ALGERIAN DEMOCRATIC AND POPULAR REPUBLIC

MINISTRY OF HIGHER EDUCATION AND SCIENTIFIC RESEARCH

ACADEMIC MASTER TRAINING OFFER

Establishment	Faculty / Institute	Department
Mohamed Khider University- Biskra	Faculty of Exact Sciences and Sciences of Nature and Life	Mathematics

Field: Mathematics and Computer Science

Sector: Mathematics

Speciality: Partial differential equations and numerical analysis

Responsible for the training area team: Pr. Boulakhras Gherbal

Academic year: 2023 – 2024

الجمهورية الجزائرية الديمقراطية الشعبية

وزارة التعليم العالي والبحث العلمي

عرض تكوين ماستر

أكاديمي

المؤسسة	الكلية/ المعهد	القسم
جامعة محمد خيضر بسكرة	كلية العلوم الدقيقة و علوم الطبيعة و الحياة	الرياضيات

الميدان : رياضيات و إعلام آلي

الشعبة: رياضيات

التخصص: معادلات ذات مشتقات جزئية و تحليل عددي
مسؤول فرقة ميدان التكوين: أ / د بولخراص غربال

السنة الجامعية: 2023-2024

SUMMARY

I – Master's identity sheet
(All fields must be completed)

1 - Location of the training:

Faculty (or Institute): Faculty of Exact Sciences and Natural and Life Sciences

Department: Mathematics

2-Coordinators:

Head of the training area team (Professor or Lecturer Class A)

Name: Gherbal

First name: Boulakhras

Rank: Professor

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Email: b.gherbal@univ-biskra.dz

Attach a brief CV as an annex to the training offer (Maximum 3 pages)

Head of the training team (Professor or Lecturer Class A)

Name: Touba

First name: Sonia

Rank: MCB

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Email: sonia.touba@univ-biskra.dz

Attach a brief CV as an annex to the training offer (Maximum 3 pages)

Head of the Specialty team (Professor or Lecturer Class A)

Name: Berbiche

First name: Mohamed

Grade: Professor

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Email: mohamed.berbiche@univ-biskra.dz

Attach a brief CV as an annex to the training offer (Maximum 3 pages)

3- Training partners *:

- Other university establishments:
- Businesses and other socio-economic partners:
- International partners:

* = Present the conventions in the appendix to the training

4 – Context and objectives of the training

A – Access conditions

(Indicate the license specialties, which can give access to the Master's degree) Bachelor is degree in Mathematics or an equivalent qualification.
This master's course is open to students who have obtained a Bachelor's degree in Mathematics.

B - Training objectives

(Targeted skills, pedagogical knowledge acquired at the end of the training - maximum 20 lines)
The Master's training in mathematics entitled: "PDE and Numerical Analysis", offers students holding a bachelor's degree in mathematics (L.M.D) or an equivalent qualification basic training in analysis and possibilities for specialization in various fields close to the applications. The main themes of this training are the theory of PDE, EDO, integral equations, and numerical analysis and simulation,...
On these themes, the training benefits from good potential for supervising dissertations or theses.
This training naturally complements the graduate training in mathematics provided by our department for several years. In addition, this will meet the expectations of our students and in particular, the best of them who plan to pursue in-depth studies in one of the themes offered by this post-graduation.

C – Targeted professional profiles and skills

(In terms of professional integration – maximum 20 lines):

This Master's degree in EDP and Digital Analysis aims to train:

- Researchers in applied mathematics likely to pursue a career in higher education or within a research organization or to participate in high-tech industry programs.
- For a substantial fraction of students, the natural extension of the Master's degree consists of continuing this introduction to research with a doctoral thesis.

D- Regional and national employability potential of graduates

• Sectors of activity: Teaching, Higher education.
• Jobs: Teacher-Researcher.

E – Gateways to other specialties

Possibility of transition to other fundamental or applied mathematics specialties:
o Differential equations.
o Applied functional analysis.
o Control theory and optimization.

F – Training monitoring indicators

Establish a commission bringing together the teachers involved in the course, which will be responsible for monitoring the training in accordance with the program, and in a second stage propose possible changes to be made to the subject programs.

G – Supervision capacity

(give the number of students that can be supported).

The mathematics department can support up to 120 students.

5 – Human resources available

A: Teachers from the establishment working in the specialty:

Name, first name	Diploma graduation + Speciality	Diploma Post graduation + Speciality	Grade	Kind intervention *	Registration
Berbiche Mohamed	SSD Analysis	Doctorat in Sciences	Prof	Courses +Td+ dissertation supervision	
Khelil Naceur	SSD Analysis	Doctorat in Sciences	Prof	Courses +Td+ dissertation supervision	
Menacer Tidjani	SSD Analysis	Doctorat in Sciences	Prof	Courses +Td+ dissertation supervision	
Chemcham Madani	SSD Analysis	Doctorat in Sciences	MC A	Courses +Td+ dissertation supervision	
Laiadi Abdelkader	SSD Analysis	Doctorat in Sciences	MC A	Courses +Td+ dissertation supervision	
Houas Amrane	SSD Analysis	Doctorat in Sciences	MC A	Courses +Td+ dissertation supervision	
Bellagoune Abdelghani	SSD Analysis	Doctorat in Sciences	MC A	Courses +Td+ dissertation supervision	
Kaboul Hanane	SSD Analysis	Doctorat in Sciences	MC B	Courses +Td+ dissertation supervision	
Laadjal Baya	SSD Analysis	Doctorat in Sciences	MC B	Courses +Td+ dissertation supervision	
Kaci Fatima	SSD Analysis	Doctorat in Sciences	MC B	Courses +Td+ dissertation supervision	
Rajah Faouzia	SSD Proba-Stat	Doctorat in Sciences	MC B	Courses +Td+ dissertation supervision	
Dakhia Ghania	SSD Analysis	Doctorat in Sciences	MC B	Courses +Td+ dissertation supervision	
Rahmani Nacer	SSD Analysis	Doctorat in Sciences	MC B	Courses +Td+ dissertation supervision	
Ouaar Fatima	SSD Analysis	Doctorat in Sciences	MC B	Courses +Td+ dissertation supervision	
Guidad Daradji	SSD Analysis	Doctorat in Sciences	MC B	Courses +Td+ dissertation supervision	
Senouci Assia	SSD Proba-Stat	Doctorat in Sciences	MC B	Courses +Td+ dissertation supervision	
Hassouna Houda	Master Mathematics	Doctorat LMD	MC B	Courses +Td+ dissertation supervision	
Brahim Rezghi	SSD Analysis	Magister	MAA	Courses +Td+ dissertation supervision	

* = Courses, tutorials, practical work, internship supervision, dissertation supervision, other (to be specified)

B: External supervision:

Home establishment:

Nom, prénom	Diplôme graduation + Spécialité	Diplôme Post graduation + Spécialité	Grade	Type d'intervention *	Emargement

* = Courses, tutorials, practical work, internship supervision, dissertation supervision, other (to be specified)

