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**Department of Mathematics**

**College of Basic Education**

**Salahaddin University- Erbil**

**Subject: Axiomatic** **System** **&** **Geometry**

**Course Book –4th stage Second Semester**

**Lecturer's name: MS. Zhyan R. Ali**

**Academic Year: 2022/2023**

**Course Book**

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| **1. Course name** | Axiomatic System & Geometry |
| **2. Lecturer in charge** | Ms. Zhyan R. Ali |
| **3. Department/ College** | Mathematics/ Basic Education |
| **4. Contact** | e-mail :zhyan.ali@su.edu.krdTel: () |
| **5. Time (in hours) per week**  | Theory: 3 |
| **6. Office hours** | 3 hours in week |
| **7. Course code** |  |
| **8. Teacher's academic profile**  | 1) B.Sc. in Mathematic. Mathematic Department- College of Education- Salahaddin University- Erbil in 1997.2) M.Sc. in Mathematic. Mathematic Department- College of Science - Salahaddin University- Erbil in 2010. |
| **9. Keywords** | Euclid’s axiom, proposition, equivalent, Hilbert’s axiom, etc. |
| **10. Course overview:** An axiomatic system is a list of undefined terms together with a list of statements (called “axioms”) that are presupposed to be “true.” A theorem is any statement that can be proven using logical deduction from the axioms Presents topics in Euclidean and non-Euclidean geometries chosen to prepare individuals for teaching geometry at the high school level. Studies Euclid's geometry and its limitations, axiomatic systems, techniques of proof, and Hilbert's geometry, including the parallel postulates for Euclidean, hyperbolic and elliptic geometries. Axiomatic systems, logic and proof, incidence geometries, absolute geometries, Euclidean geometry, and an introduction to non-Euclidean geometries and transformational geometry. Required for students seeking secondary licensure in mathematics Students should be learn the fundamental concepts of geometry, its definition, its history and how to put axioms and theorems and the way the system hit its Euclidean system, tried or how scientists think of the obvious proof for the fifth Euclid. Identify the axioms of Hilbert in plane geometry, and what are the Coaxial circles, radical axis, radical axis of two intersection circles, radical axis of two tangent circles, radical axis of two disjoint circles,. What are some of the properties of Inversion, and cross ratio of four points on a straight line and their properties? As well as to get to know them and non-Euclidean geometry, Hyperbolic and Elliptical geometry.  |
| **11. Course objective:** This course aims to develop an understanding of axiomatic geometric systems, both Euclidean and non-Euclidean. We will focus on the foundations of geometry by exploring finite and infinite geometries, neutral geometries, Euclidean plane geometry, and non-Euclidean hyperbolic geometry through an axiomatic approach  |
| **12. Student's obligation** Student readiness is very important to learn and get note about the lesson, because you are amenable to the lesson. |
| **13. Forms of teaching**White board and Data show to view the headlines, definitions and figures |
| **14. Assessment scheme**Test 1 = 20Test 2 = 20the total = 40 and final exam =60 |
| **15. Student learning outcome**:Upon successful completion of this course students will be able to 1. Write mathematical proofs in geometry that exhibit valid reasoning, correct notation and form, and appropriate use of definitions, axioms, and previously proven results. 2. Demonstrate the use of the axiomatic method to determine geometric results in a variety of settings (such as finite, neutral, Euclidean, and non-Euclidean geometries). 3. Use definitions and models to explore and analyse the properties of Euclidean and non-Euclidean geometries. 4. Demonstrate effective written and oral communication skills in mathematics |
| **16. Course Reading List and References‌:****Main References**:* Wong Yan Loi, **An Introduction to Geometry**, 2009
* Richard Fitzpatrick, **Euclid's Elements of Geometry,**  first edition, 2007
* Leslie Hogben, **Geometric construction,** 2004
* Common Mistakes, **Geometry Angles,** 2009
* **Dr.** Hamblin**, Euclidean and non- Euclidean Geometry,** 2007
* Dr. Ibrahim Othman Hamad, **Axiomatic System and Euclidean Geometry**, 2016
* Tatsulok third year vol. 12 no. 2a
* [www.emsc.nysed.gov/ciai/mst/math/glossary/](http://www.emsc.nysed.gov/ciai/mst/math/glossary/)
* [www.pgdp.net](http://www.pgdp.net)
* نظم البديهيات والهندسة، جامعة السليمانية 1979. عبدالوهاب احمد السراج،
* تاريخ الرياضيات، جامعة صلاح الدين 1987. عبدالوهاب احمد السراج،

