U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

July 2023 Semester End Main Examinations

Programme: B.E. **Semester: VI**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 20ME6DECFD **Max Marks: 100**
Course: Computational Fluid Dynamics **Date: 17.07.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

			CO	PO	Marks
		UNIT - I			
1	a)	Define CFD. Explain the steps involved in CFD?	*CO1*	*PO1*	**07**
	b)	List the applications of CFD.	*CO1*	*PO1*	**03**
	c)	Derive an integral and conservative form of continuity equation for a finite control volume, fixed in space with fluid flowing through it.	*CO1*	*PO2*	**10**
		OR			
2	a)	List and explain the different physical boundary conditions used in fluid flow and heat transfer problems.	*CO1*	*PO1*	**10**
	b)	Derive the continuity equation for a finite control volume moving with flow and convert the resulting equation in to a differential, non-conservation form of equation.	*CO1*	*PO2*	**10**
		UNIT - II			
3	a)	Show that the second-order wave equation $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$ is a hyperbolic equation.	*CO2*	*PO2*	**05**
	b)	What is finite difference method? Explain the different finite difference methods (FDM) with the help of an example.	*CO2*	*PO1*	**10**
	c)	What is discretization? List different discretization method generally used.	*CO2*	*PO1*	**05**
		UNIT - III			
4	a)	The cooling of a circular fin is to be carried by means of convective heat transfer along its length of 1 m. Convection gives rise to a temperature-dependent heat loss or sink term in the governing equation. The cylindrical fin has uniform cross sectional area *A*. The base is at a temperature of 100 °C and fin tip is insulated. The fin is exposed to an ambient temperature of 20 °C. One dimensional heat transfer in this situation is governed by	*CO3*	*PO2*	**12**

			$\frac{d}{dx}\left(kA\frac{dT}{dx}\right) - hP(T - T_\infty) = 0$. Where h is the convective heat transfer coefficient, P the perimeter, k the thermal conductivity of the material and T_∞ the ambient temperature. Where $h = 300$ W/m^2 K, $P = 0.5$ m, $k = 200$ W/m^2 K, $A=1m^2$ and $n^2 = hP/(kA)$ and $k\,A$ is constant. Divided the computational domain into five control volume and derive the discretised equations for inner and boundary nodes. Calculate the coefficients and express the system of equations in matrix form.			
		b)	Define finite volume method and explain the steps involved.	*CO3*	*PO1*	**08**
			OR			
	5	a)	The heat conduction in an insulated cylindrical rod of 0.5 meter long takes place in axial direction such that its left and right ends are maintained at constant temperatures of 100 °C and 500 °C respectively. The one-dimensional problem is governed by diffusion equation $\frac{d}{dx}\left(kA\frac{dT}{dx}\right) = 0$. The thermal conductivity k of the rod is equal to 1000 W/m K, cross-sectional area A is 10 $\times 10^{-3}$ m^2. Divided the computational domain into four control volumes and derive the discretised equations for inner and boundary nodes. Calculate the coefficients and express the system of equations in to matrices, solving for temperatures at four nodal points.	*CO3*	*PO2*	**12**
		b)	Explain how FVM is different from FDM. What are the advantages of FVM?	*CO3*	*PO1*	**08**
			UNIT - IV			
	6	a)	Solve the following system of linear equations by using Gauss elimination method. $2x + 2y + z = 12$ $3x + 2y + 2z = 8$ $5x + 10y - 8z = 10$	*CO4*	*PO2*	**10**
		b)	What are the steps involved in L-U decomposition method for solving the system of linear equations?	*CO4*	*PO1*	**05**
		c)	Explain how the consistency of a system of non-homogenous liner equations are determined using rank of the matrix.	*CO4*	*PO1*	**05**
			UNIT - V			
	7	a)	Explain how the pressure and velocity of momentum equation are coupled in SIMPLE and SIMPLER algorithm.	*CO5*	*PO1*	**10**
		b)	Explain the different types of grids used in FVM ?. With an example discuss how staggered grids can overcome unrealistic pressure gradient of collocated grids?	*CO5*	*PO2*	**10**

******