills essential for working in teams and interacting with people from diverse cultures, communities, and backgrounds.

Third, the Master of Science in Environmental Science (Studies) emphasises the importance of practical experience and builds real-world problem-solving skills through field workshops, role-plays, case studies, and close interaction with lecturers and leading practitioners. Students also develop an ethical and theoretical foundation that serves them well for professional practice.

Finally, while rooted in the Kenyan context, the Master of Science in Environmental Science (Studies) draws on international experience. Graduates of MSc Environmental Science (Studies) from Maasai Mara University can therefore apply their training locally or overseas in a variety of professional and applied fields.

2.4 Goal of the Programme

The goal of the Master of Science Environmental Science (Studies) is to train experts who will facilitate and guide society in Environmental Management at different levels and for different sectors of the societies as well as to provide solutions to environment related issues.

2.5 Expected Learning Outcomes

2.5.1 The Expected Learning Outcomes of the Programme

Graduates of Msc in Environmental Science (Studies) will be able to

- Understand the relationship between environment and development
- Understand global scale processes and their relevance in the field of environmental management
- Understand key aspects of research as well as undertaking research
- Understanding the fundamental principles of ecosystem structure and function
- Understand the laws and institutions governing environmental management as well as tools used in environmental monitoring

2.5.2 The Expected Learning Outcomes of Areas of Specialization

I. Environmental biology

Upon completion of this specialization, the student will be able to:-

- Understand planning theories, concepts and frameworks, understand their strengths and weaknesses and apply them in conservation
- Design and demonstrate the use of conservation planning processes that are sensitive to the needs of people and take into account the sustainability of political, biophysical, social & economic processes & institutions
- Understand the role played by different entities in conservation planning

- Produce simple, but technically robust, planning documents
- Understand the nature and limitations of planning for the future, and understand the role of professional judgment
- Work effectively in groups of divergent professional and personal interests.
- Do a research in ecology , apply statistical techniques in data analysis
- Understand and appreciate the structure and function and stresses of various ecological systems

II. Environmental economics

Upon completion of this specialization, the student will be able to:-

- Explain the concepts of demand and supply and price determination, demonstrate the application of microeconomic analysis in decision-making.
- Formulate a relevant model and use such analytical tools in addressing a key macroeconomic question independently
- Understand the different ways in which economic issues can be tackled
- Use econometric software for data management and statistical analysis,
- Understand, and apply, current scientific standards for documentation of data sources and analysis.
- Understand the economics of natural resource use within an environmentally sound framework showing the interaction between environmental resources and humans.
- Understand contemporary issues in environmental management and apply economic theory in the issues
- Develop skills in environmental management and an understanding of policies.
- Understand the economics and management of various ecological systems
- Understand urban economics and environment
- Conduct research in environmental economics, apply various statistical procedures and use them to analyze and process data using them.

III. Environmental health

Upon completion of this specialization, the student will be able to:-

- Understand the instrumental chemical analysis methods; various classification of instruments for analysis;
- Understand sampling and sample treatment and handling from; air, water, and soil
- Conduct instrumental sample analysis and data collection and treatment.
- Identify and classify toxic chemicals and evaluate of toxicity of the chemical substances
- To understand various hazard and risk and how to do risk and hazard assessment of chemical substances.
- Understand the Structure and physical and chemical properties of water, different sources of water pollutants and Water quality standards and monitoring
- To various sources of waste, their characteristics, effects on human health and the environment and the sustainable as if managing waste
- Cconduct research in environmental health, use various statistical procedures to analyze the data

IV. Environmental Information Systems

Expected Learning Outcomes

Upon completing this course, students will be able to:

- Understand how electromagnetic energy interacts with the atmosphere and surface
- Use spectral signatures to interpret land cover characteristics and Perform preprocessing remote sensing
- Interpret remotely sensed imagery and their properties
- Describe existing platforms and scanners as well as radar systems
- Demonstrate state-of-the-art remote sensing hardware and software.

V. Environmental Law

On completion of this course, students will be able to:

- Examine the role of law in achieving the objectives of planning policy and processes
- Have practical training in problem-solving and decision-making in litigation and advocacy
- Analyze evidence and advise on prospects of success at trial of cases
- Understand and explain the main legal principles governing the management of resources
- understand the key legal principles and legislative frameworks governing renewable energy
- Demonstrate the process of policy making and its related complexities

VI. Environmental Earth Sciences

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

- Understand the causes of regional weather and climatic patterns and processes
- Demonstrate the geological processes operating in the world oceans and oceanic processes
- Develop a literature review that reflects studies that are relevant to the student's thesis and how to document them in a specific format
- Understand why environmental geology is a collage of many different geological Sub disciplines
- Differentiate human-induced from natural global change
- Explain efficiency as a design principle in energy systems, buildings, and end-user applications

VII. Environmental Planning and Management

On Successful completion of this course, students should be able to:

- Have a clear understanding of the importance of planning and management
- Evaluate legal case studies to illustrate environmental issues, regulations, policies and principles
- Understand practical process of urban environmental planning, *and* to critically analyze existing plans and planning processes

- Prepare of planning briefs and presentations of planning statements and reports
- Assess the environmental impact from human activities to the environment
- Develop Sustainable environmental cities program and eco-city programs

2.6 Mode of Delivery

Msc. Environmental Science (Studies) will be delivered using modes such as face to face lectures, class discussion, excursion and group work, power-point presentations, laboratory demonstrations and practicals.

2.7. Academic Regulations for the Programme

2.7.1 Admission Requirements for the programme

The common regulations for the Masters degrees in the School of Natural Resources, Environmental Studies and Agriculture shall apply.

The candidates for the M.Sc. in Environmental Science (Studies) should have: -

- i. At least a second-class Honors (upper division) degree in Environmental Science, Environmental management, Geography, Wildlife Management, Agriculture, Sociology, Forestry Management, Parks Management from the Maasai Mara University, or an equivalent degree from a University recognized by the Maasai Mara University Senate, or
- ii. A holder of a second-class honors (lower division) degree in Environmental Science, Environmental management, Geography, Wildlife Management, Agriculture, Sociology, Forestry Management provided that the candidate has acquired at least two years relevant experience.

2.7.2 Regulations on Credit Transfers in the programme

Credit transfers shall be accepted for purposes of student mobility and recognition of prior learning.

Guideline

- 1) In line with the existing qualification frameworks, credit transfers shall only be accepted from accredited institutions and programmes;
- 2) Credit transfers may be permitted up to a maximum of 49% of the core course units for

Similar programmes at the same level.

2.7.3 Course Requirements

The requirements of the courses include a minimum of 80% lecture attendance, seminar participation, direct study, group work, educational visits, project work and thesis writing. The lecturer should ensure course content coverage and timely supervision of thesis.

2.7.4 Students Assessment Criteria

The general regulations for the Masters degree in the School of Natural Resources, Environmental Studies and Agriculture shall apply. The examination shall consist of two parts:

Part I

Each course shall be examined by continuous assessment and a final written examination lasting three hours at the end of the semester.

The final examination in each course shall count for 60% and continuous assessment for 40% of the total marks.

The pass mark for each course shall be 50%.

A candidate who fails in more than half of the taught course units at the first attempt in the final examination shall be discontinued.

A candidate shall be permitted to proceed to part II (research and thesis) only after passing all the required courses. A candidate who fails in one or two units shall be permitted to sit for a supplementary examination in those courses. A candidate who fails in a supplementary examination shall be discontinued.

Part II

Thesis shall be submitted by the end of the second year of study

The thesis shall be submitted and examined as specified in the common regulations for Master's degree as provided for in the Postgraduate thesis regulation manual

2.7.5 Grading System

MMU uses the Grade system which has a four-point scale (1-4). Each course is assessed based on the continuous assessment tests, end of semester examinations, practicum and other assessments and given a letter grade of A to F. The University grading is as below:

Mark	Letter Grade
70 - 100%	A
60 – 69%	B
50 – 59%	C
Below 50%	F

These inputs shall be put together as they come out, discussed at department and school level and finally and incorporated to the curriculum during annual reviews. Major overhauls, if need arises, shall be considered after a full cycle of offering the course, i.e. every 2-3 years.

2.7.6 Examination Regulations:

Regular examination regulations

The University Common Examination regulations shall apply which states that;

- (i) The Lecturer(s) responsible for a course, who shall also be the Internal Examiner (s) for the course, shall set **the** examination question paper and prepare the marking Scheme within the first four (4) weeks of the semester or otherwise as approved by Senate.
- (ii) Departmental Boards of Examiners shall moderate examination question papers internally before they are sent to external examiners.
- (iii) Regular University Examinations shall also be designated as SPECIAL, RETAKE and/or RESIT examinations. Examination booklets shall be designed to take this into account.
- (iv) Where a student has official documented reasons for missing examinations, they shall be allowed to do special examinations during regular examination period when the course is next offered. However, they SHALL be required to indicate in the answer booklet that the examination is SPECIAL. Examination booklets shall be designed to take this into account.

- (v) A copy of the question (s), marking schemes (s) titles of reference books used, detailed curricula and other relevant information shall be sent to external examiners to facilitate moderation of examinations.
- (vi) The Heads of Departments shall ensure that comments on examination papers from external examiners are discussed at Departmental Examiners Board and incorporated into the question papers by the internal examiners.
- (vii) Moderated and typed examination papers shall be sent to the Registrar Academic Affairs Office for reproduction and safe keeping five (5) weeks before the start of main examinations.
- (viii) The reproduction, collating, stapling, packing, issuing and dispatching of examination shall be conducted in the Examinations Office at Main Campus or at any other examination centre as may be approved by Senate.
- (ix) The examination centers shall be manned by qualified personnel.

Conduct of examinations

General Rules

- (i) University Examinations shall take precedence over external or any other examinations
- (ii) A candidate who has missed 20% or more of the required course attendance in a given course shall not be allowed to sit for University Examinations and shall be required to retake the course
- (iii) University Examinations shall normally be conducted from Monday to Friday, and on any other day approved by Senate.
- (iv) Candidates who may not sit University Examinations on scheduled dates on grounds approved by senate, shall seek permission immediately the examination timetable is released by filling examination deferment forms signed by the following officers; chair of relevant department and Dean of the School. A copy of the form shall be submitted to the office of the Registrar Academic Affairs.
- (v) All courses shall be examined within the semester in which they are taken, unless otherwise approved by Senate.

- (vi) All Schools shall be required to define in their curricula: core, required, pre-requisite and elective courses as approved by Senate. These should be strictly followed in administration of examinations.
- (vii) A candidate who fails to turn up for an examination shall be deemed to have failed that examination and shall be required to RESIT or RETAKE the said examinations when next offered subject to applicable clauses 5.1.2 or 5.2.2 respectively.
- (viii) Marks for Industrial Attachment shall be submitted within two weeks from the end of attachment period.

A student who misses industrial attachment will take it when next offered unless by prior permission of senate

2.7.7 Moderation of Examinations

The examination moderation shall be conducted as per the **ACADEMIC DIVISION PROCEDURE MANUAL MMU/ACPM/AC/2013**. To ensure the items and test papers to ensure their appropriateness. The Internal Moderation shall be conducted by Academic Staff at Departmental level to ensure that the required standards are met in connection with curriculum, course outlines, marking schemes and table of specification. The External Moderation shall be conducted by the relevant University appointed External Examiner.

Definition of roles

- (i) Chief Internal Examiner shall be the Dean of the School who shall chair the School Board of Examiners.
- (ii) Principal Internal Examiner shall be the Chairperson of Department, who shall chair the Departmental Board of Examiners.
- (iii) Internal Examiner shall be a member of the academic staff at the level of tutorial fellow and above, who has taught the course to be examined, unless otherwise approved by Senate.
 - (a) *Duties of Internal Examiner*
- (i) Chief Internal Examiner shall chair the School Board of Examiners and ensure standardization, consistency and compliance with regulations in all examination processes in the School.

- (ii) The Principal Internal Examiner shall chair the Departmental Board of Examiners and ensure standardization, consistency, and compliance with all examination processes and regulations in the Department.
- (iii) Internal Examiners shall mark every script based on a detailed and well structured marking scheme, to ensure consistency in marking.
- (iv) Internal Examiner shall after marking all the scripts, enter Continuous Assessment Tests and the end of semester examination marks on the individual mark-sheets and submit to the Principal Internal Examiner by the sixth week from the last day of semester exams.
- (v) The Internal Examiner for any particular examination paper shall be the main invigilator during examinations.
- (vi) If the Internal Examiner would be unavailable for invigilation, he/she shall inform the Chairperson of Department to nominate a replacement from the department.
- (vii) Internal Examiners shall certify that the total number of scripts received match the number of students in the examination attendance list.
- (viii) An Internal Examiner, who in the course of marking examination scripts, suspects that an examination irregularity has taken place, shall consult the Head of Department. If the Chairperson of Department considers that an examination irregularity has occurred, a full report shall be made through the Dean of the relevant school, to the Chairperson of the Standing Committee on examination irregularity, and the Deputy Vice- Chancellor, A & SA.
- (ix) All the examination individual mark sheets shall be accurately completed, checked and signed by the internal Examiner, the Chairperson of Department, the External Examiner (s).

Internal or External Examiners shall not divulge marks to candidates. All documents tabled during Departmental and School Board of Examiners Meetings shall be reclaimed from members of the Board at the end of the Meeting.

2.7.8 Graduation Requirements

The candidate shall have attained minimum of 780 instructional hours. The student is also required to have done all the eight core courses in the programme and at least 4 out of the six elective courses

and completing thesis in the guidance supervision of the University supervisors appointed in the Department and have done an oral defense and passed.

2.7.9 Classification of Degrees

MSc Environmental Science (Studies) will not be classified i.e. it is either a pass or a fail.

2.7.10 Description of Thesis

- (a) A student shall, during the MSc in Environmental Science (Studies) , write a thesis on a specific topic in Environmental Management.
- (b) Thesis supervisor(s) shall be appointed for the students at the start of the first semester of year two by the department. The main supervisor must be a full time Lecturer of Maasai Mara University.
- (c) A written thesis shall be submitted to the school of graduate studies for examination. The submitted thesis shall then be provided for examination by two internal examiners and an external examiner. The candidate thereafter shall be required to present himself/herself for an oral defence organized by the school of graduate studies with a panel of examiners.

The thesis format will be examined based on the university post graduate guidelines for the format of the thesis i.e

Roman number pages should include

Title

Declaration

Acknowledgement

Dedication

Abstract

Table of contents

Abbreviation

Acronyms

Operation definition of terms

List of tables list of figures

List of appendices

Body- Numerical pages

Chapter 1- Introduction
Chapter 2- Literature review
Chapter 3 – Materials and methods/ methodology
Chapter 4- Results and discussions

OR

Chapter 4- Results
Chapter 5- Discussions
Conclusions and Recommendations
References
Appendices

N/B

References

1a) listings in the references should be consistent and each reference listed must be as complete as possible.

b) Each referencing should show: volume, publisher (where applicable) page number

The length of the thesis/dissertation of a master's degree programme shall normally be at least 20,000 words as per CUE prescriptions

2.8 Course Evaluation:

The course shall be regularly evaluated at various levels:

- (a). students undertaking the course shall be issued with evaluation sheets to give their views on their experience;
- (b). Graduates of the program shall be required to give a feedback using prescribed questionnaires designed by the department;
- (c). Stakeholder evaluations shall be undertaken every cycle of graduation (i.e. every 2 years)

2.9 Management and Administration of the Program

The Master of Science degree programme in Environmental Science (Studies) will be housed in the Department of Environmental Studies, Geography and Agriculture in the School of Natural Resources, Environmental Studies and Agriculture of Maasai Mara University. Leadership is

offered by the head of the department. Quality assurance of the programme is accomplished at the Directorate of Quality Assurance through the Senate, Dean's committee, School Curriculum Board and the Departmental curriculum board.

2.10 .1 Course Distribution Table

SN	Courses	Credit Hours
1	Institutional common courses of the Programme	0
2	Core Courses of the programme of the Programme	6
3	Specialization/Option area courses of the Programme	12
TOTAL		18

2.10.2 Programme Learning Outcomes

Learning outcomes	Year 1		Year 2	
	Courses	Credit hrs	Courses	Credit hrs
Programme learning outcomes				
To understand the effect of development on environment and the various conservation strategies	SES 800	3		
	SES 810	3		
	SES 864E	3		
To understand global scale processes and their relevance in the field of environmental management	SES 801	3		
	SES 860	3		
	SES 861	3		
	SES 863	3		
	SES 863	3		
	SES 866E	3		
	SES 867E	3		
	SES 868E	3		
	SES 869AE	3		
	SES869BE	3		
	SES 869CE	3		
	SES 869DE	3		
	SES 869FE	3		
	SES 869GE	3		
	SES 869HE	3		
SES 869IE	3			
Understand key aspects of research as well as undertaking research	SES 802	2	SES 899	6
	SES 811	2		
	SES 862	2		
	SES 825	3		
	SES 834	3		
	SES 844	2		
	SES 865E	2		
Understanding the fundamental principles of ecosystem structure and function	SES 803	3		
	SES 812	3		
	SES 813	3		
	SES 814	3		
	SES 815	3		
	SES 816E	3		
	SES 817E	3		
	SES 818E	3		
	SES 818AE	3		
	SES 819E	3		
	SES 819AE	3		
	SES 819BE	3		

Understand and apply economics for environmental management	SES 820/ARE 801	3		
	SES 821/ARE 802	3		
	SES 822/ARE	3		
	SES 805	3		
	SES 823	3		
	SES 824	3		
	SES 826	3		
	SES 827E	3		
	SES 828E	3		
	SES 829E	3		
	SES 829AE	3		
	SES 829BE	3		
	SES 829CE	3		
	SES 829DE	3		
SES 829FE	3			
SES 829GE/ARE	3			
To understand the concepts tools and techniques used in Environmental Planning and Management	SES 870	3		
	SES 871	3		
	SES 872	3		
	SES 872E	3		
	SES 873A	3		
	SES 873B	3		
	SES 873C	3		
	SES 873D	3		
	SES 874E	3		
	SES 874AE	3		
	SES 874BE	3		
	SES 874CE	3		
	SES 874DE	3		
	SES 875E	3		
	SES 875AE	3		
	SES 876E	3		
	SES 877E	3		
	SES 878E	3		
	SES 878AE	3		
	SES 879E	3		
SES 879AE	3			
SES 879BE	3			
SES 879CE	3			
SES 879DE	3			
SES 879FE	3			
SES 879GE	3			
To understand major concepts used in environmental health and the various environmental health processes	SES 830	3		
	SES 831	3		
	SES 832	3		
	SES 833	3		
	SES 835	3		
	SES 836	3		
	SES 837E	3		
	SES 838E	3		
	SES 839E	3		

2.10.3 List of the institutions common courses, core courses of the programme, specialization/ option area courses and electives

A. Year One Semester 1: Core Courses for All Specializations

All the students taking a Master of Science in Environmental Science (Studies) shall take the following courses in their first semester:

Course Code	Course Title	Credit Hrs
SES 800	Environment and development	3
SES 801	Earth system science 1	3
SES 802	Research Methods ad field course	2
SES 803	Ecosystems structure and function	3
SES 804	Principles of environmental law	2
SES 805	Environmental impact Assessment	2

B. Year One Semester 2: Specialization Courses

From this section, a student shall choose a specialization and undertake the courses there in from the sections given

Environment Biology

Course Code	Course Title	Credit Hrs
SES 810	Conservation Management and Planning of Biological	3
SES 811	Ecological Research Methods	2
SES 812	Tropical Terrestrial Communities	3
SES 813	Environmental Stress on Biota	3
SES 814	Biotechnology and the Environment	3
SES 815	Restoration Ecology	3
SES 816E	Wetland Ecology	3
SES 817E	Ecology of Tropical Forests	3
SES 818E	Ecology of Savanna/Rangeland, Arid and Semi-Arid Regions 3	3
SES 818AE	Ecology of Fresh and other Inland Waters	3
SES 819E	Marine Ecology	3
SES 819AE	Special Topics in Environmental Biology	3
SES 819BE	Mangrove Ecology	3

Environmental Economics

Course Code	Course Title	Credit Hrs
SES 820/ARE 801	Microeconomics	3
SES 822/ARE 805	Econometrics	3
SES 823	Environmental Economics and Resource Systems	3
SES 824	Environmental Policy and Resource Management	3
SES 825	Research Methods in Environmental Economics	3
SES 826	Environmental Project Analysis	3
SES 827E	Trade and Environment	3
SES 828E	Energy and Environmental Systems	3
SES 829E	Economics of Renewable and Non-Renewable Resources	3
SES 829AE	Economics and Management of Coastal Zone and Marine	3
SES 829BE	The Economics and Management of Arid and semi arid lands	3
SES 829CE	Economics of Watershed and Wetlands Management	3
SES 829DE	Economics of Water Resource Management	3
SES 829FE	Urban Economics and Environment	3

Environmental Health

Course Code	Course Title	Credit Hrs
SES 830	Instrumental Methods of Chemical Analysis	3
SES 831	Toxic Substances, Health and Chemical Safety	3
SES 832	Environmental Toxicology and Physiology	3
SES 833	Environmental Microbiology	3
SES 834	Research Methods in Environmental Health	2
SES 835	Water Health and the Environment	3
SES 836	Waste Management	3
SES 837E	Atmospheric Environmental Chemistry	3
SES 838E	Risk Assessment	3

Environmental Information Systems

Course Code	Course Title	Credit Hrs
SES 840	Theory of remote sensing	3
SES 841	Environmental Applications of Remote Sensing	3
SES 842	Geographic Information Systems I (GIS I)	3
SES 843	Digital Image Processing of Remotely Sensed Data	3

SES 844	Research Methodology	3
SES 845	Geographic Information Systems II (GIS II)	3
SES 846E	Land Surveying	3
SES 847E	Computer Assisted Cartography	3
SES 848E	Photogrammetry	3
SES 849E	Environmental Mapping of Arid and	3

Environmental Law

Course Code	Course Title	Credit Hrs
SES 850	Land Use Law and the Environment	3
SES 851	Environmental Litigation Clinic	2
SES 852E	Water Resources Law	3
SES 853E	Energy Law and the Environment	3
SES 854E	Mineral Resources Law and the Environment	3
SES 855E	Forestry, Wildlife and Fisheries Law	3
SES 856E	Law and the Working Environment	3
SES 857E	Legal Control of Ocean Pollution	3
SES 858E	Law of the Sea	3
SES 859E	International Environmental Law	3
SES 859AE	International Environmental Governance	3
SES 859BE	Physical Planning Law	3
SES 859CE	Public Health Law	3
SES 859DE	Environmental Legislative Process	3
SES 859FE	Law and the Management of Poisons and Chemical Waste	3
SES 859GE	Environmental Space Law	3

Environmental Earth Sciences

Course Code	Course Title	Credit Hrs
SES 860	Climatology and Climate dynamics	3
SES 861	Environmental Oceanography	3
SES 862	Development of Research Proposal	2
SES 863	Environnemental Geology	3
SES 863E	Earth System Science II	3
SES 864E	Energy and the Environment	3
SES 865E	Environmental Statistics	3
SES 865AE	Advanced Environmental Statistics	3

SES 866E	Environmental Hydrology	3
SES 867E	Groundwater Hydrology	3
SES 868E	Environmental Impacts of Mining	3
SES 869AE	Solar Radiation and Environment	3
SES 869BE	Atmospheric Pollution and its Impacts	3
SES 869CE	Coastal and Estuarine Physical Processes	3
SES 869DE	Coastal Zone Management	3
SES 869FE	Environmental Geomorphology	3
SES 869GE	Environmental Soil Science	3
SES 869HE	Industrial Processes and Pollution	3
SES 869IE	Aquatic Chemistry	3
SES 869JE	Special Topics	3

Environmental Planning and Management

Course Code	Course Title	Credit Hrs
SES 870	Principles of Environmental Planning and Management	3
SES 871	Environmental Institutional Structures and Policy Framework	3
SES 872	Environmental Planning and Management Techniques	3
SES 872E	Environmental Planning Information Systems	3
SES 873A	Planning Studio I (Urban)	3
SES 873B	Planning Studio II (Regional/Rural)	3
SES 873C	Planning Studio III (Project based): water, sanitation, etc.	3
SES 873D	Strategic Environmental Assessment	3
SES 874E	Issues in Urban Environmental Planning and Management	3
SES 874AE	Environmental Design and Infrastructure Services	3
SES 874BE	Re-planning and Re-designing Informal Settlements	3
SES 874CE	Housing Environment Planning and Management	3
SES 874DE	Tourism, Recreation and Conservation Planning	3
SES 875E	Rural Environment Planning and Management	3
SES 875AE	Regional Environmental Planning and Management	3
SES 876E	Planning and Management of Arid and Semi-Arid Lands	3
SES 877E	Planning and Management of Coastal and Marine	3
SES 878E	Planning and Management of Drainage Basin	3
SES 878AE	Planning and Management of Agricultural Settlement	3
SES 879E	Water Resources Development Planning and Management	3
SES 879AE	Planning and Management of Forestry and Wildlife	3

SES 879BE	Land Use Development Planning	3
SES 879CE	Industrial and Transport Development Planning	3
SES 879DE	Landscape Design and Planning	3
SES 879FE	Disaster Preparedness, Management and Mitigation	3

C. Year TWO Semester 1 and 2

In their 2nd year of study, all the Master of Science in Environmental Science (Studies) students shall undertake a research activity in their area of study, culminating to writing a thesis.

Course Code	Course Title	Credit
SES 899	Research Project and thesis	6

2.10.3 Total credit hours, lecture hours, contact hours and course units required for graduation

Minimum Number of courses required for Graduation = 18

Minimum credit hours of course work = 54

Thesis weighting = 6

Total Number of Credit hours required for Graduation= 60

2.11. Duration and structure of the programme

The programme shall normally take a minimum of two (2) academic years and a maximum of three (3) years subject to review, from the monitoring, evaluation and recommendations made by appropriate academic committee of the university.

3.0 COURSE DESCRIPTIONS

CORE UNITS

SES 800: ENVIRONMENT AND DEVELOPMENT

3 UNITS

Purpose of the Course

This course recognizes that in developing countries natural resources are intricately linked with the everyday life of households. Thus, the issues and concerns are somewhat different from the management of natural resources and the environment in developed countries. Sustainability is a much more immediate concept, since it must take account of pressing concerns such as basic subsistence and even survival. Drawing on the instructor's experience in international environment and development work, the course covers a range of topics including models of development, environmental concerns in development, integrated conservation and development projects, community-based resource management, global and ecological economics perspectives and field techniques.

Expected Learning Outcomes of the Course

On completion of this course, the student will be able to:

1. To expand students knowledge of current theoretical debates on environment-development issues
2. To explore the intersections of social justice issues with the quest for economic growth.
3. To gain an overview of the key theories of environment and development in circulation today
4. To critically evaluate and differentiate approaches to environment-development questions from a variety of perspectives
5. To apply theories of development to specific examples and understand how the model of development used is relevant to the environmental issues that emerge in that particular case.

Expected Learning Outcomes of the Course

History of the global environmental movement: USA and Europe; the environmental movement in the Third World including Kenya; major global conferences and conventions on the state of the

environment; emerging global environmental problems: National and global conservation strategies; Environmental philosophy and ethics; theories of development: development policies, agriculture, labour and industry; the concept of sustainable development: population, economic growth and indigenous forms of resource management; Alternative strategies of development: poverty reduction and wealth creation, entrepreneurship, food security, hazards and coping strategies; the role of technology. International economics and the environment: multinational corporations (MNCs), development assistance and trade agreements;

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core Reading materials

Adams, W. M. (2012). Green Development, 2nd Edition Environment and sustainability in the Third World. London, Routledge.

NOVÁČEK, P. MEDERLY, P.: Global Partnership for Development. Millennium Project, Central European Node. American Council for the United Nations University and Palacky University Press, Washington, D.C., Olomouc, 2013.

NOVÁČEK, P. MEDERLY, P. a kol.: Strategie udržitelného rozvoje. Univerzita Palackého, Olomouc, 2015 OECD/DAC: DAC Guidelines on Aid and Environment: No. 1, Good Practices for Environmental Impact Assessment of Development Projects. [online].

