Course Description Form

1. Course Name:
Fractals
2. Course Code:
MATH-404
3. Semester / Year:
First Semester/Fourth Year
4. Description Preparation Date:
27 March 2024
5. Available Attendance Forms:
Classroom or by Web
6. Number of Credit Hours (Total) / Number of Units (Total)
60 Hours/3 credits
7. Course administrator's name (mention all, if more than one name)
Name: Azher Abbas Mohammad Email:drazh64@tu.edu.iq
8. Course Objectives
1. Students' realization of the basic concepts of fractals, such as the fractal dimension, the box dimension, and self-similarity. 2. Knowing the types of famous fractals and how to create them. 3. Paying attention to the philosophical and mathematical content of the subject of fractals and linking it to the subject of chaos. 4. Developing students' ability to deal with transformations and their applications in constructing fractals, such as reflection, rotation, and projection 5. Giving the student the necessary experience to deal with the IFS iterative functions system. 6. Giving students the necessary experience to construct fractals at the complex plane, the Julia and Mandelbrot groups, and the relationships between them.
9. Teaching and Learning Strategies
This course is characterized by the fact that it needs a special approach that depends mainly on the development of geometrical thinking and the mathematical approach in thinking. It also depends on prior courses in real analysis, chaos, and some imagination. Teaching is mainly based on the home works that are given at the end of each week, and the student notes the interdependence between the serial topics of this course, in addition to assigning the student (or a group of students) to write one report and represent it as a seminar for the purpose of training

in the use of scientific resources and the method of writing a subject in mathematics.

10. Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1	4	The concept of fractal	Introduction to Fractals	Theoretical Lecture and discussion	Oral tests and quizzes
2	4	Fractal dimension and how to calculate it	Definitions and examples on fractal and topological dimensions	Theoretical Lecture and discussion	Oral tests and quizzes
3	4	The mathematical structure of fractals	Topological properties of fractal	Theoretical Lecture and discussion	Oral tests and quizzes
4	4	How to construct a fractal	Iterations of functions and self-similarity property	Theoretical Lecture and discussion	Oral tests and quizzes
5	4	Examples of fractals and how to construct it with calculating its dimension	Contour set, Sherpenski triangle, Koch curve, Pythagorean tree,… etc	Theoretical Lecture and discussion	Oral tests and quizzes
6	4	Construct a transformation systems	Linear transformations and rotation with angle and inversion with axes	Theoretical Lecture and discussion	Oral tests and quizzes
7	4	How to construct a fractal by iteration functions system	Iteration functions system (IFS) and attractors.	Theoretical Lecture and discussion	Oral tests and quizzes
8	4	How to calculate the distance between two sets & midterm exam	Euclidean and Housdorf distances	Theoretical Lecture and discussion	1st Midterm exam in previous weeks(1-7)
9	4	The concept of attraction and properties of attractors.	IFS and Attractors	Theoretical Lecture and discussion	Oral tests and quizzes
10	4	The concept of stereographic projection	Riemann Sphere and stereographic projection extended complex plane	Theoretical Lecture and discussion	Oral tests and quizzes
11	4	Julia set	Definitions in Julia set With related theorems and examples	Theoretical Lecture and discussion	Oral tests and quizzes
12	4	Mandelbrot set	Definitions in Mandelbrot set With related theorems and examples	Theoretical Lecture and discussion	Oral tests and quizzes
13	4	Topological concepts of Julia and Mandelbrot set	The relation between Julia and Mandelbrot set	Theoretical Lecture and discussion	Oral tests and quizzes
14	4	Haw to find and plot Mandelbrot set in complex plan	Some theorems and examples in Mandelbrot set	Theoretical Lecture and discussion	Oral tests and quizzes

15	4	Haw to find Julia set in complex plane such as $J_0, J_{-2}, \ldots$ etc	Some examples of Julia sets in complex plane	Theoretical Lecture and discussion	2nd Midterm exam

11. Course Evaluation

Couse evolution of a student including the sum of the following two parts

1. Formative Evalution 40%
   (2 exams through the term 30% and Oral discussion 5% and Quizzes 5%)
2. Summative Evalution
   (Final Exam 60%)

12. Learning and Teaching Recourses

Required textbook(Curricular book, if any):

Elayadi , S.N.,(1999),"Discrete Chaos", CHAPMAN & HALL/CRC

Main References (Sources):

1. Gulick , D.,(1992) "Encounters with Chaos", Library of Congress
2. Paul S. Addison, "Fractals and Chaos", Institute of physics London , (1997)

Recommended book and references (Scientific journals, reports,…):

Katheleen, T. Aligood, Tim D. Sauer , James A. Yorke, (1996), "An Introduction To Dynamical Systems", Springer

Electronic Reference ,Web sites:

https://books.google.iq/books?hl=ar&lr=&id=l2E4ciBQ9qEC&oi=fnd&pg=PR9&dq=fractal+and+chaos+literature&ots=7JNqaOvP2Z&sig=Zv_kOWJBarI8hnrfHMm5MFdnoEY&redir_esc=y#v=onepage&q=fractal%20and%20chaos%20literature&f=false