**4/1/4. Course Specification:**

# COURSE SPECIFICATIONS

## Form

Course Title: **Representation Theory (2): Auslander-Reiten Theory**

Course Code: **4047404-4**

# Course Specifications

| | |
|---|---|
| Institution: Umm Al-Qura University | Date: November 2018 |
| College/Department : College of Applied Science / Department of Mathematical Sciences | |

A. Course Identification and General Information

| | | | |
|---|---|---|---|
| 1. Course title and code: Representation Theory (2) : Auslander-Reiten Theory 4047404-4 | | | |
| 2. Credit hours 4 hours | | | |
| 3. Program(s) in which the course is offered.<br>(If general elective available in many programs indicate this rather than list programs)<br>PhD in Mathematics | | | |
| 4. Name of faculty member responsible for the course : Prof. Ahmed A Khammash | | | |
| 5. Level/year at which this course is offered ($2^{nd}$ Year) | | | |
| 6. Pre-requisites for this course (if any) 4047403-4 | | | |
| 7. Co-requisites for this course (if any) | | | |
| 8. Location if not on main campus<br>Main Campus + Girls sections | | | |
| 9. Mode of Instruction (mark all that apply) | | | |
| a. traditional classroom | √ | What percentage? | 70 |
| b. blended (traditional and online) | | What percentage? | |
| c. e-learning | √ | What percentage? | 20 |
| d. correspondence | √ | What percentage? | 10 |
| f. other | | What percentage? | |
| Comments: | | | |

B Objectives

| |
|---|
| 1. What is the main purpose for this course?<br>To introduce the students to the theory of almost split sequences and the Auslander-Reiten quiver. This includes the concept and main theorems of algebras given by quivers, irreducible maps , almost split sequences and (A-R)-translate. |
| 2. Briefly describe any plans for developing and improving the course that are being implemented. (e.g. increased use of IT or web based reference material, changes in content as a result of new research in the field)<br>In certain stage of the course the students will be introduced to certain computer packages which deal with modular representation such as MATLAB, GAP … etc |

C. Course Description (Note: General description in the form used in Bulletin or handbook)

| |
|---|
| Course Description:<br>This is a 4 credit hours optional course comprising approximately 60 contact hours. |

| 1. Topics to be Covered | | |
|---|---|---|
| List of Topics | No. of Weeks | Contact hours |
| Algebras given by quivers- Split monomrphisms and split epimprphisms - Irreducible maps | 2 | 8 |
| Almost split sequences - (A-R)-translate – Existence theorem for A-R sequence. | 2 | 8 |
| A-R quivers - Auslander algebras and their homological characterization | 2 | 8 |
| Hereditary algebras of finite type – The functorial approach of A-R theory – Tilting theory | 2 | 8 |
| A-R quiver for the group algebra of cyclic group $kC_p$ | 2 | 8 |
| A-R quiver for the group algebra $kSL(2, p)$ | 2 | 8 |
| The major open problems and conjectures in representation theory | 3 | 12 |

2. Course components (total contact hours and credits per semester):

| | Lecture | Tutorial | Laboratory or Studio | Practical | Other: | Total |
|---|---|---|---|---|---|---|
| Contact Hours | 60 | | | | | 60 |
| Credit | 4 | | | | | 4 |

| |
|---|
| 3. Additional private study/learning hours expected for students per week.<br>4 hours weekly for homework and revision |

| |
|---|
| 4. Course Learning Outcomes in NQF Domains of Learning and Alignment with Assessment Methods and Teaching Strategy |
| On the table below are the five NQF Learning Domains, numbered in the left column.<br>**First**, insert the suitable and measurable course learning outcomes required in the appropriate learning domains (see suggestions below the table). **Second**, insert supporting teaching strategies that fit and align with the assessment methods and intended learning outcomes. **Third**, insert appropriate assessment methods that accurately measure and evaluate the learning outcome. Each course learning outcomes, assessment method, and teaching strategy ought to reasonably fit and flow together as an integrated learning and teaching process. (Courses are not required to include learning outcomes from each domain.) |

