

4/1/4. Course Specification:

## COURSE SPECIFICATIONS

### Form

Course Title: **Infinite Dimensional Lie Algebras**  
**(Kac-Moody algebras)**

Course Code: **4047405-4**

## Course Specifications

Institution: Umm Alqura University, Makkah Date of Report: 11 November 2018
College/Department: College of Applied Science, Mathematical Science

### A. Course Identification and General Information

1. Course Title and Code: <b>Infinite Dimensional Lie Algebras (Kac-Moody algebras) 4047405-4</b>
2. Credit hours: <b>4 Credit hours.</b>
3. Program(s) in which the course is offered: (If general elective available in many programs indicate this rather than list programs) <b>PhD in Mathematics</b>
4. Name of faculty member responsible for the course <b>Prof. Dr. Falih Aldosray</b>
5. Level/year at which this course is offered: <b>PhD/ Semester 3</b>
6. Pre-requisites for this course (if any) <b>Lie algebra 4047401-4</b>
7. Co-requisites for this course (if any): ---
8. Locations: <b>Main campus+Girls Sections</b>
9. Mode of Instruction (mark all that apply)
a. Traditional classroom <input checked="" type="checkbox"/> What percentage? <input type="text" value="100"/>
b. Blended (traditional and online) What percentage?-
c. e-learning What percentage?
d. Correspondence What percentage?
f. Other What percentage?
Comments: Mainly traditional classroom will dominant the mode on instruction.

## B Objectives

1. What is the main purpose for this course? The course is designed to introduce the students to the basic concepts of infinite dimensional Lie algebras( <b>Kac-Moody algebras</b> ).
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)
3- Encourage students to use the most updated books.
4- Advise students to submit the homework online and using internet.
5- Encourage students to write their homework and essays using LaTeX.

## C. Course Description (Note: General description in the form to be used for the Bulletin or handbook should be attached)

( **Kac-Moody algebra** is a Lie algebra defined by generators and relations through a generalized Cartan matrix. These algebras form a generalization of finite-dimensional semisimple Lie algebras, and many properties related to the structure of a Lie algebra such as its root system, irreducible representations.)

Course Description: There are 4 credit hours for this course which are comprising approximately 60 hours of lectures.
--

1. Topics to be Covered		
List of Topics	No. of Weeks	Contact Hours
Definition and Basic Properties;	2	8
- The invariant bilinear form and the generalized Casimir operator	2	8
- Integrable representations and the Weyl group of a Kac-Moody algebras.	2	8
. Some properties of generalized Cartan matrices	3	12
- Real and imaginary roots	2	8
Affine Lie algebras: the normalized invariant bilinear form, the root system and the Weyl group.	2	8
Affine Lie algebras:the realization(case k=1)	2	8

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

	Lecture	Tutorial	Laboratory	Practical /Clinical	Other: PBL	Total
Contact Hours	60	0	--	N/A	N/A	60
Credit	4	0				4

3. Additional private study/learning hours expected for students per week.	8
--	---

4. Course Learning Outcomes in NQF Domains of Learning and Alignment with Assessment Methods and Teaching Strategy
--

Course Learning Outcomes, Assessment Methods, and Teaching Strategy work together and are aligned. They are joined together as one, coherent, unity that collectively articulate a consistent agreement between student learning, assessment, and teaching.

The *National Qualification Framework* provides five learning domains. Course learning outcomes are required. Normally a course has should not exceed eight learning outcomes which align with one or more of the five learning domains. Some courses have one or more program learning outcomes integrated into the course learning outcomes to demonstrate program learning outcome alignment. The program learning outcome matrix map identifies which program learning outcomes are incorporated into specific courses.

On the table below are the five NQF Learning Domains, numbered in the left column.

**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. **Fourth**, if any program learning outcomes are included in the course learning outcomes, place the @ symbol next to it.

Every course is not required to include learning outcomes from each domain.