Recommended Reference Materials

OECD Development Assistance Committee, Paris, 1992. Available on <http://www.oecd.org/dataoecd/37/25/1887592.pdf> OECD/DAC: DAC Guidelines and Reference

Serie. Managing Aid:Practices of DAC Member Countries. OECD, Paris, 2005. ISBN 92-64-00761-X

PLANET ARK: Saving Jungles May Aid Nearby Coffee Plantations. [online]. August 4, 2004. Reuters News Service. [cit. 2005-05-12]. Available from www.planetark.com

SES 801: EARTH SYSTEM SCIENCE I

3 UNITS

Purpose of the Course

This course introduces students to the basic earth sciences with an emphasis on understanding the impact of humans on the natural earth systems. Beginning with a study of the lithosphere, principles of physical geology will be examined including the evolution and internal structure of the earth, dynamic processes that affect the earth, formation of minerals and rocks and soil, ore bodies and fossil- energy sources. Next, the biosphere will be studied, including the basic concepts of ecology including systems ecology and biogeochemical cycles. The influence of humans and the built environment on these natural systems will also be examined with a view to identifying more sustainable engineering practices. Finally, students will study the oceans and the atmosphere and the physical, chemical and thermodynamic processes involved in climate change.

Expected Learning Outcomes of the Course

To illustrate the significance to the environmental manager of understanding global-scale processes, such as:-

1. global climate change
2. radiation balance of Earth
3. origin of persistent weather patterns
4. the hydrologic cycle
5. global tectonics as the setting for landscape types and functioning
6. natural and human influence on global patterns of soil production and erosion
7. formation and functioning of large river floodplain and delta environments

8. role of the cryosphere in the Earth system
9. spatial and temporal variations in ocean circulation
10. Earth system modeling

Course Content

Energy flow in ecosystems, world energy supply options, extraction of energy from non-renewable and renewable sources, energy systems in Kenya, impact analysis and mitigation measures. Environmental meteorology and atmospheric pollution, response and feedback of the atmosphere to solar energy fluctuations from the earth's spheres; Soil erosion and sedimentation. Hydrological processes and water resources. Waste disposal and recycling. Mineral resources sustainability and integrity of the environment. Environmental applications of remote sensing and GIS in solving environment problems

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core Reading Materials

Garnaut (2015) The Garnaut Review 2016. Australia in the Global Response to Climate Change. Cambridge: Cambridge University Press.

Girod, B., Wiek, A., Mieg, H. and Hulme, M. (2012) The evolution of the IPCC's emission scenarios – changes, causes and critical aspects. *Environmental Science and Policy*, 12, 103–118

Haag, A. L. (2017). What's next for the IPCC? *Nature Reports Climate Change*. doi:10.1038/climate.2017.73
Hadjilambrinos, C. (2017). Understanding technology choices in electricity industries: a comparative study of France and Denmark. *Energy Policy*, 28, 1111–1126.

Recommended Reference Materials

Meehl, G.A., Goddard, L., Murphy, J. et al. (2009). Decadal prediction: can it be skillful? *Bulletin of the American Meteorological Society*, 90, 1467–1485. Mendelsohn, R. O. (2007). A critique of the Stern report. *Regulation*, 29, 42–46.

Mendonça, M., Lacey, S. and Hvelplund, F. (2009). Stability, participation and transparency in renewable energy policy: lessons from Denmark and the United States . *Policy and Society* *Policy and Society*, 27, 379–398.

SES 802: RESEARCH METHODS AND FIELD COURSE

3 UNITS

Purpose of the Course

This course is designed to support postgraduate students in developing their research project and to assist them in defining their mode of enquiry. The course has been constructed to guide students through a range of issues and considerations which should inform their general approach to research. It will give students a general introduction to postgraduate research, its methodologies, its challenges and its organisation, including in creative practice. Students will be introduced to a range of research tools and will be equipped to plan and organise their research, as well as to communicate their findings. The course will cover the practicalities of research, including setting and achieving realistic goals, planning, working in a team, using resources, presentation skills, and meeting institutional requirements and expectations of good practice. Techniques for advancing knowledge and understanding, such as setting up a programme of reading, literature review, techniques of archival research, interviewing, observation studies, ethnographic research, gathering evidence, quantitative methods, and creative practice and design as research. Development of a critical framework in which to review research and research methods, taking account of the contested nature of research practice.

Expected Learning Outcomes of the Course

The course aims to:

- Provide an introduction to key aspects of MPhil/MSc research, including research tools, methods, ethical and legal questions

- Support students in the development of their research project and approach
- Encourage students to reflect critically on the processes of research
- Assist students in the articulation of a critical language appropriate to their research aims and interests
- Encourage the development of a supportive research environment
- Enable students to learn from cross-disciplinary communication, which means being familiar with the range of research practices applicable to the sciences, humanities, social sciences, and art and design
- Provide pointers to further investigation into appropriate research methods

Course Content

environmental units: Coastal, ASALs, Mountainous, and Lake regions. Research methods in different environmental fields. PRA, Questionnaires, key informant interviews, group interviews. Data collection techniques. Introduction to data collection, analysis, storage and presentation. Computer packages for data analysis and presentation. Use of spreadsheets and Power-Point. Writing reports, dissertations and scientific papers for publications and poster presentation. Referencing. Electronic access to literature.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core Reading materials

Neuman, W. Lawrence. Social Research Methods – Qualitative and Quantitative Approaches

Recommended Referencing reading materials

Creswell, J. W. . *Research design: Qualitative, quantitative and mixed methods approaches*. 3rd Ed.. Thousand Oaks, CA: Sage., 2009.

SES 803: ECOSYSTEM STRUCTURE AND FUNCTION

3 UNITS

Purpose of the Course

This course provides an introduction to the ecosystem ecology underlying these services, in particular looking at how ecosystems are structured and function. The course has a practical ethos and involves fieldwork and analysis of real data from around the globe. It is suitable for students with a wide range of backgrounds. It looks at the dynamic nature of ecosystems, which often behave as complex systems. Different ways of representing and modelling such systems are explored through practical exercises and case studies. The course provides students with the core ecosystem knowledge needed for Ecosystem Valuation and Management.

Course Outcome

1. An understanding of fundamental principles of ecosystem ecology, including how ecosystem structure relates to function, and the dynamics of ecosystems.
2. Practical knowledge of how to measure and model ecosystem structure and function, manage data, and analyse large ecological data sets.
3. Appreciation of the diversity of ecosystem functions and expressions across different time, space and biome scales, illustrated through targeted case studies.
4. Appreciation for how ecosystems respond to and feed back on, global change drivers including climate change, land use change, and biodiversity loss.

Course Content

Fundamental concepts, classification and types of ecosystems. Integrative approach of structural and functional relations, ecosystem dynamics and models. Energy dynamics in ecosystems: Food web/chain, trophic levels and productivity. Carrying capacity and bio-geochemical cycles. Natural and external disturbances on the structure and function of ecosystems and their impact.

Expected Learning Outcomes of the Course

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Reading materials

Chapin, Matson and Vitousek (2014) Principles of terrestrial ecosystem ecology. 2nd edition.

Haefner, J. (2013). Modeling Biological Systems: Principles and Applications. 2nd edition.

Simpson, R. D., R. A. Sedjo and J. W. Reid (2014), 'Valuing Biodiversity for Use in Pharmaceutical Research', Journal of Political Economy 104, 163–185.

Smith, V. K. (1993), 'Nonmarket Valuation of Environmental Resources: An Interpretive Appraisal', Land Economics 69, 1–26.

Recommended Reference Materials

Steinhoff, H. W., R. G. Walsch, T. J. Peterle and J. M. Petulla (1987), 'Evolution of the Valuation of Wildlife', in D. J. Decker and G. R. Goff, eds., Valuing Wildlife. Economic and Social Perspectives. Boulder, London: Westview Press.

Strebel, O., J. Böttcher and W. H. M. Duynisveld (1993), Ermittlung von Stoffeinträgen und deren Verbleib im Grundwasserleiter eines norddeutschen Wassergewinnungsgebietes. Texte des Umweltbundesamtes 46/93. Berlin: Erich Schmidt. Swanson, T. M. (1996), 'The Reliance of Northern Economies on Southern Biodiversity: Biodiversity as Information', Ecological Economics 17, 1–8.

Purpose of the Course

This course provides a practical and lively introduction to the legal system governing the use and protection of natural resources and the environment in Canada. Students will learn about the creation and evolution of environmental law as well as the major divisions of law that relate to environmental issues. The course will also examine and critique the substantive law in Kenya dealing with specific environmental issues such as pollution, toxic substances, water management, fisheries, forestry, climate change, environmental assessment, and protecting biological diversity.

Expected Learning Outcomes of the Course

The overall objectives of the course are to:

- understand the origins, nature and scope of environmental law
- understand the structural framework and core principles of environmental law in Kenya
- understand the main techniques of environmental law
- understand the structure and operation of the main agencies and institutions that play roles in the development and implementation of environmental law
- examine the political, economic and cultural context of environmental law
- canvas developments in environmental law, with some comparison to other jurisdictions
- consider selected case studies of environmental law
- consider selected institutional and law reform proposals related to environmental law

Course Content

Analysis of common law foundations of environmental law, especially the doctrines, trespass and negligence. The Rule in Rylands vs Fletcher and riparian rights; changed character of problems and the law; the place of administrative law in the context of limitation of the common law doctrines; contemporary legislation and the role of environmental law in development; environmental impact assessment and associated approaches to redress environmental problems; and the concept and province of international environmental law. Stability and resilience of

ecosystems. Concept of the utilization of shared natural resources, including the non navigational uses of international watercourses.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core Reading materials

Robert Elliot (editor) Environmental Ethics (OUP 2015)

Viñuales, J. E., 2017 'The Contribution of the International Court of Justice to the Development of International Environmental Law: A Contemporary Assessment' (2008) 32 Fordham International Law Journal 232. (ed.), The Rio Declaration on Environment and Development. A Commentary (Oxford University Press, 2015).

Recommended Reading Materials

Voigt, C., Sustainable Development as a Principle of International Law (Leiden: Martinus Nijhoff, 2009). Wirth, D. A., 'The Rio Declaration on Environment and Development: Two Steps Forward and One Back, or Vice Versa' (1995) 29 Georgia Law Review 599.

Woods, C., The Environment, Intergenerational Equity and Long-term Investments (doctoral dissertation, University of Oxford, 2011).

Xue Hanqin, Transboundary Damage in International Law (Cambridge University Press, 2003).

SES 805: ENVIRONMENTAL IMPACT ASSESSMENT

2 UNITS

Purpose of the Course

The purpose of this course is to provide a critical overview of the theory, practice and key issues pertaining to environmental impact assessment (EIA). Emphasis will be placed on the Canadian context. Topics to be covered include, but are not limited to: the origins and evolution of EIA; steps in the EIA process; impact analysis; prediction; cumulative effects; social impacts; public involvement; strategic environmental assessment; visual impacts; scenario development and related futures techniques. By the end of the course, students should have a basic understanding of EIA, along with its key concepts, challenges and potential applications.

Expected Learning Outcomes of the Course

The objectives include:

- a) Gaining familiarity with the fundamentals of EIA
- b) Exploring issues pertaining to the practice of EIA
- c) Exploring substantive issues that may be addressed through EIA
- d) Exploring EIA methods and techniques.

Course Content

Concept, theories and methods of EIA, steps in EIA, primary impact evaluation, mitigation, measures, assessment, comparison of alternatives, documentation and decision making, environmental audits. Case studies such as EIA of water resources, energy development, agricultural development, mining, industrial development projects. EIA of small-scale activities. EIA legislation and policy in Kenya. International conventions and treaties. The course shall be offered in an intensive 3 week workshop after the second semester and which include 1 week of fieldwork. Examination: 2 weeks of fieldwork+lectures ending with written and/or oral examination to contribute 50%. Group project in the final week to contribute 50%.

Mode of Delivery

The course shall be offered in an intensive 3 week workshop after the second semester and which include 1 week of fieldwork.

Course Assessment

Examination: 2 weeks of fieldwork+lectures ending with written and/or oral examination to contribute 50%. Group project in the final week to contribute 50%.

Core Reading materials

Noble, B.F. *Introduction to Environmental Impact Assessment: A Guide to Principles and Practice* (Second Edition) Oxford University Press, 2010.

Welford R., 2016: *Corporate Environmental Management*, Earthscan, London.

World Bank 2013: *Good practices: Environmental Assessment, Operational Manual, GP 4.01*, and Environment Department World bank, Washington DC.

Recommended Reading Materials

World Bank 1999: *Operational Policy OP 4.01 Annex C: Environmental Management Plan*, World Bank Washington DC.

World Business Council for Sustainable Development, (2005): *Environmental and social impact assessment (ESIA) guidelines*. 54pp

World Health Organization 1946: *History of WHO*, <http://www.who.int/topics/en>

ENVIRONMENTAL BIOLOGY

SES 810: CONSERVATION MANAGEMNT AND PLANNING OF RESOURCES

3 UNITS

Purpose of the Course

This course provides a comprehensive review of our natural resources, including their unsustainable and planned uses. Population dynamics, land use alternatives and impacts are discussed. Natural resource systems (e.g., water, soils, minerals, air, agriculture, forests, rangeland) are explored. Selected resource use alternatives and environmental impacts are examined to identify sustainable resource management and planning practices. Key environmental policies, issues, concepts and alternative strategies in land use planning and resource management are identified in lectures and in case studies. Students will gain experience in case study approaches involving problem definition and problem solving using relevant problem, target and monitoring indicators.

Expected Learning Outcomes of the Course

Having successfully completed this course the student will:

1. Be able to design and demonstrate the use of conservation planning processes that are sensitive to the needs of people and take into account the sustainability of political, biophysical, social & economic processes & institutions
2. Be conversant in and be able to apply planning theories and concepts and appropriately use planning terms commonly used in conservation
3. Be able to discern between kinds, styles and purposes of conservation planning in the public, private and nongovernmental sectors
4. Understand and be able to explain the alternative roles for clients, citizens, technocrats, governments and enterprises in conservation planning
5. Be able to produce simple, but technically robust, planning documents
6. Be able to apply conservation planning frameworks and understand their strengths and weaknesses
7. Be able to understand the nature and limitations of planning for the future, and understand the role of professional judgment
8. Be able to work effectively in groups of divergent professional and personal interests.

Course Content

Ecology of major terrestrial and aquatic ecosystems: desert savanna, forests, rivers, inland lakes and oceans. Interaction between human beings and biological resources and related problems.

Conservation biology. Concepts on biodiversity and biological resources. Applications of ecological principles in management, conservation and planning of biological resources. International convention on biodiversity and others issues. Principles of restoration ecology. Community participation in conservation and restoration activities.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core Reading materials

Brooks, M. F. (2012). *Planning theory for practitioners*. Chicago, IL: Planners Press.

Peterken, G.F., Habitat conservation priorities in British and European woodlands. *Biological Conservation*, 2017. 11: p. 223- 236. 51.

Kirby, K.J., et al., The ancient woodland inventory in England and its uses, in *The ecological history of European forests*, K.J. Kirby and C. Watkins, Editors. 2015, CABI: Wallingford, UK. p. 323-336. 52.

Lorber, D. and D. Vallauri, Contribution à l'analyse des forêts anciennes de Méditerranée. 1. Critères et indicateurs du gradient de naturalité. 2017, WWF: Marseille. p. 95. 53.

Recommended Reference Materials

Vallauri, D., et al., Contribution à l'analyse des forêts anciennes de Méditerranée. 2. Critères et indicateurs d'empreinte humaine. 2009, WWF: Marseille. p. 62.

SES 811: ECOLOGICAL RESEARCH METHODS

3 UNITS

Purpose of the Course

This course is about learning how to do research in ecology, and especially how to prepare a research proposal. We will discuss the nature of science and inference, how an ecologist develops specific questions and testable hypotheses, and how to develop and refine a research proposal.

Expected Learning Outcomes of the Course

The students are expected to:-

1. Learn the procedures and process for doing research
2. Become confident in their ability to review literature, select a research question, refine the question into testable hypotheses, and design an experiment that will answer the research question.
3. Practice what they learn by generating ideas and developing a research proposal.
4. Explore some of the challenges they will face in managing research, and learn techniques to be able to thrive and succeed.

Course Content

Principles, purpose and basic terminologies of ecological research. Research proposals. Sampling theories: populations and samples. Qualitative and quantitative analysis of biotic and abiotic components: (populations, communities, associations, climate, soil, water) of an ecosystem. Remote sensing. Ecological indices of associations. Design of sample surveys, design of experiments, organization and data collection and analysis techniques. Computing statistical packages. Use of documents resource material, abstracting, scientific writing and presentation.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark

- Examination shall normally contribute 70% of the total mark

Core Reading materials

Ford, E.D. 2010. Scientific method for Ecological Research. Cambridge University Press.

Green, K. and Pickering, C.M. (2014). Vegetation, microclimate and soils associated with the latestlying snowpatches in Australia. *Plant Ecology and Diversity*. 2: 289-300.

Lee, A. and Kamler, B. (2017). Bridging the pedagogy to doctoral publishing. *Teaching in Higher Education*. 13: 511-523.

McGrail, M.R., Rickard, C.M. and Jones, R. (2016). Publish or perish: a systematic review of interventions to increase academic publications rates. *Higher Education Research and Development*. 25:19-35.

Morrison, C. and Pickering, C.M. (2012 – on line) Perceptions of the ski tourism industry and others to impacts, adaptation and limits to adaption to climate change in the Australian Alps. *Journal of Sustainable Tourism*. iFirst: 1–19.

Recommended Reference Materials

Mount, A. and Pickering, C.M. (2009). Testing the capacity of clothing to act as vector for nonnative seed in protected areas. *Journal of Environmental Management*. 91: 168-179.

Robins, L. and Kanowski, P. (2008). PhD by publication: A student's perspective. *Journal of Research Practice*. 4: M3. 1-20.

SES 812: TROPICAL TERRESTRIAL COMMUNITIES

3 UNITS

Purpose of the Course

This course examines the fundamental concepts of terrestrial ecosystems in tropical climate. It introduces the biophysical aspect (climate, location, landforms, soil, vegetation) of tropical environments. It also examines tropical resource systems (forest- and agroecosystems) within the framework of conventional and sustainable resource extraction, using case studies. The course will focus on current conservation issues; examples using case studies will also be presented.

The goals are to introduce students to terrestrial ecosystems in the tropics, outline the major tropical resource systems and define conservation issues and their management within the framework of global change.

Expected Learning Outcomes of the Course

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

- Understand the fundamental characteristics of terrestrial ecosystems in the tropics
- Have a basic knowledge of tropical resource systems: forest and agroecosystems
- Outline some of the current and relevant conservation issues affecting tropical ecosystems

Course Content

Ecological survey of the terrestrial plant and animal communities of the tropical region. Environmental gradient, structure, composition and population dynamics of flora and fauna; species and its environment. Environmental threats to species survival. Valuation of biotic resources. Ecological evaluation of species. The impact of man on wildlife. Habitat alteration and species loss/extinction.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core Reading materials

Chazdon, R.L. and Whitmore, T.C.. 2012. Foundations of Tropical Forest Biology – Classic Papers and Comments. The University of Chicago Press. Chicago and London.

Peters, R.L. 2017, Effects of Global Warming on Biological Diversity: An Overview. World Wildlife Fund, Washington, DC.

Pollard, D.F.W. 2017, 'Forestry in a changing climate in Climatic Applications' In: Forest Renewal and Forest Production: Proceedings of Forest Climate '86 Nov 17-20, 2017 Forestry Canada, pp. 181-184.

Ramcharan, E.K. 2013, Personal communication. Institute of Marine Affairs, Carenage, Trinidad and Tobago.

Recommended Reference Materials

Rampino, M.R. and Sanders, J.E. 1981, 'Episodic growth of Holocene tidal marshes in the northeastern United States: A possible indication of eustatic sea-level fluctuations.' *Geology* 9 (2), pp. 63-67.

Rand, A.S. 1964, 'Inverse relationship between temperature and shyness in the lizard *Anolis lineatopus*'. *Ecology* 45, pp. 863-864.

Raphael, C.N. and Jaworski, E. 1979, 'Economic value of fish, wildlife and recreation in Michigan's coastal wetlands'. *Coastal Zone Management Journal* 5, pp. 181-194.

SES 813: ENVIRONMENTAL STRESS ON BIOTA

3 UNITS

Purpose of the Course

A lecture course exploring how plants avoid or tolerate diverse biotic and abiotic stresses using mechanisms at the molecular, biochemical, cellular, and anatomical levels. Specific topics will include: stress perception and signal transduction, responses to light, temperature, and salinity; water, nutrient and oxygen availability; and defence against pathogens. The course will also cover the methods used to study plant stress responses and a discussion of how plant breeding and modern molecular biology tools are being used to improve stress resistance.

Expected Learning Outcomes of the Course

Students will be able to identify plant stressors and describe how plants respond to biotic and abiotic stresses at various levels of biological organization

- Students will gain teamwork skills in order to plan and deliver projects
- Students will utilize research, analytical, and synthesis skills to complete writing assignments
- Students will gain a broad understanding of plant biotechnology and how it impacts human affairs on this planet and why it remains a controversial issue

Course Content

Natural and man made environmental stress. Tolerance in flora and fauna. Past and present status of eco-toxicology. Eco-physiological adaptations of organisms in natural communities to environmental stress. Resistance, tolerance of organisms to toxic substances. Population ecology in disturbed habitats. Ecological responses of animals and plant communities to water, soil, air, chemical and oil pollution. Ecological risk assessment of plants and animals

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipment

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core Reading materials

Field C.B., Barros V., Stocker T.F., Qin D., Dokken D.J., Ebi K.L., Mastrandrea M.D., Mach K.J., Plattner G.-K., Allen S.K., Tignor M., Midgley P.M., editors. Intergovernmental Panel on Climate Change 2012 (IPCC 2012), Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. Cambridge: Cambridge University Press; 2012. [314]

Goodstein D.M., Shu S., Howson R., Neupane R., Hayes R.D., Fazo J., Mitros T., Dirks W., Hellsten U., Putnam N., Rokhsar D.S. Phytozome: a comparative platform for green plant genomics. *Nucleic Acids Research* 2012;40(D1) D1178-D1186. Available from: <http://www.phytozome.net>. [315] Plant Metabolic Network (PMN). <http://www.plantcyc.org>.)

Recommended Reading Materials

The UniProt Consortium. Reorganizing the protein space at the Universal Protein Resource (UniProt). *Nucleic Acids Research* 2012; 40(D1) D71-D75 (2012). Available from: <http://www.uniprot.org/>

SES 814: BIOTECHNOLOGY AND THE ENVIRONMENT

3 UNITS

Purpose of the Course

This course will provide sound technical foundation for using biotechnology in solving environmental issues and cleanup of the polluted environments. It examines current applications of biotechnology to environmental quality evaluation, monitoring, and remediation of contaminated environments. The scale of technology ranges from the molecular to macrobiotic. Relevant topics of microbiology and plant biology are presented. These provide a foundation for subsequent discussions of microbial removal and degradation of organics, phytoremediation of soil and water contaminated with toxic metals and radionuclides, wetlands as treatment processes, biofilms/biofilters for vapor-phase wastes, and composting. Emphasis is placed on modeling and design. Advantages and disadvantages of each application are compared. Case studies are presented in the areas of biosensors in environmental analysis, molecular biology applications in environmental engineering, and genetic engineering of organisms for bioremediation.

Expected Learning Outcomes of the Course

The students will be to:-

- Develop an understanding of the fundamental biological mechanisms that allow microorganisms and plants to degrade and/or remove contaminants from the environment.
- Develop an understanding of the ecological and health risk posed by major groups of environmental contaminants.
- Develop an understanding of the processes that govern the interaction between biological systems and contaminants in environmental media including, soil, sediments, surface water and ground water.

- Apply knowledge to determine the feasibility of using bioremediation and phytoremediation for cleanup in specific environmental conditions.

Course Content

Introduction to biotechnology: application of biotechnology to living organisms and industrial processes, food and energy production. Modern concepts of gene: enhancer, promoter and structural part. Gene manipulation techniques (genetic engineering) for increased agricultural production and improved animal and human health: Genomic and DNA libraries. Antibodies and hybridoma techniques. Disease diagnostics, treatment and pathogen monitoring. Microbial ecology: Biogeochemical cycles, agro-bacterium / Rhizobium plant interactions. Biodegradation of organic compounds, engineering microbes for environmental management. Environmental implications of biotechnology. Release of genetically modified organisms (GMOs) into the environment.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core Reading materials

Environmental Biotechnology : Principles and Applications Rittmann, B.E., and McCarty, P.L., McGraw Hill, 2011.

Federation of American Scientists (2012). Cases in Dual Use: Biological Research. <http://www.fas.org/biosecurity/education/dualuse/>; accessed on September 20, 2009. 48. Ibid. 49.

R.A. Udani and S.B. Levy (2006). MarA-like regulator of multidrug resistance in *Yersinia pestis*.

Antimicrobial Agents and Chemotherapy 50 (9): 2971–2975. 50. Federation of American Scientists (2011). Aerosol Delivery Case Study. <http://www.fas.org/biosecurity/education/dualuse/>; accessed September 20, 2009. 51. Ibid. 52.

Recommended Reference Material

United Kingdom Department of Environment, Food, and Rural Affairs, Expert Panel on Air Quality Standards (2004). Airborne Particles: What Is the Appropriate Measurement on which to Base a Standard? A Discussion Document. DEFRA, London, UK. 53.

SES 815: RESTORATION ECOLOGY

3 UNITS

Purpose of the Course

The science, art, and sociology of restoring damaged ecosystems, emphasizing the assessment of reference conditions, setting restoration objectives, manipulating successional trajectories, and theoretical and applied restoration ecology in a variety of ecosystems. This course explores the theory and application of restoration ecology to a range of landscapes including rainforests, woodlands, saline land, mine-sites and rivers. It also explores current practices of revegetation and river restoration and applies them to the problem of restoring a degraded urban stream.

Expected Learning Outcomes of the Course

This course is designed to provide the following:

- The basic principles and concepts of restoration ecology
- Current uncertainties and controversies in restoration ecology
- Relationship of restoration ecology to other fields in ecology
- A familiarity with restoration ecology primary literature and journals
- Practical aspects of developing an ecological restoration project

Course Content

Causes and consequences of habitat change: degradation, simplification and destruction/loss. Ecological restoration of degraded ecosystems and communities. Restoration approaches and techniques: Afforestation, reforestation, and re-introduction of species, etc. Planning and

implementing restoration projects. Community participation in conservation and restoration activities.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core Reading materials

Young, T.P., D.A. Petersen, and J.J. Clary. 2015. The ecology of restoration: historical links, emerging issues and unexplored realms. *Ecology Letters* 8:662-673.

Recommended Referencing reading materials

Ehrenfield, J.G. 2010. Defining the limits of restoration: the need for realistic goals. *Restoration Ecology* 8:2-9

SES 816: WETLAND ECOLOGY

3 UNITS

Purpose of the Course

Wetlands provide important "goods and services", including critical habitat for many aquatic and semi-aquatic species, floodwater storage, transformation of nutrients, and filtering of pollutants. These important systems, often called "kidneys of the landscape", are disappearing at a rapid rate all over the globe. Recognition of their value and concerns over these losses have prompted conservation of remaining wetlands, restoration of degraded systems, and creation of artificial wetlands to mitigate ongoing losses. Today's challenges demand that a wetland biologist be a "jack of all trades" with expertise in ecology, soil science, hydrology, engineering, and policy. Scientists, managers, and policy-makers alike need a common language and understanding to

facilitate communication with each other and the public. The goal of this course is to provide such a foundation upon which the student of wetlands can build.

Expected Learning Outcomes of the Course

1. An appreciation of the biophysical structure of wetlands, the major ecological processes that occur in wetlands and the environmental factors that control the structure and function of wetland systems
2. A wetland vocabulary (understanding of terms for wetlands and their vegetation)
3. Ability to organize and present scientific data
4. Familiarity with statistical techniques useful for analyzing environmental data (regression, classification and ordination methods)
5. Knowledge of critical ecosystem functions and services of wetlands
6. Knowledge of anthropogenic impacts (climate change, nutrient enrichment, invasives) on wetlands

Course Content

Definitions, classification and inventory of wetlands. Status of wetlands in the world. Wetland ecosystem. Major regional wetlands in East Africa. Hydrology. Bio-geochemistry. Biological adaptations. Modern theory of wetland formation, succession and ecological role. Inland wetlands : fresh water marshes; peat lands, and bogs; deep-water swamps and riparian wetlands. Strategies related to development programs in wetland ecosystem Management of wetlands. Threats to natural wetlands. Wetland conservation and international conventions. Constructed wetlands.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark

- Examination shall normally contribute 70% of the total mark

Core Reading materials

Wetland Ecosystems. 2009. William J Mitsch, James G Gosselink, Christopher J Anderson and Li Zhang. John Wiley & Sons. USA

Recommended Referencing reading materials

Ecology of Freshwater and Estuarine Wetlands, edited by Batzer and Sharitz

SES 817E: ECOLOGY OF TROPICAL FORESTS

3 UNITS

Purpose of the Course

This course will focus on the ecology of tropical rainforests. In particular, the abiotic and biotic components of tropical forest in addition to the myriad of co-evolutionary patterns/processes between plants and animals will be examined. In addition, we will examine species and diversity gradients (e.g., why are the tropical forests so diverse), the structure and function of rainforests, the causes of rainforest decline as well as the sustainable use(s), importance, and conservation of tropical rainforests.

