قسم الرياضيات والإحصاء ماجستير العلوم في الرياضيات		جامعة الإمام محمد بن سعود الإسلامية كلية العلوم

نموذج (1): مقترح المشروع البحثي ريض 699

Research Project Proposal MAT 699

Second Semester, 1438–1439 (2017–2018) **Date: 18.11.2018**	الفصل / العام الدراسي **Semester/Year**
Signature التوقيع | الإسم د. محمد عبد القوي	المشرف **Supervisor**
Legendre spectral methods for solving fractional differential equations	عنوان المشروع المقترح **Title of the project**
Numerical Analysis	مجال المشروع البحثي **Area of research project**
Math 333, Math 433, Math 641	المتطلبات **Prerequisites**
Fractional differential equations (FDEs) [1,2] are presented as powerful mathematical tools for factual and more accurate, describing different phenomena. They appear in various areas including mathematical chemistry viscoelasticity, biology, electrochemistry, physics, semi-conductors, seismology, scattering theory, heat conduction, fluid flow, metallurgy, population dynamics, optimal control theory, mathematical economics and chemical reaction. As the increasing of employing fractional differential equations in many social and scientific fields, the main challenge confront the researchers is that obtaining solutions for them. Unfortunately, for most of these fractional partial differential equations, no one able to achieve analytic solutions for such problems. In recent years there is a high level of interest of employing spectral methods for numerically solving many types of FDEs, due to their ease of application for finite and infinite domains. The speed of convergence is one of the great advantages of spectral methods. Besides, spectral methods have exponential rates of convergence; they also have high level of accuracy. Spectral methods are divided into four classifications namely, collocation [3], tau [4], Galerkin [5] and Petrov Galerkin [6] method. The main idea of all versions of spectral methods is to express the spectral solution of the problem as a finite sum of certain basis functions (orthogonal	الملخص **Abstract**

polynomials or combination of orthogonal polynomials) and then to choose the coefficients in order to minimize the difference between the exact and numerical solutions as well as possible.	
The proposed plan of study can be carried out as follows: **1.** A survey study on orthogonal polynomials is needed, in particular Legendre polynomials. **2.** A survey study on spectral methods is needed, in particular tau and collocation. **3.** A theoretical study of FDEs is needed. Legendre spectral methods will be applied to solve FDEs. **References:** **1.** A. Atangana, E. Alabaraoye, Solving a system of fractional partial differential equations arising in the model of HIV infection of CD4+ cells and attractor one-dimensional Keller-Segel equations, Adv. Differ. Eq. (2013) doi: 10.1186/1687-1847-2013-94. **2.** R. L. Magin, Fractional Calculus in Bioengineering, Begell House Publishers, 2006. **3.** A.H. Bhrawy, D. Baleanu, A Spectral Legendre-Gauss-Lobatto collocation method for a space-fractional advection diffusion equation with variable coefficients, Rep. Math. Phys., 72 (2013) 219-233. **4.** E.H. Doha, A.H. Bhrawy, R.M. Hafez, On shifted Jacobi spectral method for high-order multi-point boundary value problems, Commun. Nonlinear Sci., 17(2012) 3802-3810. **5.** E.H. Doha, A.H. Bhrawy, An efficient direct solver for multidimensional elliptic Robin boundary value problems using a Legendre spectral-Galerkin method, Comput. Math. Appl., 64 (2012) 558-571. **6.** E.H. Doha, A.H. Bhrawy, R.M. Hafez, A Jacobi-Jacobi dual-Petrov-Galerkin method for third- and fifth-order differential equations, Math. Comput. Model., 53 (2011) 1820-1832.	الخطة التفصيلية للمشروع **Detailed Plan of the Project**

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نموذج (1): مقترح المشروع البحثي ريض 699

Research Project Proposal MAT 699

Year; 1439–1440, Semester: 2 **Date: 12.11.2018**		الفصل / العام الدراسي **Semester/Year**
Signature التوقيع	**Name** **Lazhar Bougoffa** الإسم	المشرف **Supervisor**
Existence and uniqueness theorems for fourth-order nonlinear differential equations with boundary conditions		عنوان المشروع المقترح **Title of the project**
Applied Mathematics		مجال المشروع البحثي **Area of research project**
		المتطلبات **Prerequisites**
The purpose of this paper is to investigate the boundary value problems for fourth-order nonlinear differential equations u""+q(x)u=f(x, u, u") with various mixed boundary conditions. We first establish sufficient conditions on $q(x)$ that guarantee a unique solution in the Sobolev space H^4[0, 1] and then the existence and uniqueness theorem of the classical solution by using an a priori estimate and the contraction Banach mapping.		الملخص **Abstract**
1- Introduction. 2- The uniqueness of the solution in Sobolev Space 3- Existence and uniqueness theorem for the classical solution. 4- Numerical results.		الخطة التفصيلية للمشروع **Detailed Plan of the Project**

قسم الرياضيات والإحصاء ماجستير العلوم في الرياضيات		جامعة الإمام محمد بن سعود الإسلامية كلية العلوم