	NQF Learning Domains And Course Learning Outcomes	Course Teaching Strategies	Course Assessment Methods
<b>1.0</b>	<b>Knowledge:</b> After successful completion of the course, the student should be able to		
1.1	Know the basic facts and definitions of infinite dimensional Kac=Moody Lie algebras and their properties	<b>Lectures:</b> <ul style="list-style-type: none"> <li>• Build on what students already know.</li> <li>• present new concepts and principles</li> <li>• use questioning and encouraging students.</li> <li>• Doing practice and involving students in the class.</li> <li>• Draw facts and doing responds.</li> </ul>	<ul style="list-style-type: none"> <li>• Questions in the classes</li> <li>• Quizzes</li> <li>• Two periodical exams</li> <li>• Homework assignments</li> <li>• Final written exam</li> </ul>
1.2	know invariant bilinear form and the generalized Casimir operator		
1.3	know Integrable representations and the Weyl group		
1.4	Know Some properties of generalized Cartan matrices		
1.5	Affine Lie algebras: the normalized invariant bilinear form, the root system		
1.6	Affine Lie algebras: the realization (case $k=1$ )		
<b>2.0</b>	<b>Cognitive Skills</b>		
2.1	Planning rigorous proofs of different propositions and assertions in this context	<ul style="list-style-type: none"> <li>• Request from students to do some preparations for the lectures.</li> <li>• Give students challenging exercise and problems.</li> <li>• Request from students via discussions to compare the lectures with other topics in the same level.</li> </ul>	<ul style="list-style-type: none"> <li>• Questions in the classes</li> <li>• Quizzes</li> <li>• Two periodical exams</li> <li>• Homework assignments</li> <li>• Final written exam</li> </ul>
2.2	. Apply basic theorems Lie algebras		
2.3	Investigate particular examples of Lie algebras to which the theories under concern can be applied		
2.4	. Use lecture notes and other texts to solve challenging problems.		

<b>3.0</b>	<b>Interpersonal Skills &amp; Responsibility</b>		
3.1	Demonstrate communication skills with the teacher and other students in the class.	<p>Encourage students to:</p> <ul style="list-style-type: none"> <li>• Work in groups.</li> <li>• Visit library regularly.</li> <li>• Participate in the university activities.</li> <li>• Participate in college and department days and activities.</li> <li>• Joint and participate evocatively in college and department committees.</li> <li>• Joint and use useful media for education.</li> </ul>	
3.2	Analyze and illustrate basic facts.		
3.3	To show and exhibit ethical behavior.		
3.4	To show skills for judging basic facts.		
3.5	To write and work independently.		
3.6	To work effectively in teams.		
3.7	To manage time properly, meet deadlines.		
<b>4.0</b>	<b>Communication, Information Technology, Numerical</b>		
4.1	Demonstrate mathematics to others in oral form.	<p>Encourage students to:</p> <ul style="list-style-type: none"> <li>• Work in groups.</li> <li>• Visit library regularly.</li> <li>• Participate in the university activities.</li> <li>• Participate in college and department days and activities.</li> <li>• Joint and participate evocatively in college and department committees.</li> <li>• Joint and use useful media for education.</li> <li>• To use emails and internet evocatively.</li> </ul>	
4.2	illustrate mathematics to others in others in written form.		
4.3	Evaluate mathematics in a well-organized form.		
4.4	Research library in an excellent way.		
4.5	Research MathSciNet and good databases.		
4.6	Operate and use the university facilities in a good manner.		
4.7	Criticize and evaluate as well as express a judgment on the art of mathematics in this field.		

		<ul style="list-style-type: none"> <li>• Give presentations</li> <li>• Doing competitions and participate in mathematical discussions.</li> </ul>	
<b>5.0</b>	<b>Psychomotor</b>		
5.1	Not applicable	Not applicable	Not applicable

#### Suggested Guidelines for Learning Outcome Verb, Assessment, and Teaching

NQF Learning Domains	Suggested Verbs
<b>Knowledge</b>	list, name, record, define, label, outline, state, describe, recall, memorize, reproduce, recognize, record, tell, write
<b>Cognitive Skills</b>	estimate, explain, summarize, write, compare, contrast, diagram, subdivide, differentiate, criticize, calculate, analyze, compose, develop, create, prepare, reconstruct, reorganize, summarize, explain, predict, justify, rate, evaluate, plan, design, measure, judge, justify, interpret, appraise
<b>Interpersonal Skills &amp; Responsibility</b>	demonstrate, judge, choose, illustrate, modify, show, use, appraise, evaluate, justify, analyze, question, and write
<b>Communication, Information Technology, Numerical</b>	demonstrate, calculate, illustrate, interpret, research, question, operate, appraise, evaluate, assess, and criticize
<b>Psychomotor</b>	demonstrate, show, illustrate, perform, dramatize, employ, manipulate, operate, prepare, produce, draw, diagram, examine, construct, assemble, experiment, and reconstruct

Suggested **verbs not to use** when writing measurable and assessable learning outcomes are as follows:

Consider	Maximize	Continue	Review	Ensure	Enlarge
Understand					
Maintain	Reflect	Examine	Strengthen	Explore	Encourage
Deepen					

Some of these verbs can be used if tied to specific actions or quantification.

