M.E. POWER ENGINEERING FIRST YEAR SECOND SEMESTER EXAM 2024

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

Time: Three Hours **Full Marks 100**

No. of Questions		Marks	
1.a)	Explain how classification of linear 2nd order differential equation is carried out into hyperbolic parabolic and elliptic types? Give example in each case. What do you mean by 'boundary value problem' and 'initial value problem'? Give example. **OR** State the different kind of boundary conditions that are encountered in a heat conduction problem. Discuss how temperature at the boundary can be obtained by control volume method (use half control volume) when boundary heat flux is specified via heat transfer coefficient and the temperature of the surrounding fluid.	**12**	**CO1**
b)	Explain the advantages and disadvantages of Numerical Methods for analyzing a physical problem compared to other methods.	**9**	**CO1**
c)	What do you mean by consistency and stability of a numerical scheme?	**4**	**CO1**
2. a)	Discuss how equations $a_i T_i = b_i T_{i+1} + c_i T_{i-1} + d_i$ ($N \geq i \geq 1$) can be solved by Thomas Algorithm, where T_1 and T_N are known. (a, b, c and d are constants).	**13**	**CO2**
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**	**CO2**
3.	Discuss various steps in solving a 2-D unsteady purely conduction problem with source term (partly a function of temperature) using finite volume method. Explain in brief the difficulty in adopting explicit method OR Starting from generalized discretised equation show how a 2-D fluid flow problem can be solved using SIMPLER algorithm.	**25**	**CO3**

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No. of Questions		Marks	
4.a)	Explain how staggered grids are used to overcome the difficulties in solving a 2D pressure-velocity coupled steady flow problem?	10	CO3
b	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. OR 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	CO2