نموذج (1): مقترح المشروع البحثي ريض 699

Research Project Proposal MAT 699

Second Semester, 1439-1440 (2018-2019) **Date: 15.11.2018**		**الفصل / العام الدراسي** **Semester/Year**
Signature التوقيع شورار	الإسم: د. براهيم شورار	**المشرف** **Supervisor**
Combinatorial Optimization Problems in Series Parallel Graphs		**عنوان المشروع المقترح** **Title of the project**
Combinatorial Optimization		**مجال المشروع البحثي** **Area of research project**
Basics of Combinatorial Optimization		**المتطلبات** **Prerequisites**
Series parallel graphs form a special class of planar graphs. Most Combinatorial Optimization problems have been studied in series parallel graphs. The first category of authors focuses on providing a polynomial time algorithm for the considered problem when it is NP-complete in general graphs. The second one provides proofs for the hardness of the problem in series parallel graphs and then justifies the approach by approximation algorithms and heuristics for those problems. The last category provides an improvement in the running time complexity when it is already polynomial for series parallel graphs. The main objective of this project is to survey these problems in this class of graphs.		**الملخص** **Abstract**
1) Introduction and preliminaries. 2) Graphical Properties of Series Parallel Graphs. 3) Polynomial Problems in Series Parallel Graphs. 4) NP-Complete Problems in Series Parallel Graphs. 5) Fast Algorithms for Problems in Series Parallel Graphs. 6) Conclusion.		**الخطة التفصيلية للمشروع** **Detailed Plan of the Project**

قسم الرياضيات والإحصاء ماجستير العلوم في الرياضيات		جامعة الإمام محمد بن سعود الإسلامية كلية العلوم

نموذج (1): مقترح المشروع البحثي ريض 699

Research Project Proposal MAT 699

Year; 1439–1440, Semester: 2 **Date: 20.11.2018**		الفصل / العام الدراسي **Semester/Year**
Signature التوقيع	**Name** **Dr. Abdelouahed** الإسم **EL KHALIL**	المشرف **Supervisor**
On Hamiltonian-Jacobi Equations		عنوان المشروع المقترح **Title of the project**
Partial Differential Equations		مجال المشروع البحثي **Area of research project**
MAT631 or equivalent		المتطلبات **Prerequisites**
The main objective of this research project is to study Hamilton-Jacobi Equations by using Calculus of Variation approach and their characteristics in connection with Euler-Lagrange equations. The eventual derivations of Hamilton's ODEs will be based on using Legendre transform. We give also Hopf-Lax formula as solution. We study the existence of the weak solution and its uniqueness. Applications to solve some PDEs.		الملخص **Abstract**
Task 1. Reading some references and report them (2 weeks) Task 2. Motivation and derivation of Hamilton's ODEs (2 weeks)		الخطة التفصيلية للمشروع **Detailed Plan of the Project**

Task 3. Solving Hamilton's ODEs using Calculus of variations (2 weeks) Task 4. Connection to Euler-Lagrange Equations (1 week) Task 5. The Legendre transform and Hopf-Lax formula (1 week) Task 6. Mastering techniques of solving the Hamilton-Jacobi PDEs (2 weeks) Task 7. Applications and perspectives (2 week) Task 8. Writing the drafts and final reports and Mock present (3 weeks)	

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نموذج (1): مقترح المشروع البحثي ريض 699

Research Project Proposal MAT 699

<table>
<tr><td colspan="2">Year; 1439–1440, Semester: 2
Date: 19.11.2018</td><td>الفصل / العام الدراسي
Semester/Year</td></tr>
<tr><td>Signature التوقيع
ericngondiep</td><td>Name: Eric Ngondiep</td><td>المشرف
Supervisor</td></tr>
<tr><td colspan="2">Analysis of a Time-Split MacCormack Method for two Dimensional Heat Conduction</td><td>عنوان المشروع المقترح
Title of the project</td></tr>
<tr><td colspan="2">Applied Mathematics (numerical analysis)</td><td>مجال المشروع البحثي
Area of research project</td></tr>
<tr><td colspan="2"><u>Minimum qualification</u> (very important): the interested student must have a good background in finite difference representations and must be familiar with MatLab.</td><td>المتطلبات
Prerequisites</td></tr>
<tr><td colspan="2">The project considers a three-level explicit time-split MacCormack method for solving the two-dimensional heat equation. The thesis start with some preliminaries which give an overview of a two-level explicit MacCormack approach. This approach is a predictor-corrector scheme widely used in fluid dynamic to solve oscillatory problems such as: shallow water (or Saint-Venant) equations, Navier-Stokes problems, parabolic Navier-Stokes equations, and so on. The student will give a full description of a three-level explicit time-split MacCormack method applied to two-dimensional heat conduction and he will study in details the stability together with the error estimates of the numerical scheme using the discrete L^2-norm. He will also perform a wide set of numerical evidences which will confirm his theoretical analysis.</td><td>الملخص
Abstract</td></tr>
<tr><td colspan="2">Chapter 1
Preliminaries : give an overview of the two-level explicit MaCormack scheme, define the discrete L^2-norm and scalar product, recall the Poincare-Friedrichs and Holder inequalities, construct the discrete space of approximate solutions, and so on.</td><td>الخطة التفصيلية للمشروع
Detailed Plan of the Project</td></tr>
</table>

