

**Semester Examination**

**GEOINFORMATICS IN EARTH SCIENCE,  
TECTONIC HAZARD AND INFRASTRUCTURE  
MANAGEMENT**

(Marks – 100)

**Answer All five questions:**

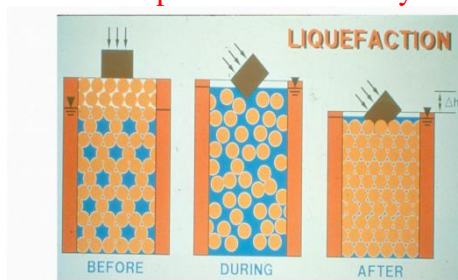
**Question 1**

**Marks: 7 + 5 + 3 + 5**

- a) Discuss in your own words with the help of diagram what is liquefaction and how liquefaction occurs during Earthquake.

**Liquefaction is more likely to occur in loose to moderately saturated granular soils with poor drainage, such as silty sands or sands and gravels that are capped or contain seams of impermeable sediments**

- Liquefaction occurs** in saturated soils, that is, soil in which the space between individual particles is completely filled with water.
- The water exerts a pressure on the soil particles that influences how tightly the particles themselves are pressed together.
- Water Pressure was low at First.
- Earthquake shaking cause the water pressure to increase to the point where the soil particles can readily move with respect to other.



- b) Discuss how natural phenomena like earthquake or landslide seen to be hazardous event and to be a disastrous event.

- ✓ Any **physical event**, such as a volcanic eruption, that does not affect human beings is a **natural phenomenon** but not a natural hazard.
- ✓ A natural phenomenon that occurs in a populated area is a **hazardous event**.
- ✓ A **hazardous event** that causes unacceptably large numbers of fatalities and/or overwhelming property damage is a **natural disaster**.

- c) Differentiate between Environmental science and Earth science.

### **Earth Science**

- Earth science, also known as geoscience, is the study of the Earth's physical components and processes.
- It examines the Earth's structure, materials, and the dynamic processes that shape its surface and interior.

### **Environmental Science**

- Environmental science is primarily concerned with the study of the;
  - interactions between living organisms (including humans) and their environment,
  - Study of Ecosystem and Biodiversity
  - Human Health

- d) List down four main branches of Earth Science and briefly discuss each.

1. geology (study of the Earth's solid materials),
2. meteorology (study of the atmosphere and weather),
3. oceanography (study of the oceans and marine environments),
4. astronomy (study of celestial bodies beyond Earth).

### **Question 2**

**Marks: 8 + 3 + 9**

- a) Discuss the four (4) listed below. Provide diagrams where necessary;

a. Weather

- ❖ **In essence, weather refers to the day-to-day variations in atmospheric conditions,**
- ❖ Short-term atmospheric conditions.
- ❖ Typically observed over a relatively short period (hours to days).
- ❖ Involves variables such as temperature, humidity, precipitation, wind speed, and atmospheric pressure.
- ❖ Can change rapidly and is subject to day-to-day fluctuations.
- ❖ Describes the current state of the atmosphere at a specific location and time.

b. Climate

**Climate represents the long-term average and trends in these conditions over a more extended period.**

- ❖ Long-term patterns of weather over an extended period (typically 30 years or more).
- ❖ Represents the average of weather conditions over a specific region and time frame.
- ❖ Characterized by parameters like average temperature, annual rainfall, and seasonal variations.
- ❖ Changes in climate occur slowly over a longer time scale (decades to centuries).

c. Climate Change

- ❖ Climate change can be seen as the changes in weather pattern /climate variance over a long period of time and is caused by either natural or human-made processes and activities.

- b) State down three (3) reasons why weather stations in PNG are not permanent always?

