平成24年度春学期

Spring Semester, 2012

電気通信大学・短期留学プログラム

UEC Exchange Program

Japanese University Studies

in Science and Technology

(JUSST)

Center for International Programs and Exchange (CIPE)

The University of Electro-Communications (UEC), Japan

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Communication Theory & Communication Theory Laboratory

（Monday #1 & Friday #5）

1. Communication Theory

Day of Class Monday #1
Credit 2
Lecturer Professor Noboru TOYAMA
E-mail toyama@fedu.uec.ac.jp
Textbook "Modern Digital and Analog Communication Systems, Third Edition, by B.P.Lathi (Oxford University Press, 1998).
Prerequisites Trigonometric identities, Integrals, Fourier series, some basic knowledge of probabilities and LCR circuits. Students are encouraged to take "Communication Systems" open at the fall semester.

Course Description

This course must be taken concurrently with the course "Communication Theory Laboratory." First two classes will review theory of probability and basic knowledge of mathematics that are necessary to understand the subjects in the course. They will include all the items listed in the Pre-requirement. Students who are not very familiar with the knowledge in those basics are strongly encouraged to concentrate their efforts on acquiring the knowledge during the first two classes. This course together with "Communications Theory Laboratory" discusses in depth how digital and analog communication systems work in the presence of noise. Topics covered in the course are behavior of FM systems in noisy channels, probability density functions, random variables, the Gaussian PDF, the Rayleigh PDF, the Rice PDF, Wiener-Hopf optimum filter, ASK, FSK, PSK, and QAM. Shannon's information theory and spread spectrum systems are also included. This course will cover from chapter10 up to Chapter 15 in the textbook. Chapter 16 (Error correcting codes) will not be included.

(Outlines of the class and contents)

Topics covered in this course are,
(1) Random Processes,
(2) Behavior of Analog Systems in the Presence of Noise,
(3) Behavior of Digital Communication Systems in the Presence of noise,
(4) Optimum signal detection,
(5) Relationship between bit error rate and Eb/No,
(6) Shannon's equation.

Assessment policy:

The same scores will be given in the course "Communications Theory Laboratory."

2. Information and Communication Networks

Day of Class Monday #2
Credit 2
Lecturer Eiji OKI
E-mail oki@ice.uec.ac.jp

Objectives:

The course Objectives are to understand the fundamental structures and functions of modern networks. The course is also aiming that students get ability to read the reference books and papers, and to obtain the new knowledge regarding future network technologies.

Outline of Class and Contents:

The following subjects are lectured in English. The subjects include mainly three parts, which are Internet Protocol (IP)-based networks, performance analysis and network design, network optimization.

Part I: IP-based networks

- Network basis (1)
- TCP/IP overview (2)
- IP protocol basics (3)
- Tools for IP network monitoring (4)
- Routing protocols: IGP (5)
- Routing protocol: EGP (6)
- IP routers and switches (7)
- TCP/IP Socket programming I (8)
- TCP/IP Socket programming II (9)
- Multi-Protocol Label Switching (10)

The following book is used as a texbook for Part I.
E. Oki, R. Rojas-Cessa, M. Tatipamula, and C. Vogt, Advanced Internet Protocols, Services, and Applications, Wiley, New York, 2012.

Part II: Network design and performance analysis:

- Network optimization (11)
- Analysis for Network Performance (12)
- Network coding (13)

Part III: Advanced research topics

- Research topic I (14)
- Research topic II (15)

Assessment Policy:

Methods:

Homework (70%) : several reports are required to submit

On-site quiz (30%) : several quizzes are required to submit in the class.

Criteria:

Fundamental knowledge (50%)

Understanding of advanced concepts (50%)

3. Antenna Engineering

Day of Class Monday #2
Credit 2
Lecturer Professor Noboru TOYAMA
E-mail toyama@fedu.uec.ac.jp
Textbook
Time-Harmonic Electromagnetic Fields" written by R.F. Harrington (McGRAW-HILL)
Prerequisites Electromagnetic Theory

Course Description

Objectives:

A device whose primary purpose is to radiate or receive radio waves is called antenna. Wherever we are, We can see one or two antennas around us that are sending you signals or waiting for you to send signals. The purpose of this course is to enable students to understand the basic concepts of various antennas.

