

**MASTER OF MECHANICAL ENGINEERING 2<sup>nd</sup> SEM EXAMINATION 2017**

**COMPUTATIONAL FLUID DYNAMICS**

Time: 3 hours

Full Marks: 100

*Answer any four questions*

1. a) Explain with examples elliptic, parabolic, and hyperbolic partial differential equations as used in fluid mechanics.  
b) Obtain the expression for the fourth order accurate central finite difference discretization expression for  $\partial^2 u / \partial x \partial y$   
c) Discuss briefly the advantages and disadvantages of higher order accuracy CFD analysis. 8+12+5
2. a) What do you mean by stability of a difference equation?  
b) What is the difference between implicit and explicit approaches in CFD analysis?  
c) Obtain the stability criterion of the one dimensional heat conduction equation by von Neumann stability method. 6+6+13
3. What do you mean by modified equation? Obtain the modified equation of 1-D wave equation. 5+20
4. a) Briefly discuss the effectiveness of Lax-Wendroff technique. How is this method used to solve time-marching problems on a Taylor series expansion in time?  
b) What do you mean by a well posed problem? 8+10+7
5. a) What is the need for staggered grid ? 6  
b) How is pressure correction introduced in finite difference method ? 6  
c) Describe the various aspects and procedure used in the SIMPLE algorithm. 13