

المركز الوطني للتقويم والاعتماد الأكاديمي

**National Center for Academic Accreditation and Evaluation**

### ATTACHMENT 5.

**T6. COURSE SPECIFICATIONS**

**(CS)**

**Math 681** (**Stochastic Differential Equations**)

**Course Specifications**

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

**A. Course Identification and General Information**

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| 1. Course title and code: **Math 681 Stochastic Differential Equations** |
| 2. Credit hours  **3 (3+0)** |
| 3. Program(s) in which the course is offered : Ph.D. Mathematics |
| 4. Name of faculty member responsible for the course |
| 5. Level/year at which this course is offered |
| 6. Pre-requisites for this course (if any): **584** |
| 7. Co-requisites for this course (if any): **None** |
| 8. Location if not on main campus |
| 9. Mode of Instruction (mark all that apply):  100%  a. traditional classroom What percentage?  b. blended (traditional and online) What percentage?  c. e-learning What percentage?  d. correspondence What percentage?  f. other What percentage?  Comments: None |

**B Objectives**

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| 1. What is the main purpose for this course?  **-Gaining insight into the mathematical foundations of the many applications of Stochastic Processes.**  **-Grasping the important notions of Probability Theory needed for a rigorous development of Stochastic Processes.**  **- Reaching the frontiers of Research in the field of Stochastic 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)  **- Exploring the usage of computers in the management of the course, whereby homework assignments, quizzes, tests and assessment are carried out in a dedicated website.** |

**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 | Contacthours |
| **Review of probability Theory; Joint Finite-dimensional distributions; Kolmogorov’s consistency theorem; isonomy; Separable processes; processes with continuous sample paths.** | **2** | **6** |
| **Gaussian Processes; Martingales, Markov Processes.** | **4** | **12** |
| **Brownian motion and Weiener Process; Ito integral, Ito formula.** | **5** | **15** |
| **Stochastic Differential equations; Existence and uniqueness of solutions; infinitesimal generator. Diffusions.** | **4** | **12** |

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| 2. Course components (total contact hours and credits per semester): | | | | | | | |
|  | | Lecture | Tutorial | Laboratory/  Studio | Practical | Other: | Total |
| Contact  Hours | Planed | 3 | 2 |  |  |  | 75 |
| Actual | 3 | 2 |  |  |  | 75 |
| Credit | Planed | 3 | 0 |  |  |  | 45 |
| Actual | 3 | 0 |  |  |  | 45 |

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| 3. Additional private study/learning hours expected for students per week.  0 |

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| 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.**  **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 | **-The fundamental notions of probability theory.**  **-Stochastic Processes; joint finite-dimensional distributions; equivalent processes; isonomous processes, separable processes, existence of continuous versions.**  **-Martingales( sub and sup martingales); decomposition theorem, martingale inequality.**  **-Markov Process; associated semi-group, infinitesimal generator.**  **-Weiener process; Martingale property, Markov property; sample paths continuous but nowhere differentiable.**  -**Ito integral; Ito Formula.**  **-Existence, uniqueness and properties of solutions of Stochastic Differential Equations.** | **Delivering direct lectures in the class.**  **-Requiring homework assignments.**  **–Offering seminars**  **-Consulting Faculty and Tutors during office hours.** | **-Two seminars**  **- One mid-term exam.**  **- Final exam.** |
| **2.0** | **Cognitive Skills** | | |
| 2.1 | **-Realising that Study of real world problems requires allowing for random effects.**  **-Realising the need for the developed set up if we were to handle situations in which there is a presence of highly erratic perturbations.**  **-Prowess in choosing the appropriate tools to handle a modelling situation.**  **-The ability to ask fresh questions when the modelling problem is sorted out.** | **-Requiring background reading by the students.**  **-Canvassing, through discussion, the opinions of the students on formulating suitable mathematical models for the examples covered.**  **-Discussing fresh problems raised by knowledge gained from the course**. | **Gauging the level of participation in class discussions.** |
| 2.2 |  |  |  |
| **3.0** | **Interpersonal Skills & Responsibility** | | |
| 3.1 | **-Teaching the students, by example, how to identify the features of a problem and how to focus on the mathematical tools for its resolution.** | **- Encouraging the students to read independently and to consult books other than the chosen text books.**  **-Correcting homework assignments with full commentary on presentation.** | **Routine check of students’ comprehension of the course.** |
| 3.2 |  |  |  |
| **4.0** | **Communication, Information Technology, Numerical** | | |
| 4.1 | **- Developing the ability to browse the university library and the web for alternate sources of the material.** | **-Offering assignments that require material not covered in detail in chosen text books.** | **-Marking the assignments.**  - **Critical appraisal of seminars required from the students**. |
| 4.2 |  |  |  |
| **5.0** | **Psychomotor** | | |
| 5.1 | NA | NA | NA |
| 5.2 |  |  |  |

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| 5. Schedule of Assessment Tasks for Students During the Semester | | | |
| Assessment | Assessment task (eg. essay, test, group project, examination etc.) | Week due | Proportion of Final Assessment |
| 1 | **First seminar** | **6th Week** | **15%** |
| 2 | **Second seminar** | **11th Week** | **15%** |
| 3 | **Mid term exam** | **8th Week** | **20%** |
| 4 | **Final exam** | **By the end** | **50%** |

**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)  **Two office hours.** |

**E Learning Resources**

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| 1. List Required Textbooks  **1-**.**Stochastic Differential Equations: L. Arnold** |
| 2. List Essential References Materials (Journals, Reports, etc.)  1- **Stochastic Differential Equations and applications: A Friedman.**  **2- Stochastic Differential Equations:I.I. Gihman, A.V. Skorohod.** |
| 3. List Electronic Materials, Web Sites, Facebook, Twitter, etc.  **A great deal of books in the university library and many online internet resources.**  **Faculty websites.**  **More generally, search engines (Google, Yahoo…) provide a lot of material.** |
| 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.)  A maximum of 25 students in each classroom. |
| 2. Technology resources (AV, data show, Smart Board, software, etc.)  **-Computer labs equipped with sophisticated machines.**  **-Increasing the capacity of the internet network in order to accommodate more users.** |
| 3. Other resources (specify, e.g. if specific laboratory equipment is required, list requirements or attach list) |

**G Course Evaluation and Improvement Processes**

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| 1. Strategies for Obtaining Student Feedback on Effectiveness of Teaching |
| 2. Other Strategies for Evaluation of Teaching by the Instructor or by the Department |
| 3. Processes for Improvement of Teaching |
| 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) |
| 5. Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement. |

Name of Course Instructor: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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

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

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