Outline of Class and Contents:

1. Brief explanatins of various antennas
2. Transmission-line concepts
3. Waveguide concepts
4. Resonator concepts
5. Radiation
6. Antenna pattern calculation
7. Practical examples of recently developed antennas
8. Some experiments on the selected items from the above will also be given.

Assessment Policy:

Report, final examination and attendance rate.

4. Advanced Quantum Mechanics

Day of Class Monday #2
Credit 2
Lecturer Professor shinichi WATANABE
E-mail shin@pc.uec.ac.jp
Textbook none
Prerequisites Elementary quantum mechanics at an undergraduate level

Course Description

Objectives:

Theme: To understand the basic principles of quantum mechanics that apply to various quantum phenomena serving as foundations of Modern Science and Technology.
Goals: To understand how to treat the evolution of a quantum system under a weak perturbation. To understand the meaning of transition probability. To understand the quantization of the Electro-Magnetic fields and of the matter wave. To understand how light interacts with matter.

Contents (tentative):

(1) Time-independent perturbation theory (review)
(2) Time-dependent perturbation theory
(3) The golden rule and transition probability
(4) Scattering states and box quantization
(5) Quantization of Electric and Magnetic fields
(6) Quantization of the Matter Wave
(7) Photo absorption and emission by an atom

(NB: The contents may change without notice.)

Assessment Policy

(a) The grade will be based on quizzes and the term paper.
(b) It is required that the student understands the class room materials to such an extent that they can explain the basic concepts by heart.

Keywords: Quantum mechanics, perturbation theory, density of states, the golden rule, number representation, creation and annihilation operators, scattering states, S-matrix, photo absorption and emission, etc.

5. Visual Media Design

Day of Class Monday #3
Credit 2
Lecturer Professor Masakatsu KANEKO
E-mail kaneko@hc.uec.ac.jp
Prerequisites Elementary knowledge and skills of video making and web programming

Course Description

The purpose of the lectures is to understand how and of what elements visual media contents are constructed. As representative examples of visual media, we consider movie (video) and manga (comic). Movie is composed not only of what you see (picturesque images), but also of what limits those images (frames) and what "is" between the images (montage). The montage, one of the key concepts of visual media, is "temporal" for movie, and "spacial" for manga. At the first half of lectures, we give theoretical explanations, and at the second half, we lean in practice by making a "movie-comic" content. (references: http://oz.hc.uec.ac.jp/lectures/kyozai/index.html username and password required)

Outline of Class and Contents:

1. Introduction
2. Historical Overview of visual media
3. Elements of visual media: frame and montage
4. Frame 1: size, angle
5. Frame 2: composition
6. Temporal montage: video
7. Spatial montage: manga
8. (Extra)
9. Content making practice 1: Guidance
10. Content making practice 2: Planning
11. Content making practice 3: Shooting and editing
12. Content making practice 4: Editing and programming
13. Content making practice 5: Editing and programming
14. Review and discussion
15. Conclusion

Assessment policy:

The second half of lectures is a kind of workshop. Assessment in this class will take account of (1) achievement of the workshop 60% and (2) attendance 40%.

6. Introduction to Micro Mechatronics

Day of Class Monday #4
Credit 2
Lecturer Professor Hisayuki Aoyama
E-mail aoyama@mce.uec.ac.jp
Textbook Mechatronics, 3rd Edition. Electronics and Control System in Mechanical and Electrical Engineering, W.Bolton
Prerequisites Mechanical and Electrical Engineering, Control Engineering

Course Description

Objective:

The integration of electronic engineering, electrical engineering, computer technology and control engineering with mechanical engineering is increasingly forming a crucial part in the design, manufacture and maintenance of a wide range of engineering products and processes. A consequence of this is the need for engineers and technicians to adopt an interdisciplinary and integrated approach to engineering. The term mechatronics is used to describe this integrated approach. A consequence of this approach is that engineers and technicians need skills and knowledge that are not confined to a single subject area. They need to be capable of operating and communicating across a range of engineering disciplines and linking with those having more specialised skills. In this class, an attempt to provide a basic background to mechatronics and provide links through to more specialised skills is given.

