

## قواعد إختبار القبول لمرحلة الدكتوراه (2022)

في إختبار القبول لمرحلة الدكتوراه، إضافة الى موضوع **التحليل الاجباري** لجميع المتقدمين يختار الطالب أو الطالبة موضوع من الموضوعات التالية حسب تخصصه (التحليل الدالي، الجبر، المعادلات التفاضلية، الهندسة والتوبولوجيا، رياضيات حاسبة و متقطعة). وفيما يلي المواضيع المطلوبة والمراجع المقترحة لكل مسار

In the doctoral admission exam, in addition to the subject of compulsory analysis for all applicants, the student selects one of the following subjects according to his specialty (functional analysis, algebra, applied math, geometry and topology, computational and discrete Mathematic). Below are the requested topics and proposed references for each track.

### التحليل الاجباري **Measure Theory and Integration**

Rings, Algebra,  $\ast$ -algebra, Monotone classes, Measure, elementary properties, outer measure, extension, completion and approximation theorems, Lebesgue's measure, Lebesgue-Stieltje's measure, measurable functions, integration with respect to a measure, the main theorems, the convergence of measurable functions, Radon-Nikodym theorem(absolutely continuous functions), Fubini-Tonelli theorem, spaces: Holder and Minkowski inequalities, completeness of spaces, space as a Banach space, the dual of space.

*References :*

- 1- *Modern Real Analysis, William P. Ziemer, Springer 2017.*
- 2- *Real Analysis, H. L. Royden, P.M. Fitzpatrick, Fourth Edition, 2010, China machine press.*

### Functional Analysis (مسار تحليل)

Chapter 2 : Normed Spaces, Banach Spaces

Chapter 3 : Inner product spaces and Hilbert spaces

**Reference :** *Introductory functional analysis with applications. By Kreyszig E. Copyright © 1978, by John Wiley & Sons. Inc.*

### (Group Theory and Modules) (مسار الجبر)

Group action on a set, Series of groups, Solvable groups, Super solvable groups, Polycyclic groups and nilpotent groups, Semi-direct product and group extensions, Free

groups, group presentations, Finite and algebraic field extensions, Normal and separable extensions, Galois extensions, Galois group and Artin's Theorem.

References :

- 1- *Algebra by Thomas W. Hungerford(or)*
- 2- *Abstract Algebra: The Basic Graduate Year by Robert B. Ash*
- 3- (<http://www.math.uiuc.edu/~r-ash/Algebra.html>)

### **(Applied Mathematics)**      **مسار الرياضيات التطبيقية**

Hyperbolic equations (Wave equation): initial Boundary value problems, Cauchy problem, Energy methods, Elliptic equations (Laplace equation): Initial boundary value problems, Parabolic equations (Heat equations): Initial boundary value problem.

Reference : *Partial Differential Equations Methods and Applications. By: Robert Mcowen (Chapter 3, Chapter 4, and Chapter 5)*

### **Geometry and Topology**      **مسار الهندسة والتوبولوجيا**

Connected spaces, Path connected spaces, Connected components, Locally connected spaces, Quotient spaces, The separation axioms (Hausdorff, Regular, Normal). Differentiable manifolds, Submanifolds of  $\mathbb{R}^n$  and Classical Lie groups, Tangent spaces, Differentiable mappings between manifolds, Inverse and Implicit function theorems on manifolds.

References :

- 1- *Topology, By James R. Munkres, 2nd Edition, Upper Saddle River, NJ, Prentice Hall, 2000.*
- 2- *Calculus on Manifolds, A modern Approach to Classical Theorems of Advanced Calculus, W. A. Benjamin Inc, 1965.*
- 3- *Differentiable Manifolds, By Yozo Matsushima, Translated by E. T. Kobayashi, Marcel Dekker Inc, 1972.*

### **Computational and Discrete Mathematic**      **مسار رياضيات حاسوبية و متقطعة**

• **رياضيات حاسوبية**

Floating point arithmetic and rounding errors, well-posed computation and convergence. Numerical methods for solving nonlinear equations with one variable: bisection, regula-falsi, functional iterative, Newton, secant and Aitken  $\Delta^2$  . Error and convergence analysis for these methods, Special numerical methods for solving polynomials: evaluation of polynomials and their derivatives, Matrix and vector norms, convergence of

vectors, Method for solving system of nonlinear equations: Fixed point, Newton, finite difference Newton, quasi-Newton, steepest descent, Error and convergence analysis for these methods.

Reference : *Numerical Analysis, Richard L. Burden, J. Douglas Faires, BROOKS COLE, 2011*

### • رياضيات متقطعة

Graphs, Directed graphs, Basic definitions, Isomorphism of graphs, Subgraphs, Paths and cycles, Matrix representation of graphs, Connectedness, Bridges, Cut-vertices. Trees, Spanning trees, Weighted graphs and minimum spanning trees, Shortest paths, Eulerian circuits, Hamiltonian cycles, Tournaments, Applications. Planar graphs, Euler's Formula, Kuratowski's theorem. Graph coloring, Vertex coloring, Edge coloring, Map coloring, Chromatic polynomials. Ordered sets, Comparability and covering graphs, Dilworth theorem, Block designs, Latin squares, Orthogonal Latin squares, Finite geometries, Basic definitions and properties.

Reference : *Graph Theory with applications, by J. A. Bondy and U.S.R. Murty, 5<sup>th</sup> edition, Elsevier Science Publishing Co., Inc.*