

课程详述

COURSE SPECIFICATION

以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

1.	课程名称 Course Title	物联网技术 Internet of Things				
2.	授课院系 Originating Department	计算机科学与工程系 Department of Computer Science and Technology				
3.	课程编号 Course Code	CS314				
4.	课程学分 Credit Value	3				
5.	课程类别 Course Type	专业选修课 Major Elective Courses				
6.	授课学期 Semester	春季 Spring				
7.	授课语言 Teaching Language	英语 English (lecture session), 中文 Chinese (practice session)				
8.	授课教师、所属学系、联系方式 (如属团队授课, 请列明其他授课教师) Instructor(s), Affiliation & Contact (For team teaching, please list all instructors)	杨双华, 讲席教授, 计算机科学与工程系, yangsh@sustech.edu.cn Shuang-Hua Yang, Chair Professor, Department of Computer Science and Technology, yangsh@sustech.edu.cn				
9.	实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact	吴静, 研究助理, 计算机科学与工程系, wuj3@mail.sustech.edu.cn Jing Wu, Research Assistant, Department of Computer Science and Technology, wuj3@mail.sustech.edu.cn				
10.	选课人数限额(可不填) Maximum Enrolment (Optional)					
11.	授课方式 Delivery Method	讲授 Lectures	习题/辅导/讨论 Tutorials	实验/实习 Lab/Practical	其它(请具体注明) Other (Please specify)	总学时 Total
	学时数 Credit Hours	32		32		64

12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	CS305 计算机网络 Computer Networks OR an equivalent course in another university
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	无
14. 其它要求修读本课程的学系 Cross-listing Dept.	电子系 Electronic and Electrical Engineering Department

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

本课程主要介绍物联网的主要最新进展，包括各种标准、框架和协议、无线通信技术，特别是移动无线通信技术、无线传感器技术、物联网技术、以及大数据技术等。本课程强调动手编程能力，学生应了解各种物联网技术在实际问题中的应用，以及如何用计算机编程语言实现算法。

The aims of this module are to introduce students to IoT's protocols and standards currently in use and to explore general wireless networking technologies, particularly in general wireless networks, wireless mobile ad hoc networks (MANET), wireless sensor networks, and Internet of Things (IoT), and associated technologies such as Big Data.

16. 预达学习成果 Learning Outcomes

在课程完成时，学生应该能够掌握本领域相关知识、分析认识能力、和实现系统的能力：

1. 能够理解和解释 (1) 物联网、大数据、无线网络、移动无线网，以及其他无线通信技术的原理； (2) 无线传感器网络原理； (3) 无线传感器节点、嵌入式软件、路由算法和能源管理的原理；
2. 能够分析认识 (1) 物联网应用中的理论； (2) 无线传感器网络中嵌入式软件设计的需要； (3) 制定设计需要。
3. 能够实施 (1) 无线传感器网络中嵌入式软件规划； (2) 无线传感器网络中嵌入式软件实现； (3) 无线传感器网络中嵌入式软件运行。

On completion of this module students should be able to:

1. Knowledge and Understanding

Repeat and explain knowledge and understanding of:

- essential principles of IoT, Big Data, Wireless Networks, MANET, and other wireless communication technologies,
- wireless sensor networks,
- essential techniques of wireless sensor nodes, embedded software, routing algorithms and power management.

2. Subject-Related Cognitive Abilities

- Apply appropriate theoretical concepts in the analysis of IoT,
- Distinguish the requirements and specifications appropriate to embedded software design for wireless sensor networks,
- Assemble and prepare such requirements and specifications.

3. Subject-Related Practical Abilities

- Sketch and schedule embedded software for wireless sensor networks,
- Practice embedded software for wireless sensor networks,
- Demonstrate embedded software for wireless sensor networks.

17. 课程内容及教学日历 (如授课语言以英文为主，则课程内容介绍可以用英文；如团队教学或模块教学，教学日历须注明主讲人)

Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)

第一周：导论

- 课程介绍
- 物联网导论

[实验课] 介绍实验课软件、工具箱、网络资源。

第二周：无线网络与无线传感器网络导论

- 无线网络导论
- 无线传感器网络导论

[实验课] 熟悉嵌入式软硬件环境和编程。

第三周：IP 与有线网络

- 互联网架构和 ISPs
- 互联网基础原理
- OSI 堆栈和 TCP/IP 模组
- IPv4 寻址，类和子网掩码

[实验课] 8051、arm 内核单片机开发

第四周：无线随建即连网络(MANET)原理

- 随建即连网络概念
- 随建即连网络与无线 LAN 的区别
- 路由的概念

[实验课] 移动自组网络协议栈开发

第五周：无线随建即连网络的路由算法 1

- 动态源路由协议 (Dynamic Source Routing, DSR)
- 无线自组网按需平面距离向量路由协议 (AODV)

