UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, April/May 2018

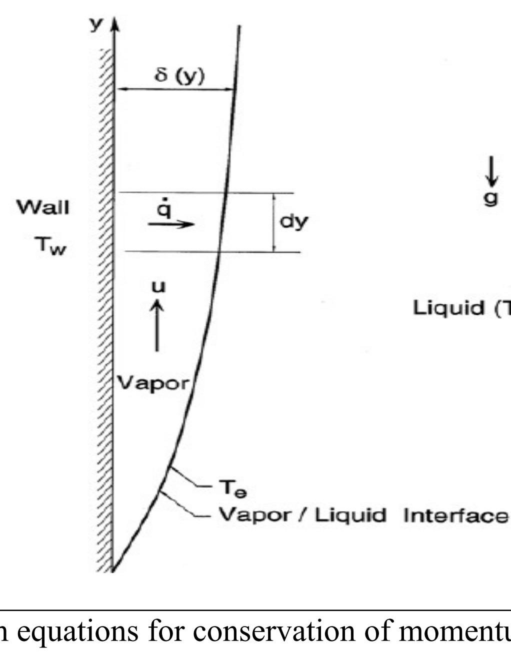
Course: Introduction to Multiphase Flows **Semester: II**
Program: M.Tech CFD
Time: 03 hrs. **Max. Marks: 100**

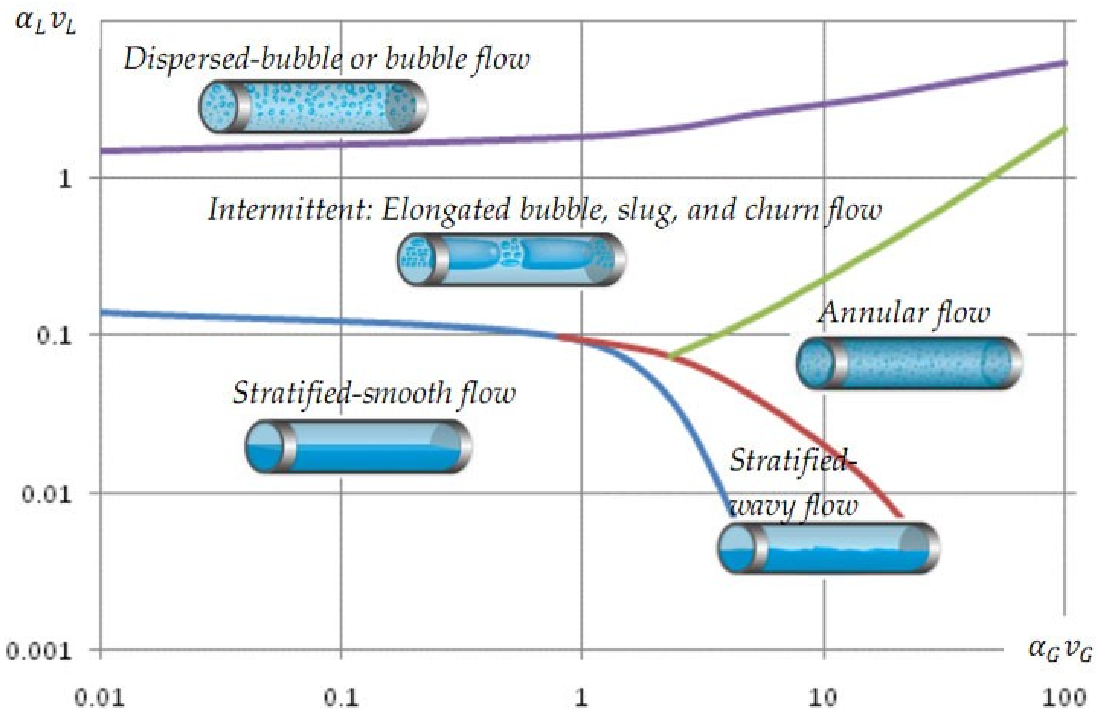
Instructions:

SECTION A

S. No.		Marks	CO
Q 1	What is Superficial velocity, Phase velocity? Explain the relationship between superficial velocity and Phase velocity?	**4**	**CO1**
Q 2	Define the - Volume fraction of dispersed phase and continuous phases - Densities of dispersed phase and continuous phase	**4**	**CO2**
Q 3	Explain about the molecular effects of flow around a sphere?	**4**	**CO3**
Q 4	Explain about the nucleate boiling in horizontal surfaces? What do you meant by boiling crisis?	**4**	**CO4**
Q 5	What is the significance of stokes number in multiphase flows?	**4**	**CO1**

