

## International Master's Degree Programme in Wireless Communication Engineering (WCE)

### Curriculum for Student Group 2016-2018

#### 1. Structure of WCE Studies

The [Centre for Wireless Communications](#) (CWC) at the [Faculty of Information Technology and Electrical Engineering](#) (ITEE), [University of Oulu](#) is responsible for organizing the 2 years international master's degree programme of [Wireless Communication Engineering](#) (WCE). WCE programme consist of 120 ECTS credits of studies based on the modules described below. 60 ECTS credits measure the workload of a full-time student during one academic year, which equals around 1500-1800 hours per year. Thus one ECTS credit stands for 25-30 working hours. The structure of WCE studies is organized in the following manner:

Basic WCE studies module (40 ECTS)
Advanced WCE studies module (18-31 ECTS)
Optional WCE studies module ( $\geq$ 16-29 ECTS)
Advanced practical training (3 ECTS)
Master's (Diploma) Thesis work (30 ECTS)
In total 120 ECTS

ECTS = European Credit Transfer System, 1 credit 25-30 hours, 1 year ca. 60 credits

All WCE courses are implemented in English. Execution of the WCE programme consist of passing the courses contained in the *basic*, *advanced* and *optional* (elective studies) modules. All courses within the basic module must be completed. There is freedom to choose elective courses for the optional module as well as for advanced module. At least 16-29 ECTS of elective studies must be chosen. The total number of elective credits depends on the number of advanced courses included into advanced module. That's why the minimum and maximum number of credit points in advanced and optional modules varies a within the limits shown above.

In addition, master's thesis work (30 ECTS equals roughly 6 month workload) and advanced practical training (3 ECTS equals roughly 2 month workload) must be done.

Mandatory WCE courses in basic and advanced modules are offered by the [Centre for Wireless Communications](#) unit. Most of elective courses are offered by other [ITEE](#) faculty units called [Electrical Engineering](#) (EE), and [Computer Science and Engineering](#) (CSE). Finnish language studies are offered by the UO [language & communication unit](#).

Student can include elective courses into his/her optional module (elective studies) even from other departments & faculties of Oulu University, provided they are accepted into student's personal study plan (PSP) by the personal study advisor (Dr. Kari Kärkkäinen). *Always consult your personal study advisor before including elective courses offered by other units & faculties into your personal study plan, or before starting to listen the course.* Courses from CWC, EE and CSE units can be included directly into your PSP without consulting your study advisor (see the list for such elective studies in Chapter 4).

If a student fails to pass an exam, she/he can try again on next final exam date of that course. Typically 3-4 exams are arranged per year for each course (depending on whether summer exams are arranged or not). *Notice, no restrictions are imposed on the number, and time-span of taken exams for each course, i.e., if you fail an exam, you can retry during next exams, or next study year.* Also, if you are not satisfied with your grade, you can try to upgrade your grade in next exams without restrictions. *Exams are typically written with a pencil.* Use of permanent ink pen is not mandatory, and it is also not recommended.

Each WCE student has to submit an electronic personal study plan (PSP) to the programme's personal study advisor Dr. Kari Kärkkäinen for approval at the beginning of studies (typically in October-November). Instructions session for creation of a PSP will be arranged at the beginning of autumn term. PSP is prepared with the aid of OodiPSP under [Weboodi environment](#). Look at the OodiPSP instructions on the page: <http://www oulu.fi/dce/node/11468>.

## 2. General Issues Dealing with Studies

A study year at the DCE department is divided into 4 periods. Periods 1, and 2 run on autumn (**A**) term, and periods 3 and 4 run on spring (**S**) term. Time span for each period is 7-8 weeks. Each study year consists of appr. 32 weeks of teaching. Between 2<sup>nd</sup> and 3<sup>rd</sup> periods there is a season break for the Christmas & New Year between 17.12.2016-8.1.2017 (weeks 51-1). No teaching and exams are arranged during that holiday season.

The exact dates for the periods of the study year 2016-2017 are the following: 1<sup>st</sup>: 29.8.-21.10.2016 (weeks 35-42) , 2<sup>nd</sup>: 24.10.-16.12.2016 (weeks 44-50), 3<sup>rd</sup>: 9.1.-10.3.2017 (weeks 2-10), 4<sup>th</sup>: 13.3.-12.5.2016 (weeks 11-19). Summer brake is between 13.5.-27.8.2017. Summer exams are typically arranged in summer time. Mandatory advanced practical training is recommended to be done during summer brake after 1<sup>st</sup> study year. Training extension of 3 ECTS equals 2 month full-time workload.

