PUBBLICAZIONE, AI SENSI DELL'ART. 19 DEL D.LGS N. 33 DEL 14 MARZO 2013, MODIFICATO DALL'ART. 18 DEL D.LGS N. 97 DEL 25 MAGGIO 2016 COME INTEGRATO DALL'ART.1 C. 145 DELLA LEGGE 27 DICEMBRE 2019 N. 160, DELLE TRACCE D'ESAME STABILITE DALLA COMMISSIONE ESAMINATRICE DELLA SELEZIONE DI SEGUITO INDICATA NELLA RIUNIONE IN DATA 28/07/2026

SELEZIONE PER IL CONFERIMENTO DI NR. 1 ***"CONTRATTO DI RICERCA"***, AI SENSI DELL'ART. 22 DELLA LEGGE 30 DICEMBRE 2010 NR. 240

Istituto di Scienze e Tecnologie per l'Energia e la Mobilità Sostenibili (Sede Secondaria di Ferrara) – CUP B73C26000410005.

BANDO CR N. 4 STEMS FE

Tracce prova orale

Domanda n. 1 – Estratta

1. Il candidato illustri sinteticamente il progetto che ha presentato.

2. **Tematica:** "CFD multifase e multi-fisica"

   Quesito:
   Il candidato illustri un caso concreto di un problema multifase in cui ha utilizzato modelli e software per la simulazione CFD multifase. Quali approcci (Euleriano, Lagrangiano, VOF, ecc.) possono essere usati con Ansys Fluent?

3. Valutazione conoscenza lingua inglese:

From "THE HANDBOOK OF FLUID DYNAMICS", Edited by Richard W. Johnson, 2000, ISBN3-540-64612-4.

Boundary Condition – All of the differential equations cited in this section must, of course, be solved with boundary and initial conditions. Although the differential equations are well established and generally agreed upon, the choice of boundary conditions can sometimes be controversial. The reason for this is that sometimes the physical or chemical situations at the boundaries of the system may not be well understood. In solving the Navier-Stokes equation it is customary to assume that the fluid "clings" to the bounding surfaces, so that fluid velocity u is equal to the velocity of the surface. This well-known "no-slip" boundary condition has been challenged [Richardson, 1973]; the "no-slip" condition on smooth walls turns out to be equivalent to a "complete slip" boundary condition at a corrugated surface! For some problems, it may be possible to specify the shearing force at the surface (the viscous normal stresses are zero for Newtonian fluids for any kind of flow, when the assumption of incompressibility is made). At the interface between two immiscible liquids, the usual interfacial conditions are that the fluid velocity and the normal component of the momentum flux are taken to be continuous. At the interface between a liquid and a gas, it is often assumed that there is no momentum transfer between the liquid and the gas.

Domanda n. 2 –Non estratta

1. Il candidato illustri sinteticamente il progetto che ha presentato.

2. **Tematica:** "Modellazione termica delle batterie Li-Ion"

   Quesito:
   Quali sono le principali sfide nella modellazione numerica del comportamento termico di una batteria agli ioni di litio e quali parametri ritiene maggiormente influenti sulla precisione delle simulazioni? Ritiene più adatto Solidworks o Ansys per queste modellazioni?

3. Valutazione conoscenza lingua inglese:

From "THE HANDBOOK OF FLUID DYNAMICS", Edited by Richard W. Johnson, 2000, ISBN3-540-64612-4.

(Simplified Forms of the General equations) Introduction – The equations for the conservation of mass, momentum, and energy and the thermodynamic relations plus boundary conditions for a viscous, compressible, heat-conducting fluid were presented in the previous chapter. In many instances the fluid phenomena of interest can be described by simplifying these equations. Simplifications are most directly determined by appropriately nondimensionalizing each term in the equations and boundary conditions such that each nondimensional term is of the same order of magnitude. The magnitude of nondimensional parameters that appear in the equations and boundary conditions as a result of this process then give the relative magnitude of individual terms and indicate simplifications that can be made under the circumstances of allowing some of the parameters to go to an extreme value of zero or infinity. The magnitude of the ignored terms should be estimated using the solution to the simplified equations and boundary conditions to compute the ignored terms and then they should be compared to retained terms to make sure that the simplification was justified for the particular application.

Domanda n. 3 – Estratta

1. Il candidato illustri sinteticamente il progetto che ha presentato.

2. **Tematica:** "Modellazione multi-scala (0D/1D vs 3D)"

   Quesito:

In quali situazioni ritiene più efficace un approccio 1D rispetto a uno 3D (o viceversa)? Può fare un esempio di integrazione tra Simcenter Amesim e Ansys?