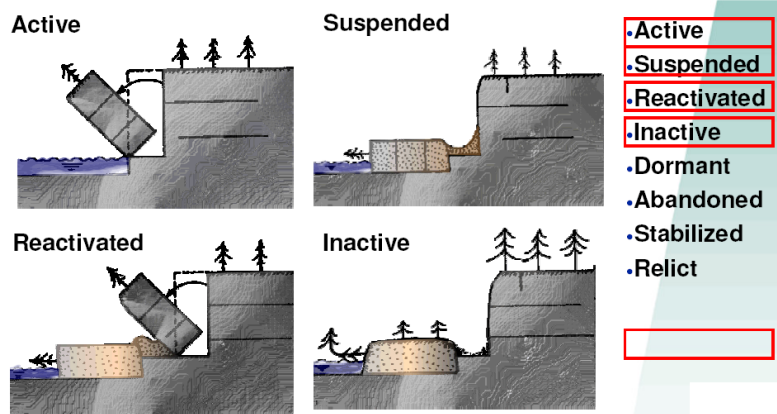
**Name change**

**Name duplication**

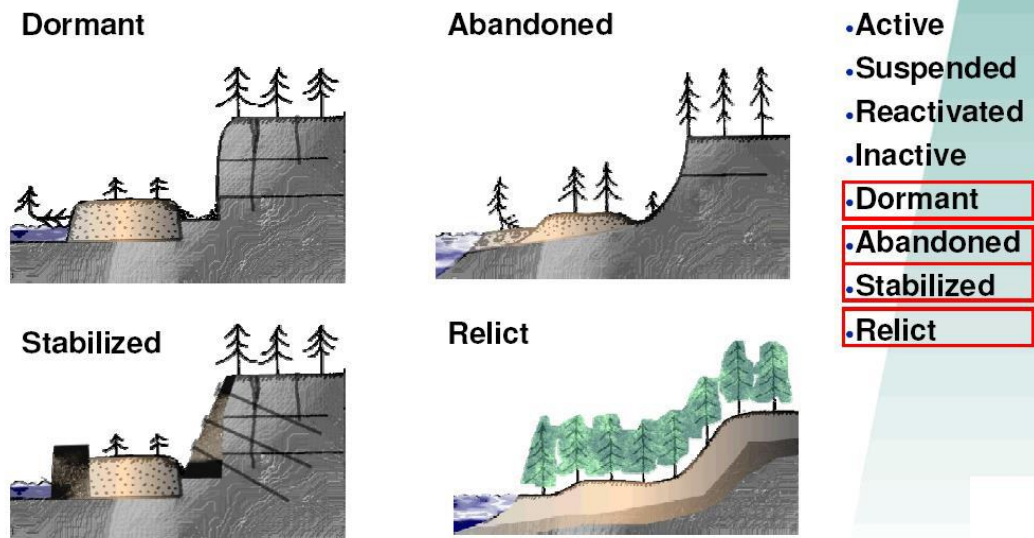
**Location move**

- c) List down in chronological order the Landslide State of Activity 1 and 2.  
Provide diagrams to show each state of activities.

**Landslide State of Activity -1**



### Landslide State of Activity -2



### Question 3

Marks: 3 + 5 + 7 + 5

(a) Discuss how Remote Sensing Technology can be utilize for disaster relief, rehabilitation and reconstruction.

- ✓ RS technology plays vital role in both the immediate relief and long-term development phases of disaster relief/rehab and Reconstruction.
- ✓ Satellite imagery assists in estimating the damaged infrastructure and analyzing the severity of vital services required to any community, undertaking detailed damage need assessments and urban development planning.

(b) Define landslide and discuss with diagram the cause of landslide.

Landslide is defined as the movement of a mass of rock, debris or earth down the slope, when the shear stress exceeds the shear strength of the material conjunction with Slope Morphology and geotechnical parameters

The occurrence of landslides is the consequence of a complex field of forces (stress is a force per unit area) which is active on a mass of rock or soil on the slope. Basically, the two main.

determinative parameters are:

- An increase of shear stress
- A decrease of material strength

(c) Differentiate between two common seismic waves that are produced during earthquake. Provide diagrams to assist your discussions.