6 – Specific material resources available

A- Educational Laboratories and Equipment: Sheet of existing educational equipment for the practical work of the planned training (1 sheet per laboratory)

Laboratory title: Applied Mathematics

N°	Title of equipment	Number	observations
1	Micro – computer	32	
2	Data-show	04	
3	Printer	12	
4	Photocopy	2	

Laboratory title: Mathematical Analysis, Probability and Optimization Laboratory

N°	Title of equipment	Number	observations
1	Micro – computer	20	
2	Data-show	06	
3	Printer	10	
4	Photocopy	1	

B- **Internship sites and in-company training:**

Lieu du stage	Nombre d'étudiants	Durée du stage

C- Master's support research laboratory (ies):

Head of the Applied Mathematics laboratory: Dr. Labed Boubakeur
Laboratory approval number 2001
Date : Opinion of the laboratory head:

Head of the laboratory Laboratory of mathematical analysis, probabilities and optimization: Prof. Hafayed Mokhtar
Laboratory approval number 2020
Date : Opinion of the laboratory head:

D- Master's support research project (s):

Title of the research project	Project code	Start date Project	End date Project
Etude et Approximation des solutions de certaines classes d'Equations Ordinaires et aux Dérivés différentielles Partielles	**C00L03UN070120220008**	**2022**	**2025**
Contrôle et Synchronisation des systèmes chaotiques d'ordre fractionnaire et leurs applications	**C00L03UN070120220010**	**2022**	**2025**
Modélisation et optimisation pour les techniques avancées d'apprentissage profond	**C00L03UN070120220011**	**2022**	**2025**

E- Personal work spaces and ICT:

- University Central Library
- Faculty library
- Library of the two laboratories
- Faculty internet room
- Educational rooms

II – Semester organization sheet for teaching (Please present the sheets for the 4 semesters)

1- Semester 1:

Teaching Unit	VHS	Weekly V.H				Coeff	Credits	Evaluation method	
	14-16 weeks	C	TD	TP	Others			Continuous	Examan
UE fundamentals									
UEF1									
Additional functional analysis	45h00	1h30	1h30			**3**	**5**	40%	60%
Distribution theory	45h00	1h30	1h30			**3**	**5**	40%	60%
UEF2									
Ordinary Differential Equations	45h00	1h30	1h30			**3**	**5**	40%	60%
Numerical methods and simulations 1	67h30	1h30	1h30	1h30		**3**	**5**	40%	60%
methodology EU									
UEM1									
Matrix analysis	45h00	1h30	1h30			**2**	**4**	40%	60%
Introduction to fractional calculations	45h00	1h30	1h30			2	**4**	40%	60%
Discovery EU	22H30	22H30							
UED1									
Scientific English 1	22h30	1h30				**1**	**2**		100%
Total Semester 1	**314h00**	**10h30**	**9h0**	1h30		**17**	**30**		

2- Semester 2

Teaching Unit	VHS	Weekly V.H				Coeff	Credits	Evaluation method	
	14-16 weeks	C	TD	TP	Others			TD	TP
fundamentals UE	180H00	90H00	90H00						
UEF3									
Sobolev s spaces	45h00	1h30	1h30			**3**	**05**	40%	60%
Spectral theory of operators 1	45h00	1h30	1h30			**3**	**05**	40%	60%
UEF4									
Integral equations	45h00	1h30	1h30			**3**	**05**	40%	60%
Partial differential equations	45h00	1h30	1h30			**3**	**05**	40%	60%
methodology EU	90H00	45H00	45H00						
UEM2									
Optimal control	45h00	1h30	1h30			**2**	**04**	40%	60%
Convex analysis	45h00	1h30	1h30			**2**	**04**	40%	60%
Discovery EU	22H30	22H30							
UED2									
UED2 Scientific English 2	22h30	1h30				**1**	**02**		100%
Total Semester **2**	**292h30**	**10h30**	**9h0**			**17**	**30**		

3- Semester 3

Teaching Unit	VHS	Weekly V.H				Coeff	Credits	Evaluation method	
	14-16 weeks	**C**	**TD**	**TP**	Others			**TD**	**TP**
Fundamentals UE	135H00	90H00	45H00						
UEF5									
Semigroup theory and evolution equations	67h30	3h00	1h30			**5**	**9**	40%	60%
Spectral theory of operators 2	67h30	3h00	1h30			**5**	**9**	40%	60%
methodology EU	112H30	45H00	45H00	22H30					
UEM3									
UEM3 Introduction to image processing	45h00	1h30	1h30			**3**	**5**	40%	60%
Numerical methods and simulations 2	67h30	1h30	1h30	1h30		**3**	**5**	40%	60%
Transversal EU	22H30	22H30							
UED3									
Research methodology	22h30	1h30				**1**	**2**		100%
Total Semester 3	270h00	10h30	6h00	1h30		**24**	**30**		

4- Semester 4:

Field: Mathematics and computer science
Branch: Mathematics
Specialty: PDE and Numerical Analysis

	VHS	Coeff	Credits
Personal work	225h00		
Internship in company			
Seminars			
Dissertation		17	30
Total Semester 4	**225h00**	**17**	**30**

5- Overall summary of the training: (indicate the separate global VH in progress, TD, for the 04 semesters of teaching, for the different types of EU)

VH \ UE	UEF	UEM	UED	UET	Total
Course	270h	135h00	67h30		472h30
TD	225h	135h00			360h00
TP	22H30	22h30			45h00
TP Personal work	225h00				225h00
Other (explain, list,)					
Total	742h30	292h30	67h30		1102h30
Credits	88	26	6		**120**
% in credits for each EU	73,3 %	21.7 %	5 %		100 %

III - Detailed program by subject (1 detailed sheet per subject)

Title of the Master: Partial differential equations and numerical analysis

Semester: S1

EU title: UEF1

Title of the subject: Additional functional analysis

Credits: 5

Coefficients: 3

Teaching objectives

This module introduces the major theorems of functional analysis and offers the student the opportunity to continue learning in the field of partial differential equations.

Recommended prior knowledge Basic functional analysis:

real analysis, elementary topology, spaces of continuous functions, etc.

Content of the material:

● Complements on Hilbert spaces: Hilbertian bases, weak and strong topology.

● Additional information on Banach spaces: Baire, Banach–Steinhaus theorems, open map and closed graph theorems. Duality.

● Space of continuous functions on a compact (General, Stone-Weierstrass theorem, Ascoli theorem, etc.).

● Hahn-Banach theorem and its corollaries.

Evaluation method:

Final exam (60%) + continuous assessment (40%)

References (Books and handouts, websites, etc.)

1. G. Choquet, Cours d'analyse. Topologie, Masson 1964.
2. H. Brésis, Analyse fonctionnelle et applications, Dunod 1999.
3. L. Lusternik, V. Sobolev, Précis d'analyse fonctionnelle, Edition MIR 1989 (Traduction Française).
4. V.Trénoguine, Analyse fonctionnelle, Edition MIR 1985 (Traduction Française)

Title of the Master: Partial differential equations and numerical analysis

Semester: S1

EU title: UEF1

Title of the subject: Theory of Distributions

Credits: 5

Coefficients: 3

Teaching objectives

This module gives the basic notions of the theory of distributions as well as their most fundamental properties.

