

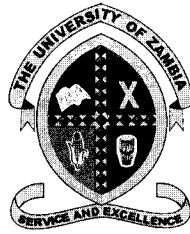
THE UNIVERSITY OF ZAMBIA

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THE UNIVERSITY OF ZAMBIA
INSTITUTE OF DISTANCE EDUCATION
UNIVERSITY EXAMINATIONS – MARCH 2019

AGS 6135: GIS APPLICATIONS IN SUSTAINABLE LAND AND ENVIRONMENTAL MANAGEMENT

Marks: 100

Time: 3 hours

1. There are several ways of making maps using primary data sources. Explain what is involved in each of the following interpolation methods during map production as well as the resultant map characteristics.
 - (a) Thiessen polygons (10 marks)
 - (b) Inverse distance weighting (10 marks)
 - (c) Kriging (10 marks)

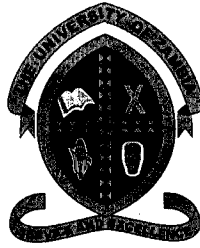
2. One of the most important considerations you will have to make when carrying out spatial analysis is to ensure that your data sets match. In this regard datums and projections are important.
 - (a) What is a datum and how does it differ from a map projection ? (10 marks)
 - (b) What factors will influence your choice of a map projection ? (10 marks)

3. You are required to think of an environmental or land related problem in your area which can be solved by using GIS. As you answer the questions below, provide your justification for your answer.
 - (a) State which data sets you may require to solve this problem. (10 marks)
 - (b) Explain how the problem can be using GIS. (10 marks)
 - (c) What data representation (vector or raster) would be appropriate for your analysis and why? (10 marks)

4. GIS is known to have wide applications in a range of fields, with this in mind answer the following questions:

- (a) List at least 8 professionals who use a GIS to solve or analyse their problems in order to find workable solutions. (10 marks)
- (b) From the list generated in (a) above, select three professionals and provide a possible description of GIS for their field. (10 marks)

END OF EXAMINATION



THE UNIVERSITY OF ZAMBIA

INSTITUTE OF DISTANCE EDUCATION

UNIVERSITY EXAMINATIONS (DEFERRED & SUPPLEMENTARY)

AUGUST 2020

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**AGS 6135: GIS APPLICATIONS IN SUSTAINABLE LAND AND ENVIRONMENTAL
MANAGEMENT**

Marks: 100

Time: 3 hours

1. For each of the following state whether it is 'True' or 'False'. (10 marks)
 - (i) A key feature of cartographic models is to define the criteria for all input layers
 - (ii) Buffering with raster data sets often produces smooth outputs.
 - (iii) Both kriging and inverse distance weighting will give similar map results when there is enough data that is evenly spaced across the area of interest.
 - (iv) While splines are said to be exact interpolators, a surface created with spline interpolation may exceed the value range of the sample point set.
 - (v) The range of the semi-variogram is the distance up to which there is spatial correlation.
 - (vi) In inverse distance weighting, far away points have no influence on the values of a given point where an estimation is being made.
 - (vii) The process of overlay allows you to derive spatial relationships between coincident but different geographical phenomena.
 - (viii) Fixed distance buffering analysis, one does not distinguish between regions that are too close to one or more features.
 - (ix) One of the projections commonly used for GIS data mapping in Zambia is the conical projection.
 - (x) Spatio-temporal models are dynamic are suitable for modeling phenomena related to climatic variables.

2. How does interpolation differ from extrapolation and which one would you recommend for making maps? (15 Marks)
3. Why is kriging often preferred instead of Thiessen polygons for mapping continuously varying spatial attributes. (15 Marks)
4. Although different map projections may distort the earth in various ways, what four (4) conditions should be maintained on the map? (10 Marks)
5. List three common map projections and briefly explain what you understand by each of them. (20 Marks)
6. How does contour sampling differ from transect sampling in the assessment of spatial phenomena. (10 Marks)
7. You are asked to critique and compare the vector and raster spatial data models as a suitable means by which to represent and subsequently analyse soil pollution arising from contamination at a dump site for areas within its vicinity. (20 marks)

END OF EXAMINATION

UNIVERSITY OF ZAMBIA
INSTITUTE OF DISTANCE EDUCATION
UNIVERSITY DEFERRED EXAMS – APRIL, 2021
AGS 6135: GIS APPLICATION IN SUSTAINABLE LAND AND
ENVIRONMENTAL MANAGEMENT

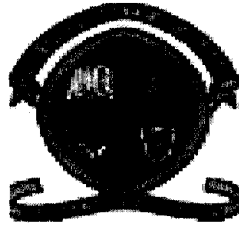
Time: Three (3) Hours

Instructions: Answer ALL Questions

Total Marks: 100

-
1. Georeferencing is one of the most important procedures used in GIS analysis. What do you understand by the term Georeferencing and describe how you can carry out the process of Georeferencing from a scanned map using GIS software. [15 Marks]
 2. Environmental processes are usually dynamic processes which change over time and space; how can one handle that in a GIS? [15 Marks]
 3. Deforestation is environmental problem that is increasing with population increase. There is therefore need to know the rate at which deforestation is occurring for us to project the future impacts. Describe the process you would use to determine the rate of deforestation in an area using GIS. [20 MARKS]
 4. Raster and vector are the two data models commonly used to represent spatial data [30 MARKS]
 - a. In your own words, explain what you understand by a vector and a raster data model
 - b. Compare and contrast between a vector and a raster data model in terms of analytical capabilities
 - c. What are the advantages and disadvantages of the two data models listed above?
 5. Buffering is one of the common proximity functions, which generally refers to the process of creating buffers. Explain the following concepts of buffering: [20 MARKS]
 - a. Fixed distance buffering
 - b. Compound buffering
 - c. Nested buffering
 - d. Raster buffering

END OF EXAM



The University of Zambia,
School of Agricultural Sciences (Dept of Soil Science)

IDE SUPPLEMENTARY EXAMINATIONS- AUGUST 2020

AGS 6145: REMOTE SENSING APPLICATIONS IN SUSTAINABLE LAND MANAGEMENT

Time: 3:00 hours

Total marks: 100

Instruction: Answer all questions

Q1. Image pre-processing and post-processing of remotely sensed data are performed to improve the quality of satellite images.

- a. What is the difference between radiometric and geometric correction? **(5 marks)**
- b. What is your understanding of the following post-processing steps **(15 marks)**
 - Contrast stretching
 - Spatial filtering
 - Rationing

Q2. Why it is that overall, upland areas (such as plateaus, piedmonts, hill lands) have a better agreement with Landsat spectral data compared to lowland areas (such as valleys, dambos, depressions) **(10 marks)**

Q3. Image classification involves the grouping of image pixels into categories of different spectral radiometric classes. **(15 marks)**

- a. Distinguish between supervised and unsupervised classification?
- b. Which of the two types of classification named above would provide more accurate classification. Explain why?
- c. What are the advantages and disadvantages of supervised and unsupervised classification?

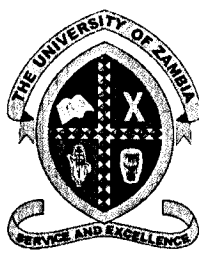
Q4. What are the main assumptions in remote sensing data acquisition and analysis for natural resources? **(15 marks)**

Q5. In image interpretation, a number of characteristics are used to identify remotely sensed objects. List these characteristics and briefly explain how they are useful in image recognition and interpretation **(10 marks)**

Q6. Remotely sensed data through the use of soil spectral reflectance has gained maximum application in soil survey.

- a. One of the key applications in remote sensing for soil mapping is the electromagnetic spectrum (EMS). Define and characterize the electromagnetic spectrum **(10 marks)**
- b. Different soil constituents and conditions have different effects on soil spectral reflectance. List these constituents/conditions and briefly explain how they affect soil reflectance **(10 marks)**
- c. One of the models used in atmospheric correction of images is the cost model. Discuss this model and explain its components **(10 marks)**

END OF EXAM



THE UNIVERSITY OF ZAMBIA
INSTITUTE OF DISTANCE EDUCATION

SEMESTER TWO DEFERRED EXAMINATIONS – OCTOBER 2019
AGS 6155 – LAND RECLAMATION AND RESTORATION

TIME ALLOWED: 3 HOURS

MARKS: 100 MARKS

INSTRUCTIONS: ANSWER ALL QUESTIONS

1. Answer the following questions [20 marks]
 - a. Define land restoration and land reclamation [3 marks]
 - b. What is the difference between land and soil [2 marks]
 - c. Discuss the importance of conducting soil analysis when determining suitability of land for vegetation or crop growth [4 marks]
 - d. Define soil flora and fauna [4 marks]
 - e. Giving specific examples, describe the importance of soil fauna in soil [5 marks]
 - f. List two factors that affect soil fauna (2 marks)

2. Degradation of natural ecosystems has become a big problem in Zambia. With knowledge gained from this course answer the following [20 marks]
 - a. Distinguish between pastures and rangelands [2 marks]
 - b. Describe the major **forms and causes** of degradation of (i) forests and (ii) national parks/game management areas, in Zambia [8 marks].
 - c. Describe practical measures you would propose to **prevent** and **manage** the degradation of forests and national parks//game management areas you described in (b) above [6 marks]
 - d. Describe the economic importance of forests to local communities [4]

3. There are two general concepts used in function-based land restoration namely; “Alleviation of Constraint by Changing their Severity” and “Alleviation of Constraints by Changing Characteristics of Use”. Answer the following questions [20 Marks]
 - a. Describe the main differences between the two approaches and mention characteristics or reasons that would make you adopt one approach over the other [6 marks]

