### ATTACHMENT 2 (e)

### Course Specifications

**Kingdom of Saudi Arabia**

**The National Commission for Academic Accreditation & Assessment**

**Course Specifications**

**(CS)**

**Introduction to Ordinary Differential equations**

**Math321**

**Course Specifications**

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| Institution Faculty of Science Date of Report 5/2/1435  |
| College/Department Mathematics Department |

**A. Course Identification and General Information**

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| 1. Course title and code: Introduction to Ordinary Differential equations (ODE), Math 321 |
| 2. Credit hours 4 Hours |
| 3. Program(s) in which the course is offered. (If general elective available in many programs indicate this rather than list programs) |
| 4. Name of faculty member responsible for the course: Salah Abdelnaby Elgharieb Khafagy |
| 5. Level/year at which this course is offered Fifth Level/Third Year  |
| 6. Pre-requisites for this course (if any) Calculus II, Math 202 |
| 7. Co-requisites for this course (if any) |
| 8. Location if not on main campus Main Campus , Zulfi city |
| 9. Mode of Instruction (mark all that apply) a. Traditional classroom What percentage? √ b. Blended (traditional and online) What percentage?1040√ c. e-learning What percentage? d. Correspondence What percentage? f. Other What percentage?Comments: |

**B. Objectives**

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| 1. What is the main purpose for this course?

1. Students will be able to model physical phenomena with first-order differential equations, to solve such equations using analytic, graphical, or numerical methods, and to analyze and communicate the results. Students will display proficiency by demonstrating the following competencies:a. Identify the order of an ordinary differential equation and determine whether it is  linear or nonlinear.b. Identify a separable first-order equation and find a family of solutions; find singular  solutions.c. Identify a first-order linear equation and find the general solution using an  integrating factor.d. Identify an exact differential equation and find a family of solutions.e. Solve initial-value problems involving first-order separable, linear, and exact  equations.f. Solve selected application problems involving first-order equations.2- Students will be able to model physical phenomena with second-order differential equations, to solve such equations using analytic methods, and to analyze and communicate the results.  Students will display proficiency by demonstrating the following competencies:a. Identify a second- or higher-order linear homogeneous differential equation and state the general form of the solution using a linearly independent set of functions.b. Solve a second- or higher-order linear homogeneous equation with constant coefficients using the characteristic equation; solve an associated initial-value problem.c. Solve a second-order linear nonhomogeneous equation with constant coefficients using the method of variation of parameters; solve an associated initial-value problem.d. Use the definition to compute the Laplace transform of a function.e. Use step functions to represent a piecewise-continuous function.f. Solve a linear differential equation using Laplace transforms.3. Students will be able to use power series to solve differential equations. Students will display proficiency by demonstrating the following competencies. a. Find a power series solution for a linear differential equation about an ordinary  point; solve an associated initial-value problem. b. Identify singular points for a linear differential equation. |
| 2. Briefly describe any plans for developing and improving the course that are being implemented. (e.g. increased use of IT or web based reference material, changes in content as a result of new research in the field) Our plan to developing and improving the course are the following:1- Using a new method for solutions like: \* the graphical methods. \* Numerical methods (Euler, Improved Euler, and Runge-Kutta).2- Solving differential equations using computer software.3- More applications of the DE.4- Cooperation with other institutions to find how they deal with the subject. 5- Re- new the course references frequently.6-Frequently check the latest discovery in science to improve the course objectives. 7- Posting some course material on the websites to help the students. 8- Focusing on generic skills. |

**C. Course Description (Note: General description in the form to be used for the Bulletin or handbook should be attached)**

