



Course Specification

— (Bachelor)

Course Title: Foundations of Mathematics

Course Code: MTH1201

Program: BSc. in Mathematics

Department: Mathematics

College: Al-Qunfudah University College

Institution: Umm Al-Qura University

Version: 2

Last Revision Date: 17/07/2024



Table of Contents

| | |
|---|---|
| A. General information about the course: | 3 |
| B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods | 4 |
| C. Course Content | 5 |
| D. Students Assessment Activities | 6 |
| E. Learning Resources and Facilities | 6 |
| F. Assessment of Course Quality | 7 |
| G. Specification Approval | 7 |



A. General information about the course:

1. Course Identification

1. Credit hours: (4)

2. Course type

A. University College Department Track Others
B. Required Elective

3. Level/year at which this course is offered: (1/1)

4. Course general Description:

Mathematics is closely related to the details and activities of human daily life and activities. Foundations of mathematics is a term sometimes used in some fields of mathematics, such as mathematical logic, sets theory, proof theory and model theory. This course will introduce principles of mathematical logic and define sets, membership, Cartesian product and relations on sets. Mappings (or sometimes called functions) and binary operations will be presented. Primary definitions with examples of groups, rings, and fields will be introduced.

5. Pre-requirements for this course (if any):

6. Pre-requirements for this course (if any):

7. Course Main Objective(s):

This course will provide a common mathematical foundation for students in all of the programs, drawing upon the full range of undergraduate courses in mathematics. In addition, it will permit students to build upon and share knowledge already acquired while pointing out areas in which additional study may be needed. In addition, it will develop the communication skills and understanding of the process of doing mathematics necessary for graduate-level study.

2. Teaching mode (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|----|-----------------------|---------------|------------|
| 1 | Traditional classroom | 4 | 100 % |
| 2 | E-learning | 0 | 0 |
| 3 | Hybrid | 0 | 0 |



| No | Mode of Instruction | Contact Hours | Percentage |
|----|---|---------------|------------|
| | <ul style="list-style-type: none"> Traditional classroom E-learning | | |
| 4 | Distance learning | 0 | 0 |

3. Contact Hours (based on the academic semester)

| No | Activity | Contact Hours |
|--------------|--|---------------|
| 1. | Lectures | 36 |
| 2. | Laboratory/Studio | 0 |
| 3. | Field | 0 |
| 4. | Tutorial | 0 |
| 5. | Others (<i>Exam, Quizzes, Activities...</i>) | 4 |
| Total | | 40 |

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Code of CLOs aligned with program | Teaching Strategies | Assessment Methods |
|------------|---|-----------------------------------|-----------------------|--------------------|
| 1.0 | Knowledge and understanding | | | |
| 1.1 | Identify statements, negation and De Morgan's laws | <i>K3</i> | Lecture and Tutorials | Exams, quizzes |
| 1.2 | Identify different methods of proofs that can be applied to prove many mathematical problems. | <i>K3</i> | Lecture and Tutorials | Exams, quizzes |
| 1.3 | Present basic concepts of sets and their operations. | <i>K3, K5</i> | Lecture and Tutorials | Exams, quizzes |
| 1.4 | State the basic rules of logical equivalence | <i>K1</i> | Lecture and Tutorials | Exams, quizzes |
| 1.5 | Describe Cartesian product of sets and the concept of relations | <i>K3</i> | Lecture and Tutorials | Exams, quizzes |
| 1.6 | Define mappings and their types. | <i>K1</i> | Lecture and Tutorials | Exams, quizzes |
| 1.7 | State groups, rings and fields. | <i>K1, K3</i> | Lecture and Tutorials | Exams, quizzes |
| 2.0 | Skills | | | |
| 2.1 | Compare between relations on sets (reflexive, symmetry and transitive). | <i>S1, S5</i> | Lecture and Tutorials | Exams, quizzes |





| Code | Course Learning Outcomes | Code of CLOs aligned with program | Teaching Strategies | Assessment Methods |
|------------|---|-----------------------------------|-----------------------------------|--------------------|
| 2.2 | Use methods of proofs for solving many mathematical problems. | S3, S9 | Lecture and Tutorials | Exams, quizzes |
| 2.3 | Apply algebraic structures on sets. | S3, S | Lecture and Tutorials | Exams, quizzes |
| 3.0 | Values, autonomy, and responsibility | | | |
| 3.1 | Prepare for success in disciplines which rely on foundations of mathematics, which is the key to understand most of mathematical subjects. | V2 | Lecture/ Individual or group work | Exams, quizzes |
| 3.2 | Interpret graphical and qualitative representations of solutions to problems | V2, V4 | Lecture/ Individual or group work | Exams, quizzes |
| 3.3 | Evaluate fundamental concepts of sets, Cartesian product, mappings, and the interrelationship between operations, groups, rings and fields. | V2, V4 | Lecture/ Individual or group work | Exams, quizzes |
| 3.4 | Generalize mathematical concepts in problem-solving through integration of new material and modeling. | V4 | Lecture/ Individual or group work | Exams, quizzes |