Outline of Class and Contents:

[1]: Mechatronics

Appreciate what mechatronics is about.
Comprehend the various forms and elements of control systems: open-loop, closed-loop and sequential.
Recognize the need for models of systems in order to predict their behavior.

[2]: Sensors and transducers

Describe the performance of commonly used sensors.
Evaluate sensors used in the measurement of: displacement, position and proximity; velocity and motion; force; fluid pressure; liquid flow; liquid level; temperature; light.
Explain the problem of bouncing when mechanical switches are used for inputting data.

[3]: Signal conditioning

Explain the requirements for signal conditioning.
Explain how operational amplifiers can be used, the requirements for protection and filtering, the

principle of the Wheatstone bridge and, in particular, how it is used with strain gauges, the principles and main methods of analogue- to-digital and digital-to-analogue converters, multiplexers and data acquisition using DAQ boards.
Explain the principle of digital signal processing.
Explain the principle of pulse-modulation.

[4]: Data presentation systems

Explain the problem of loading.
Describe the basic principles of use of commonly used data presentation elements: meters, analogue chart recorders, oscilloscopes, visual display units, printers.
Explain the principles of magnetic recording on floppy and hard discs.
Explain the principles of displays and, in particular, the use of LED seven-segment and dot matrix displays and the use of driver circuits.
Explain how data presentation can occur with the use of DAQ boards. Design measurement systems.

[5]: Pneumatic and hydraulic actuation systems

Interpret system drawings, and design simple systems, for sequential control systems involving valves and cylinders. Explain the principle of process control valves, their characteristics and sizing.

[6]: Mechanical actuation systems

Evaluate mechanical systems involving linkages, cams, gears, ratchet and pawl, belt and chain drives, and bearings.

[7]: Electrical actuation systems

Evaluate the operational characteristics of electrical actuation systems: relays, solid-state switches (thyristors, bipolar transistors and MOSFETs, solenoid actuated systems, d.c. motors, a.c. motors and steppers).

[8]: Basic system models

Devise models from basic building blocks for mechanical, electrical, fluid and thermal systems.

[9]: System models

Devise models for rotational-translational, electro-mechanical and hydraulic-mechanical systems.

[10]: Dynamic responses of systems

Model dynamic systems by means of differential equations.Determine the response of first- and second-order systems to

[11]: System transfer functions

Define the transfer function and determine the responses of systems to simple inputs by its means, using Laplace transforms. Identify the effect of pole location on transient response. Use MATLAB and SIMULINK to model systems.

[12]: Frequency response

Analyze the frequency response of systems subject to sinusoidal inputs.Plot and interpret Bode plots, using such plots for system identification.

[13]: Closed-loop controllers

Predict the behavior of systems with proportional, integral, derivative, proportional plus integral, proportional plus derivative and PID control.

[14]: Mechatronics systems

Compare and contrast possible solutions to design problems when considered from the traditional and the mechatronic points of view, recognizing the widespread use of embedded systems. Analyse case studies of mechatronics solutions.

Design mechatronics solutions to problems.

Assessment Policy:

There will be some report requirements on the topics mentioned above during the semester. And the practical mechatronics development will be given to improve the mechatronics sense.

Assessment in this class will take account of (1)these reports, (2)attendance-rate and (3)the prototype development with the score proportion of 30%, 30% and 40%, respectively. elementary Japanese IIA is designed for students who completed Elementary Japanese IA or who have equivalent standards with over 150 Kanji vocabulary.