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| **Topics to be cover** |
| **List of Topic** | No. of Weeks | Contact hours | Total of contact  | Self- Study | Discussions | total |
| Lecture | tutorials | Lab | Office Hours |  | Internet | Library | Homework |  |
| Basic definitions and construction of an ordinary differential equation  |  2 | 6 | 2 |  | **1** | 9 | 2 | 1 | 1 | 2 | **15** |
| Methods of Solving Ordinary differential equations of First Order. Orthogonal trajectories. | 3 | 9 | 3 |  | 1 | 13 | 2 | 2 | 1 | 1 | **19** |
| Mid-term 1 |  | 1 |  |  |  | 1 |  |  |  |  | **1** |
| Ordinary differential Equations of High Orders With constant coefficient and with variable coefficients. | 3 | 9 | 3 |  | 2 | 14 | 2 | 2 | 1 | 1 | **20** |
| Types of solutions. Linear systems of ordinary differential equations | 2 | 6 | 2 |  | 2 | 10 | 2 | 2 | 1 | 1 | **16** |
| Mid-term 1 |  | 1 |  |  |  | 1 |  |  |  |  | **1** |
| Series solutions of a Linear ordinary differential equation of Second Order with Polynomial coefficient. | 2 | 6 | 2 |  | 1 | 9 | 2 | 2 | 1 | 1 | **15** |
| Laplace Transform | 3 | 9 | 3 |  | 1 | 13 | 2 | 1 | 1 | 2 | **19** |
| Review |  |  |  |  |  |  |  |  | 2 | 2 | **4** |
| Final Exam |  | 2 |  |  |  | 2 |  |  |  |  | **2** |
| Total |  |  |  |  | 8 | 72 | 12 | 10 | 8 | 10 | **112** |
|  |  |  **Note: one credit hour is equal 25 – 30 load work hour** |

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| **2. Course components (total contact hours and credits per semester):**  |
| Credit | Contact Hours | Self-Study | Other | Total |
| Lecture | Tutorial | Laboratory | Practical |
| 4 | 45 | 15 |  |  | 40 | 12 | 112 |

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| 1. Additional private study/learning hours expected for students per week.

At least 3 Hours |

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| 1. Course Learning Outcomes in NQF Domains of Learning and Alignment with Assessment Methods and Teaching Strategy
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Course Learning Outcomes, Assessment Methods, and Teaching Strategy work together and are aligned. They are joined together as one, coherent, unity that collectively articulate a consistent agreement between student learning, assessment, and teaching.

The ***National Qualification Framework*** provides five learning domains. Course learning outcomes are required. Normally a course has should not exceed eight learning outcomes which align with one or more of the five learning domains. Some courses have one or more program learning outcomes integrated into the course learning outcomes to demonstrate program learning outcome alignment. The program learning outcome matrix map identifies which program learning outcomes are incorporated into specific courses.

On the table below are the five NQF Learning Domains, numbered in the left column.

**First**, insert the suitable and measurable course learning outcomes required in the appropriate learning domains (see suggestions below the table). **Second**, insert supporting teaching strategies that fit and align with the assessment methods and intended learning outcomes. **Third**, insert appropriate assessment methods that accurately measure and evaluate the learning outcome. Each course learning outcomes, assessment method, and teaching strategy ought to reasonably fit and flow together as an integrated learning and teaching process. **Fourth**, if any program learning outcomes are included in the course learning outcomes, place the @ symbol next to it.

Every course is not required to include learning outcomes from each domain.