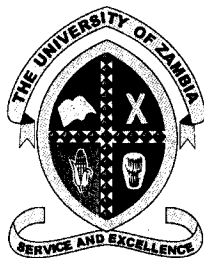
- b. Due to climate change and reduced rainfall, incidences of drought in Zambia have increased leading to crop failure and reduced incomes for smallholder farmers. Applying the principles of function-based land restoration give **three (3) recommendations**, with **justifications**, to the farmers how to cope with increased drought [6 marks]
- c. Distinguish between waterlogging and flooding [2 marks]
- d. Suggest two (2) options for utilization of wetlands for arable cropping [2 marks]
- e. Define de-vegetation and state two (2) measures to address de-vegetation. [4 marks]
4. Soil erosion is one of main forms of soil and land degradation. Answer the following [20 marks]
- a. Define soil erosion, and distinguish between water and wind erosion [3 marks]
- b. State and describe the factors that control/affect:
- i) Water erosion [3 marks]
- ii) Wind erosion [3 marks]
- c. With the aid of a diagram, describe how terraces are constructed and explain how they reduce soil erosion [6 marks]
- d. Define nutrient imbalance and mention 3 causes of nutrient imbalance [5]
5. Soil analysis of a soil from Mpika had the following results

pH	Ca ²⁺	Mg ²⁺	K ²⁺	Na ⁺	Al ³⁺	H ⁺	P
	Cmol (+)/kg soil						mg/kg
3.4	0.11	0.06	0.01	0.01	1.05	0.02	0.05

Answer the questions,, assuming a soil depth of 20cm and bulk density of 1500kg/m³ (molecular weight, Ca=40, K=39, H=1, O=16, N=14 and P=31) [20 marks]

- a. Calculate the CEC and aluminium saturation percent of this soil. [2 marks]
- b. Briefly describe the general importance of CEC in soil management [2 marks]
- c. Using the two different approaches learnt in this course, calculate the lime requirement of this soil (give your answer as number of 50 kg bags of lime). Assume lime with neutralizing value of 85% will be used by the farmer. [6 marks]
- d. Given that the amount of potassium and phosphorous recommended for optimum growth of beans is 20 kg K/ha and 30 kg P/ha, determine whether this soil has enough K and P. Show all your calculations [6 marks]
- e. Briefly explain why it is necessary to address soil acidity through liming and other methods [4 marks]

END OF EXAMINATION



THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS – AUGUST 2020

AGS 6235 - SOIL POLLUTION AND SOLID WASTE MANAGEMENT

TIME ALLOWED: 3 HOURS

TOTAL MARKS: 80

INSTRUCTIONS: ANSWER ALL QUESTIONS AND WRITE LEGIBLY

1. Write short answers to the following questions [30 marks]
 - a. Briefly define and explain the role of the fine earth fraction on the transportation of water-soluble contaminants to the ground water resources [4 marks].
 - b. With at least one example, state the three major categories of soil contaminants [6 marks].
 - c. List any 4 ways to avoid poisoning when applying chemicals using a Knapsack sprayer [4 marks].
 - d. Briefly describe how open defecation can accelerate the transmission of diseases caused by soil-transmitted helminths such as the hookworm [4 marks]
 - e. With at least one example differentiate between biodegradable and non-biodegradable solid waste [4 marks]
 - f. Define incineration and list any 3 disadvantages associated with it in solid waste management [4 marks]
 - g. Define open dumping and the pollution concerns associated with it [4 marks].

2. The closed lead mine in Kabwe town is an important source of lead contamination in the soil ecosystem in the vicinity of the mine [20 marks].
 - a. With examples, write brief notes on any three major ways that human beings get exposed to soil contaminants [12 marks].
 - b. Explain the effects of heavy metal contamination on plant growth [4 marks].
 - c. In what way can plants be used to minimize human exposure to heavy metals?
[4 marks].

3. A firm hires you as team leader in the management of municipal solid waste from your town. If composting has been chosen as a method of managing biodegradable solid waste **[20 marks]**:
- Explain in detail the different stages of making compost from municipal solid waste **[12 marks]**.
 - Explain the difference between passive and active composting **[4 marks]**.
 - Explain some of the difficulties that you may encounter in setting up your composting operations **[4 marks]**.
4. Mineral smelting involving heat treatment of the mineral ore resulting in the emission of sulphur-containing gases into the atmosphere contributes to the formation of acid rain. **[10 marks]**
- Define acid rain and name any two gases that can lead to the formation of acid rain **[4 marks]**.
 - Briefly explain the effects of acid rain on the solubility and potential leaching of heavy metals in the soil **[4 marks]**.
 - In what way can mineral processors minimise gaseous emissions into the atmosphere while at the same time increase efficiency in their operations **[2 marks]**

END OF EXAMINATION!



THE UNIVERSITY OF ZAMBIA

INSTITUTE OF DISTANCE EDUCATION

MASTER OF SCIENCE IN SUSTAINABLE LAND AND ENVIRONMENTAL
MANAGEMENT

AGS 6235 SOIL POLLUTION AND SOLID WASTE MANAGEMENT

INSTRUCTIONS:

Answer ALL Questions

Total marks: 90

Time Allowed: 3 Hours

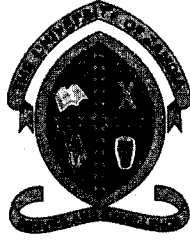
-
1. Soil pollution can be caused by the introduction of foreign chemicals in the natural soil environment. [15 marks].
 - a. Explain how agricultural practices contribute to soil pollution (10 marks).
 - b. Explain how soil contamination poses a serious health risk for human beings (5 marks).

 2. Solid-waste management is regarded as the collecting, treating, and disposing of solid material that is discarded because it has served its purpose or is no longer useful. [20 marks].
 - a. Discuss five different methods of solid waste management (10 marks).
 - b. Describe the importance of recycling and reusing solid waste material (6 marks).
 - c. Discuss the impact of improper solid waste disposal on animal and plant life (4 marks).

 3. The starting point to remediation of polluted soils is by understanding the type of pollutant in question [20 marks].
 - a. List five (5) broad categories of soil contaminants (5 marks).
 - b. Distinguish between *soil pollution* and *soil contamination* (5 marks).
 - c. Solid waste, especially plastic waste, is scattered everywhere in the environment. What is the effect of this waste on the environment (5 marks)?

- d. List two measures that can be implemented to combat the impact of plastic waste (2 marks).
 - e. List at least three effects of soil pollution that affect agricultural production (3 marks).
4. Soil pollution with heavy metals is common in the mining towns of Zambia. With specific examples: **[10 marks]**
- a. Name at least two commonly encountered heavy metals in polluted mining sites in Zambia? (2 marks)
 - b. Discuss the effects of soil acidity on the bioavailability and transport of the heavy metals named above (4 marks).
 - c. Discuss the effects of soil organic matter on the bioavailability and transport of the heavy metals named above (4 marks).
5. The use of partially treated sewage in vegetable growing is a common practice in some urban areas of Zambia **[14 marks]**
- a. With specific examples discuss three most common pollutants associated with partially treated sewage in irrigated vegetable crops? (6 marks)
 - b. What measures can vegetable growers using sewage water employ in order to minimize contamination of the vegetables with pathogens? (4 marks)
 - c. What measures can suspecting vegetable consumers use to minimize the ingestion of pathogens from contaminated vegetables? (4 marks)
6. A survey on the solid waste management practices in selected towns of Zambia revealed a wide number of challenges such as use of open trucks to transport solid waste and use of open dumpsites. **[11 marks]**
- a. What are the major pollution concerns that may come with the use of open trucks to transport solid waste? (2 marks)
 - b. What measure can be used to monitor ground water quality near open dumpsites? (3 marks)
 - c. What is the effect of soil texture on the transport of water soluble pollutants to the ground water? (6 marks)

End of Examination!



THE UNIVERSITY OF ZAMBIA

IDE DEFERRED EXAMINATIONS – APRIL 2021

AGS 6235 - SOIL POLLUTION AND SOLID WASTE MANAGEMENT

TIME ALLOWED: 3 HOURS

TOTAL MARKS: 100

INSTRUCTIONS: ANSWER ALL QUESTIONS AND WRITE LEGIBLY

1. The use of partially-treated wastewater in vegetable gardens is a common practice in some urban areas of Zambia [20 marks].
 - a. With specific examples discuss ANY three pollutants associated with wastewater? [6 marks]
 - b. What measures can vegetable growers using wastewater employ in order to minimize contamination of the vegetables with pathogens? [4 marks]
 - c. What measures can suspecting vegetable consumers use to minimize the ingestion of pathogens from contaminated vegetables? [4 marks]
 - d. Explain the possible effects of untreated wastewater on marine ecosystems [6 marks].

2. A survey on the solid waste management practices in selected towns of Zambia revealed a wide number of challenges such as use of open trucks to transport solid waste and use of unlined landfills. Discuss: [20 marks]
 - a. The major pollution concerns that may come with the use of open trucks to transport solid waste? [3 marks]
 - b. The effect of soil texture on the transport of water soluble pollutants to the ground water? [10 marks]
 - c. Measures that can be used to monitor ground water quality near unlined landfills? [3 marks]
 - d. The effect of a fluctuating ground water table on the transport of organic pollutants such as hydrocarbons that float on water in the soil [4 marks]?

3. A sound solid waste management system should consider management of waste from the point of generation to the disposal site **[20 marks]**.

- a. Discuss all the important aspects of solid waste collection, transportation and disposal [9 marks].
- b. Discuss composting as an option in solid waste management [11 marks]

4. Soil-transmitted helminths such as the hookworm are in the class of biological soil contaminants known as pathogens. **[20 marks]**.

- a. What are the three ways that the hookworm finds its way into the human body and the diseases associated with it? [6 marks].
- b. Explain how defecating in open places can accelerate the transmission of soil-borne pathogens such as the hookworm [5 marks].
- c. Discuss two enteric bacterial pathogens that are transmitted in a similar way as the hookworm and the diseases they cause [4 marks].
- d. What general hygienic and environmental management principles can you recommend to prevent diseases caused by soil-borne pathogens [5 marks]?

5. The old Bwana Mkubwa Copper Mine in Ndola town is an important source of copper contamination in the soil ecosystem in the vicinity of the mine.

