Name: Enrolment No:	UPES UNIVERSITY WITH A PURPOSE

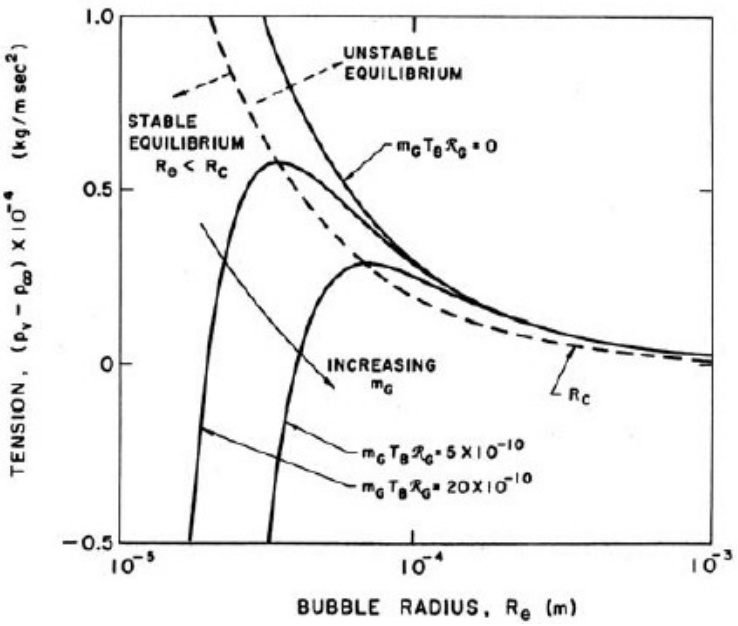
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

Course: M.Tech CFD **Semester: II**
Program: Numerical Methods for Multiphase Flows **Time 03 hrs.**
Course Code: ASEG7028 **Max. Marks: 100**

Instructions:
1. Attempt all questions
2. Section B & C are having internal choice

SECTION A

S. No.		Marks	CO
Q 1	Define the - Drift velocity - Drift flux.	**4**	**CO1**
Q 2	Illustrate the relation between volumetric flux and velocity. Define the volumetric quality.	**4**	**CO1**
Q 3	Discuss about the role of momentum response time and the average time between particle-particle collisions in dense and disperse flows?	**4**	**CO1**
Q 4	Explain the additional force terms to consider for sub micro particles.	**4**	**CO3**
Q 5	What are the methods used to predict the dispersion of particles due to turbulence in the fluid phase?	**4**	**CO2**
	SECTION B		
Q 6	Derive the continuum equations for conservation of mas and discrete phase number continuity.	**10**	**CO1**
Q 7	Derive the Rayleigh-Plesset equation of spherical bubble in an infinite liquid.	**10**	**CO3**
Q 8	Explain about the fluid-fluid, fluid-solid Interphase exchange coefficients used in a fluid flow with droplets/bubbles.	**10**	**CO2**
Q 9	Discuss about the bubble growth in the absence of the thermal effects. **(Or)** Explain about the stability of vapor/gas bubbles in bubble growth and collapse with the help of following fig.1.	**10**	**CO3 & CO2**

	 Fig.1: Stable and unstable bubble equilibrium radii as a function of the tension		
	SECTION-C		
Q 10	Explain about the Euler-Lagrange Approach for numerical simulations of Multiphase flows. **(8)** Explain the discretization methods used for particles motion of particles and how to do you implement in Runge-Kutta scheme. **(12)** **(Or)** Explain about the Euler-Euler Approach for numerical simulations of Multiphase flows. Discuss about the various types of the Euler-Euler Multiphase models. Illustrate which multiphase models is suitable for various multiphase flows. **(20)**	**20**	**CO3 & CO4**
Q 11	A vertical T junction with a horizontal branch is used with 500 mm length for each arm having inner diameter 50 mm. When a multiphase flow enters a T-Junction a redistribution of phases often occurs. The pipe has outer diameter 58mm with 500mm length for each arm. The pipe material used was structural steel. The bubble size diameter of air was taken as 4 mm. For the inlet both the velocities of air and water must be given. The velocities of air and water at inlet were given as 5m/s and 6.21m/s respectively. At the outlet since the value of pressure was unknown, outflow boundary condition was given for both the outlets. Flow rate weighting factor for outlets 1 and 2 was given as 0.2 and 0.8 respectively. Volume fraction was given as 0.52.The problem can be divided into three cases. Case 1: Simulation while considering fluid alone. Case 2: Simulation on One way coupling analysis. Case 3: Simulation on Two way coupling analysis. (a) Explain how to carry out simulation using fluent, discuss about the type of flow model, discretization and any other extra parameters if used. (10) (b) Effect of fluid on fluid structure interaction (5) (c) Effect of pipe structure on fluid structure interaction (5)	**20**	**CO4**