SECTION B

Q 6	Does the film boiling analysis in vertical surfaces can takes place from the following figure? 	**8**	**CO3**
Q 7	Derive the continuum equations for conservation of momentum for individual phase and combined phase?	**8**	**CO2**
Q 8	What is Phase Coupling? Explain about mass coupling, Momentum coupling and Energy Coupling	**8**	**CO1**

Q 9	Discuss about various Multiphase Models. Explain, which Multiphase model is suitable for Multiphase flow regimes? **Or** Write about the Laws of Heat and Mass Exchange in Discrete Phase.	**8**	**CO4**
Q 10	Discuss about the various types of flow regimes in horizontal pipes? Role of superficial velocity in liquid and gas phases for horizontal pipes from the following graph?  	**8**	**CO3**
	SECTION-C		
Q 11	A) What do you meant by Basset term? (5 Marks) B) The problem considers the cavitation caused by the flow separation after a sharp-edged orifice. The flow is pressure driven, with an inlet pressure of 5×10^5 Pa and an outlet pressure of 9.5×10^4. The orifice diameter is 4×10^{-3}m, and the geometrical parameters of the orifice are D/d = 2.88 and L/d = 4, where D, d, and L are the inlet diameter, orifice diameter, and orifice length respectively. The geometry of the orifice as shown in Figure. Explain how to do you carry out the computational analysis and with proper justification? (15 Marks)	**20**	**CO3**

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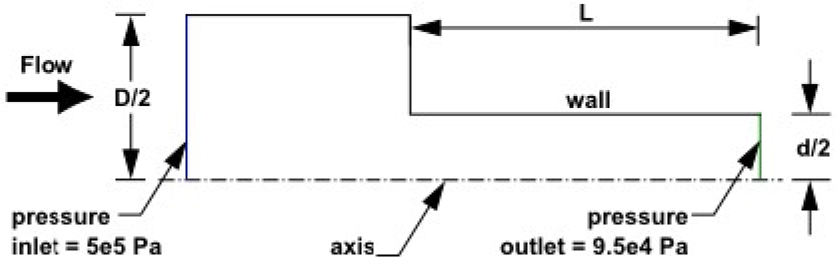
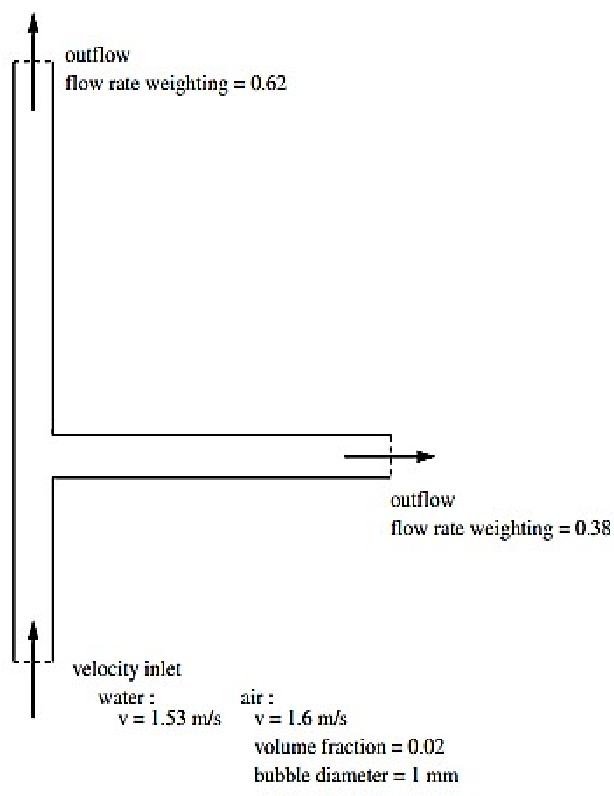


Or

This problem considers an air-water mixture flowing upwards in a duct and then splitting in a tee junction. The ducts are 25 mm in width, the inlet section of the duct is 125 mm long, and the top and the side ducts are 250 mm long. The schematic of the problem as shown in Figure. Explain the procedure how will you do analysis for this problem in fluent, which type model is suitable for this problem explain in detail and discuss the expected results? (15 Marks)