Expected Learning Outcomes of the Course

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

1. describe and understand the ecology of tropical forests including the structure, function and interactions between plants and animals
2. be familiar with the various theories that explain the diversity of tropical forests
3. identify the major threats and causes of deforestation and the subsequent loss of biodiversity
4. understand the importance of tropical forests.

Course Content

Concepts of forest ecology. Classification of tropical forest. Forest and interacting environment. The forest communities: growth physiology; energy; productivity; biomass; nutrient cycles; soils; succession; and biotic interactions. Spatial variation in the forest. Deforestation and species extinction. Management of tropical forest land.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Reading materials

1. Kricher, John 2013 A Neotropical Companion. An introduction to the animals, plants, and ecosystem of the New World Tropics. Princeton University Press.
2. Whitmore, T.C. 2014. An Introduction to Tropical Rain Forests. Oxford University Press.

SES 818E: ECOLOGY OF SAVANNA/RANGELAND, ARID AND SEMI-ARID REGIONS

3 UNITS

Purpose of the Course

Application of ecological principles and social values to the management of rangeland resources. Emphasizes history, classification, and evaluation of rangelands; plant ecology; animal nutrition and ecology; grazing management; multiple use of rangeland resources; conflict management; collaborative and adaptive management; and contemporary rangeland issues. This course weaves modern ecological principals with dryland geology, topography, biology and socio-economy. The objective is to provide a firmer scientific basis to understand environmental and ecological dilemmas of drylands, beyond the simplistic depiction offered by the media. We will cover principles in the different fields of ecology and life-sciences and will have live-examples presented in lectures and during our field-trips to the region drylands.

Expected Learning Outcomes of the Course

The course objectives are:-

1. To develop a basic understanding of the classification, evaluation, use, and conservation of rangeland resources, and how underlying principles are formed, challenged, and changed over time.
2. To demonstrate how basic sciences and social values are applied in the management of rangeland resources.
3. To connect new material presented in this course to existing knowledge, while recognizing contradictions, and identifying and challenging misconceptions
4. To have an understanding of the geophysical factors that create and maintain deserts and grasslands, be aware of some of the biological and cultural adaptations that allow survival in arid and semi-arid areas
5. To be able to distinguish among the various deserts and grasslands of the world, and have a greater appreciation of the complexity and beauty of these inspiring and forbidding landscapes.

Course Content

Definition, delineation and global distribution of the arid and semi-arid regions. Arid lands in transition. Biological deserts. Desertification causes and its control. Succession in dry lands. Structure and function of dry-land ecosystem. Sediments, decomposition and nutrient cycling. The Role of vegetation in development and reclamation; Afforestation and agroforestry. Plant water and soil relations. Life-forms and biological spectrum in dry areas of Eastern Africa with special reference to Kenya. Classification and ecological characteristics of rangeland ecosystems in East Africa. Vegetation, productivity and stability of ASALs, savanna/rangeland. Factors affecting/threats to stability and productivity including noxious plant invasion and its control. Principles of proper range use, management and improvement.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core Reading materials

Range Management Principles and Practices, 5th Edition (2014) by J.L. Holechek, R.D. Pieper.

Vavra M, Parks CG, Wisdom MJ (2017). Biodiversity, exotic plant species, and herbivory: The good, the bad, and the ungulate. *For. Ecol. Manage.* 246:66-72.

Vetter S (2015) Rangelands at equilibrium and non-equilibrium: Recent developments in the debate. *J. Arid Environ.* 62:321-341

. Walker SM, Desanker PV (2014). The impact of land use on soil carbon in miombo woodland of Malawi. *For. Ecol. Manage.* 203:345-360

Wallgren M, Skarpe C, Bergström R, Danell K, Bergström A, Jakobsson T, Karlsson K, Strand T (2009). Influence of land use on the abundance of wildlife and livestock in the Kalahari, Botswana. *J. Arid Environ.* 73:314-321.

Recommended reference materials

Warren SD, Nevill MB, Blackburn WH, Garza NE (1986). Soil response to trampling under intensive rotation grazing. *Soil Sci. Soc. Am. J.* 50(5):1336-1341.

SES 818AE: ECOLOGY OF FRESH WATERS AND OTHER INLAND WATERS

3 UNITS

Purpose of the Course

The course develops a comprehensive and integrated understanding of physical, chemical and biological processes occurring in lakes, streams and wetlands using the scientific method to investigate and contrast basic ecological processes operating in various systems. Students will study the biological and physical properties of local streams and lakes to assess general health and water quality of inland streams and watersheds.

Expected Learning Outcomes of the Course

Successful students will be able to describe and differentiate different physical, chemical, and biological phenomena occurring in freshwater ecosystems, compare and contrast these processes among different types of lakes and rivers, and integrate laboratory exercises with lecture material.

Course Content

Inland waters: Definitions, classifications occurrence and distribution: rivers, freshwater, alkaline, saline and man made lakes and their environments. Hydrographic characteristics. Dynamics and habitats of fresh and other inland water ecosystems; their physical characteristics, flora and fauna, population growth, limitation, tolerance and adaptation of organisms/communities, productivity, energetics and nutrient cycles. Economic importance. Anthropogenic effects and threats: habitat change, pollution and Eutrophication. Water borne diseases. Inland waters management.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core Reading materials

Beadle L. C (2011) *The Inland waters of Tropical Africa. An introduction to tropical limnology.* 2nd Edtn., Longman, London

Daily, G.C., S. Alexander, P.R. Ehrlich, L. Goulder, J. Lubchenco, P.A. Matson, H.A. Mooney, S. Postel, S.H. Schneider, D. Tilman, and G.M. Woodwell. 2016

Ecosystem Services: Benefits Supplied to Human Societies by Natural Ecosystems, Issues in Ecology No. 2. Carpenter, S., N. Caraco, D. L. Correll, R. W. Howarth, A. N. Sharpley, and V. H. Smith. 2015

Nonpoint Pollution of Surface Waters with Phosphorus and Nitrogen, Issues in Ecology No. 3. Naeem, S., F.S. Chapin III, R. Costanza, P.R. Ehrlich, F.B. Golley, D.U. Hooper, J.H. Lawton, R.V. O'Neill, H.A. Mooney, O.E. Sala, A.J. Symstad, and D. Tilman. 2012

Biodiversity and Ecosystem Functioning: Maintaining Natural Life Support Processes, Issues in Ecology No. 4. Mack, R., D. Simberloff, W.M. Lonsdale, H. Evans, M. Clout, and F. Bazzaz. 2009. *Biotic Invasions: Causes, Epidemiology, Global Consequences and Control, Issues in Ecology No. 5.*

Recommended Referencing reading materials

Payne A I (1986) *The ecology of Tropical Lakes and Rivers*, Wiley Publishers

SES 819E: MARINE ECOLOGY

3 UNITS

Purpose of the Course

The goals of the course are to provide an introduction to the major marine habitats, and provide a strong foundation in the ecological processes that control marine ecosystems. We will survey the various habitats of marine ecosystems, focusing on organisms that are characteristic of each habitat and the processes that control the abundance and distribution of those organisms. We

will introduce all major marine habitats, but the course will focus on tropical carbonate systems (coral reefs).

Expected Learning Outcomes of the Course

On satisfying the requirements of this course, students will have the knowledge and skills to:

1. Think critically, analyze and evaluate claims, evidence and arguments concerning marine environmental issues
2. Collect, analyze and present marine ecological data
3. Write scientific articles, environmental status reports and media releases
4. Work and communicate as part of a research team
5. Communicate effectively with a range of audiences
6. Research current issues, interpret relevant legislation and frame solutions to problems facing Kenya's marine resources

Course Content

Ocean basins and water motion. Geomorphology and hydrology. Sea profile. Physical and chemical characteristics of marine environment. Classification of marine flora and fauna. Species diversity. Sedimentation. Relationship between plants and animal communities and their zonation and succession. Phytobenthos sampling and estimation of primary production. Energy flow measurements. Pollution. Management of marine ecosystem. Nutritional value and potential economic uses of marine flora and fauna. Coral reef ecosystems.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Reading materials

Nybakken, JW and MD Bertness. 2014. Marine Biology: An Ecological Approach. Pearson. San Francisco.

SES 819BE: MANGROVE ECOLOGY

3 UNITS

Purpose of the Course

This course is an introduction to tropical marine ecology looking in particular at the biodiversity and ecology of tropical marine plankton, mangroves, seagrasses and coral reefs in East Africa. The course will also describe the main conservation issues associated with these systems and examine management strategies being utilized in Belize through case studies.

Expected Learning Outcomes of the Course

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

- Understand the basic oceanographic processes that affect the coastal ecosystems
- Identify the main species of seagrass, mangroves, corals, fish and invertebrates found in the ecosystem and describe their roles in these ecosystems;
- Describe the range and biodiversity of seagrass, mangrove and coral reef communities found in East Africa
- Understand the major ecological interactions (recruitment, competition, predation, etc) that occur in tropical plankton, coral reef, seagrass and mangrove communities;
- Conduct laboratory and field exercises looking at the diversity and ecology of tropical marine plankton, seagrasses, mangroves and coral reefs;
- Understand the impacts of natural and anthropogenic (man-made) forces on these tropical ecosystems
- Identify appropriate conservation strategies that can be used to address impacts on these ecosystems.

Course Content

Geographical distribution of mangroves with relation to environmental factors. Sedimentation, soil and chemical composition. Structure and function of mangrove swamps. Zonation and succession, productivity, association of plant and animal communities and adaptations. Economic importance. Silviculture. Pollution. Management.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core Reading materials

Dawes C. 2015 Marine Botany. 2nd Edition. John Wiley & Sons. 473 pp.

Environmental Economics

SES 820/ARE 801: MICROECONOMICS

3 UNITS

Purpose of the Course

An introduction to the basic principles of economics with special emphasis being placed on the microeconomic aspects of our economic system. We will study the basic principles of economics, demand, supply, price theory, labor analysis, and other operations of a private enterprise economic system. Specifically, we will delve into an in-depth study of demand and supply, market structure, revenue and cost theory, along with the theory of the firm.

Expected Learning Outcome

Upon completion of this course, the student will be able to :-

1. Explain the concepts of demand and supply and price determination.
2. Explain consumer and producer behavior.
3. Identify the structure and operation of the output and resource markets.
4. Demonstrate the application of microeconomic analysis in decision-making.
5. Explain the impact of globalization on microeconomics.

Course Content

Supply and demand analysis: Consumer theory, theory of the firm, Market structure and the determination of product and factor prices under various market structures, General equilibrium theory, Welfare economics, Mathematical models in microeconomics analysis, Game theory, Risk and uncertainty.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core Reading material

Economics: The Science of Common Sense; E.V. Bowden, 8th edition, South-Western College Publishing Company: 2015

SES 821/ARE 802: MACROECONOMICS

3 UNITS

Purpose of the Course

Macroeconomics deals with the structure and performance of whole economies. In this course we will describe and analyze the factors that influence aggregate economic outcomes such as growth in national output and income, unemployment and inflation. Throughout the course, we will develop several micro-founded macroeconomic models, and consider alternative theories and their competing conclusions about the nature of market economies and the role of government policies to influence macroeconomic outcomes.

Expected Learning Outcomes

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

1. Possess a coherent set of ideas for understanding macroeconomic phenomena and policy issues
2. Understand the assumptions, structure and micro-foundations of a macroeconomic model and understand its power and shortcomings
3. Formulate a relevant model and use such analytical tools in addressing a key macroeconomic question independently
4. Understand the different ways in which economic issues can be tackled

Course Content

National income and its determinants, Keynesian theory of income output and employment, Business cycle, Theories of public and private policies to stabilize employment and prices: fiscal and monetary policy including the neoclassical synthesis. Macroeconomics models: growth theory and growth models. Capital markets, Investment, consumption, inflation, output and unemployment, Trade and capital flows under fixed and varying exchange rates.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core Reading material for the course

Stephen D. Williamson (2010). Macroeconomics, 4th edition. Pearson Addison Wesley Publishers.

Recommended Readings

Barro, Robert J. (2015), "Intermediate Macro Updated Edition", Cengage/Thomson Learning Australia.

Jones, Charles I. (2013) "Introduction to Economic Growth", Second Edition University of California, Berkeley (ISBN-10 0-393-97745-5)

Blanchard, O & J. Sheen (2016), "Macroeconomics", Second Edition, Pearson Education Australia, Frenchs Forest, New South Wales. (Australasian edition)

SES 822/ARE 805: ECONOMETRICS

3UNITS

Purpose of the Course

Econometrics is a set of research tools used to estimate and test economic relationships. The methods taught in this introductory course can also be employed in the business disciplines of accounting, finance, marketing and management and in many social science disciplines. The aim of this course is to provide you with the skills helpful in filling the gap between being "a student of economics" and being "a practicing economist."

Expected Learning Outcomes

After completing this course the successful student should be able to:

1. Conduct independent econometric and statistical analysis of economic data in an applied research setting,
2. Use econometric software for data management and statistical analysis,
3. Read and critically appraise applied econometric analysis with respect to choice of model, estimation method and interpretation
4. Understand, and apply, current scientific standards for documentation of data sources and analysis.

Course Content

Definition of econometrics, Statistical estimation and hypothesis testing. Correlation theory: types and limitations of correlation analysis. Simple linear regression models: ordinary least squares [OLS] techniques, assumptions of OLS. Application of multiple linear regression models, assumptions, application, significance tests, R², F-tests, T-test, General linear regression model: problem of single equation models, detection and estimation techniques for multicollinearity, heteroscedasticity, autocorrelation or serial correlation, errors in variables. Special models in regression analysis: dummy variables, distributed lag models. Application of single equation models, Simultaneous equation models and estimation techniques: identification problem and estimation.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core Reading material for the course

Wooldridge, J.M. (2009), *Introductory Econometrics: A Modern Approach*, 4th Edition, South-Western

Recommended referencing reading materials

J.H. Stock and M.W. Watson (2013) *Introduction to Econometrics*, Addison Wesley.

R.C. Hill, W. Griffiths and G.G. Judge (2011). Undergraduate Econometrics, 2nd Edition, Wiley.

SES 823: ENVIRONMENTAL ECONOMICS AND RESOURCE SYSTEMS 3 UNITS

Purpose of the Course

To examine how economic theory is applied to the problems of environmental disruption and pollution. The factors that inhibit environmental improvement are examined. Economic policies that can be used to prevent environmental decay are studied. Introduce the student to basic economic concepts and analytic techniques which can be used to improve the management of environmental resources. Provide an understanding of the economics of natural resource use within an environmentally sound framework showing the interaction between environmental resources and humans.

Expected Learning Outcomes

At the end of the course students will have:-

1. Basic economic concepts and analytic techniques which can be used to improve the management of environmental resources.
2. An understanding of the economics of natural resource use within an environmentally sound framework showing the interaction between environmental resources and humans.

Course Content

Theory of environmental economics, welfare economics and optimization theory in relation to resource systems. Its nature in application for developing countries. Poverty and affluence in newly independent nations, poverty and environmental degradation. Commodity prices and pricing of resources; general equilibrium; pareto optimality and resource conservation. The urban and rural environment: transportation, housing, energy issues; food, water supply, conservation, pollution, third world poverty and trade in hazardous products. The environment and future

generation equity. Linkages between economic planning, development, environmental management and legislature. Risks, uncertainties and impact on resource use.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core Reading material for the course

1. Environmental Economics & Management: Theory, Policy, and Applications, by Scott J. Callan and Janet M. Thomas, 4th Edition, Thomson South-Western, Canada, 2010. ISBN-10: 0324320671.

Recommended Referencing Materials

2. Resources and Learning Tools in Environmental Economics, by Scott J. Callan and Janet M. Thomas, Thomson South-Western, Canada, 2011. ISBN-10: 0324360150.

SES 824: ENVIRONMENTAL POLICY AND RESOURCE MANAGEMENT 3 UNITS

Purpose of the Course

To explore the development and implementation of natural resources and environmental policy, through discussion of readings and other relevant materials, debates, and analysis of a resource management or environmental policy case study.

Expected Learning Outcome

Students will gain knowledge, skills and experience to:

1. Identify, investigate and problem-solve environmental issues.

2. Build an understanding of issues in sustainability of natural resources and how these affect us.
3. Develop skills in environmental management and an understanding of policies.

Course Content

Public policies related to resource management and environmental issues; process and policy alternatives. Role of government in policy formulation related to the management of natural resources and the environment. Fiscal and monetary policies and impact on resource conservation. International policy on resource conservation. Adaptation of natural environment for human needs. Ecological basis for environmental policy, allocation for natural resources for investment in environmental quality and improvement. Externalities of contemporary environmental policies. Costs and benefits of reconstruction and/or reclamation policies. Policies leading to sustainability of resource management.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core Reading material for the course

Martino, D. and Zommers. Z. [United Nations Environment Programme] (2007) “Environment for Development” (Chapter 1) in GEO-4 [Global Environmental Outlook]

Recommended Referencing Materials

Jaffe, A., Newell, R. and Stavins, R. (2002) “Environmental Policy and Technological Change”, Environmental and Resource Economics

SES 825: RESEARCH METHODS IN ENVIRONMENTAL ECONOMICS 3 UNITS

Purpose of the Course

This [course](#) introduces the process of undertaking empirical research in environmental economics leading to the formulation and preparation of a research proposal. It covers the basic steps and process of conducting applied economic research.

Expected Learning Outcomes

At the end of the course students are expected be able to:-

1. Apply economic theory to real world problems and concerns
2. Learning the vast array of information available to economists over the Internet and in the library
3. Learning where resources and data can be located
4. Using statistical methods to analyze and evaluate the application of economic theory and reasoning
5. Gaining an appreciation for the value of economic reasoning and research, while also recognizing the limitations of its application.

Course Content

Acquisitions, processing and analysis of data and use of documented resource materials: The planning of projects design and methodology, design of sample surveys, design of experiments, organization and data collection; exposure to statistical computing pack-ages; role of computers in environmental economics research. Abstracting and scientific writing; choice of dissemination media, scientific paper writing and presentation, environmental awareness building through field visits, case studies drawn from subject areas in which students intend to do their research theses.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading materials for the course

Hoover, K.D. (2015) "Causality in economics and econometrics.

Recommended Referencing materials

Greenlaw, S., Doing Economics: A Guide to Understanding and Carrying Out Economics Research, South-Western Cengage Learning.

SES 826: ENVIRONMENTAL PROJECT ANALYSIS

3 UNITS

Purpose of the Course

This course is intended to introduce students to topics in the theory and practice of environmental and ecological economics with an emphasis on the practical aspects of project analysis.

Expected Learning Outcomes

By the end of the course students are expected to have learned:-

1. Project evaluation including programs and policy reforms with an emphasis on projects having environmental or natural resources management implications.
2. Special techniques required for incorporating sustainability in project analysis.
3. Cost-benefit analysis as the main approach and alternatives such as multi-criteria analysis (MCA).
4. Valuation of nonmarket benefits and costs.
5. Economic analysis of renewable resources, including extensions involving bioeconomic modelling.
6. Game theory and its applications to environmental problems, with an extension to experimental economics methods if there is time.

Course Content

Application of economic theory to environmental decision-making. Theories underlying project analyses and decision making in environmental context. Methods of identifying and measuring

the economic benefits and costs of a project or program. Economic efficiency and monitoring value. Individual economic welfare, socio economical levels of investment planning, environmental interactions and government policy; estimation of damages to the environment; multiple activity development programs; application for cost-benefit analyses to natural resources. Economic valuation techniques. Environmental quality valuation from benefit and cost sides. Sensitivity analyses and its use in pricing of environmental conservation measures.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading materials for the course

Cost-benefit Analysis and the Environment, N. Hanley, N. and Spash, N., Edward Elgar, UK, Reprinted 2013.

Trade and Environment, Shahrukh Rafi Khan, 2012

Recommended Reference Materials

Environment and Trade, a handbook, The United Nations Environment Programme Division of Technology, Industry and Economics, Economics and Trade Unit and the International Institute for Sustainable Development

SES 827E: TRADE AND ENVIRONMENT

3 UNITS

Purpose of the Course

To give students an overview of the issues surrounding the complex interplay between trade and the environment. It covers various theories of international trade and addresses the questions of why countries trade, what they trade, how and if they benefit from trade, whether some groups can be the losers of trade. It also studies the various instruments of trade policy and the principles of WTO and explores the link between trade and the environment.

Expected Learning Outcome

Students are expected to:-

1. Have a deep understanding of various theories of international trade as well as the linkage between trade and the environment.
2. Be equipped with the ability to objectively analyse the issues in international trade.
3. Improve their knowledge both on the importance as well as the limitations of free trade.
4. Be able to critically analyse the various instruments of trade policies.

Course Content

Marketing concepts, Concepts of international trade and theory of comparative advantage in the context of UNCTAD, GATT etc. Concepts of economic theory to such topics and determinants of international and regional specialisation in trade, inter-regional economic relations and research exploitation. The role of cash crops in international trade, the impact of international trade on subsistence farming, and use practices, food production and rural development. The exports of developing countries; cartels and tariffs especially as they affect environment. Varying exchange rates and impacts on the environment, price and income stabilisation.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading materials for the course

Trade Induced Technological Change: Analysing economic and environmental Outcomes
Marina, C.D, Smulders, S.A (2014)

Cole, Matthew and Robert J. R. Elliott (2013) “Do Environmental Regulations Influence Trade Patterns: Testing Old and New Trade Theories”, The World Economy: 1163-86.

SES 828E: ENERGY AND ENVIRONMENTAL SYSTEMS

3 UNITS

Purpose of the Course

To understand, appreciate and be intrigued with universality of energy and matter, and philosophy of the fundamental Laws of Nature and their impact on the Environment and the Society we live in. Also to have an appropriate understanding and knowledge of the issues related to energy and the environment. In addition to classical technical, socioeconomic, and political perspectives, students have to understand the philosophy and physics behind the fundamental concepts in order to be aware of reality and relativity associated with these important concepts.

Expected Learning Outcomes

At the end of the course students are expected to:-

1. Understand the technological, economic, and social factors related to use of various forms of energy such as fossil fuels, solar energy, wind energy, biofuels, and other alternative and renewable energy resources
2. Understand why at various times and locations, different patterns of energy extraction, consumption, and conservation are used
3. Understand the limitations imposed on using various forms of energy by technological and socioeconomic factors
4. Understand how energy conversion methods are used to change energy from one form to another for appropriate use.
5. Understand the tradeoffs between use of energy to raise the standard of living and the impact resulting from use of energy to the environmental pollution

6. Use various sources of knowledge to write logical and coherent papers on important aspects of energy and environment
7. Understand how public policy can direct citizen's efforts in *wiser* use of energy resources, energy conservation, and prevention of pollution to the environment

Course Content

Ramifications of energy needs in contemporary societies using a comparative approach. Basic energy planning; economic, environmental and technical production modalities. The mechanism of energy production and consumption, exploitation of renewable and non-renewable energy sources, economic growth, energy supply and demand. Future perspectives and implications of energy choices on health and the environment. Economic issues on energy sources for residential, rural, commercial, industrial and transport sectors. Energy prices and its impacts on decision making and environmental implications and constraints in developing countries.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading materials for the course

Berg, LR, Hager, MC., Goodman, LG., Baydack, RK., 2011. Visualizing the Environment. 1st Canadian Edition. Wiley. ISBN: 9780470157985.

Recommended reference materials

Custom Courseware - Handbook for the Earth & Environmental Sciences Student

SES 829E: ECONOMICS OF RENEWABLE AND NON-RENEWABLE RESOURCES

3 UNITS

Purpose of the Course

To help prepare students to conduct empirical research in energy and environmental economics. The course applies economic theory and qualitative and quantitative environmental approaches to analyze natural resource use, renewable energy markets and the related policy making issues. It examines current policy trends and developments in natural resource and renewable energy, existing problems and policy instruments to address those issues as well as evaluation and design approaches for environment and energy related problem assessment

Expected Learning Outcomes

The course will provide students with the following skills:

1. Theoretical concepts of natural resource and energy economics and interactions of these policies with the agricultural sector.
2. Gain a broad understanding of current policies in the field of agricultural, environmental and energy economics worldwide, to place them in the context of current policy making.
3. Develop understanding of different empirical methods and research approaches that are commonly used in the field of environmental and energy economics.
4. Familiarize with some economic theories necessary for empirical work in this field.

Course Content

Theory of renewable resources. Economic analyses of individual resources. The scope of coastal and inland lakes fisheries and wildlife management initiatives to facilitate the economic exploitation of fisheries, forests and wildlife resources on sustainable basis: Aquatic resources zones of the Indian Ocean, Lakes Victoria, Turkana. The smaller lakes like Baringo, Naivasha, Jipe and Challa. The National Parks and Game reserves and forest reserves. Contribution of the growing interest in aquaculture, environmental significance of increasing fishponds and reforestation in rural areas. The socio-economic dichotomy of indigenous fishing strategies and modern fishing techniques on local fish consumption, and nutrition; capture techniques and local perception; distribution and marketing. Impact of modern fishing techniques. Tourism and wildlife; impacts and sustainability. Conflicts between wildlife and people; Wild life use and forestry use; causes and possible remedies. Forest use and disease. Long term planning strategy

to harmonise people's interest and wildlife conservation. The biosphere reserve strategy. Theory of extraction and use of non-renewable resources. World trends in petroleum, minerals and oil exploitation. The impact of petroleum, and oil producing countries, foreign exchange expenditures on the importation of petroleum. Re-assessment of mineral and oil exploitation by the developing countries especially the relative returns from processed as distinct from raw commodities, the international petroleum and mineral pricing policy determination. Environmental economic advantages of industrialisation based on these resources (case studies drawn Nigeria, Botswana, Zambia etc.). Cost of production, storage, disposal and utilisation of by-products. The environmental impact of exploration of selected mineral resources in Kenya. Selected examples from OPEC and industrialised countries towards conservation of mineral resources. Mineral supply and demand. Conservation and recycling. The economics of surface and under-ground mining and their effects on the restoration of mined lands.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading materials for the course

1. Perman, R.; Ma, Y.; McGilvray, J.; Common, M. (2013): Natural Resource and Environmental Economics. Pearson: Harlow, England
2. Hanley, N.; Shogren, J.F.; White, B. (2017): Environmental Economics in theory and practice. Palgrave Macmillan: Hampshire

Recommended readings

1. Field, B.C. (1997): Environmental Economics. An introduction. The McGraw-Hill companies, inc.: New York

2. Dore, M.; Mount, T.D. (1999): Global environmental economics. Equity and the limits to markets. Blackwell Publishers: Malden, MA

SES 829AE: ECONOMICS AND MANAGEMENT OF COASTAL ZONE AND MARINE RESOURCES **3 UNITS**

Purpose of the Course

To broaden the student's awareness of the economic potential of the ocean, to generate an understanding of the major marine biological resources and the physical processes controlling these resources, to provide theoretical and practical training in measuring and quantifying these resources and the effects of conflicting usage upon them, to enhance those skills necessary to manage effectively the sea area of national jurisdiction.

Expected Learning Outcomes

This course will give students an understanding of coastal zone management as a public policy issue. Students will learn:

- how to define the problems
- what data and technical expertise are needed
- the political and institutional context of coastal zone resource protection and management
- how to develop and implement tools to achieve policy objectives

Course Content

The characteristics of coastal and marine resources and environments. Evaluation of impacts of development on the coastal and marine resources; issues in private investment along the coast versus public and national interest. Effects of development on estuaries, marine life breeding grounds, siltation, water quality, coral reefs fisheries, salt mining, tidal onslaughts and mangrove swamps. The cost of cleaning up, oil spills, water pollution as health hazards; economics of waste disposal in the oceans, coastal land use policies including reclamation. Assessing economic impacts of climate change on coastal zones.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading materials for the course

1. EAME (2015) The East African Marine Ecoregion Vision. WWF, Dares Salaam
2. Government of Kenya (2010) Draft Integrated Coastal Zone Management Policy for Kenya.