University of Oulu orientation programme for all international master's degree students is arranged on second half of August, 2016 (week 34). *It is advised that WCE students could arrive to Oulu before the start of orientation programme in order to settle down and to get useful training and information in order to get started.* After orientation week from the beginning of week 35 starts the 1<sup>st</sup> period of WCE studies.

At the beginning of studies during the orientation week a WCE student will get his/her personal UO e-mail account, and a licenses to use UO computer networks, i.e. will get UID & PW for UO computer systems. Those computer systems are needed in executing exercise and design works for courses of WCE curriculum, as well as, to access lecture and exercise materials stored in pdf-format in [Optima](#) environment.

### 3. Computer Environments and Study Portals in UO Computer Networks

When enrolling to Oulu University, you will get your personal userID & password for UO IT service's computer network needed in your studies. It is called: **paju.oulu.fi –account**. You need paju-account when using [OPTIMA](#), [WEBOODI](#), [NOPPA](#) and [LUKKARI](#) study portals that will be explained briefly below.

In addition you will get your personal userID & password for CWC & EE & CSE unit's computer network, which is shortly called as **EE -network**. It is called: **ee.oulu.fi –account**.

Students will get their personal UO e-mail address & service for the Microsoft's **Office 365 for Education (O365)** cloud service: <http://o365.oulu.fi/>. Office 365 for Education (O365) It will offer our students a free Outlook email, but also free cloud services like Office Online applications (Word, Excel, PowerPoint, OneNote), calendar and OneDrive.

*All official correspondence from UO teachers and student service officers is communicated with you only using O365 system's e-mail.* Although you may prefer your personal mail system (Gmail, Yahoo, Hotmail, etc.), UO personnel does not use your personal e-mail address in matters dealing with your studies. *That's why remember every now and then check your O365 e-mail account in order not to miss important messages from teachers, etc..* Instructions how to get and activate O365 service can be found from: <http://www.oulu.fi/ict/office365> .

Course materials are typically stored into the **TTK-OPTIMA** portal: <https://optima.oulu.fi/>. OPTIMA is an interactive study envi and two-way communication channel between students and teachers in order to share study materials and work assignments, and to discuss with teachers.

**NOPPA** study portal (<https://noppa.oulu.fi/noppa/kurssit/>) is an open (i.e. no UID & PW needed to use it) study environment where all home pages of our courses exist, and learning outcomes and up-to-date daily information dealing with detailed execution of courses are located (lecture & exercise & exercise work schedules, course books, mode of delivery). All WCE courses in NOPPA: <https://noppa.oulu.fi/noppa/kurssit/>

**LUKKARI** ([https://lukkari.oulu.fi/index\\_en.html?uilang=en-US](https://lukkari.oulu.fi/index_en.html?uilang=en-US)) is an electronic study calendar & schedule environment where you can create your own course calendar, store exam dates, personal appointment times, etc. during semesters. With a single glance at your computer you can find what is scheduled for each week.

**WEBOODI** (<https://weboodi.oulu.fi/oodi/>) is an environment where all official detailed course descriptions including course books, timing periods, mode of delivery and requirements are located. Also final marks of completed courses appear there. Weboodi is a “mother of all study-related systems” at our university.

In addition, *students have to register for courses before course starts, and also for exams with WEBOODI.* When you register to a course, or an exam with the aid of Weboodi, those registrations appear automatically in your personal LUKKARI course calendar. *When registering to an exam using WEBOODI you always has to ask exam questions in English. Failing to register means that you cannot participate the exam!* Your personal student tutor will advise you at the beginning of your studies how to use those five study environments. Don't worry, you will learn them easily.

