专业课课程教学大纲Syllabus

SJQU-QR-JW-033（A0）

**【计算机系统与网络技术】**

**【Computer System and Network Technology】**

一、基本信息Basic Information（必填项）

**课程代码 Course Code：【**2050705**】**

**课程学分 Course Credits：【** 3 **】**

**面向专业 Major：【**2020数字媒体技术（双语）Bachelor in Digital Media Technology**】**

**课程性质Characteristic of the Course：**系级必修课Department-level required courses

**开课院系Department：国际教育学院**International Education College

**使用教材Teaching and Reference Materials：**

教材Textbook【计算机网络——自顶向下方法（第5版影印版）（（美）詹姆斯·F. 库罗斯（James F. Kurose）、（美）基思·W. 罗斯（Keith W. Ross）；高等教育出版社）】

Computer Network：Top-down Method (5th Edition) ((US) James F.Curros (James F.Kurose), (American) Keith W.Ross (Keith W.Ross); Higher Education Press)

**参考书目Bibliography：**【计算机网络——自顶向下方法（原书第7版）（（美）詹姆斯·F. 库罗斯（James F. Kurose）、（美）基思·W. 罗斯（Keith W. Ross）；机械工业出版社）】

Computer Network —— Top-down Method (Original Book Version 7) ((US) James F.Curros (James F.Kurose), (American) Keith W.Ross (Keith W.Ross); Mechanical Industry Press)

**课程网站网址Online Learning Website URL：**Http://www. rdjg.com.cn

**先修课程Preface Course:**【无】

二、课程简介**Course Description**（必填项）

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| --- | --- |
| The aim of this unit is to ensure leaners understand the components of networked technology systems, network protocols and network system services.  本课程旨在确保学生了解网络技术系统、网络协议和网络系统服务的组成部分。 | |
| **Learning Outcome**  **学习目标**  **The learner will**  **学生将** | **Assessment Criteria:**  **评判标准**  **The learner can:**  **学生能** |
| 1. Be able to explain and evaluate different types of network systems and protocols 2. 能解释和评估不同类型的网络系统和网络协议。 | Discuss different types of network, (LAN, WAN, internet, PAN, frame delay) and different physical topologies  讨论不同类型的网络（LAN, WAN，internet, PAN, frame delay）和不同类型的物理拓扑结构。  Identify and discuss network standards, (UDP, 802.2) and wireless technologies (802.11, Bluetooth, 3G)  识别并讨论网络标准（UDP、802.2）和无线技术（802.11、蓝牙、3G）  Apply different network protocols, (i.e DNS, DHCP, HTTP, FTP, SMTP)  应用不同的网络协议（即DNS、DHCP、HTTP、FTP、SMTP） |
| 1. Be able to understand services provided by different networks 2. 能明白不同类型网络提供的服务。 | Apply different directory service types  应用不同的目录服务类型  Use various file services  使用各种文件服务  Evaluate different telecommunication services  评估不同类型的电信服务  Identify differing application services  识别不同类型的应用服务 |
| 3. Be able to demonstrate an ability to make network systems secure  3. 能展示使用网络安全的能力 | Discuss different security methods  讨论不同类型的安全方式  Evaluate business risks associated to network security  评估与网络安全相关的商业风险  Identify and discuss hostile and intrusive software  识别和讨论恶意与侵入软件 |

三、选课建议**Suggestion for Selection of Course**（必填项）

This course as the basis of professional courses fits for the advanced level students for more knowledge of computer networking and preparation for the advanced courses.

本课程为专业基础课程，适合高年级学生选择, 以获得计算机网络的基础知识为高级课程做预备。

四、课程与专业毕业要求的关联性**The Correlation between Curriculum and Graduation Requirements**（必填项）

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| **专业毕业要求**  **Graduation Requirements** | **关联Relation** |
| LO1 表达沟通  Expressing communication  理解他人的观点，尊重他人的价值观，能在不同场合用书面或口头形式进行有效沟通。  Understand the views of others, respect their values, and communicate effectively in writing or orally on different occasions |  |
| LO2自主学习  Self-learning  能根据需要确定学习目标，并通过搜集信息，分析信息，讨论，实践，质疑，创造等方法来实现学习目标。  Be able tOidentify learning goals as needed and achieve them by gathering information, analyzing information, discussing, practicing, questioning, |  |
| LO3 专业能力  Professional ability |  |
| LO 4 尽责抗压  Due diligence and pressure resistance  遵守纪律，守信守则，具有耐挫折，抗压力的能力。  Discipline, abide by the rules, with resistance to setbacks, the ability to resist pressure. |  |
| LO 5 协同创新  Collaborative innovation  同团队保持良好的合作关系，做集团中的积极成员；勇于从不同的角度思考问题，勇于提出新设想。  Keep good cooperation with the team, be an active member of the group, be brave to think from different perspectives and put forward new ideas. |  |
| LO6信息应用  Information application  能在学习，工作中应用信息技术解决问题，具有运用计算机处理工作领域中的信息和技术交流的能力。  Can apply information technology tOsolve problems in study and work, and have the ability tOuse computers tOprocess information and technology exchanges in the field of work. |  |
| LO 7 服务关爱  Service care  愿意服务他人，服务企业，服务社会；为人热忱，富于爱心，痛得感恩（感恩， 回报， 爱心为我校校训内容之一）  Willing to serve others, enterprises and society; being enthusiastic, loving and grateful (gratitude, return, love is one of the contents of our school motto) |  |
| LO 8 国际视野  International Perspective  具有基本的外语表达沟通能力与跨文化理解能力，能够阅读专业外文资料，有国际竞争与合作意识。  With basic foreign language communication skills and cross-cultural understanding ability, able to read professional foreign language materials, with international competition and cooperation awareness. |  |

备注：LO=learning outcomes（学习成果）

五、课程目标/课程预期学习成果**Course Objectives / Course Expected Learning Outcomes**（必填项）（预期学习成果要可测量/能够证明）

