<table>
<tr><th colspan="3">Course on "Structural Plant Design"</th></tr>
<tr><th>Units and LO Statements</th><td colspan="2"></td></tr>
<tr><td rowspan="3">Unit 1 – Plant Design Criteria (20 hours)</td><td colspan="2">Responsibility / Autonomy</td></tr>
<tr><td colspan="2">Autonomous use of structural mechanics and beam and shell theory (principles and equations)</td></tr>
<tr><td>Skills</td><td>Knowledge</td></tr>
<tr><td>• Standard Design Criteria/Guidelines for Balance of Plant of Thermal Power Project
• Basic Concepts about structural design
• Design criteria: environmental factors
• General criteria and issues of plant design (services and auxiliary building, main equipment)
• System, Structure and Components seismic and quality classification
• Design loads and criteria
• Balance Equations for
o Definitions of natural/internal events
o Useful Mathematical Relationships
o Level of Detail in Balance Equations
o Integral Lumped Parameter Equations</td><td>• Characterise the state of a plant SSCs on the basis of commonly used design criteria
• Convert environment constraints into loads
• Equation of linearity, balance equations and surface/ volume integrals
• Write balance equations in Eulerian and Lagrangian form
• Write and apply lumped parameter balance equations to simple systems (water tank, heat exchanger, forces on a pipe bend)
• Write integral and differential equations
• Solve the related typical problems
• Retrieve the mass, momentum and energy equations from the general formulation of partial differential balance equations
(...)</td><td>• Definitions and practical characterisation of plant lay-out
• Distinction among the ranges of existence and new plant criteria
• Distinction between the different models adopted in thermos-mechanics or dynamic analysis
• Characteristics and limitations of different models and Equation of State (e.g., isotropic, anisotropic, etc.)
• Concept of linearity and Hook laws
• Concept of equilibrium
• De Saint Venant solution and combination of loads
• General concept of equilibrium and its applications
• Eulerian and Lagrangian points of view for writing integral and differential equations
• Implicit and semi-implic approach for solving fluid-structure interaction equation
• Understanding the relation between Eulerian and Lagrangian forms of balance equations
• (…)</td></tr>
<tr><td rowspan="3">Unit 2 – Soil Structure Interaction (10 hours)</td><td colspan="2">Responsibility / Autonomy</td></tr>
<tr><td colspan="2">Autonomous use of soil-structure mechanics (principles and equations)</td></tr>
<tr><td>Skills</td><td>Knowledge</td></tr>
<tr><td>• Overview Of Regulation and method of Analysis</td><td>• Characterise the state of a plant SSCs on the basis of commonly used design criteria</td><td>• Definitions and practical characterisation of plant and plant-soil interface</td></tr>
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• Limit State Analysis / Design • Actions and resistances • basis of shape & mode of resisting pressure due to backfill • SSI Methodology • Analysis Solution	• Convert environment constraints into loads • Equation of linearity, balance equations and surface/ volume integrals • Write balance equations • Write and apply lumped parameter balance equations to simple systems (water tank, heat exchanger, forces on a pipe bend) • Write integral and differential equations • Solve the related typical problems	• Concept of linearity and Hook laws • Distinction between the different models adopted in soil-mechanics. • Soil non-linear behavior and hydrodynamic effects; • Inertial effects associated with masses and gravity loads interacting; • compatibility between the deformations of the soil, wall, and tiebacks, when present. • Combination of loads • General concept of equilibrium and its applications • Eulerian and Lagrangian points of view for writing integral and differential equations • Implicit and semi-implicit approach for solving fluid-structure interaction equation • Understanding the relation between Eulerian and Lagrangian forms of balance equations • (…)
Unit 3 –Seismic safety design of NPP SSCs (30 hours)	**Responsibility / Autonomy** Autonomous use of structural dynamic principles and equations	
	Skills	**Knowledge**
• Safety Reference Levels • Design Basis Envelope for Existing/New NPP • Overview of seismic regulation • Assessment of natural hazards • Seismic ground motion • Seismic hazards methodology • Design earthquake • Design approach (load case and event approach) • Methodology (Linear or Nonlinear, Multi-Spectra or Time-History) • Assessment of margins • Balance Equations for	• Characterise the SSCs S by seismic and quality classification • Convert environment constraints into design basis envelop • Determine as-built conditions • Estimate capacity of components • Equation of linearity, balance equations and surface/ volume integrals • Write balance equations in Eulerian and Lagrangian form	• Definitions and practical characterisation of site • Combination of loads • General concept of equilibrium and its applications Concept of linearity and Hook laws • Inertial effects associated with masses and gravity loads interacting; • Demand/Capacity Ratio • Distinction between the different models adopted. • Compatibility between deformations of the SSCs, when present. • Member and Global Response

○ Mathematical Relationships ○ Level of Detail in Balance Equations ○ SDOF or MDOFs approach ○ Lumped Parameter Equations • Design and construction rules of the operators • Selection and design of retrofit measures • Technical standards	• Write and apply lumped parameter balance equations to simple systems • Write integral and differential equations • Force-based linear procedures • P-Δ effects • Determine safety margin • Solve the related typical problems for Piping, Valve (…)	• Lagrangian points of view for writing integral and differential equation • Implicit and semi-implicit approach for solving motion equation • Ageing mechanisms • (…)
Assessment criteria: to demonstrate mastery and innovation, advanced skills, required to solve complex and unpredictable problems in a specialised field of NPP structural integrity		
Recommended assessment methods: face to face examination,		

Course applicable (in part or fully) for the following job profiles:

- Nuclear engineer
- Safety engineer