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

Curriculum for Student Group 2015-2017

1. Structure of WCE Studies

M.Sc. degree of 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 (16-21 ECTS)
Optional WCE studies module ($\geq$ 26-31 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 26-31 ECTS of elective studies must be chosen. The total number of elective credits depends on the number of advanced courses included into advanced module. This elective studies issue thus influences on the required number of advanced studies also. That's why the minimum and maximum number of credit points varies a lot within the limits shown above.

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

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Mandatory WCE courses in basic and advanced modules are offered by the Department of Communications Engineering (DCE). Most of the elective courses are offered by the Departments of Electrical Engineering (EE), and Computer Science and Engineering (CSE) at the Faculty of Information Technology and Electrical Engineering, as well as by the UO language centre.

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 departments & faculties into your personal study plan, or before starting to listen the course. Courses from DCE, EE and CSE departments can be included directly into your PSP without consulting your study advisor (see the list for such elective studies in Chapter 4 of this document).*

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 (3-4 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 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 info session for creation of a PSP will be arranged at the beginning of autumn term. PSP is prepared with the aid of OodiPSP 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 8 weeks. Thus, each study year consists of 32 weeks of teaching. Between 2nd and 3rd periods there is a season break for the Christmas & New Year between 19.12.2015-10.1.2016 (weeks 52-1). No teaching and exams are arranged during that holiday season.

The exact dates for the periods of the study year 2015-2016 are the following: 1st: 31.8.-23.10.2015 (weeks 36-43) , 2nd: 26.10.-18.12.2015 (weeks 44-51), 3rd: 11.1.-11.3.2016 (weeks 2-10), 4th: 14.3.-13.5.2016 (weeks 11-19. Summer brake is between 14.5.-4.9.2016. Summer exams are typically arranged in summer time. Mandatory advanced practical training is recommended to be done during summer brake (3 ECTS equals 2 month full-time workload).

University of Oulu orientation programme for all international master's degree students is arranged at the beginning of September, 2015 (week 36). *It is recommend that WCE students could arrive at 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 on week 37 starts the WCE studies of 1st period for the study year 2015-2016.

At the beginning of studies during the orientation week a WCE student will get his/her personal UO e-mail account, and a license to use UO computer networks, i.e. UID & PW are given. 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 at UO server machines.

3. Electronic Study Environments at UO

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 environments explained briefly below.

In addition you will get your personal userID & password for DCE department's computer network (electrical engineering, shortly 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) will offer our students a free Outlook email, but also free cloud services like Office Web Apps applications (Word, Excel, PowerPoint, OneNote, Lync), calendar and SkyDrive Pro.

All official correspondence from UO teachers and student service officers is communicated with you 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 O365 access 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 environment 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 home pages of courses, 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, etc.). DCE courses in NOPPA:
https://noppa.oulu.fi/noppa/app?component=%24Border.%24DirectLink_0&page=CourseList&service=direct&session=T

LUKKARI (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 study terms. 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 marks of done exams 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 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 four computer-based study environments. Don't worry, you will learn them easily.

4. Curriculum Schedule for WCE Students Starting in September 2015 (Student Group 2015-2017)

Basic Module (all courses obligatory)	Course code	ECTS	Suggested study year	Precise course timing (A=autumn, S=spring)	Lecturer
Introduction to Optimization	031025A	5	1	A2015 (period 1)	Prof. Keijo Ruotsalainen
Broadband Communications Systems	521316S	5	1	A2015 (period 1)	
Elements of Information Theory and Coding	521321S	5	1	A2015 (period 2)	Prof. Markku Juntti (IT) & University Teacher Timo Kokkonen (Coding)
Mobile Telecommunication Systems	521385S	5	2	A2016 (period 2)	Prof. Marcos Katz
Wireless Communications I	521323S	5	1	A2015 (period 2)	Prof. Jari Iinatti
Communication Networks I	521340S	5	1	A2015 (period 2)	Prof. Savo Glisic
Communication Signal Processing I	521324S	5	1	S2016 (period 3)	Prof. Markku Juntti
Radio Engineering I	521326S	5	1	A2015 (period 1)	University teacher Risto Vuohtoniemi
total		35			

Advanced Module (all courses obligatory)	Course code	ECTS	Suggested study year	Precise course timing (A=autumn, S=spring)	Lecturer
Communication Networks II [@]	521377S	7	1	S2016 (periods 3-4)	Prof. Savo Glisic
Radio Engineering II [@]	521375S	5	1	S2016 (period 3)	University Teacher Risto Vuohtoniemi
Wireless Communications II [@]	521317S	8	1	S2016 (periods 3-4)	Mr. Jarkko Kaleva
Communication Signal Processing II [@]	521325S	5	2	A2016 (period 3)	Prof. Markku Juntti
Antennas *¤	521388S	5	1	S2016 (period 4)	Dr. Markus Berg
Radio Channels #¤	521386S	5	2	S2017 (period 4)	Dr. Markus Berg
total		16-21			

[@] = Choose at least two courses from this set of four courses. Rest of these four advanced courses can be allocated into optional module.