7. Optical Communication Engineering

Day of Class Monday #5

Credit 2

Lecturer Professor KISHI, Naoto

E-mail kishi@ice.uec.ac.jp

Textbook on-line materials available at http://pcwave3.ice.uec.ac.jp/kishi/optc (internal only)

Prerequisites Knowledge of basic engineering/ scientific concepts

Course Description

Objective:

Optical communication is one of the key technologies for the contemporary information society. It is hence important to understand the basic engineering concepts of optical communication. This course covers several topics in such optical communication technologies.

Outline of Class and Contents:

The following subjects are treated.

1. Tutorial introduction to optical fibre communication
2. Properties of lightwave for communication
3. Optical fibre transmission lines
4. Lightsources
5. Optical amplifiers
6. Various optical devices
7. Digital codings for optical communications
8. Optical communication systems
9. Optical fibre sensing systems

Assessment Policy:

Submission of a report will be required at the end of the term. Its subject may be fixed according to one's interested topics in the course. Assessment of this course will be made over the report and discussion in the class at the score proportion of 80% and 20%, respectively.

8. Modern Optics and Photonics

Day of Class Tuesday #1

Credit 2

Lecturer Prof. Yasuo TOMITA

E-mail ytomita@ee.uec.ac.jp

Textbook Instructor's notes will be provided. Material will also be taken from the following optional textbooks:

1. Yariv, Optical Electronics in Modern Communications, Oxford Univ. Press, Oxford, 1997.
2. S.G. Lipson et al., Optical Physics, 3rd ed., Cambridge Univ. Press, Cambridge, 1995.
3. B.E.A. Saleh and M.C. Teich, Fundamentals of Photonics, Wiley, New York, 1991.

Prerequisites

A good understanding of introductory electromagnetics and linear systems theory may be helpful.

Objectives

This is an introductory-level course in the ever-increasing field of modern optics. It includes ray- and wave-descriptions of light propagation and image formation with coherent light. An introduction to holography and optical information processing is also given as an example of parallel and multi-dimensional data handling capabilities of light. Furthermore, it contains discussions of photonic devices (such as lasers, amplifiers, light modulators and detectors) and fiber-optic communications systems.

Outline of Class and Contents

Topics in 90-minute lectures will include:

1. Geometrical (ray) optics
2. Wave optics
3. Fourier optics
4. Electromagnetic and crystal optics
5. Guided-wave and fiber optics
6. Introduction to fiber-optic communications

9. VLSI Low Power Circuit Design

Day of Class: Tuesday #5

Credit: 2

Lecturer: Professor Koichiro ISHIBASHI

E-mail: ishibashi@ee.uec.ac.jp

Textbook: non

Prerequisites:

Course Description

Recent ICT society today is based on advancement of VLSI density, performance, and its nature of low power. The purpose of this lecture is to understand not only fundamentals of VLSI device, circuits, but low power circuit technologies which have played important rolls on the ICT prosperity today.

Outline of Class and Contents

1) Introduction
2) Structure of MOSFET and its characteristics
3) Moore's law and Scaling law
4) Fundamentals of CMOS LSI circuits
5) Power on CMOS LSI
6) Low power digital circuit design techniques
7) Low power CPU design techniques

10. Mathematics for Information

Day of class: Wednesday #1

Credit: 2

Lecurer: Professor Kazuo Ohta, Assistant Professor Mitsugu Iwamoto,

Email: math_info@oslab.inf.uec.ac.jp

Textbook: Winning Ways vol.1, by E.Berlekamp, J.H.Conway, R.K.Guy, ISBN: 978-1568811307

Objectives:

This course aims to learn how to use of descrete mathematics by discussing the theory of impertial games. The elementary knowledge of discrete mathematics such as logic, sets, map, and relations, etc., are required.

Outline of Class and Contents:

The lecture consists of two parts: the first part is the lectures on Sprague-Grundy Theorem, and the latter part concsists of reports by students on several impertial games.