Recommended Referencing Reading material

1. Tychsen, J. (2016 (ed.). KenSea. Environmental Sensitivity Atlas for Coastal Area of Kenya. Copenhagen; Geological Survey of Denmark and Greenland (GEUS); ISBN 87-7871-191-6.

SES 829BE: THE ECONOMICS AND MANAGEMENT OF ARID AND SEMI-ARID LANDS

3 UNITS

Purpose of the Course

To examine the history of the formation of the arid lands, their characteristics relative to other arid parts of the world, the evolutionary history of the flora and fauna, adaptations of plants and animals to arid environments, the major arid lands ecosystems and conservation of biodiversity. To apply biological and economics knowledge to issues of land degradation, salinisation of soils, dryland farming, feral animal control and wildlife management for a sustainable future.

Expected Learning Outcomes

At the end of the course students are expected to:-

1. Be able to know the resource utilization in arid and semi-arid lands
2. Participate in planning for resource management of such lands
3. Relate the economic implications and conservation management strategies of such lands

Course Content

Economic implications of resource utilization and conservation of arid and semi-arid lands. Livestock and wildlife populations and land use policies; pastoralism; traditional versus commercial use of rangelands; socio-economic and socio-political dimensions of resource use and management in arid and semi-arid zones. Planning for integrated resources management of such lands. Economics of stocking and de-stocking of wildlife and domestic livestock, game ranging and harvesting, soil erosion and agro-forestry, dry land agricultural techniques e.g. rain water harvesting, micro-catchment farming, trickle irrigation etc., desertification. Selected case studies to be drawn from China, Pakistan, Israel and Sudan.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading materials for the course

Hazell, P., 2011: Strategies for the Sustainable Development of Drylands Areas, International Food Policy Research Institute (IFPRI)

ASARECA, 2011: NRM and Biodiversity Conservation in the Drylands of Eastern and Central Africa

Recommended Readings

Rodriguez, L., 2008: A Global Perspective on the Total Economic Value of Pastoralism: Global Synthesis Report Based on Six Country Valuations, International Union for Conservation of Nature (IUCN)

Republic of Kenya, 2008: Millennium Development Goals: Status Report for Kenya – 2007

SES 829CE: ECONOMICS OF WATERSHED AND WETLANDS MANAGEMENT

3 UNITS

Purpose of the Course

To gain an understanding of wetland ecology, including hydrology, soils, plants, and wildlife; field methods for wetland delineation and functional assessment; and public policy relating to state and federal wetland regulatory programs. Also the course has a focus on to watershed science and management, where the student will gain an understanding of the science underlying a watershed system and develop technical skills in integrated watershed management; more specifically, they will develop a strong understanding of a watershed and its relationship to natural resources and economic issues, and they will gain insights into how the various components of land cover, hydrology, terrestrial and aquatic ecosystems, socioeconomic processes, pollutant transfer, institutions, communities, and economic growth interact at a watershed scale.

Expected Learning Outcomes

Upon successful completion of this course, the student will demonstrate the ability to:

1. Compare the classes of wetlands and the ecological characteristics of each class.
2. Identify and discuss the role of the biological component of wetlands.
3. Compare physical, chemical, and biological methods of vegetation management in wetlands in terms of methods of application, economic and ecological costs and public acceptance
4. Discuss the merits and drawbacks of various methods of water-level control.
5. Develop a wetland management plan designed to improve an existing wetland for waterfowl, fur-bearers and resource users.

Course Content

The environmental factors and the changing land use patterns on water resources availability. The economic and social impact of development of watersheds (effects of deforestation settlement of catchment areas on water resources); the economic importance of river basin

management; case studies drawn from Tana River, River Zambezi, the Lake Basin Development Authority (LBDA, KENYA), the Volta River, the Mano River, the Lower Nile and others. The economics of irrigation planning, with experience from the Nile, Mekong and Yang-tse valleys, and Tennessee Valley Authority. Pollution of potable water and siltation of estuaries and the impact on fisheries. Cost-benefit analysis of large dam construction.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading materials for the course

Sharda V.N., Sikka A.K. and Juyal G.P. (2016) Participatory Integrated Watershed Management: A Field Manual, Central Soil and Water Conservation Research and Training Institute, 218, Kaulagarh Road, Dehradun – 248195.

Recommended Readings

1. Frevert R.K., Schwab G.O., Edminster T.W. and Barnes K.K. (2009) Soil and Water Conservation Engineering, 4th Ed, John Wiley and Sons, New York.
2. Jain S.K. and Singh V.P. (2016) Water Resources Systems Planning and Management, Reed Elsevier India Pvt. Ltd., New Delhi.
3. Jeffery R. and Vira B. (eds.) (2010) Conflict and Cooperation in Participatory Natural Resources Management, Palgrave, Hampshire.

SES 829DE: ECONOMICS OF WATER RESOURCE MANAGEMENT 3 UNITS

Purpose of the Course

To provide an understanding of issues and methods in water resources management, and is set especially within the framework of total, or integrated, catchment management. The course gives an introduction to the hydrology of East Africa, major issues of water resource management, the implications of past water management practices, the principles of integrated catchment management and sustainability, and current management tools and strategies.

Expected Learning Outcomes

On satisfying the requirements of this course, students will have the knowledge and skills to:

1. Understand the complex interplay between people, climate, land, water and economic development in water resource management
2. Explain how the changing balance over time in water availability, demand for water and value of water informs (and has been informed by) the history of development, institutional arrangements, policy and management
3. Demonstrate familiarity with a range of water resource management issues, including origins, impacts and management interventions in both rural and urban settings
4. Integrate information from a range of disciplines into a comprehensive picture of a water resource management issue
5. Understand the fundamentals of economic theory as applied to water resources

Course Content

Economics and EIA in water resources management within the context of cost-benefit analysis. Inventory of national water resources. Kenya's national policy on water resources management. National water institutions. Catchment management and protection measures. The hydrometeorological cycle, wetlands, swamps, groundwater and springs. Water as a renewable energy source. Major hydropower and irrigation schemes and their environmental impacts: case study of Kenya's schemes. Small scale rural water projects. The economics of urban water supply and rural water supply. Rural sanitation and development problems. Community participation in water problems.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading materials for the course

Loucks, D. P. and M. van Beek., (2012) Water Resource Systems Planning and Management: An Introduction to Methods, Models and Applications. UNESCO.

SES 829FE: URBAN ECONOMICS AND ENVIRONMENT

3 UNITS

Purpose of the Course

To show students the most important ways in which economic theory and applied methods have been used to analyse urban economies. Also the aim of the course is to enable students to analyse key issues in the markets for land, housing, and transportation using economic tools in environmental management.

Expected Learning Outcomes

After completing the course students should:

1. Have a clear understanding of the main topics of the course including the theory of location choice, spatial equilibrium and land rents, local externalities, the theory of housing investment, and congestion and transportation economics.
2. Be able to use standard models from urban economics to analyse questions related to location choice, housing markets, transportation, land use, and local public finance in environmental management.

Course Content

Application of economic planning techniques to urban problems such as: urban sprawl patterns, growth structure, residential location, urban transportation, housing, distribution of market centres, health facilities, sewage disposal, distribution of industries and the public sector. Urban aesthetics and economic growth.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading materials for the course

Brakman, S., Garretsen, H. and Marrewijk, C. (2011): An Introduction to Geographical Economics, Cambridge University Press, Cambridge

Semlitsch, R. D., & Bodie, J. R. (2013). Biological criteria for buffer zones around wetlands and riparian habitats for amphibians and reptiles. *Conservation Biology*, 17(5), 1219-1228.

Showers, K. B. (2016). Soil erosion and conservation: An international history and a cautionary tale. In B. P. Warkentin (Ed.), *Footprints in the soil: People and ideas in soil history* (1st ed., pp. 369-406). Amsterdam: Elsevier.

Recommended Reference Materials

Smith, M. P., Howes, B., & Kimball, J. (2007). Watershed planning: Securing our water future. In E. M. Hamin, P. Geigis & L. Silka (Eds.), *Preserving and enhancing communities: A guide for citizens, planners, and policymakers* (pp. 121-132). Amherst: University of Massachusetts Press.

SES 829GE/ARE806:

OPERATIONS RESEARCH

3 UNITS

Purpose of the Course

To provide a survey of fundamental methods of Operations Research and their applications at an introductory level. The emphasis is on applications rather than the details of methodology. It also exposes the student to a wide variety of applications and problems that can be addressed using Operations Research techniques.

Expected Learning Outcomes

By the end of the semester, students should be able to

1. Determine when a particular operations research model is appropriate based on a problem description
2. Identify the stakeholders, decision makers, objectives, variables and constraints of a practical engineering problem
3. Formulate a valid operations research model, solve the model using computer software, and interpret the results of the model
4. Make recommendations to improve system operations based on an operations research analysis and communicate those recommendations in reports and/or presentations.

Course Content

Nature and scope of operations research: mathematical programming problems, solving a set of linear equations. General notation of the linear programming problems. The simplex method: maximisation and minimisation problems, duality properties of the dual and its relation to the primal problems, sensitivity analysis, application of linear programming to agricultural economics, linear programming computer problems. Introduction to non-linear programming techniques and their application in agricultural and resource economics.

Course Content

Application of economic planning techniques to urban problems such as: urban sprawl patterns, growth structure, residential location, urban transportation, housing, distribution of market centres, health facilities, sewage disposal, distribution of industries and the public sector. Urban aesthetics and economic growth.

Mode of Delivery

Lectures, demonstrations, group/class discussions and practical exercises

Instructional Materials/ Equipments

Computer, writing boards, writing materials, projectors, etc.

Course Assessment

The course will be assessed in two parts:

- Coursework (continuous assessment tests) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core Reading Materials

Anderson, Sweeney, Williams and Martin. An Introduction to Management Science: Quantitative Approaches to Decision Making. 12th Edition. South-Western College Publishing. 2010.

ENVIRONMENTAL HEALTH

SES 830: INSTRUMENTAL ENVIRONMENTAL CHEMICAL ANALYSIS 3 UNITS

Purpose of the course

To introduce the learner to basic concepts in; instrumental chemical analysis methods; Theory and application of modern analytical instruments; measurement of pollutants in air, soil and water.

Expected Learning outcomes of the course

At the end of the course students should be able to demonstrate an understanding of:

1. the instrumental chemical analysis methods; various classification of instruments for analysis;
2. sampling and sample treatment and handling from; air, water, and soil
3. Instrumental sample analysis and data collection and treatment.

Course content

Principles of environmental measurements. Analytical methods. Comparative analysis of various instruments of environmental analysis. Theory and application of common modern analytical instruments with emphasis on their scope and limitations. Propagation of uncertainties in physical measurements. Applications of physical and chemical methods in the measurement of

pollutants in the air, soil, and water environments and food quality. Field and laboratory exercises. Case studies focusing on issues in the immediate environment, national, regional and global issues in environmental chemistry. Principles of data analysis and presentation.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material for the course

Harris, (2016) Quantitative Chemical analysis. *Fourth edition*

Recommended reference materials

Vogel's Textbook of Quantitative Chemical Analysis, 5th Ed., By G.H. Jefferey, J. Bassett, J. Mendham, and R.C. Denney, ELBS – Longman.

Fundamentals of Analytical Chemistry, 7th Ed., By D.A. Skoog, D.M. West and F.J. Hooler, Saunders College Publishing.

SES 831: TOXIC SUBSTANCES HEALTH AND CHEMICAL SAFETY 3 UNITS

Purpose

To introduce the learner to basic concepts in; Toxic substances (Chemicals): classification, ionizing radiations and non ionizing radiations, hazard and risk assessment methods Case studies of chemical toxicity disasters .

Expected Learning outcomes of the course

At the end of the course students should be able to demonstrate an understanding of:

1. Identification and classification of toxic chemicals;
2. Evaluation of toxicity of chemical substances
3. Hazard and risk assessment of chemical substances.

Course content

Identification and classification of toxic chemicals, microbial agents, and ionizing radiation: physiological classification, health effects; manifestation of toxicity and detoxification. Evaluation of toxicity of chemical substances, microbial agents and ionizing radiation. Hazard and risk assessment of chemical and other toxic substances (non ionizing radiation, ultraviolet radiation, noise, climate change etc). Use of animals for estimation of human health risk. Relationships between occupational diseases, harmful chemical, biological agents and physical hazards in the work place. Noise, vibrations, Raynauds's phenomena; temperature, dust ionising and non-ionizing radiation. Case studies of health hazards associated with atmospheric pressure, chemical hazards and their threshold limit value (TLV). Microbiological hazards. Chemical accidents; Seveso, Bhopal, Chernobyl.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Staff performance

To be based on student evaluations, evaluation by head of department and self evaluation.

Core reading material

Hay A. The chemical scythe. Lessons of 2,4,5-T and Dioxin. Plenum Press: New York 2012

Recommended reference materials

Bertazzi PA. Long-term effects of chemical disasters. Lessons from SEveso. Science of the Total Environment 1991

SES 832: ENVIRONMENTAL TOXICOLOGY AND PHYSIOLOGY 3 UNITS

Purpose of the Course

This course will provide a brief introductory examination of the fundamentals of Toxicology and Environmental Chemistry. It is intended to provide an awareness of some of the basic principles and issues of environmental chemistry / toxicology and will hopefully serve as a starting point for more detailed pursuits. A background in chemistry is useful to study both the chemical structures and breakdown products of various toxic agents as well as an understanding of the many reactions and interactions to which chemical groups are susceptible. A knowledge of biochemistry / physiology is highly useful to understand the implications of dose levels, physiological reactions and potential interactions with various tissues such as lipids, proteins and fatty acids. It focuses on the scientific study of the health effects associated with exposure to toxic chemicals and systems occurring in the natural, work, and living environments; the management of environmental toxins and toxicity; and the development of protections for humans, animals, and plants.

Expected Learning Outcomes of the Course

At the end of the course the student is expected to learn:-

- to provide a firm foundation in the basic principles of environmental toxicology;
- to demonstrate that environmental toxicology is by its very nature interdisciplinary, drawing on various natural and social science disciplines to address practical questions of environmental relevance;
- to characterize toxicological assessments at various levels of biological organization (from subcellular to ecosystem);
- to offer an overview of current topics and issues facing environmental toxicologists today.

Course Content

Introduction to the physiology of the skin, gastrointestinal tract, the respiratory system and the liver. Principles of toxic action of chemical substances. Routes of exposure and fate of chemicals in humans and animals. Biologically manifested health effects of chemicals; acute, chronic prolonged and reproductive studies. Dose-response relations. Mechanisms of carcinogenicity, teratogenicity, and mutagenicity. Mechanisms of toxic action of heavy metals, microbial agents and ionizing radiation. Use of animal models to estimate human health risk to toxic substances.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading materials

1. Principles of Ecotoxicology, 3rd edition. C.H. Walker, S.P. Hopkin, R.M. Sibly & D.B. Peakall. Taylor & Francis, New York. 315 pp. 2014.

Recommended Referencing material

1. Principles of Biochemical Toxicology, 3rd ed. J.A. Timbrell. Taylor & Francis, New York. 394 pp. 2010.

SES 833: ENVIRONMENTAL MICROBIOLOGY

3 UNITS

Purpose of the Course

Studies characteristics and activities of microorganisms, showing their essential relation to diagnosis, treatment, and prevention of disease. Explores fundamentals of bacteriology, mycology, and parasitology, emphasizing their relationships to community health. Includes soil, water, wastewater, and industrial microbiology

Expected Learning Outcomes of the Course

Students will be able to:

1. Discuss microbial evolution
2. Illustrate biogeochemical cycles and identify the roles of specific groups of microorganisms associated with each cycle
3. Describe the development of microbial communities
4. Calculate microbial diversity using appropriate indices
5. Explain interactions within and between microbial populations in terms of parasitism, predation, competition, commensalism, synergism and mutualism
6. Describe, in ecological terms, the interactions between microorganisms and plants, and microorganisms with animals
7. Measure microbial biomass and various metabolic activities related to microbial ecology and water quality

Course Content

Microorganisms and the Environment: The development, structure, systematics, and ecology of aquatic and terrestrial (soil) microorganisms. Synthetic and degradative capabilities of microbes. Use of bacteria or viruses to control insects, degrade waste and toxic substances. Bacterial leaching and biomining. Carbon, nitrogen and sulfur cycling by micro-organisms. Water microbiology and water borne diseases: causative agents and control strategies. Microbiological water quality. Airborne viruses and bacteria: sources, types, exposure and health effects.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading materials

1. Madigan, M. T.; Martinko, J. M. (2015) Brock Biology of Microorganisms; 13 th ed.; Pearson Prentice Hall

SES 834: RESEARCH METHODS IN ENVIRONMENTAL HEALTH 2 UNITS

Purpose of the Course

To interpret and critically assess research in environment and health, understand research designs and basic methods used in environment and health research and understand approaches to and challenges of health risk assessment.

Expected Learning Outcomes of the course

After completing this course, students will be able to:

1. Specify and assess major sources and types of environmental health hazards;
2. Specify approaches for assessing, preventing and controlling environmental health strategies
3. Describe factors that contribute to susceptibility to adverse health outcomes following exposure to environmental hazards
4. Discuss risk assessment, management and communication approaches

Course Content

Discussion on research proposal writing, research methods in epidemiology, occupational health, environmental microbiology, biochemistry and chemistry. Bioassay and toxico-logical chemistry research methods. Library and computer literature search and retrieval methods, computer methods of data analysis. Data interpretation and Presentation. Field sampling methods.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core Reading Materials for the course

Understanding Environmental Health: How We Live in the World Nancy Maxwell, 2008. Jones and Bartlett, Publisher

SES 835: WATER, HEALTH AND THE ENVIRONMENT**3 UNITS****Purpose**

To introduce the learner to basic concepts in; Structure of water; Water chemistry, Quality standards, pollution and treatment, soaps and detergents etc and Waste water classification and management.

Expected Learning outcomes of the course

At the end of the course students should be able to demonstrate an understanding of:

1. Structure and Physical and chemical properties of water.
2. Water pollutions-sources and treatment
3. Water pollution identification, analysis and management
4. Soaps and detergents and their role in water pollution
5. Industrial and municipal Waste water management
6. Water quality standards and monitoring

Course content

Structure of water. The states, physical and chemical properties of water that make it suitable for life. Water chemistry of cations and anions. Occurrence and distribution of trace elements in

natural water systems and the relationship to human and animal health. Water supply and sanitation. Water pollution and water quality standards. Water treatment. Monitoring and detection of changes in water quality. Systems for monitoring. Non-point source pollution. Analysis of water quality data. Anionics. Detergents, phosphate and plant nutrients in relation to eutrophication of water. Waste water treatment: municipal waste-water; industrial wastewater. Water resources management.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material for the course

1. Paul Smith (2015), Dictionary of water and waste management. 2ndedn. elsevier

Recommended reference materials

Vogel's Textbook of Quantitative Chemical Analysis, 5th Ed., By G.H. Jefferey

J. Bassett, J. Mendham, and R.C. Denney, ELBS – Longman. A handbook of water analysis by Leo M. Nollet 2015.

SES 836: WASTE MANAGEMENT

3 UNITS

Purpose of the Course

Effective waste management system has been highlighted as a major global concern and a common responsibility of participants in industrial development. This is brought about by the

need for sustainable development and protecting the earth's natural resources. Irresponsible waste handling has also been cited as reason for street floods and landslides in the country.

Expected Learning Outcomes of the Course

1. To understand the impact of waste to the environment.
2. To identify ways and means of minimizing waste output to the environment.
3. To be aware of how effective waste handling improves health, sanitation and safety in the community.

Course Content

Sources of waste generation. Types and classification of wastes. Transport, reactions, fate and distribution of wastes in the atmosphere, hydrosphere and the biosphere. Impacts of wastes on human health and environment. Waste management evolution, approaches and classifications. Legal aspects of waste management. Waste reduction, minimization and recycling. Methods and processes for waste treatment, transport and waste disposal. Management of hazardous waste: General principles; definition; problem of hazardous waste; administrative and legal aspects, planning of disposal facilities; collection, transport and storage; management, treatment and disposal; Trans-frontier transport; enforcement of waste management regulations.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material for the course

Waste Management Practices by Pichtel, J. Taylor and Francis, USA (2015).

Recommended Referencing Reading materials

Hazardous Waste Management by La Grega, Buckingham and Evans, 2nd Edition, McGraw-Hill (2001)

SES 837E: ATMOSPHERIC ENVIRONMENTAL CHEMISTRY

3 UNITS

Purpose of the Course

In this course students will use the fundamental principles of chemistry to gain an understanding of the source, fate, and reactivity of compounds in natural and polluted environments. Emphasis will be placed on the environmental implications of energy utilization and on the chemistry of the atmosphere, hydrosphere, and lithosphere. Environmental issues that will be discussed include climate change, air pollution, stratospheric ozone depletion, pollution and treatment of water sources, and the utilization of insecticides and herbicides.

Expected Learning Outcomes of the Course

The overall goal of this course is to gain an understanding of the fundamental chemical processes that are central to a range of important environmental problems and to utilize this knowledge in making critical evaluations of these problems. Specific goals include gaining:

An understanding of the chemistry of the stratospheric ozone layer and of the important ozone depletion processes.

1. An understanding of the chemistry of important tropospheric processes, including photochemical smog and acid precipitation.
2. An understanding of the basic physics of the greenhouse effect, the sources and sinks of the family of greenhouse gases, and the implication for climate change.
3. An understanding of the nature, reactivity, and environmental fates of toxic organic chemicals.
4. An understanding of the chemistry of natural waters and of their pollution and purification.
5. The ability to research an important environmental chemistry problem and prepare a formal presentation and white paper on that problem.

Course Content

Evolution, composition and structure of the earth's atmosphere. Air movements and environmental cycles of carbon, nitrogen, oxygen, phosphorus and sulphur: Influence of these cycles

on climate and impact on human health. Past and present variations of the atmospheric concentrations and emissions of trace substances. Elements of atmospheric photochemistry. The stratospheric ozone hole and the climatic effects of atmospheric greenhouse gases and their effects. The main air pollution issues in Kenya. Air pollutants: sources and types, Dangers to human health. Urban air pollution caused by power generation, motor vehicle traffic, residential heating and industry. Indoor air pollutants: types, sources, exposure and health effects. Public health aspects related to emission of heavy metals, poly-chloro-biphenyls and polycyclic aromatic hydrocarbons. Air quality standards and air pollution control.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

Introduction to Atmospheric Chemistry”, by D. J. Jacob, Princeton University Press, 2009.

SES 838E: RISK ASSESSMENT

3 UNITS

Purpose of the Course

The course will cover topics relating to characterizing source areas, linking fate and transport mechanisms, evaluating exposure pathways and applying toxicology data to evaluate environmental risk in a variety of differing contexts. The focus will be primarily on human health risk related to both chemical and radiological release scenarios.

Expected Learning Outcomes of the course

At the end of the course students will have knowledge related to:-

1. The broad field of environmental risk assessment

2. The important processes that affect the risk associated with a chemical or radionuclide
3. General steps involved in the risk assessment process, including statistical characterization of observed data
4. Several tools that can be used in defining environmental risks, particularly as related to human health.

Course content

Principles and methods of evaluating the toxicity of chemicals; studies in environmental epidemiology; epidemiological control; evaluation of physical accidents; evaluation of health risks to progeny associated with exposure to chemicals; aquatic (marine and freshwater) biotoxins; genetic effects in human populations; tests for carcinogenic and mutagenic chemicals. Promotion and enforcement of environmental health quality standards; collaborative efforts to study the effects of environmental hazards.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

Masters, G.M. Risk Assessment :Introduction to Environmental Engineering and Science, 2nd Ed., Prentice Hall, Englewood Cliffs, NJ, 2008.

Purpose of the Course

To study of the effect of geological phenomena on animal and human health. The public health effects of Earth materials and geological processes are well established.

Expected Learning Outcomes of the course

At the end of the course students will have knowledge on:-

- sources, transport and fate of geological agents in the environment
- trace elements in environmental health and disease
- foundations of toxicology and environmental pathology
- health impacts of natural geological processes

Course Content

The health field concept; disease ecology; geography and disease. Principal chemical constituents of the human body; essential trace elements in life systems. Controls on elemental intake; antagonistic and synergistic effects. Dose-response curves. Impacts of human activities. Causal links between specific diseases and the geological environment. Geochemical maps in medical geology; health effects of excess/deficiency of selenium, lead, mercury, zinc, cadmium and arsenic, dust emission in mining and mineral processing and the fate of inhaled particles; chronic bronchitis; allergic lung disease; coal workers pneumoconiosis; silicosis; asbestosis; berylliosis. Cancer and mutagens. Coronary heart disease; regional variation in heart disease. Ionizing radiation; disposal of radioactive waste. The epidemiological approach to environmental problems; environmental data sources; medical data sources. Analysis; Pearson's correlation; stepwise multiple regression. Cause and effect. Hypothesis; implications for prevention and treatment. The changing nature of disease. Health spans and mineral waters.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

Komatina, 2014, Medical Geology-Effects of Geological Environments on Human Health:

Elsevier.

Recommended Referencingreading materials

Selinus, O., ed., 2005, Essentials of Medical Geology, Elsevier.

ENVIRONMENTAL INFORMATION SYSTEMS

SES 840: THEORY OF REMOTE SENSING

3 UNITS

Purpose of the Course

To offer an introduction to the basic principles and techniques of earth observation sensors and imagery. This course will provide an understanding of the theory underlying satellite remote sensing of the earth, energy interactions in the atmosphere and the surface, and digital image processing techniques.

Expected Learning Outcomes of the Course

In completing this course, students will be able to:

1. Understand how electromagnetic energy interacts with the atmosphere and surface
2. Use spectral signatures to interpret landcover characteristics
3. Perform preprocessing of remotely sensed imagery
4. Describe and interpret properties of remotely sensed imagery

Course Content

Definitions, principles of electromagnetic radiation, interaction of electromagnetic energy with the atmosphere; atmospheric windows, interaction of electromagnetic energy with the earth's features; spectral reflectance of selected objects and field measurements; data acquisition and interpretation;

active and passive systems, the multispectral concept, multitemporal concept, multiscale concept, platforms and sensors; photographic systems; air photo interpretation, aerial, radiometric characteristics of aerial photographs; thermo-graphic systems, air-borne multispectral scanning systems; space-borne remote sensing systems; existing platforms and scanners, radar systems.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

Jensen, RJ “Introduction to Digital Image Processing. A Remote Sensing Perspective, 3rd Edition”, Prentice Hall, 2015.

SES 841: ENVIRONMENTAL APPLICATIONS OF REMOTE SENSING 3 UNITS

Purpose of the Course

This course offers an introduction to remote sensing systems and a selection of environmental applications of remote sensing. The basic properties of electromagnetic radiation, its interaction with the atmosphere and earth surfaces (e.g., vegetation, minerals, water, etc.), and the interpretation of these interactions are dealt with in the first half of the course. An introduction is provided to pre-processing and analysis techniques that are useful for extracting information from such sensors.

Expected Learning Outcomes

At the end of the course students will be expected:-

1. To gain a better understanding of the potential applications of remote sensing to natural resource assessment, as related to the principles that underpin the interaction of electromagnetic energy with natural surfaces.
2. To be exposed to a wide range of remote sensing sensors, pre-processing techniques, and analytical approaches used to study the natural environment.
3. To study systems (airborne and satellite) that cover the range of electro-optic sensing systems, analysis of imagery, and specific high-profile natural resource applications.
4. To demonstrate state-of-the-art remote sensing hardware and software.

Course Content

Applications of remote sensing in: geology, forestry, natural and man-made hazards (floods, fires, pollution), agriculture, land-use/land cover, engineering (project sites, dams), soil studies, water resources (water catchment areas, underground water), wetlands, wildlife ecology, archaeology, urban and regional planning, weather monitoring, environmental impact assessment.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

John R. Jensen (2015) Remote Sensing of the Environment: An Earth Resource Perspective, Prentice-Hall, Old Tappan, NJ

SES 842: GEOGRAPHIC INFORMATION SYSTEMS I (GIS I) 3 UNITS

Purpose of the Course

To introduce you to Geographic Information Systems (GIS). It looks at the importance of geographic information in understanding and managing resources, while introducing you to powerful tools and concepts you can use to pose and solve spatial questions.

