**Course Syllabus**

**offered by College/School/Department of Management Sciences**
**with effect from Semester A in 2016 / 2017**

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**Part I Course Overview**

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|---|---|
| **Course Title:** | Matrix-Analytic Methods in Stochastic Models |
| **Course Code**: | MS8954 |
| **Course Duration:** | One semester |
| **Credit Units**: | 3 |
| **Level**: | R8 |
| **Proposed Area:** *(for GE courses only)* | ☐ Arts and Humanities<br>☐ Study of Societies, Social and Business Organisations<br>☐ Science and Technology |
| **Medium of Instruction:** | English |
| **Medium of Assessment:** | English |
| **Prerequisites**: *(Course Code and Title)* | Nil |
| **Precursors**: *(Course Code and Title)* | Nil |
| **Equivalent Courses**: *(Course Code and Title)* | Nil |
| **Exclusive Courses**: *(Course Code and Title)* | Nil |

**Part II Course Details**

**1. Abstract**

*(A 150-word description about the course)*

This course offers a brief introduction to matrix-analytic methods and their applications in queueing theory, inventory theory, supply chain management, telecommunications networks, reliability, finance mathematics, risk and insurance analysis, and biostatistics. In the first half of the course, the basic theory on phase-type distributions, Markovian arrival processes, and matrix-geometric solutions is introduced. In the second half of the course, applications of matrix-analytic methods in stochastic modeling (queueing, reliability, inventory, supply chain, etc.) are examined.

**2. Course Intended Learning Outcomes (CILOs)**

*(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)*

| No. | CILOs[#] | Weighting* (if applicable) | Discovery-enriched curriculum related learning outcomes (please tick where appropriate) | | |
|---|---|---|---|---|---|
| | | | *A1* | *A2* | *A3* |
| 1. | Learn matrix-analytic methods and apply them in the analysis of stochastic models. | | √ | √ | √ |
| 2. | Develop efficient algorithm for computing performance measures and quantities. | | √ | √ | √ |
| | | 100% | | | |

** If weighting is assigned to CILOs, they should add up to 100%.*

*[#] Please specify the alignment of CILOs to the Gateway Education Programme Intended Learning outcomes (PILOs) in Section A of Annex.*

*A1: Attitude*
*Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.*

*A2: Ability*
*Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to self-life problems.*

A3: *Accomplishments*
*Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.*

**3. Teaching and Learning Activities (TLAs)**

*(TLAs designed to facilitate students' achievement of the CILOs.)*

| TLA | Brief Description | CILO No. | | Hours/week (if applicable) |
|---|---|---|---|---|
| | | 1 | 2 | |
| 1. Lecture | Introduce concepts and methods; Explain results and prove them; | √ | √ | |
| 2. Assignment | Practice the use of techniques to solve problems, and to enhance the understanding of concepts and techniques; extend the skills. | √ | √ | |

**4. Assessment Tasks/Activities (ATs)**

*(ATs are designed to assess how well the students achieve the CILOs.)*

| Assessment Tasks/Activities | CILO No. | | Weighting* | Remarks |
|---|---|---|---|---|
| | 1 | 2 | | |
| Continuous Assessment: 100% | | | | |
| **1. Assignments** | √ | √ | 60% | |
| **2. Course project**<br>Write a course project report about MAM related research in certain area(s) and make possible extension of the theory. | √ | √ | 40% | |
| Examination: ____% (duration: , if applicable) | | | | |
| ** The weightings should add up to 100%.* | | | 100% | |

## 5. Assessment Rubrics

*(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)*

| Assessment Task | Criterion | Excellent (A+, A, A-) | Good (B+, B, B-) | Adequate (C+, C, C-) | Marginal (D) | Failure (F) |
|---|---|---|---|---|---|---|
| Assignments | | Strong evidence of knowing how to apply the key concepts of managing services into real life service operations scenarios. | Evidence of knowing how to apply the key concepts of managing services into real life service operations scenarios. | Some evidence of knowing how to apply the key concepts of managing services into real life service operations scenarios. | Sufficient familiarity with the subject matter to enable the student to progress without repeating the assignment. | Little or no evidence of familiarity with the subject matter. |
| Course project | | Strong evidence of original thinking; good organization, capacity to analyse and synthesize; superior grasp of subject matter; evidence of extensive knowledge base. | Evidence of grasp of subject, some evidence of critical capacity and analytic ability; reasonable understanding of issues; evidence of familiarity with literature. | Some evidence of grasp of subject, little evidence of critical capacity and analytic ability; reasonable understanding of issues. | Sufficient familiarity with the subject matter to enable the student to progress without repeating the case report. | Little evidence of familiarity with the subject matter; weakness in critical and analytic skills; limited or irrelevant use of literature. |

**Part III Other Information** (more details can be provided separately in the teaching plan)

**1. Keyword Syllabus**

*(An indication of the key topics of the course.)*

Part 1: Introduction to matrix-analytic methods

Part 2: From the exponential distribution to phase-type distributions

- Basic concepts and definitions
- Basic closure properties

Part 3: From the Poisson process to Markovivan arrival processes

- Basic concepts and definitions
- Performance measures

Part 4: From the birth-and-death process to structured Markov chains

- Basic concepts and definitions
- Matrix-geometric solutions

Part 5: Applications in queueing theory and inventory management

- Basic queueing models and modeling techniques
- Inventory-production system

**2. Reading List**

**2.1 Compulsory Readings**

*(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)*

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|---|---|
| 1. | He, Qi-Ming (2014). *Fundamentals of Matrix-Analytic Methods*, Springer, New York. |

**2.2 Additional Readings**

*(Additional references for students to learn to expand their knowledge about the subject.)*

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|---|---|
| 1. | Neuts, M. F. (1981), *Matrix-Geometric Solutions in Stochastic Models – An Algorithmic Approach*, The Johns Hopkins University Press, Baltimore. |
| 2. | Latouche, G. and V. Ramaswami (1999), *Introduction to Matrix Analytic Methods in Stochastic Modelling*, ASA & SIAM, Philadelphia, USA. |
| 3. | Asmussen, S. (2003), *Applied Probability and Queues*, 2nd, Springer, New York. |