

COURSE SYLLABUS AND COURSE REQUIREMENTS

ACADEMIC YEAR 2022/2023 SEMESTER II

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|------------------------------|-----------------------------------|
| <i>Course title</i> | <i>Internet Technologies</i> |
| <i>Course Code</i> | IVB167ANMI |
| <i>Hours/Week: le/pr/lab</i> | 2 lecture |
| <i>Credits</i> | 3 |
| <i>Degree Programme</i> | Computer Science Engineering, BsC |
| <i>Study Mode</i> | Daily |
| <i>Requirements</i> | Exam |
| <i>Teaching Period</i> | 2022/23 II. |
| <i>Prerequisites</i> | IVB368ANMI |
| <i>Department(s)</i> | Department of Automation |
| <i>Course Director</i> | |
| <i>Teaching Staff</i> | Dr. Dóra Maros |

COURSE DESCRIPTION

A short description of the course (max. 10 sentences).

Neptun: Instruction/Subjects/Subject Details/Basic data/Subject description

The aim of the course is to give students a comprehensive picture of the current and future internet technologies that will fundamentally determine/will determine the functioning of the digital society. For the different fields of application, the telecommunications (primarily wireless) and network solutions used, system hierarchies, their connections and the related market trends and future trends are described.

SYLLABUS

Neptun: Instruction/Subjects/Subject Details/Syllabus

1. GOALS AND OBJECTIVES

Goals, student learning outcome.

Neptun: Instruction/Subjects/Subject Details/Syllabus/Goal of Instruction

The aim of the education is to enable students to comprehensively design and operate integrated and complex multifunctional systems with a wide range of professional perspectives, as well as to recognize the innovative development opportunities of these systems.

2. COURSE CONTENT

Neptun: Instruction/Subjects/Subject Details/Syllabus/Subject content

TOPICS

| LECTURE | TOPICS |
|---------|---|
| | <ol style="list-style-type: none"> 1. Topic: Introduction to modern Internet technologies, new market trends and applications (digital society, IoT, Smart transport, smart home and smart city, etc.) 2. Topic: Classification of wireless communication systems, Fundamentals of mobile communication (2G-5G), standardization organizations, development of mobile networks (2G-5G), frequency bands used, access and duplexing technologies, modulations, problems with radio transmission (pathloss, fading, ISI, etc.), error detection and error correction on the radio channel. 3. Topic: Introduction to 5G networks, QoS triangle, features and applications of service groups, application of 5G in industrial environments: broadband, MMTC, mission critical KPIs and their comparison. Operation of 5G networks, antenna solutions, cell organization, core network, network slicing, network and mobility management (location update, handover, registration, attach/detach) , databases (HSS, EIR, VLR) and their functions. |

4. Topic: Introduction to IoT, history, market trends, applications. IoT standardization, types of networks PAN, LAN, WAN network structures and their characteristics. Comparison of wireless communication solutions in terms of bandwidth, range, performance, sensitivity and availability (BT, Zegbee, Wifi, NB-IoT, LTE-M, Lora, Sigfox, 4-5G). IoT network layers (Sensor, Communication, Management, Application), their characteristics and tasks, mesh network structures, examples and applications, IOT Smart Cities, ITS, smart grid, etc. applications. Geographical spread and technical characteristics of Lora and NB-IoT. Designing Lora networks (gateway, network server, join server, application server), NB-IoT channels, IoT edge cloud solutions.
5. Topic: Introduction to cloud computing, history of the formation of cloud systems, cloud service piramyd, IaaS, PaaS, SaaS characteristics and application environment. Privat, public and hybrid cloud solutions, application features, advantages, disadvantages. Definition of IaaS virtualization solutions, data, network, server, storage, desktop virtualization, network design, and examples. SAN, IT network management tasks (configuration, virtual machine, operation, data storage).
6. Topic: Significance of QoS in IP-based networks, ITU QoS definitions, QoS technical (instrumental measurement) and non-technical (subjective) measurement, MOS and KPI (Key Performance Indicators), characteristics of key KPIs (IPTD, IPDV, IPER, IPLR), IP network SLAs to provide QoS, bottleneck phenomenon.
7. Topic: Blockchain and artificial intelligence funds, their application in various fields. Areas and tools of AR and VR application, related current and future virtual solutions.