I. Sprague-Grundy Theorem (7 lectures):

(1) Combinatorial game and Nim
(2) Algebra in games
  2.1: Adding two games
  2.2: Partition of two games
  2.3: Algebraic properties of games
(3) Characterizing the winning positions
  3.1: Observations on Nimbers
  3.2: Sprague-Grundy theorm: formal proof
(4) Winning ways

II. Discussion on several impertial games:

Topics will be selected from the textbook and they will depend on situations.

Assessment policy:

Reports (resume and talk) in part II, and contribution (discussion) throughout the class

11. Advanced Theory of Systems Reliability

Day of Class Thursday #2

Credit 2

Lecturer Professor Kazuyuki SUZUKI

E-mail suzuki@se.uec.ac.jp

Textbook nothing (handout prints)

Prerequisites Calculus

Course Description

Objectives:

This lecture deals with Reliability Engineering and its theory which focus on the philosophy, ideas and scientific methods to build in quality and reliability into systems. Here, up-stream management plays an important role. Also, recent development of information technology has been changing the way of Reliability Engineering.
These new aspects are also dealt with.

Outline of Contents

1. Information Technology and Reliability
2. TQM(Total Quality Management) and Reliability
3. Reliability Assurance using FMEA and FTA
4. Reliability Failure Model and its Theory
5. Reliability Design
6. Reliability Testing and Data Analysis
7. Design of Experiments in reliability
8. Maintainability and Condition Monitoring Maintenance

Assessment policy:

Assessment will be based on the level of understanding

12. Introduction to Computational Methods in Science and Engineering using MATLAB

Day of Class Thursday #2
Credit 2
Lecturer Associate Professor Hans-Georg Matuttis
E-mail hg@mce.uec.ac.jp
Textbook
Hand-outs will be prepared in the class
Further Reading:

- Steve Macconnell, Code Complete, Microsoft Press, 1993,ISBN 1-55615-484-4
- C.W. Ueberhuber: Numerical Computation 1 Springer, 1997, ISBN 3-540-62058-3
- C.W. Ueberhuber: Numerical Computation 2 Springer, 1997 ,ISBN 3-540-59152-4
- Hairer, Norsett and Wanner: Solving Ordinary Differential Equations I, 2nd edition. Springer, 1993, ISBN 3-540-56670-8
- E. Hairer and G. Wanner, Solving Ordinary Differential Equations II 2nd edition, Springer 1996,ISBN 3-540-60452-9

Prerequisites
Knowledge of 1 procedural Computer language (Fortan, C, Pascal ....)

Course Description

Objectives:
Computational methods have replaced analytical methods already in many fields of science and engineering, and their importance is still increasing. The aim of the lecture is to provide fundamental criteria for the choice of numerical methods, give an overview about some available methods in some fields, and give ideas about performance-oriented implementation for such methods. Depending on the background and interest of the auditory, some subjects can be changed.

Outline of Class and Contents:

1. Simple MATLAB-Synthax
2. How to write better programs
3. Non-numerical methods: Monte-Carlo techniques
4. Representation of Numbers

5. Elementary numerical analysis: What are numerical errors, and how to get "correct" results from calculations "with error"
6. Graphics
7. Introduction to numerical Linear algebra and how to draw a line through more than 2 points (or maybe not)
8. Polynomials and Roots
9. Solving ordinary differential equations
10. Performance analysis: Which algorithm take long, which are fast, and when does it matter
11. Programming Paradigms: From spaghetti-code to object-orientation, and what does one really need in science and engineering

Assessment policy:

Presence in the lecture, weekly homework during the term and one mid-term exam and one at the end of the term.

Comment:

Participants should apply for an account at the Computer Center 1 Week before the start of the lecture, if possible !!!

13. Visual Communications

Day of Class Thursday #5
Credit 2
Lecturer Professor Masahide KANEKO
E-mail kaneko@ee.uec.ac.jp
Textbook Handouts will be prepared in the class
Prerequisites NIL
Course Description

Objectives:

As represented by the famous proverb "Seeing is believing", visual information plays a very important role in our daily lives. In this class, the fundamentals of visual communication, especially image coding techniques, are lectured from the viewpoint of efficient transmission of image information and better communication through visual media. International activities to establish the common standards of image coding are also introduced.

