Name: Enrolment No:	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2018

Course : Usage of CFD in Multidisciplinary Application **Semester : III**
Course Code : MCFD 801 **Time : 03 hrs.**
Programme : M.Tech CFD **Max. Marks : 100**

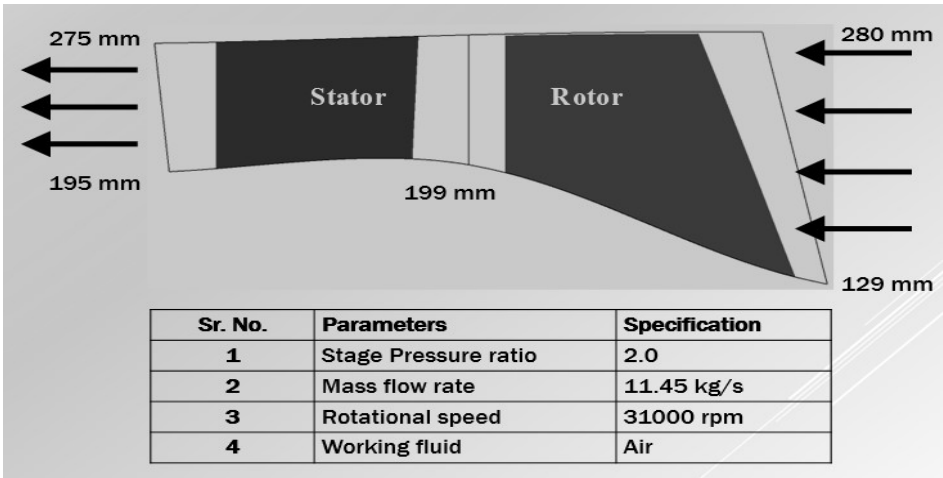
Instructions:
1. **The Question paper has three sections: Section A, B and C.**
2. **Section B and C have internal choices.**

SECTION A

S. No.		Marks	CO
Q 1	Give examples of factors that may cause transition to turbulence at lower Reynolds numbers	4	CO1
2	Explain the advantages of CFD tool in automobile and aerospace industry with suitable example.	4	CO4
3	Briefly explain the following a) SST model for Turbomachinery application b) Multiphase model available in fluent	4	C02
4	Discuss the powertrain and non-powertrain components of automobile and advantages to use CFD tool.	4	C04
5	Describe briefly the importance of wall function approach while using in industrial flow simulations.	4	C01

SECTION B

6	Discuss the selection of airfoil in turbomachinery application based on Mach number.	10	CO2
7	Explain the steps used for meshing the profile in ICEM with suitable example in details.	10	C01
8	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	10	CO3

9	Discuss the brake cooling modeled in the automobile with all the boundary condition used in CFD tool. **Or,** Describe the modeling of electric motor cooling used in the I.C engine with the temperature and heat transfer coefficient as primary boundary condition.	**10**	**CO4**
	SECTION-C		
10	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 |	**20**	**CO3**
11	Design the horizontal wind turbine and analyze the flow domain through basic preliminary design to CFD Post processing and discuss the results out come in details. Take input data Atmospheric pressure 100 Kpa Power to be generated = 200 KW Velocity of air at inlet = 8 m/s Specific heat ratio = 1.4 (Assume the suitable data if required). **Or** Explain the complete modeling of condenser for the process industry from the basic requirements to CFD analysis and discuss the results in details where the mass flow rate of steam is 100 tons per hours and specific heat at constant pressure of water is 4.17 KJ/kgK. (Assume the suitable data if required)	**20**	**C05**

Name: Enrolment No:	UPES

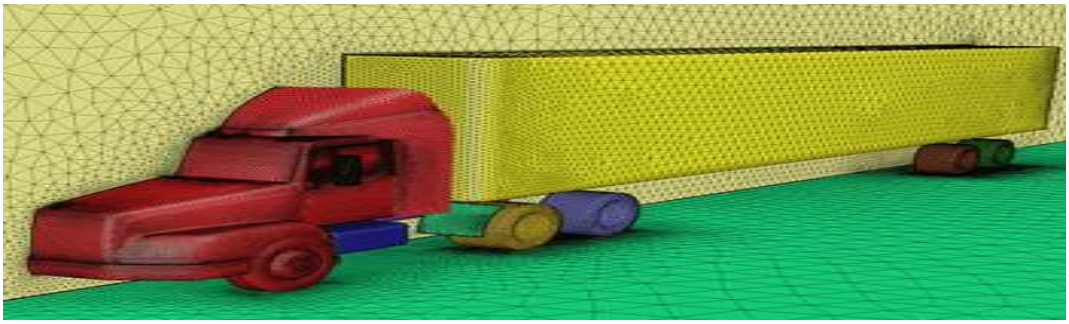
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2018

Course : Usage of CFD in Multidisciplinary Application **Semester : III**
Course Code : MCFD 801 **Time : 03 hrs.**
Programme : M.Tech CFD **Max. Marks : 100**

Instructions:
1. **The Question paper has three sections: Section A, B and C.**
2. **Section B and C have internal choices.**

SECTION A

S. No.		Marks	CO
Q 1	How does CFD solver work and explain the method used to solve the equation	4	CO5
2	Distinguish between viscous sublayer and Log layer	4	C01
3	Define the following Non-Dimensional numbers: a) Rayleigh Number b) Prandtl Number	4	C01
4	Explain the boundary condition used in the high pressure fan in a CFX.	4	C03
5	Expain types of meshing and its importance.	4	C03
	SECTION B		
6	Explain the following in details with example a) K- epsilon and K- omega model b) Conformal and non conformal mesh	10	CO1
7	Explain in brief the following models a) zero equation model b) one equation model	10	C04
8	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.	10	CO3
9	Model a low pressure axial flow fan which is placed before the low pressure compressor for the given boundary condition, starting from basic equation to CFD	10	CO5

	modeling , pressure ratio – 2.8, mass flow rate – 5 kg/s, temperature and pressure at inlet take as a sea level **Or**, Discuss the following term used in the CFD analysis. a) Rotor alone analysis b) Grid independence c) Moving reference plane d) Airfoil stacking e) Effect of changes in incidence angle		
	SECTION C		
10	Modeled the following tractor in fluent for heavy load application. Write down all the procedure and the boundary condition with results. (Assume the suitable data). 	**20**	**CO4**
11	Explain the procedure of aero thermal analysis through basic preliminary design to CFD Post processing of the axial compressor used in the aircraft application for the given boundary and discuss the results out come in details. (Assume the suitable data if required) , Pressure ratio- 8 , Mass flow rate – 20 kg/s Inlet temperature and pressure at sea level **Or**, Explain the complete modeling of Centrifugal pump for the process industry from the basic requirements to CFD analysis and discuss the results in details from the following boundary condition. Pressure head = 15 meter Density of fluid = 1000 kg/m^2 Rotational speed = 1200 RPM (Assume the suitable data if required) .	**20**	**C03**