Expected Learning Outcome

By the end of this course it is expected that you will:

1. Be familiar with what GIS is, articulate the key concepts and some of its topics and challenges
2. Understand and appreciate the scope and usefulness of GIS for real world applications
3. Understand the key stages and distinct challenges in the creation, use and maintenance of a GIS, paying particular attention to the unique structure of spatial information (topology), the issues associated with its storage, the role of metadata and the quality of data
4. Know how to collect GIS data through digitizing, fieldwork and importing diverse data sources
5. Apply GIS software skills in ArcGIS for the effective exploration, communication and analysis of geographic information
6. Demonstrate an understanding of spatial information by identifying and applying appropriate GIS techniques to the solution of practical applications.

Course Content

Definition and purpose of GIS, historical developments of GIS, components of GIS; GIS data; spatial data structures, attribute data and database management systems, topological relationships, GIS functions; data capture and editing, data analysis, information presentation, areas of GIS applications. Setting up a GIS.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

1. Longley, P.A., Goodchild, M.F., Maguire, D.J. & Rhind, D.W. 2011, Geographic Information Systems and Science, 3rdedn, Wiley, London.

Recommended readings

2. Heywood, I., Cornelius, S and Carver, S. 2012, An introduction to geographical information systems, 2ndedn, Prentice Hall, New York. G70.212 H622 I 2ed

SES 843: DIGITAL IMAGE PROCESSING OF REMOTELY SENSED DATA 3 UNITS

Purpose of the Course

To have an in-depth study of current algorithms in remote sensing digital image processing and analysis. The course will focus on hyperspectral data analysis, textural analysis, object-oriented classification, radar data processing and analysis, change detection, structural pattern recognition and integration with GIS.

Expected Learning Outcomes

At the end of the course the student is expected to:-

1. Describe and demonstrate basic proficiency in image preparation and pre-processing in methods
2. Demonstrate basic proficiency in digital image classification, field data collection and accuracy assessment.
3. Understand some fundamental concepts and theories underpinning digital analysis of remotely sensed data for the purpose of mapping land covers and detecting their changes
4. Learn how to use a major digital image analysis package

Course Content

The image as information, image generation; image processing: image restoration: pre-processing, radiometric corrections, geometric corrections, geo-referencing, resampling, enhancement. Data formats: Band Sequential (BSQ), Band Interleaved by Line (BIL), Band Interleaved by Pixel (BIP). Image analysis and classification: spatial techniques, spectral techniques, statistical classification. Applications of image processing to environmental problems.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

GeoEye (2014). GeoEye imagery products: GeoEye 1

Recommended Referencing materials

Jensen, J. R. (1996). *Introductory digital image processing: A remote sensing perspective*. Upper Saddle River, N.J.: Prentice Hall.

SES 844: RESEARCH METHODOLOGY

2 UNITS

Purpose of the Course

This course provides an introduction to the methods used in empirical analyses of societies, humans in societies, and social groups. It also provides a way to select among the variety of methods and designs used by social scientists the tools that are best suited to the question one wants to address.

Expected Learning Outcomes of the course

At the end of the course students will be able to apply the logics and major elements of research methods and design in the social sciences.

Course Content

Project design and methodology, organisation and data collection, interpretation and ground-truthing in remote sensing data, processing and analysis of data, overview of available software and hardware in EIS, acquisition of satellite imagery data and aerial photographs, case studies of projects involving GIS and remote sensing, proposal writing, abstracting and scientific paper writing.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

Booth, Wayne C., Gregory G. Colomb and Joseph M. Williams (2008 -3rd edition) The Craft of Research Part I: "Research, Researchers, and Readers"

SES 845: GEOGRAPHIC INFORMATION SYSTEM II (GIS II)

3 UNITS

Purpose of the Course

This is an advanced level course in Geographic Information Systems (GIS). It will build on the techniques learned in the Introduction to Geographic Information Systems (GIS) course by exposing the student to more advanced methods in developing and utilizing GIS data.

Expected Learning Outcomes of the course

3. At the completion of this course, the student should be able to do the following:

4. Plan and execute a successful GIS project using multiple data sources
5. Collect and input spatial data using a variety of different methods
6. Use a Global Positioning System (GPS) for collecting field GIS data
7. Understand digitizing and scanning as tools for data acquisition
8. Geo-reference aerial photographs to their true coordinates
9. Query and manipulate GIS data using database techniques
10. Identify and solve common problems found in a GIS project
11. Exchange data between different GIS systems

Course Content

GIS analysis functions; networks, neighbourhood, spatial decision support systems, spatial interpolation, TIN. The modelling process; modelling spatial problems. Data quality; propagation of error, dealing with uncertainty, metadata, data standardization. WebGIS. Case studies using available GIS software.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

Heywood Ian et al. An Introduction to Geographical Information Systems 3rd ed. 2010 Perason Prentice Hall.

Purpose of the Course

This course covers the principles of measurements of distances, elevations, and angles. It also includes basic error theory in measurements and calculations, traverse field techniques and office calculations, and basic principles of surveying and map making.

Expected Learning Outcomes of the course

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

1. Undertake setting out of engineering works; & advanced levelling procedures & techniques.
2. Perform basic survey computations, including area calculations, intersection and resection calculations, free station calculations, including the use of handheld calculator to solve surveying problems.
3. Demonstrate basic knowledge of applications of GNSS in surveying, including specific observation techniques and equipment limitations, specifically wrtheighting.
4. Be able to operate GNSS equipment at a basic level, in both static and RTK modes.
5. Demonstrate knowledge of cadastral survey systems & different survey types, including LINZ standards and controls.
6. Outline land tenure & interests in land, including CT's, easements, covenants and other land interests; NZ land registration system, NZ legislation affecting surveys, & demonstrate an understanding of Landonline.
7. Demonstrate knowledge of the land subdivision process in NZ, including show an understanding of the RMA & resource consent processes, the typical subdivision process, & relevant infrastructure design requirements, & relevant subdivision costs. Include in this section an overview of public versus private drainage, what constitutes a legal road.

Course Content

Introduction: Definitions, branches, principles, control and checks in surveying, plane co-ordinate systems. Linear measurements: methods, equipment, field procedure, correction of results; height measurements, levelling instruments, Angular measurements; the magnetic compass, theodolite, horizontal angles, bearings, vertical angles, errors in observation of horizontal and vertical angles,

computations. Mapping methods: control and detail surveys; chain surveying, tacheometry, traversing, global positioning systems and other modern surveying techniques.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

A Guide to understanding Land Surveys(2015) 3rd Ed. John Wiley and Sons.

Recommended reference materials

Lewis, M. J. T. (2001): Surveying instruments of Greece and Rome. Cambridge University Press.

SES 847E: COMPUTER ASSISTED CARTOGRAPHY (3 UNITS)

Purpose of the course

To extend the concepts, theory and techniques developed in map interpretation or cartography to an automated level where computers will be used to handle the mechanics of map compilation. This course will provide an overview of computer operation (with an emphasis on microcomputers) and the application of computers to input, manipulation, analysis and cartographic output of spatial data.

Expected Learning Outcomes of the course

By the end of the course the student should be able:-

1. To provide a working overview of computing systems
2. To become conversant with the theory behind automated cartography

3. To be able to construct maps with a variety of cartographic software
4. To be able to analyze spatial data with a variety of cartographic software
5. To provide a foundation for further study of geographic information systems

Course Content

History of cartography, map projections, scale and reference systems, representation of relief, symbology, map content. Computer assisted cartography: introduction, cartographic data sources, data preparations, data automation, feature coding, manipulations of attribute data, map compilation and production.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

Dexter, L. R., 2013, Analytical and Computer Cartography: Exercise Manual Scholargy Publishing

Mind the Map: Creative Mapmaking and Cartography, (2015), by Antonis Antoniou and R. Klanten, Publisher: Gestalten

Recommended Reference material

- Mapping the World: An Illustrated History of Cartography, (2005), by Ralph E Ehrenberg, Cartography Past, Present and Future, (1989), by David W. Rhind(Author), D. R. F. Taylor(Editor), Publisher: Elsevier Applied Science;

Purpose of the course

To introduce photogrammetry as a data acquisition tool, and provides a general overview of its theory and working principles. This course covers the factors that influence the formation of the photographs, and the process of reconstructing the three-dimensional model for the real world.

Expected Learning Outcomes of the course

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

1. Define and illustrate the general principles and applications of photogrammetric.
2. List and define the photographic process as it applies to aerial mapping.
3. Identify the types of optics used in aerial cameras.
4. Determine and calculate the appropriate geometry for various focal lengths and elevations of cameras relative to terrain conditions.
5. Define and illustrate stereoscopy and its applications to aerial mapping.
6. Identify specific objects and features using aerial photography interpretation techniques.
7. Identify and calculate the appropriate stereo plotting equipment and instruments.
8. Describe and compute ground control and flight planning for aerial mapping projects.

Course Content

Definitions; historical development; types of photographs. Stereoscopy: depth of perception, principle of stereo viewing, types of stereo models, instruments. Geometry of aerial photographs; tilt and relief effects; heights from aerial photographs; parallax-height formula, parallax bar. Flight planning; scales, overlaps, overhang (side laps), mosaics, orthophotos.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

Mikhail, E., Bethel, J., McGlone, J., 2011. Introduction to Modern Photogrammetry. John Wiley & Sons, Inc.

Elsheimy, N., Valeo, C., Habib, A., 2005. Digital Terrain Modelling: Generation, Manipulation and Application. Artech House.

Recommended Referencing reading materials

Jie Shand and Charles Toth (Editors), 2008. Topographic Laser Ranging and Scanning: Principles and Processing. CRC Press (Taylor & Francis Group)

SES 849E: ENVIRONMENTAL MAPPING OF ARID AND SEMI-ARID LANDS (ASALS) 3 UNITS

Purpose of the Course

To introduce students to application of remote sensing and technology in management of arid and semi-arid lands through mapping.

Expected Learning Outcomes of the course

At the end of the course students are expected to:-

1. Be able to identify and apply mapping skills in arid and semi-arid lands
2. Be able to monitor changes in ASAL resources from remotely sensed data.

Course Content

Definition of ASAL. Location of ASALs in Kenya. Mapping ASALS using remotely sensed data; geology, topography, soils, vegetation, wildlife census, settlements and infrastructure, water resources, land degradation. Classification and monitoring changes in ASAL resources from remotely sensed data.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

Heywood Ian et al. An Introduction to Geographical Information Systems 3rd ed. 2015 Perason Prentice Hall.

Recommended Referencing materials

Surveying and mapping for field scientists. By Ritchie, W., Wood, M., Wright, R. and Tait, D. 1988.

SES 849AE: ENVIRONMENTAL INFORMATION RESOURCES, SYSTEMS AND SERVICES **3 UNITS**

Purpose of the Course

To introduce the student to handling environmental information using computerized systems. It also focuses on storage and dissemination methods in monitoring and evaluation of environmental information.

Expected Learning Outcomes of the course

At the end of the course students will be expected to:-

1. Be able to use computerized systems to manage environmental information

2. Have an understanding of assessing information need of environmental managers.
3. Develop and design appropriate environmental information systems

Course Content

Definition of Environmental Information; Existing computerised data bases; searching for and collection of environmental information; manual and computerised storage of environmental information; dissemination of environmental information; Access to environmental information: problems and solutions; Assessing information needs of Environmental managers; Development and design of appropriate environmental information system for specific tasks/needs, e.g. for pollution monitoring and control and for environmental planning; National and international Environmental Information Policy issues. Legal aspects of environmental information access and dissemination.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

James A. O'Brien (2011). Introduction to Information Systems, George Marakas, University of Kansas ISBN: 0073402923

Recommended reading materials

Longley, P.A., Goodchild, M.F., Maguire, D.J and Rhind, D (2005) Geographic Information Systems and Science, Wiley.

ENVIRONMENTAL LAW

SES 850: LAND USE LAW AND THE ENVIRONMENT

3 UNITS

Purpose of the Course

To examine land use and environmental assessment legislation, policy and case law. The course will focus on: the objectives of land use policy, particularly in an era of sustainability; balancing private and public interests through planning laws; the role of law in achieving traditional (eg urban infrastructure) and contemporary (eg sustainable cities and climate change adaptation) planning goals; the planning instruments and regulatory mechanisms for implementing planning policies; the role of courts and tribunals in reviewing planning decisions; and the rights and role of the community in planning law.

Expected Learning Outcomes of the course

At the conclusion of this course students should be able to:

- understand and explain the traditional and contemporary principles of planning;
- describe the planning and planning-related functions of different levels of government;
- critically examine the role of law in achieving the objectives of planning policy and broader environmental objectives and the place for community in the planning process;
- understand and explain environmental impact assessment procedures (including under the Environment Protection and Biodiversity Conservation Act);
- identify the limitations and strengths of environmental assessment regimes, particularly having regard to the role and contribution of the community; and

Course Content

The concept of land tenure relative to agricultural and municipal land uses; the impact of changing land use and tenure policies on the environment, especially questions of soil conservation; fiscal (e.g. land use tax) policies as instruments of controlling intensification of land use and agricultural productivity; and the fiscal incentives to enhance efficacious application of conservation laws. Ranges of statutes on land in Kenya, as compared to selected countries are surveyed.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

Land Use Controls (3d ed. 2015), by Robert C. Ellickson and Vicki L. Been

Recommended Referencing reading materials

B. Richardson & S. Wood, eds., Environmental Law for Sustainability (Oxford & Portland, Ore: Hart Publishing, 2006)

SES 851: ENVIRONMENTAL LITIGATION CLINIC**2 UNITS****Purpose of the Course**

To take students inside the practice of environmental litigation to teach the practical skills of being a litigator set within a wider theoretical context of environmental regulation.

Expected learning Outcomes of the course

At the end of the course students are expected to:-

1. Integrate litigation skills within an overall policy and regulatory framework
2. Have practical training in problem-solving and decision-making in litigation
3. Have advocacy and legal drafting skills
4. Have ability to analyse evidence and advise on prospects of success at trial
5. Avoid and narrow issues in dispute to achieve cost-effective outcomes for clients

Course Content

Environmental litigation as a new field in Kenya and in Africa; examples of court decisions in related fields in tort or under statutes. This course will be conducted as a clinic to prepare students

in handling cases in these technical fields. Sessions will cover requirements for preparations of environmental cases; techniques for relating scientific facts to law; client counseling as well as drafting of the submissions on appeals. The concept of *locus standi*; the role of NGO's and individuals in environmental litigation. On selected basis the participants may prepare and submit *amicus curiae* briefs on selected significant cases before national courts. (The actual modalities of running the clinic will be specified from time to time).

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

1. Gunningham N and GraborskyP, Smart Regulation: Designing Environmental Policy (Oxford University Press, 2008).
- 2.

SES 852E: WATER RESOURCES LAW

3 UNITS

Purpose of the Course

This course is a study of terrestrial water resources law, with a focus on the water quality management of the lakes and rivers.

Expected Learning Outcomes of the course

At the conclusion of this course students should be able to:

1. Understand and explain the main legal principles governing the management of water resources in their own jurisdictions and make some comparisons with other jurisdictions
2. Ascertain the legal effect of the national water policy reforms agreed and implemented by State legislation;

3. Identify and use the principal legal and policy materials applied in the management of water resources in their own jurisdiction
4. Comment critically on the law and policy relevant to a particular problem of water resources management that was the focus of the research assignment. E.g. by comparing the law and policy with the experiences in the European Union.

Course Content

Concepts in water rights systems; public and private water rights in Kenya; riparian and appropriation systems; legal control of qualitative and quantitative utilization of water; an appraisal of the legal and institutional arrangements for water resources management in Kenya, in comparison with other African countries; legal issues in irrigated agriculture and the question of equitable utilization; determination of equitable access to water resources including ground water to small scale agricultural users vis a vis large scale farmer; and the legal provision of fiscal instruments to induce water resources.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

Larson, Rhett B.(2015) Water Resource Management: A Casebook in Law and Public Policy 6th ed.

Recommended Referencing materials

- Hydrology and management of watersheds; K. N. Brooks; P. F. Ffolliott; H. M. Gregersen and L. F. Deban. (2003), 3rd Ed. Wiley Blackwell. 574pgs.

SES 853E: ENERGY LAW AND THE ENVIRONMENT

3 UNITS

Purpose of the Course

To examine the emerging legal regime for the development and deployment of renewable energy in the stationary energy sector. Set against the backdrop of climate change and the need to secure future energy security, the course examines the origins and development of energy laws and provides an overview of the provisions of relevant renewable energy framework legislation.

Expected Learning Outcomes of the course

A candidate who has successfully completed this course should be able to:

- describe the origins and development of legislative, common law and policy frameworks surrounding renewable energy
- be familiar with the interaction of laws and policies surrounding energy
- be familiar with and understand the legal and policy issues relating to the constraints on the development and implementation of laws dealing with renewable energy and environment
- identify and understand the key legal principles and legislative frameworks governing the development of renewable energy

Course Content

Various energy options for domestic industrial and agriculture purposes, especially in Kenya (petroleum, hydropower, wind technologies, fuel wood, geothermal, nuclear, solar, and ocean Thermal Energy Conversion); the corpus of Kenya statutes regulating respective energy resources and use; as they affect conservation, especially as regards fuelwood, economic incentives for enhancing conservation and the place of such incentives in legislation; economic incentives for development of renewable energy resources, and the legal mechanisms for their implementation. Comparative appraisal of institutions concerned with energy production and marketing.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

Rosemary Lyster and Adrian Brabrook, *Energy Law and the Environment* (Cambridge University Press 2014)

Recommended Referencing materials

McCallum, Malcolm L.; Gwendolynn W. Bury. "Google search patterns suggest declining interest in the environment.". *Biodiversity and Conservation*.

Miller, G. Tyler (1995). *Environmental science*. California: Wadsworth. ISBN

United Nations Conference on Sustainable development, RIO + 20, 2011

SES 854E: MINERAL RESOURCES LAW AND THE ENVIRONMENT 3 UNITS**Purpose of the Course**

The subject begins by identifying fundamental legal principles of mineral exploration and production that transcend jurisdictional boundaries. It then examines the application of these principles in statutory title regimes in selected jurisdictions. The approach to these matters is considered in the international context of foreign mineral regimes.

Expected Learning Outcomes of the course

At the end of the course students are expected:-

1. to assess key concepts and definitions associated with mineral resource management and policy;
2. to assess those skills, tools, and methods useful in understanding the mineral resource sector at the local, regional national and international levels.
3. to identify the importance and role of social values in shaping mineral resource policy;

Course Content

Kenyan statutes on mining in marine and terrestrial areas covering petroleum, natural gas and hard rocks; legal regimes of exploration, jurisdictional issues including personal, national and international aspects; principles and practice of the concept of permanent sovereignty over natural resources; legal regimes providing for economic systems e.g. royalties, taxes and pricing in the context of national benefits and conservation imperatives of sustainable development as well as national strategic reserves; responsibility not to pollute and for the restoration and reclamation of mine sites; Environmental Impact Assessment requirement in the context of mineral exploration law.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading materials for the course

Waye A, D. Young, J. P. Richards and J. A. Doucet, 2009. Sustainable Development and Mining -An Exploratory Examination of the Roles of Government and Industry. J. P. Richards (eds.) Mining, Society, and a Sustainable World. Springer-Verlag, Berlin Heidelberg.

Recommended Readings Materials

Campbell K. 2004. Undermining Our Future: How Mining's Privileged Access to Land Harms People and the Environment. West Coast Environmental Law.

Purpose of the Course

Provides students with an understanding of the key legal frameworks within which they will work to conserve forests, fish and wildlife resources. Examines federal law and policy relating to allocation and conservation of forests, fish and wildlife resources.

Expected Learning Outcomes of the course

At the end of the course students should:-

1. Be able to make analyses of specific laws and regulations in forestry, fisheries and wildlife management
2. Demonstrate the importance and complexity of policy making

Course Content

Critical factors challenging the conservation of forestry and wildlife, viz. economic benefits accruing from the uninhibited and the contending land use interests especially for agriculture; Kenyan statutes on forestry, game and fisheries; the maritime zones and the configuration of conservation jurisdictions; international instruments e.g. the 1968 African Convention on the conservation of Nature and Natural Resources (and the proposed revisions); CITES World Conservation Strategy and the World Convention. Approaches for effective legislation and enforcement. Effective utilization and conservation of the living resources of the exclusive economic zone.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading materials for the course

1. Plater, Z.J.B., R.H. Abrams, W. Goldfarb, and R.L. Graham. 2011 Environmental Law and Policy: Nature, Law, and Society. 2d ed. St. Paul, Minn.: West Law Publishing

Recommended Reference materials

1. Conrad, J. M. and C. W. Clark (1987). Natural Resource Economics: Notes and Problems. Cambridge, Cambridge University Press. Arts HC59 C693

SES 856E: LAW AND THE WORKING ENVIRONMENT

3 UNITS

Purpose of the Course

This course addresses the law applicable to work environment. Problems related to occupational health and safety, collective bargaining as a mechanism for altering technology in the workplace, job alienation, productivity, and the organization of work are also addressed.

Expected Learning Outcomes of the course

At the end of the course students are expected to:-

Have an understanding of the ‘contract lifecycle’

Be familiar with contractual documents

Have an understanding of what is within the boundaries of a contract and is therefore legally enforceable

Course Content

The concept of working environment and law in relation to agrarian and industrial environment; law in relation to the problems of occupational health and hazards, in terms of occupational injuries, diseases and disabilities; Occupiers Liability Act; Workmen’s Compensation Act; Kenyan statutes on the production of chemicals specifically the Factories Act; the scope of protection and remedial measures; international standards adopted through the WHO and ILO; comparison with selected country standards; and suggestion for improving legislation and enforcement.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

Nicholas A. Ashford and Charles C. Caldart (2015) Technology, Law, and the Working Environment: Revised Edition

Referencing Reading Materials

M. Doelle& C. Tollefson, Environmental Law: Cases and Materials (Carswell: 2009)

SES 857E: LEGAL CONTROL OF OCEAN POLLUTION**3 UNITS****Purpose of the course**

To develop a detailed understanding of the major categories of anthropogenic impacts on marine systems, their mechanisms of effect, their sources, and fates. The practical exercises provide opportunities for the application of data analysis techniques to real life problems.

Expected Learning Outcomesof the course

Students who successfully complete this course will have a knowledge and understanding of:

1. the sources of inputs;
2. the biological, chemical and/or physical nature of the inputs and how those inputs interact with water;
3. the roles that freshwater, estuaries and the ocean play in receiving, altering and distributing inputs;
4. how pollutants are sampled and measured;
5. mitigation approaches that can be taken to prevent or minimize pollution;
6. the various policies, treaties, laws and regulations that affect pollution;
7. the economic impacts of pollution.

Course Content

Environmental law in relation to the sources and pathways of marine pollutants, especially the land-based, ship-borne sources, exploitation of natural resources, test of armaments and airborne sources, impact on aquatic resources, appraisal of statutes of Kenya, Somalia, Tanzania and Seychelles dealing with the respective problems; a survey of international (regional and global) standards and the organizations promulgating them; approaches to effective regulation (unilateral state, regional and global actions) and a review of the regional Seas Programme performance especially in 'African Oceans'.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material for the course

Sindermann, Carl J. 2013. Coastal Pollution. CRC Press, Taylor & Francis Group, Boca Raton, FL. ISBN-13: 978-0-8493-9677-9

Recommended Referencing reading Materials

Clark, R.B. 2001. Marine Pollution, 5th ed. Oxford University Press, Oxford, UK and New York, NY. ISBN 0 19 879292 1

Laws, Edward A., 2000, Aquatic Pollution: An Introductory Text, (3rd Ed), John Wiley & Sons, Inc.

Purpose of the Course

This course will outline the public international law that applies to the oceans: how states establish maritime boundaries, the rights and duties that exist with regard to maritime zones such as the territorial sea, exclusive economic zone and the high seas, and the processes for resolution of disputes regarding the seas. Current issues of particular relevance to will be examined including the management of international fisheries, concerns about maritime security and pollution prevention.

Expected Learning Outcomes of the course

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

1. Understand the legal, historical and political influences on the current law of the sea;
2. Analyse factual situations in terms of the law of the sea and provide advice on that basis;
3. Evaluate the policy and legal implications of proposals to amend the law of the sea.

Course Content

The evolution of the legal regimes for the seas as a response to perceived or actual environmental and resource uses; exposition of early adjustment of the law of the sea; attempts at formal codification of the law (1930, 1950-1960); the Third United Nations Conference on the Law of the Sea and its results (1967-1982) particularly the jurisdictional questions, legal regime for fisheries, regime of exclusive economic zone with respect to fisheries, regime for marine environment, navigational, marine non-living resources, especially questions of conservation and equity.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark

- Examination shall normally contribute 70% of the total mark

Core reading material for the course

D Rothwell and T Stephens The International Law of the Sea (Hart, 2010).

Recommended Referencing Reading Materials

D Anderson Modern law of the sea: selected essays (MartinusNijhoff, Leiden, 2008)

H Caminos (ed) Law of the Sea (Ashgate, Burlington, 2000)

Caron and Scheiber (eds) Bringing New Law to Ocean Waters (MartinusNijhoff, Leiden, 2004)

SES 859E: INTERNATIONAL ENVIRONMENTAL LAW

3 UNITS

Purpose of the Course

To understand the General Principles of International Environmental Law and examine the Emerging International Environmental Regimes and India's National Policy. It also aims to study the link between Environment and Sustainable Development and Enforcement of International and National Environmental Law.

Expected Learning Outcomes of the course

1. Upon completing this course you should be able to:
2. Recall and recount the historical origins and specifics of the on-going development of the current international environmental legal regime
3. Explain in your own words the meaning of legal concepts, doctrines and principles we have studied
4. Comprehend and evaluate the importance of international environmental law to international relations and the requirements of the international community in protecting the global environment
5. Identify and analyse issues involved in international environmental disputes

6. Identify some key areas of international environmental law which are currently the subject of debate and reform
7. Demonstrate your ability to research and access information on international environmental law issues
8. Demonstrate your ability to think critically and to justify your ideas in a reasoned manner and communicate effectively, in speaking and writing, on matters concerning international environmental law issues

Course Content

Introduction to the theories of international law, including the various expositions, the role of the state in the community of states; especially treaty-making and state responsibility for injury to nationals and aliens; sovereign responsibility as expressed in the Trail Smelter and Lac Lanoux arbitrations; Corfu Channel and Nuclear Tests cases; the doctrine of *sic uteretur* transboundary environmental responsibility and management; international protection of surface and ground water resources; transboundary atmospheric interference comprising: air pollution, ozone layer depletion and climatic change; marine environment, including an overview of global and regional standards and machinery for fisheries and environmental management; and the protection of the commons.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

Donald K. Anton, Jonathan I. Charney, Philippe Sands, Thomas Schoenbaum and Michael J. Young International Environmental Law: Cases, Materials, Problems (LexisNexis 2007).

Recommended Referencing reading Materials

Elli Louka, International environmental law: fairness, effectiveness, and world order, Cambridge University Press, 2006

Pilippe Sands, Principles of international environmental law, Cambridge University Press, 2003

S Bhatt, International Environmental Law, APH Publishing, 2007 -

SES 859E: INTERNATIONAL ENVIRONMENTAL GOVERNANCE 3 UNITS

Purpose of the Course

To examine the ways in which world society is striving to address environmental challenges by means of global governance—that is, by means of the international, transnational and global institutions and organisations that deal with international and global environmental issues. It will do so by examining the ways in which international, transnational and global structures have evolved over time, as well as specific organisations and other actors active in global environmental governance today and specific global environmental challenges.

Expected Learning Outcomes of the course

By the end of the course students will:-

1. Have a deeper understanding of emerging patterns of global governance through an in-depth examination of one of the most important and extensive arenas of international policymaking.
2. Develop knowledge of the political and policy challenges posed by reimagining the environment as an integrated, global system.
3. Strengthen their skills in international policy analysis.