[20 marks]

- a. List the three major ecological risks associated with soil pollution [3 marks]
- b. With examples, write brief notes on any three major ways that human beings get exposed to soil-borne contaminants [6 marks].
- c. Explain the effects of heavy metal contamination on plant growth [4 marks].
- d. Briefly explain the effect of soil organic matter on heavy-metal uptake by plants [3 marks]
- e. In what ways can plants be used to minimize human exposure to heavy metals? [4 marks].

END OF EXAMINATION!



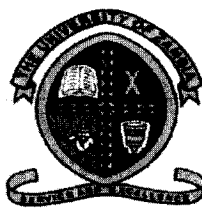
THE UNIVERSITY OF ZAMBIA
UNIVERSITY EXAMINATIONS - MARCH/APRIL 2023
AGS 6235 - SOIL POLLUTION AND SOLID WASTE MANAGEMENT

ANSWER ALL QUESTIONS AND WRITE LEGIBLY

DURATION: 3 HOURS

1. Using vivid examples briefly discuss the terms contamination and pollution. [10 marks]
2. Briefly discuss the influence of open defecation on soil and water contamination. [10 marks]
3. Using specific examples briefly explain the contribution of agricultural activities to soil and water contamination. [10 marks]
4. Briefly discuss soil and water contaminants associated with wastewater and explain ways in which crop contamination can be minimized when irrigating crops using wastewater. [10 marks]
5. Briefly discuss why the cholera disease is common in places where there are shallow wells coupled with poor sanitation. [10 marks]
6. Using vivid examples briefly discuss the difference between biodegradable and degradable waste. [10 marks]
7. Briefly discuss the term solid waste reduction and give examples of how this can be achieved at household level. [10 marks]
8. Briefly discuss some of the negative impacts of incineration as a method of managing solid waste on the soil environment. [10 marks]
9. Briefly discuss ways in which inappropriate solid waste disposal can lead to the pollution of ground water resources. [10 marks]
10. Briefly discuss the ways in which solid waste recycling can contribute to environmental pollution. [10 marks]

END OF EXAMINATION!



THE UNIVERSITY OF ZAMBIA
INSTITUTE OF DISTANCE EDUCATION
MASTER OF SCIENCE IN SUSTAINABLE LAND AND
ENVIRONMENTAL MANAGEMENT
SEMESTER 1 FINAL EXAMINATIONS
AGS 6245 PAPER 1- ENVIRONMENTAL BIOLOGY

13TH MARCH 2019

Time allowed: Three (3) HOURS

INSTRUCTIONS

1. ATTEMPT FIVE (5) QUESTIONS
2. QUESTION 1 AND 2 ARE COMPULSORY
3. ANSWER ANY OTHER THREE (3) QUESTIONS
4. THIS EXAMINATION CARRIES A TOTAL OF 100 MARKS

COMPULSORY QUESTIONS-ATTEMPT BOTH QUESTIONS

1. a. There are five (5) multiple choice questions with several possible choices. You must attempt ALL.

- I. Advanced treatment is generally used to treat waste water to
 - A. remove coarse solids
 - B. remove settleable solids
 - C. reduce BOD
 - D. remove additional objectionable substances
- II. Treatment of municipal water supplies is based upon
 - A. coagulation, filtration, chlorination
 - B. chlorination, filtration, coagulation
 - C. filtration, coagulation, chlorination
 - D. coagulation, chlorination, filtration
- III. What is an anaerobic digester?
 - A. New diet drink
 - B. Microbe that eats hazardous waste
 - C. Method to convert agricultural waste into a biogas
 - D. All of the above
- IV. Activated sludge contains large number of
 - A. bacteria
 - B. yeasts and molds
 - C. protozoa
 - D. all of these
- V. The magnitude of BOD of wastewater is related to
 - A. bacterial count
 - B. amount of organic material
 - C. amount of inorganic material
 - D. all of the above

1. b. Analyse the secondary and tertiary steps of wastewater treatment and the relevance of each step. [15]
 2. Explain the application of microbiology to environmental and molecular studies. [20]
-

ATTEMPT ANY THREE (3) QUESTIONS

3. Interactions among soil microorganisms can be neutral, positive or negative. Give a critical account of the negative microbial associations in the soil. [20]
4. Illustrate the structure and function of a typical bacterial cell as an example of a prokaryotic organism. [20]
5. Give an account of the growth phases of microorganisms in culture. [20]
6. Compare and contrast prokaryotic and eukaryotic cells [20]
7. Classify microorganisms based on the following;
 - a. their cell shapes and arrangements, [5]
 - b. energy source [5]
 - c. carbon source [5]
 - d. oxygen demand. [5]

END OF EXAMINATION



UNIVERSITY OF ZAMBIA

INSTITUTE OF DISTANCE EDUCATION

UNIVERSITY SEMESTER I EXAMINATIONS – AUGUST, 2020

AGS 6245 II: MICROBIOLOGY OF THE ENVIRONMENT

Instructions:

Answer all questions

Marks are indicated at the end of the question

Total marks: **100**

SECTION A

1. Define the following terms as used in environmental microbiology. **[20 Marks]**
 - a. Eukaryotes
 - b. Microbial ecology
 - c. Parasite
 - d. Binary fusion
 - e. Mitosis
 - f. Organelles
 - g. Microbiology
 - h. Prokaryotes
 - i. Symbiosis
 - j. Cytoplasm

SECTION B

1. Cells come in a variety of complexity. However, all living cells are classified as either Prokaryotes or eukaryotes based on their structural and functional characteristics?
 - a. Give three examples of eukaryotic cells and one example of prokaryotic cell?
[2 Marks]
 - b. Outline the difference and similarity between eukaryotic and prokaryotic cells based on structure and functionality. **[8 Marks]**

2. Microorganisms are found almost everywhere and soil is one habitat that microbes are found. Give four (4) soil properties that affect micro-organisms activity in the soil and explain how each soil property affects activity of micro-organisms? **[10 Marks]**
3. In the presence of conducive environments, microorganism can multiply and increase in population. Microbial growth experiments have been investigated to understand the different stages of growth. Describe in detail the **four** stages are microbial growth. **[10 Marks]**
4. Micro-organisms are classified using different criteria including how they conduct metabolic processes. Briefly describe the classification of micro-organisms in terms of Metabolism? **[10 Marks]**

SECTION C

1. Microbiology has various environmental uses one of which includes waste water treatment. This enables water to be reused for other economic activities. Explain in detail the process of waste water treatment as an application of microbiology **[10 Marks]**
2. Students of environmental micro-biology carried out a gram staining procedure on two samples, A and B. after viewing the two samples under a microscope, cell A was pink while cell B was purple.
 - a. What is the purpose of gram staining procedure? **[4 Marks]**
 - b. Which of the two cells is gram positive? **[1 Marks]**
 - c. Clearly explain why sample A was pink and sample B purple basing your answer on the **principle** behind the gram staining procedure? **[15 Marks]**
3. The nitrogen cycle is one of the important transformation processes of nitrogen from different organic forms to various inorganic forms in the soil for plant nutrition. Explain in detail how micro-organisms facilitate this process? **[10 Marks]**

END



THE UNIVERSITY OF ZAMBIA
INSTITUTE OF DISTANCE EDUCATION

DEFERRED/SUPPLEMENTARY EXAMINATION – AUGUST 2020
AGS 6245 – ENVIRONMENTAL CHEMISTRY AND BIOLOGY
PAPER TWO

TIME ALLOWED: 3 HOURS

MARKS: 100 MARKS

INSTRUCTIONS: ANSWER ALL QUESTIONS

Some useful information:

Atomic mass: C=12.0 g, N=14.0 g, H=1.0 g, S=32.1 g, O=16.0 g, Cl=35.4 g, Na=23.0 g, Ca=40.1 g, K=39.1 g

1. Briefly describe/explain the differences between the following: (15 marks)
 - a. Climate variability and climate change (3 marks)
 - b. Biosphere and Anthrosphere (3 marks)
 - c. Molarity and Normality (3 marks)
 - d. Compound and element (3 marks)
 - e. Point Source and non-point source pollution (3 marks)
2. Answer the following questions. (25 marks)
 - a. List any five roles the atmosphere plays in protecting life on earth. (5 marks)
 - b. Describe with the aid of a diagram the structure of the atmosphere. (10 marks)
 - c. Describe a simplified hydrological cycle (with the aid of a diagram) showing the movement and residence of water. (10 marks)
3. Answer the following questions. (35 marks)
 - a. Complete and balance the following chemical reactions. (15 marks)
 - i. $\text{H}_2\text{SO}_4 + \text{Na}_2\text{CO}_3$ (3 marks)
 - ii. $\text{CaO} + \text{H}_2\text{O}$ (3 marks)

- iii. $\text{Zn} + \text{HCl}$ (3 marks)
- iv. $\text{Al} + \text{HNO}_3$ (3 marks)
- v. $\text{SO}_2 + \text{H}_2\text{O}$ (3 marks)
- b. If 37.28 g of KCl is dissolved in 500 ml water, calculate the molarity of the KCl solution. (5 marks)
- c. How many grams per millilitre of NaOH are contained in 0.5 M NaOH solution? (5 marks)
- d. How many ml of 94% concentrated sulphuric acid (H_2SO_4) with density 1.83 g/cm^3 are required to prepare 1 L of a 0.1M solution? (show all your calculations). (10 marks)
4. The Greenhouse Effect is a natural phenomenon that is thought to be crucial for life survival on earth. (25 marks)
- a. Explain the greenhouse effect phenomenon (use a diagram to illustrate this effect). (10 marks)
- b. How is the greenhouse effect crucial for life survival on earth? (5 marks)
- c. Which gases are thought to contribute significantly to this effect? (4 marks)
- d. Describe two (2) ways of mitigating and two (2) ways of adapting to climate change and global warming. (6 marks)
-

END OF EXAMINATION

UNIVERSITY OF ZAMBIA
INSTITUTE OF DISTANCE EDUCATION

2019/20 ACADEMIC YEAR FINAL UNIVERSITY EXAMINATIONS

AGS 6645: *CLIMATE CHANGE IMPACTS AND RESPONSES*

TIME: Three hours

INSTRUCTIONS: Answer question 1 and any other three. ALL questions carry equal marks. The use of an approved calculator is allowed. Candidates are encouraged to use illustrations wherever appropriate.

