UNIVERSITY OF CAPE TOWN

DEPARTMENT OF OCEANOGRAPHY

JUNE 2011 EXAMINATION

SEA2004F – PRINCIPLES OF OCEANOGRAPHY

INSTRUCTIONS:

ATTEMPT ALL QUESTIONS IN ALL 5 SECTIONS.

TIME : 3 HOURS

(TOTAL: 150 MARKS)

(The Final Exam counts 60% towards your final mark for the course).

SECTION A:

Question 1

a) What are the six major dissolved constituents of seawater? Why do they occur in almost fixed ratios despite variations in the salinity of ocean waters? [6]

b) What is meant by the terms “thermocline”, “halocline” and “pycnocline” [3]

c) With the aid of diagrams explain the seasonal effect on the structure of the thermocline [6]

Question 2

a) Give a sketch of an ARGO profiling float and describe how it operates**.** [7]

b) Discuss in detail the advantages and limitations of this form of measurement compared to a mooring device. [8]

SECTION B:

Question 1

a) List three ways in which excess heat absorbed in the tropics is re-distributed to higher latitudes [6]

b) Draw a simple diagram in the vertical-longitude plane that shows the annual mean circulation in the atmosphere [9]

Question 2

Draw a diagram of a section across the equatorial Pacific that depicts the structure of the winds, and the circulation and thermocline in the upper ocean. In a second diagram, illustrate how these features change during an El Nino event [15]

Question 3

a) List the different fluxes that make up the energy balance at the ocean surface [8]

b) What are the units of these fluxes? [2]

c) On the annual average, would you expect the latent heat flux or the sensible heat flux at the surface to be greater for the Gulf Stream? Briefly explain why. [5]

SECTION C

Question 1

a) Briefly discuss what three factors are necessary for waves of any type to be present. [3]

b) Discuss the nature of "deep" and "shallow water" waves. Give the speed of a shallow water wave in terms of the depth. Calculate the speed of a tsunami in 4000 m deep water. [6]

c) Discuss the nature of the tides around southern Africa. Where are the strongest tidal currents likely to be found in South Africa. [6]

SECTION D

Question 1
In a stratified productive marine water column, dissolved oxygen concentrations are high at the surface and low in deeper waters. Explain. [5]

Question 2
How is an inertial current formed? What would the period and sense of rotation of it be at 30°S latitude? NB Ti (inertial period) = 12 / sin Θ (Use Θ in degrees, and give the units of the Ti). [5]

Question 3
The Baltic and Mediterranean are restricted exchange systems. Sketch the surface and deep water flows and label their relative salinities. Designate them as estuarine or anti-estuarine. [5]

Question 4
Why is the ocean salty and why has the ocean's salinity not changed over long time scales? [15]

SECTION E

Question 1
How does ocean acidification occur and how does this affect marine calcifying organisms? [15]

Question 2
a) When particulate organic nitrogen sinks through the water column, how is this re-mineralised to ammonium and to nitrate [5]

b) What is the significance of the f-ratio? [5]

c) Briefly explain the importance of dissolved Fe for phytoplankton photosynthesis and nitrogen uptake in the Southern Ocean [5]