Hall Ticket Number:

Code No. : 16505 N (C)

VASAVI COLLEGE OF ENGINEERING *(Autonomous)*, HYDERABAD

B.E. (CBCS) VI-Semester Main Examinations, May-2019 MECH

Computational Fluid Dynamics

Time: **3** hours Max. Marks: **70**

*Note:Answer **ALL** questions in **Part-A** and any **FIVE** from **Part-B***

Q.No.	Stem of the question	M	L	CO	PO
	Part-A (10 × 2=20 Marks)				
1.	List the steps involved in CFD procedure.	2	1	1	1
2.	Determine if the following velocity fields satisfy continuity. $V_x=x^2+2xy$ $V_y=y^2-2xy$	2	3	1	2
3.	Name any, one equation and two equations turbulence models.	2	1	1	1
4.	What are characteristic lines?	2	2	2	1
5.	Define truncation error and round off errors in finite difference method?	2	1	3	1
6.	Define consistency and stability of the finite difference model.	2	1	3	1
7.	List various grid quality parameters used in CFD	2	1	4	1
8.	Why iterative methods are used in solving numerical problems.	2	2	4	1
9.	Considering air flow over a hot plate with following conditions, suggest suitable scheme between central difference and upwind scheme. Density of air 1.1 kg/m^3; Flow velocity is 50 m/s; Thermal conductivity of plate is 400 W/mK; Grid spacing is 1cm.	2	3	3	1
10.	What are the benefits of staggered grid compared to collocated grid	2	2	3	1
	Part-B (5 ×10=50 Marks)				
11. a)	Derive the continuity equation for compressible flow in Cartesian Co-coordinate system in partial differential form?	7	3	1	2
b)	Compare analytical, experimental and numerical methods of fluid dynamics	3	2	1	1
12. a)	Classify the following differential equations into elliptic, parabolic or hyperbolic equations. (1) 2Dimensional Laplace Equation (2) 1DimensionWave equation (3) 1Dimension unsteady heat transfer equation	5	2	1	2
b)	Describe mixing length model along with its benefits and limitations.	5	2	1	1
13. a)	List the advantages and disadvantages of explicit method	3	2	3	1
b)	Consider a large uranium plate of thickness L = 4 cm and thermal conductivity k = 28 W/m °C in which heat is generated uniformly at a constant rate of $g\cdot$ = 5 x 10^6 W/m^3. One side of the plate is maintained at 0°C by iced water while the other side is subjected to convection to an environment at T_∞ = 30°C with a heat transfer coefficient of h = 45 W/m^2°C. Considering a total of three equally spaced nodes in the medium, two at the boundaries and one at the middle, estimate the exposed surface temperature of the plate under steady conditions using the finite difference approach.	7	4	3	2

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14. a)	Find the solution to the following system of equations using the Gauss-Seidel iteration method up to 2 steps with initial guess [1, 1, 1] $10x_1 + x_2 - x_3 = 17$ $2x_1 + 20x_2 + x_3 = 28$ $3x_1 - x_2 + 25x_3 = 105$	6	4	4	2
b)	List the differences between structured and unstructured grid methods	4	1	5	1
15. a)	Source-free heat conduction in an insulated rod of length 0.3 m whose ends are maintained at constant temperatures of 100 °C and 450 °C respectively. Considering as one-dimensional problem calculate the steady state temperature distribution in the rod using finite volume method. Thermal conductivity k equals 800 W/m-K, cross- sectional area A is 10×10^{-3} m^2. (Assume 3 elements).	7	4	3	2
b)	What are the benefits of upwind scheme compared to central difference scheme	3	2	3	1
16. a)	Show the general stress system in a deformable fluid element and write the momentum equation considering normal and shear stress in x- direction.	5	2	1	2
b)	Describe initial and boundary value problems with suitable examples	5	2	3	1
17.	Answer any ***two*** of the following:				
a)	Explain the method of solving $\frac{\partial T}{\partial t} = \alpha \frac{\partial^2 T}{\partial x^2}$ using explicit method and discuss its stability using Von Neumann stability analysis.	5	3	3	1
b)	What is stream function and vorticity formulation? List the assumptions of this method?	5	2	3	1
c)	List the steps in solving an incompressible fluid flow problem using a SIMPLE algorithm.	5	2	3	1

M: Marks; L: Bloom's Taxonomy Level; CO: Course Outcome; PO: Programme Outcome

S. No.	Criteria for questions	Percentage
1	Fundamental knowledge (Level-1 & 2)	59
2	Knowledge on application and analysis (Level-3 & 4)	41
3	*Critical thinking and ability to design (Level-5 & 6) (*wherever applicable, subject to a maximum of 10%)	

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