STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Computer networks		**1010334551010334959**
Field of study	Profile of study (general academic, practical)	Year /Semester
Information Engineering	**(brak)**	**3 / 5**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
-	**Polish**	**obligatory**
Cycle of study:	Form of study (full-time,part-time)	
First-cycle studies	**part-time**	
No. of hours		No. of credits
Lecture: **24** Classes: **-** Laboratory: **16** Project/seminars: **-**		**6**
Status of the course in the study program (Basic, major, other)	(university-wide, from another field)	
(brak)	**(brak)**	
Education areas and fields of science and art		ECTS distribution (number and %)

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	K_W02: Student has basic knowledge of physics, especially in such fields as mechanics, thermodynamics, optics, electricity, magnetism, nuclear physics, solid-state physics, including knowledge essential to understand physical phenomena in electronic circuits. K_W05: Student has organized knowledge with theoretical foundations of basic program constructions, algorithm implementations, paradigms and programming styles, software verification methods, formal languages, compilers, platforms.
2	**Skills**	K_U01: Student is able to acquire information from literature, data bases and other sources; student is able to integrate acquired information, to interpret it, to draw conclusions and to formulate and justify judgments. K_U03: Student is able to create engineer work documentation and to prepare text with the work result discussion. K_U10: Student is able to use software platforms and environments for simple programs encoding, running and testing in programming languages.
3	**Social competencies**	K_K02: Student understands and is aware of the importance of nontechnical issues related to computer engineer activity. Student understands the responsibility associated to his engineering decisions.

Assumptions and objectives of the course:

The main objective of the course is to present advanced network technologies - not only those already widely used in computer networks, but also those that have recently gained popularity as potentially effective solutions to already identified problems to be faced by so-called Future Internet. In particular, the course provides knowledge in the area of new wireless network technologies, including wireless mesh, mobile ad-hoc networks (MANET) and wireless multi-hop networks (large networks without or with little fixed infrastructure), as well as technologies enabling effective operation of multi-service heterogeneous networks, in particular dynamic routing protocols, social collaboration and fairness enforcement frameworks, Quality of Service (QoS) management techniques.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. Student has organized knowledge with theoretical foundations of computer networks. - [K_W07]
2. Student has organized knowledge with theoretical foundations of Internet technologies. - [K_W11]
3. Student has organized knowledge with theoretical foundations of teleinformatics, protocols and services in telecommunication networks. - [K_W15]

Skills:

1. Student is able to do critical analysis of computer hardware operations, operating system and computer networks. - [K_U11]
2. Student is able to carry out work with web sites and Internet services. - [K_U15]

Social competencies:
1. Student understands and is aware of the importance of nontechnical issues related to computer engineer activity. Student understands the responsibility associated to his engineering decisions. - [K_K02]

Assessment methods of study outcomes
Lecture: final exam. Laboratory: tests before exercises, exercises assesment, reports assesment. More than 50% points are necessary for positive result.

Course description
The topics of the course include: - Distributed and semi-distributed queuing management techniques for IP networks - Quality of Service (QoS) management techniques - Fully dynamic routing (including Optimized Link-State Routing) - Network-layer resource optimization techniques (multi-path routing and its influence on QoS, Max Weight Scheduling technique, backpressure principle, IntServ and DiffServ models, RSVP protocol) - Effectiveness of transport-layer protocols (new versions of TCP: Reno2, Vegas, FAST, TCP delayed reordering technique) - Network resource optimisation from application-layer perspective (differences between file transmission and audiovisual streaming, TCP flow control vs UDP/RTP+RTCP flow control, adaptive streaming, application-layer flow control) - Various fairness models (reverse engineering of TCP utility, delay-aware Network Utility Maximization, multi-service fairness) - Interdependence of transport-layer and network-layer functions and protocols - Cross-layer network functions and protocols optimisation, interdependence of MAC-sublayer algorithm and queuing management in fixed and wireless networks - IP network operation stability - Design and implementation of network protocol stacks - New types of wireless networks (wireless mesh networks, mobile ad-hoc networks (MANET), wireless multi-hop networks, heterogeneous networks, fully dynamic routing in wireless multi-hop networks, Optimized Link-State Routing) - Selected important research activities conducted in EU and USA in the area of Future Internet technologies Topics of laboratory exercises: 1. Network services configuration 2. Protocol implementation in MIT Click Modular Router environment 3. Static routing in a multi-path network 4. Dynamic routing - RIP protocol 5. Dynamic routing - OSPF protocol 6. Multicast addressing and routing - PIM-SM protocol 7. Effectiveness of TCP - configuration of logical connection 8. Effectiveness of TCP - flow control optimisation 9. Quality of UDP transmission: QoS parameters, comparison to TCP 10. Text-based application-layer protocols - Telnet, FTP 11. HTTP protocol, virtual sessions 12. DNS system 13. Transport protocols for audiovisual streaming systems (RTP, RTCP) 14. Session setup and control protocols for 3G systems (SIP, RTSP) 15. Advanced firewall with QoS functionalities 16. SOAP protocol for inter-application communication

Basic bibliography:

Additional bibliography:

Result of average student's workload

Activity	Time (working hours)
1. Lectures	24
2. Laboratory	16
3. Consultations and exam	10
4. Preparation for laboratory	54
5. Laboratory reports preparation and exam preparation	46

Student's workload		
Source of workload	**hours**	**ECTS**
Total workload	150	6
Contact hours	50	2
Practical activities	70	3