1. There are many feedback mechanisms in the climate system that can either amplify ('+v feedback') or diminish ('-v feedback') the effects of climate change. Describe five (5) climate change feed-back mechanisms.
 2. Describe the primary components of the earth's climate system, processes and interactions and some aspects that may change.
 3. Write short explanatory notes on ALL of the following:
 - a. Climate adaptation measures in the agricultural sector in Zambia
 - b. Climate Smart Agriculture (CSA)
 - c. Natural factors of climate change
 - d. Climate mitigation strategies
 - e. Ring of fire
 4. Explain the impacts and vulnerabilities of Africa to climate change. Take into account the impacts (temperature, precipitation, extreme events), sector (Water, Health, Agriculture and food security, Terrestrial ecosystems) vulnerabilities and adaptive capacity.
 5. Describe weather, climate and the meteorological variables measured to determine the state of the atmosphere.
-

END OF EXAMINATION



UNIVERSITY OF ZAMBIA

INSTITUTE OF DISTANCE EDUCATION

UNIVERSITY SEMESTER I EXAMINATIONS – AUGUST, 2020

AGS 6245 II: MICROBIOLOGY OF THE ENVIRONMENT

Instructions:

Answer all questions

Marks are indicated at the end of the question

Total marks: **100**

SECTION A

1. Define the following terms as used in environmental microbiology. **[20 Marks]**
 - a. Eukaryotes
 - b. Microbial ecology
 - c. Parasite
 - d. Binary fusion
 - e. Mitosis
 - f. Organelles
 - g. Microbiology
 - h. Prokaryotes
 - i. Symbiosis
 - j. Cytoplasm

SECTION B

1. Cells come in a variety of complexity. However, all living cells are classified as either Prokaryotes or eukaryotes based on their structural and functional characteristics?
 - a. Give three examples of eukaryotic cells and one example of prokaryotic cell?
[2 Marks]
 - b. Outline the difference and similarity between eukaryotic and prokaryotic cells based on structure and functionality. **[8 Marks]**

2. Microorganisms are found almost everywhere and soil is one habitat that microbes are found. Give four (4) soil properties that affect micro-organisms activity in the soil and explain how each soil property affects activity of micro-organisms? **[10 Marks]**
3. In the presence of conducive environments, microorganism can multiply and increase in population. Microbial growth experiments have been investigated to understand the different stages of growth. Describe in detail the **four** stages are microbial growth. **[10 Marks]**
4. Micro-organisms are classified using different criteria including how they conduct metabolic processes. Briefly describe the classification of micro-organisms in terms of Metabolism? **[10 Marks]**

SECTION C

1. Microbiology has various environmental uses one of which includes waste water treatment. This enables water to be reused for other economic activities. Explain in detail the process of waste water treatment as an application of microbiology **[10 Marks]**
2. Students of environmental micro-biology carried out a gram staining procedure on two samples, A and B. after viewing the two samples under a microscope, cell A was pink while cell B was purple.
 - a. What is the purpose of gram staining procedure? **[4 Marks]**
 - b. Which of the two cells is gram positive? **[1 Marks]**
 - c. Clearly explain why sample A was pink and sample B purple basing your answer on the **principle** behind the gram staining procedure? **[15 Marks]**
3. The nitrogen cycle is one of the important transformation processes of nitrogen from different organic forms to various inorganic forms in the soil for plant nutrition. Explain in detail how micro-organisms facilitate this process? **[10 Marks]**

END



THE UNIVERSITY OF ZAMBIA
UNIVERSITY DEFERRED EXAMINATIONS – APRIL 2021

AGS 6645
CLIMATE CHANGE IMPACTS AND RESPONSES

TIME: 3 Hours

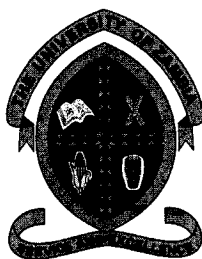
Marks: 100

INSTRUCTIONS: ANSWER ALL QUESTIONS AND WRITE LEGIBLY

1. a.) In the context of the international framework on climate-on-climate change, give the long form and significance of the following structures:
 - i. UNFCC [5 Marks]
 - ii. IPCC [5 Marks]
 - iii. COP [5 Marks]
- b.) briefly discuss or outline the mandate of the IPCC [10 Marks]
2. a.) Briefly outline how good water management practices can be linked to reduction of greenhouse gases (GHG) [8 Marks]
- b) Outline how good water management is key in to adaptation strategies? [10 Marks]
- c.) What are some of the negative implications of poor water management on adaptation to climate change? [10 Marks]

3. a.) Briefly outline how anthropogenic activities intensify climate change?
[8 Marks]
- b.) Briefly discuss the major sources of GHGS and the importance of greenhouse gases especially with regard to their negative impacts on the global climate system
[10 Marks]
4. Give an objective and professional evaluation of how you anticipate anthropogenic activities including the efforts of the IPCC, will influence the GHGs profile in the next few decades?
[10 Marks]
5. a.) What are the key attributes for describing?
- i. Weather **[5 Marks]**
 - ii. Climate **[5 Marks]**
- b.) Briefly describe what is meant by, 'Climate forcing mechanism' citing three examples?
[5 Marks]
- c.). List four of the greenhouse gases (GHG) that are associated with global warming?
[4 Marks]

END OF EXAMINATION



THE UNIVERSITY OF ZAMBIA

DEFERRED/SUPPLEMENTARY EXAMINATIONS – APRIL 2021

AGS 6245 - ENVIRONMENTAL CHEMISTRY AND BIOLOGY

INSTRUCTIONS

1. THIS PAPER HAS TWO SECTIONS- USE A SEPARATE ANSWER BOOK FOR EACH SECTION
2. THIS EXAMINATION CARRIES A TOTAL OF 100 MARKS
3. READ THE INSTRUCTIONS FOR EACH SECTION CAREFULLY

Molar mass of elements: O=16g, Na=23g, S=32g, N=14g, P=31g, Al=27g, H=1g, K=39g

SECTION A - ENVIRONMENTAL CHEMISTRY [50 MARKS]

ANSWER ALL QUESTIONS

1. State whether the following statements are **true (T)** or **false (F)**. [10 marks]
 - a. An atom has a net charge of zero because the positive charge from neutrons is equal to the negative charge from the electrons.
 - b. Of the earth's total water distribution, only 5 % is fresh water.
 - c. Global warming will lead to more of the coastal lands being submerged.
 - d. Pollution found in rivers that flow across large land areas is a non-point source pollution.
 - e. Degradation is one of the processes that may reduce the strength of a pollutant.
2. Answer the following questions. [20 marks]
 - a. Describe the five (5) segments of the environment. [8 marks]
 - b. Briefly discuss, with examples, how human activities influence the four (4) segments of the environment. [6 marks]
 - c. List any five (5) roles the atmosphere plays in protecting life on earth. [5 marks]
 - d. Briefly describe the tropopause. [1 marks]
3. Answer the following questions. [20 marks]

- a. Describe how you would prepare 10 L of 0.1 M Sulphuric acid from 98% concentrated hydrochloric acid. Take specific density to be 1.831 kg/l. (show all your calculation). [8 marks]
- b. Five (5) grams of NaOH is dissolved in a 500 ml volumetric flask. Calculate the molarity of the NaOH solution. [5 marks]
- c. Complete and balance the following chemical reactions. [4 marks]
 - i. $\text{Ca} + \text{H}_2\text{O}$
 - ii. $\text{H}_2\text{SO}_4 + \text{NaOH}$
 - iii. $\text{Na} + \text{HCl}$
 - iv. $\text{Al} + \text{O}_2$
- d. What is the difference between ionic bonding and covalent bonding? [3 marks]

SECTION B- ENVIRONMENTAL BIOLOGY [50 MARKS]

ANSWER ALL QUESTIONS

QUESTION 1: TRUE OR FALSE [10 MARKS]

1. Microorganisms are often placed into nutritional groups based on their ability to survive in the presence of oxygen [1 mark]
2. The stationary phase is sometimes absent the microbial growth curve [1 mark]
3. The log-phase of the microbial growth curve is also known as exponential phase because not all the daughter cells grow into new individual cells [1 mark]
4. Given that maximum growth rate during the exponential phase bacterial is 1.65 h^{-1} , the microbial population during 3 hours of this phase from an initial bacterial population of 10^2 cfu/ml will be $3.3 \times 10^2 \text{ cfu/ml}$. [1 mark]
5. Given that during the exponential phase of bacterial growth the population doubles every 28 minutes from an initial population of 10^2 cfu/ml , the number of generations after 2 hours and 20 minutes would be 7. [1 mark]
6. Microbial decomposition of dissolved organic matter during sewer treatment using septic tank systems is not affected by the texture of the soil [1mark]
7. *Escherichia coli* is commonly used as a proxy for faecal contamination of fresh water because is more numerous than other enteric bacteria [1 mark]
8. Chemical oxygen demand can be defined as the quantity of oxygen needed in the microbial breakdown of dissolved organic matter [1 mark]
9. Saprophytes are a sub-group of chemo heterotrophs [1 mark]
10. Photosynthetic bacterial can also be referred to as autotrophic bacteria [1 mark]

QUESTION 2

2. Briefly discuss the following topics on wastewater quality and treatment
- a. Any **TWO** indicators of the quality of waste water [4 marks]
 - b. The various stages of sewage treatment [12 marks]
 - a. Name the bacterium commonly used as an indicator for faecal contamination of ground water. What are some of the characteristics of an indicator organism? [4 marks]

QUESTION 3

3. Briefly discuss the various components of the bacterial growth curve and explain why bacteria are used to model microbial growth. [20 marks]

