Form 2B

City University of Hong Kong

Information on a Course offered by Department of Electronic Engineering with effect from Semester B 2014/15

Part I

Course Title:	Queueing Theory with Telecommunications Applications
Course Code:	EE6610
Course Duration:	One Semester (13 weeks)
No. of credits:	3
Level:	P6
Medium of Instructions	English

Prerequisites *(Course Code and Title)*:	NA
Precursors *(Course Code and Title)*:	CS2363 Computer Programming, or equivalent, and, either EE3313 Applied Queueing Systems or MA3160 Probability &Stochastic Processes; or equivalent.
Equivalent Course *(Course Code and Title)* :	NA
Exclusive Courses: *(Course Code and Title)*:	NA

Part II

1. Course Aims:

This course aims to provide students with an understanding of probability and queueing models and their analyses, simulation and numerical algorithms, and their use in modelling of practical present and future telecommunications traffic and networking applications. An important focus is how such models can lead to cost effective provision of telecommunications services. This course also aims to stimulate students' appreciation in the potential to make research contributions in this area and to provide preparation for research degrees in telecommunications applications of probability models and queueing theory.

2. Course Intended Learning Outcomes (CILOs)

Upon successful completion of this course, students should be able to:

No.	CILOs
1.	Describe applications of probability and queueing theory to practical problems in performance analysis of present and future (based on current trends) telecommunications and computer systems.
2.	Develop new models and analytical results of key performance measures, such as blocking probability and queue size and delay statistics, from first principles.
3.	Program computer simulations of queueing systems including evaluation of confidence intervals, and analyze the results.
4.	Calculate link capacity dimensioning in telecommunications networks, and analyse such networks to evaluate their performance.

3. Teaching and Learning Activities (TLAs)

CILO 1, 2, 4	Lecture, tutorial, group discussion, assignments, test, final exam
CILO 3	Lecture, tutorial, assignments

The course is enriched by what is called *Group Learning* where challenging assignments requiring programming or analyses (or both) are posed to the students. Then the students participate in a social network, using CityU e-learning platform, to solve the problems together. The e-platform is also used for the students to pose questions and other students contribute suggestions and solutions. Participation in this social network is part of the coursework assessment. At the end of the semester, students are required to submit a report on their participation in the Discussion Board throughout the semester on which they are assessed. The Group Learning involves competition – whoever solves the problem first obtains the higher mark. However, the number of opportunities (problem posed by the course leader or by students themselves) is large, so all students have opportunities to excel. It also provides opportunities for students to help each other. Students have freedom in choosing their own problems, but the problems must be closely related to the EE6610 curriculum. Assessment on the Group Learning activities and report are based on novelty, initiative, accuracy, contribution, and presentation. Through Group Learning, the students will experience *discovery learning* by performing simulations and analyses and discover certain effects for themselves, and sharing and discussing them with others via the e-learning platform. They will then use the feedback gained for further understanding and improvement of their work quality.

Timetabling Information

Pattern	Hours
Lecture:	26
Tutorials:	13
Laboratory:	
Other activities:	

4. Assessment Tasks/Activities

	Type of assessment tasks	*Weighting (if applicable)*
Continuous Assessment	Assignments, Test	30%
Examination	Written exam	70% 2 hours

Remarks: To pass the course, students are required to achieve at least 35% in course work and 35% in the examination.

5. Grading of Student Achievement:

Letter Grade	**Grade Point**	**Grade Definitions**
A+ A A-	4.3 4.0 3.7	Excellent
B+ B B-	3.3 3.0 2.7	Good
C+ C C-	2.3 2.0 1.7	Adequate
D	1.0	Marginal
F	0.0	Failure

6. Constructive Alignment with Programme Outcomes

PILO	**How the course contribute to the specific PILO(s)**
1. An ability to describe current and anticipated trends in the selected areas.	In this course the students will develop and demonstrate ability to understand fundamental performance issues such as throughput, loss and delay of telecommunications networks which will enable them to describe current trends and future evolutions of networking technology.
2. An ability to evaluate and analyze new technologies in the selected areas.	In this course the students will develop and demonstrate ability to analyze and evaluate the performance of new and evolving optical and wireless telecommunications technologies. Performance measures will include delay, blocking probability and throughput.
3 An ability to apply specialist knowledge in the selected areas.	In this course the students will develop and demonstrate ability to apply knowledge of probability, stochastic processes, queueing theory and statistics to analysis, evaluation and dimensioning of modern and evolving telecommunications networks.

4. An ability to assess, evaluate and formulate solutions to problems or specifications, in the selected areas.	The focus of the course is on the development of understanding of the fundamentals of probability and queueing theory and the ability to develop new models and analytical results of key queue size and delay statistics from first principles, evaluate performance of telecommunications network and to be able to design them such that they meet QoS requirements subject to traffic demand. Traffic is described by its statistical behaviour and the QoS requirements are packet/ message/ page-download delay and acceptable loss levels. In all assessed activities, the students will be required to make decisions on system parameters, such as link capacities and buffer sizes to meet QoS specifications for given traffic load.
5. Research and develop new technologies and products in the selected areas.	In the lectures, tutorials, Group Learning activities, test and exam, students will be challenged with current research problems relevant to developments of new telecommunications technologies that are designed to meet QoS requirements of various services. They will be required to develop models which can lead to a solution of these problems.
6. Apply effective communication skills in their professions.	Although this is not a direct part of the assessment, lectures and tutorials are interactive and students are given many opportunities to talk in public and improve their oral communications skills. Part of the assessment of the Group Learning report is its presentation. Also the Group learning activities themselves that involve discussions and interactions help the students improve their written and communication skills.
7. An ability to manage teams of technologists with good senses of business and marketing (BM option only).	

Part III

Keyword Syllabus:

probability, queueing theory; teletraffic; Little's Formula, Markov chains; M/M/1, M/M/k, M/M/k/k; queues with finite buffer, finite source models, state dependent queueing models, Markov modulated processes; D/D/1, D/D/k, D/D/k/k, M/G/1, G/G/1; priority queues; queueing networks; simulation; numerical algorithms; traffic modelling; Internet traffic models; telecommunications, circuit switched networks, mobile networks, optical networks.

Recommended Reading:

- D. Bertsekas and R. Gallager, Data Networks, Prentice Hall, Englewood Cliff, New Jersey 1992.

Online Resources (if any)

- Moshe Zukerman, “Introduction to Queueing Theory and Stochastic Teletraffic Models”, (Classnotes) It is available on CityU Website: http://www.ee.cityu.edu.hk/~mzu/classnotes.pdf