TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES
DEPARTMENT OF MATHEMATICS AND PHYSICS

UNIVERSITY EXAMINATIONS 2017/2018
AES 4341: EARTH SYSTEM AND ATMOSPHERIC PHYSICS

SERIES: SEPTEMBER 2018 TIME: 2 HOURS

Instructions to candidates:
You should have the following for this examination:

Answer booklet, Examination paper, Examination Pass and Student ID.

This examination paper contains Five questions.
Answer question **ONE and any TWO** other questions.
Question **ONE** carries **30 marks** while the rest of the questions carry **20 marks** each.

Given constants:
Stefan-Boltzmann constant, 5.67×10^{-8} $Wm^{-2}K^{-4}$.
Radius of the sun, 6.96×10^{9} m,
Radius of Earth = 6.34×10^{6} m.
Sun–Earth distance = 1.5×10^{11} m.

QUESTION ONE (30 MKS)

a). The earth rotation takes 24 hours. If the radius of the earth's equatorial radius is 6378 km, find the maximum speed on the earth's surface.

(3marks)

b). State Kepler's First Law and give its significance to the variation of earth surface temperature.

(2marks)

c). Explain the difference in albedo between the southern and the northern hemispheres of the earth.

(3marks)

d). State four aspects of earth warming.

(4marks)

e). Describe the primary components of the earth system.

(2marks)

f). (i). Describe atmospheric aerosols.

(2marks)

(ii). How are atmospheric aerosols characterized?

(2marks)

g). Name the motions that cause the following Earth system phenomena.

(2marks)

(i). Day-Night cycles.

(ii).Seasons.

h) Explain the property of water responsible for:
(i). Stabilizing the earth temperature.

(2marks)

(ii) Distributing heat energy in the atmosphere.

(2marks)

(iii) Preserving aquatic life.

(2marks)

i). The earth system is in "metastable state". Explain.

(2marks)

j). Differentiate between the Earth's orbital oscillations and Earth's Precession.

(2marks)

QUESTION TWO. (20MKS)

a). What are the human activities responsible for global warming today?

(2mks)

b). Show how atmospheric pressure below 40 km varies with altitude using a sketch graph.

(4marks)

c). Name are the four factors that are associated with climate change.

(4marks)

d). Name the various classes of the sources atmospheric aerosols.

(4marks)

e). How do satellites do remote sensing of aerosols?

(6marks)

QUESTION THREE (20MKS)

a). Present-day global warming has several causes. Describe two.

(2marks)

b). Describe the temperature profile of the troposphere by means of a sketch graph.

(4marks)

c). Explain the term "greenhouse gas" and give two examples of a greenhouse gas.

(3marks)

d). Explain how the presence of aerosols in the atmosphere relates to cloud formation.

(3marks)

e). Explain the unique existence of the triple-point of water with the aid of a graph of atmospheric pressure (y-axis) against temperature (x-axis).

(4marks)

f). (i) Describe the process of photosynthesis using a chemical equation.

(2marks)

(ii) Phytoplankton use CO_2 for photosynthesis. What is the source of this CO_2?

(2marks)

QUESTION FOUR. (20MKS)

a). Describe the uniqueness of the earth in the Solar System.

(2marks)

b). What evidence is there to show that the earth is experiencing global warming?

(4marks)

c). (i). What are atmospheric aerosols and how can we tell that atmospheric aerosols exist?

(2marks)

(ii). What is the method used to measure aerosol concentration in the atmosphere?

(2marks)

d). Give two effects of deforestation.

(2marks)

e). Describe acid rain and state the dangers associated with it.

(2marks)

f). (i) Find the radiant flux, P from the sun as computed from the irradiance by taking the sun is a black body at 6000K.

(3marks)

(ii) Find the solar constant $\boldsymbol{F}_{earth}$, at the earth's surface using the radiant flux in (i) above.

(3marks)

QUESTION FIVE (20 MKS)

a). Global warming has negative effects What are they?

(2marks)

b).What are the various states of water on the earth and where are the various water states located on the earth surface?.

(6marks)

c). (i). Describe the biogeochemical cycle.

(2marks)

(ii). Give two major biogeochemical cycles

(2marks)

d). (i). Name three important carbon sinks other than the ocean.

(3marks)

(ii). Photosynthesis in surface waters affect the exchange of carbon from the surface water to the deep ocean. Explain.

(2marks)

e). How can the carbon cycle be affected by human activities?

(3marks)