

Ministry of Higher Education and Scientific research



Department of **Mathematics**

College of **Science**

University of **Salahaddin-Erbil**

Subject: **Mathematical Analysis**

Course Book: **Third Year Class-First Semester**

Lecturer's name: **Sebar Haje Jumha**

Academic Year: **2022-2023**

# Course Book

<b>1. Course name</b>	<b>Mathematical Analysis</b>
<b>2. Lecturer in charge</b>	<b>Sebar Haje Jumha</b>
<b>3. Department/ College</b>	<b>Mathematics/Science</b>
<b>4. Contact</b>	<b>e-mail: sebar.jumha@su.edu.krd Tel: (optional)07503916373</b>
<b>5. Time (in hours) per week</b>	<b>For example Theory: 3 hours Practical:</b>
<b>6. Office hours</b>	<b>Availability of the lecturer to the student during the week</b>
<b>7. Course code</b>	
<b>8. Teacher's academic profile</b>	<p><b>Education:</b>  <b>M. Sc.</b>  <i>Date:</i> 29-10-2015  <i>Title:</i> On Some New Type of Functions in Nonstandard Analysis  <i>Place of Attainments:</i> Mathematics Department, College of Science, University of Salahaddin\Erbil, Hawler (Erbil), Kurdistan Region, Iraq.  Supervisor: Assist. Prof. Dr. Ibrahim Othman Hamad  Supervisor <i>Address:</i> Mathematics Department, College of Science, University of Salahaddin\Erbil, Hawler (Erbil), Kurdistan Region, Iraq. Email: ibrahim.hamad@su.edu.krd</p> <p><b>B. Sc</b>  <i>Date:</i> 27-6-2010  <i>Place of Attainments:</i> Math. Dept.-College of Sci.-Univ. of Salahaddin\Erbil-Iraq  Title of the Graduation Project:  Number of Limit Cycles of Nonlinear Autonomous Homogeneous System of Degree Three  Academic recordsq  2013 – 2015: M.Sc student,  2015 – 2020: Researcher in Math.Dept.  2011 – 2013: Assistant Researcher in Math. Dept.</p>
<b>9. Keywords</b>	<b>Mathematics, analysis real &amp; math.analysis, metric spaces</b>
<b>10. Course overview:</b>	<p>The main goal of the mathematical analysis course is to explain the basic principles and methods of higher mathematics that are necessary for the study of Mathematical science, moreover, ability to analyze mathematical concepts and to find solution for theoretical application. <i>There are also more objectives of mathematical analysis:</i></p> <p>To explore the foundations of mathematics (logic and set theory) at a level and depth appropriate for someone aspiring to study higher-level mathematics and/or to become a professional mathematician.</p> <ul style="list-style-type: none"> <li>• To introduce the student to what it means to do mathematics, as opposed to learning about mathematics or to learning to do computational exercises.</li> <li>• To help the student learn how to write mathematical text according to the standards of the profession.</li> </ul>

- To prepare students for higher profound level of math classes in college and to help students get a strong foundation that will give them the tools to succeed in future mathematics courses.

### **11. Course objective:**

Students majoring in Mathematics attain proficiency in

#### ***Critical thinking***

The ability to identify, reflect upon, evaluate, integrate, and apply different types of information and knowledge to form independent judgments. Analytical and logical thinking and the habit of drawing conclusions based on quantitative information.

#### ***Problem solving***

The ability to assess and interpret complex situations, choose among several potentially appropriate mathematical methods of solution, persist in the face of difficulty, and present full and cogent solutions that include appropriate justification for their reasoning.

#### ***Effective communication***

The ability to communicate and interact effectively with different audiences, developing their ability to collaborate intellectually and creatively in diverse contexts, and to appreciate ambiguity and nuance, while emphasizing the importance of clarity and precision in communication and reasoning.

Students acquire and enhance these abilities in mathematical contexts, but the acquired habits of rigorous thought and creative problem-solving are invaluable in all aspects of life. These skills are acquired through experience in the context of studying specific mathematical topics and exploring problems chosen to challenge students' abilities, spurring them on to acquire new techniques and abandon familiar but restrictive habits of thought. The overarching objectives can be realized in terms of more focused, appraisable objectives specific to mathematics as follows:

#### **Students will be**

- Understand the basic rules of logic, including the role of assumptions.
- Appreciate the role of mathematical proof in formal deductive reasoning.
- Be able to distinguish a coherent argument from a fallacious one, both in mathematical reasoning and in everyday life.
- Understand and be able to articulate the differences between method of solving problems and reasoning of arise the problems.
- The connection between space and metrics define on them as operators.
- present mathematics clearly and precisely to an audience of peers and faculty
- appreciate the role of mathematical proof as a means of conveying mathematical knowledge
- understand the differences between proofs and other less formal arguments
- describe mathematical ideas from multiple perspectives
- explain fundamental mathematical concepts or analyses of real-world problems to non-mathematicians
- Students must demonstrate mastery in the three basic areas of mathematics: algebra, analysis, and topology/geometry.
- Describe the real line as a complete, ordered field.
- Determine the basic topological properties of subsets of the real numbers.

- Use the definitions of convergence as they apply to sequences, series, and functions.
- Determine the continuity, differentiability, and integrability of functions defined on subsets of the real line.
- Apply the Mean Value Theorem and the Fundamental Theorem of Calculus to problems in the context of real analysis.
- Produce rigorous proofs of results that arise in the context of real analysis.
- Write solutions to problems and proofs of theorems that meet rigorous standards based on content, organization and coherence, argument and support, and style and mechanics.
- Determine the Riemann integrability and the Riemann-Stieltjes integrability of a bounded function and prove a selection of theorems concerning integration.
- Recognize the difference between pointwise and uniform convergence of a sequence of functions.
- Illustrate the effect of uniform convergence on the limit function with respect to continuity, differentiability, integrability, and the convergence properties of power series.

