Roll No: ----------

UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program: M.Tech CFD | **Semester – III**
Subject (Course): Commercial CFD Software Applications | **Max. Marks : 100**
Course Code : MCFD802 | **Duration : 3 Hrs**
No. of page/s: 3

Section – A (5x4=20 Marks)

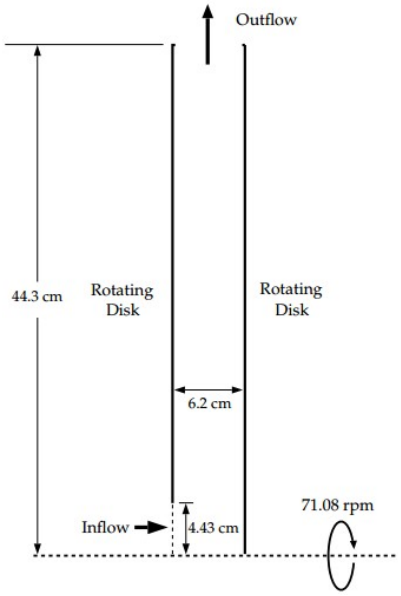
1. Consider a flow over a airfoil at 15 m/s having length 1 m, calculate the Y+ value (μ=1.8*10^-5, y= 10^-3 m)
2. Explain Inertial Frame of Reference and Moving Reference Frame?
3. Explain about:
   a. Non – Iterative Advancement
   b. High Relaxation factor
   c. K- Omega Turbulence Model
   d. Turbulent Viscosity ratio
   e. Spalart Allamaras Model
4. Explain the parameters, which decide how to choose appropriate radiation model?

Section – B (10x4 = 40 Marks)

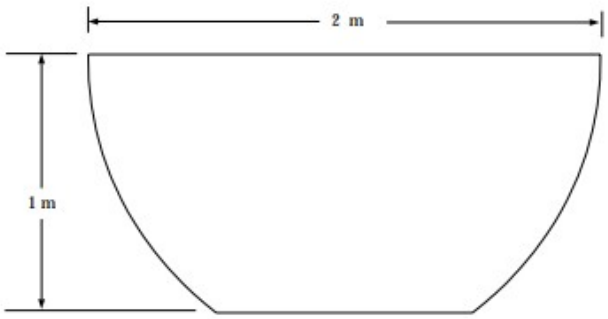
5. Write about interface treatment of Multiple Reference Model for the moving parts and explain how the interface treatment of absolute velocity formulation and relative velocity formulation occurs?
6. Draw Schematic diagrams for various chemical system configurations that can be model using Single and Two Mixture Fraction Approach? Explain restrictions on the Mixture Fraction Approach?
7. Write and explain Radiative Transfer equation? What are the advantages and limitations of S2S Radiation Model and Rooseland Model?
8. Comparison between Mixture model and Eulerian model? Explain, which Multiphase model is suitable for Multiphase flow regimes?

Section – C (20x2 = 40 Marks)

9. Consider an air enters the cavity between 2D, axisymmetric, co-rotating disks as shown in figure. The disks are 8.86 cm in diameter. The disks, which are 6.2 cm apart, are spinning at 71.08 rpm, and the air enters with no swirl. As the flow is diverted radially, the rotation of the disk has a significant effect on the viscous flow developing along the surface of the disk**.** Suggest what kind of reference frame will suitable for this problem, type of model, solution scheme and explain the solution steps to do analysis in fluent and discuss the expected results for the problem, in detail?



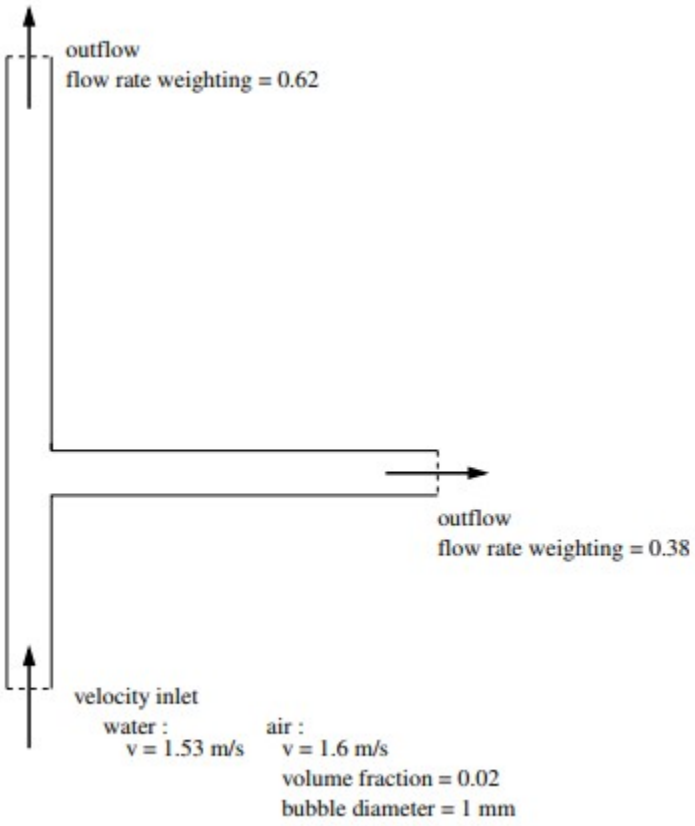
10. A) Consider a large bowl, 1 m in radius, is one-third filled with water and is open to the atmosphere. The bowl spins with an angular velocity of 3 rad/sec. Based on the rotating water, the Reynolds number is about 106, so the flow is modeled as turbulent. Explain the procedure how will you do analysis for this problem in fluent, which type model is suitable for this problem explain in detail and discuss the expected results?



