# BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE - PILANI
## Department of Chemical Engineering, Pilani Campus, Rajasthan
## II Semester 2022-2023
## CHE G554 Computational Fluid Dynamics
### Mid Sem Test (Closed Book)

**Duration: 90 Mins** **Date: 15.03.2023** **Max Marks: 25**

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**Q 1** **[4 X 1.5 = 6]**

(a) What is an ill-posed problem?
(b) Explain the need for grid transformation.
(c) Write the pro and cons of the vorticity transport equation method.
(d) Explain the staggered grid

**Q 2** **[5]**

Formulate the finite difference equations using the explicit method for a three-dimensional unsteady state heat conduction problem. Find out the limiting value of $\frac{\Delta x^2}{\alpha \Delta \tau}$, if $\Delta x = 2\Delta y = 3\Delta z$

**Q 3** **[5]**

Two plates are 10 cm apart, and the fluid between them is at rest at $t$ = 0. Suddenly, the top plate moved at a constant speed (8 cm/s). Find the dynamic velocity distribution (two-time interval results) considering the gird spacing of 2.5 cm using the implicit finite difference method. Consider the following data:

$\Delta t$ = 5 seconds ; Viscosity of oil = 3 cP; Density of oil = 900 kg/m$^3$

**Q 4** **[4]**

Explain the SIMPLER algorithm in detail.

**Q 5** **[5]**

The energy equation for a steady two-dimensional flow is given below in Cartesian coordinates.

$$\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} = 0$$

There is a need to transform the grid using the following relations.

$$\xi = \frac{x}{L} \; and \; \zeta = \frac{y}{y_t}$$

$$where \; y_t = H_1 + (H_2 - H_1)\frac{x}{L}$$

Transform the governing equation in the computational domain and draw the schematic of the corresponding computational domain for the physical domain shown in Fig Q5.

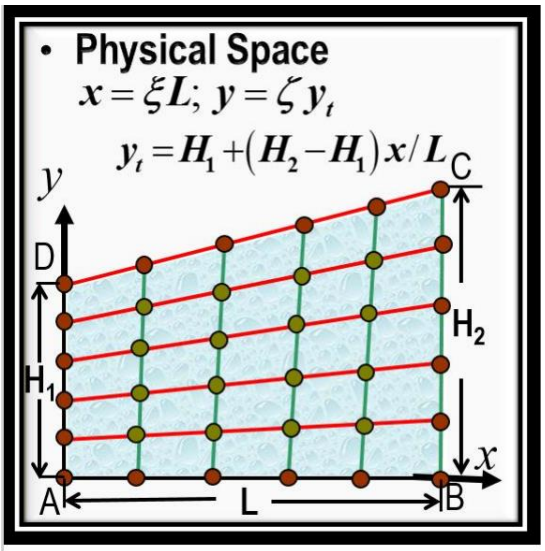


**Fig Q5**