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|  | **NQF Learning Domains** **And Course Learning Outcomes** | **Course Teaching****Strategies** | **Course Assessment****Methods** |
| **1.0** | **Knowledge** |
| 1.1 | **Define** the basic fundamentals in ODE such as: Differential equations, order of DE, degree of DE, Classifications of DE, Linear, nonlinear, exact, homogeneous, Bernolli, Ricataau, Claiarot, Cauchy-Euler differential equations and the power series solutions. | **Begin** each topic with the explanation of various basic ideas giving plenty of examples**Start** each section by general idea and the benefit of it.**Demonstrate** the course information and principles through lectures.  | ExamsMidtermsFinal examination. |
| 1.2 | **Outline** the logical thinking.  | **Provide** several ways to deal with the exercises. | Home work. Classroom activities group work. |
| 1.3 | **Apply** mathematical concepts to models of real world problems | **Solve** some examples during the lectures.  | Continuous discussions with the students during the lectures. |
| **2.0** | **Cognitive Skills** |
| 2.1 | The students will **explain and interpret** the basic fundamentals of ODE. | **Encourage** the student to look for some application problems in other references.  | Oral and written exams Quizzes. |
| 2.2 | Enable students to **analyses** the mathematical problems. | **Ask** the student to attend lectures for practice solving problem. | Doing homework.Check the problems solution. |
| 2.3 | Students will have the ability to **introduce** the physical problems in a mathematical model. | Homework assignments. | Discussion of how to simplify or analyses some problems. |
| **3.0** | **Interpersonal Skills & Responsibility** |
| 3.1 | The student should **illustrate** how take up responsibility.  | Ask the students to search in the internet and use the library.Encourage them to attend lectures regularly by assigning marks for attendance.  | Quizzes of some previous lectures.Ask the absent students about the last lectures. |
| 3.2 | Must be **shown** the ability of working independently and with groups.  | Teach them how to cover missed lectures.Give students tasks of duties | Discussion during the lecture. |
| **4.0** | **Communication, Information Technology, Numerical** |
| 4.1 | The student should **illustrate** how to communicating with: Peers, Lecturers and Community.  | Creating working groups with peers to collectively prepare: solving problems and search the internet for some topics. | Discussing a group work sheets.  |
| 4.2 | The student should **interpret** how to Know the basic mathematical principles using the internet.  | Give the students tasks to measure their: mathematical skills, computational analysis and problem solving. | Discuses with them the results of computations analysis and problem solutions. |
|  | The student should **appraise** how to Use the computer skills and library. | Encourage the student to ask for help if needed. | Give homework's to know how the student understands the numerical skills. |
|  | The student should **illustrate** how to Search at the internet and using software programs to deal with problems.  | Encourage the student to ask good question to help solve the problem. | Give them comments on some resulting numbers.  |
| **5.0** | **Psychomotor** |
| 5.1 | Not applicable  | Not applicable  | Not applicable  |
| 5.2 | Not applicable  | Not applicable  | Not applicable  |

**Suggested Guidelines for Learning Outcome Verb, Assessment, and Teaching**

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| **NQF Learning Domains** | **Suggested Verbs** |
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| **Knowledge** | list, name, record, define, label, outline, state, describe, recall, memorize, reproduce, recognize, record, tell, write |
| **Cognitive Skills** | estimate, explain, summarize, write, compare, contrast, diagram, subdivide, differentiate, criticize, calculate, analyze, compose, develop, create, prepare, reconstruct, reorganize, summarize, explain, predict, justify, rate, evaluate, plan, design, measure, judge, justify, interpret, appraise |
| **Interpersonal Skills & Responsibility** | demonstrate, judge, choose, illustrate, modify, show, use, appraise, evaluate, justify, analyze, question, and write |
| **Communication, Information** **Technology, Numerical** | demonstrate, calculate, illustrate, interpret, research, question, operate, appraise, evaluate, assess, and criticize |
| **Psychomotor** | demonstrate, show, illustrate, perform, dramatize, employ, manipulate, operate, prepare, produce, draw, diagram, examine, construct, assemble, experiment, and reconstruct |

Suggested ***verbs not to use*** when writing measurable and assessable learning outcomes are as follows:

Consider Maximize Continue Review Ensure Enlarge Understand

Maintain Reflect Examine Strengthen Explore Encourage Deepen

Some of these verbs can be used if tied to specific actions or quantification.

**Suggested assessment methods and teaching strategies are:**

According to research and best practices, multiple and continuous assessment methods are required to verify student learning. Current trends incorporate a wide range of rubric assessment tools; including web-based student performance systems that apply rubrics, benchmarks, KPIs, and analysis. Rubrics are especially helpful for qualitative evaluation. Differentiated assessment strategies include: exams, portfolios, long and short essays, log books, analytical reports, individual and group presentations, posters, journals, case studies, lab manuals, video analysis, group reports, lab reports, debates, speeches, learning logs, peer evaluations, self-evaluations, videos, graphs, dramatic performances, tables, demonstrations, graphic organizers, discussion forums, interviews, learning contracts, antidotal notes, artwork, KWL charts, and concept mapping.

