City University of Hong Kong
Course Syllabus

offered by Department of Electrical Engineering
with effect from Semester <u>A 2022/2023</u>

Part I   Course Overview

Course Title: <u>Signaling, Switching and Routing in Telecommunication Networks</u>

Course Code: <u>EE6412</u>

Course Duration: <u>One Semester (13 weeks)</u>

Credit Units: <u>3</u>

Level: <u>P6</u>

Medium of Instruction: <u>English</u>

Medium of Assessment: <u>English</u>

Prerequisites:
(Course Code and Title)   <u>Nil</u>

Precursors:
(Course Code and Title)   <u>EE5412 Telecommunication Networks; or equivalent</u>

Equivalent Courses:
(Course Code and Title)   <u>Nil</u>

Exclusive Courses:
(Course Code and Title)   <u>Nil</u>

Part II Course Details

1. **Abstract**

   This course aims to provide students with an understanding of important concepts and techniques on signaling, switching and routing in telecommunication networks.

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.	Identify the fundamental concepts and components about voice over IP, especially the signaling protocol (SIP) and its calling procedure.		✓	✓	✓
2.	Identify various types of switches and their roles in the telephone network and compute the cost and blocking probability of various switches.		✓	✓	
3.	Identify various routing schemes and their applications to the real world circuit-switched networks and compute the blocking probability of various routing schemes.		✓	✓	
4.	Identify the fundamental techniques/concepts of Multi-Protocol Label Switching (MPLS).		✓	✓	
		100%			

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	3	4			
Lecture	Knowledge of the general concepts in signaling, switching and routing in telecommunication networks	✓	✓	✓	✓			27 hrs
Laboratory	Lab sessions with hand-on experience for building a voice over IP application, especially the signaling protocol (SIP) and its calling procedure	✓						12 hrs
In-class exercise	To encourage students to apply the knowledge learn from the course to solve the in-class exercise	✓	✓	✓	✓			
Mini project	To encourage students to apply the knowledge learn from the course to build a voice over IP application	✓						

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	3	4				
Continuous Assessment: 40%								
Test 1 & 2	✓	✓	✓	✓			20%	
At least 3 assignments (laboratory etc.)	✓						20%	
Examination: 60% (duration: 2hrs , if applicable)								
							100%	

Remark:
To pass the course, students are required to achieve at least 30% in course work and 30% in the examination. Also, 75% laboratory attendance rate must be obtained

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

Applicable to students admitted in Semester A 2022/23 and thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B,)	Marginal (B-, C+, C)	Failure (F)
1. Examination	Achievements in CILOs	High	Medium	Low	Not even reaching marginal level
2. Coursework	Achievements in CILOs	High	Medium	Low	Not even reaching marginal level

Applicable to students admitted before Semester A 2022/23

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Examination	Achievements in CILOs	High	Significant	Moderate	Basic	Not even reaching marginal level
2. Coursework	Achievements in CILOs	High	Significant	Moderate	Basic	Not even reaching marginal level

6.   Constructive Alignment with Programme Outcomes

PILO	How the course contribute to the specific PILO(s)
1, 2, 3, 4	This course aims to provide students with skills and knowledge in three major areas of telecommunication networks. Upon completion of this course, students will be able to apply analytical skills to access and evaluate network performance in those areas.

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

1.   Keyword Syllabus

The Telephone Network
- The big picture
- Routing: routing algorithms, essence of problem, features of telephone network routing
- Transmission: multiplexing, link technologies, analogue to digital conversion, voice coding
- Switching: motivation, space division switching, time division switching
- Signaling: signaling network, switch controller, Signalling System 7 (SS7), state transition diagram

Voice over Internet Protocol
- Enabling technologies?
- Real Time Transport protocol (RTP)
- RTP Control Protocol (RTCP)
- Signaling protocol: Session Initiation Protocol (SIP), SIP's call establishment procedure

Circuit Switching
- Link systems: concentrator, route switch, expander, multi-stage switching network
- Grades of service of link systems
- Time-division switching, grades of service of time-division switching networks

Routing in the telephone network
- Telephone network topology
- Features of telephone network routing
- Alternate/dynamic routing, Trunk reservation
- Random routing, Least loaded routing, Real world examples: DNHR, RTNR
- Erlang fixed point approximation

IP routing and label switching in Multi-Protocol Label Switching (MPLS)
- Motivation
- Label switching routers, label switched path
- IP packet forwarding, IP routing, label switching
- Label assignment, label allocation, label distribution

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.)

1.	John E. Flood*, Telecommunications Switching, Traffic and Networks*, Prentice Hall, 1995.
2.	Keshav S: *An Engineering Approach to Computer Networking: ATM Networks, the Internet, and the Telephone Network,* Addison Wesley, 1997. (http://www.awl.com/cseng/titles/0-201-63442-2)
3.	Cisco web site: http://www.cisco.com

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

1.	D. E. Comer, *Computer Networks and Internets, with Internet Applications*, 3rd ed., Prentice Hall, (http://www.netbook.cs.purdue.edu)
2.	G. R. Ash, *Dynamic Routing in Telecommunications Networks*, McGraw-Hill, 1997.
3.	K.W. Ross, *Multiservice Loss Models for Broadband Telecommunication Networks*, Springer, 1995.
4.	Bruce Davie and Yakov Rekhter, *MPLS: Technology and Applications*, Morgan Kaufmann, 2000.
5.	Zheng Wang, *Internet QoS: Architectures and Mechanisms for Quality of Service*, Morgan Kaufmann, 2001.
6.	Uyless Black, *MPLS and Label Switching Networks*, Prentice Hall, 2001.