Universidad Carlos III de Madrid

COURSE: COMPUTATIONAL TECHNIQUES IN THERMAL AND FLUIDS ENGINEERING (TÉCNICAS COMPUTATIONALES EN INGENIERÍA TÉRMICA Y DE FLUIDOS)		
POSTGRADUATE PROGRAM: UNIVERSITY MASTER ON INDUSTRIAL MECHANICS (MÁSTER UNIVERSITARIO EN MECÁNICA INDUSTRIAL) Instructors: Antonio Acosta Iborra (coordinator) and Immaculada Iglesias Estradé	ECTS: 6	TERM: 1

WEEKLY PLANNING

WEEK	SESSION	DESCRIPTION	GROUP		SPECIAL ROOM FOR SESSION: Computer classroom (CC) , audio-visual classroom (AVC).	WEEKLY PROGRAMMING FOR STUDENT		
			1	2		DESCRIPTION	CLASS HOURS	HOMEWORK HOURS Max. 7 H per week
1	1	Curse presentation. General concepts concerning computational techniques. Main equations in thermal and fluids engineering.	X			Reading and study of theory. Consultation of provided references.	1,5	5
1	2	Classification of the equations and levels of approximation.		X		Deduction of equations and coding. Solution calculation and interpretation of results.	1,5	
2	3	Sources of inaccuracy in numerical calculations. Discretization of derivatives and numerical schemes for ODEs.	X			Reading and study of theory. Consultation of provided references.	1,5	6
2	4	Practical session: introduction to the programming language used in the course (Matlab and/or Python). Solution of simple exercises.		X	CC	Deduction of equations and coding. Solution calculation and interpretation of results.	1,5	

3	5	Errors in numerical calculations, discretization of derivatives using finite differences (FD). FD schemes for ODEs.	X			Reading and study of theory. Consultation of provided references.	1,5	6
3	6	Practical session: numerical solution of ODEs.		X	CC	Deduction of equations and coding. Solution calculation and interpretation of results.	1,5	
4	7	Systems of ODEs: boundary value problems. PDEs: elliptic equations.	X			Reading and study of theory. Consultation of provided references.	1,5	6
4	8	Practical session: Laplace equation (I).		X	CC	Deduction of equations and coding. Solution calculation and interpretation of results.	1,5	
5	9	Coordinate systems and boundary conditions.	X			Reading and study of theory. Consultation of provided references.	1,5	6
5	10	Collective tutoring session: Laplace equation (II).		X	CC	Deduction of equations and coding. Solution calculation and interpretation of results.	1,5	
6	11	PDEs: parabolic equations. Truncation error, convergence, consistency and stability.	X			Reading and study of theory. Consultation of provided references.	1,5	6

6	12	Practical session: numerical methods for the heat diffusion equation.		X	CC	Deduction of equations and coding. Solution calculation and interpretation of results.	1,5	
7	13	PDEs: linear hyperbolic equations.	X			Reading and study of theory. Consultation of provided references.	1,5	6
7	14	Practical session: numerical methods for the linear advection equation.		X	CC	Deduction of equations and coding. Solution calculation and interpretation of results.	1,5	
8	15	PDEs: nonlinear hyperbolic equations.	X			Reading and study of theory. Consultation of provided references.	1,5	6
8	16	Collective tutoring session: numerical methods for the Burgers equation.		X	CC	Deduction of equations and coding. Solution calculation and interpretation of results.	1,5	
9	17	Finite volume methods (FVM): general concepts and application to conservation equations. FVM applied to the solution of incompressible flows (I). SIMPLE method with upwinding.	X			Reading and study of theory. Consultation of provided references.	1,5	6
9	18	Practical session: presentation of the course project. Date structure of a FVM mesh and general organization of a FVM code.		X	CC	Deduction of equations and coding. Solution calculation and interpretation of	1,5	

						results.		
10	19	FVM applied to incompressible flows (II).	X			Reading and study of theory. Consultation of provided references.	1,5	6
10	20	Practical session: 2D simulation of an incompressible flow in simple domains (I).		X	CC	Deduction of equations and coding. Solution calculation and interpretation of results.	1,5	
11	21	FVM applied to compressible flows.	X			Reading and study of theory. Consultation of provided references.	1,5	6
11	22	Collective tutoring session: 2D simulation of an incompressible flow in simple domains (II).		X	CC	Deduction of equations and coding. Solution calculation and interpretation of results.	1,5	
12	23	FVM applied to non isothermal flows. Discretization of the energy equation.	X			Reading and study of theory. Consultation of provided references.	1,5	6
12	24	Collective tutoring session: 2D simulation of an incompressible flow in simple domains (III).		X	CC	Deduction of equations and coding. Solution calculation and interpretation of results.	1,5	

13	25	Finite elements methods (FEM): general concepts. Application of Galerkin methods to the equations of fluid mechanics and heat transfer.	X			Reading and study of theory. Consultation of provided references.	1,5	6
13	26	Collective tutoring session: data processing and verification of a code.		X	CC	Deduction of equations and coding. Solution calculation and interpretation of results.	1,5	
14	27	Collective tutoring session: Enquiry session and seminars.	X			Reading and study of theory. Consultation of provided references.	1,5	6
14	28	Collective tutoring session: final theoretical-practical questions.		X	CC	Deduction of equations and coding. Solution calculation and interpretation of results.	1,5	
15	-	Class retakes, tutorials, delivery of assignment and project reports, etcetera.				Preparation of final projects and reports.	-	10
16-17	-	Exam preparation and attendance.			CC	Reading and study of theory. Consultation of provided references. Review of procedures seen in the practical sessions. Exam.	3	12
TOTAL HOURS							**45h**	**105h**