* = A bi-annual course lectured only on even years 2016, 2018, 2020,…

\# = A bi-annual course lectured only on odd years 2015, 2017, 2019, …

¤ = Student has to choose one from this set of two courses (one course of these is obligatory, and the other one can be allocated into the optional module). Antenna course is lectured on spring terms of years 2016 and 2018. Radio Channels course is lectured on spring terms of years 2017 and 2019.

With the elective courses of an optional module a student can extent his/her knowledge from wireless communications, e.g., into the areas of practical electronics design and computer science & engineering. Notice there are below some recommendations depending on your interests. You are anyway free to choose the elective courses you like. You have to choose at least 26-31 ECTS of elective courses depending on how many credits are contained in 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, especially during first study year, in order to

integrate to 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
Modern Topics in Telecommunications and Radio Engineering	521318S	3-7	2	annually *♥ (periods 1-4)	Lecturers announced yearly, Prof. Matti Latva-aho is a course coordinator
RF Components and Measurements	521225S	5	2	S2017 ♥ ♠ (period 4)	Dr. Jari Hannu and Dr. Matti Kinnunen
Electronics Design II	521443S	5	2	A2016 ♠ (period 1)	Prof. Juha Häkkinen
Electronics Design III	521435S	6	2	A2016 ♠ (period 2)	Dr. Tarmo Ruotsalainen
Special Course in Electronic Design	521410S	4-7	2	A2016 ♠ (periods 1-2)	Prof. Timo Rahkonen
Computer Aided Circuit Design	521332S	5	2	S2017 ♠ (period 3)	Dr. Janne Aikio
Laboratory Exercises on Analogue Electronics	521433A	5	2	A2016 ♠ (periods 1-2)	University Lecturer Kari Määttä
Wireless Measurements	521097S	5	2	S2017 ♥ (period 3)	Dr. Esko Alasaarela
Research Method	813621S			A2016-S2017♣ (periods 2-3)	Dr. Arto Lanamäki
Biosignal processing	521273S	5	2	S2017 ♣ (periods 3-4)	Prof. Tapio Seppänen
Digital Video Processing	521259S	5	2	A2016 ♣ (periods 1-2)	Prof. Janne Heikkilä
Human Computer Interaction	521145A	5	2	A2016 ♣ (periods 1-2)	Prof. Vasillis Kostakos
Signal Processing Systems	521279S	5	2	A2016 ♣ (periods 1-2)	Prof. Jari Hannuksela
Ubiquitous Computing Fundamentals	521148S	5	2	A2016 ♣ (periods 1-2)	Prof. Timo Ojala
Application Specific Signal Processors	521281S	5	2	S2017 ♣ (periods 3-4)	University Researcher Jani Boutellier
Computer Graphics	521493S	7	2	S2017 ♣ (periods 3-4)	Dr. Guoying Zhao, Dr. Jie Chen, Jukka Holappa
Distributed Systems	521266S	5	2	S2017 ♣ (periods 3-4)	Prof. Timo Ojala
Machine Vision	521466S	5	2	S2017 ♣ (periods 3-4)	Janne Heikkilä
Mobile and Social Computing	521147S	5	2	S2017 ♣ (periods 3-4)	Prof. Vasillis Kostakos
Pattern Recognition and Neural Networks	521497S	5	2	S2017 ♣ (periods 3-4)	Prof. Tapio Seppänen
Programmable Web Project	521260S	5	2	S2017 ♣ (periods 3-4)	Prof. Jukka Riekki
Software Project	521479S	7	2	A2016 ♣ (periods 1-2)	Prof. Juha Röning
DSP Laboratory Work	521280S	5	2	S2017 ♣ (periods 3-4)	Miguel Bordallo López
Survival Finnish Course	900017Y	2	1	announced at the beginning of semester #	UO language center/open university
Beginner's Finnish I Course	900013Y	3	1	announced at the beginning of semester #	UO language center/open university
Beginner's Finnish II Course	900053Y	5	1,2	announced at the beginning of semester #	UO language center/open university
total		≥ 26-31			

* =   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.

=   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/

Other obligatory studies included in WCE Master's degree	Course code	ECTS	Suggested study year	Precise timing
Advanced practical training (includes also a written training report)	521016A	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	521998S	30	2	A2016–S2017
Written English language proficiency test		0	2	after written master's thesis is ready
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 can be found from the NOPPA portal: https://noppa.oulu.fi/noppa/app

Courses are also described in the pdf-version of official study guide of Faculty of Information Technology and Electrical Engineering, the book you will receive when you enrol to university: http://www.oulu.fi/ttk/node/298