2017

M.Sc.

3rd Semester Examination

APPLIED MATHEMATICS WITH OCEANOLOGY AND COMPUTER PROGRAMMING

PAPER—MTM-305(OM)

Full Marks : 50

Time : 2 Hours

The figures in the right-hand margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Illustrate the answers wherever necessary.

(Dynamical Oceanology)

Answer *Q. No. 1* and any *four* questions from the rest.

1. Answer any *four* questions : 4×2

(a) Define solvent and solute with example. Give one example for each of Gaseous solution, liquid solution and solid solution.

(b) State the basic laws of physics which are taken as axiomatic in developing the study of the dynamics of the ocean.

(c) Derive the equation of continuity of volume.

(d) For typical horizontal length scale (L) of 1000 km, horizontal speeds (U) are of the order of 0.1 ms^{-1} and a vertical scale length (H) of 10^3 m, estimate a typical vertical speed (W).

(e) Write the Sverdrup equation for motion of wind-driven circulation with friction.

(f) Show the directions of rotation of cyclonic around low-and high-pressure regions in northern and southern hemispheres.

2. (a) Derive the pressure term in the equation of motion of oceanography.

(b) Write the equation of motion (in component form) in oceanology and identify the Coriolis term in all the equations. Discuss the importance of these Coriolis term in dynamical oceanology. Finally write the remaining terms of Coriolis terms into a combined form and find its magnitude at different latitude ϕ = 90°, 45° and 30° for a current speed of 1 ms^{-1}.

3+5

3. (a) Write all the equations of motion in terms of eddy viscosities.

(b) For the ocean with horizontal and vertical length scales 10^3 Km and 1 Km, respectively and horizontal speed of order 0.1 ms^{-1}, scale all the above equations written in part-(a) and reduces the equations with order of accuracy 1%. 2+6

4. Derive the Reynolds equation for the y-component of velocity. 8

5. (a) Write the geostrophic equation and discuss what we get from this equation.

(b) Derive the equation for calculating relative velocities of geostrophic flow. 2+6

6. Derive the horizontal equations of motion for current with friction (wind-driven circulation) in terms of eddy viscosity. 8

7. (a) From the Ekman experimental observations establish the relation.

(i) between the wind-driven circulation speed V_0, wind speed W and Ekman depth D_E

(ii) between the wind-driven circulation speed V_0, wind speed W

(iii) calculate the wind-driven circulation speed V_0, and Ekman depth D_E for the case of wind speed W = 30 ms^{-1} at latitude 45°.

(b) For the geostrophic flow, show (i) the directional relationships of velocity components (u, v) to pressure and Coriolis force terms, and (ii) directional relationship of total horizontal velocity (V_H) to pressure and Coriolis force terms in northern hemisphere. 6+2

[Internal Assessment—10 Marks]

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