#### 4. Curriculum Schedule for WCE Students Starting in September 2016 (Student Group 2016-2018)

Basic Module (all courses obligatory)	Course code	ECTS	Suggested study year	Precise course timing (A=autumn, S=spring)	Lecturer
Introduction to Optimization	<a href="#">031025A</a>	5	1	A2016 (period 1)	Prof. Keijo Ruotsalainen
Broadband Communications Systems	<a href="#">521316S</a>	5	1	A2016 (period 1)	Prof. Matti Latva-aho
Elements of Information Theory and Coding	<a href="#">521321S</a>	5	1	A2016 (period 2)	Prof. Markku Juntti (IT part) & University Teacher Timo Kokkonen (Coding part)
Mobile Telecommunication Systems	<a href="#">521385S</a>	5	2	A2017 (period 2)	Prof. Marcos Katz
Wireless Communications I	<a href="#">521323S</a>	5	1	A2016 (period 2)	Prof. Jari Iinatti
Communication Networks I	<a href="#">521340S</a>	5	1	A2016 (period 2)	Prof. Savo Glisic
Communication Signal Processing I	<a href="#">521324S</a>	5	1	S2017 (period 3)	Prof. Markku Juntti
Radio Engineering I	<a href="#">521326S</a>	5	1	A2016 (period 1)	University teacher Risto Vuohoniemi
total		40			

Advanced Module (all courses obligatory)	Course code	ECTS	Suggested study year	Precise course timing (A=autumn, S=spring)	Lecturer
Communication Networks II <sup>@</sup>	<a href="#">521377S</a>	7	1	S2017 (periods 3-4)	Prof. Savo Glisic
Radio Engineering II <sup>@</sup>	<a href="#">521327S</a>	6	1	S2017 (period 3)	University Teacher Risto Vuohoniemi
Wireless Communications II <sup>@</sup>	<a href="#">521317S</a>	8	1	S2017 (periods 3-4)	Dr. Antti Tölli
Communication Signal Processing II <sup>@</sup>	<a href="#">521325S</a>	5	2	A2017 (period 1)	Prof. Markku Juntti
Antennas <sup>*□</sup>	<a href="#">521388S</a>	5	2	S2018 (period 4)	Dr. Markus Berg
Radio Channels <sup>#□</sup>	<a href="#">521386S</a>	5	1	S2017 (period 4)	Dr. Markus Berg
total		16-21			

<sup>@</sup> = Choose at least two courses from this set of four courses. Rest of these four advanced courses can be allocated into optional module.

<sup>□</sup> = Student has to choose one from this set of two courses (one course of these is obligatory, and the other one has to be allocated into the optional module). Antenna course is lectured on spring terms of years 2018 and 2020. Radio Channels course is lectured on spring terms of years 2017 and 2019.

<sup>\*</sup> = A bi-annual course lectured only on even years 2018, 2020, 2022, ...

<sup>#</sup> = A bi-annual course lectured only on odd years 2017, 2019, 2021, ...

With the elective courses of an optional module a student can extend his/her knowledge from wireless communications, e.g., into the areas of practical electronics design, wireless measurement techniques and computer science & engineering. Notice that on the next page's table there some recommendations depending on your interests. You are anyway free to choose the elective courses you like. You have to choose at least 16-29 ECTS of elective courses depending on how many credits are chosen into your advanced module. You can also do more courses than the minimum ECTS requirement if you wish. *It is also possible to include at most 5 ECTS of Finnish language studies into your optional module.* Finnish language studies are recommended for all WCE students, especially during first study year, in order to integrate with Finnish society. Basic Finnish vocabulary is useful in daily life, although most Finnish people speak satisfying English outside our university campus.

