EITM120I Communication Systems

Studiengang	Elektro- und Informationstechnik (Master)
Modulname	EITM120I Communication Systems
Zugeordnete Lehrveranstaltungen	EITM121I Architecture of Communication Systems EITM122I Signal Processing in Communication Systems
Studiensemester	1st semester
Modulverantwortliche r	Prof. Dr. Manfred Litzenburger
Dozenten	Prof. Dr. Manfred Litzenburger
Sprache	English or German; the course language will be announced at the beginning of the semester
Lehrform, SWS und Gruppengröße	Course, 2h + 2h/week
Modus	Mandatory in the study field Information technology, elective in the other study fields of the program
Turnus	Winter semester
Arbeitsaufwand	On-campus program 60 h, self study 60 h
Kreditpunkte	4 CP
Empfohlene Vorkenntnisse	Knowledge in Systems Theory, Digital Signal Processing, and Digital Communications
Voraussetzungen nach Prüfungsordnung	none
Lernziele / Kompetenzen	*Allgemein:* The module provides theoretical background and practical knowledge on advanced schemes for adaptive signal processing algorithms in digital transmission systems as well as architectural principles and functional building blocks of modern digital transmitters / receivers. *Zusammenhänge / Abgrenzung zu anderen Modulen:* Based on knowledge in digital modulation and digital signal processing techniques, this module introduces specific algorithms for signal processing in communication systems and basic architectures for communication devices. Complementary to the module “RF-Instrumentation” which focuses on analog RF-frontends, this module concentrates on the digital part of the communication system, including A/D- and D/A-converters as the interface

	between these two domains. Information theoretical aspects and error correction coding are covered by the module “Information Theory and Coding“. *Kenntnisse, Fertigkeiten, Kompetenzen:* After having successfully completed the course, the students • know principles and performance of advanced signal processing algorithms in modern digital communication systems like adaptive equalisation, optimum sequence detection, and multi-antenna processing • understand the mathematical principles and the importance of adaptive optimisation for efficient digital signal transmission • are able to apply these principles to adaptive systems like equalisers, smart antennas and adaptive MIMO-schemes • understand the architectural principles and components of modern digital communication systems • are able to design critical building blocks in the digital frontend of a communication device like filters, decimators / interpolators, and converters • can assess and quantify the computational complexity of these functional building blocks • know the motivation and the background of software-defined radios and the roads towards their realisation in actual communication systems
Inhalt	*Lecture Signal Processing in Communication Systems* • Adaptive filters und equalisation • Maximum-likelihood detection • Channel estimation / System identification • Multi - antenna algorithms (smart antennas, beamforming, MIMO-schemes) *Lecture Architectures of Communication Systems* • Transmitter- and receiver architectures, digital frontends • Digital down- and up- conversion • Multi-rate signal processing • Direct digital synthesis (DDS) • A/D- and D/A- converters in communication systems • Software Defined Radio
Studien- und Prüfungsleistungen	Assessment is done by either a written exam (120 minutes) or an oral examination (20 minutes). The form of examination will be announced at the beginning of the semester.
Medienformen	• course manuscript • slides (Powerpoint, PDF) • Matlab simulation programs • collection of problems with solutions

Literatur	F. Harris: *Multirate Signal Processing for Communication Systems*, Prentice-Hall, 2004 S. Haykin: *Adaptive Filter Theory*, Prentice Hall, 2001 J. Reed: *Software Radios. A modern approach to Radio Engineering*, Prentice Hall, 2002 J. Mitola: *Software Radio Architecture*, Wiley, 2001 A. Oppenheim, R. Schafer, J. Buck: *Discrete-Time Signal Processing*, Prentice-Hall, 1999 J. Proakis: *Digital Communications*, McGraw Hill, New York, 5. Ed., 2008 K. D. Kammeyer: *Nachrichtenübertragung*, Teubner, Stuttgart, 5. Aufl. 2011 Data Sheets and Application Notes of current integrated circuits for digital communication systems