Recommended prior knowledge

- Spaces of continuous functions, differentiable functions, and the different types of convergence of sequences of functions. Fourier Transform

Content of the material:

Part 1 – Distributions Definitions and properties:

Test functions D(Ω). Space of distributions D'(Ω). Operations on distributions: Convergence, derivation, convolution.

2nd part - Tempered distributions and Fourier Transformation

The space S(Rn) of rapidly decaying functions. The space S' (Rn) of temperate distributions. Fourier transformation on S (Rn) and on S'(Rn).

Applications.

Evaluation method:

Final exam (60%) + continuous assessment (40%)

References (Books and handouts, websites, etc.).

1. L.Schwartz, Théorie des distributions. Hermann, 1966, Paris.
2. L.Schwartz, Méthodes mathématiques pour les sciences physiques. Hermann.
3. C. Zuily, Éléments de distributions et équations aux dérivées partielles. Dunod, 2002.
4. R.S. Pathak, A course in distribution theory and applications. Alpha Science International Ltd, 2001.
5. F.Hirsch – G.Lacombe, Eléments d'analyse fonctionnelle. Dunod, 1997.

Title of the Master: Partial differential equations and numerical analysis

Semester: S1

EU title: UEF2

Subject title: Ordinary differential equations

Credits: 5

Coefficients: 3

Teaching objectives

This course presents a logical continuation of the one done in the bachelor's degree, its interest is to study non-linear ODEs then the stability of the solutions then, at the end, answer some fundamental questions such as: bifurcations and periodicity.

Recommended prior knowledge

It is important that the student has knowledge of the undergraduate OED course, as well as the techniques of analysis and algebra.

Module content:

1-Autonomous nonlinear differential systems:

Concepts and preliminary definitions (flows, phase space, fixed point, etc.),

Cauchy problem - Existence and uniqueness of solutions, extension of solutions and maximal solutions, Poincaré-Bendixson theory for the existence and uniqueness of periodic solutions, stable and unstable varieties.

2. Stability theory: stability in the Lyapunov sense, linearization theorem (Hartman-Grobman theorem),

Lyapunov function method, central manifold method.

3. Differential systems dependent on a parameter: introduction to the theory of Bifurcations (local and global bifurcations), introduction to control theory.

Evaluation method:

Final exam (60%) + continuous assessment (40%)

References (Books and handouts, websites, etc.).

1. M. W. Hirsch, S. Smale& R. L. Devaney, *Differential Equations, Dynamical Systems and an Introduction to Chaos,* Academic Press, San Diego, London, Second Edition, 2004.
2. C. Chicone, *Ordinary Differential Equations with Applications*, Springer-Verlag, New-York, Second edition, 2006.
3. F. Verhulst, *Nonlinear Differential Equations and Dynamical Systems,* Springer-Verlag, Berlin, Heidelberg, Second edition, 1996.
4. T. A. Burton, Stability and Periodic Solutions of Ordinary and Functional Differential Equations, Dover Publications, Mineola and New York, 2005.
5. Yuri A. KUZNETSOV, Elements of Applied Bifurcation Theory (Second Edition), Ed. Springer Volume 112 in Applied Mathematical Sciences, 1998

Title of the Master: Partial differential equations and numerical analysis

Semester: S1

EU title: UEF2

Subject title: Numerical methods and simulations 1

Credits: 5

Coefficients: 3

Teaching objectives

Give the essentials on finite differences and fast Fourier transforms and their applications in sampling.

Recommended prior knowledge

Knowledge of real analysis and numerical analysis at Bachelor level.

Content of the subject

Chapter 1 : Multiple step numerical methods:

Adams-Bashforth methods. Adams-Moulton methods. Prediction-correction methods.

Chapter 2 -The fundamental notions of the finite difference method

(Consistency, stability and convergence): The finite difference method in dimension two applied to an elliptical problem. Discretization of the Dirichlet problem. Consistency error Maximum principle (discrete). Matrix form of five-point diagram. Schema stability for the standard. A priori estimation of the error (convergence of the method).

Chapter3: Fourier series and applications:

Reminders of the Fourier transform discrete case, brief indications on sampling, the links between filtering and convolution and the FFT.

Evaluation method:

Final exam (60%) + continuous assessment (40%)

References

1-John C. Strikwerda, "Finite Difference Scheme and Partial Differential Equations", SIAM, 2004.

2-C. Gasquet & P. Witomski, « Analyse de Fourier et Applications », Masson, 1995.

3-M. Sibony& J.-CL. Mardon, « Approximations et équations différentielles », Hermann.

M. Schatzman, « Analyse Numérique. Une approche mathématique », Dunod.

Title of the Master: Partial differential equations and numerical analysis

Semester: S1

EU title: UEM1

Subject title: Matrix analysis

Credits: 4

Coefficients: 2

Teaching objectives;

Developing students' knowledge in the field of digital analysis (image processing, e.g. Image Restoration, Compression and Coding)

Recommended prior knowledge

Topology, functional analysis, measurement, and license integration

Content of the subject

Chapter I

1- Linear algebra reminders 2- General information on matrices 3- Unitary matrices and normal matrices 4- Pseudo-inverse of a matrix and projectors

Chapter II

1-Functions of matrices 2-Matrix norms-condition number of a matrix –regular matrices 3-Kronecker product and factorization of matrices 4-Decomposition into singular values 5-Reduction of matrices

Chapter III

1-Well and ill-posed problems and Krylov spaces 2-General information on solving linear systems 3-Overdetermined problem and Underdetermined problem. 4-Iterative methods to solve an ill-posed problem 5-Sylvester's general matrix equation and their solution.

Evaluation method:

Final exam (60%) + continuous assessment (40%)

References (Books and handouts, websites, etc.).

1. Robert M. Corless and Nicolas Fillion, A Graduate Introduction to Numerical Methods, Springer 2013.
2. Roger A. Horn and Charles R. Johnson, Matrix Analysis, second Edition, Cambridge University, 2013.
3. Carl D. Meyer, Matrix analysis and linear applied algebra, SIAM 2000.

Title of the Master: Partial differential equations and numerical analysis

Semester: S1

EU title: UEM1

Subject title: Introduction to fractional calculations

Credits: 4

Coefficients: 2

Teaching objectives

This course aims to give students the introductions and basic notions of derivatives of fractional order and give them the basic tools that help them access this area which becomes necessary for most mathematical disciplines, particularly for the analysis.

Recommended prior knowledge

Usual derivation and integration, ordinary differential equations and partial differential equations done in mathematics degree

Content of the material:

Part 01: Fractional derivatives:

1. Specific functions for fractional calculation: Gamma function, Beta function, Mittag-Lefler function.

2. Fractional derivatives and integrals: Grünwald-Letnikov fractional derivatives, Riemann-Liouville fractional derivatives, Caputo fractional derivatives, comparison and equivalence between these derivatives. Properties of fractional derivatives.