Course Content

The events behind the UNGA Res. 2997 (XXVII) of 15 December 1973. The principal actors in the June 1972 Stockholm Conference which led to UNEP being the Environment Programme of the UN focusing attention through catalytic and coordination role. Major international institutions and their functions; special major international institutions and their functions; special focus on UNESCO, WHO, UNEP, UN and IMO, role and function of GESAMP; the

scope and operations of GIMPE as well as its component parts; the Brundtland Commission and its impacts on environmental thought and governance; ozone depletion and global climate change; depletion of biodiversity; desertification; the Commission on sustainable Development; Agenda 21; the role of regional economic commissions, the OECD; and the non-governmental institutions such institutions do developing countries especially in institution building and mobilization of action.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

Jennifer Clapp and Peter Dauvergne, Paths to a Green World: The Political Economy of the Global Environment, Second Edition (Cambridge, MA: MIT Press, 2011)

Referencing reading material

Bowell, T. & Garry K. (2009), *Critical Thinking: A Concise Guide*. 3rd ed. London: Routledge.

SES 859BE: PHYSICAL PLANNING LAW

3 UNITS

Purpose of the course

An overview of how planning tools and practice shape the built form of cities. This course introduces twentieth century physical planning within its historical, social, legal, and political contexts.

Expected Learning Outcomes of the course

By the end of the course, students will gain an awareness of :-

1. The relationship between land use planning, regulation & development controls and constitutional/property law.
2. An understanding of the requirements, limits, and burdens placed on the regulation of private property by land use controls.
3. The relationship of case and controversy concepts to actual planning regulatory practice.

Course Content

Rural and urban planning; administrative and legal principles relating to urban planning, development and redevelopment as well as housing policy. Zoning and subdivision control in relation to land use and public health issues in residential, and industrial areas, and sitting on land for specific purposes; preservation of historical sites; The Land Planning Act and the interaction of urban construction and agricultural land. Regulation of urban settlements and urban and peri-urban agriculture. Discussion of urban housing will examine and create awareness of laws for equitable housing development for the poor of the society and middle grade categories. Laws on compulsory acquisition of land and the legal protection of the persons displaced for the construction of development infrastructure.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

Daniel Mandelker (et al) (2016) Land Use Law Student Edition 8th(Lexis Law Publishers)

Recommended Reference Materials

F. Stuart Chapin and Edward J Kaiser. (1995). Urban Land Use Planning

W. Addington Willis (2016) Housing and Town Planning in Great Britain: Being a Statement of the Statutory Provisions Relating to the Housing of the Working Classes and to Town Planning, Including the Housing, Town Planning, Etc. Act, 190

SES 859CE: PUBLIC HEALTH LAW

3 UNITS

Purpose of the Course

To give attention to fundamental legal principles and legal reasoning, recurring legal issues confronted by public health agencies and healthcare providers, the use of law to advance a public health agenda, risk management and compliance. Emphasis is placed on giving students tools to use when they encounter law-related problems in their professional careers.

Expected Learning Outcomes of the course

At the end of the course students are expected to:-

1. Describe the legal and ethical bases for public health and health services
2. Demonstrate understanding of the basic concepts of health law and compliance requirements as they affect decision making in public healthcare organizations
3. Demonstrate the ability to analyze organizational issues and to discern those that require the advice and assistance of legal counsel.
4. Apply the key concepts, principles, and legal aspects of strategic human resources management in healthcare organizations, and labor relations.

Course Content

Major public health issues requiring legal intervention; statutes in Kenya dealing with the public health issues, such as malaria, trypanosomiasis, schistosomiasis, diarrhoeal and respiratory diseases. Standards regarding biological substances, pesticides and other pharmaceuticals; formulation of environmental health standards and responses to injuries. Related provisions in Kenya's statutes on public health, water, drugs and poisons will be appraised. The role of international institutions such as WHO and FA, especially the work of Cordex Alimentarius Commission in the context of national laws. Examples from selected countries for comparison and contrast.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

Goodman et al., Law in Public Health Practice, 2nd ed. (Oxford Univ. Press 2013)

Recommended Reference Materials

Gostin et al., Public Health Law 2nd ed. (Univ. of Calif. Press 2008)

SES 859DE: ENVIRONMENTAL LEGISLATIVE PROCESS**3 UNITS****Purpose of the Course**

To provide students with an understanding of the legal system in, the scientific and legal bases of current environmental legislation both on the National level and in globally, and the trends which will inform future environmental legislation.

Expected Learning Outcomes of the course

2. Students should be able to:
3. Demonstrate the ability to think critically
4. Demonstrate the ability to integrate knowledge and ideas in a coherent and meaningful manner
5. Describe the environmental movement in the country
6. Explain the Kenyan legal system, including the creation of law, the litigation process, and the place of administrative agencies
7. List and explain existing national environmental legislation, including what type of pollution each law regulates and how

8. Discuss the history and present state of environmental legislation
9. Analyze the probable direction of environmental regulation in the future

Course Content

Identification of the requirements for environmental legislation and the determination of the targets and purposes of environmental standards; the distinction between prescription of control standards or environmental rules and the legal prescription to induce or facilitate positive behaviour; identification of the actual and potential actors in law creation; the role of lobby and special; interest groups in law making especially in their relation to technical departments, the state law officers and the legislature. A comparative analysis between Kenya and selected countries. The role of sanctions in enforcement of environmental standards.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

Kubasek, N.K. and G.S. Silverman (2015). “Environmental Law”, Prentice-Hall, Inc.

Recommended Referencing Reading Materials

Bryant, B. , Editor (1995). “Environmental Justice: Issues, Policies, and Solutions”, Island Press

Valente, C.M. and W.D. Valente (1995). “Introduction to Environmental Law and Policy: Protecting the Environment Through Law”, West Publishing Company

**SES 859FE: INTERNATIONAL LEGAL ASPECTS OF THE MANAGEMENT OF
POISONS AND WASTES** **3 UNITS**

Purpose of the Course

To give an overview of hazardous materials, wastes and poisons regulations. It will also focus on linking the legislations with EPA regulations in order to protect the environment.

Expected Learning Outcomes of the course

At the end of the course students are expected to:-

1. Have an understanding of problems related to waste disposal and how to solve them
2. Demonstrate knowledge of legal regulations of poisons and waste disposal

Course Content

Evolution of the problems of industrial and municipal wastes which necessitated the conclusion of the Oslo and London Dumping Conventions in 1972; A Comparative analysis of Basel and Bamako Conventions on transfer and dumping of wastes; National laws on the control of industrial and domestic wastes. The statutes for the control of manufacture and custody of poisonous substances. Comparative appraisal of national and international institutions regulating custody and disposal of poisons and wastes.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

Stine, K.E., & Brown, T. M. (2016). Principles of Toxicology. New York: Lewis Publishers.

Purpose of the Course

To examine the underlying legal principles that specifically regulate the use, exploration and exploitation of space, and to determine how these and other principles of International Law can and should be applied to the many different State and private commercial uses of outer space. Space law represents an increasingly important area of International Law and impacts on a wide range of Governmental and private commercial activities. Many activities in space affect everyday life - including telecommunications, direct satellite broadcasts, weather forecasting, agricultural planning, mapping, remote sensing, spying and other military activities, exploration and scientific experimentation.

Expected Learning Outcomes of the course

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

1. To understand the historical evolution of the existing legal regime
2. To introduce and examine the details of the international Treaties and the various United Nations Principles which regulate certain activities in space
3. To understand the legal framework regarding space activities
4. To determine and analyse the legal issues raised by new uses of space for which the existing legal regime is ill-suited
5. To examine ways in which these unanswered legal issues should be addressed

Course Content

Definition of 'Space'. International Space Law and the protection of the human environment, environmental risks arising from space activities, man-made space debris and international law; legal control of ozone depleting and greenhouse gases; global climate change; legal aspects of Solar powered satellites, microwave exposure standards. Transportation in space: space transport system, International legal considerations, legal aspects of international space flights, e.g. Space Shuttle. Liability: liability in Space Law, dispute settlement. Remote Sensing: The 'open sky' policy; An introduction to international institutions dealing with space matters (e.g. Intelsat, Comsat e.t.c.) Space stations: legal aspects of stations in space 'space objects', jurisdiction and

control. Arms Control: Limiting the use of arms in outer space (space without arms), legal and policy issues.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

I H Ph Diederiks-Verschoor *An Introduction to Space Law*, 2015, 3rd Edition, Kluwer Law International, Netherlands

Referencing reading materials

E. Hughes, A. Lucas & W. Tilleman, eds., *Environmental Law and Policy*, 3rd ed., (North York: Emond Montgomery, 2003).

ENVIRONMENTAL EARTH SCIENCES

SES 860: CLIMATOLOGY AND CLIMATE DYNAMICS

3 UNITS

Purpose of the Course

The goal of this advanced course in climatology is to equip graduate students in the earth, atmosphere, hydrologic and environmental sciences with a comprehensive understanding of how global and regional weather patterns and atmospheric circulation processes interact to produce unique and varying climates worldwide. This course builds on presumed background knowledge of "*the climate system*" by applying a synoptic meteorological and climatological approach to analyze and explicate the complexity of climatic patterns and processes from continent to continent across the globe.

Expected Learning Outcome of the course

At the end of the course the student will:-

1. Have an in-depth treatment of the causes of regional weather and climatic patterns and processes in terms of synoptic atmospheric circulation patterns.
2. Be able to examine and analyze regional examples of processes driven by the energy and moisture fluxes at the global scale
3. Understand the climatic basis for a critical evaluation of some of the most urgent regional climate-related extreme-events facing us today; especially floods and droughts
4. Have a sound climate-based foundation for the analysis of climatic environments of the past and/or future and a physical basis for the interpretation of climates in different parts of the world using indices, modeling and/or paleoenvironmental techniques

Course Content

Physical processes controlling the global climate system, interactions between atmosphere, lands, ocean and ecosystems, equations governing atmosphere and ocean motions, scale analysis and map projections, climate models and parameterizations of the physical processes like convection and radiative transfers, interannual variability of the regional and global climate, past and present states of regional climate as observed from proxy and instrumental records, palaeoclimatology (use of tree rings, sediment cores, isotope studies, animal shells, etc..) as indicators of the past climate), quality and space-time distributions of climatological records, climate change concepts, man's impacts on the natural environment, atmospheric greenhouse effect, predictions of the future climate from statistical-dynamic methods, mitigation for the adverse climate events.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark

- Examination shall normally contribute 70% of the total mark

Core reading material

Solomon et al., Climate Change 2007: The Physical Science Basis, Cambridge University Press
Barry & Chorley, Atmosphere, Weather and Climate (9th ed. 2010).

Recommended Reference materials

Earth: Portrait of a Planet, 5th Edition. (2015), By Stephen Marshak(Author). Publisher: W. W. Norton & Company.

Lecture Tutorials in Introductory Geoscience 2nd Edition (2011), By Karen M. Kortz(Author), Jessica J. Smay(Author), Publisher: W. H. Freeman.

SES 861: ENVIRONMENTAL OCEANOGRAPHY

3 UNITS

Purpose of the Course

To present a basic understanding of the science of oceanography to provide a greater appreciation of oceanic processes and their impact on the global environment.

Expected Learning Outcomes of the course

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

1. To learn how ocean waters are studied
2. To understand the basic chemical, geological, and physical features of the world oceans
3. To understand the geological processes operating in the world oceans
4. To develop an appreciation for the diversity and importance of life in the oceans
5. To understand how oceanic processes affect the global environment

Course Content

The general circulation of the oceans. Global transport processes and energy balance, fundamental equations governing ocean circulation, physical and chemical properties of sea water, space-time characteristics of ocean currents, tides, upwelling and downwelling, tsunamis, cyclones, storm surges, ocean-atmosphere interactions, Walker circulation, El-Nino and southern oscillation,

marine observations and forecasting, chemical oceanography. Marine resources, marine pollution, transport and disposal of wastes in the ocean, control of marine pollution, coastline erosion and protection measures. Measurement techniques in oceanography.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

Oceanography: An Invitation to Marine Science, 7th Edition, Tom Garrison, 2010, 582 pages, ISBN-13: 978-0-495-39193-7, Brooks/Cole, Cengage Learning

Reference reading materials

Marshall, J. and Plumb, R. A., 2007. Atmosphere, Ocean, and Climate Dynamics: An Introductory Text, Elsevier

Stewart, R. Introduction to Physical Oceanography.2004

SES 862: DEVELOPMENT OF RESEARCH PROPOSAL 2 UNITS

Purpose of the Course

Provides a grounding for postgraduate students in a wide range of approaches to research in the humanities. Supports students in the preparation of their first substantive piece of written work for the degree - a comprehensive thesis proposal - but relevant for any humanities student in the early stages of thesis writing. Topics include the selection and framing of a research question; making an original contribution; writing a research proposal; and discussion of a range of epistemological, methodological and theoretical approaches to research in the discipline.

Expected Learning Outcomes of the course

1. Construct and follow a stringent but achievable project plan that is agreed upon by the research advisor
2. Compile a literature review that reflects studies that are relevant to the student's thesis, and document these sources in the field-specific format.
3. Write and revise drafts to achieve clear and direct prose style, and employ standard editing practices for self- and peer-reviews.
4. Design usable documents, including graphic elements.
5. Discuss ethical issues ranging from plagiarism and intellectual property to human subjects protocols and public responsibility.

Course Content

The course co-ordinator will instruct students on how to develop a research proposal in physical sciences. This will contribute to continuous assessment marks of 40%. In consultation with their advisors/supervisors students will develop and present research proposals on their thesis research which will contribute 60% of course marks. Electronic access to literature.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

Punch, K. F. 2016. Developing Effective Research Proposals (2nd Edition). Sage: London

Recommended reference material

Öberg, Gunilla. 2011. Interdisciplinary Environmental Studies: A Primer. Hoboken, NJ:

WileyBlackwell. ISBN 978-1-4443-3687-0

Kuhn, Thomas S. 1996. *The Structure of Scientific Revolutions*, 3rd ed. Chicago: Univ. of Chicago Press. ISBN 0-226-45808-3

SES 863: ENVIRONMENTAL GEOLOGY

3 UNITS

Purpose of the Course

To present and discuss the role that natural geologic processes play in creating conditions that are detrimental to human activities. It also assesses how some types of human activity can negatively affect the environmental setting on local, regional, and global scales. To examine how the impact of these natural and man-induced hazards—human suffering, property damage, economic disruption—can be mitigated by proper consideration of geologic factors in planning.

Expected Learning Outcomes of the course

Students will be able to:-

Define the relationship between environmental geology and other branches of physical, chemical, biological, and social science;

Demonstrate how nearly all of our major environmental concerns and hazards are rooted in basic geological processes;

Understand how environmental geology is a collage of many different geological disciplines, from hydrology to geochemistry, from economic geology to geomorphology;

Outline how our perception of geological hazards, environmental and resource conservation, and human interaction with geological processes has evolved over time and is different in various other cultures;

Identify the differences between mission oriented geoscience and problem-solving pursuits;

Course Content

The structure and composition of the earth. The weathered zone as the interface between geo-bio-atmosphere, geologic and physical property settings affecting the earth's surface and internal processes. Geophysical studies of landslides, earthquakes and volcanoes. Other geological hazards. Risk assessment. Water pollution and management. Geo-environmental distribution of diseases. Monitoring and mitigation of geological hazards.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

Pipkin, B. W. Geology and the Environment. St. Paul, MN: West Publishing, 2014.

Recommended references

R.W. Jones, Applied Palaeontology, Cambridge University Press, 2006

M.J. Benton, D.A.T. Harper, Introduction to Paleobiology and the Fossil Record, Wiley-Blackwell, 2009

SES 863E: EARTH SYSTEM SCIENCE II**3 UNITS****Purpose of the Course**

To build onto the introduction and explore aspects of Earth's evolutionary changes that have affected both climate and life through time. The chemical and physical interactions between the solid Earth, the atmosphere, the hydrosphere, and the biosphere are investigated, providing a basis for understanding how Earth behave as a self-regulating system that controls the global environment. The effect of human activity on modern Global Change will also be emphasized.

Expected Learning Outcomeof the course

Students that have completed this course will be able to:

- 1) Understand in general the dynamics of the evolution of the Earth system;
- 2) Explain how climate varied through Earth history and what were the major driving mechanisms of past global change;

- 3) Differentiate mechanisms that regulate both short- and long-term global change;
- 4) Differentiate human-induced from natural global change;
- 5) Recognize and explain the current signs of global change;
- 6) Infer the timeframe of both human-induced and natural global change.

Course Content

The atmosphere, biosphere, hydrosphere, cryosphere and lithosphere, energy and material flows at interfaces, response and feedback of different spheres to perturbations in other spheres, response modelling, environmental history since creation of the earth, earth observing and data collection methodology, computer models, sediment cores, ice cores, fossils and tree rings, earth system behaviour.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

Mackenzie, F. T., Our changing Planet: An introduction to Earth System Science and Global Environmental Change, Third Edition, Prentice Hall, Inc., 2013

Recommended Reference

Kump, L. R., Kasting, J. F., and Crane, R. G., The Earth System, First Edition, Prentice Hall, Inc., 1999.

Purpose of the Course

To look at the role that energy plays in our modern world. It will explore the physics of energy, learning to calculate the energy content of a wide variety of systems and apply these concepts to the various energy production schemes and usages found in our lives. We will discuss today's dominant energy sources, supply lifetimes, alternative energy sources, environmental impacts, and the future of energy in our world.

Expected Learning Outcomes of the course

1. Understand and explain energy and power and how mechanical systems harness primary energy to do work
2. Be aware and develop strategies for the consequences of dependence on fossil fuels, environmental, economic, and political
3. Understand and develop options for clean energy development, and how to migrate our energy system
4. Articulate the engineering challenges and business opportunities in clean energy deployment
5. Explain the nature of greenhouse warming and likely impacts of climate change using simple numerical models
6. Explain efficiency as a design principle in energy systems, buildings, and end-use applications
7. Develop strategies for engaging in policy development for clean energy solutions
8. Engage in simple energy and GHG audits, develop a personal Climate Action
9. Plan

Course Content

World energy supply options, extraction of energy from fossil fuels, nuclear energy, hydro-power, geothermal energy, solar energy, biomass and other renewable energy sources, energy systems in Kenya, cost analysis and conservation measures, different uses of energy, types and sources of impacts, cleaner production technology and industrial ecology, impacts from different energy uses such as transport sector and power generating sectors, fusion energy, radiation damage in power

reactors and its effect on surrounding environment. Generation of energy from waste. Methods used in protection from radioactivity.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

Ristinen, R.A. and Kraushaar, J.J. (2016). Energy and the Environment. John Wiley & Sons, Inc., USA.

Recommended Readings

Boyle, G., Everett, B. and Ramage, J. (Editors) (2003). Energy Systems and Sustainability: Power for a Sustainable Future. Oxford University Press, UK.

Boyle, G. (2004). Renewable Energy: Power for a Sustainable Future. Oxford University Press, UK

SES 865E: ENVIRONMENTAL STATISTICS

2 UNITS

Purpose of the Course

To introduce the basic statistical concepts relevant to environmental science and to provide experience in the correct use and interpretation of the various statistical methods currently used in the analysis of weather/climate observed and model simulated data. This is an advanced graduate course that covers many of the statistical methodologies used in the environmental sciences, including spatial statistics, time series analysis and extreme value theory applied in

such areas as air pollution modeling, global climate change and the prediction of extreme environmental events such as floods and hurricanes.

Expected Learning Outcomes of the course

At the of the course the learner is able to :-

1. Understand statistical methods and stochastic approaches that are important in ecological and environmental research, teaching, and service:
2. Carry out problem formulation and observational economy;
3. Demonstrate modeling, analysis, and synthesis; data acquisition, analysis, and decision making; regional policy with remote imagery;
4. Carry out geoinformatic surveillance; hotspot detection and prioritization; early warning system

Course Content

Populations and samples, Types of environmental data and analytical methods. Frequency distribution, relative frequency, measures of central tendency, measures of spread and symmetry, probability and probability distributions: normal, Poisson and binomial distributions, parametric and nonparametric methods of hypothesis testing, curve fitting, linear regression and correlation analysis. Spearman's rank correlation. Computer applications in environmental statistics.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

Bryan F. J. Manly (2009) Statistics for Environmental Science and Management, Second Edition

Recommended Reading references

Cole, R. and McBride, G. 2004. Assessing impacts of dredge spoil disposal using equivalence tests: implications of a precautionary (proof of safety) approach. Marine Ecology Progress Series 279:63-72.

Erickson, W.P. and McDonald, L. L. 1995. Tests of bioequivalence of control media and test media in studies of toxicity. Env. Tox. and Chem. 14:1247-1256.

McBride, G.B. 1997. Potential for use of equivalence testing in environmental science and management. NIWA, Hamilton NZ.

SES 865AE: ADVANCED ENVIRONMENTAL STATISTICS

3 UNITS

Purpose of the Course

This course will provide students with a further understanding of statistical methods and practical experience of applying those techniques to problems in the environmental sciences.

Expected Learning Outcomes of the course

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

1. Identify the most appropriate statistical techniques to use for data analysis in their academic discipline.
2. Discriminate between the most common statistical techniques used in the environmental sciences.
3. Apply these techniques to real data using the statistical software package SPSS
4. Interpret the output from SPSS and communicate the results of these techniques.
5. Have the confidence to explore beyond the techniques explored in this course.

Course Content

Discrete and continuous probability functions. Moments. Moment generating functions. Multivariate regression and correlation. Methods of estimation. Properties of estimators.

Likelihood ratios. Analysis of variance. Multiple and polynomial regression. Time series analysis. Cluster analysis, trend surface analysis, factor analysis, principal component analysis. Applications to environmental problems.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

De Veaux, Velleman, Bock, Vukov, and Wong (2012) Stats: Data and Models, Canadian Edition. Pearson.

Recommended Reference material

Barnett, V. and O'Hagan, A. 1997. Setting Environmental Standards: the statistical approach to handling uncertainty and variability. Chapman and Hall.

Breidt, F.J., Boes, D.C, Wagner, J.I, and Flora, M.D. 1991. Antidegradation water quality criteria for the Delaware River: a distribution-free statistical approach. Water Resources Bulletin 27:593-602.

SES 866E: ENVIRONMENTAL HYDROLOGY

3 UNITS

Purpose of the Course

To introduce students to the basic principles and issues in hydrology, so that they may critically analyze current issues in environmental hydrology for their scientific, economic, political and social significance.

Expected Learning Outcomes of the course

Upon completion of this course students will have an appreciation of the interdisciplinary nature of hydrology and the technical issues needed for the management of water issues.

Course Content

Hydrological cycle, precipitation: types, measurement of rainfall, analysis of rainfall data, infiltration: measurement and modelling of infiltration processes, evaporation, evapotranspiration: measurement and estimation methods, Penman, Thornthwaite and Morton models, surface water: hydrograph, curve number and infiltration approaches for estimation of storm runoff volume, hydrometry: velocity area methods, dilution gauging methods, hydrologic models: unit hydrograph and cascade models, groundwater: saturated and unsaturated flow, water quality, waste water, water treatment, water borne diseases, flood hazards, forecasting and mitigation.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

Textbook: *Environmental Hydrology*. Second Edition. Authors: Andy Ward and Stanley Trimble. Lewis Publishers. CRC Press. ISBN: 1-56670-616-5.

Ward, R.C. and M. Robinson. Principles of Hydrology. 4th Edition, McGraw-Hill, 2009

Recommended reference materials

Environmental hydrology, (2016), By Andrew D Ward; Stanley Wayne Trimble; Suzette RenaeBurckhard; J G Lyon; Publisher: Boca, CRC press

.SES 867E: GROUNDWATER HYDROLOGY

3 UNITS

Purpose of the Course

To develop an understanding of the basics of fluid properties, fluid mechanics and fluid flow in saturated and unsaturated porous media. It will focus on groundwater flow in aquifers on local and regional scales, learn about well hydraulics, and field characterization techniques.

Expected Learning Outcomes

1. Understand the importance of groundwater as a source of drinking water
2. Understand the fundamentals of fluid flow in porous media
3. Predict groundwater flow paths in natural systems
4. Evaluate field and laboratory tests to determine aquifer parameters (hydraulic conductivity, transmissivity, storativity)
5. Understand the fundamentals of contaminant transport in the subsurface
6. Learn the fundamentals of groundwater flow modeling

Course Content

Principles of the saturated flow, Darcy's law, hydraulics of wells, steady and unsteady groundwater flow towards the wells, aquifer types and properties, pumping tests for determination of the formation constants, unsaturated flow, Green and Ampt equation for vertical infiltration. Rates of recharge and abstraction, movement of pollutants in the groundwater flow system. Measurement and modelling in ground water hydrology. Environmental impacts of groundwater abstraction.

Mode of delivery

Lectures, demonstrations, group/class discussions and practical Experiments.

Instructional Materials/Equipment:

Writing boards, writing materials, projectors, Laboratory glassware and chemicals etc.

Course Assessment:

The course will be assessed in two parts:

- Coursework (continuous assessment tests, Laboratory reports and assignments) which will normally contribute 30% of the total mark
- Examination shall normally contribute 70% of the total mark

Core reading material

Applied Hydrogeology by C.W. Fetter (2011) 4th Edition

Recommended reference material

Hydrology and management of watersheds; K. N. Brooks; P. F. Ffolliott; H. M. Gregersen and L. F. DeBano. (2003), 3rd Ed. Wiley Blackwell. 574pgs.

Environmental Planning and Management

SES 870: Principles of Environmental Planning and Management 3 Units

Purpose of the course/Course objectives

This course addresses the genesis and evolution of environmental protection movement and history of planning concepts of environment and sustainable development and theories of management. It will also review benefits and challenges of Spatial Planning

Expected Learning outcomes of the Course

Upon successful completion of this course, students should:

- Have a clear understanding of the importance of planning and develop techniques in the preparation of plans
- Develop knowledge of theories of environmental concerns, spatial planning and management

COURSE CONTENT

Genesis and evolution of environmental protection movement and history of planning concepts of environment and sustainable development. Concepts of spatial planning and management. Theories of environmental concerns. Theories of spatial planning. Theories of management. Designating spatial planning regions with specific reference to socio-economic and environmental concerns (national, sub-national (regions), urban, rural, project, and programme)

Mode of delivery;

Lectures, class discussion, field observations, laboratory demonstrations and practical's and library research.

Instructional Material and / or Equipment;

Lecture notes, Chalk boards, Laptops, LCD projector and slides

Course assessment:

- C.A.T.s, term paper and other assignments 30%
- End of semester exam 70%

Core Reading Materials for the Course;

United Nations, 2014 Spatial Planning Key Instrument for Development and Effective Governance with Special Reference to Countries in Transition UNITED NATIONS New York and Geneva, 2014

Recommended Reference Materials;

Stephen G. Haines (2004). *ABCs of strategic management : an executive briefing and plan-to-plan day on strategic management in the 21st century.*

Michael Allison and Jude Kaye (2005). *Strategic Planning for Nonprofit Organizations.* Second Edition. John Wiley and Sons.

SES 871: Environmental Institutional Structures and Policy Framework (3 Units)

Purpose of the course/Course objectives

This covers the evolution, typology and structural organization of global, regional, national and local environmental institutions and the concept and significance of environmental policy

Expected Learning outcomes

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

1. Evaluate legal case studies to illustrate environmental issues and principles
2. Explain the difference between environmental regulations, laws, and policy
3. Summarize the most significant Kenyan environmental laws, policies and their basic principles.

COURSE CONTENT

Evolution, typology and structural organization of global, regional, national and local environmental institutions. [**Global:** UNEP, East African Community. **National:** National Environment Action Plan (NEAP process), National Development Plans, National Land use Policy formulation process. **Regional:** Provincial and District Environment Action Plans, District Development Plans, Regional Development Authority Master Plans. **Local level:** Urban and Town Plans, Action plans (project)]. Social-economic and political issues in environmental planning and management. Goals and objectives of environmental planning institutions, their

capacities and capabilities. The concept and significance of environmental policy. Environmental policy design and formulation process. Policy frameworks in environmental planning and management. Policy implementation instruments: Environmental Management and co-ordination Act No. 8 of 1999, Physical Planning Act cap 286 and other environment related Acts (Water Act 2002, Forest Act, and Agriculture Act).

Mode of delivery;

Lectures, class discussion, field observations, laboratory demonstrations and practical's and library research.

Instructional Material and / or Equipment;

Lecture notes, Chalk boards, Laptops, LCD projector and slides

Course assessment:

- C.A.T.s, term paper and other assignments 30%
- End of semester exam 70%

Core Reading Materials for the Course;

Goldsteen, Joel B. 2013. The ABCs of Environmental Regulation (2nd Ed.) Rockville (MD): Government Institutes.