**PRACTICE
LABORATORY
PRACTICE**

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DETAILED SYLLABUS AND COURSE SCHEDULE

ACADEMIC HOLIDAYS INCLUDED

LECTURE

| week | Topic | Compulsory reading; page number (from ... to ...) | Required tasks (assignments, tests, etc.) | Completion date, due date |
|------|---|---|---|---------------------------|
| 1. | Introduction to modern Internet technologies, new market trends and applications (digital society, IoT, Smart transport, smart home and smart city, etc.) | A presentation for the curriculum delivered in class. | | ... |
| 2. | Classification of wireless communication systems, Fundamentals of mobile communication (2G-5G), standardization organizations, development of mobile networks (2G-5G), frequency bands used, access and duplexing technologies, modulations, problems with radio transmission (pathloss, fading, ISI, etc.), error detection and error correction on the radio channel. | A presentation for the curriculum delivered in class. | | |
| 3. | Introduction to 5G networks, QoS triangle, features and applications of service groups, application of 5G in industrial environments: broadband, MMTC, mission critical KPIs and their comparison. | A presentation for the curriculum delivered in class. | Online test at the lecture. | |
| 4. | Operation of 5G networks, antenna solutions, cell organization, core network, network slicing, network and mobility management (location update, handover, | A presentation for the curriculum delivered in class. | | |

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| | registration, attach/detach), databases (HSS, EIR, VLR) and their functions. | | | |
| 5. | Introduction to IoT, history, market trends, applications. IoT standardization, types of networks PAN, LAN, WAN network structures and their characteristics. Comparison of wireless communication solutions in terms of bandwidth, range, performance, sensitivity and availability (BT, Zegbee, Wifi, NB-IoT, LTE-M, Lora, Sigfox, 4-5G). | A presentation for the curriculum delivered in class. | Online test at the lecture. | |
| 6. | IoT network layers (Sensor, Communication, Management, Application), their characteristics and tasks, mesh network structures, examples and applications, IOT Smart Cities, ITS, smart grid, etc. applications. | A presentation for the curriculum delivered in class. | | |
| 7. | Geographical spread and technical characteristics of Lora and NB-IoT. Designing Lora networks (gateway, network server, join server, application server), NB-IoT channels, IoT edge cloud solutions. | A presentation for the curriculum delivered in class. | Online test at the lecture. | |
| 8. | Introduction to cloud computing, history of the formation of cloud systems, cloud service piramyd, IaaS, PaaS, SaaS characteristics and application environment. Privat, public and hybrid cloud solutions, application features, advantages, disadvantages. | A presentation for the curriculum delivered in class. | | |
| 9. | Spring break | | | |
| 10. | Holiday | | | |
| 11. | IaaS virtualization solutions, data, network, server, storage, desktop virtualization definition, network design and examples, SAN, IT network management tasks (configuration, virtual machine, operation, data storage). | A presentation for the curriculum delivered in class. | Online test at the lecture. | |
| 12. | Significance of QoS in IP-based networks, ITU QoS definitions, QoS technical (instrumental measurement) and non-technical (subjective) measurement, MOS and KPI (Key Performance Indicators), characteristics of key KPIs (IPTD, IPDV, IPER, IPLR), IP network SLAs to provide QoS, bottleneck phenomenon. | A presentation for the curriculum delivered in class. | | |
| 13. | Holiday | | | |
| 14. | Blockchain and artificial intelligence funds, their application in various fields. | A presentation for the curriculum delivered in class. | Online test at the lecture. | |
| 15. | Areas and tools of AR and VR application, related current and future virtual solutions. | A presentation for the curriculum delivered in class. | | |

PRACTICE, LABORATORY PRACTICE

| <i>week</i> | Topic | Compulsory reading; page number (from ... to ...) | Required tasks (assignments, tests, etc.) | Completion date, due date |
|-------------|--------------|--|--|----------------------------------|
| 1. | ... | | | |
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3. ASSESSMENT AND EVALUATION

(Neptun: Instruction/Subjects/Subject Details/Syllabus/Examination and Evaluation System)

ATTENDANCE

In accordance with the Code of Studies and Examinations of the University of Pécs, Article 45 (2) and Annex 9. (Article 3) a student may be refused a grade or qualification in the given full-time course if the number of class absences exceeds 30% of the contact hours stipulated in the course description.

