UNIVERSITY OF ESWATINI

DEPARTMENT OF GEOGRAPHY, ENVIRONMENTAL SCIENCE AND PLANNING

MAIN EXAMINATION-DECEMBER 2019

B.A., BASS, B.Ed. & B.Sc.

TITLE OF PAPER: HAZARDS, RISKS AND VULNERABILITY ANALYSES

COURSE CODE: GEP419

TIME ALLOWED: THREE (3) HOURS

INSTRUCTIONS:
1. ANSWER THREE (3) QUESTIONS
2. QUESTION 1 IS COMPULSORY
3. ANSWER ANY TWO QUESTIONS FROM SECTION B
4. WHERE APPROPRIATE, ILLUSTRATE YOUR ANSWER WITH DIAGRAMS AND EXAMPLES

MARKS ALLOCATION: QUESTION ONE (1) CARRIES 40 MARKS. THE REST OF THE QUESTIONS CARRY 30 MARKS EACH.

THIS QUESTION PAPER SHOULD NOT BE OPENED UNTIL PERMISSION HAS BEEN GRANTED BY THE INVIGILATOR

GEP419: HAZARDS, RISKS AND VULNERABILITY ANALYSES – DECEMBER 2019

SECTION A: COMPULSORY

QUESTION 1

a) Draw a graph showing that the probability of damage or death (P_d) is a function of location of the adverse event and distance of the receptor. (5 marks)

b) An oil supply pipe passing through a nearby community well had been leaking for two weeks at a velocity of 2.3 m/s.

i) Calculate the amount of oil that flows through the hole in the pipe with a constant pressure if the diameter of the hole is 2 inches. (6 marks)

ii) How much volume of oil would have spilled into the environment after 2 weeks? (4 marks)

iii) What determines if a liquified gas stored in a pressurised tank would be released either as a gas plume or as an evaporating liquid pool. (4 marks)

c) Discuss the circumstances under which you would consider conducting a Hazard and Operability study (HAZOP). (8 marks)

d) Calculate the lifetime average daily dose (LADD) in mg/kg-d that an adult male receives from drinking water from a polluted community well which contains 35 μg/L of acid contaminants. Assume the man is exposed for 65 years, and drinks 2 L/day of water, 7 days/week, 48 weeks per year (because every year he takes vacation for 4 weeks) and he weighs 84 kg. Also assume 81% of the acid is absorbed into his body each time he drinks the contaminated water. (8 marks)

i) Show that the above calculated risk is either acceptable or too high and likely to result in cancer for the adult male. (5 marks)

(40 Marks)

SECTION B: ANSWER ANY TWO QUESTIONS

QUESTION 2

a) Why is environmental risk assessment of chemicals important for environmental management? (5 marks)

b) Explain the following:

i) Permissible exposures (3 marks)

ii) Biological effect (3 marks)

iii) Adverse effect (3 marks)

c) Discuss the relationship between exposure and dose in the study of carcinogens. (8 marks)

d) Using examples describe the fault tree hazard analyses approach. (8 marks)

(30 Marks)

QUESTION 3

a) Describe the different types of vulnerability and explain why some communities are more prone to the adverse effects of disasters compared to others. (15 marks)

b) Explain the difference between a quantitative risk assessment and a qualitative risk assessment. (15 marks)

(30 Marks)

QUESTION 4

Critically discuss the complexities of crises and disaster management systems in urban areas.

(30 Marks)

QUESTION 5

Using examples, discuss the steps involved in an environmental risk assessment and explain the goals or purpose of each identified step. **(30 Marks)**

Appendix 1

Formulae

Release of Liquids or Gases from Containment

Mass discharge of a liquid [kg/s] through a hole can be calculated:

$$m(kg/s) = C_d A \quad v(m/s)$$

where

$$v(m/s) = \sqrt{2 \frac{P \quad P_a}{} + gh \div}$$

C_d – discharge coefficient (dimensionless – 0.6)
A – area of the hole (m^2)
ρ – liquid density (kg/m^3)
P - Liquid storage pressure (N/m^2)
P_a – ambient pressure (N/m^2)
g – gravitational constant (9.81 m/s^2)
h – liquid height above the hole (m)

Step 1: Collect Measurements of the Pipe

- Obtain measurements: diameter (D) of the hole in the pipe and height (h) of the surface of the fluid above the hole.
- Make sure all measurements are in the same standard unit.
- For example, 1 inch = 0.0254 meters, so if you use inches, convert your measurements to metric units.

Step 2: Determine the Cross-Sectional Area

- Calculate the cross-sectional area of the hole (A).
- Divide the diameter of the hole in half to get the radius.
- Use the formula $A = \pi r^2$ (radius to the second power).
- The result will be in square length units.

Step 3: Find the Fluid Velocity

- Use the Bernoulli equation to find the fluid velocity (v) if it is not already provided.
- If the fluid pressure in a pipe is constant (i.e., if the flow is steady), the fluid leaves through the hole in the pipe at a velocity of $v = \sqrt{2}\_g\_h$, where g is acceleration due to gravity, 9.8 m/s^2.

Step 4: Find the Fluid Volume Flow (Flux)

- Multiply the cross-sectional area of the hole by the fluid velocity to find the volume flow rate of the fluid (Q):

  $Q = A * v$

- This will be the volume of the fluid that leaves the hole in cubic meters per second.

Lifetime average daily dose calculation

LADD=C* IR*B*D/BW*LT

- BW= Body weight (kg).
- B= Bioavailability
- D= Duration
- IR= Ingestion Rate
- C= Mean exposure concentration
- LT= Life time-70 years or 25,550 days