A **Reg. No. :** | | | | | | | | | | |

Question Paper Code: 99705

B.E./B.Tech. DEGREE EXAMINATION, NOV 2024

Elective

Mechanical Engineering

19UME905– COMPUTATIONAL FLUID DYNAMICS

(Regulation 2019)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. For partial differential equation, if $b^2 - 4ac = 0$ then equation is called CO1- U

   (a) hyperbolic (b) parabolic (c) elliptic (d) None of the above

2. Truncation error becomes zero as mesh spacing tends to CO1- U

   (a) maximum (b) minimum (c) zero (d) equal

3. When a direct computation of dependent variables can be made in terms of known quantities, computation is said to be CO2- U

   (a) implicit (b) explicit (c) unique (d) dependent

4. Navier-stokes equation is useful in analysis of CO2- U

   (a) viscous flow (b) non viscous flow (c) Turbulent flow (d) None of the above

5. For compressible, two-dimensional flows, the minimum number of partial differential equations (pde) to be solved is CO3- U

   (a) 3 (b) 4 (c) 5 (d) 6

6. Method in which volume occupied by fluid is divided into a surface mesh is CO3- U

   (a) Finite Volume method (b) Finite element method

   (c) Boundary element method (d) Spectral element method

7. Fluid flow with no energy loss is CO4- U

   (a) viscous fluid (b) non viscous fluid

   (c) either viscous either non viscous (d) None of the above

8. If Pu is upstream pressure and Pd is downstream pressure, Euler number is equal to CO4- U

(a) Pd - Pu/pV² (b) Pu - Pd/pV² (c) Pu - Pd/pV³ (d) Pu - Pd/pV

9. Euler equation is useful for CO5- U

(a) viscid flow (b) inviscid flow (c) rotational flow (d) None of the above

10 Test used to check accuracy of solution is called CO5- U

(a) grid independence test (b) solution test (c) optimal test (d) aspect test

PART – B (5 x 2= 10 Marks)

11 What are the fundamental governing equations of fluid dynamics? CO1- U

12 What are time marching problems? CO2- U

13 Explain the fully implicit scheme. CO3- U

14 Write the Power law scheme for steady one dimensional convection diffusion. CO4- U

15 Explain the advantages of RSM model CO5- U

PART – C (5 x 16= 80 Marks)

16 (a) Derive the mass equation for a 3D compressible flow CO1-App (16)

Or

(b) Consider heat transfer in the boundary layer over a flat plate. The flow is steady, two- dimensional incompressible laminar flow over a flat plate. For stream velocity of the flow is uniform and parallel to the plate. Write the governing (partial differential equation for flow and heat balance. Give the appropriate boundary conditions. Identify whether the equations is linear, parabolic or elliptic. CO1-App (16)

17 (a) Develop the Elliptic equations using Finite Difference Solution methods. CO2-App (16)

Or

(b) Derive the Accuracy of Finite Difference Solutions CO2-App (16)

18 (a) Explain FVM for 1D Steady State Diffusion. CO3-App (16)

Or

(b) Explain Implicit method for 2D and 3D scheme and derive the discretization for transient convection diffusion equation. CO3-App (16)

19	(a)	Explain in detail about the Central Difference scheme.	CO4-App	(16)
		Or		
	(b)	Explain briefly about the assessment of the Central Difference scheme for convection diffusion problems.	CO4-App	(16)
20.	(a)	Compare the general comments on SIMPLE, SIMPLER, SIMLEC and PISO algorithm.	CO5-App	(16)
		Or		
	(b)	Develop k-€ model equation for the turbulence flow.	CO5-App	(16)