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| --- | --- | --- | --- | --- |
| **序号**  **No.** | **课程预期**  **学习成果**  **Course Expected Learning Outcomes** | **课程目标**  **（细化的预期学习成果）**  **Course Objectives（Detailed Expected Learning Outcomes）** | **教与学方式**  **Teaching and Learning Methods** | **评价方式**  **Assessment Methods** |
| 1 | LO2 | To understand different types of network and different physical topologies. To identify and understand network standards, (UDP, 802.2) and wireless technologies (802.11, Bluetooth, 3G)  理解不同类型的网络和物理拓扑结构。识别并理解多种网络标准（UDP、802.2）和无线技术（802.11、蓝牙、3G） | Lecture and Discussion and Individual Presentation  授课与讨论及个人演示 | Multiple Questions, Quiz, Case Study, and Team Work  各类问题，章节测验，案例学习，和团队项目 |
| 2 | LO3 | To apply different network protocols, (i.e DNS, DHCP, HTTP, FTP, SMTP). To apply different directory service types. To use various file services. To evaluate different telecommunication services. To identify differing application services  应用不同的网络协议（即DNS、DHCP、HTTP、FTP、SMT），应用不同的目录服务类型。使用各种文件服务。评估不同类型的电信服务。识别不同类型的应用服务 | Lecture and Discussion  授课与讨论 | Multiple Questions, Quiz, Case Study, and Team Work  各类问题，章节测验，案例学习，和团队项目 |
| 3 | LO5 | To identify different security methods. To evaluate business risks associated to network security. To identify and discuss hostile and intrusive software.  识别不同类型的安全方式。  评估与网络安全相关的商业风险。识别并讨论各类恶意与入侵软件。 | Lecture, Discussion, Case Study and Team Work  授课、讨论、案例分析和团队项目 | Multiple Questions, Quiz, Case Study, and Team Work  各类问题，章节测验，案例学习，和团队项目 |

六、课程内容**Course Contents**（必填项）

**Chapter 1 Introduction 第一章 概论 理论课时Hours 9/实践课时Actual Hours 9**

教学内容 Teaching Content:

1.1 What Is the Internet? (two approaches of the Internet description: nut-and-bolts and service, introduction of protocols)

1.1 什么是因特网？（有关因特网的两种描述方式：具体构成描述和服务描述，及网络协议概述）

1.2 The Network Edge (three access networks and wired and wireless physical media)

1.2 网络边缘 （三种接入网和有线及无线物理媒体）

1.3 The Network Core (two prominent switching approaches: packet switching, circuit switching, and hierarchical network structure)

1.3 网络核心（两种主要数据交换方式：分组交换与电路交换，及分层网络结构）

1.4 Delay, Loss, Throughput in Packet-Switched Networks (overview of delay in packet-switched networks, queuing delay and packet loss, end-to-end delay, and throughput in computer networks)

1.4分组网络中的延迟、丢失、吞吐量（分组交换网络中的延迟概述、排队延迟和分组丢失、端到端延迟和计算机网络中的吞吐量）

1.5 Protocol Layers and Their Service Models (Layered Architecture and Encapsulation Concept)

1.5协议层及其服务模型（分层架构和封装概念）

1.6 Networks under Attack (survey of common attacks in the Internet)

1.6面对攻击的网络（互联网常见攻击简述）

1.7 History of Computer Networking and the Internet (a brief history of the Internet: the development of packet switching, proprietary networks and internetworking, a proliferation of networks, and the new millennium)

1.7计算机网络和因特网的历史（因特网简史：分组交换、专有网络和互联网络的发展、网络的繁荣发展期和新千年）

知识要求 Knowledge Requirements:

1. To get feel of the basic computer network knowledge via several essential concepts and terms in relation to the internet. After the class, students should capture two approaches of describing the Internet: nuts-and-bolts view and service description. They have to explain hosts/end systems, network applications, communication links and physical media, transmission rate, packets, packet switches, route/path, ISP, socket interface, protocols.

通过与因特网有关的几个基本概念和术语，了解计算机网络的基本知识。课后，学生应该掌握两种描述互联网的方法：具体网络构成描述和服务描述。他们必须解释主机/终端系统、网络应用、通信链路和物理介质、传输速率、分组、分组交换机、路由/路径、ISP、套接字接口、协议。

1. To know basic hardware and software components of the Internet: the network’s edge and core. To understand DSL and HFC access networks, enterprise access networks, and wireless access networks. To distinguish several physical media: Twisted Pair, Coaxial Cable, Optical Fiber, and Radio Links. Students should be able to list several access networks and physical media, and explain their differences.

了解互联网的基本硬件和软件组件：网络的边缘和核心。了解DSL和HFC接入网、企业接入网和无线接入网。区分几种物理介质：双绞线、同轴电缆、光纤和无线电链路。学生应该能够列出几种接入网络和物理媒体，并解释它们的区别。

1. To understand packet transmission delay, store-and-forward, queueing delay, loss, and internet hierarchical structure. Students should distinguish FDM and TDM, compare packet switching and circuit switching, explain internet structure.

了解数据包传输延迟、存储转发、排队延迟、丢失和internet分层结构。学生应区分FDM和TDM，比较分组交换和电路交换，解释互联网结构。

1. To grasp the basic concept of delay, loss, and throughput in packet-switched network that commonly occur in the Internet. After the class, students should explain how loss and delay occur, distinguish four sources of packet delay, understand real internet delays between routers through Traceout, and determine bottleneck link in the networks.

掌握互联网中常见的分组交换网络中时延、丢失和吞吐量的基本概念。课后，学生应解释丢失和延迟是如何发生的，区分包延迟的四种来源，通过Traceout了解路由器之间的真实互联网延迟，并确定网络中的瓶颈链路。

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掌握互联网中常见的分组交换网络中时延、丢失和吞吐量的基本概念。课后，学生应解释丢失和延迟是如何发生的，区分包延迟的四种来源，通过Traceout了解路由器之间的真实互联网延迟，并确定网络中的瓶颈链路。

1. To comprehend protocol layers and corresponding services and the concept of encapsulation. Students should be able to list several protocol layers of the Internet and interpret their corresponding services, and explain how message transmit between protocol layers during the period of its transmission from source to destination.