3. Laplace transform and Fourier transform of fractional derivatives.

Part 02: Fractional differential equations:

1. Existence and uniqueness theorems, the Laplace transform method, standard differential equations: ordinary linear fractional, partial linear fractional derivatives. Other methods of solving fractional equations.

2. Numerical solutions of fractional equations.

3. Applications of fractional calculus.

Evaluation method:

Final exam (60%) + continuous assessment (40%)

References (Books and handouts, websites, etc.).

1-Igor Podlubny, Fractional Differential Equations, Academic Press, 1999.

2-A Review on Fractional Differential Equations and a Numerical Method to Solve Some…

DOI: http://dx.doi.org/10.5772/intechopen.86273u

3-TomášKisela, Fractional Differential Equations and Their Applications, BRNO 2008

4-Juan J. Nieto, Fractional Differential Equations: Theory, Methods and Applications, Printed Edition of the Special Issue Published in Symmetry

Title of the Master: Partial differential equations and numerical analysis

Semester: S1

EU title: UED1

Subject title: Scientific English 1

Credits: 2

Coefficients: 1

Teaching objectives

The objectives are to give students the ability to express themselves clearly and simply by Improving students' skills in scientific communication (oral and written)

Recommended prior knowledge

(brief description of the knowledge required to be able to follow this course – Maximum 2 lines).

Content of the material:

Scientific presentation (use of slides, presentation materials / description of experiments, results and commentary / acquisition of register and structures specific to the scientific presentation).

• Pronunciation, phonetics.

• Interview simulation (recruitment / evaluation / motivation / contradictory debate), preparation for mobility in an English-speaking country.

• Writing summaries

• Acquisition of vocabulary relating to the general scientific field (description and commentary of experiments, graphs, trends) and logical argumentation (comparisons, consequences, hypotheses).

• Writing cover letters, CVs, letters to an editor for publication.

• Analysis of publications and scientific articles.

Evaluation method:

Final exam (100%)

References (Books and handouts, websites, etc.).

Title of the Master: Partial differential equations and numerical analysis

Semester: S2

EU title: UEF3

Title of the subject: Sobolev spaces

Credits: 5

Coefficients: 3

Teaching objectives:

In this module we study Sobolev spaces and their fundamental properties. We also give some variational formulations of some boundary problems.

Recommended prior knowledge

-Theory of measurement and integration: Spaces of continuous, integral functions…

-Theory of distributions

– Fourier transformation.

Content of the material:

Part 1 : -Reminder of the fundamental properties of spaces Lp(Ω) (Ω is an open of Rn).

-Definitions and fundamental properties of Sobolev spaces Hm(Ω), Wm,p (Ω) (where Ω is a regular open of Rn).

-Definition and fundamental properties of Sobolev spaces Hs(Rn).

2nd Part: (Variational formulation of some boundary problems)

- Variational formulation of Elliptic boundary problems (weak solution, regularity of weak solutions, maximum principle, eigen functions and spectral decomposition, etc.).

-Parabolic boundary problem (properties of the solutions of the heat equation, associated Cauchy problem and mixed problems, weak solution and regularity, etc.).

Evaluation method:

Final exam (60%) + personal work note (40%)

References

1-R.Adams, Sobolev spaces Academic Press, 1975.

2-HaïmBrezis, Analyse fonctionnelle, Dunod 1999.

3-V.Mikhailov, Équation aux dérivées partielles, Edition Mir 1980 (Traduction Française).

4-Yu.v.Egorov- M.A.Shubin, Foundations of the classical theory of partial differential equations, Springer-Verlag,1998.

Title of the Master: Partial differential equations and numerical analysis

Semester: S2

EU title: UEF3

Title of the subject: Spectral theory of operators 1

Credits: 5

Coefficients: 3

Teaching objectives:

The aim of this course is to provide basic training in the spectral theory of bounded operators.

Recommended prior knowledge

Additional functional analysis, Algebra 3, Algebra 4, and Topology.

Content of the material:

1. Bounded linear operators - Adjoint, self-adjoint, unitary, normal, compact operators - Resolving. Properties of the resolving. Spectrum, Spectral Ray.
2. Positive operators and square roots.
3. Holomorphic functional calculus.
4. Spectral theorem and spectral decomposition of self-adjoint operators.
5. Spectral theorem and spectral decomposition of self-adjoint compact operators.
6. Fredholm operators. Hint. Fredholm alternative.
7. Trace and Hilbert-Schmidt operators.
8. Spectral theorem and disturbance theory.

Evaluation method:

Final exam (60%) + personal work note (40%)

References

[1].A. Kolmogorov, S. Fomine, Eléments de la théorie des fonctions et de l'analyse fonctionnelle. 1974.
[2]. K. Yosida ; Functional Analysis.
[3]. T.Kato, Perturbation Theory for Linear Operators.
[4]. N.Dunford, J. Schwartz ; Linear Operators , T1,2.

Title of the Master: Partial differential equations and numerical analysis

Semester: S2

EU title: UEF4

Subject title: Integral equations

Credits: 5

Coefficients: 3

Teaching objectives:

Integral equations are a priori less simple to solve than algebraic equations or differential equations:
1. Introduce to the elementary theory of linear integral equations, which are used in a growing number of disciplines.

2. Integral equations intervene in physical problems where there is a preferred direction of variation of the independent variable (for example, time, energy, etc.)

Recommended prior knowledge:

Differential and integral calculation, functions with one or more variables.

Classical integral calculation (eigenvectors, eigenvalues).

Supplement to functional analysis.

Content of the material:

1. General: L2(a,b) space, C(l)(a,b) space, Function of the complex variable, Residue theorem, Fourier transformation, Laplace transformation.

2. Volterra integral equations of the second kind: Connection between linear differential equations and Volterra integral equations, Solving, Abel integral equation.

3. Fredholm integral equations: Fredholm method, Kernels.

4. Green's function.

5. Application of integral transformations to the resolution of integral equations:

Resolution of integral equations by the Fourier and Laplace transformation.

6. Integral equation of the first kind.

7. Approximate solution method for integral equations.

Evaluation method:

Final exam (60%) + personal work note (40%)

References

1. Krasnov, M. L., Kiselev, A. I., & Makarenko, G. I. (1977). *Équations intégrales : problèmes et exercices*. Editions Mir.
2-Brunner, Hermann. *Volterra integral equations: an introduction to theory and applications*. Vol. 30. Cambridge University Press, 2017.
3-Corduneanu, Constantin. *Principles of differential and integral equations*. Vol. 295.American Mathematical Soc., 2008.
4-Hochstadt, Harry. *Integral equations*. John Wiley & Sons, 2011.

Title of the Master: Partial differential equations and numerical analysis

Semester: S2

EU title: UEF4

Subject title: Partial differential equations

Credits: 5

Coefficients: 3

Teaching objectives:

The aim of this course is to provide basic training in the theory of partial differential equations.

Recommended prior knowledge:

EPHM (Mathematics License). Functional analysis supplements.