## Body Waves: P and S waves

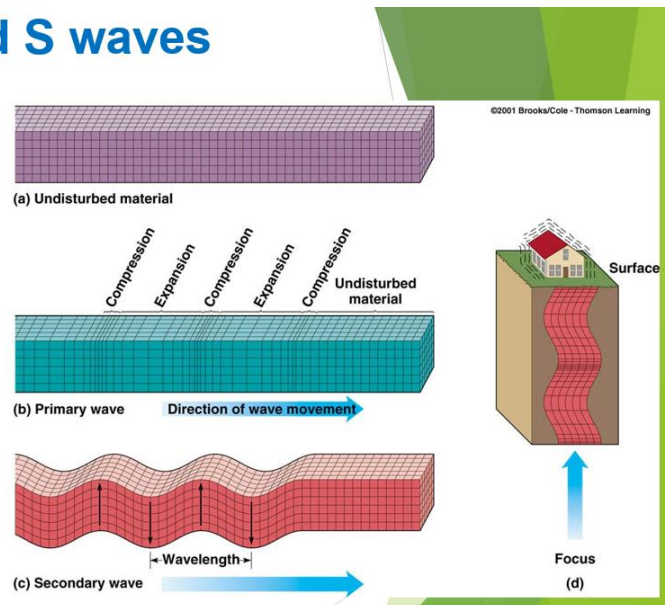
### ▶ Body waves

#### ▶ P or primary waves

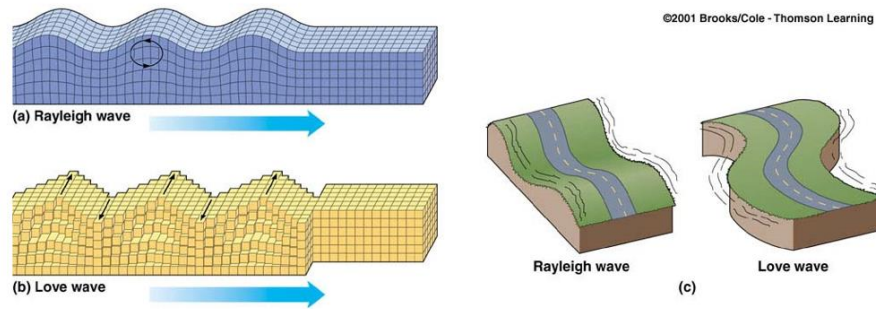
- ▶ fastest waves
- ▶ travel through solids, liquids, or gases
- ▶ compressional wave, material movement is in the same direction as wave movement

#### ▶ S or secondary waves

- ▶ slower than P waves
- ▶ travel through solids only
- ▶ shear waves - move material perpendicular to wave movement



## Surface Waves: R and L waves



### ► Surface Waves

- Travel just below or along the ground's surface
- Slower than body waves; rolling and side-to-side movement
- Especially damaging to buildings

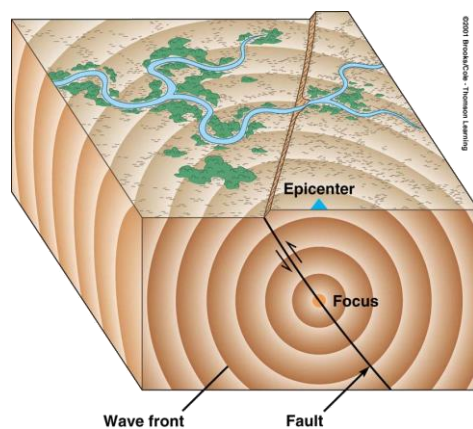
(d) Discuss the common cause of earthquake and how and where does it triggers.

The earthquake is mainly cause by tectonic plate movements

The focus or hypocenter of the earthquake is the place where energy is release.

The focus is underground measured as earthquake depth

The point directly above the focus on the surface is the epicenter



### Question 4

**Marks: 7 + 8 + 5**

a) Discuss El-nino, La-nina weather patterns and how does it occur. Provide diagrams to assist your discussions.

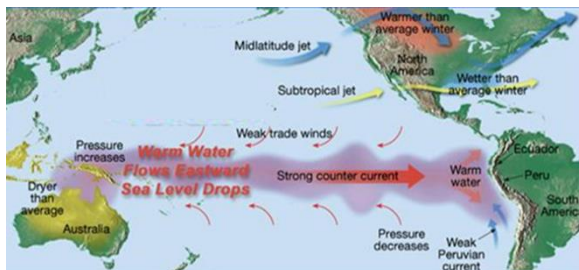
❖ El Niño and La Niña events are a natural part of the global climate system.