Bowl: Ω = 3 rad/s
Air: ρ = 1.225 kg/m^3
μ = 1.7894 x 10^{-5} kg/m-s
Water: ρ = 998.2 kg/m^3
μ = 1 x 10^{-3} kg/m-s

(Or)

B) 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?



Roll No: ----------

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program: M.Tech CFD | **Semester – III**
Subject (Course): Commercial CFD Software Applications | **Max. Marks : 100**
Course Code : MCFD802 | **Duration : 3 Hrs**
No. of page/s: 2

Section – A (5x4 = 20 Marks)

1. Write about applications of CFD in Biomedical and Civil Engineering?
2. Explain Inertial Frame of Reference and Moving Reference Frame?
3. Explain about:
    a. Frozen flux formulation
    b. Pseudo transient
    c. K- epsilon Turbulence Model
    d. Turbulent Intensity
    e. Spalart Allamaras Model
4. What is User defined functions? Explain how it is useful for doing analysis?

Section – B (10x4 = 40 Marks)

5. Write about interface treatment of Mixing Plane concept, algorithm and explain how the interface treatment of absolute velocity formulation and relative velocity formulation occurs in the domain?
6. Define Mixture Fraction. Explain the Mixture Fraction theory approach for modeling Non-Premixed Combustion?
7. Explain about a Radiative Transfer equation. What are the advantages and limitations of P1 Radiation Model and DTRM Model?
8. A) Discuss about various Multiphase Models. Explain, which Multiphase model is suitable for Multiphase flow regimes?

(Or)

B) Write about Laws of Heat and Mass Exchange in Discrete Phase?

Section – C (40 Marks)

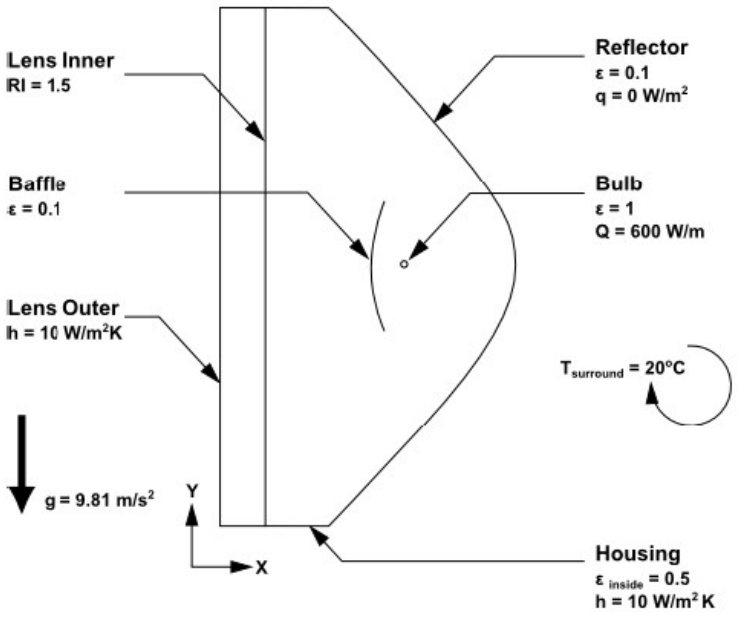
9. A)Consider a flow over an airfoil with protrusion at 0.50 Chord at 15 m/s having length 1 m, calculate first length value (μ=1.8*10^-5, y+ = 1) (5 – Marks)

B) Suggest the domain length and how will you perform grid generation for an airfoil with protrusion at 0.50 Chord (5 – Marks)

C) Explain how the transient numerical analysis can carried out for the mentioned problem in detail at different angles of attack (0 to 20 deg); solution steps and discuss the expected results? (10 – Marks)

10. A) Write about advantages & limitations of Discrete Ordinate Radiation model? (5 – Marks)

B) The problem to be considered is illustrated in Figure, showing a simple two-dimensional section of a headlamp construction. The key components to be included are the bulb, reflector, baffle, lens, and housing. For simplicity, the heat output will only be considered from the bulb surface rather than the filament of the bulb. The radiant load from the bulb will cover all thermal radiation - this includes visible (light) as well as infrared radiation. The ambient conditions to be considered are quiescent air at 20°C. The rear reflector is assumed to be well insulated and heat losses will be ignored. The lens is made from glass and has a refractive index of 1.5. Explain how to carry the numerical analysis and why are we choosing particularly those constraints, discuss the expected results? (15- Marks)



(Or)

The problem to be considered is shown schematically in Figure 5.1. A square box of side L has a hot right wall at T = 2000 K, a cold left wall at T = 1000 K, and adiabatic top and bottom walls. Gravity acts downwards. A buoyant flow develops because of thermally-induced density gradients. The medium contained in the box is assumed to be absorbing and emitting. All walls are black. The objective is to compute the flow and temperature patterns in the box, as well as the wall heat flux, using the DTRM radiation model available in FLUENT, and to compare their performance for different values of the optical thickness aL.

(20– Marks)