



## Course Specification

**Course Name:**[Mathematics - 3 ]

**Course Code:**[MA214]

### I. Basic Course Information

Major or minor element of program:[ General]

Department offering the course:[Faculty]

Academic level:[ 200 Level]

Semester in which course is offered:[First (fall) Semester]

Course pre-requisite(s): [[Mathematics–2] ]

Credit Hours:3

Contact Hours Through:

| Lecture | Tutorial* | Practical* | Total |
|---------|-----------|------------|-------|
| 2.5     | 1.5       | 0.0        | 4.0   |

\* 1.5 hours for **either** Tutorial or Practical

Approval date of course specification:September 2014

### II. Overall Aims of Course

[To provide students with a systematic understanding of important core areas and some advanced topics in mathematics, an appreciation of its wide-ranging applications, and to offer the students a range of ways to develop their skills and knowledge. Also, the course will offer several specialized areas of mathematics and its applications. The student will examine how the principal results in these areas, how they relate to real-world problems. ]

### III. Program ILOs covered by course

| Program Intended Learning Outcomes (By Code) |                     |                     |                |
|--|---------------------|---------------------|----------------|
| Knowledge & Understanding                    | Intellectual Skills | Professional Skills | General Skills |
| [K12,K14 ]                                   | [I5 ]               | [P8 ]               | [G4,G6,G7,G9 ] |



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**IV. Intended Learning Outcomes of Course (ILOs)**

**a. Knowledge and Understanding**

- K.1 Operate and manipulate matrices and determinants; and solve systems of linear equations using matrices and determinants.
- K.2 Identify the linear correlation between vectors, and obtain orthonormal vectors.
- K.3 Compute Eigen values and corresponding vectors; and use them to obtain function of matrix.
- K.4 Apply the formulation of Ordinary Differential Equations: First, High Order and Applications. ]

**b. Intellectual/Cognitive Skills**

- I.1 Demonstrate knowledge of key mathematical concepts and topics, both explicitly and by applying them to the solution of problems.
- I.2 Grasp how mathematical processes may be applied to problems including, where appropriate, an understanding that this might give only a partial solution.
- I.3 Develop and present mathematical arguments and conclusions from them with clarity and accuracy, in forms suitable for the audiences being addressed. ]

**c. Practical/Professional Skills**

- P.1 Calculate fluently and accurately in abstract notation.
- P.2 Use of mathematical computer packages. ]

**d. General and Transferable Skills**

- G.1 Analyse and solve problems and apply reason creatively.
- G.2 Communicate effectively and presentation orally.
- G.3 Learn independently.
- G.4 Think critically about solutions and defend an intellectual position. ]

**V. Course Matrix Contents**

|    | Main Topics / Chapters  | Duration (Weeks) | Course ILOs Covered by Topic (By ILO Code) |             |          |           |
|----|---|------------------|--|-------------|----------|-----------|
|    |   |                  | K & U                                      | I.S.        | P.S.     | G.S.      |
| 1- | [Linear Algebra<br>Matrix Algebra; solving system of linear Equations ]   | [3 ]             | [K1 ]                                      | [I1,I2 ]    | [P1,P2 ] | [G1,G2,G4 |
| 2- | [Vectors:Vector Spaces;<br>Vector Algebra;<br>Independence of vectors;<br>Orthonormalization, Linear Transformation ]               | [3 ]             | [K2 ]                                      | [I1,I2 ]    | [P1,P2 ] | [G1,G2,G4 |
| 3- | [Eigen Value Problem:Eigen values and Eigen vectors;<br>diagonalization; function of a matrix ]                                     | [2 ]             | [K3 ]                                      | [I1,I2 ]    | [P1,P2 ] | [G1,G2,G4 |
| 4- | [Ordinary Differential Equations:<br>i. First Order: First Degree, and High Degrees<br>ii. Linear High Order<br>iii. Applications ] | [5 ]             | [K4 ]                                      | [I1,I2,I3 ] | [P1 ]    | [G1,G2,G4 |
|    | <b>Net Teaching Weeks</b>   | <b>13</b>        |  |             |          |           |