- ❖ They occur when the Pacific Ocean and the atmosphere above it change from their neutral ('normal').
- ❖ El Niño events are associated with a warming of the central and eastern tropical Pacific, while La Niña events are the reverse, with a sustained cooling of these same areas.

Note: as the reversal happens, one side experiencing higher rainfall and flooding and the other side experience dry and drought

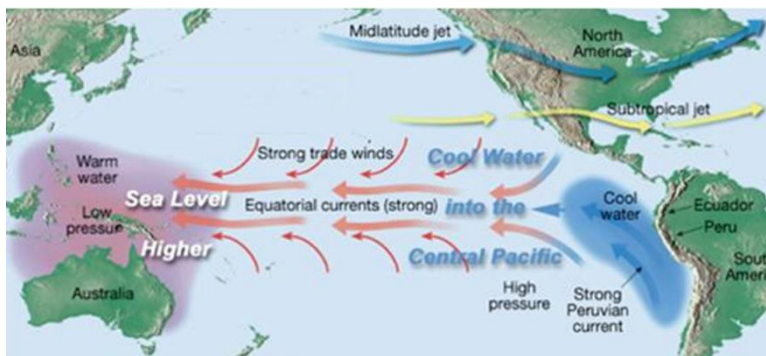
### EL-nino

- ❖ Weak trade winds and weak upwelling cause warm water off the coast of S. America
- ❖ PNG/Indonesia Experiencing Drought



### La Nino

- ❖ Strong trade winds blow surface water towards east, creating colder surface temperatures off South American coast.
- ❖ PNG/Indonesia Experience heavy and continuous rainfall



b) What are these initials stands for:

1. AWC – Available Water Holding Capacity
2. PGV – Peak Ground Velocity
3. AHP – Analytical Hierarchy Process
4. CI – Consistency Index

(c) Discuss cost raster and how is it utilized or integrated to create least cost path?

To identify a least cost path for a new road link, the cost weighted distance function is used. To calculate the least accumulative cost the source and a cost raster is needed by cost distance weight function.

The cost Raster identifies cost of travel to every cell. Weight values assigned to each class level. Higher the weight value, more the cost. Example, steep slope of class 54 degree to 83 degree slope will be assigned higher weightage since it will incur more cost of construction towards steep slope.

**Question 5**

**Marks: 6+ 5+3 +**

**6**

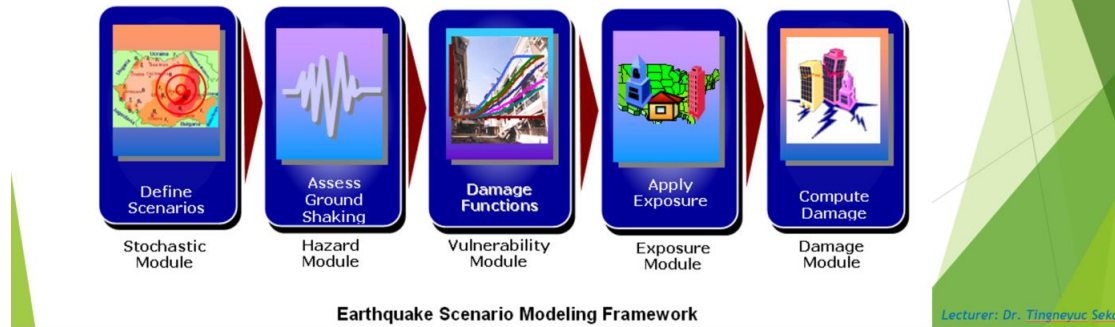
(a) Discuss with diagram how global warming occurs that leads to climate change and its impact.