| Code # | NQF Learning Domains And Course Learning Outcomes | Course Teaching Strategies | Course Assessment Methods |
|---|---|---|---|
| **1.0** | **Knowledge** | | |
| 1.1 | Knowing the concept of irreducible maps between indecomposable modules as well as the almost split sequences. The homological properties of almost split sequences will be discussed. | Lectures and tutorials | Quizzes, periodical and final exams |
| 1.2 | The student will also aware of the role played by the A-R quiver in the representation of f d algebras as well as how to construct such quivers for some concrete examples. Moreover, the student will gain some knowledge on conjectures and open problems in the subject. | Lectures and tutorials | Quizzes, periodical and final exams |
| **2.0** | **Cognitive Skills** | | |
| 2.1 | Constructing almost split sequences and A-R quivers for finite dimensional algebras | Lectures and tutorials | Quizzes, periodical and final exams |
| 2.2 | Develop practical skills on dealing with different operations on indecomposable modules over finite dimensional algebras | Lectures and tutorials | Quizzes, periodical and final exams |
| **3.0** | **Interpersonal Skills & Responsibility** | | |

| | | | |
|---|---|---|---|
| 3.1 | Develop the students ability towards working in small teams and discuss matters loudly and critically | Working in small groups | Oral Presentations |
| 3.2 | Develop independent thinking and judging | Working in small groups | Oral Presentations |
| **4.0** | **Communication, Information Technology, Numerical** | | |
| 4.1 | Knowing and getting used to the exixting computer packages such as GAP, MATLAB | Directions and Homework | Homeworks |
| **5.0** | **Psychomotor** NOT APPLIED | | |

5. Schedule of Assessment Tasks for Students During the Semester

| | Assessment task (e.g. essay, test, group project, examination, speech, oral presentation, etc.) | Week Due | Proportion of Total Assessment |
|---|---|---|---|
| 1 | First periodical | 6 | 20 |
| 2 | Mid term exam | 9 | 20 |
| 3 | Final exam | 15 | 50 |
| 5 | An oral presentation given by a student or small group of students | 8 , 10, 12 | 10 |

D. Student Academic Counseling and Support

1. Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice. (include amount of time teaching staff are expected to be available each week)
The instructor is available during office hours for at least six hours per week. He is also available on appointments

E Learning Resources

1. List Required Textbooks
1] M. Auslander, I. Reiten and S. Smalo, Representation theory of Artin algebras , Cambridge studies in advanced math. , Vol.36, Cambridge, 1994
[2] J. Alperin, Local representation theory, Cambridge studies in advanced math. Vol.11, Cambridge 1986
[3] C. Curtis, I. Reiner, Methods of representation theory with applications to finite

| |
|---|
| groups and orders , Vol.2 , WILEY , New York 1985.<br>[4] D.J. Benson , Representation and cohomology , Vol. I&II, Cambridge University Press , Cambridge 1991. |
| 2. List Essential References Materials (Journals, Reports, etc.)<br>According to the needs along the semester |
| 3. List Recommended Textbooks and Reference Material (Journals, Reports, etc)<br>1- W. Feit, Representation of finite groups 1982.<br>2- L. Dornhoff, Group Representation Theory, Part B: Modular representation theory. Marcel Dekker Inc., New York, (1972). |
| 4. List Electronic Materials, Web Sites, Facebook, Twitter, etc.<br>GAP ( groups , algorithms and programming ) Website |
| 5. Other learning material such as computer-based programs/CD, professional standards or regulations and software.<br>The algebra computer package GAP as well as other packages such as MATLAB |

F. Facilities Required

| |
|---|
| Indicate requirements for the course including size of classrooms and laboratories (i.e. number of seats in classrooms and laboratories, extent of computer access etc.) |
| 1. Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)<br>A class of capacity 15 as well as computer lab of the same capacity |
| 2. Computing resources (AV, data show, Smart Board, software, etc.)<br>The computer lab should be equipped with the following packages<br>GAP , MATLAB and MATHEMATICA |
| 3. Other resources (specify, e.g. if specific laboratory equipment is required, list requirements or attach list) |

G Course Evaluation and Improvement Processes

| |
|---|
| 1 Strategies for Obtaining Student Feedback on Effectiveness of Teaching<br>Regular polls as well as direct discussions |
| 2 Other Strategies for Evaluation of Teaching by the Instructor or by the Department |
| 3 Processes for Improvement of Teaching<br>Updating knowledge of new trends in teaching beside peer consultations and reviews |
| 4. Processes for Verifying Standards of Student Achievement (e.g. check marking by an independent member teaching staff of a sample of student work, periodic exchange and remarking of tests or a sample of assignments with staff at another institution)<br>Peer consultations and reviews |
| 5 Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement. |

| |
|---|
| By regulations, the whole study plan as well as individual courses should be reviewed , revised and updated for improvement and this is done on a regular basis |

Name of Instructor: Prof Ahmed Khammash

Signature: *Ahmed Khammash* Date Report Completed:_____

Name of Field Experience Teaching Staff Algebra (Representation Theory)

Program Coordinator:_____

Signature: _____ Date Received: 20/2/2018