Chapter 2 **Full description of a time-split MacCormack:** starting from a two-level explicit MacCormack, describe a three-level time-split MacCormack scheme by the use of the Taylor series expansion.	
Chapter 3 **Stability analysis of the method:** under the assumption that the exact solution is bounded (for the discrete L^2-norm) by a positive constant independent of the time step "k", and the mesh size "h", describe how to combine the exact solution and the approximate one obtained by a time-split MaCormack scheme in order to get the error and then show that the approximate solution is also bounded (for the discrete L^2-norm) by a positive quantity independent of both parameters "k" and "h".	
Chapter 4 **Error estimates of the method:** show that the discrete L^2-norm of the error provided by a three-level time-split MacCormack is bounded by a term of the form $C(k^m+h^n)$, where k is the time step, h represents the mesh size, and C is a positive constant independent of both "k" and "h."	
Chapter 5 **Numerical examples and convergence rate:** perform some numerical examples in order to verify the stability, convergence and convergence rate of the considered method.	

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نموذج (1): مقترح المشروع البحثي ريض 699

Research Project Proposal MAT 699

Year; 1439–1440, Semester: 2 **Date: 18.11.2018**		الفصل / العام الدراسي **Semester/Year**
Signature التوقيع	**Name: Fahir Talay Akyildiz**	المشرف **Supervisor**
Similarity solutions of the boundary layer equations		عنوان المشروع المقترح **Title of the project**
Applied Mathematics		مجال المشروع البحثي **Area of research project**
Ordinary Differential Equations, Numerical Analyses		المتطلبات **Prerequisites**
In this project, we consider the steady three-dimensional boundary layer flow due to a shrinking sheet and analyses the resulting nonlinear third order differential equation over infinite region. Miklavcic and Wang [1, Cited 421] consider the same problem and establish the existence of the solution. They used $C^2[0,\infty]$ Banach space and Contraction principles prove the existence of the solution. In this project, we give numerical results for above problem also study of the above paper(if possible consider the some other methods)		الملخص **Abstract**

الخطة التفصيلية للمشروع **Detailed Plan of the Project**	1- Reading the paper of Miklavcic and Wang [1] 2- Understand the technique in the paper and rewrite the theorems in the paper in detail (if possible consider the some other technique) 3- Write Maple and Matlab programme and solve the problem numerically. **Reference** Miklavcic, M., Wang, C.Y.: Viscous flow due to a shrinking sheet. Q. Appl. Math. 64, 283–290 (2006)

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نموذج (1): مقترح المشروع البحثي ريض 699

Research Project Proposal MAT 699

Year; 1439–1440, Semester: 2 **Date: 18.11.2018**		الفصل / العام الدراسي **Semester/Year**
Signature التوقيع	الإسم : منى محمد خندقجي	المشرف **Supervisor**
Conformal fractional derivatives and its applications on solving fractional differential equations		عنوان المشروع المقترح **Title of the project**
Applied mathematics (differential equations)		مجال المشروع البحثي **Area of research project**
Ordinary differential equation		المتطلبات **Prerequisites**
Introducing the main popular definitions of the fractional derivative and fractional integrals in the fractional calculus, then introducing a new definition concerning fractional derivative done in 2013 and discuss its main properties and solving differential equations using this fractional derivative. Also introduce a generalization of this definition done in 2014. Also comparing the properties of the old and the new definitions.		الملخص **Abstract**
1.History of fractional calculus (what is the physical meaning or geometric interpretations of the α-derivative, where α is a fraction. 2.Some special functions. 3.Common definitions of fractional derivatives and fractional integrals. 4.Introduction of a new definition in conformal fractional differential equation (2013).		الخطة التفصيلية للمشروع **Detailed Plan of the Project**

5.Properties and applications. 6.Solvability of some fractional differential equations. 7.Introduction of a generalization of this definition (2014) and main properties.	

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نموذج (1): مقترح المشروع البحثي ريض 699
Research Project Proposal MAT 699

Year; 1439-1440, Semester: 2 **Date: 12/11/2018**		الفصل / العام الدراسي **Semester/Year**
Signature التوقيع	Name: **Dr. Mohamed Sidaty**	المشرف **Supervisor**
The Riesz-Markov representation Theorem		عنوان المشروع المقترح **Title of the project**
Functional Analysis		مجال المشروع البحثي **Area of research project**
Topology-Banach Spaces-Measure Theory		المتطلبات **Prerequisites**
The Riesz-Markov representation Theorem provides a nice description of the topological dual space of many of real valued function spaces using the Radon Measure. Our purpose is to give the main properties of this measure, to show how to extend this duality to certain Banach valued function spaces.		الملخص **Abstract**
1) Introduction 2) Radon Measure 3) Representation Theorem 4) Extension to some Banach valued functions spaces		**الخطة التفصيلية للمشروع** **Detailed Plan of the Project**