

ASL 880 – Dynamic Oceanography  
Minor 2 (II Semester 2014-15)

MM. 25

22 March 2015  
Time: 05:30 – 06:30 PM

Instructions: Q 1 is compulsory. Answer any 3 questions from Q 2-5. If additional question is answered then low scored 3 questions will be considered.

[5x2]

Q 1.

- Briefly explain the 'coastal ocean upwelling' and its effect on coastal weather.
- What is 'warm core eddy' in the ocean?
- Give names and directions of 4 major surface currents in Indian ocean.
- What drives the thermohaline circulation? What is importance of this deep circulation.
- To which side of landfall location of cyclone in the Bay of Bengal, the maximum Storm Surge is expected and why?

Q 2. What is the role of oceans or oceanic processes under the El Nino and La Nina conditions? What is Indian Ocean Dipole (IOD) and Dipole Mode Index (DMI)? How the IOD is related with regional precipitation? [5]

Q 3. What is surface Ekman layer in the ocean? For a westward wind speed of  $20 \text{ ms}^{-1}$  measured at 10 m above sea level at  $30^\circ$  latitude in northern hemisphere, calculate wind stress at sea surface, surface current speed and direction, and Ekman layer depth (Exact solution or Approximate formula solution both are accepted) [Given that,  $\rho_{\text{water}} = 1027 \text{ kg m}^{-3}$ ,  $\rho_{\text{air}} = 1.25 \text{ kg m}^{-3}$ ,  $C_D = 2.6 \times 10^{-3}$ ,  $A_z = 1.3 \times 10^{-4} \text{ m}^2 \text{ s}^{-1}$ ] [5]

Q 4. What are Geostrophic equations and approximations used to obtain these from momentum equations? If you want to calculate actual surface currents over oceans, which data sets you need and methods/formulas to be used? [5]

Q 5. What assumptions were made and limitations in Sverdrup's theory of oceanic circulation? Give Sverdrup's relation (no derivation) between wind stress and transport. Highlight the additions from Munk in his theory of ocean circulation and distinctive circulation features seen from his theory. [5]



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Answer All Questions

Q 1. [6x2]

(a) On global ocean zonal average, at what latitudes the sea surface salinity is maximum and minimum, why?

(b) Define terms Shear, Diffluence, Relative vorticity, Divergence of fluid motion.

(c) What is 'Geoid' and its application in oceanography?

(d) Write Navier-Stokes equation in three dimensions.

(e) Starting from the coast towards sea, give a sketch of Continental margin showing different zones.

(f) Write the equation for x-component of momentum equation for the mean flow that have turbulent eddies in it.

Q 2. What is oceanic mixed layer and the factors affecting its depth? Draw temperature, salinity and density profiles in tropical ocean under (i) clear sky condition, (ii) just after heavy rainfall. [4]

Q 3. What are different terms in the oceanic heat budget. Give formula with the terms involved for the latent heat flux and sensible heat flux at the sea surface. What is the effect of ice/snow covered sea surface on the oceanic heat budget? [5]

Q 4. Explain Static stability and Double diffusion instability in ocean. What is importance of Richardson number in ocean stability. [4]

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