Enrolment No:	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, July 2020

Course: Numerical Methods for Multiphase Flows **Semester: II**
Program: M.TECH CFD **Time 24 hrs.**
Course Code: ASEG 7028 **Max. Marks: 100**

Instructions:

1. **Read the Instruction carefully before attempting**
2. **For Theory based : Type the Answers in word file**
3. **For Figures if any : Draw a free hand sketch and insert the same word file**
4. **For Numerical : Solve it in a paper and insert in the same word file**
5. **Upload as a single word file for all the Question in Blackboard.**

Note : Please upload the word document only, Do not upload PDF and or other format. The answer scripts will be considered for evaluation only through Blackboard. No other mode of submission is acceptable.

SECTION A [Case Based Study] 60 Marks

S. No.		Marks	CO
Q 1	Modelling of particles and droplets are challenging aspects of multiphase flows; the basic classification of these secondary phases' elements is based on physical size variation. The challenge in this domain is attached with finite size particle modelling. The conventional point-particle approach for treating the dispersed phase in a continuous flow field is extended by taking into account the effect of finite particle size, using a Gaussian interpolation from Lagrangian points to the Eulerian field. The inter-phase exchange terms in the conservation equations are distributed over the volume encompassing the particle size, as opposed to the Dirac delta function generally used in the point-particle approach. the flow over a circular cylinder is simulated for a Reynolds number of 3900 at 1 atm pressure. Results show good agreement with experimental data for the mean stream wise velocity and the vortex shedding frequency in the wake region. The calculated flow field exhibits correct physics, which the conventional point-particle approach fails to capture. The second case deals with diesel jet injection in quiescent environment over a pressure range of 1.1–	**25**	**CO4**

NOTE : The submission time of the Question Paper Answer Sheet is 24 Hhrs from the scheduled time (*exceptional provision due to extraordinary circumstance due to COVID-19 and due to internet connectivity issues in the far-flung areas*).
No Submission will be entertained after 24 Hrs

	5.0 MPa. The calculated jet penetration depth closely matches measurements. It decreases with increasing chamber pressure, due to enhanced drag force in a denser fluid environment. **Explain the following questions using the below given data and plots** a. Explain the nature of dispersed droplet in external flows over smoothed surfaces? b. How Eulerian- Lagrangian Calculations adopted for liquid gas does flows? c. Explain about phase coupling involved in modelling turbulent diffusion, Droplet Break-up, droplet-gas and droplet-Droplet Interaction? d. How do we account drag coefficient in finite size approach using Gaussian function? e. Explain the effect of accumulation of droplets due to downstream injection of liquid jets?		
Q 2	Explain the implementation and solution limitations for Physics-informed neural networks: A deep learning framework for solving forward and inverse problems involving nonlinear partial differential equations	**15**	**CO 3**
Q 3	It transpires that a homogenous, quiescent multiphase mixture may be internally unstable as a result of gravitational relative motion. It results in horizontally oriented, vertically propagating volume fraction waves or layers of dispersed flow. To evaluate the stability of the uniformly dispersed two component mixture with uniform relative velocity induced by gravity and density difference a mathematical model need to be developed using a vertically upwind velocity assumption. With the above given information model the number continuity equation, volume continuity for the suspending fluid, individual phase momentum equation, force interaction model for relative motion of the particles?	**20**	**CO 4**
SECTION B [Numerical and Short Answers] 40 Marks			
Q 4	In a turbulent flow environment, explain about Interaction of particles with turbulence and its complex unsteady motions. Explain the detailed modeling approach with the help of examples.	**10**	**CO 3**
Q5	With the schematic diagram, explain the fundamental principle and working of magnetron microwave devices.	**5**	**CO 2**

NOTE : The submission time of the Question Paper Answer Sheet is 24 Hhrs from the scheduled time (*exceptional provision due to extraordinary circumstance due to COVID-19 and due to internet connectivity issues in the far-flung areas*).

No Submission will be entertained after 24 Hrs

Q 6	Explain about Eularian model, VOF model, Mixture model and DPM. Explain the modeling limitations of each model	**5**	**CO 1**
Q 7	Explain about phase coupling and derive expressions for Momentum and Mass coupling for various phases?	**5**	**CO 2**
Q 8	Derive equation of motion for a single particle motion in a continuous Two- Phase flow and interpret the forces acting on the particle	**5**	**CO 2**
Q 9	Derive Individual phase Energy equation and Continuous phase Energy equation for two-fluid approach.	**5**	**CO 1**
Q 10	Explain about Terminal Velocity of Particles in Annular flow, slug flow and explain the significance of Superficial Velocity.	**5**	**CO 1**

NOTE : The submission time of the Question Paper Answer Sheet is 24 Hhrs from the scheduled time (*exceptional provision due to extraordinary circumstance due to COVID-19 and due to internet connectivity issues in the far-flung areas*).

No Submission will be entertained after 24 Hrs