理解协议层和相应的服务以及封装的概念。学生应能列出互联网的几个协议层，并解释其相应的服务，并解释消息在从源到目的地的传输期间如何在协议层之间传输。

1. To understand the Internet is vulnerable to different types of attacks. Students should distinguish virus, worm, spyware malware, and botnet, explain Dos, packet sniffing, Ip spoofing

了解互联网容易受到不同类型的攻击。学生应区分病毒、蠕虫、间谍软件恶意软件和僵尸网络，解释Dos、数据嗅探、Ip欺骗。

1. To know brief history of the Internet.

了解因特网简史。

教学难点 Difficulties in Teaching：

1. Two approaches of the Internet and Protocols

两种因特网的描述方式及网络协议的概念

1. DSL and HFC, and different physical media

DSL和HFC,及不同物理传输媒介

1. Store and forward of packet switch, queueing delay, loss

数据交换机的存储和转发，排队延迟，丢失

1. Store and forward of packet switch, queueing delay, loss

数据交换机的存储和转发，排队延迟，丢失

1. Comparison of packet switching and circuit switching

数据交换与电路交换的对比

1. Hierarchical Internet structure

互联网分层结构

1. Four sources of packet delay and their differences.

四种数据延迟的来源及他们的区别。

1. Throughput of data of the computer network.

网路数据吞吐量。

1. Protocol layers and services models.

协议分层和服务模型。

1. Encapsulation

封装。

1. Different attacks: virus, worm, spyware malware, botnet, Dos, packet sniffing, and Ip spoofing.

不同的攻击：病毒、蠕虫、间谍软件恶意软件、僵尸网络、Dos、数据嗅探和Ip欺骗。

**Chapter 2 Application Layer 第二章 应用层 理论课时Hours 6/实践课时Actual Hours6**

教学内容 Teaching Content:

2.1 Principles of Network Applications (network application architecture, process communicating, transport services available to applications and provided by the Internet, application-layer protocols)

2.1网络应用原理（网络应用架构、过程通信、应用可用的传输服务和由互联网提供的传输服务、应用层协议）

2.2 Web and HTTP (non-persistent and persistent connections, http message format, cookies and web caching)

2.2 Web和HTTP（非持久性和持久性连接、HTTP消息格式、Cookie和Web缓存）

2.3 Electronic Mail in the Internet (SMTP, mail message formats and mail access protocols)

2.3因特网上的电子邮件（SMTP、邮件消息格式和邮件访问协议）

2.4 DNS—The Internet’s Directory Service (service provided by DNS, DNS mechanism, records and messages)

2.4 DNS Internet的目录服务（由DNS提供的服务、DNS工作机理、记录和消息）

2.5 Peer-to-Peer Applications (P2P file distribution mechanism)

2.5对等应用（P2P文件分发机制）

2.6 Video Streaming and Content Distribution Networks (Internet video, HTTP steaming and DASH, and content distribution networks)

2.6视频流和内容分发网络（互联网视频、HTTP流和短消息以及内容分发网络）

2.7 Socket Programming : Creating Network Applications (Socket Programming with UDP and TCP)

2.7套接字编程：创建网络应用程序（使用UDP和TCP进行套接字编程）

知识要求 Knowledge Requirements:

1. To grasp the basic conceptual and implemented principles of application layer: Client-Server and P2P architectures; Processes, API, and Addressing Process; Transport Service Requirements; TCP and UDP; Application-Layer Protocols. After the class, students should explain two application architectures, distinguish four sources transport service requirements, understand API and addressing processes, TCP/UDP services and SSL, and define a simple application layer protocol.
2. 掌握应用层的基本概念和实现原理：客户端-服务器和P2P架构；进程、API和寻址过程；传输服务要求；TCP和UDP；应用层协议。课后，学生应讲解两种应用架构，区分四种来源的传输服务需求，了解API及寻址流程、TCP/UDP服务及SSL，并定义一个简单的应用层协议。
3. To comprehend web pages’ components and corresponding concepts in terms of HTTP: Non-Persistent/Persistent connections, HTTP message format, cookies, web caching, and conditional GET. Students should be able to explain the effectiveness of different TCP connections and interpret the advantages of cookies and web caching, and conditional GET methods.
4. 理解web页面的组件和超文本传输协议的相应概念：非持久/持久连接、HTTP报文格式、cookies、web缓存和条件GET。学生应能解释不同TCP连接的有效性，并解释Cookies和web缓存的优势，以及条件GET方法。
5. To understand key components of e-mails, SMTP, email message format, and mail access protocols. Students should distinguish the differences of SMTP and HTTP and three types of mail access protocols.
6. 了解电子邮件的关键组件、SMTP、电子邮件格式和邮件访问协议。学生应区分SMTP和HTTP以及三种邮件访问协议的区别。
7. To grasp the basic concept of DNS and corresponding services, DNS hierarchical structure, DNS records and messages. After the class, students should explain two different DNS queries solution, discuss their effectiveness.
8. 掌握DNS及其相关服务的基本概念、DNS层次结构、DNS记录和消息。课后，学生应解释两种不同的DNS查询解决方案，讨论它们的有效性。
9. To comprehend HTTP steaming and DASH, the basic principles of CDN. Students should be able to distinguish HTTP steaming and DASH, present how DNS redirects a user’s request to a CDN server.
10. 理解HTTP流和DASH，CDN的基本原理。学生应该能够区分HTTP流和破折号，演示DNS如何将用户的请求重定向到CDN服务器。
11. To understand Socket Programming with UDP and TCP in Python. Students are enable to tell the difference of UDP and TCP.
12. 了解使用Python进行UDP和TCP的套接字编程。学生应能分辨UDP与TCP传输的差异。