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VI. Course Weekly Detailed Topics / hours / ILOs

| Week No. | Sub-Topics  | Total Hours | Contact Hours     |                  |
|----------|---|-------------|-------------------|------------------|
|          |   |             | Theoretical Hours | Practical Hours* |
| 1        | [Linear Systems of Equations<br>Notation and a Review of Numbers<br>Gaussian Elimination: Basic Ideas ]   | [2.5 ]      | [2.5 ]            |                  |
| 2        | [Matrix Addition and Scalar<br>Multiplication<br>. Matrix Multiplication<br>. Applications of Matrix Arithmetic<br>. Special Matrices and Transposes<br>. Matrix Inverses<br>Solution of linear systems of equations<br>using matrices. ] | [4 ]        | [2.5 ]            | [1.5 ]           |
| 3        | [Determinants<br>- Determinants and geometry ..<br>- Cofactor expansion for the determinant<br>.-Adjoint matrix ..<br>- Kramer's Rule .<br>-Properties of determinants .. ]   | [4 ]        | [2.5 ]            | [1.5 ]           |
| 4        | [Vector Spaces<br>• Definitions and Basic Concepts<br>• Subspaces<br>• Subspaces Associated with Matrices<br>and Operators<br>• Bases and Dimension<br>• Linear Systems Revisited ]   | [4 ]        | [2.5 ]            | [1.5 ]           |
| 5        | [Vector Algebra Basics; cross product and<br>vector product; Projection and angle<br>between vectors; Vector Span; Vector<br>Orthogonalization; Orthonormal matrix ]  | [4 ]        | [2.5 ]            | [1.5 ]           |
| 6        | [Linear Transformation (LT)<br>Matrices and LT<br>LT and Linear Combination<br>New LT from Old ]  | [4 ]        | [2.5 ]            | [1.5 ]           |
| 7        | <b>Midterm Exam</b>   |             |                   |                  |
| 8        | [Eigenvalues and Eigenvectors<br>Eigenvalues of matrix<br>Polynomial and Matrices<br>Existence and computing of<br>Eigenvalues and Eigenvectors<br>- Properties of Eigenvalues and<br>Eigenvectors<br>- Multiplication of eigenvalues ]   | [4 ]        | [2.5 ]            | [1.5 ]           |
| 9        | [Eigen value problem:<br>Characteristic Polynomial<br>Similarity and Diagonalization<br>Similar matrices  | [4 ]        | [2.5 ]            | [1.5 ]           |



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|                             |   |           |           |           |
|-----------------------------|---|-----------|-----------|-----------|
|                             | Diagonalization<br>Orthonormal diagonalization<br>Matrix Function   |           |           |           |
| 10                          | [Ordinary and Partial differential equations; Order and degree of a differential equations; Linear and nonlinear differential equations; Solution of a differential equations]            | [4]       | [2.5]     | [1.5]     |
| 11                          | [Equations of first order and first degree: Introduction; Separation of variables; Equations reducible to separable form Homogeneous differential equations and reducible to homogeneous] | [4]       | [2.5]     | [1.5]     |
| 12                          | [Equations of first order and first degree: Exact differential equations; Linear differential equations; Bernoulli's equations]   | [4]       | [2.5]     | [1.5]     |
| 13                          | [High Order Differential Equation]  | [4]       | [2.5]     | [1.5]     |
| 14                          | [Applications of first order differential equations<br>Growth and Decay<br>Newton's Law of cooling]   | [4]       | [2.5]     | [1.5]     |
| 15                          | <b>Final Exam</b>   |           |           |           |
| <b>Total Teaching Hours</b> |   | <b>51</b> | <b>33</b> | <b>18</b> |

\* No Practical/Tutorial during the first week of the semester

VII. Teaching and Learning Methods

| Teaching/Learning Method                 | Selected Method | Course ILOs Covered by Method (By ILO Code) |                     |                     |                |
|--|-----------------|---|---------------------|---------------------|----------------|
|  |                 | K & U                                       | Intellectual Skills | Professional Skills | General Skills |
| Lectures & Seminars                      | x               | K1,K2,K3,K4                                 | I1,I3               | P1                  | G1,G4          |
| Tutorials                                | x               |   | I2                  |                     | G2,G3          |
| Computer lab Sessions                    | x               |   |                     | P2                  |                |
| Practical lab Work                       | []              |   |                     |                     |                |
| Reading Materials                        | []              |   |                     |                     |                |
| Web-site Searches                        | []              |   |                     |                     |                |
| Research & Reporting                     | []              |   |                     |                     |                |
| Problem Solving / Problem-based Learning | []              |   |                     |                     |                |
| Projects                                 | []              |   |                     |                     |                |
| Independent Work                         | []              |   |                     |                     |                |
| Group Work                               | []              |   |                     |                     |                |
| Case Studies                             | []              |   |                     |                     |                |
| Presentations                            | []              |   |                     |                     |                |
| Simulation Analysis                      | []              |   |                     |                     |                |
| Others (Specify):                        | []              |   |                     |                     |                |



