Exam. Code: 0944
Sub. Code: 7081

1058

B. Engg. (Mechanical Engg.)

8th Semester

MEC-803: Computational Fluid Dynamics

Time allowed: 3 Hours | Max. Marks: 50

NOTE: *Attempt **five** questions in all, including Q. No. 1 which is compulsory and selecting atleast two questions from each Unit.*

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I. Attempt the following: -

(a) Distinguish between conservation and non-conversation forms of fluid flow.

(b) What are the difficulties in solving the Navier-Stokes equations?

(c) Why forward and backward difference approximations are not more accurate than central difference expressions?

(d) What are the attractive features of quick scheme?

(e) Compare the stability aspect of explicit and implicit equations solving approaches in CFD. (5×2)

UNIT-I

II. (a) Explain the steps to solve a CFD problem. What are the commercial software for CFD? Explain them.

(b) What are different methods used for solving CFD problems? Write their relative merits and demerits.

(c) Write a note on different type of errors and uncertainty in CFD. (3+4+3)

III. (a) Derive the momentum equation used in computational fluid dynamics.

(b) Derive expression for substantial derives ad explain the meaning of its different components. (6+4)

IV. (a) Give your comments on the forms of the governing equations particularly suited for CFD: comments on the conservation form, shock fitting and shock capturing.

(b) Consider the following heat conduction problem $(0 \le x \le 1)$:

$$\frac{d}{dx}\left(K\frac{dT}{dx}\right)+S=0$$

The boundary conditions specified are as follow: $T(1)=\sqrt{2}, \left(\frac{dT}{dx}\right)_{x=0} = 0$

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(i) Is $T = \cos(\pi x) + \sec\left(\frac{\pi x}{4}\right)$ a valid trial function? Explain.

(ii) Is $T = \sin(\pi x) + \cos ec(\pi x)$ a valid weighing function? Explain.

UNIT-II

V. (a) Distinguish between the basic discretization schemes. Derive the expression for 1st order forward, 1st order backward and 2nd order central difference equation with respect to x.

(b) Explain and list the differences between implicit and explicit methods. (5+5)

VI. (a) Derive the finite volume method for connection diffusion equation.

(b) Explain the concept of grid generation in detail. (5+5)

VII. (a) Discuss the properties of discretizatiton schemes and explains upwind discretization applied to FVM.

(b) What is a SIMPLE-R algorithm used for? Explain the steps involved in the algorithm. (5+5)

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