**Suggested assessment methods and teaching strategies are:**

According to research and best practices, multiple and continuous assessment methods are required to verify student learning. Current trends incorporate a wide range of rubric assessment tools; including web-based student performance systems that apply rubrics, benchmarks, KPIs, and analysis. Rubrics are especially helpful for qualitative evaluation. Differentiated assessment strategies include: exams, portfolios, long and short essays, log books, analytical reports, individual and group presentations, posters, journals, case studies, lab manuals, video analysis, group reports, lab reports, debates, speeches, learning logs, peer evaluations, self-evaluations, videos, graphs, dramatic performances, tables, demonstrations, graphic organizers, discussion forums, interviews, learning contracts, antidotal notes, artwork, KWL charts, and concept mapping.

Differentiated teaching strategies should be selected to align with the curriculum taught, the needs of students, and the intended learning outcomes. Teaching methods include: lecture, debate, small

#### 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	Continuous Assessment Evaluation	Weekly	20%
2	First Periodic Exam	6	20 %
3	Second Periodic Exam	10	20%
4	Final Examination (written Exam)	End of the semester	40%

#### 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)

- Each group of students is assigned to a particular faculty where he or she will provide academic advising during specific academic hours. Each staff will provide at least one session/week.
- There will be an academic advisor how will be a responsible for helping the student by doing the general supervision .
- The people in the library will support the students during the time of the course.

#### E. Learning Resources

##### Text books:

1. Kac, Victor G. (1994). Infinite dimensional Lie algebras (3rd ed.). New York: Cambridge University Press. ISBN 0-521-46693-8.

2. Wakimoto, Minoru (2001). Infinite dimensional Lie algebras. Providence, Rhode Island: American Mathematical Society. ISBN 0-8218-2654-9

3.Wan, Zhe Xian. Introduction to Kac-Moody algebra. World Scientific Publishing Co., Inc., Teaneck, NJ, 1991.

2. List Essential References Materials (Journals, Reports, etc.

) ) MathSciNet, Springer, Scopus, Researchgate.net, ResearchId, Google Scholar, Academia, ORCID.

3. List Recommended Textbooks and Reference Material (Journals, Reports, etc)

) MathSciNet, Springer, Scopus, Researchgate.net, ResearchId, Google Scholar, Academia, ORCID.

4. List Electronic Materials(eg. Web Sites, Social Media, Blackboard, etc.)

- <https://en.wikipedia.org/wiki/BlockTheory>

- ) MathSciNet, Springer, Scopus, Researchgate.net, ResearchId, Google Scholar, Academia, ORCID

5. Other learning material such as computer-based programs/CD, professional standards or regulations and software.

-LaTeX and Latexbeamer.

-Magma

-Gap

#### 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.)

Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)

- Lecture classroom which can accommodate 15 students for lectures (normal and classical

classroom)

2. Computing resources (AV, data show, Smart Board, software, etc.)

**Data Show (projector): sometimes shall be used.**

3. Other resources (specify, e.g. if specific laboratory equipment is required, list requirements or attach list)

**This course is a basic and fundamental course in commutative algebra.**

## G Course Evaluation and Improvement Processes

1 Strategies for Obtaining Student Feedback on Effectiveness of Teaching

Following completion of the prescribed course study in Pediatrics module, an evaluation should be conducted through the following:

- A student questionnaire feedback should be carried out on the quality & effectiveness of teaching and evaluation

2 Other Strategies for Evaluation of Teaching by the Program/Department Instructor

- A staff questionnaire feedback about course

3 Processes for Improvement of Teaching

- Submission of a final evaluation report at the end of the course
- A review of the recommended teaching strategies should be submitted after evaluation

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)

- Compare the standards of students' achievements' with standards archived elsewhere (inside KSA or students from outside the kingdom) by checking the marking of a sample of some student work : tests, course work
- Assignment by an independent member of teaching staff either from the UQU or other universities

5 Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement.

- Reviewing feedback on the quality of course report from staff members, other university' staffs.
- Looking for strengthen and weak points gathered at the end of the course and working on it.
- Plan to introduce updating material and technology that could improve the quality

**Faculty or Teaching Staff: Prof. Dr. Ahmad Mohammed Ahmad Alghamdi**

**Signature: \_\_\_Ahmad Mohammed Ahmad Alghamdi\_\_\_**

**Date Report Completed: 14 November 2018\_\_\_\_\_**

**Received by: \_\_\_\_\_ Dean/Department Head**

**Signature: \_\_\_\_\_ Date: \_\_\_\_\_**