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VIII. Assessment Methods, Schedule and Grade Distribution

| Assessment Method   | Selected Method | Course ILOs Covered by Method<br>(By ILO Code) |         |      |       | Assessment Weight / Percentage | Week No. |
|---------------------|-----------------|--|---------|------|-------|--------------------------------|----------|
|                     |                 | K & U  | I.S.    | P.S. | G.S.  |                                |          |
| Midterm Exam        | [x]             | [K1,K2]  | [I1]    | [P1] | [G1]  | [20%]                          | [7]      |
| Final Exam          | [x]             | [K1,K2,K3,K4]                                  | [I1]    | [P1] | [All] | [60%]                          | [15]     |
| Quizzes             | [ ]             | [ ]  | [ ]     | [ ]  | [ ]   | [ ]                            | [ ]      |
| Course Work         | [x]             | [ ]  | [I2,I3] | [ ]  | [ ]   | [10%]                          | [12]     |
| Report Writing      | [ ]             | [ ]  | [ ]     | [ ]  | [ ]   | [ ]                            | [ ]      |
| Case Study Analysis | [ ]             | [ ]  | [ ]     | [ ]  | [ ]   | [ ]                            | [ ]      |
| Oral Presentations  | [ ]             | [ ]  | [ ]     | [ ]  | [ ]   | [ ]                            | [ ]      |
| Practical           | [ ]             | [ ]  | [ ]     | [ ]  | [ ]   | [ ]                            | [ ]      |
| Group Project       | [x]             | [ ]  | [I2]    | [P2] | [ ]   | [10%]                          | [10]     |
| Individual Project  | [ ]             | [ ]  | [ ]     | [ ]  | [ ]   | [ ]                            | [ ]      |
| Others (Specify):   | [ ]             | [ ]  | [ ]     | [ ]  | [ ]   | [ ]                            | [ ]      |

IX. List of References

|  |   |
|--|---|
| <b>Essential Text Books</b>            | <ul style="list-style-type: none"> <li>James R. Brannan: Clemson University, William E. Boyce: Rensselaer Polytechnic Institute; "Differential Equations With Boundary Value Problems"; John Wiley &amp; Sons, Inc. ; 2010.</li> <li>B. P. Parashar; "Differential And Integral Equations; CBS Publishers &amp; Distributers; Second Edition, 2008.<br/>Carmen Chicone, Ordinary Differential Equations with Applications, Springer; 2nd edition, 2006.</li> <li>Alan Jeffry: University of Newcastle-upon Tyne; "Mathematics for Engineers and Scientists"; Nelson Canada Ltd; Second Edition; 1980. ]</li> </ul>  |
| <b>Course notes</b>                    | <ul style="list-style-type: none"> <li>[None]</li> </ul>  |
| <b>Recommended books</b>               | <ul style="list-style-type: none"> <li>[Murry R. Spiegel, Polytechnic Institute of Connecticut; "Theory and Problems of Advanced Mathematics", McGRAW-HILL Book Company; 1980.</li> <li>Eugene Butkov: St. John's University; "Mathematical Physics"; ADDISON-WESLEY PUBLISHING COMPANY; 1973</li> <li>Frank Ayres, Dickinson College; "Theory and Problems of Differential and Integral Calculus", McGRAW-HILL, Inc; Second Edition; 1972. ]</li> </ul>  |
| <b>Periodicals, Web sites, etc ...</b> | <ul style="list-style-type: none"> <li>[<a href="http://en.wikipedia.org/wiki/Ordinary_differential_equation">http://en.wikipedia.org/wiki/Ordinary_differential_equation</a></li> <li><a href="http://mathworld.wolfram.com/OrdinaryDifferentialEquation.html">http://mathworld.wolfram.com/OrdinaryDifferentialEquation.html</a></li> <li><a href="http://mathworld.wolfram.com/First-OrderOrdinaryDifferentialEquation.html">http://mathworld.wolfram.com/First-OrderOrdinaryDifferentialEquation.html</a></li> <li><a href="http://archives.math.utk.edu/topics/ordinaryDiffEq.html">http://archives.math.utk.edu/topics/ordinaryDiffEq.html</a></li> <li><a href="http://www.maths.surrey.ac.uk/explore/emmaspages/option1.html">http://www.maths.surrey.ac.uk/explore/emmaspages/option1.html</a></li> <li><a href="http://en.wikipedia.org/wiki/Determinant">http://en.wikipedia.org/wiki/Determinant</a> ]</li> </ul> |



*Course Specification*

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**X. Facilities required for teaching and learning**

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| <ul style="list-style-type: none"><li>• [Appropriate teaching accommodation , teaching aids, materials, calculator, computer labs, computers ]</li></ul> |
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**Course coordinator:**[Ass. Prof. Ibrahim Elbata]

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**Date:** September 2014