# Course Specifications

| | |
|---|---|
| **Course Title:** | **Sets and Algebraic Structures** |
| **Course Code:** | **30112401-4** |
| **Program:** | **BSc. Mathematics 301100** |
| **Department:** | Mathematical Science |
| **College:** | Applied Sciences |
| **Institution:** | **Umm Al-Qura University** |

## Table of Contents

## A. Course Identification

| |
|---|
| **1. Credit hours:** 4 hours |
| **2. Course type**<br>**a.** University ☐ College ☐ Department ■ Others ☐<br>**b.** Required ■ Elective ☐ |
| **3. Level/year at which this course is offered:** Third Level / Second Year |
| **4. Pre-requisites for this course** (if any)**:** Does not exist |
| **5. Co-requisites for this course** (if any)**:** Does not exist |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | **Traditional classroom** | 4 Hours /Week | 100% |
| 2 | **Blended** | 0 | 0% |
| 3 | **E-learning** | 0 | 0% |
| 4 | **Correspondence** | 0 | 0% |
| 5 | **Other** | 0 | 0% |

**7. Actual Learning Hours** (based on academic semester)

| No | Activity | Learning Hours |
|---|---|---|
| **Contact Hours** | | |
| 1 | **Lecture** | (4 hours) x (15 weeks) |
| 2 | **Laboratory/Studio** | 0 |
| 3 | **Tutorial** | (1 hour) x (15 weeks) |
| 4 | **Others** (specify) | 0 |
| | **Total** | 75 hours |
| **Other Learning Hours*** | | |
| 1 | **Study** | (1 hour) x (15 weeks) |
| 2 | **Assignments** | (1 hour) x (15 weeks) |
| 3 | **Library** | (1 hour) x (15 weeks) |
| 4 | **Projects/Research Essays/Theses** | (1 hour) x (15 weeks) |
| 5 | **Others** (specify) | 0 |
| | **Total** | 60 hours |

* The length of time that a learner takes to complete learning activities that lead to achievement of course learning outcomes, such as study time, homework assignments, projects, preparing presentations, library times

## B. Course Objectives and Learning Outcomes

**1. Course Description**

The name "algebra" comes from the title of the book Hisab al-jabr w'al-muqabala by Abu Ja'far Muhammad ibn Musa Al-Khwarizmi, a Persian mathematician who lived in Baghdad early in the Islamic era (and whose name has given us the word 'algorithm' for a procedure to carry out some operation). Al-Khwarizmi was interested in solving various algebraic equations (especially quadratics), and his method involves applying a transformation to the equation to put it into a standard form for which the solution method is known. In this elementary introductory course we develop much of the language and many of the basic concepts of sets in fairly simple contexts.Some topics we could discuss include:

What exactly are the sets, and how are operations on them defined?

Do union and intersection of sets behave like addition and multiplication of numbers? What about composition of permutations?

What are the "usual laws"? What consequences do they have?

In this course, in addition, we will define and study slightly two kinds of algebraic object: rings, with operations of addition, multiplication, and groups, with just one operation (like multiplication or composition). We use simplicity: groups are in some ways simpler, having just a single operation, but rings are more familiar since the integers make a good prototype to think about.

**2. Course Main Objective**

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.

**3. Course Learning Outcomes**

| | CLOs | Aligned PLOs |
|---|---|---|
| 1 | **Knowledge:** | |
| 1.1 | Define logical equivalence, quantifiers and the contrapositive of a conditional statement | |
| 1.2 | State the basic rules of logical equivalence | |
| 1.3 | Identify different methods of proofs | |
| 1.4 | Outline the main properties of the different types of sets | |
| 1.5 | Recognize groups, subgroups, rings and subgroups. | |
| **2** | **Skills :** | |
| 2.1 | Show the fact that a proposition is true or false | |
| 2.2 | Examine the relation between the elements of a set A and the elements of a set B | |
| 2.3 | Demonstrate that a group is cyclical | |
| 2.4 | Summarize the main properties of rings | |
| **3** | **Competence:** | |
| 3.1 | Exemplify important concepts in specific cases | |
| 3.2 | Formulate important results and theorems covered by the course | |
| 3.3 | Analyze information presented verbally and translate it into mathematical form | |