教学难点 Difficulties in Teaching：

1. Two Applications Architectures

两种应用软件的构架。

1. Processes Communicating: Processes, API, and Addressing Processes

进程通信：进程的概念，应用程序编程接口和寻找进程。

1. Four Transport Services Requirements Applications Needed

四种应用软件的通信服务需求。

1. TCP/UDP Services & SSL

TCP/UDP服务与安全接口层。

1. Non-Persistent & Persistent Connections

非连续连接与连续连接。

1. HTTP Message Format

HTTP报文格式。

1. Differences of SMTP & HTTP

SMTP和HTTP之间的差异。

1. Mail Message Format

邮件报文格式。

1. DNS and Services

域名系统及其服务。

1. DNS Hierarchical Structure

域名系统的层级结构。

1. Two Different DNS Queries Solution

两种不同的DNS查询方案。

1. DNS Records and Message

DNS记录和报文。

1. P2P File Distribution

P2P文件分发

1. Socket Programming with UDP and TCP

UDP和TCP套接字编程。

**Chapter 3 Transport Layer 第三章 传输层 理论课时Hours 6/实践课时Actual Hours6**

教学内容 Teaching Content:

3.1 Introduction and Transport-Layer Services (relationship between transport and network layers and overview of the transport layer)

3.1介绍和传输层服务（传输层和网络层之间的关系以及传输层的概述）

3.2 Multiplexing and Demultiplexing (Multiplexing and Demultiplexing within UDP and TCP)

3.2多路复用和多路分解（UDP和TCP内的多路复用和多路分解）

3.3 Connectionless Transport: UDP (UDP segment structure and UDP checksum)

3.3无连接传输：UDP（UDP分段结构和UDP校验和）

3.4 Principles of Reliable Data Transfer (building reliable data transfer protocol, pipelined reliable data transfer protocols, and Go-Back-N and Selective Repeat)

3.4可靠数据传输的原则（建立可靠的数据传输协议、流水线可靠的数据传输协议、回退N步和选择性重复）

3.5 Connection-Oriented Transport: TCP (TCP connection, TCP segment structure, round-trip time estimation and timeout, reliable data transfer, flow control and TCP connection management)

3.5面向连接的传输：TCP（TCP连接、TCP分段结构、往返时间估计和超时、可靠的数据传输、流量控制和TCP连接管理）

3.6 Principles of Congestion Control (causes and costs of congestion and approaches to congestion control)

3.6拥堵控制的原则（拥堵的原因和成本以及控制拥堵的方法）

3.7 TCP Congestion Control (fairness and explicit congestion notification)

3.7 TCP拥塞控制（公平性和明显拥塞通告）

知识要求 Knowledge Requirements:

1. To grasp the basic concept of transport services and protocols. After the class, students should distinguish the service provided by transport layer and network layer, tell pros and cons of TCP and UPD.

掌握传输服务和协议的基本概念。课后，学生应区分传输层和网络层提供的服务，讲述TCP和UPD的优缺点。

1. To comprehend multiplexing and demultiplexing. Students should be able to explain how multiplexing and demultiplexing work in TCP and UDP, and tell a given packet’s source’s IP & Port No. and destination’s IP & Port No.

理解多路复用和解复用。学生应能解释TCP和UDP中多路复用和解复用的工作原理，并辨别给定数据包的源IP和端口号以及目标的IP和端口号。

1. To understand UDP and its characteristics. Students should distinguish UDP from TCP and calculate UDP checksum.

了解UDP及其特性。学生应该区分UDP和TCP并计算UDP校验和。

1. To know the basic of concepts of principles of reliable data transfer: Stop-To-Wait rdt: rdt1.0, rdt2.0, rdt2.1, and rdt2.2; pipelined rdt: GBN & SR.

了解可靠数据传输原理的基本概念：停止等待可靠数据传输:rdt1.0、rdt2.0、rdt2.1、rdt2.2；流水线可靠数据传输:GBN和SR。

1. To grasp the basic concept of TCP, segment format, reliable data transfer service, and flow control. After the class, students should explain the processes of TCP: handshaking and connections, calculate timeout interval, and illustrate flow control and TCP connection management.

掌握TCP的基本概念、数据包格式、可靠的数据传输服务、流量控制。课后，学生们应该解释TCP的过程：握手和连接，计算超时间隔，并演示流控制和TCP连接管理。

1. To comprehend reasons and costs of congestions, and methods of congestion control. Students should be able to list scenarios of congestions and their costs, and two control methods.

了解拥塞的原因和成本，以及控制拥塞的方法。学生应该能够列出拥塞的情景及其成本，以及两种控制方法。

1. To understand TCP congestion control algorithm. Students should explain slow-start, congestion avoid, fast recover, and fairness.

了解TCP拥塞控制算法。学生应解释慢启动、避免拥挤、快速恢复和公平。

教学难点 Difficulties in Teaching：

1. Transport Services and Protocols

传输服务和协议

1. Multiplexing & Demultiplexing

多路复用和多路分解。

1. UDP and its characteristics

UDP及其特性。

1. Stop-To-Wait RDT and Pipelined RDT.

停止等待可靠数据传输和流水线可靠数据传输。

1. TCP

TCP的基本概念。

1. Segment format, reliable data transfer service, and flow control.

数据包格式、可靠的数据传输服务、流量控制。

1. Reasons and costs of congestions.

拥塞的原因和成本。

1. Methods of congestion control.

控制拥塞的方法。

1. TCP congestion control algorithm.

TCP拥塞控制算法。

**Chapter 4 Transport Layer 第四章 网络层 理论课时Hours 9/实践课时Actual Hours9**

教学内容 Teaching Content:

4.1 Overview of Network Layer (forwarding and routing: the network data and control planes, and network service models)

4.1网络层概述（转发和路由选择：网络数据平面和控制平面、网络服务模型）

4.2 What’s inside a Router (input port processing and destination-based forwarding, switching, output port processing, and packet scheduling)