Content of the material:

Part 1:

Second order elliptic equations

1-General definitions

2-Existence of weak solutions

3-Regularity of solutions

4-Principles of maximum

Part 2: Second order parabolic equations

-1Fundamental solution of the heat equation.

3- Regularity of solutions

4- Heat equation on a bounded domain and maximum principle

6- Energy methods

Part 3: Second order hyperbolic equations

1- Solution via the Fourier transform
2- The solution in arbitrary dimensions
3- Regularity of solutions
4- Energy methods

Evaluation method:

Final exam (60%) + personal work note (40%)

References :

1- H Bresis Analyse Fonctionnelle Masson Paris.
2- H Reinhard Equations aux dérivées partielles Dunod Paris.
3- J.L Lions et E.Magenes Problèmes aux limites non homogènes et application Dunod Paris.
4- J L Lions Quelques méthodes de résolution des problèmes aux limites non linéaires Dunod Paris.
5- Tikhonov, A.N. and Samarskii, A.A., 2013. Equations of mathematical physics. Courier Corporation.

Title of the Master: Partial differential equations and numerical analysis

Semester: S2

EU title: EMU2

Subject title: Optimal control

Credits: 4

Coefficients: 2

Teaching objectives

Modern tools for optimal control. Some examples of biology and medicine models based on optimal control.

Recommended prior knowledge

Ordinary differential equations. Some elements of convex analysis.

Content of the material:

1 Controllability, observability and stabilization of linear systems

1.1 Controllability of autonomous linear systems.

1.2 Observability of autonomous linear systems.

1.3 Stabilization of autonomous linear systems.

1.4 Remarks on the controllability of non-autonomous linear systems

1.5 Remarks on the controllability of nonlinear systems.

2 Optimal control of linear systems

2.1 Minimum time control.

2.2 Standard linear quadratic problems.

2.3 Any convex integral cost.

2.3.1 Existence of optimal control.

2.3.2 Maximum principle, Hamiltonian and uniqueness of optimal control.

3 Optimal control of nonlinear systems

3.1 Existence of optimal control

3.2 Maximum principle and Hamiltonian.

3.3 Dynamic programming.

3.3.1 Optimal feedback control.

Evaluation method

Final exam (60%) + continuous assessment (40%)

Bibliography

1- Jacques-Louis Lions, Contrôle optimal de systèmes gouvernés par des équations aux dérivées partielles, Dunod, 1968.

2- Emmanuel Trélat, Contrôle optimal : théorie et applications, Seconde édition: 2008, Vuibert, Collection "Mathématiques Concrètes",250 pages. ISBN-10: 2711722198.

3- Dr. Mokkedem Fatima Zahra, Introduction à la théorie du contrôle, notes de cours, Université Abou BekrBelkaid Tlemcen, 2018/2019.

Title of the Master: Partial differential equations and numerical analysis

Semester: S2

EU title: EMU2

Subject title: Convex analysis

Credits: 4

Coefficients: 2

Teaching objectives:

This course is an introduction to some fundamental notions in convex analysis, in particular the notion of conjugate convex functions. Concrete applications could be studied (balance of a pile of sand, etc.)

Recommended prior knowledge:

Topology, additional functional analysis, differential calculus

Content of the material:

1. Convex sets
2. Carathéodory's theorem.
3. Topological properties of convexes.
4. Hahn-Banach theorem, Krein-Milman theorem
5. Polarity
6. Convex functions
7. Legendre-Fenchel transform
8. Convexity and differentiability
9. Convex Optimization
10. John's Theorem

Evaluation method

Final exam (60%) + continuous assessment (40%)

References

1. D. Azé, Eléments d'Analyse Convexe et Variationnelle, Ellipses, 1998.
2. M. Bergounioux, Optimisation et contrôle des systèmes Linéaires, Dunod, 2001.
3. J.-B. Hiriart-Urruty, L'Optimisation, Collection Que sais-je, Presses Universitaires de France, 1996.
4. J.-B. Hiriart-Urruty& C. Lemaréchal, Convex Analysis and Minimization Algorithms, I and II, Springer-Verlag, 1993.
5. R.T. Rockafellar, Convex Analysis, Princeton University Press, Princeton, 1970.
6. M. Willem, Analyse Convexe et Optimisation (troisième édition), Editions Ciaco, Bruxelles, 1989.

Title of the Master: Partial differential equations and numerical analysis

Semester: S2

EU title: UED2

Subject title: Scientific English 2

Credits: 2

Coefficients: 1

Teaching objectives

The aim of this unit is to help students master English in the context of research and teaching in mathematics and applications of mathematics. Develop their ability to understand, write and present mathematics in English, and oral comprehension during less formal exchanges (questions during a conference, etc.)

Recommended prior knowledge

Scientific English 1 of the first semester

Content of the material:

Reading scientific articles.

Learning to write.

Oral presentation training

Evaluation method:

Final exam (100%)

References (Books and handouts, websites, etc.).

Title of the Master: Partial differential equations and numerical analysis

Semester: S3

EU title: UEF5

Subject title: Semigroup theory and evolution equations

Credits: 9

Coefficients: 5

Teaching objectives:

This module gives the definitions and fundamental properties of semi-groups as well as their application for solving Abstract Cauchy problems.

Recommended prior knowledge:

Theory of linear operators.

Subject content :

1st Part :

- Uniformly continuous semigroup of bounded linear operators.
- Strongly continuous semigroup of bounded linear operators.

-Hille- Yosida 's theorem . – Lumer -Phillips theorem .

-Characterization of the infinitesimal generator of a C_0 Semi-group.

-Semi-group generated by an m-dissipative operator.

-Semi-group of contractions and their generators.

Part 2 : (Abstract Cauchy Problems)

- Homogeneous Cauchy problem – Examples.

-Non-homogeneous Cauchy problem – Examples

Evaluation method:

Final exam **(50%)** + personal work note **(50%)**

References

1. A.Pazy , Semigroups of linear operators and applications to partial differential equations, SpringerVerlag 1983.
2. Milan Miklavčič : Applied functional analysis and partial differential equations, World Scientific 1998.

Title of the Master: Partial differential equations and numerical analysis

Semester: S3
EU title: UEF5
Title of the subject: Spectral theory of operators 2.
Credits: 9
Coefficients: 5

Teaching objectives:
This course aims to introduce the spectral theory of unbounded operators.

Prior knowledge recommended.
Spectral theory of bounded linear operators, M1 (S2).

Content of the material:
1 - General information about unbounded operators.
2 - Closed operators. Closure of operators.
3 - Symmetric and self-adjoint operators.
- Extensions of symmetric operators.
- index of an operator
-Cayley's Transformation.
4 - Spectral theory of unbounded operators.
- Characterization of the spectrum.
- Essential spectrum and discrete spectrum.
- Operators with compact resolvent

Evaluation method:
Final exam **(50%)** + personal work note **(50%)**

References
[1].A. Kolmogorov, S. Fomine, Eléments de la théorie des fonctions et de l'analyse fonctionnelle. 1974
[2]. K. Yosida ; Functional Analysis.
[3]. T.Kato, Perturbation Theory for Linear Operators.
[4]. N.Dunford, J. Schwartz ; Linear Operators , T1,2

Title of the Master: Partial differential equations and numerical analysis

Semester: S3
EU title: UEM3
Subject title: Introduction to image processing
Credits: 5
Coefficients: 3

Teaching objectives

Discover the theory of Image processing and master the essentials of this theory using mathematical techniques. Introduce the types of PDEs in image processing

Recommended prior knowledge

Matrix analysis, Distribution and spectral theory. Numerical analysis and simulation 1.

