**TEMPLATE FOR COURSE SPECIFICATION**

HIGHER EDUCATION PERFORMANCE REVIEW: PROGRAMME REVIEW

Course Instructor : Prof. Dr. Shahlaa Esmil Ebrahim

**COURSE SPECIFICATION**

This course presents numerical methods for solving mathematical problems. It deals with the theory and application of numerical approximation techniques as well as their computer implementation. It covers computer arithmetic, solution of nonlinear equations, interpolation and approximation, numerical integration and differentiation, solution of differential equations, and matrix computation.

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| 1. Teaching Institution | University of Baghdad/ College of Engineering |
| 2. University Department/Centre | Environmental Engineering Department |
| 3. Course title/code | Numerical Analysis |
| 4. Modes of Attendance offered | 2 days per week electronic |
| 5. Semester/Year | Year ( Annual) |
| 6. Number of hours tuition (total) | 90 h |
| 7. Date of production/revision of this  specification | 2020-2021 |
| 8. Aims of the Course | |
| **The student will be capable of solving the mathematical models** | |
| **that represent different physical and engineering models** | |
| **numerically and find the best fit to the experimental data and** | |
| **widened the engineering image of the student.** | |
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9· Learning Outcomes, Teaching ,Learning and Assessment Methode

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| 1. Cognitive goals  |  | | --- | | A1. Develop an understanding of the core ideas and concepts of Numerical Methods. | | A2. Attract and welcome undergraduate students to our Bachelor of Science program in Environmental Engineering, and to graduate B.S. students who are innovative problem solvers, who become leaders in their organizations, and who possess the knowledge and skills required for a wide range of careers and career changes. | |
| B. The skills goals special to the course.   |  | | --- | | B1. Be able to recognize the power of abstraction and generalization, and to carry out investigative mathematical work with independent judgment. | | B2. Concentrating on scientific research and its leading role in helping to serve the society and solving its problems through conducting application researches  and resource recovery/recycling, transport. | |
| Teaching and Learning Methods |
| More description of case studies and applications |
| Assessment methods |
| Homework related to problem solving |
| C. Affective and value goals   |  | | --- | | C1. Be able to apply rigorous, analytic, highly numerate approach to analyze and solve problems using Numerical Methods. | | C2 Prepare students for successful careers in environmental engineering | |
| Teaching and Learning Methods |
| Intensive homework and applications |
| Assessment methods |
| Team work and problem solving |

D. General and rehabilitative transferred skills(other skills relevant to employability and personal development)

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| D1. Be able to communicate problem solutions using correct mathematical terminology and good English. |
| D4.An ability to identify, formulate, and solve engineering problems |

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| 10. Course Structure | | | | | |
| Week | Hours | ILOs | Unit/Module or  Topic Title | Teaching  Methods | Assessment  Method |
| 1 | 3 | Approximation and round of errors | Studying types of error, Exact and approximate solutions | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 2 | 3 | Approximation and round of errors | truncation, round of error, relative error,  absolute, applications | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 3 | 3 | Roots of equations | Open and closed methods  Bisection method | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 4 | 3 | Roots of equations | Newton Method | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 5 | 3 | Interpolation | Linear and quadratic | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 6 | 3 | Linear algebraic equations | Jacobi , Gauss Siedal, Gauss Elimination, | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 7 | 3 | Linear algebraic equations | Cramer's rule, matric inversion | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 8 | 3 | Curve fitting | First and second order | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 9 | 3 | Curve fitting | Applications | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 10 | 3 | Numerical differentiation | Forward, backward, central | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 11 | 3 | Numerical differentiation | Divided difference  errors | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 12 | 3 | Numerical differentiation problems | Field applications | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 13 | 3 | Numerical Integration | Elements of numerical integration | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 14 | 3 | Numerical Integration | Composite rule | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 15 | 3 | Ordinary differential equations | Euler method | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 16 | 3 | Ordinary differential equations | Modified Euler method | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 17 | 3 | Advanced numerical differentiation | Two dimensional | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 18 | 3 | Advanced numerical differentiation | Applications | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 19 | 3 | Advance numerical integration | Two dimensional applications | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 20 | 3 | Partial differential equations | Two dimensional  problems | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 21 | 3 | Partial differential equations | Two dimensional  problems | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 22 | 3 | Solution of set of partial differential equations | Using different techniques | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 23 | 3 | Numerical solution of partial differential equations | Introduction to problem solver | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 24 | 3 | Numerical solution of partial differential equations | Elliptic | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 25 | 3 | Numerical solution of partial differential equations | Parabolic | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 26 | 3 | Numerical solution of partial differential equations | Hhyper bolic | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 27 | 3 | Numerical solution of partial differential equations | Parabolic equations in two spatial dimensions | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 28 | 3 | Numerical solution of nonlinear equations | Application of nonlinear equation solving | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 29 | 3 | Applications | Field applications | Electronics | Questions during the lectures ,quiz, exam, present in the class |
| 30 | 3 | Applications | Field applications | Electronics | Questions during the lectures ,quiz, exam, present in the class |

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| 11. Infrastructure | |
| 1. Books Required reading: | 1-Steven C. Chapra, and Raymond P. Canale, 2006, Numerical Methods for Engineers, Fifth Edition, McGraw Hill.  2- N. S. Asaithambi , Numerical analysis theory and practice  3- James L. Bauchanan and Turner ,Numerical methods and analysis |
| 2. Main references (sources) | George W. and Collins, II, 2003, Fundamental Numerical Methods and Data Analysis |
| A- Recommended books and references (scientific journals, reports…). | J.B.Dixtt, Numerical Methods  Acta Numerica Journal  Siam Journal on Numerical Analysis |
| B-Electronic references, Internet  sites… | <https://www.coursera.org/learn/intro-to-numerical-analysis> |

12. The development of the curriculum plan

The development includes more computer applications using Matlab program and other software