Differentiated teaching strategies should be selected to align with the curriculum taught, the needs of students, and the intended learning outcomes. Teaching methods include: lecture, debate, small group work, whole group and small group discussion, research activities, lab demonstrations, projects, debates, role playing, case studies, guest speakers, memorization, humor, individual presentation, brainstorming, and a wide variety of hands-on student learning activities.

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| **5. Schedule of Assessment Tasks for Students During the Semester** |
| Assessment  | Assessment task (eg. essay, test, group project, examination etc.) | Week due | Proportion of Final Assessment |
| 1 | Midterm 1 | 5th week  | 20 % |
| 2 |  Midterm 2 | 15th week  | 20% |
| 3 | Homework + Reports  | During the semester  | 20% |
| 4 | Final exam  | End of semester  | 40 % |

**D. Student Academic Counseling and Support**

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| 1. Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice. (include amount of time teaching staff are expected to be available each week)1- 8-office hours per week in the lecturer schedule. 2- The contact with students by e-mail and website.  |

**E. Learning Resources**

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| **1. Required Text(s)** Edwards, C. Henry, and David E. Penney, Elementary Differential Equations, 6th edition, Pearson Prentice Hall 2008.  |
| **2. Essential References** 1) JAMES C. ROBINSON: An introduction to ordinary differential equations, Cambridge U.  Press, 2004.2) Schaum Outline: Differential Equations, McGraw Hill, 2003.3) Eare A. Coddington : An introduction to ordinary differential equations . New Jersy, 1961. |
| **3- Recommended Books and Reference Material (Journals, Reports, etc) (Attach List):** All papers or books in the library having the same topics. |
| **4-.Electronic Materials, Web Sites etc**http:// mathforum.org/advanced/numerical.html/http://www.arxiv.org/ http://faculty.mu.edu.sa/skhafagy/DE |
| **5- Other learning material such as computer-based programs/CD, professional standards/regulations:** None  |

**F. Facilities Required**

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| Indicate requirements for the course including size of classrooms and laboratories (ie number of seats in classrooms and laboratories, extent of computer access etc.) |
| **1. Accommodation (Lecture rooms, laboratories, etc.)**-Classroom with capacity of 30-students. - Library.  |
| **2. Computing resources:** Not available |
| **3. Other resources (specify --eg. If specific laboratory equipment is required, list requirements or attach list):**  None |

**G Course Evaluation and Improvement Processes**

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| **1 Strategies for Obtaining Student Feedback on Effectiveness of Teaching:** Student evaluation electronically organized by the University. |
| **2 Other Strategies for Evaluation of Teaching by the Instructor or by the Department**Departmental meetings, frequent meetings/ consultation among the teaching staffs,meeting between course coordinators and the tutors**.** .  |
| **3 Processes for Improvement of Teaching**- This may be done from time to time by the course coordinator in consultation with  other faculty members teaching this course.- Expert opinion may be taken.- Course report, Program report and Program self-study.  - A tutorial lecture must be added to this course.   |
| **4. Processes for Verifying Standards of Student Achievement (eg. check marking by an independent member teaching staff of a sample of student work, periodic exchange and remarking of tests or a sample of assignments with staff at another institution)**The instructors of the course are checking together and put a unique process of evaluation. |
| **5 Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement.**The following points may help to get the course effectiveness:  \* Student evaluation.  \* Course report.  \* Program report.  \* Program self-study.  |

**Faculty or Teaching Staff:**  Salah Abdelnaby Elgharieb Khafagy

**Signature:**  

**Date Report Completed: 5-2-1435**

**Received by: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Dean/Department Head**

**Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**