Content of the material:

- What is image processing?
-Treatment of ill-posed problems and applications to image processing
- Sylvester 's equation
-Krylov spaces
-The minimum residual generalization method (GMRES Method)

Evaluation mode

Final exam (50%) + continuous assessment (50%)

References *(Books and handouts , websites , etc.).*

1." Introduction au Traitement d'Images" par Diane Lingrand, Vuibert 2004.
2."Fundamentals of Digital Image Processing" par A. Jain. Prentice Hall, 1989.

Title of the Master : Partial differential equations and numerical analysis

Semester: S3
EU title: UEM3
Subject title : **Numerical methods and simulations 2**
Credits: 4
Coefficients: 3

Teaching objectives
Present mathematical methods and techniques for solving difficult problems in fluid mechanics and optimization.

Recommended prior knowledge
Knowledge of real analysis and numerical analysis at Bachelor level.

Content of the subject
-Approximate methods for integral equations.
-Finite element methods.
-Finite volume method applied to fluid mechanics.
-Numerical methods for constrained optimization problems: Linear programming. Nonlinear programming

Evaluation mode
Final exam (50%) + continuous assessment (50%).

References :

1. L.S.Lasdon, Optimization Theory for Large Systems, Mc Millan,1970.
2. G.L.Nemhauser, L.A.Wolsey, Integer and Combinatorial Optimization John Wiley & Sons, 1988.
3. M.Minoux, Programmation mathématique : Théorie et algorithmes, Paris 1983.
4. Stephen Boyd and Lieven Vandenberghe. Convex optimization. Cambridge University Press, 2004
5. BACON, G. Méthode des volumes-finis, 1994.

Title of the Master: Partial differential equations and numerical analysis

Semester *: S3*

EU title: UET1

Subject title: Research Methodology

Credits: 3

Coefficients: 1

Teaching objectives

Allow students to learn the main research methods, to correctly carry out a research project, and to know how to communicate research results.

Recommended prior knowledge

Content of the material:

- Public and corporate research
- Research methods
- Research evaluation
- The tools of a researcher
- Communication of research results.

References

1. Dalhoumi S. « Cours de méthodologie », support de cours, Formation de formateurs, Cerist, Alger, Février 2004.
2. Labasse B., « La communication scientifique ; principes et méthodes », Pôle Universitaire de Lyon, 2001
3. Mucchielli A., « La nouvelle communication : épistémologie des sciences de l l'information – communication », Armand Collin, 2000
4. Salvador Juan. « Méthodes de recherche en sciences socio-humaines : Approche critique des techniques », Presses Universitaires de France (PUF), 1999, p304.

.

V- Agreements or conventions

NO

(If yes, transmit the agreements and/or conventions in the paper-training file)

STANDARD LETTER OF INTENT

(In the case of a master's degree co-sponsored by another university establishment)
(Official paper on the letterhead of the university establishment concerned)

Subject: Approval of co-sponsorship of the master's degree entitled:
The university (or university center) hereby declares co-sponsorship of the above-mentioned master's degree throughout the accreditation period of this master's degree.
To this end, the university (or university center) will assist this project by:
- Giving his point of view in the development and updating of teaching programs:
- Participating in seminars organized for this purpose,
- By participating in defense juries,
- By working to pool human and material resources.

SIGNATURE of the legally authorized person:

FUNCTION :

Date :

STANDARD LETTER OF INTENT

(In the case of a master's degree in collaboration with a company in the user sector)
(Official company letterhead)

SUBJECT: Approval of the project to launch a master's degree course entitled:
Dispensed to:
The company hereby declares its willingness to demonstrate its support for this training as a potential user of the product.
To this end, we confirm our support for this project and our role will consist of:
- Give our point of view in the development and updating of teaching programs,
- Participate in seminars organized for this purpose,
- Participate in defense juries,
- Facilitate as much as possible the reception of interns either as part of end-of-study dissertations or as part of tutored projects.

The means necessary to carry out the tasks incumbent on us to achieve these objectives will be implemented on a material and human level. Mr. (or Madam)…….is designated as external coordinator of this project.

SIGNATURE of the legally authorized person:

FUNCTION :

Date :

OFFICIAL STAMP or COMPANY SEAL

VI- Curriculum Vitae of Coordinators

CURRICULUM VITAE (Gherbal Boulakhras)

RENSEIGNEMENTS GENERAUX

Nom: Gherbal
Prénom: Boulakhras
Adresse: Cité 50 logs Bloc 3, Appart 46, Biskra (07000)
Date de naissance: 23/03/1975
Lieu de naissance: Biskra
Situation familiale: Marié et j'ai trois enfants
Situation militaire: Carte Jaune
Etablissement : Université Mohamed khider Biskra
Spécialité : Mathématiques
Grade : Professeur
Mob: 0697.54.62.33
E-mail:bgherbal@yahoo.fr
E-mail Professionnelle :b.gherbal@univ-biskra.dz
Adresse researchgate : https://www.researchgate.net/profile/Boulekhrass-Gherbal
Laboratoire :Laboratory of Mathematical Analysis, Probabilities and Optimizations University of Biskra. Algeria.

FORMATION ET DIPLOMES

- ✓ Baccalauréat: Sciences exactes., 1994.
- ✓ D.E.S (Diplôme des Etudes Supérieurs) en mathématiques, option: Recherche Opérationnelle, Université de M'sila, 1998.
- ✓ Magistère en mathématiques, option: Logique et Analyse Combinatoire, Université de M'sila, 2001.
- ✓ Doctorat en mathématiques, option:Probabilités, Université de Biskra, 2011.
- ✓ Habilitation universitaire en mathématiques, Université de Biskra, 2015.
- ✓ Grade Professeur . Université de Biskra, 2020.

POSTES OCCUPES

- ✓ Maître Assistant, Université de Biskra, de 0512-2001 au 05.12.2004.
- ✓ Maître-Assistant Charge de Cours: du 06/12/2004 au 15/03/2011.
- ✓ Maître de Conférences "B": Du 16/03/2011 au 15/04/2015.
- ✓ Maître de Conférences "A": Du 16/04/2015 au 07/12/2020.
- ✓ Professeur depuis le 08/12/2020.

THEMES DE RECHERCHE

- ✓ Equations différentielles stochastiques (EDSs)
- ✓ Existence de contrôle optimal
- ✓ Principe du maximum stochastique
- ✓ Existence et unicité des solutions.
- ❖ Mots clés: Contrôle optimal, contrôle strict, contrôle relaxé, tension, perturbation, Principe de Maximum, EDSR, EDSPR, EDDSR, EDDSPR.

