Evaluation criteria – PhD cycle XXXIX

Qualifications and project will be evaluated according to the following evaluation grid:

1. Titles (max 44 points)

1.1 Curriculum studiorum (max 32 points)

1.1.1 For students who have already graduated, at the time of assessment of qualifications, the degree grade (master's, specialist or single-cycle) is considered to assign a maximum of 32 points in accordance with the following table:

Mark	Points
110 e lode	32
110	30
109	28.5
108	27
107	25.5
106	24
105	22.5
104	21
103	19.5
102	18
101	16.5
100	15
<100	13

1.1.2 For students who will discuss the thesis after the assessment of qualifications, the arithmetic mean of the marks achieved in the courses taken in the master's degree will be taken into consideration to assign a maximum of 32 points in accordance with the following table:

Arithmetic mean		Points
>28,50		32
28,23	28,49	30
27,95	28,22	28.5
27,68	27,94	27
27,41	27,67	25.5
27,14	27,40	24
26,86	27,13	21

26,59	26,85	18
26,32	26,58	15
<26,31		13

1.2. other titles (max 12 points)

- Path of Excellence or equivalent qualification issued by other universities (2 points)

- Experiences relevant to the educational objectives of the doctorate such as diplomas and training or specialization courses, collaboration grants, research grants and the like, and other activities related to the topics of the doctorate, but carried out outside the training courses of the CdS followed by the candidate (max 6 points).
- Publications (max 4 points)

2. Research project (max 16 points)

For the purposes of selection for the research doctorate, the candidate must present a project that allows assessing the candidate's propensity for research and his or her ability to organize the various phases independently. The project must have a maximum length of less than 12,000 characters (including spaces), under penalty of exclusion from the admission procedure. However, the project presented for competition purposes does not constitute a constraint in carrying out the research activity during the PhD course.

Elements of specific evaluation will constitute:

• Knowledge of the state of the art (4 points)

• Originality and innovative content (4 points)

• Clarity and completeness of the presentation of the objectives, methodologies and potential results (4 points)

• Relevance of the project to the educational objectives of the PhD (4 points)

3. Oral examination (max 60 points)

Candidates who have obtained a vote of at least 32/60 in the overall assessment of qualifications and the project are admitted to the oral test.
During the oral exam, the basic knowledge and two disciplinary sectors chosen by the candidate among the five proposed (see syllabus) (max 40 points) will be verified.
The Commission will also evaluate the motivations, interests and aptitude for research, through discussion of previous activity and presentation of up to 3 illustrative slides relating to the research project (max 20 points).
The oral test is considered passed if the candidate has obtained the vote of 42/60.
The minimum overall score for admission to the research doctorate is 74/120.

SYLLABUS (Cycle 39)

COMMON TOPICS: These topics are mandatory to all candidates.

MATHEMATICS AND NUMERICAL METHODS
Trigonometry: trigonometric functions, Pythagorean identities, angle transformation formulae, Euler's formula. Complex number and analytic functions.

Analytical Geometry: coordinates, equations and curves, distance and angle, intersection of geometric objects, tangent and normal, coordinate transformation.

Calculus: limits and continuity; differential calculus; integral calculus, series, partial and directional derivatives; vector-valued functions; definite and improper integrals; line integrals; surface integrals; multidimensional integrals; differential operators: gradient, divergence and curl, vector identities. theorems of Stokes, Gauss and Green.

Linear algebra: matrix algebra, linear systems of equations, eigenvalues and eigenvectors.

Ordinary differential equations: first order linear and nonlinear equations; systems of linear differential equations; higher order linear ODEs with constant coefficients, Cauchy and Euler equations, initial and boundary value problems.

Numerical methods: root finding of linear and nonlinear algebraic equations, numerical quadrature; unconstrained optimization methods.

PHYSICS AND ANALYTICAL MECHANICS
Physical quantities, units, and scientific method.
Measurement, probability, errors.
Dynamics of point particles, systems, and rigid bodies.
Newton's laws of motion, cardinal equations, conservation laws.
Macroscopic systems and the laws of thermodynamics: Temperature and heat, First and Second Law of Thermodynamics.
Gravitational and electromagnetic fields.
Waves and vibrations: Oscillations, wave propagation.

PROGRAMMING LANGUAGE

The candidate should have a working experience with at least one of the following programming languages: ForTran, C Programming, C++ Programming, Mathematica, MATLAB, Python

SPECIFIC TOPICS: Each candidate should select two topics for the oral test among those in the following lists.

AERODYNAMICS
Laminar and turbulent flows
Compressible flows: fluid compressibility, sound speed, Mach number.
One-Dimensional Compressible Flow with Area Change, Friction, and Heat
Normal and Oblique Shock Waves
Airfoils and wings: Classification of airfoils, aerodynamic characteristics, Kutta Joukowski theorem; lift generation; wing theory; induced drag.

AEROSPACE STRUCTURES
Aeronautical and Space mechanical and thermal environments.
Mechanical constitutive laws of isotropic and anisotropic materials.
Beam (1D), plates, and shells (2D) theories.
Semi-monocoque structures.
Theoretical foundation and numerical issues on Finite Element analysis.
Structural dynamics of continuous and discretized systems

FLIGHT DYNAMICS
Prediction of aircraft performance
Aircraft modeling
Static stability and control
Dynamics of aircraft motion and response to controls
Basic methods for aircraft closed-loop control

AERONAUTICAL PROPULSION
Thermodynamic cycle analysis in aeronautical engines
Thrust and performance parameters of aeronautical engines
Air intakes in aeronautical engines
Combustion chambers of aeronautical engines
Nozzles in aeronautical engines
Elementary theory of turbomachinery

SPACE PROPULSION
Thermodynamic cycle analysis in space engines
Thrust and performance parameters of space engines
Thrust chambers of space engines
Nozzles in space engines
Elementary theory of turbomachinery

ORBITAL MECHANICS
Newtonian mechanics
Two-body orbital mechanics
Classical Orbital Elements
Rigid body kinematics and dynamics

AIRCRAFT SYSTEMS

Aircraft systems (flight control, avionics, fuel, engine control, electrical, hydraulic, environmental control, emergency)
Aircraft instruments
System and subsystem design and development

SPACE SYSTEMS
Space missions analysis and design (space mission life cycle, mission objectives, requirements and constraints, mission architectures and mission budget)
Space environment and survivability
Spacecraft design
Spacecraft systems (electrical power, thermal control, telecommunications, telemetry and command, attitude and orbital determination, ground control)