COLLEGE OF ENGINEERING, PUNE

(An Autonomous Institute of Government of Maharashtra.)
SHIVAJI NAGAR, PUNE - 411 005

END Semester Examination

(ME-DE-14001) Computational Fluid Dynamics and Heat Transfer

Course: B.Tech Branch: Mechanical Engineering

Semester: Sem VII

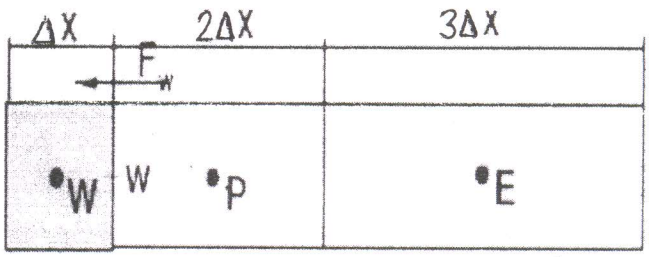
Year: 2014-2015 Max.Marks:60

Duration: 3 Hours Time:- 2 to 5 p.m. 28 NOV 2014 Date: /11/2014

Instructions: MIS No. | | | | | | | | | | |

1. Figures to the right indicate the full marks.
2. Mobile phones and programmable calculators are strictly prohibited.
3. Writing anything on question paper is not allowed.
4. Exchange/Sharing of anything like stationery, calculator is not allowed.
5. Assume suitable data if necessary.
6. Write your MIS Number on Question Paper.
7. Solve any **six** questions.

Q. 1	A.	For a simple geometry problem on a staggered grid system, derive equations for prediction of velocity and mass-fluxes using Semi-Explicit method with complete expressions for advection and diffusion.	**[10]**
Q. 2	A.	Consider 2-D unsteady state pure conduction equation. For explicit finite volume discretization method with uniform grid size $\Delta x = \Delta y$, determine the coefficient of the linear algebraic equation $a_P T_P^{n+1} = a_E T_E^n + a_W T_W^n + a_N T_N^n + a_S T_S^n + b$ for a representative interior cell	**[6]**
	B.	Write a Taylor's series expression. For a rectangular grid form state the expressions for single order Forward, Backword and Central difference PDE's.	**[4]**
Q. 3	A.	Consider a square steel plate having thermal conductivity 63.9 W/m-K maintained left wall at 100°C, bottom wall insulated, right wall with 10 kW/m^2 constant heat generation and top wall with convective heat transfer, having coefficient of convective heat transfer 10 W/m^2-K. Write down the finite volume discretized form of equation and boundary conditions for steady state heat conduction. Consider the 6 x 6 cells. Determine the temperature distribution for at least 3 iterations and an initial condition of 50°C. Present your result for $T_{j,i}$ in tabular form.	**[10]**
Q. 4	A.	Consider a problem of heat transfer in a square plate with circular hole. Discuss the various types of elliptic grids for this problem	**[10]**

		with the help of figures for physical as well as computational domain. Show branch cut in the physical domain for the different types of grids.	
Q. 5	A.	What do you mean by advection scheme? Explain any four advection schemes for 2-D simple geometry problem.	**[10]**
Q. 6	A.	Derive an expression for ϕ_w as a function of cell center values using QUICK convection scheme for the flow in the negative x-direction on the west face with a non-uniform grid structure as shown in fig. 	**[10]**
Q. 7	A.	Define the terms consistency, convergence and stability in FDM. Explain with suitable example the difference between explicit and implicit approach.	**[6]**
	B.	Differentiate between the simple domain and complex domain with examples.	**[4]**