END OF EXAMINATION



THE UNIVERSITY OF ZAMBIA
UNIVERSITY EXAMINATIONS – MARCH 2023

AGS 6635
SOIL AND WATER CONSERVATION

TIME: 3 Hours

Marks: 100

INSTRUCTIONS: ANSWER ALL QUESTIONS AND WRITE LEGIBLY

1. a). Discuss the challenges of resource conservation in the agricultural sector in Zambia. [10 Marks]
b). Why is it necessary to undertake resource conservation? [10 Marks]
2. You are approached as a soil and water conservation expert by a large firm intending to start up a large-scale agricultural cropping and livestock enterprise. What would be your advice on the key features of a 'good conservation plan'? [20 Marks]
3. Indicate whether the statement is true or false for the questions. [15 Marks]
 - i. Gully erosion is more costly in preventing soil erosion than sheet erosion
 - ii. The texture of the soil can be changed through organic matter incorporation.
 - iii. The penetrometer can be used to determine the resistance the seed experiences during germination
 - iv. The crop management practice is a function of growth stage in controlling soil erosion
 - v. Climate change can contribute significantly to soil erosion
 - vi. Relief can affect the amount of solar radiation a crop intercepts and affects yield.
 - vii. Contouring can reduce soil loss significantly compared to contour strip cropping

- viii. Remote sensing and GIS can help understand the severity of soil erosion
 - ix. Drought can cause severe crop failure compared to soil nutrient imbalance
 - x. Salinization can increase the irrigation frequency of fields and cause farming to be expensive
 - xi. Quantitative survey works independently of the qualitative survey.
 - xii. Soil erosion tolerance level is a useful phenomenon in soil formation.
 - xiii. Yard paving can reduce floods at community catchment levels
 - xiv. Waterlogging and flooding are the same phenomenon
 - xv. Retention ditches are more effective and more costly in preventing soil erosion than terracing.
4. The table shows the monthly rainfall received in Siavonga District in the 2021/2022 season.

Months	1	2	3	4	5	6	7	8	9	10	11	12
Rainfall (mm)	100	70	60	3	-	-	-	-	-	-	100	90

- a. Calculate the annual rainfall received in Siavonga? [1 Marks]
- b. Given that the Town received 40% deficit of rainfall, what is the expected long term mean of rainfall? [2 Marks]
- c. State three crops you would recommend for such as area and stating the reason why? [2 Marks]
- d. Given that the amount of rainfall received in the month of January in Lusitu town of Siavonga District is 100 mm and that a 100 square foot house with slanted shingle roof, calculate the potential amount of water harvested in the month given the $e=0.9$ and $k=1000 \text{ lm}^{-2}$? [3 Marks]
- e. Given the rainfall totals in the table, estimate the potential amount of water that can be harvested during the season, given the $e=0.9$ and $k=1000 \text{ lm}^{-2}$. [5 Marks]
- f. Suggest how harvested water could be used in the town of Siavonga? [3 Marks]
- g. State four advantages of harvesting water from rainfall? [4 Marks]

5. Soil erosion is a threat to the sustainable environment management and ultimately food security. This land being proposed for crop production and house settlement has a length dimension of 500m with an erodibility of 0.3, the rainfall erosivity is 200, slope of 14% and assuming a bulk density 1.5ton/m³: (Refer to Figure 1 attached)
- Given that they are no crop management and erosion control processes being practiced, calculate the soil loss in tons/ha/year [2 marks]
 - Based on your answer in (a), calculate the depth of soil removed in cm by erosion per annum? [2 marks]
 - Given that the all area would be planted with velvet velvet bean with a crop management practice of 0.2 and that the erosion control practice is 0.5, calculate the soil loss tons/ha/year? [2 marks]
 - Given that the all area would be planted with maize which has a crop management practice of 0.5 and that the erosion control practice is 0.5, calculate the soil loss in tons/ha/year? [2 marks]
 - Based on c and d which option would reduce soil erosion significantly? [2 marks]
 - Given that soil losses of 17 t/ha/year causes crop loss of 8% annually, state whether they will be losses for velvet beans and maize give that the expected yield are 3 and 5 t/ha. [3 marks]
 - With the aid of a drawing, design 100 m terraces and calculate the soil that need to moved, given that the new slope is 10% and that 1m³=1.5ton. [10 marks]
 - Why is terracing applied as the last option in controlling soil erosion [2 marks]

Formulas

1. Water harvesting

$$V=A*A*K*e$$

V=Potential amount of rainfall harvested in litres

A= Monthly amount of rainfall receive in mm

k = 1000 l/m³,

e=0.9

2. Topographic estimation

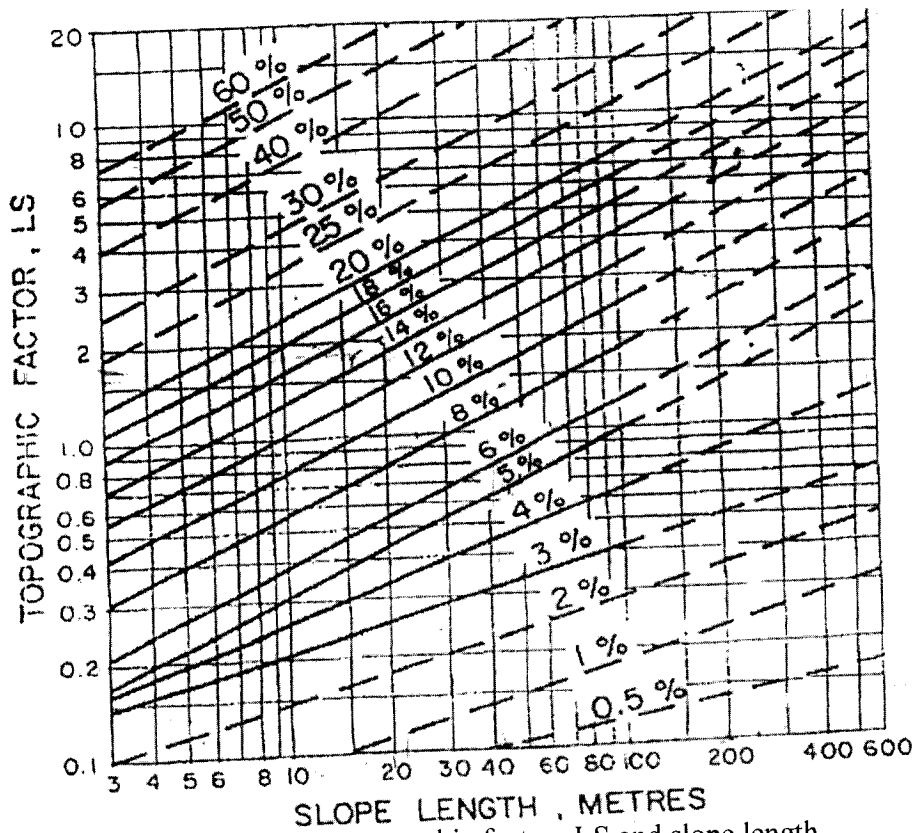


Figure 1: Relation between topographic factors LS and slope length

END OF EXAMINATION



THE UNIVERSITY OF ZAMBIA

INSTITUTE OF DISTANCE EDUCATION

MASTER OF SCIENCE IN SUSTAINABLE LAND AND ENVIRONMENTAL
MANAGEMENT

AGS 6655 WATERSHED MONITORING AND MANAGEMENT

INSTRUCTIONS:

Answer ALL Questions

Time: 3 Hours

1. A watershed is an area that drains into a water body such as a river, stream or lake, from which it derives its nomenclature, e.g. the Kafue River Watershed or catchment [25 marks].
 - a. What are the common land use activities in the Kafue River Watershed? (6 marks)
 - b. How do *mining* and *agricultural* activities affect the watershed? (10 marks)
 - c. How can you, as an Environmental expert, ensure that the watershed is not adversely affected by the activities in (b) above? (5 marks)
 - d. Deforestation is a major concern especially along the line of rail in Zambia. What strategies can be put in place to curb this act? (4 marks)

2. Watershed management involves understanding several aspects of the watershed, including the climatic and hydrological aspects. [25 marks].
 - a. List *any* five (5) climatic factors and name the instruments used to measure them. (10 marks)
 - b. What are the disadvantages of *manual collection* of weather data?(6 marks)
 - c. Apart from manual collection, what two (2) alternative ways can be used to collect climatic data? (4 marks)
 - d. Briefly state how an automated weather system operates. (5 marks)

3. One important component of watershed management is *land management*. Land management activities are determined by characteristics such as terrain, slope, formation, depth, texture, moisture, and infiltration rate and soil capability. **[25 marks]**.
- Why must one understand topography in watershed management? (10 marks).
 - Why is soil an important factor in land management (5 marks)
 - What are some measures that can be taken to prevent soil erosion in steep mountainous areas with arid soils? (5 marks)
 - Describe *briefly* how vegetation cover helps protect watersheds. (5 marks)
4. Water management, which includes water quality monitoring, is a key component of watershed management. Water quality monitoring is performed to determine the condition of the water bodies within the watershed. **[25 marks]**
- What parameters must be included in a water quality sampling event? (5 marks)
 - How does industrialization affect the water quality in a given watershed? (5 marks)
 - Explain how you can effectively manage wetlands. (5 marks)
 - Why do the dissolved oxygen and nitrates vary in a given watershed? Explain differences in terms of upstream and downstream locations (10 marks)



UNIVERSITY OF ZAMBIA

INSTITUTE OF DISTANCE EDUCATION

UNIVERSITY SEMESTER I SUPPLEMENTARY EXAMINATIONS

– APRIL 2021

AGS 6655: WATERSHED MANAGEMENT

Time: Three (3) Hours

Marks: 100

Instructions: Answer ALL Questions

1. Briefly define each of the following terms: **[25 marks]**
 - a) Watershed
 - b) Non-point pollution
 - c) Recharge wells
 - d) Aquifer
 - e) Hydrological response unit
2. Transboundary conflicts can arise in shared watersheds such as the Zambezi basin. State the measures in place to govern water use and manage conflicts in the said basin. **[10 marks]**
3. Monitoring the collection of water flow data should be designed to provide datasets suitable for data analysis procedures that will allow a project to meet specified objectives. Give possible range of objectives that can be achieved through these measurements **[15 marks]**
4. In understanding the watershed water budget, the water balance equation forms the basis for the analysis. With an illustration show the different components of the water balance equation. **[20 marks]**
5. How can you, with your knowledge of environmental management, ensure that the watershed is not adversely affected by the activities in (a) mining and (b) in agriculture? **[10 marks]**

6. Water governance is important in managing water resources in Zambia. Using the excerpt of the paper below answer the following questions on water governance and IWRM.