Recommended Reference Materials;

Switzer (2004) "An Historical Framework for Environmental Poltiics," *Environmental Politics*

SES 872: ENVIRONMENTAL PLANNING AND MANAGEMENT TECHNIQUES

3 UNITS

Purpose of the course/Course objectives

The goal of this course is to provide an introduction to the ideas and information necessary to integrate environmental viability and sustainable development with other primary concerns of urban planners, namely, equity, healthy communities and economic development. The course will explore the historical roots of current trends in environmental planning; examine theories that have developed recently to encourage the restructuring and redesign of land use patterns, environmental regulation and systems of production; and review the status of some of the basic methods and processes of environmental planning.

Expected Learning outcomes of the course

to understand the methods and practical process of urban environmental planning, *and* to critically analyze existing plans and planning processes in terms of the social equity objectives and the other goals of sustainable development

COURSE CONTENT

Decision-making process as a management science: linear programming, Dynamic Programming, critical path analysis, SWOT analysis, Goal Achievement Matrix. Problem identification: Planning Balance Sheet, Multi-criteria Evaluation, Sieve-map Techniques. Modelling and forecasting. Multivariate techniques: multiple correlation, multiple regression, principal component and factor analysis. Land suitability analysis. Environmental Impact Assessment as tool in spatial planning.

Mode of delivery;

Lectures, class discussion, field observations, laboratory demonstrations and practical's and library research.

Instructional Material and / or Equipment;

Lecture notes, Chalk boards, Laptops, LCD projector and slides

Course assessment:

- C.A.T.s, term paper and other assignments 30%
- End of semester exam 70%

Core Reading Materials for the Course;

Scott Campbell and Susan S. Fainstein, *Readings in Planning Theory* (Malden, MA: Blackwell Publishing 2013)

Recommended Reference Materials;

John Randolph, *Environmental Land Use Planning and Management* (2004).

The World Bank, *Reshaping Economic Geography* (Overview), World Development Report 2009, Washington: World Bank, 2008 (33 pgs)

Economist Intelligence Unit, *ICT for City Management*, Singapore: Siemens for World Cities Summit, 2010

SES 872E: ENVIRONMENTAL PLANNING INFORMATION SYSTEMS 3 UNITS

Purpose of the course/Course objectives

This course covers the theory and use of geographic information systems (GIS) within the context of socio-environmental planning and policy. The course combines an overview of general principles of GIS with hands-on experience in the analytical use of spatial information, covering both raster and vector processing.

Expected Learning outcomes of the course

At the conclusion of this course, students should be able to:

- Use GIS and Remote sensing for environmental planning and management
- Organize, manage and co-ordinate workshops and seminars.
- Prepare of planning briefs and presentations of planning statements and reports

COURSE CONTENT

GIS for environmental planning. Remote sensing for environmental planning and management. Computer based approach to environmental planning and management. Statistical information for environmental planning and management. Consultation and public participation in environmental planning: Participatory Rural/Urban Appraisals (PRA). Administration and development of questionnaire and interviews. Organising, managing and co-ordinating workshops and seminars. Preparation of planning briefs. Presentation of planning statements and reports.

Mode of delivery;

Lectures, class discussion, field observations, laboratory demonstrations and practical's and library research.

Instructional Material and / or Equipment;

Lecture notes, Chalk boards, Laptops, LCD projector and slides

Course assessment:

- C.A.T.s, term paper and other assignments 30%
- End of semester exam 70%

Core Reading Materials for the Course;

Steinberg and Steinberg (2015) *Geographic Information Systems for the Social Sciences*, Sage Publications, 272 p.

Exploring the Urban Community: A GIS Approach by Richard P. Greene, James B. Pick, 2011, Published by Pearson Prentice Hall

Recommended Reference Materials;

Chrisman, Nicolas (2002) *Exploring Geographical Information Systems (2nd Edition)*, John Wiley and Sons, 320 p.

SES 873: PLANNING STUDIOS 3 UNITS

The student is required to do at least two studios.

SES 873A	Planning Studio I (Urban)	3 units
SES 873B:	Planning Studio II (Regional/Rural)	3 Units
SES 873C:	Planning Studio III (Project based): water, sanitation, etc.	3 Units

Purpose of the course

The planning studios have been developed to enable students to connect academic education and preparation for professional practice. Students learn to work together as a team by applying their respective capabilities and knowledge to produce a professional report or plan in response to a common real-world problem.

Expected Learning outcomes of the course

At the conclusion of this course, students should be able to design, implement, monitor and evaluate of programmes, plans and projects and analyse field data and present results in the form of project reports

COURSE CONTENT

Design, implementation, monitoring and evaluation of programmes, plans and projects. Group project work will be based on selected real world problems. The planning studio will be carried out in three phases: Design and planning of projects, project implementation in the field and data analysis and presentation of results in the form of project reports.

Mode of delivery;

Lectures, class discussion, field observations, laboratory demonstrations and practical's and library research.

Instructional Material and / or Equipment;

Lecture notes, Chalk boards, Laptops, LCD projector and slides

Course assessment:

- C.A.T.s, term paper and other assignments 30%
- End of semester exam 70%

Core Reading Materials for the Course;

Balassiano, Katia. 2011. Tackling “wicked problems” in planning studio courses.

Journal of Planning Education and Research 31(4):449-460.

Daniels, Tom, and Katherine Daniels. *The Environmental Planning Handbook*. Washington, DC: Planners Press, American Planning Association, 2013

Recommended Reference Materials;

Randolph, John. *Environmental Land Use Planning and Management*. Washington, DC: Island Press, 2004.

SES 873DE: STRATEGIC ENVIRONMENTAL ASSESSMENT 3 UNITS

Purpose of the course

This course provides basic knowledge of Strategic Environmental Assessment for environmentalists. It outlines the widely used assessment techniques, as well as the current relevant regulatory and legal framework. It also provides a basic knowledge of contemporary issues in environmental management and a comprehensive picture of different environmental problems and of the possibilities to manage them with an emphasis on environmental impact assessment approaches.

Expected Learning outcomes of the course

After completing the course activities, the student should:

- have acquired basic knowledge of SEA and EIA components, their characteristics and functioning of such systems;

- Be able to assess the environmental impact from human activities and to make appropriate and critical use of appropriate techniques in different sectors and applications.
- have a broad understanding of the conflict between environment and development

COURSE CONTENT

Acquire the skills and techniques of reviewing public policy, plans and programmes (National development plans, District development plans, local/urban physical development plans. Policy: International conventions, National development policies, National land policy, Agriculture policy, Water policy etc. Programmes and projects related to water, forest, soil conservation, transport, communication, cell-phone, etc. Cumulative environmental effects of small-scale activities: Jua Kali industries, petroleum outlets, urban car wash, brick-making, sand harvesting, rural development activities, informal settlement development, and other small-scale projects. The process for preparation of strategic environmental assessment reports.

Mode of delivery;

Lectures, class discussion, field observations, laboratory demonstrations and practical's and library research.

Instructional Material and / or Equipment;

Lecture notes, Chalk boards, Laptops, LCD projector and slides

Course assessment:

- | | |
|---|-----|
| • C.A.T.s, term paper and other assignments | 30% |
| • End of semester exam | 70% |

Core Reading Materials for the Course;

Sheate, W.R. et al (2014) Implementing the SEA Directive. Sectoral Challenges and Opportunities for the UK and EU, European Environment, Vol 14 (2), 73-93

Freedman, B. (2015). Environmental Ecology: Ecological Effects of Pollution Disturbance and Other Stresses, 2nd Edition. Elsevier, ISBN 0122665422

Therivel, R. et al (2015) Strategic Environmental Assessment. Earthscan, London .

Recommended Reference Materials;

Cherp, A: Environmental assessment and environmental review. 2005 (compendium).

Glasson, J, Therivel, R, Chadwick A: Introduction to environmental impact assessment. Routledge 2005 (3rd edition).

**SES 874E: ISSUES IN URBAN ENVIRONMENTAL PLANNING AND MANAGEMENT
(3 UNITS)**

Purpose of the course

The objectives of the course are twofold: to understand the methods and practical process of urban environmental planning, *and* to critically analyze existing plans and planning processes in terms of the social equity objectives and the other goals of sustainable development.

Expected Learning outcomes of the course

After completing this course, students will have a clear understanding of:

1. The spatial and local theories in urban development.
2. The logic of urbanism, structure and function of urban economy, society and politics
3. Sustainable environmental cities program and eco-city programs

COURSE CONTENT

The spatial and local theories in urban development. The logic of urbanism. Structure and function of urban economy, society and politics. Urban environmental problems and challenges. Environmental consideration in urban planning and management. Urban land use types. Land tenure systems. Municipal governance and administration. Urban environmental strategies. Sustainable environmental cities program: eco-city programs. Process of preparing an urban physical development plan.

Mode of delivery;

Lectures, class discussion, field observations, laboratory demonstrations and practical's and library research.

Instructional Material and / or Equipment;

Lecture notes, Chalk boards, Laptops, LCD projector and slides

Course assessment:

- C.A.T.s, term paper and other assignments 30%
- End of semester exam 70%

Core Reading Materials for the Course;

Howard Frumkin, "Urban Sprawl and Public Health," *Public Health Reports*, May-June 2002, Vol. 117.

Recommended Reference Materials;

Davis, M. 2004. Planet of Slums. *New Left Review* 26:5-34.

"Vulnerability of Global Cities to Climate Hazards." *Environment & Urbanization*. Vol 19, N.1. April 2007. SAGE publications: Reducing risks to cities from disasters and climate change.

Davis, M. (2010) Who Will Build The Ark? *NLR*, Jan-Feb 2010.

John Randolph, *Environmental Land Use Planning and Management* (2004).

SES 874AE: ENVIRONMENTAL DESIGN AND INFRASTRUCTURE SERVICES

(3 UNITS)

Purpose of the course

This course provides historical examples, and the theoretical, social, technical, and environmental forces that influence design and shape our contemporary environment. Students will study the interplay between environmental conditions and human behavior, as manifest in everyday experience.

Expected Learning outcomes of the course

On completing the course, students working knowledge of:

1. Principles, concepts and theories of design and design processes
2. Social-economic and political issues of infrastructure development
3. Process of preparing a site plan and an infrastructure project design

COURSE CONTENT

Principles of design and design processes, concepts and theories of design: Urban, building and housing designs. Infrastructure designs: types of infrastructure (basic social services, environmental). Site planning and design. Environmental problems and challenges: Social-economic and political issues of infrastructure development. Process of preparing a site plan. Process of preparing an infrastructure project design. Selected case studies.

Mode of delivery;

Lectures, class discussion, field observations, laboratory demonstrations and practical's and library research.

Instructional Material and / or Equipment;

Lecture notes, Chalk boards, Laptops, LCD projector and slides

Course assessment:

- C.A.T.s, term paper and other assignments 30%
- End of semester exam 70%

Core Reading Materials for the Course;

Design and Environment: A Global Guide to Designing Greener Goods by Helen Lewis, John Gertsakis, Tim Grant, Nicola Morelli and Andrew Sweatman

Recommended Reference Materials;

Sustainable by Design: Explorations in Theory and Practice by Stuart Walker

SES 874BE: RE-PLANNING AND RE-DESIGNING INFORMAL SETTLEMENTS**3 UNITS****Purpose of the course**

This course is designed to ensure that students are exposed to fundamental activities and concerns of planning. It introduces the study of analytical and imperative views of human settlement and understanding of the legal, political and organizational context of planning.

Expected Learning outcomes of the course

On completing the course, students knowledge of the typology and concepts of urban and rural informal settlement. They should be able to identify main concepts and approaches regarding informal improvement and slum-upgrading programs and strategies.

COURSE CONTENT

Typology and concepts of urban and rural informal settlement. Design and planning issues. Socio-economic and political issues. Environmental problems and challenges. Theories and

concepts of informal improvement and slum-upgrading programs. Slum upgrading programs and strategies. Planning for the urban and rural poor (challenges and implications). Selected case studies.

Mode of delivery;

Lectures, class discussion, field observations, laboratory demonstrations and practical's and library research.

Instructional Material and / or Equipment;

Lecture notes, Chalk boards, Laptops, LCD projector and slides

Course assessment:

- C.A.T.s, term paper and other assignments 30%
- End of semester exam 70%

Core Reading Materials for the Course;

Dalal-Clayto, B., Dent, D. and Dubois, O. 2013: *Rural Planning in Developing Countries: Supporting Natural Resource Management and Sustainable Livelihoods*. iied. Earthscan Publications Ltd.

Satterthwaite, D (2015): *The Scale of Urban Change Worldwide 1950-2000 and its underpinnings*. International Institute for Environment and Development,

Tacoli, C. (2016). *Rural-urban Linkages*. Earthscan Pubns Ltd.

Lehtola. M, Salmi, P, (2014) *Beyond the Rural Urban Divide*. Emerlad Group Publishing Limited

Recommended Reference Materials;

Agyeman, J, Bullard, RD and Evans, B. (2003). *Joined-up Thinking: Bringing Together Sustainability, Environmental Justice and Equity*. In *Just sustainabilities: Development in an Unequal World*. J,Agyeman, RD, Bullard and B, Evans (eds). Earthscan. MIT Press. Cambridge, Massachussets.

Reed, D. (1996) *Structural Adjustment, the Environment, and Sustainable Development*. WWF and Earthscan Publications. London.

SES 874CE: HOUSING ENVIRONMENT PLANNING AND MANAGEMENT 3 UNITS

Purpose of the course

This course outlines theories and concepts of housing development. It explores the socio-economic and political issues in housing development, environmental problems and challenges of housing. It will help students explore the complexity of housing and housing-related issues from a planning perspective.

Expected Learning outcomes of the course

On completing this course, students should be able to:

- Define housing and its various uses
- Understand building codes and housing standards as well as housing policy in an educated manner
- Have a knowledge of selected tools of city and regional planning
- demonstrate the connection between housing and community development

COURSE CONTENT

Theories and concepts of housing development. Socio-economic and political issues in housing development. Environmental problems and challenges of housing. Comparative housing designs, standards and models in Kenya and Africa. Housing, microclimate and energy use. Housing materials and environment. Building codes and housing standards. Housing policies and strategies: Low-cost housing programs, eco-city concept in housing. The process of preparing housing scheme. Management of housing projects. Selected case studies.

Mode of delivery;

Lectures, class discussion, field observations, laboratory demonstrations and practical's and library research.

Instructional Material and / or Equipment;

Lecture notes, Chalk boards, Laptops, LCD projector and slides

Course assessment:

- C.A.T.s, term paper and other assignments 30%
- End of semester exam 70%

Core Reading Materials for the Course

Richard W. Hull 2015 African Cities and Towns Before the European Conquest

Recommended Reference Materials;

The City in History: Its Origins, Its Transformations, and Its Prospects by Lewis Mumford (1972)

Better Not Bigger : How to Take Control of Urban Growth and Improve Your Community (99)

by Eben V. Fodor

SES 874DE: TOURISM, RECREATION AND CONSERVATION PLANNING 3 UNITS

Purpose of the course

This course aims to provide students with an understanding of the principles and practices associated with tourism planning and development.

Expected Learning outcomes of the course

On completion of this course, students should be able to:

1. Identify the key policies, structures and issues that impact tourism planning and development at national, state and regional levels;
2. Critically discuss different approaches to the tourism planning process and how this can be applied to current planning and development issues;
3. Effectively apply planning and marketing concepts to the development of tourism infrastructure and services.

COURSE CONTENT

Theories and concepts of tourism, recreation and conservation planning. Environmental issues and challenges. Socio-economic and political issues. Planning and management for: eco-tourism, leisure, sports, recreational facilities, heritage areas, cultural sites, arch-aeological and architectural and monument areas, festival markets. The process of preparing tourist plan, recreation and conservation plans. Selected case studies.

Mode of delivery;

Lectures, class discussion, field observations, laboratory demonstrations and practical's and library research.

Instructional Material and / or Equipment;

Lecture notes, Chalk boards, Laptops, LCD projector and slides

Course assessment:

- C.A.T.s, term paper and other assignments 30%
- End of semester exam 70%

Core Reading Materials for the Course;

Dredge D, Jenkins J, *Tourism Planning and Policy* (2012), John Wiley ISBN: 0470807768

Edgell D, *Tourism Policy and Planning. Yesterday, Today and Tomorrow* (2011), Butterworth-Heinemann ISBN: 0750685573

Recommended Reference Materials;

Douglas, N., Douglas, N. G., and Derrett, R. (2001). *Special Interest Tourism: Context and Cases*, Brisbane, Australia; Wiley and Sons

SES 875E: RURAL ENVIRONMENT PLANNING AND MANAGEMENT 3 UNITS

Purpose of the course

This course covers theories, concepts and significance of rural environments. It also covers resource utilisation in rural environment and the problems of rural development (social, economics, political).

Expected Learning outcomes of the course

Students completing this course will develop a good understanding of:

1. Theories, concepts and significance of rural environments.
2. Resource utilisation in rural environment.
3. Problems of rural development (social, economics, political).
4. Environmental degradation in rural environments.
5. Rural human settlement types and patterns and environmental planning and management implications.
6. Demographic trends and patterns and their implications to rural environment and development planning.
7. The process of preparing a rural settlement plan

COURSE CONTENT

Theories, concepts and significance of rural environments. Resource utilisation in rural environment. Problems of rural development (social, economics, political). Environmental degradation in rural environments. Rural human settlement types and patterns and environmental planning and management implications. Demographic trends and patterns and their implications to rural environment and development planning. The process of preparing a rural settlement plan.

Mode of delivery;

Lectures, class discussion, field observations, laboratory demonstrations and practical's and library research.

Instructional Material and / or Equipment;

Lecture notes, Chalk boards, Laptops, LCD projector and slides

Course assessment:

- C.A.T.s, term paper and other assignments 30%
- End of semester exam 70%

Core Reading Materials for the Course;

Rural Environmental Planning for Sustainable Communities by Frederic O. Sargent, Paul Lusk, Jose Rivera and Maria Varela

Rural Development: Principles and Practice by Malcolm Moseley

Recommended Reference Materials;

Rural Environmental Planning for Sustainable Communities by Frederic O. Sargent, Paul Lusk, Jose Rivera and Maria Varela

SES 875AE: REGIONAL ENVIRONMENTAL PLANNING AND MANAGEMENT

3 UNITS

Purpose of the course

This course deals with problems of regional development focusing on environmental problems and challenges and the identification and mobilization of resources

Expected Learning outcomes of the course

Students who complete this course will have an understanding of the concepts and theories of regional environmental planning. They will also be able to prepare a Regional Environmental Plan.

COURSE CONTENT

Problems of regional development. Environmental problems and challenges. Types and delineation of environmental regions. Identification and mobilization of resources. Concepts and theories of regional environmental planning. Process of preparing a Regional Environmental Plan. Selected case studies.

Mode of delivery;

Lectures, class discussion, field observations, laboratory demonstrations and practical's and library research.

Instructional Material and / or Equipment;

Lecture notes, Chalk boards, Laptops, LCD projector and slides

Course assessment:

- C.A.T.s, term paper and other assignments 30%
- End of semester exam 70%

Core Reading Materials for the Course;

The Regional City: Planning for the End of Sprawl. Peter Calthorpe, William Fulton 2011

Recommended Reference Materials;

Planning and Urban Design Standards. Megan Lewis, et al. 2006

Urban Transit: Operations, Planning, and Economics. Vukan R. Vuchic 2005.

SES 879AE: PLANNING AND MANAGEMENT OF FORESTRY AND WILDLIFE RESOURCES 3 UNITS

Purpose of the course

This course provides an analysis of forest and wildlife resources focusing on typology of forests, ecological, cultural and economic functions of forestry. It also reviews deforestation trends and implications and problems of human and wildlife competition for land; fauna and flora diversity and ecological range, habitats, migration, human population.

Expected Learning outcomes of the course

Students who complete this course will have an understanding of:

1. Forest and wildlife resources **in Kenya**
2. Ecological, cultural and economic functions of forestry
3. Problems of human and wildlife competition and traditional and modern perception of human-wildlife interface
4. Collaborative community management including community participation, co-management and Social forestry

COURSE CONTENT

Analysis of forest and wildlife resources. Typology of forests. Ecological, cultural and economic functions of forestry. Deforestation trends and implications. Types of a forestation. Problems of human and wildlife competition for land; fauna and flora diversity and ecological range, habitats, migration, human population. Traditional and modern perception of human-wildlife interface; case studies of competing land use in specific wildlife parks. Strategies for sustainable forestry programmes and wildlife conservation. Collaborating community management: Community participation; Co-management; Social forestry; Commercial forest development; Nature reserve conservation and Private sanctuary.

Mode of delivery;

Lectures, class discussion, field observations, laboratory demonstrations and practical's and library research.

Instructional Material and / or Equipment;

Lecture notes, Chalk boards, Laptops, LCD projector and slides

Course assessment:

- C.A.T.s, term paper and other assignments 30%
- End of semester exam 70%

Core Reading Materials for the Course;

Forest Wildlife Ecology and Habitat Management by David R. Patton October 12, 2010

Recommended Reference Materials;

The Wildlife Techniques Manual: Volume 1: Research. Volume 2: Management 2-vol. set by Nova J. Silvy

SES 879BE: LAND USE DEVELOPMENT PLANNING

3 UNITS

Purpose of the course

This course provides students with an understanding of the history and evolution and legal framework of land use (LU) planning in Kenya with some comparisons with other countries. It also introduces students to the planning process as well as the common goals and specific procedures for LU decision making and involving the public in those decisions.

Expected Learning outcomes of the course

1. At the completion of this course, students will have an:
2. Understanding of the history and evolution and legal framework of land use (LU) planning in Kenya
3. Understanding of the basic planning process as well as the common goals and specific procedures for LU decision making and involving the public in those decisions.
4. Be able to describe and compare the types of LU planning that occur at the local, regional and national levels and the interrelationships between them.
5. Become familiar with and able to use the procedures and resources (ie.spatial and other information) that are frequently used in LU inventory/site analysis, planning and decision making.

COURSE CONTENT

Nature and types of land uses: agriculture, livestock etc. Land use determinants. Land use planning theories. Types and spatial dimensions of land development. Environmental implications of land use policies and practices. Programmes for sustainable land use development.

Mode of delivery;

Lectures, class discussion, field observations, laboratory demonstrations and practical's and library research.

Instructional Material and / or Equipment;

Lecture notes, Chalk boards, Laptops, LCD projector and slides

Course assessment:

- C.A.T.s, term paper and other assignments 30%
- End of semester exam 70%

Core Reading Materials for the Course;

Guidelines for land-use planning. FAO Development Series 1

Facilitator's Guide to Participatory Land Use and Development Planning by Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH

Recommended Reference Materials;

1. *Urban Land Use Planning* by Phillip R. Berke, Edward J. Kaiser; Donald Godschalk; and Daniel A. Rodriguez., 5th Edition

SES 879CE: INDUSTRIAL AND TRANSPORT DEVELOPMENT PLANNING 3 UNITS

Purpose of the course

This course is designed to provide students with knowledge of the legislation, policies, and regulations that guide transportation planning and development. It will also provide them with concepts and theories of industrial location and industrial policy and industrialisation trends in Kenya.

Expected Learning outcomes of the course

This course will enable students to:

1. Gain knowledge of the legislation, policies, and regulations that guide industrialization and transportation planning and development;
2. Establish an awareness and understanding of a number of technical and analytical elements of industrial and transportation planning;
3. Develop an understanding of the direct relationship between industrialization and transportation decisions, the environment, land use, and economic and social development.

COURSE CONTENT

Environmental problems and challenges of industrial and transport development. Concepts and theories of industrial location. Industrialisation trends in Kenya. Industrial policies. Spatial dimensions of industrial development. Socio-economic and environmental impact of industrial development. Need for movement studies; the transportation planning process; definition of study area and traffic zones; factors influencing trip generation; factors influencing modal split; characteristics of transport systems; transportation strategies for human settlements. Strategies for sustainable industrial development: industrial ecology concept and industrial eco-parks. Strategies for sustainable transport development; non motorised transport/ pedestrian movement; public transport, environmentally friendly transport modes.

Mode of delivery;

Lectures, class discussion, field observations, laboratory demonstrations and practical's and library research.

Instructional Material and / or Equipment;

Lecture notes, Chalk boards, Laptops, LCD projector and slides

Course assessment:

- C.A.T.s, term paper and other assignments 30%
- End of semester exam 70%

Core Reading Materials for the Course;

Barriers to Sustainable Transport: Institutions, Regulation and Sustainability by Piet Rietveld, Roger R. Stough

Recommended Reference Materials;

Public Parks: The Key to Livable Communities By Alexander Garvin

Reinventing the Automobile: Personal Urban Mobility for the 21st Century by WilliamJ. Mitchell, Christopher E. Borroni-Bird and Lawrence D. Burns

SES 879DE: LANDSCAPE DESIGN AND PLANNING

3 UNITS

Purpose of the course

This course is about sharing, developing and obtaining knowledge of history and theory of landscape design, planning and management at a variety of scales and in various contexts, in order to develop a broad view and perspective.

Expected Learning outcomes of the course

Students will learn the various methods and techniques for assessing ecological, cultural, aesthetics and historical values of landscapes. They will also gain an understanding of the physical planning aspects of landscapes.

COURSE CONTENT

Basic Concepts: Elements of a site, analysing a site, landscape architecture, preparation of landscape plan and design project. Assessment of landscape conditions and their uses. Methods and techniques for assessing ecological, cultural, aesthetics and historical values of landscapes. Physical planning aspects of landscapes.

Mode of delivery;

This course will use a lecture and discussion format, with engaged participation by students

Instructional Material and / or Equipment;

Lecture notes, Chalk boards, Laptops, LCD projector and slides

Course assessment:

- C.A.T.s, term paper and other assignments 30%
- End of semester exam 70%

Core Reading Materials for the Course;

Scarfone, S. 2007. Professional Planting Design, An Architectural and Horticultural Approach for Creating Mixed Planting Beds

Bertauski, T. 2005. Designing the Landscape, An Introductory Guide for the Landscape Designer

Recommended Reference Materials;

Birnbaum, Charles A., editor. 1999. Preserving Modern Landscape Architecture: Papers from the Wave Hill National Park Service Conference, Cambridge, Massachusetts: Spacemaker Press.

Prigann, Herman and Heike Strelow and Vera David. 2004. Ecological Aesthetics. Boston: Birkhouser.

SES 879FE: DISASTER PREPAREDNESS, MANAGEMENT AND MITIGATION

3 UNITS

Purpose of the course

This course will provide students with information the four traditional phases of disaster management and the roles of the various phases of disaster management and issues concerning planning and policies in those phases

Expected Learning outcomes of the course

The course will provide students with:

1. Understanding of the roles of the various phases of disaster management and issues concerning planning and policies in those phases.
2. Understanding of comprehensive emergency management from a planning and policy perspective
3. Knowledge of mitigation planning and policy strategies.
4. Understanding of comprehensive emergency management and related plans
5. Understanding of factors affecting short and long-term recovery and rebuilding and the role of planners and policy-makers.
6. Understanding of the factors that give rise to disaster vulnerabilities (e.g. natural, physical, social, economic, policies, and governance).
7. Knowledge and capabilities to assess and manage these vulnerabilities through disaster planning and policy-making.

COURSE CONTENT

Advance planning for managing disasters. Types of disasters: famine, floods, earthquakes wars, pollution, cyclone and fire. Early warning systems. Global historical perspectives on monitoring techniques and remote sensing and international and national disaster prepa-redness. National machinery. Preparation of disaster action/contingency plans. Planning for disaster human settlement areas (refugee camps). Actors perception of victims and relief agencies. Reconstruction. Case studies.

Mode of delivery;

Lectures, class discussion, field observations, laboratory demonstrations and practical's and library research.

Instructional Material and / or Equipment;

Lecture notes, Chalk boards, Laptops, LCD projector and slides

Course assessment:

- C.A.T.s, term paper and other assignments 30%
- End of semester exam 70%

Core Reading Materials for the Course;

Hazard Mitigation and Preparedness (Wiley Pathways by Anna K. Schwab, Katherine Eschelbach and David J. Brower

Disaster Response and Recovery by David A. McEntire

Recommended Reference Materials;

1. Waugh, William L. Jr. (2000). Living with Hazards, Dealing with Disasters: An Introduction to Emergency Management. Armonk, New York: M.E. Sharpe.
2. Burby, Raymond (1998). Cooperating with Nature: Confronting natural hazards with land-use planning for sustainable communities. Joseph Henry Press.