| CLOs | | Aligned PLOs |
|---|---|---|
| 3.4 | Use appropriate mathematical models, formulae or techniques to process information and to draw relevant conclusions | |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | Sets, Operations on Sets, Cartesian product of sets | 8 |
| 2 | Mathematical Logic and Methods of Proof, integers, primes and division algorithm. | 12 |
| 3 | Relations and Mappings, Binary Operations and closure, commutative and associative properties, identity and inverse elements | 12 |
| 4 | Introduction of groups: examples | 8 |
| 5 | Cyclic Groups, permutations and the symmetric groups: examples | 12 |
| 6 | Rings: Definition and examples | 8 |
| **Total** | | 60 |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| **1.0** | **Knowledge** | | |
| 1.1 | Define logical equivalence, quantifiers and the contrapositive of a conditional statement | Lecture Tutorials | Exams (Quizzes, Midterm and Final). Written and possibly oral exam at the end of the course. In addition, compulsory work may be given during the course |
| 1.2 | State the basic rules of logical equivalence | Lecture Tutorials | |
| 1.3 | Identify different methods of proof | Lecture Tutorials | |
| 1.4 | Outline the main properties of the different types of sets | Lecture Tutorials | |
| 1.5 | State groups, subgroups, rings and subgroups. | Lecture Tutorials | |
| **2.0** | **Skills** | | |
| 2.1 | Show the fact that a proposition is true or false | Lecture Individual or group work | Exams (Quizzes, Midterm and Final). Homework |
| 2.2 | Examine the relation between the elements of a set A and the elements of a set B | Lecture Individual or group work | |
| 2.3 | Demonstrate that a group is cyclical | Lecture Individual or group work | |
| 2.4 | Summarize the main properties of rings | Lecture Individual or group work | |
| **3.0** | **Competence** | | |
| 3.1 | Exemplify important concepts in specific cases | Lecture Individual or group work | Exams (Quizzes, Midterm and Final) |

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 3.2 | Formulate important results and theorems covered by the course | Lecture<br>Individual or group work | |
| 3.3 | Analyze information presented verbally and translate it into mathematical form | Lecture<br>Individual or group work | |
| 3.4 | Use appropriate mathematical models, formulae or techniques to process information and to draw relevant conclusions | Lecture<br>Individual or group work | |

### 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Pentage of Total Assessment Score |
|---|---|---|---|
| 1 | Midterm 1 | 6th week | 20% |
| 2 | Midterm 2 | 12th week | 20% |
| 3 | Homework + reports + Quizzes | During semester | 10% |
| 4 | Final exam | End of semester | 50 % |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :**
All faculty members are required to be in their offices outside teaching hours. Each member allocates at least 4 hours per week to give academic advice to students and to better explain the concepts seen during the lectures.

## F. Learning Resources and Facilities

### 1.Learning Resources

| | |
|---|---|
| **Required Textbooks** | Guide to Abstract Algebra by: Carol Whitehead, Edited by David Towers Edition 2nd Edition ISBN:9780333794470 |
| **Essential References Materials** | - 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<br>- Modern Algebra: An Introduction 6th Edition, by John R. Durbin; Publisher: Wiley; 6 edition (December 31, 2008)<br>ISBN-10: 0470384433 ISBN-13: 978-0470384435 |
| **Electronic Materials** | None |
| **Other Learning Materials** | None |

## 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation** (Classrooms, laboratories, demonstration rooms/labs, etc.) | Large classrooms that can accommodate more than 30 students |
| **Technology Resources** (AV, data show, Smart Board, software, etc.) | Data Show, Smart Board |
| **Other Resources** (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list) | None |

# G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| Effectiveness of teaching and assessment | Students | Direct |
| Quality of learning resources | Students | Direct |
| Extent of achievement of course learning outcomes | Faculty Member | Direct |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

# H. Specification Approval Data

| | |
|---|---|
| **Council / Committee** | Council of the Mathematics Department |
| **Reference No.** | |
| **Date** | |