Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–VI EXAMINATION – WINTER 2025

Subject Code:3161915 Date:29-11-2025

Subject Name:Computational Fluid Dynamics

Time:02:30 PM TO 05:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Define CFD. Briefly explain various steps involve in CFD analysis?	**03**
	(b)	What do you mean by result validation in CFD analysis? Why it is needed?	**04**
	(c)	Explain theoretical, experimental and numerical approach in CFD.	**07**
Q.2	**(a)**	List out basic fundamental principal utilized for CFD analysis. Explain conservation of mass principal briefly.	**03**
	(b)	Differentiate between structured and unstructured grids.	**04**
	(c)	Explain the classification of quasi-linear partial differential equation by using Cramer's rule.	**07**
		OR	
	(c)	Explain Navier-Stokes equation.	**07**
Q.3	**(a)**	Explain various types of boundary condition.	**03**
	(b)	Differentiate between explicit and implicit approach.	**04**
	(c)	List out various computational errors. Explain rounding error with examples.	**07**
		OR	
Q.3	**(a)**	Justify – "Implicit methods are unconditionally stable".	**03**
	(b)	Explain ordinary and partial differential equation with its physical significance.	**04**
	(c)	Explain Tridiagonal Matrix Algorithm by using one dimensional heat conduction equation.	**07**
Q.4	**(a)**	Differentiate between finite difference and finite element method.	**03**
	(b)	Explain finite volume central differencing scheme.	**04**
	(c)	Using Taylor's series derive second order central for the mixed derivative expressions for $\left(\frac{d^2u}{dxdy}\right)_{i,j}$.	**07**
		OR	
Q.4	**(a)**	Compare One and Two equation turbulence models.	**03**
	(b)	Explain RANS turbulence modeling in brief.	**04**
	(c)	Explain different types of grid elements. List out the factors of grid element selection.	**07**
Q.5	**(a)**	Compare SIMPLE and SIMPLEC algorithm.	**03**
	(b)	List out advantages and disadvantages of explicit approach.	**04**
	(c)	Write a note on application of CFD in automobile engineering.	**07**
		OR	
Q.5	**(a)**	Why grid generation is needed in CFD? Explain it.	**03**
	(b)	Explain stretched grid.	**04**
	(c)	Write a note on requirement of grid independence study in CFD.	**07**

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Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–VI (NEW) EXAMINATION – WINTER 2024

Subject Code:3161915 Date:12-12-2024

Subject Name: Computational Fluid Dynamics

Time:02:30 PM TO 05:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	What are the important applications of CFD in engineering?	**03**
	(b)	How do you classify boundary conditions?	**04**
	(c)	What are the different types of Partial Differential Equations (PDE)? Explain the physical Behavior of PDE.	**07**
Q.2	**(a)**	List down the advantages of CFD over experimental methods.	**03**
	(b)	Explain the features of TDMA method.	**04**
	(c)	Explain SIMPLE algorithm.	**07**
		OR	
	(c)	Compare upwind, central and blended difference approximations for convection- diffusion problems.	**07**
Q.3	**(a)**	What is grid transformation? Why it is required?	**03**
	(b)	What are the advantages and disadvantages of κ -ε model ?	**04**
	(c)	Derive an expression for 2-D steady state heat conduction equation in Cartesian coordinates by finite volume method. State the stability criteria.	**07**
		OR	
Q.3	**(a)**	Differentiate between structured and unstructured mesh.	**03**
	(b)	Explain the features of Crank-Nicolson scheme.	**04**
	(c)	Explain the method of solving an incompressible flow problem using stream function vorticity formulation.	**07**
Q.4	**(a)**	Explain factors affecting grid generation.	**03**
	(b)	Differentiate FDM, FEM and FVM.	**04**
	(c)	Derive energy equation in non conservation form.	**07**
		OR	
Q.4	**(a)**	Explain Reynolds transport theorem.	**03**
	(b)	Derive the expression for substantial derivative.	**04**
	(c)	Derive Navier-Stokes equation.	**07**
Q.5	**(a)**	List out difference types of error. Explain any one	**03**
	(b)	Differentiate between explicit and implicit approach.	**04**
	(c)	Explain Lax-Wendroff Method briefly.	**07**
		OR	
Q.5	**(a)**	Difference between One and Two equation models in turbulence modeling.	**03**
	(b)	Explain the momentum equation in no conservation form.	**04**
	(c)	Using Taylor's series expansion 1st order forward, backward and 2nd order central difference formulas.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) EXAMINATION – WINTER 2023