Outline of Class and Contents

1. Visual media
    - Definition of "visual media"
    - Classification of "visual media"
    - Use of visual information in the fields of information and communication
2. Fundamentals to handle digital images
    - Definition of "digital image / digital picture"
    - Digitization : sampling + quantization
    - Amount of information contained in digital images
    - Characteristics of human vision
3. Visual communication and Image / Video Coding
    - Role of visual communication and image / video coding
    - Redundancies contained in images
    - Basic methods of image data compression
    - predictive coding, transform coding, interframe coding, motion compensation, coding of facsimile (MH, MR,MMR)
4. International standards of image / video coding
    - JPEG, JPEG2000, JPEG XR, Motion-JPEG2000, JBIG,
    - H.261, H.263, H-264 (MPEG-4 / AVC)
    - MPEG-1, MPEG-2, MPEG-4, MPEG-7, MPEG-21

- JPEG ==> Digital camera, Pictures used in Web site
  MPEG-2 ==> Digital broadcasting (satellite, terrestrial), DVD
  MPEG-4 ==> Digital movie camera, Video by mobile phone (One segment broadcasting), and so on

5. Video over Internet and over mobile network
   - Internet as transmission media of video
   - Streaming
   - Mobile network as transmission media of video
   - Error resilience coding

Samples of coded and decoded images will be demonstrated by OHP and video tapes.

Assessment policy:

There will be some report requirements on the topics mentioned above during the semester. One examination will be carried out at the end of semester.
Assessment in this class will take account of these reports, examination, attendance-rate and contribution for class discussions at the score proportion of 30%, 30%, 20%, and 20% respectively.

14. Digital Engineering in Broadcasting

Day of Class Friday #4
Credit 2
Lecturer Professor Noboru TOYAMA
E-mail toyama@fedu.uec.ac.jp
Textbook "Digital Television" written by H Beoit (Arnold)
Prerequisites Some knowledge of Fourier Analysis and Probability

Course Description

Objectives:
Digital terrestrial broadcasting is a very hot topic in Japan.
Students will see some of the digital broadcasting related items almost every day in the newspaper. Digital broadcasting uses the most sophisticated digital technique. The purpose of the course is to give students, as simply and as completely as possible, the various aspects of the very complex problems to be solved in realizing digital broadcasting.

(Outlines of the class and its contents)
1. A review of current analogue TV,
2. Digitization of video signals,
3. Compression of video signals using Fourier cosine transform,
4. Compression of video signals using motion compensation technique,
5. Error correction using Reed-Solomon coding,
6. Error correction using Viterbi decoding algorithm,
7. Trellis coded 8 PSK modulation,
8. Orthogonal frequency division multiplex.
9. Some experiments on the selected items from the above will also be given.

Assessment policy:
Report, final examination and attendance rate.

15. Communication Theory Laboratory

Day of Class Friday #5
Credit 1
Lecturer Professor Noboru TOYAMA
E-mail toyama@fedu.uec.ac.jp
Textbook "Modern Digital and Analog Communication Systems, Third Edition, by B.P.Lathi (Oxford University Press, 1998).
Prerequisites Trigonometric identities, Integrals, Fourier series, some basic knowledge of probabilities and LCR circuits. Students are encouraged to take "Communication Systems" open at the fall semester.

Course Description

This course is an exercise session for the course "Communications Theory." This course must be taken concurrently with the course "Communications Theory." Students will be given problems directly related to the lecture given in "Communications Theory." By solving the problems students can understand the real aspects of the theory given in the lecture. Some experiments related to the lectures will also be given.

(Outline of Class and Contents)

Topics covered in this course are,
(1) Random Processes,
(2) Behavior of Analog Systems in the Presence of Noise,
(3) Behavior of Digital Communication Systems in the Presence of noise,
(4) Optimum signal detection,
(5) Relationship between bit error rate and Eb/No,
(6) Shannon's equation.

Assessment policy:

The same scores given in the course "Communications Theory."