## 12. Student's obligation

### Rights:

- Students have the right to expect that the assessment requirements in their courses will be linked to the objectives for that course, and these objectives should be clearly laid down at the beginning of each course.
- Students have the right to know in advance the nature and extent of the assessment, the marking criteria for each assessment, and its relative contribution towards the final grade.
- Students have a right to know who assessed their work in order to facilitate questions or comments that they may have.
- Students have a right to receive adequate feedback on their work which relates to the assessment criteria mentioned above.
- Students have the right to appeal a mark. There are certain steps you can take if you believe that you have a case for your result to be reviewed.

### Obligations:

- Students must attend classes. For all courses, the minimum attendance as a requirement for passing the course was stipulated previously.
- Students are expected to submit assignments on the due date
- Students are expected to familiarise themselves with the relevant policies and procedures for late submission of assessment.
- Students are expected to familiarise themselves, and comply with the Kurdistan Region Higher Education Ministry Examinations rules.
- Students are required to be familiar with the university's policies on Student Integrity and Misconduct.
- Students are expected to prepare for and participate in tutorials and workshops. Competence in verbal communications is seen as a key skill of the curriculum and is a core skill of practice.

- When undertaking group work, students are expected to treat their student colleagues and any facilitators with the same courtesy they would expect in return. For example, students must advise if they pull out of the group or course, change groups, or make any decisions which might impact upon the group product or process.
- Students are expected to be courteous at all times to all School staff and student colleagues.
- All students and staff at the University are bound by the Student Charter.

### 13. Forms of teaching

White board and I give hard copy of my lecture notes to students before coming lecturer time.

### 14. Assessment scheme

Breakdown of overall assessment and examination

- Critical thinking
- Daily quizzes
- Class activity
- Course exam(monthly exam)

### 15. Student learning outcome:

Students who have learned to logically question assertions, recognize patterns, and distinguish the essential and irrelevant aspects of problems can think deeply and precisely, nurture the products of their imagination to fruition in reality, and share their ideas and insights while seeking and benefiting from the knowledge and insights of others.

Students will be able to

- Formulate and solve abstract mathematical problems
- Recognize real-world problems that are amenable to mathematical analysis, and formulate mathematical models of such problems
- apply mathematical methodologies to open-ended real-world problems
- Recognize connections between different branches of mathematics
- Recognize and appreciate the connections between theory and applications.

### 16. Course Reading List and References:

- [1] Browder B., *An Introduction to Mathematical Analysis*. Springer-Verlag New York, 1996
- [2] Bartle R.G & Sherbert D., *Introduction to Real Analysis*. 3<sup>ed</sup> John Wiley & Sons, 2000
- [3] Brgant V., *Metric Spaces*. Cambridge Univ. Press, 1985
- [4] Burrill J. R. & Knudsen C. W., *Real variables*. Holt Rinehart Winston, Inc, 1969
- [5] D'Angelo J. P., *Mathematical Analysis*. Prentice-Hall, Inc, 1997
- [6] Das G., *Mathematical Analysis*. 6<sup>ed</sup>, McGraw-Hill Book Comp. 2003
- [7] Goldberg R. R., *Methods of Real Analysis*. John Wiley & Sons, 1976
- [8] Pugh C. C., *Real Mathematical Analysis*. Springer-Verlag New York, 2002
- [9] Pultr A., *Introduction to Mathematical Analysis*. 2<sup>ed</sup>, Springer Basel, 2013
- [10] Rudin W., *Principles of Mathematical Analysis*. 2<sup>ed</sup>, McGraw-Hill Book Comp., 1976
- [11] Searcóid M., *Metric Spaces*, Springer-Verlag London Limited 2007
- [12] Vasudeva H., *Metric Spaces*, Springer-Verlag London Limited 2006

17. The Topics:	Lecturer's name
<p><b>Week 1, 2, 3, 4:</b> Real number system, Real Numbers and the Number Line, Important Sets of Real Numbers Field Properties The Order Relation, Greatest and Least Elements Upper and Lower Bounds, Supremum and Infimum, The Completeness Axiom (Supremum property), The Archimedean Property, Rational and Irrational Numbers, Density of the Rationals and Irrationals.</p> <p><b>Week 5, 6, 7,8:</b> Some Necessary Inequalities, Metric Spaces, Examples of metric spaces, open ball and closed ball, Some Topological concepts in a Metric Space, Open and Closed Sets, Limit point, Interior, Boundary and Closure.</p> <p><b>Week 9, 10,11, 12:</b> Sequences in Metric Spaces, Convergence of sequences, Cauchy Sequences Completeness in metric spaces, Compact Spaces.</p>	<p><b>Sebar H. Jumha</b> (3 hrs/week)</p> <p>The date of each lectures depend on the request duration of each component and the local national holydays</p>
<b>18. Practical Topics (if there is any)</b>	
<p><b>19. Examinations:</b></p> <p><b>1. Compositional:</b> In this type of exam the questions usually starts with Explain how, What are the reasons for...?, Why...?, How....? With their typical answers.Examples should be provided</p> <p><b>2. True or false type of exams:</b> In this type of exam a short sentence about a specific subject will be provided, and then students will comment on the trueness or falseness of this particular sentence. Examples should be provided</p> <p><b>3. Multiple choices:</b> In this type of exam there will be a number of phrases next or below a statement, students will match the correct phrase. Examples should be provided.</p>	
<p><b>20. Extra notes:</b> Here the lecturer shall write any note or comment that is not covered in this template and he/she wishes to enrich the course book with his/her valuable remarks.</p>	
<b>21. Peer review</b>	پیداچوونہوہدی ھاوہل