[20 marks]

Good water governance and IWRM in Zambia: challenges and chances

Thomas Uhlendahl, Pritam Saliab, Claudia Casarottoc and Jakob Doetschda

Corresponding author. Institute of Cultural Geography, University of Freiburg, Werthmannstraße 4, 79098 Freiburg, Germany. E-mail: thomas.uhlendahl@geographie.uni-freiburg.de

bICLEI European Secretariat, Team water. Leopoldring 3, 79098 Freiburg, Germany Centre for Development and Cooperation (NADEL), Swiss Federal Institute of Technology Zurich (ETHZ), Voltastrasse 24, 8092 Zurich, Switzerland Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Lusaka Office, Plot No. 6469 Kariba Road, Kalundu, Private Bag RW 37X, Lusaka, Zambia

Water Policy 13 (2011) 845–862

Abstract

The implementation of principles for water governance is widely accepted but challenging for the whole water sector of a developing country like Zambia, because of the legal and administrative changes and organizational requirements involved. In February 2010, a revised water policy for Zambia was approved by the Cabinet. The revised National Water Policy 2010 aims to improve water resources management by establishing institutional coordination and by defining roles as well as responsibilities for various ministries. Taking into account the previous political and administration changes, this paper points out the problems and challenges of the implementation of good water governance mechanisms in Zambia. Focusing on the Kafue River Basin, from which water is abstracted for a variety of conflicting purposes (like municipal supplies, industrial use, mining, irrigation of agricultural land, fishery activities, wetland reserves and hydropower production), the gaps in implementing good water governance and Integrated Water Resources Management (IWRM) in Zambia are identified, as well as the factors causing these gaps in the Zambian water sector. The paper finishes with an overview of the opportunities given by the new water policy through Water User Associations (WUAs) at a local level.

Keywords: Integrated water resources management; Kafue River; Water Governance.

- a. What is the full citation of this paper? [5 marks]
- b. How would you cite this paper in-text? [2 marks]
- c. What is the problem that is being investigated in this study? [2 mark]
- d. What was reason the authors identified the gaps in their paper? [3 marks]
- e. What is the main conclusion of the paper? [4 marks]
- f. What components are missing and would need to be included to improve the presentation of this abstract? What items are included in the abstract that would need to be removed? [4 marks]



UNIVERSITY OF ZAMBIA

INSTITUTE OF DISTANCE EDUCATION

UNIVERSITY SEMESTER I EXAMINATIONS – MARCH 2023

AGS 6655: WATERSHED MANAGEMENT

Time: Three (3) Hours

Marks: 100

Instructions: Answer ALL Questions

1. Briefly define each of the following terms: [25 marks]
 - a) Drainage basin
 - b) Riparian area
 - c) Ecological zones
 - d) Aquifer
 - e) Hydrological response unit
2. Several government and institutions have guiding principles and actions tabulated in a policy document. For Zambia, state the guiding principles in the Zambia water policy document. [12 marks]
3. Biological assessments (bio-assessments) are conducted at selected monitoring sites to determine the health of the benthic macro-invertebrate and fish communities for water bodies within the assessment area. Give possible components of a monitoring plan for conducting bio-assessments. [12 marks]
4. In understanding the watershed water budget, the water balance equation forms the basis for the analysis. With an illustration show the different components of the water balance equation. [19 marks]
5. How can you, with your knowledge of environmental management, ensure that the watershed is not adversely affected by the activities in (a) mining and (b) in agriculture? [10 marks]

6. Hydrological modeling is important in managing water resources at river basin level in Zambia. Using the excerpt of the paper below answer the following questions. [20 marks]

Model-based analysis of the influence of catchment properties on hydrologic partitioning across five mountain headwater sub-catchments

Authors: Christa Kelleher, Thorsten Wagener, and Brian McGlynn

Water Resources Research, Volume 51, Issue 6, Pages: 3837–4860, Published: June 2015

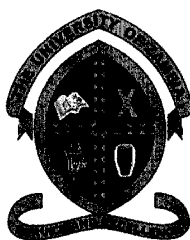
Abstract

Ungauged headwater basins are an abundant part of the river network, but dominant influences on headwater hydrologic response remain difficult to predict. To address this gap, we investigated the ability of a physically based watershed model (the Distributed Hydrology-Soil-Vegetation Model) to represent controls on metrics of hydrologic partitioning across five adjacent headwater sub-catchments. The five study sub-catchments, located in Tenderfoot Creek Experimental Forest in central Montana, have similar climate but variable topography and vegetation distribution. This facilitated a comparative hydrology approach to interpret how parameters that influence partitioning, detected via global sensitivity analysis, differ across catchments. Model parameters were constrained a priori using existing regional information and expert knowledge. Influential parameters were compared to perceptions of catchment functioning and its variability across sub-catchments. Despite between-catchment differences in topography and vegetation, hydrologic partitioning across all metrics and all sub-catchments was sensitive to a similar subset of snow, vegetation, and soil parameters. Results also highlighted one sub-catchment with low certainty in parameter sensitivity, indicating that the model poorly represented some complexities in this sub-catchment likely because an important process is missing or poorly characterized in the mechanistic model. For use in other basins, this method can assess parameter sensitivities as a function of the specific ungauged system to which it is applied. Overall, this approach can be employed to identify dominant modeled controls on catchment response and their agreement with system understanding.

Keywords: headwater; water basin; mechanistic model, watershed.

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- a. What is the full citation of this paper? [3 marks]
- b. How would you cite this paper in text? [3 marks]
- c. What is the problem that is being investigated in this study? [2 mark]
- d. What was reason the authors identified the gaps in their paper? [2 marks]
- e. What components are missing and would need to be included to improve the presentation of this abstract? [2 marks]
- f. What items are included in the abstract that would need to be removed? [2 marks]
- g. List three main key findings of the paper [6 marks]



THE UNIVERSITY OF ZAMBIA
INSTITUTE OF DISTANCE EDUCATION

DEFERRED/SUPPLEMENTARY EXAMINATION – AUGUST 2020
AGS 6735 – SOILS AND ENVIRONMENT

TIME ALLOWED: 3 HOURS

MARKS: 100 MARKS

INSTRUCTIONS: ANSWER ALL QUESTIONS

Some useful information:

Molecular weights; Ca = 40 g, O =16, C =12, Mg = 24, K=39

- 1) Soils play an important role in the environment and are essential for life of several organisms. **[25 marks]**
- a) List five (5) functions of soils. [5 marks]
 - b) Parent material is one of the soil forming factors. Define parent material and explain how it influences soil quality. [6 marks]
 - c) Define primary and secondary minerals. [4 marks]
 - d) List 4 major components of the soil and state the importance of each component. [8 marks]
 - e) Define weathering [2 marks]
- 2) Answer the following questions **[25 marks]**
- a) Describe problems associated with high sodium (Na^+) concentration in soils and explain possible ways of addressing the mentioned problems. [6 marks]
 - b) i) Define soil salinity [1 mark]
ii) List 3 causes of soil salinity [3 marks]
iii) List 3 ways of managing soil salinity [3 marks]
 - c) Explain how a soil's cation exchange capacity (CEC) is important for soil fertility and list two (2) ways you can improve CEC [7 marks]
 - d) Using two (2) examples, describe the importance of bacteria in soils [5 marks]

3) Plants require different nutrients for their growth. Answer the following questions. **[25 marks]**

- a) What is the difference between micro and macro-nutrients [3 marks]
- b) Despite nitrogen (N) making up 78% of the air, it is often one of the most limiting elements/nutrient for plant growth. Explain why this is the case? [5 marks]
- c) Mention any 2 ways we can improve soil fertility without using chemical fertilizers. [4 marks]
- d) Farmers can minimize the negative effects of fertilizers by applying the “3R” principles of fertilizer application. What are the “3R” principles and how do they help minimize negative effects of fertilization? [8 marks]
- e) A wet soil was collected in a core-ring with a volume of 50 cm³ and together weighed 50g. After oven drying the weight reduced 30g. If the weight of the core-ring is 15g, calculate the volumetric soil moisture content. [5 marks]

4) Answer the following. **[25 Marks]**

- a) A wet soil was obtained from the field and weighed. The mass of the wet soil was found to be 30 g. After oven drying, the mass of the soil reduced to 27 g. [7.5 marks]
 - i. Calculate the gravimetric moisture content of this soil.
 - ii. If the soil has a bulk density of 1.3 g/cm³, calculate the volumetric moisture content of the soil.
 - iii. Assuming particle density of 2.5 g/cm³, calculate the porosity
- b) Given a soil with the following chemical properties, calculate how many 50 kg bags of lime that has an effective neutralizing value of 85 % are required to raise the pH of the top 20 cm of one lima (0.25 hectares) of this soil to pH 7? [10 marks]

Depth (cm)	CEC	Ca ²⁺	Mg ²⁺	Na ⁺	K ⁺	H ⁺	Al ³⁺	Pb	pH
	pH 7	(-----meq/100g soil-----)					g/cm ³	0.01M CaCl ₂	
0-20	4.0	0.2	0.4	0.0	0.2	0.1	0.3	1.4	4.5

- c) List three (3) causes of soil acidity and give two (2) reasons why soil acidity affects soil quality. [7.5]

END OF EXAMINATION

**THE UNIVERSITY OF ZAMBIA
INSTITUTE OF DISTANCE EDUCATION
MASTER OF SCIENCE IN SUSTAINABLE LAND AND ENVIRONMENTAL
MANAGEMENT**