ENCADREMENT

- ✓ Encadrement de plusieurs mémoires de Master (M2)

ACTIVITES DE RECHERCHE

- ✓ Responsible de Projet de recherché PRFU: Existence des contrôles optimaux pour les EDSPRs et les EDDSPRs de type champ moyen. Université Mohamed Khider--Biskra. C00L03UN070120180005. (2018).
- ✓ Responsible de Projet de recherché PRFU: Existence et unicité des solutions, existence de contrôle optimal et principe de maximum pour des systèmes dynamiques de type McKean-Vlasov. Université Mohamed Khider--Biskra. C00L03UN070120220005. (2022)

COMMUNICATIONS NATIONALES

- ✓ B. GHERBAL, Existence of optimal control for systems governed by FBSDE with controlled diffusion. Colloque International sur les Mathématiques Appliquées "CIMA'10", 07
  et 09 Novembre 2010 à l'Université 8 Mai 1945 Guelma.
- ✓ B. GHERBAL, Existence and optimality conditions in stochastic control of linear BSDEs. 1er Workshop International sur les Mathématiques Appliquées et la Modélisation "WIMAM'2011", 25-26 Septembre 2011 à l'Université 8 Mai 1945 Guelma.
- ✓ B. GHERBAL, Existence and maximum principle in stochastic control of linear backward doubly stochastic differential equations. 2ème Workshop International sur les Mathématiques Appliquées et la Modélisation "WIMAM'2012", 23-24 Septembre 2012 à l'Université 8 Mai 1945 Guelma.
- ✓ B. GHERBAL, Maximum principle for backward doubly stochastic differential equations. Workshop de Probabilités et statistique à la mémoire du Professeur Seid Bahlali, 29-30 Janvier 2013 à l'Université Mohamed Khider--Biskra.

PUBLICATIONS

[1] Nassima Berrouis, Boulakhras Gherbal and Abdelhakim Ninouh, Stochastic optimal control for dynamics of forward backward doubly SDEs of mean-field type, Bol. Soc. Paran. Mat. (3s.) v. 2023 (41), pp 1-27.
[2] AbdulRahman Al-Hussein and Boulakhras Gherbal, Existence and Uniqueness of the Solutions of Forward Backward Doubly Stochastic Differential Equations with Poisson Jumps, Random. Oper. Stoc. Equ., 28, No 4, (2020), 253-268.
[3] AbdulRahman Al-Hussein and Boulakhras Gherbal, Necessary and Sufficient Optimality Conditions for Relaxed and Strict Control of Forward-Backward Doubly SDEs with Jumps under Full and Partial Information, J Syst Sci Complex, (2020) 33: 1804–1846.
[4] A.NINOUH, B. GHERBAL and N. BERROUIS, Existence of optimal controls for systems of controlled forward-backward doubly SDEs. Random. Oper. Stoc. Equ., Vol. 28, No 2, (2020), 93-112.
[5] A. Al-HUSSEIN and B. GHERBAL. Sufficient Conditions of Optimality for Forward-Backward Doubly SDEs with Jumps. Statistical Methods and Applications in Insurance and Finance (2016), pp 173-191.
[6] A . Al-HUSSEIN and B. GHERBAL. Stochastic Maximum Principle for Hilbert Space Valued Forward-Backward Doubly SDEs with Poisson Jumps. 26th IFIP TC 7 Conference, CSMO 2013, Klagenfurt, Austria, September 9-13, 2013. System Modeling and Optimization, (2014), 1-10.

[7] B. Gherbal, Optimal control problems for linear backward doubly stochastic differential equations. Random. Oper. Stoc. Equ., Vol. 22, No 3, (2014), 129-138.

TACHES ACCOMPLIS

- ✓ Maitrise de l'outil informatique (Word, Excel, Power point, Scientific Work Place, La Tex).

CURRICULUM VITAE (TOUBA SONIA)

RENSEIGNEMENTS GENERAUX

Nom: **TOUBA**
Prénom: **Sonia**
Adresse: B.P 51 Biskra (07000)
Date de naissance: 11 Avril 1977 à Biskra.
Lieu de naissance: Biskra
Situation familiale: Marié
Situation militaire: Rien
Etablissement : Université Mohamed khider Biskra
Spécialité : Mathématiques
Grade : Maitre de conférence<<B>>
Mob: 06 98 88 69 60
E-mail: sonia.touba@univ-biskra.dz
E-mail Professionnelle : sonia.touba@univ-biskra.dz
Adresse researchgate :
Laboratoire :

FORMATION ET DIPLOMES

- ✓ ***Doctorat en sciences*** en Mathématique : Décembre 2013, Département de Mathématique, Université de Biskra.
- ✓ ***Magister*** en Mathématique, Mars 2006, Département de Mathématique, Université de Biskra.
- ✓ ***Diplôme d'étude supérieur*** en Mathématique, Option : Probabilité et statistique, Juin 2000, Département de Mathématique, Université Mohamed Mentouri - Constantine.
- ✓ ***Baccalauréat*** : sciences Exactes - Juin 1996. Lycée Lichana,- Biskra.

POSTES OCCUPES

- ✓ Depuis Décembre 2013: Maître de Conférences Classe B, Département de Mathématique, Université de Biskra.
- ✓ Septembre 2009 – Décembre 2013: Maître Assistant Classe A, Département de Mathématique, Université de Biskra.
- ✓ Septembre 2006- Septembre 2009: Maître Assistant, Département de Mathématique, Université de Biskra.
- ✓ Septembre 2000- Juin 2006 : Enseignante Vacataire ; Département d'Informatique de Gestion, Université de Biskra.

THEMES DE RECHERCHE

- ✓ Les évènements rares et les mesures de risque

ENCADREMENT

- ✓ En licence et en Master depuis 2006 jusqu'a 2023

PUBLICATIONS

- ✓ Bias-Reduced estimation of Wang's two- sided deviation risk mesure under Lévy-stable regime.
- ✓ M.M. Touba, A. Titaouine, **S**. **Touba** and O. Bennis, " ***Probability Density Function Estimation using Multi-layer perceptron*** ", The Online Journal of Science and Technology, Vol. 5, No. 2, pp. 54-63, April 2015.

TACHES ACCOMPLIS

- ✓ Maitrise de l'outil informatique (Word, Excel, Power point, Scientific Work Place, La Tex).