Human beings continually emit more greenhouse gases into the atmosphere, exacerbating the existing levels and contributing to the warming of the Earth's surface. Adequate warming of the Earth is beneficial for all living organisms, as it supports growth and survival. However, the increased production and release of greenhouse gases such as methane, carbon dioxide, nitrous oxide, and chlorofluorocarbons lead to the retention of more solar radiation in the atmosphere. Solar radiation reaches the Earth's surface, only approximately 20-30% manages to escape, while rest are captive and send back to earth, resulting in a maximum warming effect. This phenomenon ultimately leads to climate change, characterized by rising temperatures, alterations in rainfall patterns, the formation of cyclones, and an increase in sea levels

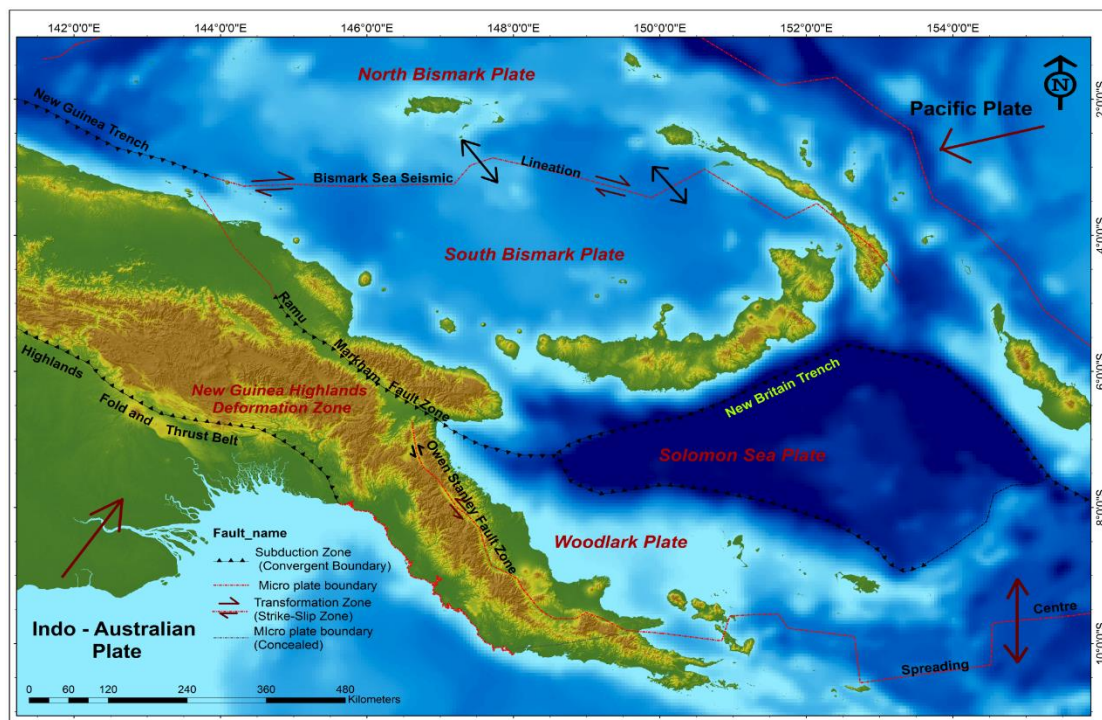
(b) Discuss with diagram the scenario based vulnerability mapping in relation to earthquake.

### Scenario Based Vulnerability Mapping - Earthquake Example

- ▶ Starts with scenarios,
- ▶ then defines the hazard,
- ▶ then estimates the vulnerability,
- ▶ calculates what is the exposure and finally
- ▶ estimates probable total damage



(c) List down any three (3) types of fault lines/plate boundaries within PNG.



(d) State down at least three (3) reasons why we do infrastructures planning.

- ✓ Infrastructures planning to avoid cost inflation
- ✓ Planning in such a way that it will have greater revenue in return. In more general term “greater economic impact”
- ✓ Planning in such a way that to avoid infrastructures dangers to near by communities (EIA)

- ✓ and compensate accordingly.
- ✓

Further to that, give at least two (2) separate examples of how Geo-Informatics can be utilize for infrastructures planning.

- Locate appropriate sites for dams, bridges and airfields
- Select suitable land corridors for railway, highway and pipeline routes
- Identify sites for locating coastal infrastructure, beach development and harbors

-----End of question-----