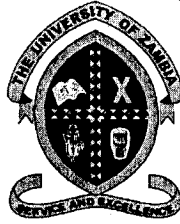
AGS 6825 DEFERRED FINAL EXAM 2019

DATE: 16TH OCTOBER 2019, TIME: 14:00 HOURS – 17:00 HOURS

INSTRCUTIONS: Answer all questions

1. Briefly explain the roles each of the following institution plays in Environmental Management Policy process (30 marks);
 - a. The Ministry of Lands, Natural Resources and Environmental Protection (MLNREP)
 - b. The Zambia Environmental Management Agency (ZEMA)
 - c. The Ministry of Agriculture and Livestock (MAL)
 - d. The Ministry of Local Government and Housing
 - e. The Ministry of Mines, Energy and Water Development
 - f. The Ministry of Tourism and Arts
 - g. The Ministry of Transport, Works and Supply and Communication
 - h. The Ministry of Finance (MoF)
 - i. The Disaster Management and Mitigation Unit (DMMU)
 - j. The Zambia Meteorological Department (ZMD)
 - k. Cooperating Partners/Donors:
 - l. Civil Society Organizations:
 - m. Private sector:
 - n. Research institutions
 - o. Traditional Leaders
2. Environmental Policy analysis consists of the evaluation of government decisions to change the behaviour of actors through a suitable environment management policy framework. Briefly discuss the 4 Components of an Environmental Policy Framework giving suitable examples (20 marks).
 - a. Objectives
 - b. Constraints
 - c. Policies
 - d. Strategies
3. Degradation and unsustainable management of natural resources are the worst culprits that erode the value of natural resources in Zambia. Discuss the threats to the environment caused by the following human activities (20 marks):
 - a. Unsustainable Agricultural Practices
 - b. Mining Operations
 - c. Charcoal and Wood fuel use
 - d. Poaching and illegal fishing
 - e. Poor Governance
4. An environmental management policy is a government's chosen course of action or plan to address issues such as pollution, wildlife protection, land use, energy production and use, waste generation, and waste disposal. Discuss the advantages and disadvantages of implementing Market-Based policy instruments (MBIs) to pollution control in Zambia (20 marks).

5. The agricultural sector impacts the environment negatively through farmers' production practices. The impact of such activities can effectively be identified through specific *Agriculture Based Environmental Impact* indicators which include the *Means-based indicators* and *Effect-based indicators*. Using relevant examples discuss the above two indicators (10 marks).



THE UNIVERSITY OF ZAMBIA
INSTITUTE OF DISTANCE EDUCATION
MASTER OF SCIENCE IN SUSTAINABLE LAND AND ENVIRONMENTAL
MANAGEMENT
AGS 6825 FINAL EXAM 2022

DATE: 5TH SEPTEMBER 2022, TIME: 09:00 HOURS – 12:00 HOURS

INSTRUCTIONS: Answer all questions

Question 1

Select or pick the correct answer (5 Marks for each question)

- I. Environmental resources are
 - a. the gross production value of the world's goods and services
 - b. the maintenance of the productivity of natural, produced, and human assets to the next generation
 - c. resources provided by nature that cannot be allocated unit by unit
 - d. the total amount of solar energy converted into biochemical energy through plant photosynthesis

- II. Which of the following are reasons why conventional microeconomic principles cannot be used to study the allocation of environmental and natural resources?
 - a. conventional economics is static, generally neglecting future implications of investment decisions
 - b. environmental and natural resources are often public goods, not subject to the exclusion principle
 - c. many decisions about environmental and natural resources are irreversible
 - d. all of the above
 - e. none of the above

- III. Sustainable development means maximizing
 - a. economic growth
 - b. income inequality
 - c. the productivity of produced assets
 - d. none of the above

- IV. What would happen to the market for petrol, with the passage of a tax proportional to carbon emissions?
 - a. price would decrease and quantity demanded would fall
 - b. price would decrease and quantity demanded would rise

- c. price would increase and quantity demanded would fall
- d. price would increase and quantity demanded would rise
- e. price would not be affected

Question 2

Discuss in details, the policy formulation cycle (20 marks).

Question 3

Identify **the key stakeholders** and **discuss their roles**, in the Environmental Policy Formulation process in Zambia (20 marks).

Question 4

Environmental Policy analysis consists of the evaluation of government decisions to change this behaviour. Briefly discuss the four (4) Components of a Policy Framework (20 Marks).

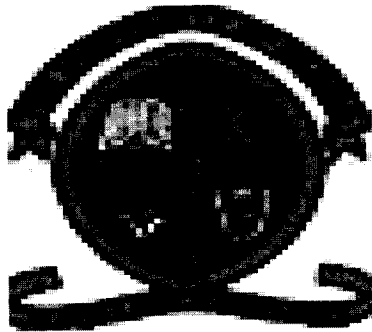
- a. Objectives
- b. Constraints
- c. Policies
- d. Strategies

Question 5

Degradation and unsustainable management of natural resources are the worst culprits that erode the value of natural resources in Zambia. Discuss the **key threats** to the environment caused by following human activities: (20 Marks)

- a. Unsustainable Agricultural Practices
- b. Mining Operations
- c. Charcoal and Wood fuel use
- d. Poaching and illegal fishing (illegal Off-takes)
- e. Poor Governance

GOOD LUCK



**The University of Zambia,
School of Agricultural Sciences
Dept of Soil Science**

IDE SUPPLEMENTARY EXAMINATIONS- OCTOBER 2019

AGS 6835: ENVIRONMENTAL RISK MANAGEMENT

**Time: 3:00 hours
Instruction: Answer all questions**

Total marks: 100

Q1. In your own words, explain the meaning of Sustainable development in relation to human activities and natural resources **(10 marks)**

Q2. Several human activities have resulted into many environmental hazards. Give examples of these hazards and explain how they are caused by human activities **(20 marks)**

Q3. Discuss the three main elements of an environmental impact assessment (EIA) **(15 marks)**

Q4. The environmental impact assessment process (EIA) has a number of steps. What are these steps? State the importance of each one of them **(20 marks)**

Q5. List the four (4) spheres of the earth and discuss the interactions among them **(10 marks)**

Q6. What are the differences between environmental impact assessment (EIA) and Strategic Environmental Assessment (SEA) **(10 marks)**

Q7. Discuss the components of the biophysical and socio-economic environment and explain why an environmental impact assessment (EIA) should consider impacts on both the biophysical and socio-economic components of the environment **(15 marks)**

END OF EXAM

THE UNIVERSITY OF ZAMBIA

INSTITUTE OF DISTANCE EDUCATION

Master of Science in Sustainable Land and Environmental Management

Environmental Risk Assessment (AGS 6835)

EXAM QUESTIONS

Total marks 100

This exam has an ANNEX attached

Answer all questions

1. Assuming you are an officer at ZEMA talking to a developer that does not see the reason for carrying out an environmental impact assessment. The developer's project has been identified to have potentially high negative impacts. List five (5) reasons that you would use to convince the developer to carry out an EIA. [5 marks]

2. List three (3) main things achieved by environmental impact assessments. [3 marks]

3. Scientists are concerned about the threatened extinction of several coffee varieties. Their concern arises from the negative effects that climate change is expected to have on coffee production. The negative effects threaten to bring about the extinction of the two main wild coffee varieties, *Coffee Arabica* and *Coffee robusta*.
 - a. Should coffee researchers be concerned about the extinction of 'wild coffee varieties'? Explain why or why not. [3 marks]
 - b. The threatened extinction of wild coffee varieties is of great concern to coffee farmers and also to coffee lovers across the world. What measures can be taken to preserve the wild coffee varieties for future generations? [2 marks]
 - c. Most crop producing areas (e.g. coffee growing areas, banana growing areas) are expected to reduce in size due to rising temperatures and decreasing rainfall amounts.

Explain how these impacts of climate change reduce 'crop producing areas' (or crop growing zones)? Be concise in your explanation. [3 marks]

d. How does climate change negatively impact communities depending on crop production in the tropics? List five (5) ways. [5 marks]

4. An American investor plans to setup a 900 ha soy bean plantation in Zambia's Southern province. A site has already been selected. The investor will need the land for 50 years. The site is currently occupied by rural poor communities that depend on subsistence farming. The local people also practise fishing in the streams located in this area. The land is still largely forested and undisturbed and is rich in native flora and fauna. The local people occupying the selected site also depend on the forest for firewood and other forest products. The site also has two small hospitals that provide health services to the local people. The farming to be carried out by the investor will be intensive, with a large dependence on chemical fertilisers and herbicides that have not been used in the country. Machinery will be used for cultivation and harvesting and for other farm operations. Only a limited number of farm labourers will be needed as most activities will be mechanised. Aerial spraying will be used for pesticide application and an airstrip of about 2,000 m will be constructed for this purpose. Water will also be used for irrigation and two reservoirs each 30 ha in size are planned to be built at two different points on the plantation. The plantation will also have five large ventilated silos where the soy bean will be stored after being harvested. The harvested soya beans will be chemically treated during storage.

a. What characteristics make the soy beans project to require a project brief or an Environmental impact statement? You can refer to the schedules provided (Annex 1). *Please note that the project characteristics listed in both schedules are numbered. Hence, only write down the number in front of each characteristic (e.g. 1f, 24c, 57d...) you select and not the entire sentence. Your answers can come from any of the two schedules.* [10 marks]

b. What characteristics of the soy bean project pose potential negative impacts to either the social or biophysical environment but have not been included in either the First or Second schedules? Kindly list them down. [5 marks]

c. In the right order, list down the key activities that will be involved at each stage of the project development life cycle of the soy beans project. In your answer, mention the

project development stage and at least one activity that will occur at each stage. [10 marks]

- d. List five (5) negative impacts that the soy bean production project may have on the biophysical environment? Impacts arising from both primary and secondary causes should be listed. [5 marks]
 - e. How can the negative impacts to the biophysical environment that you have listed in (4d) be mitigated? [5 marks]
 - f. What should be monitored to ensure that the negative impacts that you have listed in (4d) are not occurring? [5 marks]
 - g. What negative impacts do you expect to occur to the social environment as a result of the soy beans project? [5 marks]
 - h. How can the negative impacts to the social environment that you have listed in (4g) be mitigated? [5 marks]
5. You are a land management expert on an Environmental impact assessment study team. You are currently assessing alternatives involving the change of location for a maize plantation project. You are aware of the land suitability requirements for maize production. As a team, you have decided to use the matrix method to help you visualise your options amongst the three sites which are all located in Zambia's agro-ecological region II. The developed matrix is shown below in Fig 1, all data plotted on the graph was obtained from Table 1.

