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# The Open University of Sri Lanka
# Faculty of Engineering Technology

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| Study Programme | : | Bachelor of Science Honours in Engineering |
| Name of the Examination | : | Final Examination |
| **Course Code and Title** | : | **DMX6304 – COMPUTATIONAL FLUID DYNAMICS** |
| Academic Year | : | 2024/25 |
| Date | : | 26th February 2026 |
| Time | : | 13.30-16.30 hrs |
| Duration | : | **3 hours** |

**General instructions**

1. Read all instructions carefully before answering the questions.
2. Answer all **five (04)** Questions. All questions carry equal marks.
3. Relevant charts/ codes are provided.
4. This is a Closed Book Test (CBT).
5. Answers should be in clear handwriting.

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Q1 Consider the steady 1D heat conduction equation without heat generation:

$$\frac{d^2T}{dx^2} = 0$$

A rod of length 3 m is divided into **3 equal control volumes** using the **Finite Volume Method (FVM)**.

Boundary conditions:

- $T = 100°C$ at $x = 0$
- $T = 400°C$ at $x = 3$

You may use following discretization if necessary.

For steady 1D conduction:

$$\frac{d}{dx}\left(k\frac{dT}{dx}\right) = 0$$

For uniform grid:

$$a_P T_P = a_W T_W + a_E T_E$$

Since spacing is uniform:

$$T_P = \frac{T_W + T_E}{2}$$

Rearranged:

$$-T_W + 2T_P - T_E = 0$$

(a) Using the finite volume method, derive the discretized equations for the three internal nodes. (8 Marks)

(b) Write the equations in matrix form (5 Marks)

(c) Solve the system of equations using Gaussian Elimination (without pivoting). (8 Marks)

(d) Comment on the temperature distribution obtained. (4 Marks)

Q2 (a) Explain what is meant by Computational Fluid Dynamics (CFD). Discuss its importance in modern engineering applications. (6 Marks)

(b) Describe the governing equations used in CFD. Explain the physical meaning of the continuity, momentum, and energy equations. (6 Marks)

(c) What is grid generation in CFD? Discuss structured and unstructured meshes and their applications. (6 Marks)

(d) Explain the following types of numerical errors in CFD: (7 Marks)

- Truncation error
- Round-off error

Q3 (a) Explain what ANSYS is and discuss its role in Computational Fluid Dynamics (CFD) analysis. (5 Marks)

(b) Discuss the importance of mesh generation in ANSYS. Explain the difference between structured and unstructured meshes and their effect on solution accuracy. (5 Marks)

(c) What is grid generation in CFD? Discuss structured and unstructured meshes and their applications. (8 Marks)

(d) Describe different types of boundary conditions available in ANSYS Fluent. Provide examples of practical applications. (7 Marks)

Q4 A partial differential equation is given below.

$$A\frac{\partial^2 U}{\partial x^2} + B\frac{\partial^2 U}{\partial x \partial y} + C\frac{\partial^2 U}{\partial y^2} + D\frac{\partial U}{\partial x} + E\frac{\partial U}{\partial y} + FU + G = 0$$

Derive the conditions that this equation should satisfy if it is,

(a) Elliptic (10 Marks)

(b) Parabolic (8 Marks)

(c) Hyperbolic (7 Marks)

END

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