CURRICULUM VITAE (MOHAMED BERBICHE)

RENSEIGNEMENTS GENERAUX

Nom: Berbiche
Prénom: Mohamed
Adresse: B.P 51 Biskra (07000)
Date de naissance: 23/02/1976
Lieu de naissance: Biskra
Situation familiale: Marié avec 04 enfants
Etablissement : Université Mohamed khider Biskra
Spécialité : Mathématiques
Grade : Professeur
Mob: 0664.66.93.98
E-mail:berbichemed@yahoo.fr
E-mail Professionnelle :mohamed.berbiche@univ-biskra.dz
Adresse researchgate : https://www.researchgate.net/profile/Mohamed-Berbiche
Laboratoire : Laboratory of Mathematical Analysis, Probabilities
and Optimizations University of Biskra. Algeria

FORMATION ET DIPLOMES

- ✓ Baccalauréat: Sciences exactes, 1996.
- ✓ Licence en en mathématiques, ENS Kouba, Alger option: Mathématiques 2000.
- ✓ Magistère en mathématiques, option: Equations aux dérivées partielles & Théorie des opérateurs, Université de Annaba, 2003.
- ✓ Doctorat en mathématiques, option: Equations aux dérivées partielles, Université de Sidi Bel-Abbes, 2011.
- ✓ Habilitation universitaire en mathématiques, Université de Sidi Bel-Abbes, 2013.
- ✓ Professorat en mathématiques, Université de Biskra, 2020.

POSTES OCCUPES

- ✓ Maître Assistant B, Université de Khenchela, 2003-2006.
- ✓ Maître Assistant A, Université de Khenchela, 2007-2010.
- ✓ Maître de conférences B, Université de Khenchela, 2011-2012.
- ✓ Maître de conférences A, Université de Khenchela, 2013-2015.
- ✓ Maître de conférences A, Université de Biskra, 2016-2020.
- ✓ Professeur, Université de Biskra, Juillet 2020-à ce jour.

THEMES DE RECHERCHE

- ✓ Equations aux dérivées partielles de type parabolique
- ✓ Equations aux dérivées partielles de type hyperbolique
- ✓ Equations aux dérivées fractionnaires

ENCADREMENT

- ✓ Encadrement de plusieurs mémoires de Licence à l'universités de Khenchela (2009-2015).

- ✓ Encadrement de plusieurs mémoires de Master (M2) aux universités de Khenchela (2009-2015) et de Biskra (2016-2022).
- ✓ Encadrement 1 thèse de Doctorat LMD en 2020.
- ✓ Co Encadrement une thèse de Doctorat en sciences en 2022.

ACTIVITES DE RECHERCHE

- ✓ Chef équipe d'EDP et calcul fractionnaire dans le Laboratoire de l'Analyse Mathématiques, Probabilités et Optimisations, Université Mohamed Khider Biskra depuis 2019.
- ✓ Membre de projet de recherche CNEPRU intitulé : Etude des problèmes d'évolution non linéaires. 2012-2015 CNEPRU B02120110061.
- ✓ Membre de projet de recherche CNEPRU intitulé : Analyse spectrale d'opérateurs 2013-2016. CNEPRU B03520120016.
- ✓ Membre de projet de recherche PRFU intitulé: Méthodes comparables dans la résolution d'un problème de contrôle stochastique inconsistant, 2019-2022, PRFU C00L03UN070120190003.

COMMUNICATIONS NATIONALES

- ✓ M Berbiche, Sufficient conditions for nonexistence of solutions to certain fractional telegraph equation. La première conférence nationale sur les systèmes dynamiques équations différentielles et applications ,10-11 Mars, (2015), Oum El Bouaghi.
- ✓ M Berbiche, On the global existence and blow-up of solutions for some systems of fractional evolution, Days of Applied Mathematics, December 18-19, (2017), Biskra University.
- ✓ M. Terchi, M Berbiche, Existence and blow-up of solutions for nonlinear hyperbolic system with a damping term" Congrès des Mathématiciens Algériens CMA' 2018, Boumerdès, 12-13 mai 2018.

✓ COMMUNICATIONS INTERNATIONALES

- ✓ M Berbiche, On the asymptotic behaviour and blow-up of solutions for certain system of fractional evolution equations. International Conference on Operator Theory ICOT- 19-21 Decembre 2022, Sousse, Tunisia.
- ✓ Berbiche, M. "On the blow-up in finite time of solutions for certain nonlinear damped wave equations in RN." In Singular Problems, Blow-up, and Regimes with Peaking in Nonlinear PDEs, pp. 14-14. 2019.
- ✓ M Berbiche, On the large time behaviour and blow-up of solutions for some systems of evolution equations, Sousse Tunisie Decembre, 2018, International Conference on Advances in Applied Mathematics ICAAM- 2018 Association Tunisienne de Maths Appliquées.
- ✓ M Berbiche, On the global solvability and blow-up of solutions to certain evolution equations. In the 30 th International Conference of the Jangjeon Mathematical Society (ICJMS-2017), Algiers 12-15 July (2017). http://www.usthb.dz/icjms2017/index.html.
- ✓ M Berbiche, Global existence and blow-up of solutions for certain evolution equations, Equadiff 2017, Slovak university of technology in Bratislava July 23-27 Slovakia (2017). http://www.math.sk/equadiff/

PUBLICATIONS

1- Berbiche, Mohamed. "Asymptotic behavior of solutions for linear evolutionary boundary value problem of viscoelastic damped wave equation." Mathematica Bohemica 145, no. 2 (2020): 205-223.
2- Berbiche, Mohamed; Terchi, Messaouda. Global small data solutions for a system of semilinear heat equations and the corresponding system of damped wave equations with nonlinear memory. Adv. Pure Appl Math. 11 (2020), no. 2, 57--87.

3- Ahmad, Bashir, Ahmed Alsaedi, Mohamed Berbiche, and Mokhtar Kirane. "Existence of global solutions and blow-up of solutions for coupled systems of fractional diffusion equations." EJDE (2020).
4- Berbiche, Mohamed. "Energy Decay Estimates of Solutions for Viscoelastic Damped Wave Equations in R n." Bulletin of the Malaysian Mathematical Sciences Society 44, no. 5 (2021): 3175-3214.
5- Ahmad, B., Alsaedi, A., Berbiche, M., & Kirane, M. (2022). Global Existence and Blow-up of Solutions for a System of Fractional Wave Equations. Taiwanese Journal of Mathematics, 26(1), 103-135.
6- Berbiche, M., & Melik, A. (2022). Global existence and decay estimates for the semilinear nonclassical-diffusion equations with memory in $\mathbb {R}^{n} $. Advanced Studies: Euro-Tbilisi Mathematical Journal, 15(2), 29-53.
7- Berbiche, Mohamed, and Ammar Melik. "Global existence and decay estimates for the semilinear heat equation with memory in $ mathbb {R}^{n} $." International Journal of Nonlinear Analysis and Applications 13.2 (2022): 2271-2285.

TACHES ACCOMPLIS

✓ Maitrise de l'outil informatique (Word, Excel, Power point, Scientific Work Place, La Tex).

Opinions and Visas from Administrative and Consultative Bodies

Title of the Master: Academic Master in PDE and numerical Analysis

<table>
<tr><th>Head of Department</th><th>Responsible for the domain</th></tr>
<tr><td>Date and Visa:</td><td>Date and Visa:</td></tr>
<tr><td colspan="2">Dean of the faculty (or Institute Director)</td></tr>
<tr><td colspan="2">Date and Visa:</td></tr>
<tr><td colspan="2">Head of university establishment</td></tr>
<tr><td colspan="2">Date and Visa:</td></tr>
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