4.2路由器工作原理（输入端口处理和基于目的地转发、交换、输出端口处理和分组调度）

4.3 The Internet Protocol (IPv4 datagram format and fragmentation, and addressing, network address translation, and IPv6)

4.3互联网协议（IPv4数据报格式和碎片和寻址、网络地址转换和IPv6）

4.4 Generalized Forwarding and SDN (match, action, and OpenFlow examples of match-plus-action in action)

4.4通用转发和SDN（匹配、动作和匹配加动作操作中的OpenFlow）

4.5 Routing Algorithms (link-state routing algorithm and distance-vector routing algorithm)

4.5路由算法（链路状态路由选择算法和距离向量路由选择算法）

4.6 Routing in the Internet (OSPF and BGP)

4.6互联网路由（OSPF和BGP）

4.7 The SDN Control Plane (SDN controller and SDN control applications, OpenFlow protocol, data and control plane interaction)

4.7 SDN控制平面（SDN控制器和SDN网络控制应用程序、OpenFlow协议、数据平面和控制平面交互）

4.8 ICMP and SNMP (the internet control message protocol, network management framework, and the simple network management protocol)

4.8 ICMP和SNMP（因特网控制报文协议、网络管理框架和简单网络管理协议）

知识要求 Knowledge Requirements:

1. To grasp the basic concept of network layer, basic concepts of two important functions of network layer, and network service model. After the class, students should explain forwarding and routing, distinguish the works on data plane and control plane.

掌握网络层的基本概念、网络层两个重要功能的基本概念和网络服务模型。课后，学生应讲解转发和路由，区分数据平面和控制平面上的工作。

1. To comprehend the basic concept of virtual circuit and datagram networks, destination-based forwarding. Students should be able to how to use the longest prefix matching rule to quickly obtain the outgoing interface.

了解虚拟电路和数据报网络的基本概念，及基于目的地转发。学生应能使用最长前缀匹配规则快速获得输出接口。

1. To understand the router architecture: input ports, switch fabric, output ports, and routing processor, and packet scheduling. Students should explain the difference between destination-based forwarding and generalized forwarding, three switch approaches, and FIFO, priority queueing, round robin queueing discipline.

了解路由器架构：输入端口、交换结构、输出端口、路由处理器、分组调度。学生应解释基于目的地的转发和广义转发的区别，三种交换方法，以及FIFO、优先级排队、循环排队规则。

1. To grasp the basic concept of IPv4 and IPv6, IPv4 datagram, addressing, DHCP, NAT, and tunneling. After the class, students should explain IPv4 datagram format and IPv6 format, CIDR, and how to translate IPv6 into IPv4.

掌握IPv4和IPv6的基本概念, IPv4数据报，IPv4寻址，动态域名分配协议，网络地址转换，及建隧道。课后，学生应讲解IPv4和IPv6数据报格式，无差别域间路由选择，以及如何将IPv6封装入IPv4。

1. To comprehend the basic concept of generalized forwarding, SDN, and Openflow. Students should be able to understand match plus action and practice the rule.

了解通用转发，SDN, 及Openflow。学生应能理解匹配加动作并能使用这一原则。

1. To understand the control plane of network layer, routing algorithm, centralized routing algorithm and decentralized routing algorithm. Students should explain the difference between per-router routing and logically centralized routing, know how to classify routing algorithm.

了解网络层的控制平面， 路由算法，集中路由算法和分散路由算法。学生应解释每路由控制与逻辑集中式控制的区别。

1. To grasp the basic concept routing algorithm, graph abstraction, the Link States algorithm. After the class, students should explain how to execute Link States algorithm and practice LS.

掌握路由算法、图抽象、链路状态算法的基本概念。课后，学生应讲解如何执行链路状态算法并练习LS。

1. To comprehend the basic concept of the Distance Vector. Students should be able to how to execute DV and compare advantages and disadvantages of LS and DV.

理解距离向量的基本概念。学生应掌握如何执行DV，并比较LS和DV的优缺点。

1. To understand Autonomous System and Inter-AS and Intra-AS routing protocols: OSPF and BGP. Students should explain two issues AS can resolve and OSPF’s hierarchical layer, BGP policies.

了解自治系统和AS间及AS内部路由协议：OSPF和BGP。学生应该解释两个可以解决的问题和OSPF的层次结构，BGP政策。

1. To master the basic of concept of SDN and IMCP and SNMP. Students should distinguish SDN and traditional routing and point out the functions of IMAP and SNMP.

掌握SDN、IMCP和SNMP的基本概念。学生应区分SDN和传统路由，指出IMAP和SNMP的功能

教学难点 Difficulties in Teaching：

1. Network layer and two important functions.

网络层和两个重要功能。

1. Data plane and Control plane.

数据平面和控制平面。

1. Network services model.

网络服务模型。

1. Virtual circuit and datagram networks

虚拟电路和数据报网络。

1. Destination-based forwarding.

基于目的地转发。

1. Longest prefix matching rule.

最长前缀匹配规则。

1. Router architecture.

路由器架构。

1. Three main packet scheduling.

三种主要的分组调度。

1. Two important approaches of forwarding.

两种重要的转发方式。

1. Basic concept of IPv4 and IPv6

IPv4和IPv6的基本概念。

1. IPv4 datagram, IPv4 addressing, CIDR, DHCP, NAT, and tunneling.

IPv4数据报，IPv4寻址，无差别域间路由选择，动态域名分配协议，网络地址转换，及建隧道。

1. Basic concept of generalized forwarding and SDN.

通用转发和软件定义网络的基本概念。

1. Rule of match plus action

匹配加动作的转发原则。

1. Control plane of network layer and routing algorithm

网络层控制平面和路由选择算法。

1. Classification of routing algorithm.

路由选择算法的分类。

1. Per-routing and logically centralized routing.

路由控制与逻辑集中式控制

1. Link States

链路状态

1. Distance Vector

距离向量

1. OPSF

开放最短路优先协议。

1. BGP

自治系统间路由选择协议互联网控制报文协议

1. SDN.

软件定义网络

**Chapter 5 Link Layer & LANs 第五章 链路层和局域网 理论课时Hours 6/实践课时Actual Hours 6**

教学内容 Teaching Content:

5.1 Introduction to the Link Layer (the service provided by the link layer and implementation)

5.1链路层概述（链路层提供的服务及实现）

5.2 Error-Detection and -Correction Techniques (parity checks, checksumming methods, and cyclic redundancy check)

5.2 差错检测和校正技术（奇偶校验、检验和方法和循环冗余校验）

5.3 Multiple Access Links and Protocols (channel partitioning protocols, random access protocols, taking-turns protocols, and DOCIS )

5.3 多路访问链路和协议（信道分区协议、随机访问协议、轮流协议和DOCIS）

5.4 Switched Local Area Networks (link-layer addressing and ARP, ethernet, link-layer switches and VLANs)

5.4交换局域网（链路层寻址和ARP、以太网、链路层交换机和VLANs）

5.5 Link Virtualization: A Network as a Link Layer (multiprotocol label switching)

5.5链路虚拟化：作为链路层的网络（多协议标签交换）

5.6 Data Center Networking (load balancer, hierarchy of router and switch, and data center networking trends)

5.6数据中心网络（负载均衡器、路由器和交换机的层次结构、数据中心的发展趋势）

5.7 A Day in the Life of a Web Page Request

5.7 Web页面请求的历程

知识要求 Knowledge Requirements:

1. To grasp the basic concept of link layer and service provided. After the class, students should explain node, link, framing, MAC, RDT on link layer, Error Detection and Correction, and where is the link layer implemented.

掌握链路层和所提供服务的基本概念。课后，学生应讲解链路层上的节点、链路、帧、媒体访问控制、可靠传输、错误检测和纠正，以及链路层在哪里实现。

1. To comprehend Error-Detection and Correction: parity bit, Internet checksum, and Cyclic Redundancy Check. Students should be able to how to execute parity bit, Internet checksum, and CRC.

了解错误检测和纠正：奇偶校验位、互联网校验和、循环冗余校验。学生应该能够执行奇偶校验位，互联网校验和，和CRC。

1. To understand the multiple access problem and multiple access protocols: channel partitioning protocol, random access protocol, and taking-turns protocol. Students should list common protocols of three multiple access protocols and analyze their efficiency.

了解多路访问问题和多路访问协定：信道划分协定、随机接入协定，轮流协议。学生应列出三类多路访问协定的常见协议，并分析其效能。

1. To grasp the basic concept of Link layer addressing and ARP, Ethernet, switches, and VLANs. After the class, students should explain MAC addresses, ARP, Ethernet frame format, filtering and forwarding of switches, self-learning, and compare switches and routers.

掌握链路层寻址和地址解析协议、以太网、交换机、虚拟局域网的基本概念。课后，学生应讲解MAC地址、ARP、以太网帧格式、交换机的过滤和转发、自学，并比较交换机和路由器。

1. To comprehend the basic concept of link virtualization and multiple label switching. Students should be able to compare MPLS and IP paths.

了解链路虚拟化和多标签交换的基本概念。学生应该能够比较MPLS和IP路径。

1. To understand the concept of data center network, load balancing and its hierarchy of router and switches. Students should explain why data center networks emerge.

了解数据中心网络的概念、负载平衡及其路由器和交换机的层次结构。学生应解释为什么会出现数据中心网络。

教学难点 Difficulties in Teaching：

1. Basic concept of link layer and service provided

链路层和所提供服务的基本概念。

1. Error-Detection and Correction.

错误检测和纠正。

1. Parity bit, Internet checksum, and Cyclic Redundancy Check.

奇偶校验位、互联网校验和、循环冗余校验。

1. Multiple access problem and multiple access protocols.

多路访问问题和多路访问协定。

1. Channel partitioning protocol, random access protocol, and taking-turns protocol。

信道划分协定、随机接入协定，轮流协议。

1. Link layer addressing and ARP.

链路层寻址。

1. Ethernet

交换以太网。

1. Switches

分组交换器

1. VLANs

虚拟局域网。

1. Link virtualization

链路虚拟化。

1. MPLS

多协议标签交换。

1. Data center networks

数据中心网络。

**Chapter 6 Wireless & Mobile Network 第六章 无线网络和移动网络 理论课时Hours 6/实践课时Actual Hours 6**

教学内容 Teaching Content:

6.1 Introduction

6.1 无线网路和移动网路概述

6.2 Wireless Links and Network Characteristics (CDMA)

6.2无线链路和网络特性（CDMA）

6.3 WiFi: 802.11 Wireless LANs (802.11 architecture, MAC protocol, frame, and mobility in the same IP subnet, and PAN )

6.3 WiFi:802.11无线局域网（802.11体系结构、MAC协议、帧、相同IP子网中的移动性和PAN）

6.4 Cellular Internet Access (cellular network architecture, 3G cellular data networks, and 4G)

6.4蜂窝互联网接入（蜂窝网络架构、3G蜂窝数据网络和4G）

6.5 Mobility Management (addressing and routing to a mobile node)

6.5移动管理（寻址和路由选择到移动节点）

6.6 Mobile IP

6.6 移动IP

6.7 Managing Mobility in Cellular Networks (routing calls to a mobile user and handoffs in GSM)

6.7管理蜂窝网络中的移动性（在GSM中路由呼叫到移动用户和切换）

知识要求 Knowledge Requirements:

1. To grasp the basic concept of wireless networks and wireless network taxonomy. After the class, students should list the elements of wireless networks and wireless network classification.

