UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program: M.Tech CFD	**Semester – III**
Subject (Course): Usage of CFD in Multidisciplinary Application	**Max. Marks : 100**
Course Code : MCFD 801	**Duration : 3 Hrs**
No. of page/s: 2	

Instructions- Read all the below mentioned instructions carefully and follow them strictly
1) ATTEMPT ALL THE PARTS OF A QUESTION AT ONE PLACE ONLY.
2) Internal choice is given for question number 10.
3) Assume suitable data if required

Section A [5 X 4 = 20 marks]

1) Explain the application of different CFD tool in various domain with example.
2) Define the following non dimensional number
   a) Rayleigh No b) Prandtl number c) Nussult number d) Biot number
3) Explain in details the selection of airfoil in turbomachinery with suitable example.
4) Explain the advantages of CFD tool in automobile and aerospace industry with suitable example.

Section B   [10 X 4 = 40 Marks]

5) Explain the following in details with example
   a) K- epsilon and K- omega model
   b) Conformal and non conformal mesh
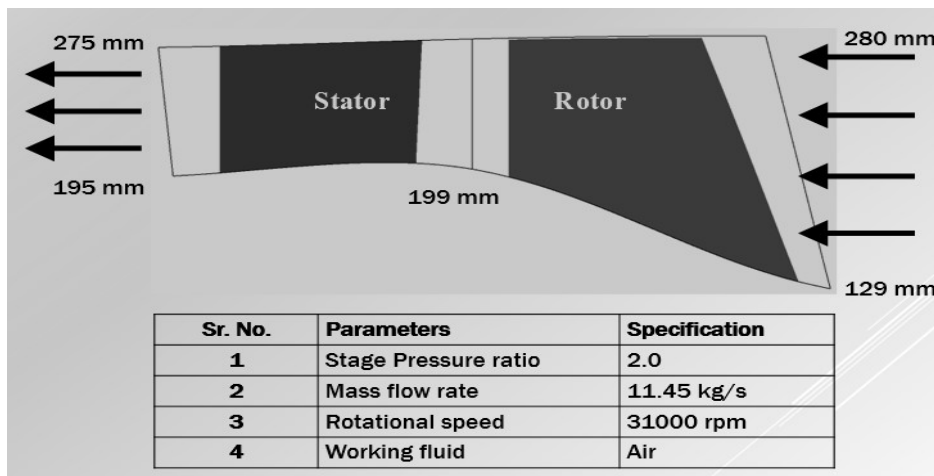
6) Modeled the HVAC blower in proper sequence
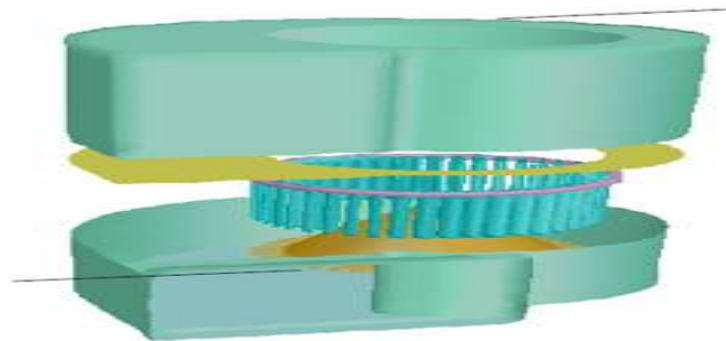
7) An axial flow compressor of 50 percent reaction design has blades with inlet and outlet angles at 45^0 and 10^0 respectively. The compressor is to produce a pressure ratio of 6:1 with overall isentropic efficiency of 0.85 when inlet static temperature is 37^0C. The blade speed and axial velocity are constant throughout the compressor. Assuming a value of 200 m/s for blade speed. Find the number of stages required if the work done factor is (a) unity and (b) 0.87.

8) Explain the flow physics of turbomachinery from the following results and identified the system.
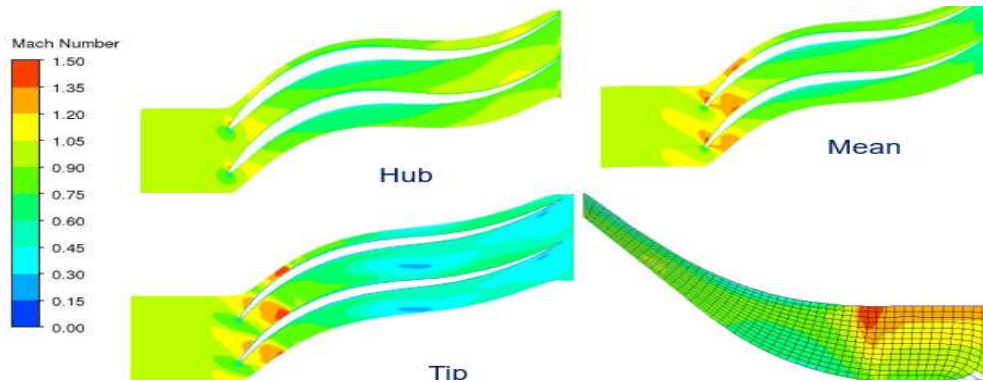
Section C   [20 X 2= 40 marks]

9) Describe the methodology best suited to compute the flow domain for the given boundary condition.

