

1. Course Title (Course Code)

Fundamentals of Information Networks (2201)

2. Instructor

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3. Term

Fall 2

4. Outline and Objectives

In this course the students study the technologies for constructing and operating computer network which underlying the Internet infrastructure. The aim is to gain a fundamental understanding and knowledge of the Internet technologies for their work in future. The course consists of lectures along with the layered network technologies that are the essential structure of the Internet technologies. The lectures contain the content about the link technology, IP/TCP/UDP technologies, some network applications and some network related technologies.

5. Goals (Attainment Targets)

- (1) To understand how physical-layer and link-layer support for data transmission.
- (2) To understand how Internet-Protocol-layer creates the Internet.
- (3) To become able to understand how the Internet works.
- (4) To understand application design on the Internet.

6. Correspondence relationship between Educational goals and Course goals

| Educational goals | | | Course goals |
|-------------------------------|--|---------------------------|--------------|
| High level ICT skill | Basic academic skills | | (1), (2) |
| | Specialized knowledge and literacy | | (3), (4) |
| Human skill (Tankyu skill) | Ability to continually improve own strengths | | |
| | Ability to discover and resolve the problem in society | Problem setting | |
| | | Hypothesis planning | |
| | | Hypothesis testing | |
| | | Practice | |
| | Fundamental Competencies for Working Persons | Ability to step forward | |
| | | Ability to think through | |
| | | Ability to work in a team | |
| Professional ethics | | | |

7. Course Requirements

Foundations of Computer Systems (achievement of attainment targets is required)

8. Textbooks

None

9. Reference Books

IBM Redbook “TCP/IP Tutorial and Technical Overview”

10. Evaluation

| Goals | Evaluation method & point | | | | | |
|------------|---------------------------|------|--------|--------------|-------------|-------|
| | term-end exam | quiz | report | presentation | deliverable | other |
| (1) | | | ○ | | | |
| (2) | | | ○ | | | |
| (3) | | | ○ | | | |
| (4) | | | | ○ | | |
| Allocation | | | 60 | 40 | | |

Course Schedule

(Notice) This schedule is a tentative plan, there might be changes, additions, revisions etc. at the time of delivering the course.

Lesson 1: Introduction (lecture, 90 min.)

This lesson explains an outline of the course and a brief summary of the Internet technologies. The Internet consists of stacked multiple protocols, which is called “layered network architecture”. As a beginning of the Internet studying, students learn the layered network architecture of the Internet communication to help them to obtain the perspective view how the Internet communication mechanism works.

1. Orientation (learning objectives, schedule, evaluation)
2. A summary of the present Internet technologies and applications
3. An introduction of the layered network architecture

Lesson 2: Link-layer technology (1) (lecture, 90 min.)

This lesson explains the function of the link layer and the physical layer mechanisms. The link layer deals with a reliable data transmission between pairs of nodes that connected with same link media. The lesson introduces current major link technologies, e.g. the Ethernet, the WiFi, the LTE and so on, to help students to judge appropriate link technologies for their demanding.

1. A brief summary of the link layer mechanism
2. An introduction of the major link technologies

Lesson 3: Link-layer technology (2) (lecture, 90 min.)

This lesson continues to explain the link layer mechanism. Students learn fundamental functions about the link layer mechanism, e.g. media access control and network topology creation with link connection. They experience the link layer functions through practical exercises. The aim is to understand the link layer communication capabilities and limitations.

1. A study of the link layer functions (MAC, Addressing, Topology)
2. Practical exercises (check MAC address, ARP table)

Lesson 4: Network-layer technology (1) (lecture, 90 min.)

This lesson explains the function of the network layer mechanism. The network layer is responsible for a data transmission over the multiple link media. This lesson introduces the Internet Protocol (IP) as the representative network layer protocol of the current Internet and its related technologies. Students learn the fundamental of the IP technologies first, e.g. the IP address, the addressing assignment rules, the IP packet structure. Then students learn additional IP related technologies, such as Dynamic Host Configuration Protocol (DHCP) and Network Address Translation (NAT) mechanisms.

1. A brief summary of the IP mechanism.
2. A study of the network layer functions (IP address, IP packet)
3. A study of the network layer related mechanisms (DHCP, NAT)

Lesson 5: Network-layer technology (2) (lecture, 90 min.)

The network layer deals with packet forwarding and routing functions. The router is a computer to support the IP packet transmission over different link media. While the transmission, the routers have to decide an appropriate route sender node to receiver node. This lesson introduces

the principle of the routing mechanisms. The aim is to understand the network layer communication capabilities and limitations. Moreover, this lesson explains Internet Communication Message Protocol (ICMP) that is used for control message transmission with IP mechanism.