掌握无线网络的基本概念和无线网络分类法。课后，学生应列出无线网络的要素和无线网络的分类。

1. To comprehend the wireless link characteristics and CDMA. Students should be able to explain SNR and BER, hidden terminal problem and signal attenuation, illustrate Code division multiple access.

了解无线链路特性和CDMA。学生应能解释信噪比和误码率，隐藏终端问题和信号衰减，说明码分多址。

1. To understand IEEE802.11 system, IEEE802.11 LAN architecture, channels and association, IEEE802.11 MAC protocol, IEEE802.11 frame, and its advanced capabilities. Students should list the components of IEEE802.11 LAN, distinguish passive scanning and active scanning, explain how to deal with collision in 802.11.

了解IEEE802.11系统、IEEE802.11局域网结构、信道和关联、IEEE802.11 MAC协议、IEEE802.11帧及其高级功能。学生应列出IEEE802.11LAN的组件，区分被动扫描和主动扫描，解释如何处理802.11中的碰撞。

1. To master the architecture and standards of cellular network access. Students should illustrate the evolution of cellular networks and its standards.

掌握蜂窝网络接入的体系结构和标准。学生应说明蜂窝网络的发展及其标准。

1. To grasp the basic concept of mobility and approaches to mobility addressing. After the class, students should list the elements of mobility management, distinguish mobility via indirect routing and direct routing, and their characteristics.

掌握移动性的基本概念和移动性寻址的方法。课后，学生应列出移动性管理的构件并区分间接路由和直接路由的移动性及其特点。

1. To comprehend mobile IP, handling mobility in cellular networks, and wireless and mobility’s impact on higher layer protocols. Students should be able to list three components to standards, components of cellular network architecture, distinguish differences of cellular versus Mobile IP.

了解移动IP，处理蜂窝网络中的移动性，以及无线和移动性对高层协议的影响。学生应能列出无线网路标准的三个组件，蜂窝网络架构的组件，区分蜂窝网路与移动IP的区别。

教学难点 Difficulties in Teaching：

1. Basic concept of wireless networks.

无线网络的基本概念。

1. Wireless network taxonomy。

无线网络的分类。

1. Important differences from wired link.

无线网络与有线网路间的重大区别。

1. SNR and BER, Hidden Terminal and Signal Attenuation

信噪比和比特差错率及隐藏终端问题和信号衰减。

1. CDMA.

码分多址。

1. IEEE802.11 architecture and 802.11 MAC protocols.

IEEE802.11体系结构和802.11MAC协议。

1. IEEE802.11 frame and 802.11 capabilities.

IEEE802.11帧和802.11的特性。

1. Principles of mobility.

移动管理原理。

1. Elements of mobile networks architecture.

移动网路体系结构中的要素。

1. Two approach of addressing.

两种寻址方式。

1. Standards to mobile IP.

移动IP标准。

1. Agent discovery and Registration.

代理发现与归属代理注册。

1. Handling mobility in Cellular networks.

处理蜂窝网络的移动性。

1. Impact on higher layer protocols.

对高层协议的影响。

**Chapter 7 Security in Computer Networks 第七章 计算机网络中的安全 理论课时Hours 1/实践课时Actual Hours 1**

教学内容 Teaching Content:

7.1 What is Network Security (introduction of network security)

7.1什么是网络安全（网络安全简介）

7.2 Principles of Cryptography (symmetric key cryptography and public key encryption)

7.2密码学原理（对称密钥加密和公开密钥加密）

7.3 Message Integrity and Digital Signature (cryptographic hash functions, message authentication, and digital signatures)

7.3报文完整性和数字签名（加密散列函数、报文鉴别码和数字签名）

7.4 End-Point Authentication (Authentication Protocols)

7.4 端点鉴别（端点鉴别协议）

7.5 Securing E-Mail (Secure E-Mail and PGP)

7.5保护电子邮件（安全电子邮件和PGP）

7.6 Securing TCP Connections: SSL (the big picture and more complete picture)

7.6保护TCP连接：SSL（全局和更完整的描述）

7.7 Network Layer Security: IPsec and Virtual Private Networks (IPsec and VPNs, AH and ESP protocols, security associations, IPsec datagram, and IKE)

7.7网络层安全性：IPsec和虚拟专用网络（IPsec和VPN、AH和ESP协议、安全关联、IPsec数据报和IKE）

7.8 Securing Wireless LANs (WEP and IEEE 802.11i)

7.8使无线局域网安全（WEP和IEEE 802.11i）

7.9 Operational Security (firewalls and intrusion detection systems)

7.9操作安全（防火墙和入侵检测系统）

知识要求 Knowledge Requirements:

1. To grasp the basic concept of network security, Principles of cryptography. After the class, students should explain confidentiality, message integrity, end-point authentication, and operational security, distinguish symmetric key cryptography and public key cryptography.

掌握网络安全的基本概念、密码学原理。课后，学生应解释机密性、消息完整性、端点认证和操作安全性，区分对称密钥加密和公钥加密。

1. To comprehend the approaches of message integrity and authentication. Students should be able to explain digital signatures, MD5 and SHA, certification authority, and ap1.0, ap2.0, ap3.0, ap3.1, ap4.0.

了解消息完整性和身份验证的方法。学生应能解释数字签名、MD5和SHA、证书颁发机构以及ap1.0、ap2.0、ap3.0、ap3.1、ap4.0。

1. To understand the securing e-mail, SSL, IP Security, VPN, WEP, Firewalls, IDS. Students should distinguish two IPsec protocols, Toy SSL and real SSL, explain IKE, WEP encryption and authentication, the principles of Intrusion detection systems, and list three types of firewalls.