Optional Module (elective studies)	Course code	ECTS	Suggested study year	Suggested course timing	Lecturer
Survival Finnish Course	<a href="#">900017Y</a>	2	1	annually, announced at the beginning of semester #	UO language center/open university
Beginner's Finnish I Course	<a href="#">900013Y</a>	3	1	annually, announced at the beginning of semester #	UO language center/open university
Beginner's Finnish II Course	<a href="#">900053Y</a>	5	1,2	annually, announced at the beginning of semester #	UO language center/open university
Modern Topics in Telecommunications and Radio Engineering	<a href="#">521318S</a>	3-7	2	annually (periods 1-4) *♥	Prof. Matti Latva-aho is a responsible course professor
RF Components and Measurements	<a href="#">521225S</a>	5	2	S2018 (period 4) ♥♠	Dr. Jari Hannu
Electronics Design II	<a href="#">521443S</a>	5	2	A2018 (period 1) ♠	Prof. Juha Häkkinen
Electronics Design III	<a href="#">521435S</a>	6	2	A2018 (period 2) ♠	Dr. Tarmo Ruotsalainen
Special Course in Electronic Design	<a href="#">521410S</a>	4-7	2	A2018 (periods 1-2) ♠	Prof. Timo Rahkonen
Computer Aided Circuit Design	<a href="#">521305S</a>	5	2	S2018 (period 4) ♠	Dr. Janne Aikio, Prof. Timo Rahkonen
Laboratory Exercises on Analogue Electronics	<a href="#">521307A</a>	5	2	A2017 (periods 1-2) ♠	University Lecturer Kari Määttä
Wireless Measurements	<a href="#">521097S</a>	5	2	S2018 (period 3) ♥	Dr. Esko Alasaarela, Dr. Juha Saarela
Research Method	<a href="#">813621S</a>			A2016-S2017 (periods 2-3) ♣	Dr. Arto Lanamäki
Biosignal processing	<a href="#">521273S</a>	5	2	S2017 (period 2) ♣	Prof. Tapio Seppänen
Digital Video Processing	<a href="#">521259S</a>	5	2	A2017 (period 2) ♣	Dr. Esa Rahtu
Human Computer Interaction	<a href="#">521145A</a>	5	2	A2017 (period 2) ♣	Prof. Vasillis Kostakos
Signal Processing Systems	<a href="#">521279S</a>	5	2	A2017 (period 1) ♣	Prof. Olli Silven
Ubiquitous Computing Fundamentals	<a href="#">521148S</a>	5	2	A2017 (periods 1-2) ♣	Dr. Hannu Kukka
Application Specific Signal Processors	<a href="#">521281S</a>	5	2	A2017 (period 1) ♣	University Researcher Jani Boutellier
Computer Graphics	<a href="#">521493S</a>	7	2	S2018 (period 4) ♣	Dr. Guoying Zhao, Dr. Jie Chen, Dr. Jukka Holappa
Distributed Systems	<a href="#">521290S</a>	5	2	S2018 (period 3) ♣	Prof. Timo Ojala
Machine Vision	<a href="#">521466S</a>	5	2	S2018 (period 3) ♣	Dr. Esa Rahtu
Mobile and Social Computing	<a href="#">521147S</a>	5	2	S2018 (periods 3-4) ♣	Prof. Vasillis Kostakos, Dr. Denzil Ferreira
Programmable Web Project	<a href="#">521260S</a>	5	2	S2018 (periods 3-4) ♣	Dr. Mika Rautiainen
Software Project	<a href="#">521479S</a>	7	2	A2017 (periods 1-2) ♣	Prof. Juha Röning
total		≥ 16-29			

# = See details of timing either from WEBOODI (<https://weboodi oulu.fi/oodi/>), or from NOPPA (<https://noppa oulu.fi/noppa/app>), or from UO language centre's web page: <http://www oulu.fi/languagesandcommunication/>

\* = Exact topics will be announced along each semester. Typically there will be several topics for each study year. *Notice also, you can choose several course topics of 3-7 ECTS credits under this "umbrella course" 521318S, not just one.*

♥ = This course is recommended for all WCE students.

♠ = If you are interested in radio frequency electronics design, a proper collection from these courses course is recommended.

♣ = If you are interested in computer engineering issues to widen your expertise, a proper collection from these courses is recommended.

<b>Other obligatory studies included in WCE Master's degree</b>	<b>Course code</b>	<b>ECTS</b>	<b>Suggested study year</b>	<b>Precise timing</b>
Advanced practical training (includes also a written training report )	<a href="#">521016A</a>	3	after first study year, suggested between June and August of summer 2016	2 months of full workload equals 3 ECTS credits
M.Sc. (Diploma) thesis work	<a href="#">521998S</a>	30	2	A2017–S2018
Written English language proficiency test		0	2	after written master's thesis is accepted and ready to be loaded to LATURI and URGUND check.
total		33		

Course descriptions, learning outcomes and detailed content of all courses can be found in electronic form by from the WEBOODI portal:

<https://weboodi oulu.fi/oodi/>

Course home pages, as well as up-to-date timing info and calendar changes dealing with courses (cancelled/moved lectures, room changes) can be found from the NOPPA portal:

<https://noppa oulu.fi/noppa/app>

All WCE curriculum documents can be founded from here:

<http://www oulu.fi/dce/node/11451>