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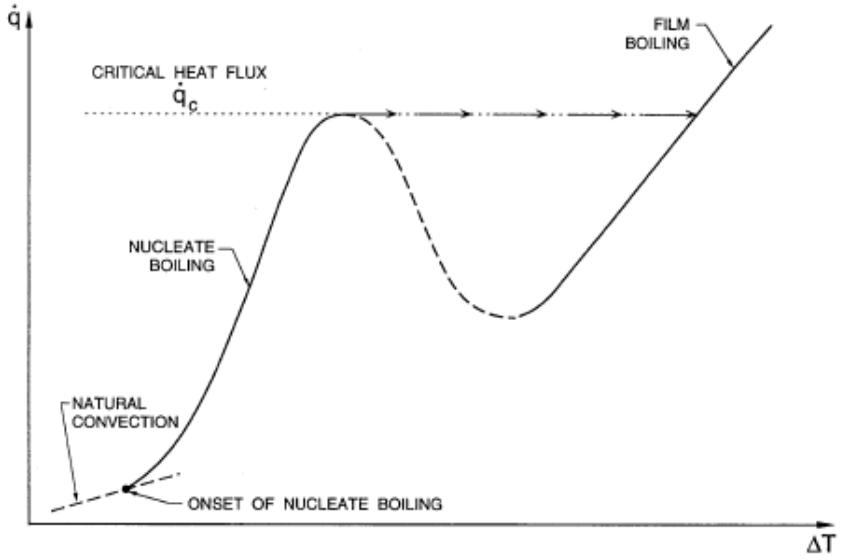
SECTION A

S. No.		Marks	CO
Q 1	Discuss about the significance of stokes number in multiphase flows.	**4**	**CO1**
Q 2	What are the molecular effects to consider when a single particle in motion	**4**	**CO3**
Q 3	Explain about - One way coupling - Two way coupling - Sub-cooled boiling - Super-heated condensation	**8**	**CO1**
Q 4	Discuss about the leidenfrost effects on horizontal surfaces of a circular pipe.	**4**	**CO3**
	SECTION B		
Q 5	Consider a quite simple external geometry such as a fully-developed pipe flow, are very complex and their solution at low Reynolds numbers requires the use of empirical models to characterize the unsteady motions. Explain the behavior of particles in a low Reynolds number flow.	**10**	**CO1**
Q 6	What do you meant by condensation? Explain about the film condensation on a vertical plate.	**10**	**CO3**
Q 7	Discuss about the bubble collapse in the absence of the thermal effects.	**10**	**CO3**
Q 8	What are the schemes used to treat the Interpolation near the interface? Explain the each scheme in detail. **(Or)** Explain about the various Euler-Euler Multiphase Models. Write about the Limitations of those models.	**10**	**CO2**
	SECTION-C		
Q 9	Explain the following phenomena associated with a plane horizontal boundary of a circular pipe. Sketch the diagrams if required - Pool Boiling	**20**	**CO3 & CO2**

	- Nucleate Boiling - Film Boiling  Fig.1: Pool boiling characteristics **(Or)** (A)Discuss about the mixture model theory in multiphase flows. (10) (B) Explain the film boiling phenomena associated with a plane vertical surfaces of a circular pipe. Explain in detail with the help of diagrams. (10)		
Q 10	Gas-particle flows are characterized by coupling between phases. For example, a spray, issuing into a hot gas stream, exemplifies thermal coupling through heat transfer to the droplet, momentum coupling through aerodynamic drag responsible for droplet motion, and mass coupling through evaporation. Inclusion of these coupling mechanisms complicates the analysis of gas-particle flows. Another difference between the flow of a single phase and gas-particle flow lies in the mechanism of information transfer between the elements of the particulate phase. The relative volume and mass of a component in a gas particle mixture are quantified by the volume fraction and bulk density. For pneumatic transport of coal in a pipe with average loading of unity, the volume fraction of particles is .001 so the corresponding volume fraction of air is .999. Under these conditions, one can assume the bulk density of the air is equal to material density of the air. This assumption is generally true for dilute gas-particle flows. (A)Explain about the Numerical approach modeling the flow of a gas particle using one-way coupling and two-way coupling. (7) (B) Explain about the modeling the flow of a gas particle using trajectory model approach. (8) (C) Discuss about the model gas-particle flow in a Laval nozzle. (5)	**20**	**CO4**