# Collage of Engineering, Pune
# End Semester Examination-Nov-Dec 2012

Course: MTech. Branch: Automotive Technology Semester: III

**ME312: COMPUTATIONAL MODELLING AND SIMULATION**

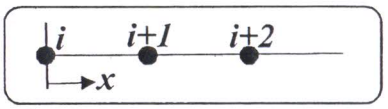
Date: Duration: 3 hrs

Time: Maximum Marks: 60

**INSTRUCTIONS**: All the questions carry equal Marks. Attempt ANY two out of the three (A., B. & C.) for EACH of the five questions below.

Q. 1
A. Discuss the advantages and disadvantages of computational in comparison to experimental and analytical methods in fluid dynamics.
B. Consider a general PDE (partial differential equation) and discuss the condition for an equation to be called as elliptic, parabolic and hyperbolic. Furthermore, write down one elliptic, parabolic and hyperbolic equation encountered in fluid dynamics and heat transfer.
C. Write down the NS (Navier-Stokes) equations and discuss the physical interpretation of the different terms in the equations. Also write down the simplified form of the NS equations.

Q. 2
A. Using a finite difference method, derive the (i) FIRST and (ii) SECOND order discretized equation for $\partial T/\partial x$ at $x=0$; in terms of temperature at $T_i$, $T_{i+1}$ and $T_{i+2}$ (refer the figure).




B. Define stability, convergence and accuracy for a numerical method.
C. What is pressure velocity decoupling in a solution of NS equations on a collocated grid? Explain clearly how this is avoided by using a staggered grid.

Q. 3
A. Consider an example of a square plate with a circular hole, for a heat conduction problem. For this problem, discuss the procedure for generating O- and C- type of curvilinear structured grid.
B. What is the criterion to select a particular type of grid? Discuss the importance of the parameters which are used for mesh quality.
C. Discuss the solution methodology for explicit and implicit method of solution of 2D unsteady heat conduction equation. Also discuss the advantages and disadvantage of the two methods. Write down the stability criterion for explicit method.

Q. 4
For a two-dimensional Cartesian coordinate system, discretize by finite volume method and discuss the approximations used for
A. Unsteady state heat conduction
B. Steady state heat convection
C. Mass conservation or continuity equation and pressure term in X-momentum equation.

Q. 5
A. Write down the equations used for prediction and correction, of $u$- as well as $v$- velocity, in a Semi-Explicit Method for staggered grid system. Also write down the solution algorithm for the semi-explicit method.
B. Write down the equations used for prediction and correction, of $u$- as well as $v$- velocity, in a Semi-Implicit Method for non-staggered grid system. Also write down the solution algorithm for the semi-implicit method.
C. Discuss the philosophy of pressure correction method and derive the pressure correction equation.