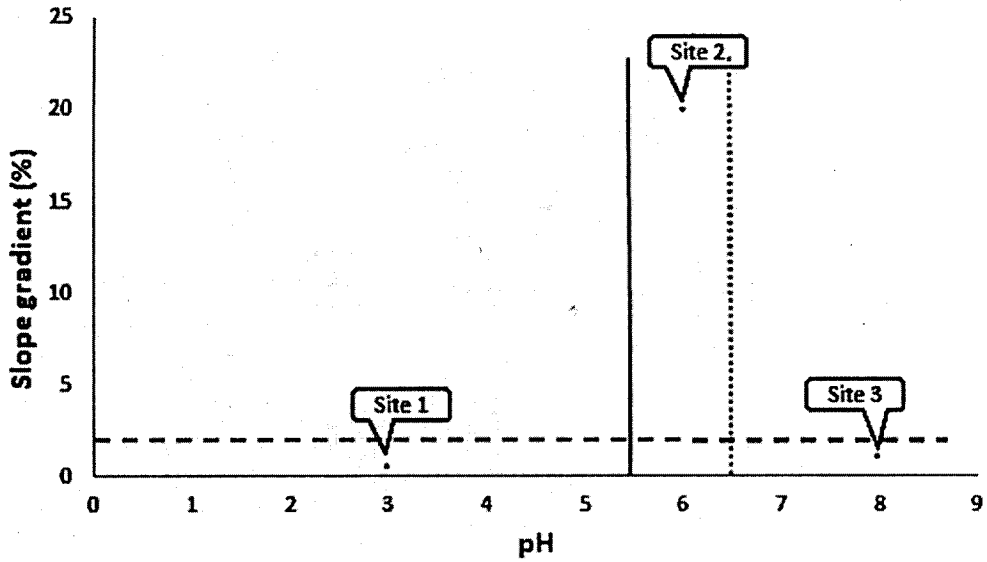


Figure 1

Table 1

Location	pH	Slope gradient (%)
Site 1	3	0.5
Site 2	6	20
Site 3	8	1

- a. Which site location will you opt to select amongst the three available sites? [1 mark]
- b. Give reasons for selecting the site you have you have opted for, explaining the advantages it has over the sites you have left. [6 marks]

6. What is the the difference between an Environmental Impact Assessment and a Strategic Environmental Impact Assessment? [2 marks]

7. What is the difference between a project and a program? [6 marks]

8. Describe and give one example (it can be fictional or real) of the following:
- a. A policy [2 mark]
 - b. A plan [2 mark]
9. The words or statements listed below fit into three (3) separate sentences which describe some form of impact corrective action for damage made to the land. Group the words into three (3) groups. Words belonging to the same sentence, according to your thinking, must be placed together. [10 marks]
- largely degraded
 - mitigation
 - repair measures
 - regeneration
 - restoration
 - moderately degraded
 - rehabilitation
 - corrective action
 - slightly degraded
 - preventive measures

End of exam.

FIRST SCHEDULE

(Regulation 3(2))

PROJECTS WHICH REQUIRE PROJECT BRIEFS

1. Urban Development

- a) Designation of new townships which are more than 5 ha or more or sites covering 700 dwellings and above.
- b) Establishment of industrial estates.
- c) Establishment or expansion of recreational areas such as golf courses, which would attract 200 or more vehicles.
- d) Shopping centres and complexes-10,000 m² and above, floor area.

2. Transportation

- a) All major roads outside urban areas, the construction of new roads and major improvements over 10 km in length or over 5 km in length if the road passes through a national park or Game Management Area.
- b) Railway lines: 10 km from built up area.
- c) Airport and airfields: runway 1,800 m or more.
- d) Pipelines: for water, diameter 0.5 m and above and length 10 km outside built up area, for oil 15 km or more of which 5 km or more of their length will be situated in a protected area, a seriously polluted or a water abstraction area.
- e) Establishment or expansion of harbours or pontoon areas.

3. Dams, Rivers and Water Resources

- a) Dams and barrages: covering a total of 25 ha or more.
- b) Exploration for, and use of, ground water resources including production of geothermal energy: water to be extracted to be more than 2 million cumsec m³/s.
- c) Water supply-reservoir surface area 50 m² or more.

4. Mining: Including Quarrying and Open-Cast Extraction

- a) Copper mining, coal site.
- b) Limestone, sand, dolomite, phosphate and clay extraction's of 2 ha or more.
- c) Precious metals (silver, zinc, cobalt, nickel).

- d) Industrial metals.
- e) Gemstones
- f) Radioactive metals.

5. Forestry Related Activities

- a) Clearance of forestry in sensitive areas such as watershed areas or for industrial use 50 ha or more.
- b) Reforestation and afforestation.
- c) Wood processing plants - 1,000 tonnes or more.

6. Agriculture

- a) Land clearance for large scale agriculture.
- b) Introduction and use of agrochemicals new to Zambia.
- c) Introduction of new crops and animals especially exotic ones new to Zambia.
- d) Irrigation schemes covering an area of 50 ha or more.
- e) Fish farms-production of 100 tonnes or more a year.
- f) Aerial and ground spraying - industrial scale.

7. Processing and Manufacturing Industry

- a) Cement works and lime processing - 1,000 tonnes or more a year.
- b) Fertilizer manufacturing or processing - 1,000 tonnes or more a year.
- c) Tanning and dressing of hides and skins - 1,000 skins a week.
- d) Abattoirs and meat processing plants - 20,000 carcasses and above a month.
- e) Fish processing plant-more than 100 tonnes a year.
- f) Pulp and paper mills-daily output 50 air dried tonnes and above a day.
- g) Food processing plants - 400 tonnes or more output a year.

8. Electrical Infrastructure

- a) Electricity generation stations.
- b) Electrical transmission lines - 220 kV and more than 1 km long.
- c) Surface roads for electrical and transmission lines for more than 1 km long.

9. Waste Disposal

- a) Sites for solid disposal: construction of permanent disposal site with 1,000 tonnes and above a day.
- b) Sites for hazardous disposal 100 tonnes or more a year.
- c) Sewage disposal works - with capacity of 15,000 litres or more a day.

10. Nature Conservation Areas

- a) Creation of national parks, game management areas and buffer zones.
- b) Commercial exploitation of natural fauna and flora.
- c) Introduction of alien species of flora and fauna to local ecosystems.

SECOND SCHEDULE

(Regulation 7(2))

PROJECTS WHICH REQUIRE ENVIRONMENTAL IMPACT ASSESSMENT

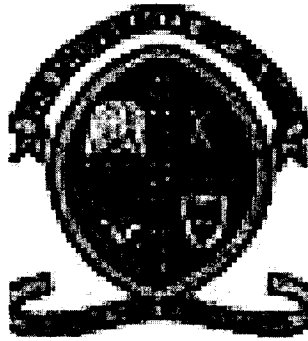
11. Projects

- a) Urban area rehabilitation.
- b) Water transport.
- c) Flood control schemes.
- d) Exploration for, and production of, hydrocarbons including refining and transport.
- e) Timber harvesting and processing in forestry.
- f) Land consolidation schemes.
- g) Mining, and mineral processing, reduction of ores, minerals, cement and lime kilns.
- h) Smelting and refining of ores and minerals.
- i) Foundries.
- j) Brick and earthen manufacture.
- k) Glass works.
- l) Breweries and malting plants.
- m) Plants for the manufacture of coal briquettes.
- n) Pumped storage schemes.
- o) Bulk grain processing plants.

- p) Hydro power schemes and electrification.
- q) Chemical processing and manufacturing.

12. Others

- a) Resettlement schemes.
- b) Storage of hydrocarbons
- c) Hospitals, clinics and health centres.
- d) Cemetery designation.
- e) Tourism and recreational development in national parks or similar reserves.
- f) Projects located in or near environmental sensitive areas such as-
 - i. indigenous forests;
 - ii. wetlands;
 - iii. zones of high biological diversity;
 - iv. areas supporting populations of rare and endangered species;
 - v. zones prone to erosion or desertification;
 - vi. areas of historical and archaeological interest;
 - vii. areas of cultural or religious significance;
 - viii. areas used extensively for recreation and aesthetic reasons;
 - ix. areas prone to flooding and natural hazards;
 - x. water catchments containing major sources for public, industrial or agricultural uses; and
 - xi. areas of human settlements (particularly those with schools and hospitals).



**The University of Zambia,
School of Agricultural Sciences
Dept of Soil Science**

AGS 6835: ENVIRONMENTAL RISK MANAGEMENT

IDE EXAMINATIONS- SEPTEMBER 2022

Time: 3:00 hours

Instruction: Answer all questions

Total marks: 100

1. What is your interpretation of sustainable development in the context of environmental risk management **(10 marks)**?
2. Some human activities have resulted into many environmental hazards. Name at least 10 such hazards and indicate briefly how each one of them is caused by human activity **(20 marks)**
3. Briefly discuss the three main elements of an environmental impact assessment (EIA) **(15 marks)**
4. Describe the relationship between an environmental impact assessment (EIA) and a Social impact assessment (SIA) **(10 marks)**
5. Name the steps of the environmental impact assessment process (EIA) and state the importance of each one of them **(10 marks)**
6. Discuss the components of the biophysical and socioeconomic environment and explain why an environmental impact assessment (EIA) should consider impacts on both biophysical and socioeconomic components of the environment **(15 marks)**
7. According to Brownlie and Treweek (2018), what are the functions or services provided by biodiversity and ecological processes? **(10 marks)**
8. In your own understanding, compare and contrast between environmental impact assessment (EIA) and strategic environmental assessment (SEA)? **(20 marks)**