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<td>Q 12</td>
<td>Modeling of Axisymmetric Two-phase Dilute Flows: The two-dimensional axisymmetric, unsteady model for a two-phase gas-droplets flow has solved by</td>
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considering the two models that are Delhaye and ishii model. Fig:1 is the physical representation of the problem. To study relevant phenomena, an injection of droplets in a gaseous nozzle flow is considered. The length of the nozzle is 11.5 cm, its throat and exit radius are equal to 4.2cm and 1.145cm respectively. For the nozzle calculation, with a 75*21 grid points, the integration time size is 0.2 CFL number. The dispersed phase (droplets) injected in a one-phase, isentropic and steady flow: a one-phase solution provides the initial conditions for the two-phase calculation. Droplets are injected from the wall in the divergent section of the nozzle between $X_{inj\ I}$ = 7.77 cm and X_{inj2} = 8.55 cm. The particles injected with a-55° angle from the horizontal axis (x-axis). The injection velocity is imposed at 500 m/s and the mass rate is 123 kg/so the initial diameter of the droplets is 25 µrn leading to a density number, no, equal to 0.12 10^{12} droplets per unit volume. The void fraction is then equal to 0.999.

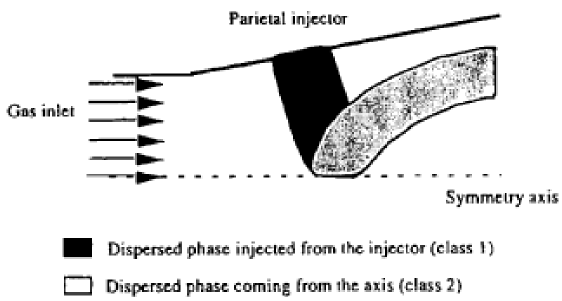

Fig 1: Representation of the physical problem and the different classes of particles.

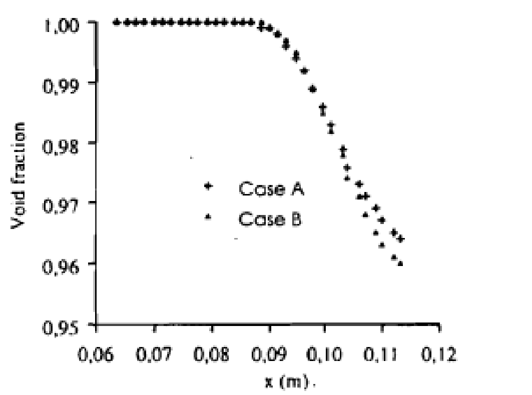

Fig: 2 Evolution of the viod fraction from the nozzle throat to the exit, at y = Δy/2, for cases A and B

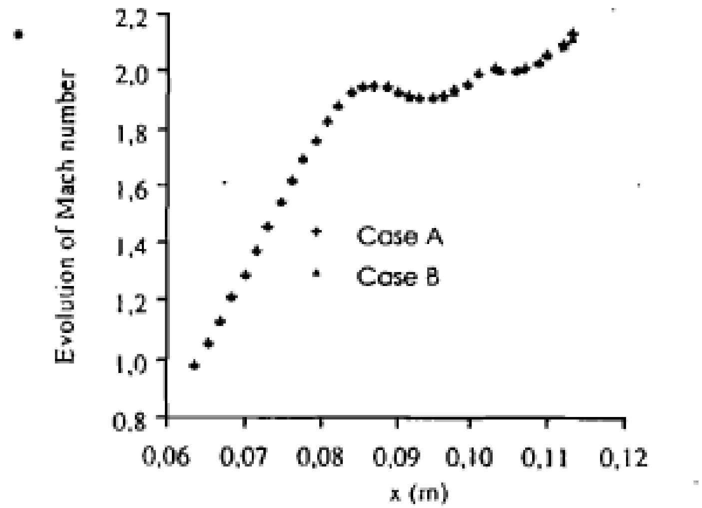

Fig:3 Evolution of the Mach number from the nozzle throat to the exit, at y= Ymaxj2, for cases A and B.

Answer the following: (20 Marks)

1. Explain the assumptions of Delhaye and Ishii models, discuss about the equations based on the assumptions for both models
2. Numerical approach for Delhaye model and ishii model.
3. Boundary conditions used for solving the problem, treatment of the symmetric axis.
4. From Fig 2, Fig 3 explain the relation between the void fraction and Mach number from nozzle throat to exit.