Ref. No. Ex/PG/PE/T/128B/2019

M.E. POWER ENGINEERING FIRST YEAR SECOND SEMESTER EXAM 2019

*SUBJECT: **Computational Heat Transfer & Fluid Flow***

Time: Three Hours **Full Marks 100**

Attempt Any FOUR questions.

No. of Questions		Marks
1.a)	Discuss how equations $a_iT_i = b_iT_{i+1} + c_iT_{i-1} + d_i$ ($N \geq i \geq 1$) can be solved by Thomas Algorithm, where T_1 and T_N are known. (a, b, c and d are constants).	13
b)	Briefly discuss the Gauss-Siedel method for solving a set of liner equations, with conditions of convergence. Why it is not popular among reasearches? What is its difference with direct method?	12
2.	Discuss various steps in solving a 2-D unsteady purely conduction problem with source term (partly a function of temperature) using finite volume method.	25
3.a)	Explain how staggered grids are used to overcome the difficulties in solving a 2D pressure-velocity coupled steady flow problem?	10
b)	With an example, explain 'false diffusion'. A 2-D purely convection equation is discretised following upwind scheme. Show mathematically that 'false diffusion' decreases with grid refinement.	15
4.	Show that for 1D convection diffusion equation $\frac{d}{dx}(\rho u\phi) = \frac{d}{dx}(\Gamma\frac{d\phi}{dx})$, the exponential scheme yields the following discretised equation. $a_P\phi_P = a_E\phi_E + a_W\phi_W$, where $a_E = \frac{F_e}{Exp(F_e/D_e)-1}$, $a_W = \frac{F_w Exp(F_w/D_w)}{Exp(F_w/D_w)-1}$ and $a_P = a_E + a_W + (F_e - F_w)$. Hence briefly discuss the hybrid scheme as a simplification of exponential scheme. How the difficulties of central difference scheme and the upwind scheme can be eliminated using this scheme?	25

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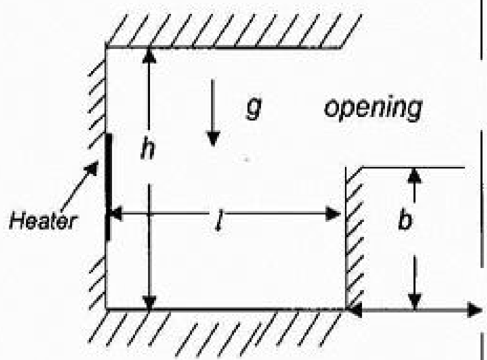
5.	The figure shows a 2-D cavity of height h and length l filled with air. A constant temperature heat source of length s is placed at the center of the LHS wall. There is a barrier at RHS which covers 50% of the RHS side. Remaining 50% is open. All the walls are insulated. (hatched lines in the Figure1). Considering steady laminar natural convection, develop the transport equations with boundary conditions. Also show the non-dimensional form of the equations and boundary conditions using suitable scale. (Incorporate the density variation in the body force term using Boussinesq approximation.)  Figure 1	**25**
6.	Starting from generalized discretised equation show how a 2-D fluid flow problem can be solved using SIMPLER algorithm.	**25**