AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Module name:	Switching nodes for telecommunication and computer networks

Academic year:	2014/2015	Code:	IET-1-608-s	ECTS credits:	3

Faculty of:	Computer Science, Electronics and Telecommunications

Field of study:	Electronics and Telecommunications	Specialty:	—

Study level:	First-cycle studies	Form and type of study:	Full-time studies

Lecture language:	English	Profile of education:	Academic (A)	Semester:	6

Course homepage:	—

Responsible teacher:	Stoch Stanisław (stoch@agh.edu.pl)

Academic teachers:	Stoch Stanisław (stoch@agh.edu.pl)

Module summary

Teletraffic theory; Switching networks; Layered network architecture; Signaling systems; Switches of type T and type S; Switching systems EWSD, 5ESS, S12; Switches in IP networks; Photonic switching.

Description of learning outcomes for module

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Connections with FLO	Method of learning outcomes verification (form of completion)
Social competence			
M_K001	Student is able to work in a team.	ET1A_K04	Activity during classes
Skills			
M_U001	Student is able to evaluate characteristics of a given switching network structure	ET1A_W01	Execution of exercises
M_U002	Student is able to assess approaches used in switching node management	ET1A_W01	Execution of exercises
M_U003	Student is able to explain and distinguish various kinds of switching network control approaches	ET1A_W01	Execution of exercises
M_U004	Student is able to select a proper structure of a switching network matching the needs of a particular node	ET1A_W01	Execution of exercises
Knowledge			

M_W001	Student knows typical structures of interconnection fabrics used in switching nodes and understands their operation	ET1A_W01	Execution of exercises
M_W002	Student knows key notions and units in the area of traffic engineering	ET1A_W02, ET1A_W01	Execution of exercises
M_W003	Student knows and understands fundamental notions related to switching nodes	ET1A_W01	Execution of exercises
M_W004	Student knows the roles and principles of operation of contemporary signaling systems	ET1A_W01	Execution of exercises

FLO matrix in relation to forms of classes

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Form of classes										
		Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Fieldwork classes	Workshops	Others	E-learning
Social competence												
M_K001	Student is able to work in a team.	-	+	-	-	-	-	-	-	-	-	-
Skills												
M_U001	Student is able to evaluate characteristics of a given switching network structure	-	+	-	-	-	-	-	-	-	-	-
M_U002	Student is able to assess approaches used in switching node management	-	+	-	-	-	-	-	-	-	-	-
M_U003	Student is able to explain and distinguish various kinds of switching network control approaches	-	+	-	-	-	-	-	-	-	-	-
M_U004	Student is able to select a proper structure of a switching network matching the needs of a particular node	-	+	-	-	-	-	-	-	-	-	-
Knowledge												
M_W001	Student knows typical structures of interconnection fabrics used in switching nodes and understands their operation	-	+	-	-	-	-	-	-	-	-	-
M_W002	Student knows key notions and units in the area of traffic engineering	-	+	-	-	-	-	-	-	-	-	-

| M_W003 | Student knows and understands fundamental notions related to switching nodes | + | + | - | - | - | - | - | - | - | - | - |
| M_W004 | Student knows the roles and principles of operation of contemporary signaling systems | - | + | - | - | - | - | - | - | - | - | - |

Module content

Lectures

Role of telecommunications switching in telecommunication networks
Notion of telecommunications switching, a very brief history of telecommunications switching, basic components of aa switching node, traffic concentrators, line units.

Basics of telecommunications traffic theory
Traffic intensity, traffic variations, busy hour, traffic types, quality of service. Full availability system models: Kendall's notation, loss systems, Little's formula, waiting systems, other models.

Switched networks
Access networks to switched networks, ISDN, networking aspects of xDSL, Automatically Switched Optical Network (ASON), Software Defined Network (SDN).

Signaling systems
Notion and functions of signaling, types of signaling, subscriber signaling, DSS1 signaling, interexchange signaling, SS7 signaling, RSVP signaling.

Space-division switching networks
Role of switching networks, taxonomy, combinatorial properties of switching networks, networks nonblocking in the strict- and wide-sense, repackable networks, rearrangeable networks, continuous and discrete optimization of switching networks.

Time-division switching networks
The need for time-division networks, time- and time-multiplexed space switches and relevant networks, digital switching matrices, time-division switching networks, combinatorial properties, scalability and capacity expansion of time-division networks, connecting signal senders, multirate networks.

Packet-switched networks
IP networks, IP and ATM switching, the concept, buffering, addressing, switch and router examples.