SES 879GE: ENVIRONMENTAL PLANNING LAW, STANDARDS AND ENFORCEMENT 3 UNITS

Purpose of the course

This course introduces students to the content and controversies of planning and environmental laws governing the use, development, and preservation of land and the built environment. It is designed to provide students with the review of the various laws, legislations and policies dealing with environment and environmental planning. It will address environmental and physical standards and the planning process

Expected Learning outcomes of the course

Students will have a good knowledge of

- 1.the content and controversies of planning and
- 2.Environmental laws governing the use
- 3.Development, and preservation of land and the built environment

COURSE CONTENT

The principles of environmental planning and law. Planning principles in environmental management and co-ordination Act No. 8 of 1999. Physical planning principles in the physical planning Act CAP 286: Environmental planning principles contained in other related acts (Land Laws, Agriculture Act, Forest Act, Wildlife conservation and management Act, Architecture Antiques and Monument Act – among others. Subsequent legislation, regulations and standards. Environmental standards and physical standards. The planning approval process.

Mode of delivery;

Lectures, class discussion, field observations, laboratory demonstrations and practical's and library research.

Instructional Material and / or Equipment;

Lecture notes, Chalk boards, Laptops, LCD projector and slides

Course assessment:

- C.A.T.s, term paper and other assignments 30%
- End of semester exam 70%

Core Reading Materials for the Course;

Readings will be provided by the lecturer

Recommended Reference Materials;

Readings will be provided by the lecturer

SES 879HE: ENVIRONMENTAL PLANNING AND MANAGEMENT OF WASTES AND POLLUTION **3 UNITS**

Purpose of the course

This course focuses on planning and management techniques of waste disposal. Methods for managing waste collection, recycling, and transportation of non-hazardous and hazardous materials will also be covered

Expected Learning outcomes of the course

Students should be able to:

1. Identify and apply major environmental laws, regulation, and related guidance in waste and pollution
2. Identify waste streams and the applicable laws and regulations and management techniques for this waste stream.
3. Students should be able conduct environmental research and publish findings

COURSE CONTENT

Nature and sources of wastes. Disposal techniques and their environmental implications. Planning of waste treatment facilities. Factors affecting the location and operation of disposal methods. Environmental sound planning approaches in waste management

Mode of delivery;

Lectures, class discussion, field observations, laboratory demonstrations and practical's and library research.

Instructional Material and / or Equipment;

Lecture notes, Chalk boards, Laptops, LCD projector and slides

Course assessment:

- C.A.T.s, term paper and other assignments 30%
- End of semester exam 70%

Core Reading Materials for the Course;

Handbook of Environment and Waste Management Air and Water Pollution Control edited by:
Yung-Tse Hung, Lawrence K Wang and Nazih K Shammas

Recommended Reference Materials;

Environmental Hazards: The Fluid Dynamics and Geophysics of Extreme Events by H K
Moffatt and Emily Shuckburgh

Restoring Streams in Cities: A Guide for Planners, Policymakers, and Citizens by Ann L. Riley

SES 899: Research Project and Thesis

6 UNITS

MSc Thesis shall be an original research, aimed at generation of new insights and knowledge that significantly contributes to scientific advancement and excellence, and those with relevance for development are encouraged. A candidate shall pursue an original research under the supervision of Maasai Mara University academic staff and any other person(s) recommended to the Board of Post-Graduate Studies of Maasai Mara University and approved by the Senate.

4.0 Appendices

4.1 Appendix 1: Facilities

S/N	Name of Facility	Number	Capacity	Usage
1	Lecture rooms	67	80 X67 per session	Shared
2	Internet Access points	All learning facilities	-	Shared
3	Maasai Mara university Library	1	200	shared

4.2 Appendix II Equipment and Teaching Materials

S/N	Teaching equipment	Number	Capacity	Usage
1	Chairs	60		Shared
2	Tables	2		Shared
3	Drawing board	2		Shared
4	Desk top computers	2		Shared
5	Lap top	2		Shared
6	Projector	10		Shared
7	Drawing set			Shared
8	Planning maps	6		Shared
9	Plans	5		Shared
10	Power sockets	2		Shared
11	Extension cables	1		Shared
12	Internet access cables	1		Shared
13	White board	1		Shared
14	Printer	4		Shared

4.3 Appendix III: Core-Texts and Journals

S/N	Subject Area	Number of Titles	Volumes
Core-Texts (Print)			
1.	Environmental Biology	12	25
2.	Environmental Economics	13	22
3.	Environmental Health	14	23

4.	Environmental Information Systems	12	24
5.	Environmental Law	16	22
6.	Environmental Erath Sciences	15	30
7.	Environmental Planning and Management		
8.			
Core Texts (Electronic)			
1.	Environmental Biology	14	22
2.	Environmental Economics	16	24
3.	Environmental Health	15	21
4.	Environmental Information Systems	16	24
5.	Environmental Law	17	21
6.	Environmental Erath Sciences	15	22
7.	Environmental Planning and Management		
Journals (Electronic)			
1.	Environmental Biology	22	30
2.	Environmental Economics	15	22
3.	Environmental Health	17	22
4.	Environmental Information Systems	18	30
5.	Environmental Law	15	18
6.	Environmental Erath Sciences	14	22
7.	Environmental Planning and Management		
Journals (Print)			
1.	Environmental Biology	16	19
2.	Environmental Economics	15	22
3.	Environmental Health	17	24
4.	Environmental Information Systems	22	24
5.	Environmental Law	19	28
6.	Environmental Erath Sciences	20	39
7.	Environmental Planning and Management		

4.4 Appendix IV: Academic Staff

Name	Teaching Experience (Yrs)	Professional Experience	Publications	Patents	ACADEMIC QUALIFICATIONS						Academic Rank	Workload per Year	Mode of engagement
					Bachelors		Masters		PhD				
					University	Date	University	Date	University	Date			
Prof. Romulus Abila	25	22	17	0	Moi University	1992	Moi University	1995	Maseno University	2005	Professor	3 courses	Full time
Prof. Francis Mburu	21	20	20	0	Moi University	1993	Moi University	2000	Nancy University, France	2007	Professor	2 courses	Full time
Dr. Samson Mabwoga	10	8	12	0	Guru Nanak Dev University, Amritsar, India	2003	Guru Nanak Dev University, Amritsar, India	2005	Guru Nanak Dev University, Amritsar, India	2014	Lecturer	3 courses	Full time
Dr. Paul Webala	6	17	16	0	Moi University	1997	Addis Ababa University	2001	Murdoch University, Australia	2010	Senior Lecturer	6 courses	Full time
Dr. Charity Konana	16	16	7	0	Daystar University	1997	Moi University	2001	University of Nairobi	2017	Lecturer	6 courses	Full time
Dr. Omari Ngodhe	15	10	20	0	Moi University	2010	Moi University	2012	Rongo University	2021	Lecturer	6 courses	Full time
Dr. Maurice Omollo	22	16	17	0	Kenya University	1995	Kenya University	2000	Kenya University	2016	Lecturer	6 courses	Full time
Dr. Ruth Kangai	15	15		0	Kenya University	2000	Kenya University	2004	Kenya University	2021	Lecturer	6 courses	Full time
Dr. Jedidah Nankaya	10	8	16	0	University of Nairobi	2010	Clemson University	2014	University of Nairobi	2021	Lecturer	6 courses	Full time
Dr. Meshack Lagat	10	5	5	0	Moi University	2011	Kenya University	2015	Maasai Mara University	2022	Lecturer	4 courses	Full time

4.5 Appendix V: University Policy on Curriculum Development

CURRICULUM DEVELOPMENT AND REVIEW POLICY

Version Number	001
Revision Number	001
Document Status	Draft
Date Approved	
Approved By	

Effective Date	
Department Responsible	Directorate of Quality Assurance and Performance Contracting

Foreword

To achieve her vision of being a *World Class University Committed to Academic Excellence for Development*, Maasai Mara University (MMU) need to continually develop, review and implement market demand driven academic programmes, which meet the needs of a highly dynamic labour market. The Universities Standards and Guidelines 2014 define an academic programme as learning content consisting of courses that are weighed in terms of credit hours and are taught within a stipulated timeframe. There is therefore need to put in place a robust policy that will guide development and continuous review of academic programmes at Maasai Mara University. An academic programme is a dynamic document reviewed regularly in a predetermined cycle in order to align it with the prevailing needs of a market, local or world trends in education and the ever-changing backgrounds of students.

This policy therefore provides an avenue for a participatory approach to curriculum development and review process at Maasai Mara University to ensure standards of quality are met as well as form a basis for stakeholder involvement. It is envisaged that effective implementation of this policy will ensure that programmes on offer at MMU are of high standard of quality and relevance.

Prof. Mary K. Walingo, Ph.D., MKNAS, EBS.

Vice-Chancellor.

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List of Abbreviations:

- **CUE** – Commission on University Education
- **DVC (AR&SA)** – Deputy Vice-Chancellor (Academics, Research and Student Affairs)
- **AA-** Academic Affairs
- **QA&PC** – Quality Assurance and Performance Contracting.

1.0 Introduction:

Curricular are the heart and soul of a university and a university is as good as the programmes it offers. Universities are constantly under the challenge to develop and implement new academic programmes that reflect and respond to evolving development needs of the society. Changing labour markets trends require that new academic programmes be developed and existing ones be reviewed to reflect the emerging labour market need trends. In the course of delivery of an academic programme, new ideas, innovations or even better methods of solving problems may emerge that could be integrated in one or more of the courses within a programme. Students themselves could have difficulties understanding certain topics in one course due to a prerequisite topic missed out in another course. Such issues need to be addressed as they arise without having to wait for a full programme cycle to be corrected. The subtle changes are done continuously whenever they are detected but in a formal process provided for by the policy on continuous review of academic programmes.

2.0 Mission, Vision and Mission of the University:

2.1 Vision:

To be a world Class University committed to Academic Excellence for Development.

2.2 Mission:

To provide quality University education through innovative teaching, research and consultancy services for development

2.3 Core Values:

The core values of MMU constitute the fundamental beliefs that drive the University. These beliefs are essential and must be upheld because they make the University visionary for the standards of behavior that define her culture. MMU therefore upholds the following core values:

2.3.1 Teamwork

Adopt a participatory approach in discharging the mandate of the University.

2.3.2 Professionalism

Maintain high standards of professionalism in executing the mandate of the University.

2.3.3 Creativity and Innovativeness

Utilize up-to-date and most appropriate technology in achieving the University's objective.

2.3.4 Transparency and Accountability

Uphold clarity and simplicity in all endeavors of the University.

2.3.5 Excellence

Uphold the practice and orientation for excellent performance within the University.

2.3.6 Equity and Social Justice

Uphold equal treatment to all and practice fair judgment in all matters of the University. These values will help MMU in the transformation of human conduct in governance and management practices.

2.4 Mandate

The mandate of Maasai Mara University is to teach, conduct research, provide consultancy and community services in accordance with the Universities ACT, 2012 and the Maasai Mara University Charter, 2013. The University is required to:

2.4.1 Provide directly or in collaboration with other institutions of higher learning, facilities of University education (including technological, scientific and professional education), the integration of teaching, research and effective

application of knowledge and skills to the life, work and welfare of the citizens of Kenya

- 2.4.2** Participate in the discovery, transmission and preservation, and enhancement of knowledge and to stimulate the intellect, participation of students in the economic, social, cultural, scientific and technological development of Kenya.
- 2.4.3** Provide and advance University education and training to appropriately qualified candidates, leading to the conferment of degrees and award of diplomas and certificates and such other qualifications as the Council and the Senate shall from time to time determine and in so doing contribute to manpower needs.
- 2.4.4** Conduct examinations for such academic awards as may be provided in the statutes pertaining to the University.
- 2.4.5** Examine and make proposals for new faculties, schools, institutes, departments, resource and research centers, degree courses and subjects of study.

3.0 Objectives of the Policy:

The general objective of the policy is: To ensure quality academic programmes in Maasai Mara University that meet and exceed customer requirements as well as comply with regulatory requirements.

Specific Objectives include:

- i. To ensure development of quality academic programmes
- ii. To ensure that all academic programmes are regularly reviewed for continued relevance and quality
- iii. To ensure that new customer/industry/regulatory requirements are factored into existing academic programs

4.0 Policy Statement:

Maasai Mara University is committed to continually develop quality curriculum/programme that address the needs in the market. The University is further committed to review its existing programs for continued relevance and quality improvement.

Development and review of academic programs/curricular shall be based on the guidelines provided in this policy and in line with Universities Standards and Guidelines 2014 and Academic Quality Assurance in Higher Education- Codes of practice

This policy spells out guidelines of curriculum development and review. The objectives of this policy shall be to ensure that demand driven programmes are developed and implemented, programmes are up to date and meet the needs of the learner and to ensure prompt response to programme deficiencies when detected.

5.0 Reference Documents

The following documents are the main legal instruments and institutional policies used as references when developing this policy:

- i. Universities Act (2012) and related amendments
- ii. Universities Standards and Guidelines, 2014
- iii. Universities Regulations Act, 2014
- iv. Maasai Mara University Quality Manual and Procedures, 2013
- v. Maasai Mara University Charter
- vi. Maasai Mara University Strategic Plan 2014 – 2019

6.0 Scope

This Policy shall apply to design, planning, development, implementation and review of academic programmes at Maasai Mara University.

7.0 Definitions

S/N	Word/ Term	Definition
1	Curriculum	Means any documented programme of study (<i>Universities Standards and Guidelines, 2014; pp45</i>).
2	Academic programme	
3	Academic staff	means any person who has been appointed to teach, train or to do research at a university
4	Academic year	means a period of teaching and examination organized in a full year in either two, three or four segment
5	Course	means a single unit in a programme of study

S/N	Word/ Term	Definition
6	Department	means an academic division into which a faculty is divided for purposes of teaching, examinations and administration; <i>Universities Standards and Guidelines, 2014 Page 46 of 170</i>
7	Faculty/school	means an academic division so designated or established under the instruments constituting a university
8	Institution	means an organization founded for purposes of university education and research
9	Lecture hour	means a period of time equivalent to one hour and representing one such instructional hour in lecture form, two in a tutorial or open learning session, three in a laboratory practical or practicum and five in farm or similar practice
10	Programme of study	means the prescribed syllabus that students must be taught at each key stage
11	Standard	means a dereference point against which different aspects of the programme are compared or evaluated for quality.
12	Learning Outcomes	Statement of knowledge understanding and skills students are expected to achieve as a result of engagement with content of the course

8.0 Curriculum Development and Review

8.1 Principle responsibility

The responsibility of Curriculum Development and review policy shall be DVC (AR&SA) and coordinated by Director (QA&PC).

8.2 Procedural Authorities:

Curriculum development and review shall go through the following organs whose roles are explained in the Maasai Mara University Curriculum Development and Review Procedure.

- i. Departmental Academic Board Meeting
- ii. School Board Meeting
- iii. External Subject Experts
- iv. Validation Panel Members
- v. Deans Committee
- vi. University Senate
- vii. University Council
- viii. Professional Bodies
- ix. Commission for University Education

8.3 Key roles and responsibilities:

8.3.1 Deputy Vice-Chancellor (Academic Research and Student Affairs) - DVC (AR&SA): will have oversight of curriculum development and review process. The DVC (AR&SA) will liaise with all those involved in the process to provide advice and guidance, act as internal validation panel member.

8.3.2 Director (Quality Assurance & Performance Contracting)-Director (QA&PC): Has operational oversight and management of curriculum development and continuous review process and is the primary source of advice on the process. They will liaise DVC (AR&SA), Registrar (AA), Deans of Schools, Heads of Departments and Academic programme leaders regarding coordination, preparation and undertaking development and review activities.

8.4 Curriculum Development Guidelines.

The following standards shall guide development of an academic programme in Maasai Mara University as provided for in the third schedule of University Standards and Guidelines 2014

- i. An academic programme shall facilitate a balance learning process, ensuring that the students are able to acquire such cognitive, effective and psychomotor skills as are consistent with educational goals and aspirations.
- ii. Each level of academic programme shall be differentiated by specific attributes. Higher levels of academic programmes shall require more complex attributes according to blooms taxonomy.
- iii. A thesis, project or dissertation shall be an original research document submitted in support of candidature for a given postgraduate degree or professional qualification presenting the author's research and findings.
- iv. An academic programme structure shall be aligned to as standard format as provided for by the commission for University Education and shall include the background information of the University, information on the various programme facets and details on academic resources for the support of the programme.
- v. Academic programme title shall be reflective of its overall content.
- vi. Maasai Mara University academic programme shall clearly articulate the academic organization and structure of its programmes.
- vii. The rationale of the academic programme shall be convincing and evidence based.
- viii. The expected learning outcomes of a programme shall be learner-centered and concisely and precisely articulated.
- ix. Minimum admission requirement shall be provided for in every academic programme in line with nationally accepted admission requirements.
- x. Credit transfer shall be accepted for purposes of student mobility and recognition of prior learning.
- xi. The quality of an academic programme shall not be compromised by the mode of delivery of the programme, and shall promote student engagement.

- xii. The content of a given academic programme shall be systematically presented, relevant and aligned to Maasai Mara University, national and global goals and trends.
- xiii. An academic programme courses shall have a distinct course codes.
- xiv. Maasai Mara University degree classification system shall be clearly articulated.
- xv. Procedures for evaluation of courses of a given programme shall be clearly documented.
- xvi. An academic programme shall be effectively managed and the structures, mechanisms and process for the same clearly documented.
- xvii. An academic programme shall be supported by adequate full-time staff holding requisite academic qualifications.
- xviii. An academic programme shall be guided by appropriately qualified academic leader.
- xix. An academic programme shall be supported by appropriate and adequate facilities and equipment.
- xx. An academic programme shall be supported by current resources and materials.
- xxi. Maasai Mara University shall conduct self-assessment of its programmes at regular intervals.
- xxii. Structures shall be put in place by an institution for continual assessment of its academic programmes for quality and efficiency.

Curriculum Development Process shall be as per the Curriculum Development and Review Procedure in the Academics Manual of the Quality Management System.

8.5 Curriculum Review

8.5.1 Curriculum Review schedule

- i. Maasai Mara University academic programmes shall be reviewed every four(4) to five(5) years
- ii. Senate Shall approve programme review
- iii. Course review shall be done every end of the semester using the course review form
- iv. School board shall approve course review and forward to senate for ratification.

- v. DVC (AR&SA) shall ensure course and programme review happen as per (i), (ii), (iii) and (iv) above.

8.5.2 Curriculum Review Policy Principles.

- i. Curriculum review shall identify strengths to be built on and opportunities for improvement.
- ii. Curriculum review shall strengthen engagement by staff, students and other relevant stakeholders.
- iii. Curriculum review process shall be rigour, transparent, accountable, collegial and objective.
- iv. Curriculum review process shall include a clear statement of scope and terms of reference for the review.
- v. Curriculum review process shall include clearly defined responsibilities for all stages of review.
- vi. Curriculum review process shall have a clear realistic timeframe.
- vii. Curriculum review process shall have reference to stakeholder's feedback
- viii. Curriculum review process shall have clear reference to relevant to institutional key performance indicators and relevant data.
- ix. Curriculum review process shall have clear reference to relevant external standards and benchmarks.
- x. Curriculum review process shall have clear appropriate approval, reporting, communication and implementation of the outcomes of the review.

8.5.3 Scope of Curriculum Review

Curriculum review shall be comprehensive and be able to assess the continuing validity and relevance of the programme in light of the following:

- i. Effectiveness of academic programme in supporting the Mission and Vision of Maasai Mara University.

- ii. The quality of learning environment for both undergraduate and post graduate students
- iii. Quality of academic programmes teaching, creative and research within disciplinary context.
- iv. Adequacy and effective utilization of resources by the Academic Programme.
- v. The effect of changes, including those which are cumulative and those made over time, to the design and operation of the programme.
- vi. The continuing availability of staff and physical resources
- vii. Current research and practice in the application of knowledge in the relevant discipline(s), technological advances, and developments in teaching and learning.
- viii. Changes to external points of reference, such as subject benchmark statements, relevant Professional, Statutory and Regulatory Bodies (PSRB) requirement.
- ix. Changes in student demand, employer expectations and employment opportunities.
- x. Data relating to student progression and achievement.
- xi. Student feedback, including the relevant Student Surveys.
- xii. Academic programme against another comparable peer programmes as appropriate.

8.5.4 Initiation of Curriculum Review

- i. A programme review schedule shall be developed in a Consultative meeting between DVC (AR&SA), Director Quality Assurance and Performance Contracting, Registrar (AA) and the Deans of Schools. The schedule shall guide timelines for curriculum review.
- ii. The Director (QA&PC) shall be custodian of the Programme Review Schedule.
- iii. The Chair of Department shall be responsible to initiate the program review process as per the Curriculum Development and Review Process.
- iv. Curriculum review may cover an individual course or suit of courses
- v. An unscheduled Curriculum review may be initiated where curriculum accreditation changes or where serious performance issue is identified through monitoring process.
- vi. Issues that may lead to an unscheduled curriculum review may include, but are not limited to:
 - a) Poor student outcomes.

- b) Negative student feedback.
 - c) Evidence of decline in academic standards
 - d) Changes to student enrolment patterns.
 - e) Course restructure
 - f) Change to industry or other external requirements
- vii. In an event of an unscheduled review, the Director Quality Assurance shall adjust the next review date

8.5.5 Curriculum Development and Review Committee

- i. There shall be a Curriculum Development and Review Committee at Maasai Mara University whose composition shall include the following
 - a) Deputy Vice Chancellor (AR & SA) - Chairman
 - b) Registrar (Academic and Student Affairs) - Member
 - c) All Deans of Schools - Members
 - d) Director Quality Assurance -Member and to provide secretariat
- ii. The roles and functions of the Curriculum Development and Review Committee (CDRC) shall be;
 - a) Provide guidance to the Departments to ensure that all academic programmes are developed, implemented and reviewed according to Commission for University Education (CUE) Standards, Guidelines and Requirements, University Vision, Mission, and University Strategic and other development Plans.
 - b) Recommend all new and reviewed academic programmes before presentation to Deans Committee for considerations.
 - c) Oversee and monitor piloting of new academic programmes.

9.0 Programme Withdrawal

In the event of a decision to discontinue a programme, the DVC (AR&SA) shall take measures to notify and protect the interests of students registered for, or accepted for admission to, the programme. Senate shall approve withdrawal of any programme upon satisfaction of the grounds of withdrawal and the University Council will be notified appropriately.

Maasai Mara University shall be responsible for managing its portfolio of provision, including any awards that are offered jointly with another institution, and other collaborative partners. This may involve the withdrawal of existing programmes as well as the design and development of new ones.

It is important that the process for the orderly withdrawal of programmes is as well embedded, articulated and understood as those for design, approval and review.

In the event of significant changes to the character of the programme, an institution should have a process in place to manage this change effectively. It also needs to be clear about what, in its own institutional context, constitutes a significant alteration to the character of the programme, and how any collaborating partners are kept informed.

10.0 Complimentary Documents and Policies:

The following documents and policies shall be used alongside this policy during the curriculum review and development process:

- i. Curriculum Development and Review Procedure in the Academics Manual in the Quality Management system.
- ii. A guide for the programme review panel.
- iii. Common courses, coding and course weighting guidelines
- iv. Guidelines for designing courses for University Academic Programs(CUE)
- v. Universities Standards and Guidelines 2014(CUE)

APPENDIX I: STUDENT EVALUATION FORM OF TEACHING AND LEARNING



**MAASAI MARA UNIVERSITY
OFFICE OF THE REGISTRAR (ACADEMIC AFFAIRS)**

STUDENT'S EVALUATION FORM OF TEACHING AND LEARNING

SCHOOL: _____ **DEPARTMENT:** _____

ACADEMIC YEAR: _____

COURSE

CODE/TITLE: _____ **SEMESTER** _____

LECTURER'S

NAME: _____ **DATE:** _____

The feedback you provide will be used primarily to assess and improve the quality of services rendered by the lecturer and the University.

Note: Indicate your rating with a tick [✓] according to the following Scale Excellent (5);

Very good (4); Good (3); Fair (2); Poor (1) Very Poor (0); Not applicable (N/A)

ITEMS	DESCRIPTION	5	4	3	2	1	0	N/A
COURSE CONTENT	Rate the course based on your overall impression on:							
	<i>1. Objective of the course is clearly stated</i>							
	<i>2. Load of course content is manageable</i>							
	<i>3. Content is relevant to student aspirations</i>							
	<i>4. There is appropriateness of theory</i>							
	<i>5. There is appropriate practice/practicals/hands on experience</i>							

THE LEARNING ENVIRONMENT	Rate the student learning environment based on your overall impressions on adequacy of:								
	<i>6. class rooms, chairs, Space for private study</i>								
	<i>7. Computer rooms</i>								
	<i>8. Access to laboratories</i>								
	<i>9. Library, availability of textbooks</i>								
	<i>10. Teaching tools and timetable</i>								
	<i>11. Access to relevant information and communication to students by the relevant authorities</i>								
THE LECTURER	Rate the lecturer on the following:								
	<i>13. Provision of course outline on the first day of class</i>								
	<i>14. Provision of study materials for the course</i>								
	<i>15. Organization, preparedness & presentation of lessons in a clear understandable way.</i>								
	<i>16. Lecturer's mastery of course content</i>								
	<i>17. Good coverage of syllabus</i>								
	<i>18. Lecturer's Punctuality in class</i>								
	<i>19. Regularity in teaching</i>								
	<i>20. Good interaction with and fairness in handling students. Avails opportunity for students to ask questions and express their views</i>								
	<i>21. Good use of class time and inspires students to learn and gain knowledge</i>								
	<i>22. Timely feedback on CATs and Assignments to students (Feedback should be at least one week before start of end of semester examinations)</i>								
<i>23. Availability of lecturer for out of class consultations with students</i>									

	<i>24. Lecturer's adherence to the teaching timetable</i>								
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ADDITIONAL COMMENTS (IF ANY):

APPENDIX II : COURSE REVIEW FORM

MAASAI MARA UNIVERSITY		MMU/AA0322/F-----
SCHOOL: DEPARTMENT:		
COURSE REVIEW FORM		
A. GENERAL INFORMATION		
Academic Year: <input type="text"/>	Year: <input type="text"/>	Semester: <input type="text"/> No. of Credit hours: <input type="text"/>
Course Code and Name: <input type="text"/>		
Lecturer: <input type="text"/>	Other Members: <input type="text"/>	
B. INPUT INFORMATION		
COURSE PASS RATE <small>Number & % of Students Enrolled: No. & % of Students passed in MAIN exam: No. & % of Students failed in MAIN exam:</small>	AVERAGE MARKS OF COURSE <small>Average Exam Mark: % Average CAT marks: % Course MEAN Mark: %</small>	EXTERNAL EXAMINER'S COMMENTS <small>(from external examiner's report):</small>
STUDENT'S FEED BACK (FROM STUDENT EVALUATION FORM) <small>Rating of Course: % Rating of lecturer: % Rating of Learning Environment: % Positive Comments: Negative: Suggestions for improvement:</small>	LECTURER'S REMARKS	
C. Reflections on points in Section B above (including the effects of any changes made from the previous year). <small>(Were all the Learning Outcomes achieved? How appropriate was the learning and teaching strategy, the assessment strategy and the learning environment (labs, lecture theatre, etc.)? In particular, what were the elements of the Continuous Assessment, and how well did the students perform on them?)</small>		
D. PLAN OF ACTION FOR NEXT ACADEMIC YEAR: <small>(Changes to Course Description, methods of teaching or assessment, material in other courses, laboratory or other facilities, teaching environment, etc.)</small>		

APPENDIX III: PROGRAM REVIEW FORM

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MAASAI MARA

UNIVERSITY

OFFICE OF THE REGISTRAR (ACADEMIC AFFAIRS)

COURSE REVIEW SUMMARY FORM FOR DEPARTMENTS

(Filled in each semester)

(A) LIST OF LECTURERS AND COURSES

(B) FEEDBACKS FROM STUDENTS

(C) PROPOSED CHANGES IN THE COURSES

Year and Number of students	Course Code and Name	% Passed	Proposed Change	APPROVED/NOT APPROVED by departmental board <i>(Changes are in italics)</i>