Method for monitoring attendance (e.g.: attendance sheet / online test/ register, etc.)

online test

ASSESSMENT

Cells of the appropriate type of requirement is to be filled out (course-units resulting in mid-term grade or examination). Cells of the other type can be deleted.

~~Course resulting in mid-term grade~~ (PTE TVSz 40§(3))

Mid-term assessments, performance evaluation and their ratio in the final grade (The samples in the table to be deleted.)

| Type | Assessment | Ratio in the final grade |
|---|-------------------|--------------------------|
| e.g.: Test 1 | eg. max 20 points | eg. 20 % |
| e.g.: Test 2 | eg. max 30 points | eg. 30 % |
| e.g.: home assignment (project documentation) | eg. max 30 points | eg. 30 % |
| ... | eg. max 15 points | eg. 20 % |

Opportunity and procedure for re-takes (PTE TVSz 47§(4))

The specific regulations for improving grades and resitting tests must be read and applied according to the general Code of Studies and Examinations. E.g.: all tests and assessment tasks can be repeated/improved at least once every semester, and the tests and home assignments can be repeated/improved at least once in the first two weeks of the examination period.

...

Grade calculation as a percentage

based on the aggregate performance according to the following table

| Course grade | Performance in % |
|------------------|------------------|
| excellent (5) | 85 % ... |
| good (4) | 70 % ... 85 % |
| satisfactory (3) | 55 % ... 70 % |
| pass (2) | 40 % ... 55 % |
| fail (1) | below 40 % |

The lower limit given at each grade belongs to that grade.

Course-unit with final examination

Mid-term assessments, performance evaluation and their weighting as a pre-requisite for taking the final exam

(The samples in the table to be deleted.)

| Type | Assessment | Weighting as a proportion of the pre-requisite for taking the exam |
|--|------------|--|
| In the lessons, short, online tests (10-15 questions, 5 tests in total) are completed on average at least 50%. | | 100% |

Requirements for the end-of-semester signature

(Eg.: mid-term assessment of 40%)

Short online tests (max. 10 questions, 5 tests in total) with an average of at least 50% completion of the lessons.

Re-takes for the end-of-semester signature (PTE TVSz 50§(2))

The specific regulations for grade betterment and re-take must be read and applied according to the general Code of Studies and Examinations. E.g.: all the tests and the records to be submitted can be repeated/improved each at least once every semester, and the tests and home assignments can be repeated/improved at least once in the first two weeks of the examination period.

Last week of lectures online test min 50% completion.

Type of examination (written, oral): Test

The exam is successful if the result is minimum 50 %. (The minimum cannot exceed 40%.)

Calculation of the grade (TVSz 47§ (3))

The mid-term performance accounts for ... %, the performance at the exam accounts for 100 % in the calculation of the final grade.

Calculation of the final grade based on aggregate performance in percentage.

| Course grade | Performance in % |
|------------------|------------------|
| excellent (5) | 88 % ... |
| good (4) | 75 % ... 87 % |
| satisfactory (3) | 63 % ... 74 % |
| pass (2) | 50 % ... 62 % |
| fail (1) | below 50 % |

The lower limit given at each grade belongs to that grade.

4. SPECIFIED LITERATURE

In order of relevance. (In Neptun ES: Instruction/Subject/Subject details/Syllabus/Literature)

COMPULSORY READING AND AVAILABILITY

Teacher Presentations uploaded to MS Teams.

RECOMMENDED LITERATURE AND AVAILABILITY

Videos mentioned on lectures.