Code No: 56070 **R09**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year II Semester Examinations, December - 2018
COMPUTATIONAL AERO DYNAMICS
(Aeronautical Engineering)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks
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1.a) Derive an expression for substantial derivative, considering 'moving infinitesimally small fluid element ' flow model.
b) Explain different types of fluid flow models with neat sketches. What is the need for analyzing the flow behaviour computationally? [8+7]

2.a) Explain why conservation form of governing equations is important for calculations using shock capturing method with the help of an example of flow across a normal shock wave.
b) Discuss why integral form of governing equations is more fundamental than differential form. [8+7]

3.a) What are the characteristics of well posed problems? Explain range and dependence of influence.
b) Classify the quasi-linear partial differential equations by Cramer's rule and explain how it differs with Eigen value method. [8+7]

4.a) What is the order of accuracy for this finite difference approximation?
b) From the Taylor series expansion shown below obtain an expression for the derivative f '(x_0) [7+8]

$$f(x)=\sum_{n=0}^{\infty}\frac{f^{(n)}(x_0)}{n!}.(x-x_0)^n$$

5.a) Explain cell-vertex discretization methodologies used in finite volume approach with the help of sketches.
b) Discuss the general formulation of a numerical scheme based on finite volume method. [7+8]

6.a) What are the available structured grid generation techniques and explain elliptic grid generation.
b) Explain C-H, H-O-H, O-H grid topologies with sketches along with their applications. [7+8]

7. Explain explicit Lax-Wendroff technique for an unsteady, two-dimensional, Inviscid flow. [15]

8.a) Explain PISO algorithm for solving incompressible viscous flow problems.
b) What is the need for staggered grid in CFD techniques? [8+7]

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