**Secondary References** * Roberto Bonola**, Non –Euclidean Geometry**
* Joseph Verdina**, Geometry**
* Ellery B. Golos, **Foundations of Euclidean and non-Euclidean Geometry**, 1968
* George Francis,  **Axiomatic systems for Geometry,** 2002
* **J.** M. Basilla, **Geometric systems,** 2011
* Adam Coffman, **Notes on Aximatic Geometry,** 2007
* [www.math.brown.edu/](http://www.math.brown.edu/)
* [www.gutenberg,org](http://www.gutenberg,org)
* مقدمة في تاريخ الرياضيات علم وعلماء، طبعة الاولى 2008. محمود محمد سليم صالح،
* خالد السامرائي، الهندسة، جامعة بغداد 1967.
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| **17. subject** |  |
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| **subject**  | **Week** |
| Some basic information of geometry with figures , | 1 |
| History of geometry, Babylonian's geometry | 2 |
| Axiomatic system, Models, Finite Geometry, Fano’s geometry | 3 |
| Euclidean's systems, definitions , axioms, theorems , Proposition 1, Proposition 4 | 4 |
| Proposition 6, Proposition 8, Proposition 9, Proposition 10, Proposition 11, Proposition 12 | 5 |
| Proposition 15, Proposition 16, Proposition 27, Proposition 28, Proposition 29, | 6 |
| Proposition 31, Equivalent Axiom, some of Equivalent to Euclid's fifth axiom, | 7 |
| Playfair’s axiom, Ptolemy, Omer Khayyam with first and second case, Nasiraddin | 8 |
| Abhary with first, second, and third way ,Hilbert's Axioms, Axioms of connection, | 9 |
| Axioms of order, axioms of congruence, axioms of continuity, axioms of parallels | 10 |
| Coaxial circles, radical axis, radical axis of two intersection circles, radical axis of two tangent circles, radical axis of two disjoint circles,  | 11 |
| Elliptic pencils of circles, Hyperbolic pencils of circles | 12 |
| Inversion, basic properties, some examples | 13 |
| Cross ratio, some properties of cross ratio , example | 14 |

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| **18. Practical Topics (If there is any)** |  |
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| **19. Examinations:**Q1/ state and prove the Playfair's axiom Q2/ A isosceles triangle that the basis angles are equivalents and the outside angles are equivalents too. Q3/ if each line contains n points, then prove that each plane contains n2 points, use the Hilbert's axioms. Q4/ find inversion of point (6,1)by the inverse circle K: x2+y2=16  Q5/if A(-2,3 ) , B(-1,2 ) and D(3,-2 ) points, then find the point C , where the cross ratio (AB,CD) = 6. 5Q6/ find right and left parallel equation for Hyperbolic line g of point p(2,3) where g: x2+y2-2x = 0 Q7/A/ find Elliptic line equation which goes through two points  A(2, 1, -0.5) and B(3, 2, 0.6) on the ball surface , then find the Elliptic distance between A and B. Q8/ How did Legendre prove that the sum of triangle angles is impossible to be less than two right angles Q9/ if the sum of triangle angles is an arbitrary quantity, then prove that this quantity is equal to two right angles. Q10/ use the Hilbert's axioms to prove that (each line and a point outside it, are forming only one plane). Q11/ find the point which has inversion (-2,5) by inverse circle K: 2 x2+2y2-6y=6 Q12/ prove that (DC,AB)=(BA,CD) where (AB,CD) is cross ratio. Q13/If {AB. CD} is cross ratio, then prove that {AB. CD}+ {AC. BD}=1  Q14**/** Prove that Elliptic circles intersection with each other. **Q15**/Prove that the radical axis of two disjoint circles is perpendicular of the equal power of the point for two circles on the line between center of circles.  Q16**/** Let ABCD be a Khayyam quadrilateral with summit CD and let E and F be the midpoints of AB and CD respectively, then prove that EF is perpendicular to the AB and CD. **Q17/** If a straight line falling across two straight lines makes the alternate anglesequal to one another, then prove that the two straight lines will be parallel to one another. **Q18/** Show that **a(b+c) = ab + ac** by Babylonian method **Q19/** Stat 3 axioms for the equivalent axioms. **Q20/** Defined all the following 1. Scalene triangle
2. Trapezoid
3. Hexagon

**Q**21/ Find the inverse of line **x+ y= -2** by the inversion circle W: **x2+y2 +6x-2y= -1**  Q22**/** Prove that Elliptic circle orthogonal with Hyperbolic circle. **Q23**/Use axioms of connection for Hilbert system to prove that there exist at least 6 straight lines do not lie on a plane. **Q24/** The sum of the angles of any triangle is constant number, then prove that this constant number is two right angles. **Q25/** If two straight lines cut one another, then they make the vertically opposite angles equals to one another.  **Q26/** Stat the **playfair’s** axiom and use it to prove the Euclid’s fifth axiom.  |
| **20. Extra notes:** |
| **21. Peer reviewپێداچوونه‌وه‌ی هاوه‌ڵ** Dr. Azad Ibrahim Ameen |