Subject Code:3161915 Date:18-12-2023

Subject Name: Computational Fluid Dynamics

Time: 02:30 PM TO 05:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	What are the needs for problem solving with CFD?	**03**
	(b)	State application of CFD in the field of aeronautical.	**04**
	(c)	Derive Continuity equation for any model of finite control volume. fixed in space.	**07**
Q.2	**(a)**	Define Discretization.	**03**
	(b)	Derive the expression for substantial derivative.	**04**
	(c)	Derive energy equation in non conservation form.	**07**
		OR	
	(c)	Explain the classification of quasi-linear partial differential equation by using Cramer's rule.	**07**
Q.3	**(a)**	Explain inlet and outlet boundary condition	**03**
	(b)	Explain advantages and disadvantages of implicit approach.	**04**
	(c)	Using Taylor's series expansion 1st order forward, backward and 2nd order central difference formulas.	**07**
		OR	
Q.3	**(a)**	Draw a small element representing all the forces acting on it to derive a momentum equation in X direction.	**03**
	(b)	Write a short note on error and stability. And define the stable equation.	**04**
	(c)	Solve FVM problem for 1-D heat diffusion.	**07**
Q.4	**(a)**	Define: Truncation error Round-off error	**03**
	(b)	Discuss unstructured grid.	**04**
	(c)	Explain steps for CFD Preprocessing and CFD Post Processing.	**07**
		OR	
Q.4	**(a)**	What is Boundary Condition? State its importance in solving fluid flow problem.	**03**
	(b)	Write a note on stretched grid.	**04**
	(c)	Derive expressions to transform first derivatives w.r.t x, y & t to ξ, η & τ.	**07**
Q.5	**(a)**	What is grid transformation? Why it is required?	**03**
	(b)	Derive 2nd order derivative terms of Laplace equation in difference terms	**04**
	(c)	Write a short note on Lax-Wendroff technique	**07**
		OR	
Q.5	**(a)**	Explain factors affecting grid generation.	**03**
	(b)	Write a note on relaxation technique.	**04**
	(c)	Using Taylor's series, derive second order central difference for the mixed derivative expressions for $\left(\frac{\partial^2 u}{\partial x \partial y}\right)_{i,j}$	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI(NEW) EXAMINATION – WINTER 2022

Subject Code:3161915 Date:20-12-2022

Subject Name:Computational Fluid Dynamics

Time:02:30 PM TO 05:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Define CFD.	**03**
	(b)	Explain Finite volume method shortly.	**04**
	(c)	Write a note on Experimental, Theoretical and Numerical approach in CFD.	**07**
Q.2	**(a)**	Write an application of CFD in different engineering field.	**03**
	(b)	Write a short note on Reynolds transport theorem.	**04**
	(c)	Derive Navier-Stokes equation.	**07**
		OR	
	(c)	Difference between FVM, FDM and FEM.	**07**
Q.3	**(a)**	What is Tridiagonal matrix algorithm method?	**03**
	(b)	What is Alternative Direction Implicit method?	**04**
	(c)	What is the procedure to find out "1-D steady state diffusion problem" using Finite Volume method?	**07**
		OR	
Q.3	**(a)**	List out different types of Turbulence model.	**03**
	(b)	Make a list of different types of grid. Explain any one in short.	**04**
	(c)	What is the procedure to find out "2-D steady state diffusion problem" using Finite Volume method?	**07**
Q.4	**(a)**	What is the purpose of domain or control volume in CFD problem?	**03**
	(b)	Write a note on "False diffusion".	**04**
	(c)	List out difference types of error. Explain any one	**07**
		OR	
Q.4	**(a)**	Why Boundary condition is required to solve the problem in CFD?	**03**
	(b)	What is advection scheme? Explain	**04**
	(c)	What are the difference between First order Upwind scheme and Second order Upwind scheme? Explain in brief.	**07**
Q.5	**(a)**	Difference between One and Two equation models in turbulence modeling.	**03**
	(b)	What is PISO Algorithm?	**04**
	(c)	Write a note on SIMPLE Algorithm.	**07**
		OR	
Q.5	**(a)**	Explain Domain and boundaries for the solution of elliptic equations in two dimensions.	**03**
	(b)	Explain factors affecting the grid in numerical grid generation.	**04**
	(c)	Briefly explain Lax-Wendroff Method	**07**

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