Ref. No. Ex/PE/PE/H/T/422C/2023

B.E. Power Engineering - Fourth Year - Second Semester Examination, 2023

SUBJECT: ***Computational Fluid Dynamic (Hons.)***

Time: Four Hours **Full Marks 100**

		Group A (CO1) (25 Marks)	Marks
1	a	The region of interest for analysis in CFD is called a) Cell; b) domain c) range d) node	1
	b	Analysis of steady flow of water through a turbine can be treated as a) Initial value problem, b) boundary value problem c) Marching problem, d) all of the a, b and c	1
	c	The solution in CFD is obtained at different points within the zone of interest. These points are known as a) Grids; b) elements; c) nodes; d) cells;	1
	d	CFD can give _____ results than experiments. Detailed; b) Accurate; c) Reliable; d) Approximate	1
	e	The mass flux out should be equal to the mass flux in. This is mathematically expressed by _____ a) energy equation; b) momentum equation; c) continuity equation; d) flux conservation	1
	f	What is Numerical Method? What are the advantages and disadvantages of numerical methods over other methods of solving a fluid flow problem?	2 +8
	g	Explain how classification of linear 2nd order differential equation is carried out into hyperbolic parabolic and elliptic types? Give example in each case..	10
		Group B (CO2) (20 Marks)	
2	a	Heat flows through an iron rod (radially insulated). One end is open to a heat source, where heat flux is constant. This kind of boundary condition is known as a) Dirichlet bc; b) Neumann bc; c) mixed bc; b) none of these	1
	b	Only boundary conditions are required to given in a _____ problems. a) time-dependent problems; b) marching problems; c) Steady state problems; d) none of these;	1
	c	A nonlinear partial differential equation (related to fluid flow) can be solved using CFD by following method. Direct; b) iterative; c) analytical d) none of these	1
	d	Which of these methods is not a method of solving a set of linear algebraic equation ? a) Matrix inversion b) TDMA c) Gauss-Seidel method d) Spectral element method	1

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	e	Discretization of the governing equations result in _____ a) Integral equations b) Quasi-linear partial differential equations c) Partial differential equations d) Algebraic equations	1
	f	Explain why discretization of PDEs are is required in CFD? Name three types of discretization techniques?	**6**
	g	Explain how one dimensional continuity equation can be discretized by Finite Difference Method (Forward, Backward and central)	**9**
		Group C (CO3) (45 Marks)	
3	**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 TDMA, when T_1 and T_N are known. (a, b, c and d are constants).	**10**
	b	How a set of algebraic equations can be solved by direct method and Gauss-Siedel method? Discuss why these methods are discouraged to solve a fluid flow problem. In this context describe the Scarborough criterion	**15**
	c	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 $a_P = a_E + a_W + (F_e - F_w)$.	**20**
		Group D (CO4) (10 Marks)	
4	**a**	What are the main components of a commercial CFD packages? Name three such commercial software available in the market. Why these software are costly?	2+1+3
	b	What are the main activities required to be done before execute solver of a commercial CFD software.	4