

المركز الوطني للتقويم والاعتماد الأكاديمي

**National Center for Academic Accreditation and Evaluation**

### ATTACHMENT 5.

**T6. COURSE SPECIFICATIONS**

**(CS)**

Math 673: Differential Geometry, Lie Groups and Symmetric Spaces

**Course Specifications**

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| Institution: King Saud University | Date: |
| College/Department : College of Science/Department of Mathematics | |

**A. Course Identification and General Information**

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| 1. Course title and code: MATH-673 Differential Geometry, Lie Groups and Symmetric Spaces |
| 2. Credit hours: 03 |
| 3. Program(s) in which the course is offered. Ph. D. in Mathematics  (If general elective available in many programs indicate this rather than list programs) |
| 4. Name of faculty member responsible for the course: SHARIEF DESHMUKH |
| 5. Level/year at which this course is offered: First Semester |
| 6. Pre-requisites for this course (if any): Differentiable Manifolds, Riemannian Geometry |
| 7. Co-requisites for this course (if any): None |
| 8. Location if not on main campus: |
| 9. Mode of Instruction (mark all that apply):  a. traditional classroom What percentage?100  b. blended (traditional and online) What percentage?  c. e-learning What percentage?  d. correspondence What percentage?  f. other What percentage?  Comments: The course requires teaching and discussions with students. |

**B Objectives**

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| 1. What is the main purpose for this course? To prepare the students to work on Homogeneous spaces, Harmonic analysis and Applications of Differential geometry to areas such as Geometry of Lie groups, representation theory of Lie groups to ordinary and partial differential equations. |

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| 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): The course instructor prepares lecture notes to be handed over to students which includes list of exercises on the topics covered. |

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

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| Course Description: |

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| 1. Topics to be Covered | | |
| List of Topics | No. of  Weeks | Contact hours |
| Lie Groups and their Lie-algebras |  | 8 |
| Action of Lie groups on smooth manifold |  | 6 |
| Homogeneous spaces, Riemann homogeneous spaces, the canonical connection and Jacobi equations, two-point homogeneous spaces |  | 12 |
| Riemannian symmetric space, structure of orthogonal involute Lie algebras |  | 6 |
| Symmetric spaces and orthogonal involute Lie algebras |  | 5 |
| Curvature of symmetric spaces, Riemannian symmetric spaces of rank one |  | 8 |
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| 2. Course components (total contact hours and credits per semester): | | | | | | | |
|  | | Lecture | Tutorial | Laboratory/  Studio | Practical | Other: | Total |
| Contact  Hours | Planed | 45 |  |  |  |  |  |
| Actual | 45 |  |  |  |  |  |
| Credit | Planed |  |  |  |  |  |  |
| Actual |  |  |  |  |  |  |

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| 3. Additional private study/learning hours expected for students per week.  Five hours a week for homework and revisions. |

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| 4. Course Learning Outcomes in NQF Domains of Learning and Alignment with Assessment Methods and Teaching Strategy: The outcome of this course is the students learns to find the Lie algebra of a given matrix Lie group, and the computational skills of finding the curvature tensor with respect to a left invariant metric on the Lie group. | | | |
| **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. (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 | Knowledge of Lie groups, Action of a Lie group on a smooth manifold, Homogeneous spaces, Symmetric spaces | All the concepts are introduced through examples, specially using matrix Lie groups | Through home assignments and giving topics for seminars. |
| 1.2 | Curvature of Riemannian symmetric spaces | The notion of curvature is explained through simple to difficult examples of Riemannian symmetric spaces | Through home assignments and giving topics for seminars |
| **2.0** | **Cognitive Skills** | | |
| 2.1 |  |  |  |
| 2.2 |  |  |  |
| **3.0** | **Interpersonal Skills & Responsibility** | | |
| 3.1 | Description of cognitive skills to be developed Clarifying the main points of the course and linking previous knowledge to the lectures through solving problems, also identifying how useful the material in applications |  |  |
| 3.2 | Teaching strategies to be used to develop these cognitive skills  -Directing the students to how to think in formulating mathematical models through discussions during the lectures..  -Home works.  -The use of modern technology. |  |  |
| **4.0** | **Communication, Information Technology, Numerical** | | |
| 4.1 | Description of the interpersonal skills and capacity to carry responsibility to be developed |  |  |
| 4.2 | Directing students to the way of thinking , handling the material and encouraging them to discuss problems related to the subject. |  |  |
| **5.0** | **Psychomotor** | | |
| 5.1 | NA |  |  |
| 5.2 |  |  |  |

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| 5. Schedule of Assessment Tasks for Students During the Semester | | | |
|  | Assessment task (i.e., essay, test, quizzes, group project, examination, speech, oral presentation, etc.) | Week Due | Proportion of Total Assessment |
| 1 | First midterm exam. | Week 6 | 20% |
| 2 | Second mid term exam. | Week 10 | 20% |
| 3 | Homework and tutorial activities | Over all weeks | 10% |
| 4 | Final exam | end | 50% |
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**D. Student Academic Counseling and Support**

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| 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)  Three office hours of the faculty |

**E Learning Resources**

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| 1. List Required Textbooks:  Differential Geometry, Lie groups and Symmetric Spaces By S. Helgason, American Math. Soc. 2001 |
| 2. List Essential References Materials (Journals, Reports, etc.)  Lectures on Lie groups By W. Y. Hsiang, World Scientific Singapore 2000 |
| 3. List Electronic Materials, Web Sites, Facebook, Twitter, etc. |
| 4. Other learning material such as computer-based programs/CD, professional standards or regulations and software. |

**F. Facilities Required**

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| 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.):  Available |
| 2. Technology resources (AV, data show, Smart Board, software, etc.)  Classrooms with Smart Board is available |
| 3. Other resources (specify, e.g. if specific laboratory equipment is required, list requirements or attach list)  NA |

**G Course Evaluation and Improvement Processes**

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| 1. Strategies for Obtaining Student Feedback on Effectiveness of Teaching  Students are encouraged to have discussions among themselves and the faculty interacts with them to evaluate the outcome of the discussion and to evaluate the outcome. |
| 2. Other Strategies for Evaluation of Teaching by the Instructor or by the Department  Different types of exercises are developed (not available in text book) and assigned to students to test their understanding in the subject. |
| 3. Processes for Improvement of Teaching  At the end of each important theorem taught in the lectures, the students are given to understanding what could be possible improvement in the result and explained that could lead to the future research in the topic. |
| 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)  This is an advanced course and only the faculty who is teaching the course could be best to evaluate |
| 5. Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement. |

Name of Course Instructor: \_\_\_SHARIEF DESHMUKH\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date Specification Completed: \_\_\_\_\_\_\_\_\_\_\_\_

Program Coordinator: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date Received: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_