Sr. No.	Parameters	Specification
1	Stage Pressure ratio	2.0
2	Mass flow rate	11.45 kg/s
3	Rotational speed	31000 rpm
4	Working fluid	Air

10) Explain the procedure of aero thermal analysis through basic preliminary design to CFD Post processing of the axial compressor used in the aircraft application and discuss the results out come in details.   (Assume the suitable data if required)

Or

11) Explain the complete modeling of Centrifugal pump for the process industry from the basic requirements to CFD analysis and discuss the results in details. (Assume the suitable data if required)

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Section A [4 X 5 = 20 marks]

1) Briefly explain the following

   a) SST model b) multiphase model available in fluent

2) List and explain the powertrain and non-powertrain application of CFD in automobile

3) How does CFD solver work and explain the method used to solve the equation

4) State briefly the importance of near wall modelling

Section B   [10 X 4 = 40 Marks]

5) Derive the RANS equation and in turn explain the following terms:
   a) Velocity decomposition   b) Ensemble averaging
6) Explain the steps used for meshing the profile in ICEM with suitable example in details.

7) A 10 stage axial flow compressor develops an overall pressure ratio of 8.0 with and isentropic efficiency of 0.85. The absolute velocity component of air enters the rotor at an angle of 27o to the axial direction. The axial component of velocity is constant throughout the compressor and is equal to 150 m/s. The mean blade speed is 200 m/s. If the ambient air conditions are 15oC and 1 bar, determine the angle which the relative component of velocity makes with the axial direction at the exit of the rotor.

8) Discuss the Following CFD results which are model of I.C engine used in automobile. where each color has their own meaning.
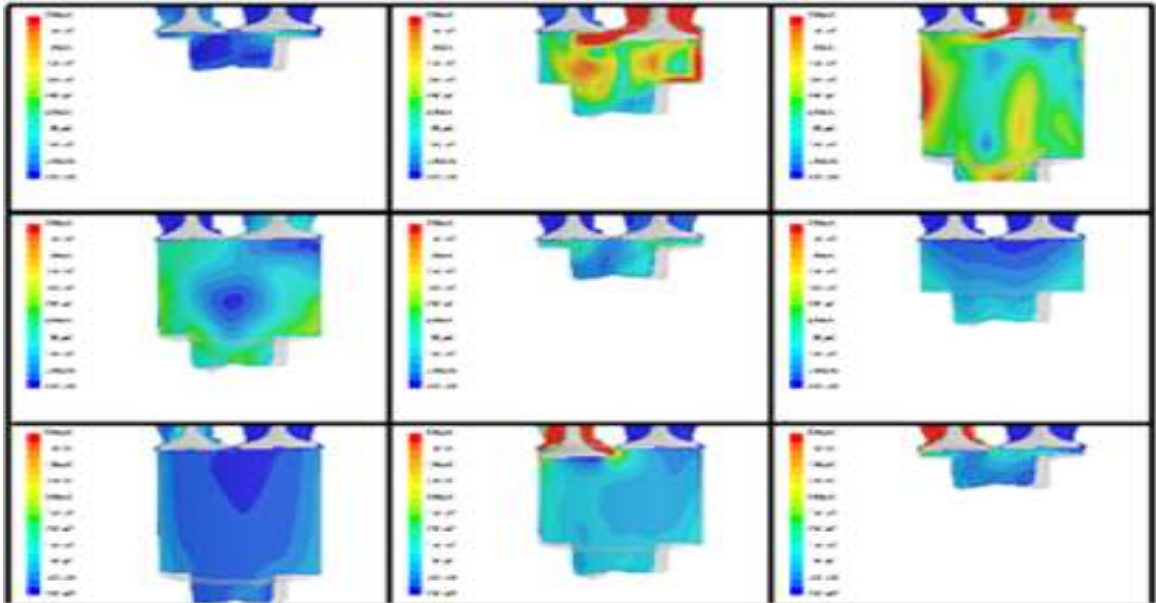
Section C (20 X 2 = marks)

9) Modeled the following tractor in fluent for heavy load application. Write down all the procedure and the boundary condition with results.
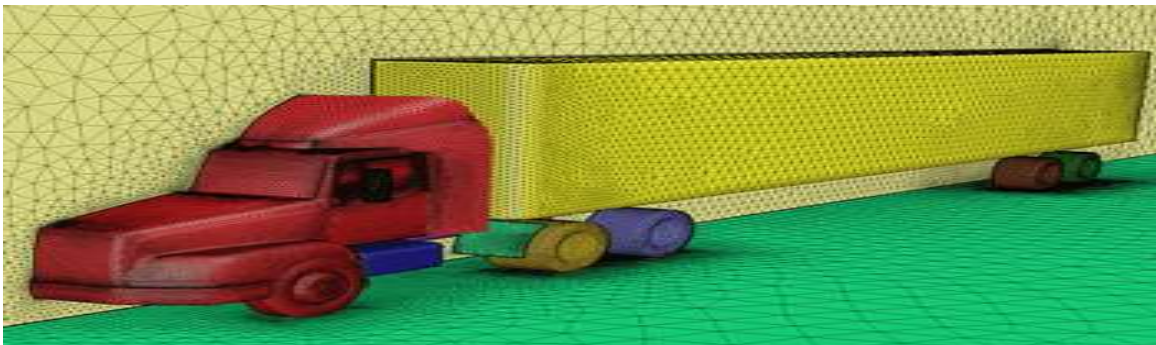
10) Explain the procedure of aero thermal analysis through basic preliminary design to CFD Post processing of the fan used in the aircraft application and discuss the results out come in details.   (Assume the suitable data if required)

Or

11) Explain the complete modeling of condenser for the process industry from the basic requirements to CFD analysis and discuss the results in details.
(Assume the suitable data if required)