C. Course Content

| No | List of Topics | Contact Hours |
|----|--|---------------|
| 1. | <u>Principle of Mathematical Logic:</u> <i>Statements, negation of statements, truth tables and Connectives Methods of proofs (direct proof, proof by contrapositive, proof by contradiction, proof by mathematical induction)</i> | 4 |
| 2. | <u>Sets, membership and algebra of sets:</u> <i>Method of defining a set (listing method, characteristic property), finite and infinite sets. Membership and inclusion, Universal and existential quantifiers. Power set, Algebra of sets (union, intersection, universal set, complement of a set, symmetric difference, De Morgan's laws, Venn diagrams, Membership tables, membership tables, sets of numbers (N, Z, Q, R and C).</i> | 6 |
| 3. | <u>Cartesian Product and Relations on Sets</u> <i>Ordered pairs, Cartesian product of sets, Binary relations on sets, reflexive, symmetric, transitive relations, Skew-symmetric (Anti-symmetric), Equivalence relation, ordered relation, Partition of sets and equivalence classes, Partial ordered relation, Inverse of relation, Composition of relations. Diagrams of relations.</i> | 6 |
| 4. | <u>Mappings (Functions):</u> <i>Definition of mapping, Image of mapping, Inverse image of mapping Special types of mappings (injective (1-1), surjective (onto), bijective (1-1 and onto), Identity mapping, Composition of mappings, Bijection mappings as permutations, inverse of mapping. Equivalence of sets,</i> | 6 |





| | | |
|--------------|---|-----------|
| | Countable sets and non-countable sets, Cardinal numbers, Contour Theorem. | |
| 5. | Binary Operations: Definition and examples of binary operations, closure of a binary operation, commutative and associative operations, Identity element, Inverse of element, Systems of two operations, Homomorphism between two closed algebraic systems. | 6 |
| 6. | Introduction to Groups: Definition of semigroups and examples, Definition of groups and elementary examples, Definition of subgroups and examples Definition of cyclic groups and examples, Definition of symmetric groups and examples, Partition of groups and cosets. | 6 |
| 7. | Introduction to Rings and Fields: Definition of rings and elementary examples, Integral domains, Definition of fields and elementary examples, some properties of rings. Ring of polynomials. | 6 |
| Total | | 40 |

D. Students Assessment Activities

| No | Assessment Activities * | Assessment timing (in week no) | Percentage of Total Assessment Score |
|----|-------------------------|--------------------------------|--------------------------------------|
| 1. | Midterm exam | 6th | 30 % |
| 2. | Quizzes and homework's | During semester | 20 % |
| 3. | Final exam | End of semester | 50 % |

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

| | |
|------------------------------|--|
| Essential References | <p>1- Guide to Abstract Algebra by: Carol Whitehead, Edited by David Towers Edition 2nd Edition: ISBN:9780333794470.</p> <p>2- Set Theory and related topics by: Seymour Lipschutz, Schaum's Outlines Series : ISBN:0-07-038159-3</p> <p>3- Basic Abstract Algebra by: P. B. Bhattacharya, S. K. Jain, S. R. Nagpaul, Cambridge University Press, Jum. II 21, 1415 AH - Mathematics - 487 pages ISBN: 0-521-46081-6 and 0-521-46629-6</p> |
| Supportive References | <p>1- A First Course in Abstract Algebra, 7th Edition 7th edition, by John B. Fraleigh; Publisher: Pearson; 7 edition (November 16, 2002) ISBN-10: 0201763907: ISBN-13: 978-0201763904</p> <p>2- Modern Algebra: An Introduction 6th Edition, by John R. Durbin; Publisher: Wiley; 6 edition (December 31, 2008) ISBN-10: 0470384433 ISBN-13: 978-0470384435.</p> <p>3 – Theory and Problems of Abstract Algebra by Frank Ayres and Lloyd R. Jaisingh, Schaum's Outlines Series. Second Edition.</p> |
| Electronic Materials | https://en.wikipedia.org/wiki/Set_theory |





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|---------------------------------|--|
| | https://en.wikipedia.org/wiki/Map_(mathematics) https://en.wikipedia.org/wiki/Binary_operation https://en.wikipedia.org/wiki/Group_(mathematics) https://en.wikipedia.org/wiki/Ring_(mathematics) |
| Other Learning Materials | None |

2. Required Facilities and equipment

| Items | Resources |
|---|-------------------------------|
| facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.) | Classrooms |
| Technology equipment (projector, smart board, software) | Data Show, Smart Board |
| Other equipment (depending on the nature of the specialty) | None |

F. Assessment of Course Quality

| Assessment Areas/Issues | Assessor | Assessment Methods |
|--|-------------------------|--------------------------------------|
| Effectiveness of teaching | Students | Courses Assessment survey |
| Effectiveness of Students assessment | | Courses Assessment survey |
| Quality of learning resources | Students | Courses Assessment survey |
| The extent to which CLOs have been achieved | Faculty Member | Post-Rubric and Course report |
| Periodically reviewing course effectiveness and planning for improvement | Course committee | Annual report |

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify))

Assessment Methods (Direct, Indirect)

G. Specification Approval

| | |
|---------------------------|-----------------------|
| COUNCIL /COMMITTEE | Curriculum Committees |
| REFERENCE NO. | 1 |
| DATE | 17/07/2024 |