Switches in IP networks
Router structures, generations of routers, scheduling algorithms for routers, examples of high-speed routers, flow-aware networks and relevant routers.

Photonic switching
Optical circuit and packet switching, optical switches: guided wave based switches, laser-diode based switches, WDM switches, time-division switches, free-space switching, bubble switches.

Intelligent networks and control of next-generation networks
Intelligent networks, architectures of next-generation networks, softswitch vs. Peer-to-

peer networks.

<u>Control of switching nodes</u>
Evolution of control systems, programmable control, control of switching networks.

<u>Management of switching systems</u>
Operation, maintenance, typical operation and maintenance functions, testing of switching networks, simple fault models, fault masking.

<u>Examples of switching systems</u>
Examples: IP router, telecommunication switching system, cross-connect.

<u>Future of telecommunications switching</u>
Challenges and trends.

Auditorium classes

<u>Telecommunications traffic theory</u>
Traffic intensity, traffic variations, busy hour, traffic types, quality of service. Full availability system models: Kendall's notation.

<u>Erlang's and Engset's models</u>
Loss systems, Little's formula, waiting systems, other models.

<u>Switching networks – basic notions</u>
Role of switching networks, taxonomy, combinatorial properties of switching networks, networks nonblocking in the strict- and wide-sense, repackable networks, rearrangeable networks, continuous and discrete optimization of switching networks.

<u>Time-division switching networks</u>
The need for time-division networks, time- and time-multiplexed space switches and relevant networks, digital switching matrices, time-division switching networks, combinatorial properties, scalability and capacity expansion of time-division networks, connecting signal senders, multirate networks.

<u>Photonic switching networks</u>
Optical circuit and packet switching, optical switches: guided wave based switches, laser-diode based switches, WDM switches, time-division switches, free-space switching, bubble switches.

<u>IT routers</u>
IP networks, IP and ATM switching, the concept, buffering, addressing, switch and router examples, router structures, generations of routers, scheduling algorithms for routers, examples of high-speed routers, flow-aware networks and relevant routers.

Method of calculating the final grade
The passing final mark is related to the marks received at excercise's tests.
The student is allowed to take re-sit examination in the appropriate time period.

Prerequisites and additional requirements
Knowledge of mathematics (elementary combinatorics and probability theory)

Recommended literature and teaching resources
A. Jajszczyk, "Wstęp do telekomutacji", WNT, Warszawa 2009, wyd. IV (dodruk)
W. Kabaciński, "Nonblocking electronic and photonic switching fabrics" Springer, NY 2005

ITU-T recommendations, ETSI standards, IETF documents
Journals and magazines:
IEEE Communications Magazine
IEEE Transactions on Communications
IEEE Journal on Selected Areas in Communications
IEEE/ACM Transactions on Networking
Optical Switching and Networking

Scientific publications of module course instructors related to the topic of the module

1. Stanisław Stoch, „Podręcznik Inżynierii Ruchu dla Telekomunikacji Polskiej S.A." (współautor), Kraków, listopad 2000.
2. Stanisław Stoch, Telekomunikacja Cyfrowa, Kraków 1998, Tom1, zeszyt 2 s. 79-90, „Zalecenie ITU-T G.803 w kontekście dotychczasowego sposobu opisu sieci telekomunikacyjnych".
3. Stanisław Stoch, „Telefonia cyfrowa i cyfrowe systemy komutacyjne." (skrypt na Studium Podyplomowe „Nowoczesne sieci i usługi telekomunikacyjne") Wydawnictwo Fundacji Postępu Telekomunikacji, Kraków, 2000. (potem 2001, 2002, 2003) ISBN 83 86476 34 6

Additional information

Przedmioty obieralne są dobierane co roku, na postawie bieżących trendów w nauce i technice oraz potrzeb rynku pracy.
Wykłady oraz ćwiczenia dobierane są indywidualnie przez prowadzących, tematyka jest zatwierdzana przez Dziekana ds. studenckich.
Liczba miejsc na niektórych przedmiotach jest ograniczona, dlatego w przypadku większej liczby chętnych, brana będzie pod uwagę średnia ze wskazanych przedmiotów inżynierskich.

Student workload (ECTS credits balance)

Student activity form	Student workload
Participation in lectures	28 h
Preparation for classes	15 h
Participation in auditorium classes	14 h
Realization of independently performed tasks	30 h
Summary student workload	87 h
Module ECTS credits	3 ECTS