Registration No. : | | | | | | | | | | |

Total number of printed pages – 4

B. Tech.

CPCH 4201 (New)

Third Semester Examination – 2010

FLUID FLOW AND FLOW MEASUREMENT

(New Course)

Full Marks – 70

Time : 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest.*

The figures in the right-hand margin indicate marks.

1. Answer the following questions: 2×10

(a) What is kinematic viscosity ? What are its units ?

(b) What is NPSH ?

(c) A liquid has a specific gravity of 1.9 & kinematics viscosity of 6 stokes. What is its dynamic viscosity?

(d) Define minimum fluidization velocity. Make a force balance at this condition.

(e) The viscosity of liquids _____ with increase in temperature and the same for gas _____ with decrease in temperature.

(f) Bulk modulus of elasticity is the ratio between _____ and _____ .

(g) Define Mach Number. The value of Mach number for supersonic flow is _____ .

(h) Write the force balance, when a particle falls in a fluid medium under terminal settling velocity condition?

P.T.O.

(i) What is drag coefficient ? Find out the projected area of a sphere having radius 'r' when a fluid flows over it parallelly.

(j) The pressure drop of 10 m head of water is equivalent to _____ .

2. (a) Write all the assumption made while deriving Bernoulli's equation. What is the limitation of Bernoulli's equation? 2+3

(b) What do you mean by moment of momentum? Derive the expression for the same. 5

3. (a) Describe a venturimeter and derive an expression for measuring discharge of a fluid flowing through a pipe with this device. 6

(b) Derive an expression for momentum correction factor. 4

4. (a) Derive an expression for the velocity distribution of viscous flow through a circular pipe. Also sketch the distribution of velocity. 4

(b) A lubricating oil of viscosity 1 poise and a specific gravity 0.9 is pumped through a 30 mm diameter pipe. If the pressure drop per meter length of the pipe is 20 KN/m^2, determine : 6

(i) The mass flow rate in Kg/min

(ii) The shear stress at pipe wall

(iii) The Reynolds no. of

5. (a) Develop on the basis of dimensional analysis suitable parameter to present the thrust developed by a propeller. Assume that the thrust P depends on the angular velocity ω, speed of advance V, diameter D, dynamic viscosity μ, mass density ρ elasticity of the fluid medium which can be denoted by the speed of sound in the medium C. 7

(b) What do you mean by kinematic similitude? 3

6. (a) The average drag coefficient for turbulent layer flow past athin plate is given by $C_D = \frac{0.455}{(\log_{10} R_e)^{2.58}}$, where Re is Reynolds number based on plate length. A plate 500mm wide and 5m long is kept parallel to the flow of water with free stream velocity 3 m/s calculate the drag force on both side of the plate. $\nu = 0.01$ stokes. 5

(b) Recognize the following substances as fluids or solid and if fluids, classify them further. The values are obtained from isothermal tests. 5

Substance A	Velocity gradient	1	2	3	4
	Shear stress	2	4	6	8
Substance B	Velocity gradient	1	2	3	4
	Shear stress	2	3	4	5
Substance C	Velocity gradient	0.5	1.0	1.5	2.0
	Shear stress	1.0	2.5	4.0	6.0
Substance D	Velocity gradient	0	0	0	0
	Shear stress	0.5	1	1.5	2
Substance E	Velocity gradient	1	2	3	4
	Shear stress	0	0	0	0

7. (a) Derive an expression for Ergun equation with suitable assumption and discuss its applicability. 6

(b) Air flows through a packed bed of a powdery material of 1 cm depth at a superficial gas velocity of 1 cm/sec. A manometer connected to the unit, registers a pressure drop of 1 cm of water. The bed has a porosity of 0.4. Assuming that Kozeny Carman equation is valid for the range of study. Estimate the particle size of the powder. 4

Data given :

$\rho_{air} = 1.23\ kg/m^3$

$\mu_{air} = 1.8 \times 10^{-5}\ kg/m.sec$

8. Write short Notes on any *two* : 5×2

(a) Terminal settling velocity.

(b) Head loss due to sudden Expansion.

(c) Characteristic curve of centrifugal pump

(d) Cavitation.