1. **Basic Information**

**Course Title**: Modern Topics in Differential and Integral Equations   **Code**: **EMM 702 Units: 3**

**Lecture**: 3 **Tutorial**: - **Practical**: - **Total:** 3

**Program on which the course is given:**  Doctor of Philosophy in Engineering Mathematics

**Major or minor element of program:** Major

**Department offering the program:** Department of Engineering Mathematics and Physics

**Department offering the course:** Department of Engineering Mathematics and Physics

**Academic year / level:** Academic year2014 / 2015 Second Semester

**Date of specifications approval:**  December 2015

1. **Professional Information**
2. **Overall aims of course**

By the end of the course the students will be able to:

* Deal with Fredholm integral equations.
* Construct Green’s function for ordinary differential equations and use it in solving boundary value problems.
* Deal with some singular integral equations.
* Deal with some approximate methods for solving integral equations.
* Deal with some approximate methods for finding characteristic numbers.

1. **Intended Learning outcomes of Course (ILOs)**
2. **Knowledge and Understanding:**

2.1.1 Identify theories, fundamentals of integral and differential equations.

2.1.4 List the principles and fundamentals of Fredholm equations

1. **Intellectual Skills**

2.2.2 Solve problems based on a Ritz method, The method of traces and Kellogg’s method.

1. **Professional and Practical Skills**

2.3.3 Assess methods and current tools in the field of integral and differential equations.

1. **General and Transferable Skills**

2.4.4 Assess him/her self and continue to learn approximate methods of differential and integral equations.

2.4.5 Use different sources for obtaining information and knowledge for differential and integral equations

1. **Contents**

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| **No** | **Topic** | **No. of hours** | **Teaching / learning methods and strategies** | **Assessment method** |
| 1 | The Method of Fredholm Determinates | 2 | Lectures, Tutorial | Assignments |
| 2 | The recursion relation to find the resolvent kernel | 2 | Lectures, Tutorial | Assignments |
| 3 | Iterated kernels to find the resolvent kernel | 2 | Lectures, Tutorial | Assignments |
| 4 | Integral equations with degenerate kernels | 3 | Lectures, Tutorial | Assignments |
| 5 | Characteristic number and Eigen functions | 3 | Lectures, Tutorial | Assignments |
| 6 | Solution of homogeneous integral equations | 3 | Lectures, Tutorial | Assignments |
| 7 | Solution of non-homogeneous integral equations | 3 | Lectures, Tutorial | Assignments |
| 8 | Fredholm alternative investigate for solvability of the integral equations | 3 | Lectures, Tutorial | Assignments |
| 9 | Construction of Green’s function for ordinary differential equation | 3 | Lectures, Tutorial | Assignments |
| 10 | Using Green’s function in the solution of boundary value problems. | 3 | Lectures, Tutorial | Assignments |
| 11 | Boundary value problems containing a parameter reducing them to integral equations | 3 | Lectures, Tutorial | Assignments |
| 12 | The solution of certain Singular Integral equations with the aid of Efro’s theorem (generalized product theorem) | 3 | Lectures, Tutorial | Assignments |
| 13 | The solution of certain Singular Integral equations with the aid of the Mellin transformation | 3 | Lectures, Tutorial | Assignments |
| 14 | Approximate methods of solving integral equations:1-Replacing the kernel by a degenerate kernel, 2-The method of successive approximations | 3 | Lectures, Tutorial | Assignments |
| 15 | Approximate methods for finding characteristic numbers:1-Ritz method, 2-The method of traces, 3-Kellogg’s method | 3 | Lectures, Tutorial | Assignments |
| 16 | Mid-term Exam | | | |
| 17 | Final Exam | | | |

1. **Teaching and Learning Methods**
   1. Lectures
   2. Class activity
   3. Self study
   4. Research assignments and the use of internet. 
2. **Student Assessment Methods**
   1. Homework assignments and others
   2. Mid-term exam
   3. Final exam to assess understanding and scientific knowledge. 
3. **Assessment schedule**

Assessment 1 All weeks 

Assessment 2 Quizzes

Assessment 3 Final exam on the 15thweek

1. **Weighting of Assessments**

Final- Term Examination 67 %

Oral Examination 00 %

Practical Examination 00 %

Year Work 33 %

Other 00 %

Total 100 %

1. **List of References**
   1. Course Notes

* Lecture material and training sheets
  1. Essential Books (Text Books)
* M. Krasnov, A. Kiselev, G. Makarenko; “Problems and Exercises in Integral Equations”, Moscow 1971.
  1. Recommended Books
* Tslaf, L. Yac; “The Calculus of Variation and Integral Equations”, 1970.
* A. V. Bit Sadze; “Equations of Mathematical Physics” (Translated from Russian).
* A. D. Myskis; “Advanced Mathematics for Engineers”, MIR publishers Moscow 1975.
* B. D. Gupta; “Mathematical Physics”, India.
  1. Periodicals Web sites, etc
* [www.Google.com](http://www.Google.com)

1. **Facilities Required for Teaching and learning**

White board, prepared notes, Sheets and solving problems.

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| **Course coordinator:** Ass. Prof. Dr. Moawad El Sharnouby |
| **Course instructor:** Ass. Prof. Dr. Moawad El Sharnouby |

**Head of department:** Prof. Dr. Said Abdallah **Date: 28 / 7 / 2015**