University of Mumbai

Program: **Mechanical Engineering**

Curriculum Scheme: R-16

Examination: BE(Mechanical) Semester VIII

Course Code: MEDL07034 Course Name: Computational Fluid Dynamics

Time: 2 hour Max. Marks: 80

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Q1.	**Choose the correct option for following questions. All the Questions are compulsory and carry equal marks. 2 Marks each**
1.	The general structure of CFD analysis consist of
Option A:	geometry, meshing, grid, solving
Option B:	pre-processing, solving, post processing
Option C:	domain geometry, meshing, grid, governing equation, boundary conditions, solution
Option D:	solving using governing differential equations
2.	Discretization means
Option A:	integration of governing equation over all control volumes
Option B:	solution of algebric equation by iterative methods
Option C:	conversion of resulting integral equation into system of algebric equation
Option D:	generating valuable results from analysis
3.	The conservation law of general flow variable is rate of increase of variable in control volume with respect to time is
Option A:	sum of increase of variable due to convection and source only
Option B:	sum of increase of variable due to convection, diffusion only
Option C:	sum of increase of variable due to convection, diffusion and source only
Option D:	sum of increase of variable due to body force and surface force only
4.	The sub-division of domain into a number of small, non-overlapping sub-domains is called
Option A:	Structure
Option B:	Computational domain
Option C:	Grid
Option D:	Node
5.	A matrix is said to be singular in which of the following cases?
Option A:	Only if its determinant is zero
Option B:	All elements in the matrix are zero
Option C:	If it contains negative values
Option D:	If its co-factor matrix is a null matrix
6.	Tracking the motion and computing the rate of change of conserved property Ø for fluid particles is called
Option A:	Eulerian Approach
Option B:	Lagrangian Approach

Option C:	Newtonian approach
Option D:	Stokes Approach
7.	Method of weighted resudial is
Option A:	Powerful method to solve differential equations
Option B:	Powerful to solve the algebraic equations
Option C:	Efficient as iterative method
Option D:	Powerful to analyze the domain gemometry
8.	In equation of general transport, terms need surface integral are
Option A:	Rate of change and diffusion
Option B:	Rate of change and source
Option C:	Convection and diffusion
Option D:	Convention and rate of change
9.	Computational fluid dynamic results are _____ wind tunnel results.
Option A:	Better than
Option B:	Analogous to
Option C:	More reliable than
Option D:	Energy consuming when compared to
10.	Stretched grids are
Option A:	Uniform along one coordinate axis and non-uniform along other
Option B:	Uniform grid along both coordinate axis
Option C:	Curvilinear grid having curved grids
Option D:	Boundary grids
11.	System of linear algebraic equations can be solved by which of the following method
Option A:	Gauss-elimination method
Option B:	Differential method
Option C:	Integral method
Option D:	Linear algebra
12.	O-type grids are
Option A:	Uniform grid
Option B:	Structured grid
Option C:	Curvilinear boundary grids
Option D:	Stretched grids
13.	In equation of general transport, terms need surface integral are
Option A:	Rate of change and diffusion
Option B:	Rate of change and source
Option C:	Convection and diffusion
Option D:	Convention and rate of change
14.	Conservativeness is the fundamental property for discretization scheme represent
Option A:	The flux Ø leaving the control volume across certain face must not be same as entering to adjacent control volume.

Option B:	The flux Ø leaving the control volume across certain face must be same as entering to adjacent control volume.
Option C:	There exist various conservation equation at each control volume
Option D:	There is not existence of similarity of flux across adjacent control volume
15.	UPWIND Difference scheme is to overcome
Option A:	Inadquencies of bondedness
Option B:	Inadquencies of conservativeness
Option C:	Inadquencies of transportiveness
Option D:	Inadquencies of identifying flow direction in central differencing
16.	The three point upstream weighted quadratic interpolation for cell face values is sometimes referred as
Option A:	UPWIND Scheme
Option B:	QUICK scheme
Option C:	SIMPLE scheme
Option D:	SIMPLE-R scheme
17.	The hybrid differencing scheme is the combination of
Option A:	Forward differencing and central differencing
Option B:	Central differencing and backward differencing
Option C:	Central differencing and upwind differencing
Option D:	Forward differencing and upwind differencing
18.	The equating corelating pressure density and temperature is
Option A:	Navier stokes equation
Option B:	Momentum Equation
Option C:	Energy equation
Option D:	Equation Of States
19.	Pressure velocity coupling could be achieved by
Option A:	Using momentum equation along three coordinate axis
Option B:	Using Navier Stokes equation along three coordinate axis
Option C:	Using equation of state and continuity equation
Option D:	Using energy equation
20.	Which of the following can be considered as body forces that act on a fluid particle?
Option A:	Centrifugal force
Option B:	Coriolis force
Option C:	Electromagnetic force
Option D:	Gravitational force

Q2	**Solve any Four out of Six.** **5 marks each**
A	Derive the continuity equation in three dimensions
B	Explain the meaning and significance of relaxation techniques used in CFD soltion
C	Discuss the ke-epsilon model used in turbulence modelling
D	Explain the concept of meshing and mesh quality
E	Give an account of errors in CFD

F	What is QUICK? Give the distribution of flux ϕ(Phi) at the face values of a control volume

Q3.	**Solve any Two Questions.** **10 marks each**
A	Consider a large plate of thickness t = 3 cm with an internal heat generation of 1200 kW/m3 and a constant thermal conductivity of 1.1 W/mK. The faces of the plate are maintained at 150 ^{0}C and 300 ^{0}C. Assume that the dimensions in the directions perpendicular to the thickness are so large that the temperature gradients due to conduction are significant in the direction of thickness only • Write the one dimensional governing equation for the above phenomena • Obtain the discretized equation for each node • Arrange the equations in the matrix form and solve it to find the steady state temperature at five equally spaced nodes using TDMA
B	A property ϕ is transported by means of convection and diffusion through a one dimensional domain. The governing equation to be used is $d/dx\ (\rho\ u\ \phi) = d/dx\ (\ \Gamma\ d\phi\ /dx)$. The boundary conditions to be used are at **x = 0, ϕ_0 = 1 and at x = L, ϕ_L = 0.** Assume that the property is transported from x= 0 to x = L. Using five equally spaced nodes and an Upwind scheme, calculate the distribution of ϕ as a function of x for u = 0.15 m/s, L = 2.5 m, ρ = 1.1 kg/m3, Γ = 0.15 kg/ms
C	A thin plate is initially at a uniform temperature of 300^0C. At a certain time t=0, the temperature of the east side of the plate is suddenly reduced to 0^0C. The other surface is insulated. Use the explicit method and time step of 3 seconds; calculate the transient temperature distribution of the plate at the end of the first time step. The plate thickness is 30 mm; thermal conductivity is 20 W/mK and $\rho c = 10 \times 10^6$J/m^{3}K. The governing equation to be used is $\rho\ c(\partial T/\partial t) = \partial/\partial x\ (\ K\ \partial T\ /\partial x)$.