了解安全电子邮件、SSL、IP安全、VPN、WEP、防火墙、IDS。学生应区分两种IPsec协议，玩具SSL和真实SSL，解释IKE、WEP加密和认证、入侵检测系统的原理，并列出三种类型的防火墙。

教学难点 Difficulties in Teaching：

1. Basic concept of network security.

网络安全基本概念。

1. Principles of cryptography.

密码学原理。

1. Symmetric key crypto and public key crypto.

对称加密和公钥加密。

1. Digital signatures and CA.

数字签名和认证中心。

1. Authentication protocols.

鉴别协议。

1. Securing e-mail and SSL.

安全电子邮件和安全套接字层

1. IPsec and VPN.

IP安全和虚拟专用网。

1. WEP，Firewalls, and IDS.

有线等效保密，防火墙和入侵检测系统。

**Chapter 8 Multimedia Networking 第八章 多媒体网络 理论课时Hours 1/实践课时Actual Hours 1**

教学内容 Teaching Content:

8.1 Multimedia Networking Applications (properties of video and audio and types of multimedia network applications)

8.1多媒体网络应用（视频和音频的性质和多媒体网络应用的类型）

8.2 Streaming Stored Video (UDP Steaming and HTTP Steaming)

8.2流式存储视频（UDP流和HTTP流）

8.3 Voice-over-IP (limitations of the best-effort IP service, removing Jitter at the receiver for audio, recovering from packet loss)

8.3 IP语音（尽力而为IP服务的限制，消除音频接收器的抖动，从丢包中恢复）

8.4 Protocols for Real-Time Conversational Applications (RTP and SIP)

8.4实时会话应用协议（RTP和SIP）

8.5 Network Support for Multimedia (dimensioning best-effort networks, providing multiple classes of service, Diffserv, and per-connection QoS guarantees)

8.5多媒体网络支持（定制尽力而为的网络，提供多种类型的服务、区分服务和每连接服务质量保证）

知识要求 Knowledge Requirements:

本次授课目的与要求 Teaching Objectives and Requirements

1. To grasp the characteristics of audio and video, multimedia networking applications taxonomy. After the class, students should explain the characteristics of audio and video and list three main multimedia networking applications.

掌握音视频的特点，多媒体网络应用分类。课后，学生应解释音频和视频的特点，并列出三种主要的多媒体网络应用。

1. To comprehend the types of streaming stored video, Http streaming, client-side buffering and playout. Students should be able to list three types of streaming stored video, challenges of streaming stored video, and analyze client-side buffering.

了解流存储视频的类型、Http流、客户端缓冲和播放。学生应能够列出三种类型的流式存储视频、流式存储视频的挑战，并分析客户端缓冲。

1. To understand Voice over IP and VoIP characteristics. Students should explain packet loss and delay, and jitter, the approaches to remove jitter, and loss recovery scheme.

了解IP语音和VoIP特性。学生应解释包丢失和延迟、抖动、消除抖动的方法和丢失恢复方案

1. To master protocols for real-time conversational applications: RTP and SIP. Students should illustrate RTP and SIP.

掌握实时会话应用的协议：RTP和SIP。学生应说明RTP和SIP。

1. To realize the network support multimedia and their limitations. Students should list approaches to support multimedia.

实现网络对多媒体的支持及其局限性。学生应列出支持多媒体的方法。

教学难点 Difficulties in Teaching：

1. Characteristics of audio and video.

音视频的特点。

1. Multimedia networking applications taxonomy。

多媒体网络应用分类。

1. Types of streaming stored video.

流存储视频的类型。

1. Challenges of streaming stored video.

流存储视频面对的挑战。

1. Client-side buffering and playout。

客户端缓冲和播出。

1. VoIP characteristics.

IP语音的网络特性。

1. Approaches to remove jitter and loss recovery scheme.

消除抖动的方法和丢包恢复方案。

七、课内实验名称及基本要求**In-Class Experiment and Basic Requirements**（选填，适用于课内实验）

列出课程实验的名称、学时数、实验类型（演示型、验证型、设计型、综合型）及每个实验的内容简述。

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| --- | --- | --- | --- | --- | --- |
| 序号  No. | 实验名称  Name of Experiment | 主要内容  Main Content of the Experiment | 实验  时数  Experiment  Hours | 实验  类型  Experiment  Type | 备注  Notes |
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七、实践环节各阶段名称及基本要求**Stages of Practice Link and Basic Requirements**（选填，适用于集中实践、实习、毕业设计等）

列出实践环节各阶段的名称、实践的天数或周数及每个阶段的内容简述。

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| --- | --- | --- | --- | --- |
| **序号**  No. | **各阶段名称**  Name of Each Stage | **实践主要内容**  Main Content of the Stages | **天数/周数**  Days/Weeks | **备注**  Remarks |
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八、评价方式与成绩**Assessment Index & Weightage**

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| --- | --- | --- |
| **总评构成（1+X）**  **Grading Computation** | **评价方式**  **Assessment Index** | **占比（%)**  **Weightage（%）** |
| 1 | 期末考核：个人项目报告（2000 words）  Final Personal Report（2000 words） | 50% |
| X1 | 过程考核：个人作业（800 words）  Personal Work（800 words） | 20% |
| X2 | 过程考核：小组团队作业（1200 words）  Team Work（1200 words） | 20% |
| X3 | 过程考核：课堂表现、出勤  Class Performance | 10% |

“1”一般为总结性评价, “X”为过程性评价，“X”的次数一般不少于3次，无论是“1”、还是“X”，都可以是纸笔测试，也可以是表现性评价。与能力本位相适应的课程评价方式，较少采用纸笔测试，较多采用表现性评价。

常用的评价方式有：课堂展示、口头报告、论文、日志、反思、调查报告、个人项目报告、小组项目报告、实验报告、读书报告、作品（选集）、口试、课堂小测验、期终闭卷考、期终开卷考、工作现场评估、自我评估、同辈评估等等。**一般课外扩展阅读的检查评价应该成为“X”中的一部分。**

同一门课程由多个教师共同授课的，由课程组共同讨论决定X的内容、次数及比例。

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| --- | --- |
| 撰写人 邵苏Su Shao  Tutor Signature： | 系主任审核  Program Leader Signature： |
| 时间  Date： | 时间  Date： |