SC/MATH/PG/DSE/TH/04/A18/2024

MASTER OF SCIENCE EXAMINATION, 2024

(Second Year, First Semester)

MATHEMATICS

PAPER : DSE - 04

[Computational Fluid Dynamics - I] (Theory)

Full Marks : 24 *Time* : *One hour and fifteen minutes*

Symbols / Notations have their usual meanings.

*Answer **any two** questions.*

1. Derive the computational scheme of finite volume method for solving two-dimensional steady state diffusion equation $\frac{\partial}{\partial x}\left(k\frac{\partial \phi}{\partial x}\right)+\frac{\partial}{\partial y}\left(k\frac{\partial \phi}{\partial y}\right)+S_\phi=0$, where S_ϕ denotes the source term. 12

2. Sketch the control volume for discretizing the continuity equation, x-momentum equation and y-momentum equation while using staggered grid arrangement. Write an algorithm and draw a flowchart for SIMPLE method. 6+3+3

3. Consider a problem of source-free heat conduction in an insulated rod whose ends are maintained at constant temperatures of 100 °C and 500 °C respectively. Calculate the steady state temperature distribution in the rod using finite volume method. Given that the thermal conductivity $\kappa = 1000$ W/mK, cross-sectional area $A = 10 \times 10^{-3}$ m^2. 12

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