3. Valutazione conoscenza lingua inglese:

From "THE HANDBOOK OF FLUID DYNAMICS", Edited by Richard W. Johnson, 2000, ISBN3-540-64612-4.

(Conservation Laws in Control Volume Form) Basic Forms – Four basic conservation laws, (i) mass, (ii) momentum, (iii) moment-of-momentum, and (iv) energy will be considered in this section. Their respective uses can be summarized as providing (i) inflow/out-flow/storage mass balances, (ii) evaluation of the net force on a spatial domain, (iii) evaluation of the effective point-of-application of a net force, and (iv) evaluation of the power required to induce a given flow and/or the expected flow rate for a given power consumption or driving "potential" in the form of an "elevation head"- such as a water tower - or a pressurized plenum. A generic representation of a control volume is shown in Fig. 5.7. The "thermodynamic system" has the conventual designation of "a fixed collection of mass particles" and the system is surrounded by the control surface at time "t". The symbol n represents the outward drawn normal to the control surface. At time t+δt, the control surface may have deformed and the system will (in general) be convected past the control surface boundary. Hence, nonsystem material will (in general) be present within the control volume and system material will (in general) be beyond the control volume at time t+δt.

Domanda n. 4 – Estratta

1. Il candidato illustri sinteticamente il progetto che ha presentato.

2. **Tematica:** "Flussi multifase ad alta temperatura"

   Quesito:
   Quali sono le principali difficoltà nella simulazione di flussi multicomponente con condensazione e separazione di particolato? Come le affronterebbe in Ansys Fluent o CFX?

3. Valutazione conoscenza lingua inglese:

From "THE HANDBOOK OF FLUID DYNAMICS", Edited by Richard W. Johnson, 2000, ISBN3-540-64612-4.

Momentum Transfer – In gas-solid flows, flow patterns of both phases depend not only on the initial conditions and physical boundaries of the system but also on the mechanisms of momentum transfer or the interacting forces between the phases. The forces controlling the motions of particles may be classified into three groups:(1) forces through the interface between fluid and particles; (2) forces due to the interactions between particles; and (3) forces imposed by external fields. Although interparticle forces and field forces do not directly change the course of the fluid motion, they may indirectly influence the motion via particle-fluid interactions. The motion of a single particle without short-range interactions and in the absence of external forcefields may be generally described by a nonspherical particle accelerating and rotating in a nonuniform flow field. The complex movement of the particle may be logically perceived to comprise four types of simple motion of a sphere or an equivalent sphere assuming that they are noninteractive: (1) a particle moving with a constant velocity in a uniform flow field; (2) a particle accelerating in a uniform flow field;(3) a particle moving with a constant velocity in a nonuniform flow field; and (4) a particle rotating with a constant angular velocity in a uniform flow field.

Domanda n. 5 – Estratta

1. Il candidato illustri sinteticamente il progetto che ha presentato.

2. **Tematica:** "Validazione e similitudine"

   Quesito:
   Come definirebbe i criteri di similitudine idraulica per scalare un sistema reale a un modello sperimentale o numerico? Quali parametri adimensionali considererebbe e come valuterebbe l'incertezza del modello? In che modo software tipo Ansys Fluent o CFX forniscono elementi per valutare l'incertezza del modello?

3. Valutazione conoscenza lingua inglese:

From "THE HANDBOOK OF FLUID DYNAMICS", Edited by Richard W. Johnson, 2000, ISBN3-540-64612-4.

Classification of Finite-Difference Models – As in the case of finite-element models, there are many alternative classifications available for categorizing finite-difference approximations. The first relevant classification is a geometric one, based on whether the finite-difference grid is structured (i.e., possesses a regularly spaced lattice structure) or unstructured. In order to maintain optimal convergence rates, finite-difference models must use regular spacings of grid points. This regularity is easy to maintain when the problem geometry is simple, but if the natural geometry is complicated, then the regularity of the difference grid will be compromised, with the potential for an attendant loss of convergence rate. In cases of irregular geometry, unstructured meshes are used, and if optimal convergence rates are to be realized, then a coordinate mapping from the actual problem geometry to regularized computational domain must be constructed. The problem with using structured grids on irregular or curved domains is diagrammed in Fig. 26.4. Here a curved boundary is approximated using a low-order linear finite-element mesh (on the left of the figure) and a corresponding finite-difference/finite volume scheme (on the right).

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