4th International School on Numerical Modelling for Applied Superconductivity
June 17th-21st 2024, Barcelona, Spain

DETAILED SCHOOL PROGRAMME

Start time	End time	Length	Title/Description	Teacher
Monday 17 June 2024				
8:30 am	9:00 am	30	Registration	
9:00 am	9:15 am	15	Introduction and opening welcome	A. Portone (F4E), M. Breschi (University of Bologna)
Session I: Introduction to applications				
9:15 am	10:30 am	75	Introduction to fusion magnets: present status and design aspects	A. Portone (F4E)
10:30 am	**10:50 am**	**20**	**Coffee Break**	
10:50 am	12:05 pm	75	Introduction to electrical machines: present status and design aspects	T. Reis (Oswald Elektromotoren GmbH, Germany)
Session II: Introduction to numerical methods				
12:05 pm	1:05 pm	60	Basics of different numerical methods. Finite element method: theory, weak formulation, meshing, basis functions, implementation.	C. Geuzaine, Université de Liege, Belgium
1:05 pm	**2:35 pm**	**90**	**Lunch**	
2:35 pm	4:35 pm	120	Introduction to superconductor modelling. Poisson and Laplace equations with FEM.	C. Geuzaine, Université de Liege, Belgium
4:35 pm	**4:55 pm**	**20**	**Coffee Break**	
Session III: Introduction to numerical methods - computer practice				
4:55 pm	6:45 pm	110	Multiphysics modelling of superconductors	B. Bordini (CERN)
Tuesday 18 June 2024				
Session IV: Electromagnetics (Electrical machines)				
8:30 am	9:30 am	60	Relevance of benchmarks in numerical models of super-conducting devices. Simplified model of a rotating machine: dynamo with permanent magnets	M. Ainslie (King's College London, UK)
9:30 am	**9:50 am**	**20**	**Coffee Break**	
Session V: Electromagnetics (Electrical machines) - computer practice				
9:50 am	11:50 am	120	Dynamo with permanent magnets: a numerical benchmark	M. Ainslie (King's College London, UK)
11:50 am	**12:00 pm**	**10**	**Short Break**	
12:00 pm	**1:30 pm**	**90**	**Student Poster session**	**All students**
1:30 pm	**3:00 pm**	**90**	**Lunch**	

Start time	End time	Length	Title/Description	Teacher
Session VI: Electromagnetics (Fusion)				
3:00 pm	4:30 pm	90	Field computation for fusion magnets. Static (TF) and dynamic (CS/PF) field analysis methods on magnets. Plasma magnetic equilibrium and control, plasma disruptions and AC losses analysis. Force computation.	F. Villone (University Federico II, Naples, Italy)
Session VII: Electromagnetics (Fusion) - computer practice				
4:30 pm	6:30 pm	120	Magnetic analysis of tokamak magnets. Brief introduction to the electromagnetic module of ANSYS and APDL scripts. ANSYS EMAG #1: 2D axisymmetric mesh generation and computation of B-field map and forces on CS and PF smeared winding pack. ANSYS EMAG #2: 2D mesh extrusion and computation of field profile along 1 specific TF conductor and volumetric forces on CS and PF coils for subsequent mechanical analysis.	P. Testoni (F4E)
Wednesday 19 June 2024				
Session VIII: Design of superconducting electrical machines				
08:30:00	10:00:00	90	Analytical design of HTS electrical machines	Y. Liu (Harbin Institute of Technology, China)
10:00 am	**10:20 am**	**20**	**Coffee Break**	
Session IX: Design of superconducting electrical machines - computer practice				
10:20 am	12:20 pm	120	Numerical design of a specific machine	Y. Liu (Harbin Institute of Technology, China)
12:20 pm	**1:50 pm**	**90**	**Lunch**	
Thursday 20 June 2024				
Session X: Dynamic modelling and AC loss calculation in rotating machines (Electrical machines)				
8:30 am	10:00 am	90	Calculation of AC losses in windings subjected to a rotating magnetic field	F. Trillaud (UNAM, Mexico)
10:00 am	**10:20 am**	**20**	**Coffee Break**	
Session XI: AC loss calculation in rotating machines (Electrical machines) - computer practice				
10:20 am	12:20 pm	120	COMSOL modelling of AC losses in rotating machines	F. Trillaud (UNAM, Mexico)
12:20 pm	**1:50 pm**	**90**	**Lunch**	
Session XII: Thermo-hydraulics and quench in Cable in Conduit Conductors (Fusion magnets)				
1:50 pm	3:50 pm	120	Margin, cooling and quench of Cable in Conduit Conductors	L. Bottura (CERN)
3:50 pm	**4:10 pm**	**20**	**Coffee Break**	
Session XIII: Quench in Cable in Conduit Conductors (Fusion magnets) - computer practice				
4:10 pm	6:10 pm	120	Quench analysis of tokamak magnets	L. Bottura (CERN)
8:00 pm			**Social dinner and best poster awards ceremony**	

Start time	End time	Length	Title/Description	Teacher
			Friday 21 June 2016	
			Session XIV: Mechanics (Fusion)	
8:30 am	10:30 am	120	Fundamentals of mechanics of composites for superconducting magnets (Strain sensitivity of commercial superconductors, Forces and stresses in S.C. magnets, Stress analysis in TF, CS and PF coils. Static stresses and fatigue. Introduction to structural assessment)	J. Lorenzo (F4E)
10:30 am	**10:50 am**	**20**	**Coffee Break**	
			Session XV: Fusion magnets mechanics - computer practice	
10:50 am	12:50 pm	120	Mechanical analysis of tokamak magnets {ANSYS MECH#1: compute conductor smeared mechanical properties (from local to global). ANSYS MECH#2: generate a 3D cyclic symmetric Central Solenoid (CS) smeared mesh, apply loads and B.C. then compute stresses; ANSYS MECH#3: compute stresses in CS conductor by mapping displacements on local model, compute stresses on detailed, local model (from global to local). *Optional: Path definition, stress linearization and basic assessment*	L. Reccia (F4E)
12:50 pm	**2:20 pm**	**90**	**Lunch**	
			Exam for EU PhD credits	
2:20 pm	3:20 pm	60	Exam for the acquisition of European credits	Students interested in the official EU credits
			Wrap up session	
3:20 pm	4:00 pm	40	School wrap-up and discussion with participants	All participants