Reg.No. \_\_\_\_\_\_\_\_\_\_\_\_



**UNIVERSITY**

(Karunya Institute of Technology & Sciences)

(Declared as Deemed-to-be University under Sec.3 of the UGC Act, 1956)

**End Semester Examination – Nov/Dec 2017**

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| **Code :** | **14AE3002** | **Duration :** | **3hrs** |
| **Sub. Name :** | **ADVANCED COMPUTATIONAL FLUID DYNAMICS** | **Max. marks :** | **100** |

**ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)**

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| **Q. No.** | | **Sub Div.** | | **Questions** | **Course**  **Outcome** | **Marks** |
| 1. | a. | | Write the Cartesian component form of continuity equation for two dimensional unsteady, Incompressible fluid flow and explain the terms involved | | CO1 | 4 |
| b. | | How does a CFD code work? | | CO1 | 4 |
| c. | | Derive the momentum equation for a viscous flow in non conservation form. | | CO1 | 12 |
| (OR) | | | | | | |
| 2. | a. | | What are the important applications of CFD in engineering andJustify CFD is a research tool. | | CO2 | 6 |
| b. | | Consider the irrational, two dimensional, inviscid, steady flow of a compressible gas. If the flow is slightly perturbed from its free stream condition and the Mach number is either subsonic or supersonic then classify the following equation | | CO1 | 14 |
| 3. | a. | | Consider the 1 D heat conduction equation    Prove that this equation is a Parabolic equation. | | CO1 | 4 |
|  | b. | | Consider the second order PDE  and boundary values are u (1) = 0 .007  u (5.5) = 0 .002  Divide the domain into five grid points. Discretize the above equation by finite difference method and calculate the values of u at three grid points and compare the results with analytical solution. | | CO2 | 16 |
| (OR) | | | | | | |
| 4. |  | | For the following equation     1. Obtain finite discretized form of finite difference quotient. 2. Using explicit approach write the algebraic equation for 4×4 grid. | | CO1 | 20 |
| 5. | a. | | Write the advantage and disadvantage of implicit approach. | | CO1 | 5 |
|  | b. | | Apply the Gaussian elimination to solve the following equations.  5 x1 -2 x2  + 3 x3 = -1  - 3x1 + 9x2  + x3 = 2  2 x1 - x2  -7 x3 = 3 | | CO2 | 15 |
| (OR) | | | | | | |
| 6. |  | | Differentiate between explicit approach and implicit approach for the solution of difference equation. Formulate the implicit form for 1D heat conduction equation. | | CO1 | 20 |
| 7. |  | | Describe the various turbulence approaches used to predict the turbulent flow and highlight the merits of each approach. | | CO2 | 20 |
| (OR) | | | | | | |
| 8. | a. | | What is turbulence modeling. | | CO2 | 5 |
|  | b. | | Explain in detail about the different turbulence models used in CFD and also explain about its significance in real time practical problems. | | CO2 | 15 |
|  | | | **Compulsory**: | |  |  |
| 9. | a. | | Draw and explain the subsonic and supersonic flow through the CD nozzle and derive the continuity equation for the quasi one dimensional flow through the CD nozzle. | | CO2 | 15 |
|  | b. | | Derive the energy equation for the supersonic flow over the flate . | | CO1 | 5 |

ALL THE BEST