2016

M.Sc. 2nd Seme. Examination

APPLIED MATHEMATICS WITH OCEANOLOGY AND COMPUTER PROGRAMMING

PAPER—MTM-201

Full Marks : 50

Time : 2 Hours

The figures in the margin indicate full marks.

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

Illustrate the answers wherever necessary.

(*Fluid Mechanics*)

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

1. Answer any *four* : 4×2

(a) Write the expression for substantial derivative for flow variable T (temperature) and describe the physical meaning of each term.

(b) Write the N-S equation in vector form an for 3D unsteady incompressible viscuss laminar flow and describe the physical meaning of each term.

(c) Write the vorticity equation for vorticity about Z-axis in 3D and describe the physical meaning of each term.

(d) Define Reynolds number (Re) and then discuss the effect of low and high value of Re on the N-S equation.

(e) For N-S equation, what kind of boundary conditions for velocity available ?

(f) Define the vortex doublet and derive the expression for complex potential.

2. (a) What is the physical principal considered for energy equation ? State that principal.

(b) Draw the infinitesimally small element and show the energy fluxes along n-direction associated with the element.

(c) Derive the energy equation in the non-conservation form.

1+2+5

3. (a) An encompressible velocity field is given by $u = a(x^2 - y^2)$, v unknown, w = 6 where a and b are constants. What must be the form of v ?

(b) For the velocity field with u defined in Q. 3(a), and $v = -2axy$, $w = 0$, determine under what condition it is a solution of N-S equation.

(c) Assuming the conditions on part(b) are met, determine the resulting pressure distribution when 'Z' is up.

2+3+3

4. (a) State the assumptions for Boundary Layer Theory.

(b) Derive the set of equations for 2D steady incompressible flow without gravity effect.

(c) Write the equation for outside the Boundary Layer. What is the name of this equation ? 2+4+2

5. (a) State the necessary assumptions for Couette-Poisseuille flow.

(b) Derive the velocity profile for this.

(c) Draw the above velocity profile for pressure gradient $p = -1, 0 \& 1$. 2+4+2

6. (a) Derive the vorticity equation in vector form.

(b) Deduce the above equation for 2D (x, y) flow. 6+2

7. (a) State the Lemma for theorem of Blassius.

(b) State and prove the Kutta-Joukowski Lift theorem.

2+6

(Internal Assessment —10)

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