1. A study of the routing mechanism (IP forwarding, Static/Dynamic routing)
2. A study of the ICMP protocol (ICMP message type, ICMP applications)
3. Practical exercises (check routing table, check dynamic routing function, traceroute, ping)

Lesson 6: Transport-layer technology (lecture, 90 min.)

This lesson explains the function of the transport layer mechanism. The transport layer deals with logical units of a data transmission. The major transport layer protocols are Transmission Control Protocol (TCP) and User Datagram Packet (UDP). TCP provides error-free data transmission with their packet retransmission mechanism. TCP also regulates bandwidth usage of the transmission for keeping fair use and avoiding congestion at the link media. Meanwhile, UDP does not provide any reliable control for data transmission. In this lecture, students learn TCP and UDP mechanisms and their works. The aim is to understand the transport layer communication characteristics.

1. A study of the transport layer functions (TCP, Flow control, Congestion avoidance, UDP)
2. Practical exercises (monitor TCP/UDP transmission, check TCP flow control)

Lesson 7: Presentation and discussion (lecture, 90 min.)

In this lesson, students have to present their presentation. The presentation must include the situation of the Internet deployment in student's country. Otherwise, the interested link-layer technologies and its usage are acceptable as the presentation. Students have 15 minutes for their presentation and discussion.

1. Presenting student's presentation.
2. Having discussion based on their presentations.

Lesson 8: Review for lectures (lecture, 90 min.)

In this lesson, students have an opportunity to clear their doubts and to demand an additional lecture about the things they want to know more.

1. A review of the previous lectures
2. An opportunity for having questions
3. An opportunity for demanding an additional lecture

Lesson 9: Domain Name technology (lecture, 90 min.)

This lesson explains the concept of domain name on the Internet and how the naming space is operated. Domain name is one of the significant technologies for the ordinary users. It is operated with DNS (Domain Name System) as the huge scale distributed databases. With the DNS, the ordinary users can access to the host on the Internet without any concern for IP addresses and physical location. Students learn the divide-and-conquer operation of the domain name and how the DNS supports the operation. The aim is to understand the principle of the naming function on the Internet and its application.

1. A study of the concept of domain name on the Internet (Structure and Management)
2. A study of the mechanism of DNS (divide-and-conquer strategy, distributed operation)

Lesson 10: Application-layer technology (lecture, 90 min.)

This lesson explains the function of the application layer abstraction. The application layer is an abstraction layer providing communication methods designed for process-to-process data transmission across an IP network. As hiring communication on the application layer function, Socket API is provided for network programming. Students learn the abstraction of the layer and some examples for network application. The aim is to understand the method to use communication functions for their demand.

1. A study of the concept of the application layer
2. Practical exercise (Socket programming examples)

Lesson 11: WWW technology (lecture, 90 min.)

This lesson explains World Wide Web technology as a representative application on the Internet. WWW is a major application on the Internet. WWW can support various kinds of services. WWW technology consists of three technologies such as HTTP, URL and HTML. Through the lecture of the technologies, students learn how to make WWW technology with them. Students also learn about the possible applications on the Internet from some examples. The aim is to understand WWW capability and to become able to design WWW services.

1. A study of the summary for the WWW technology
2. A study for key technologies of WWW (HTTP, URL, HTML)
3. A study of the typical examples of the application on WWW

Lesson 12: Other technologies (lecture, 90 min.)

This lesson explains network related important technologies, Public key cryptosystem, Virtualization and Distributed computing. Public key cryptosystem is one of the most significant techniques against security concerns on communication via the Internet. Virtualization is expected that it may contribute to give more flexibility and more controllability to networking by software-based network control. Distributed Computing provides powerful and interesting services based on communication on the Internet. Students learn these technologies for understanding more about applications and the capabilities in future.

1. A study of Public key cryptosystem
2. A study of Virtualization technologies (Virtual Machine, Virtual Network, Cloud Computing)
3. A study of Distributed Computing (Server-Client, Clustering, Distributed Computing, P2P)

Lesson 13: Presentation and discussion (lecture, 90 min.)

In this lesson, students have to present their presentation. Students are required to choose the technical mechanisms or the services. And students investigate them and present their presentations. Students and teacher have a discussion with their presentations.

1. Presenting student's presentation.
2. Having discussion based on their presentations.

Lesson 14: Review for lectures (lecture, 90 min.)

In this lesson, students have an opportunity to clear their doubts and to demand an additional lecture through about the things they want to know more.

1. A review of the previous lectures
2. An opportunity for having questions
3. An opportunity for demanding an additional lecture

Lesson 15: Conclusion (lecture, 90 min.)

In this lesson, the course content from the 1st up to 14th is reviewed briefly for confirming and supporting student's understanding.

1. A summary of the whole course content
2. Presentation