[实验课] MANET 网络拓扑结构实验 1

第六周：无线随建即连网络的路由算法 2

- DSDV 协议
- 未知和已知的问题

[实验课] MANET 网络拓扑结构实验 2

第七周：无线传感器节点(WSN)硬件设计

- WSN 硬件设计注意事项
- WSN 可用年限计算
- 电源管理

[实验课] zigbee 无线传感网络广播实验

第八周：WSN 的嵌入式软件设计 1

- 嵌入式软件设计架构
- 传感器驱动设计
- 物理层和 MAC

[实验课] NB-IOT 物联网嵌入式软硬件环境和编程

第九周：WSN 的嵌入式软件设计 2

- 网络层
- 应用层

[实验课] NB-IOT 物联网系统基础编程实验

第十周：路由算法

- 扁平网络路由
- 分级路由
- 基于位置的路由
- 常用的路由协议

[实验课] NB-IOT 传感网络实验

第十一周：无线系统的共存

- 2.4GHz ISM 频段的干扰
- 抗干扰策略设计

[实验课] NB-IOT 无线通信实验

第十二周：流媒体数据融合

- 从数据融合到传感器数据融合
- 传感器数据融合的技术
- 物联网的大数据

[实验课] 物联网云平台实验

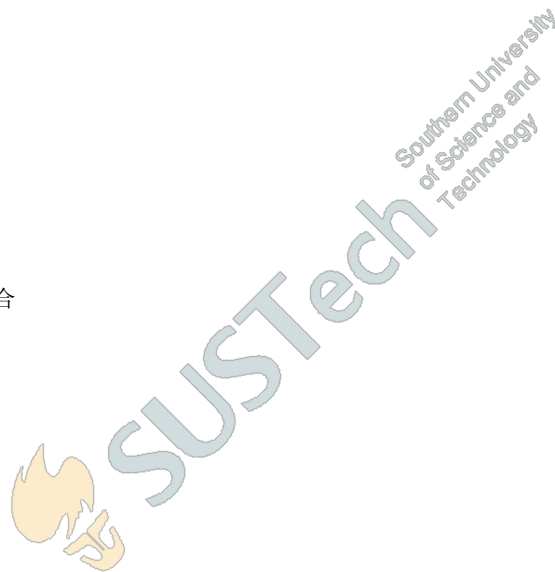
第十三周：物联网的安全性

- 高级加密标准 (AES)
- 计数器 (CTR) 模式加密
- 密码块链 (CBC) 模式加密
- ZigBee 的安全性
- 系统级防护-拒接访问 (DoS)

[实验课] 物联网智慧停车实训实验

第十四周：大数据

- 大数据价值链



- 数据集成
- 可视化
- Hadoop
- HDFS 和 MapReduce

[实验课] 物联网智慧环境实训实验

第十五周：室内追踪定位

- 定位方法
- 定位和追踪系统
- 基于 ZigBee 的 RTLS

[实验课] 物联网共享单车实训实验

第十六周：物流管理和复习

- RFID, 传感器与 WSNs
- 集成 RFID 和无线传感器网络
- 实际案例
- 总结与复习

[实验课] 复习与问答

Week 1: Introduction

- Overview of the module specification
- Introduction of Internet of Things
- Lab session: Understand the lab test toolbox

Week 2: Introduction to wireless networks and WSN

- Introduction to wireless networks
- Introduction of wireless sensor networks
- Lab session: Understand embedded software and hardware environment and programming

Week 3: IP and Wired Networks

- Internet structure and ISPs
- Internet fundamental principles
- OSI stack and TCP/IP model
- IPv4, addressing, classes, subnet and masks
- Lab session: Development of 8051 and ARM core microcontroller

Week 4: Principle of Wireless Mobile Ad Hoc Networks (MANET)

- Concept of Ad Hoc networks
- Differences between Ad Hoc network and wireless LAN
- Concept of routing
- Lab session: Development of Protocol Stack for MANET

Week 5: Routing Algorithms of Wireless Ad Hoc Networks 1

- Dynamic Source Routing (DSR)
- AODV
- Lab session: MANET Network Topology1

Week 6: Routing Algorithms of Wireless Ad Hoc Networks 2

- Destination Sequenced Distance Vector (DSDV)
- Hidden/exposed problems
- Lab session: MANET Network Topology2

Week 7: Wireless Sensor Node Hardware Design

- WSN hardware design considerations
- WSN's lifetime calculation
- Power management
- Lab session: Broadcasting experiment of Zigbee Wireless Sensor Network

Week 8: Embedded Software Design for WSN 1

- Architecture of embedded software design
- Sensor driver design
- Physical and MAC layer
- Lab session: Embedded software and Hardware Environment and Programming of NB IOT

Week 9: Embedded Software Design for WSN 2

- Network layer
- Application layer
- Lab session: Basic Programming Experiment of NB IOT

Week 10: Routing Algorithms

- Flat networking routing
- Hierarchical routing
- Location-based routing
- Routing protocols commonly used
- Lab session: NB IOT Sensor Network Experiment

Week 11: Co-existence of Wireless Systems

- Interferers on the 2.4 GHz ISM bands
- Interference mitigation strategies design
- Lab session: NB IOT Wireless Communication Experiment

Week 12: Streaming data fusion

- From data fusion to sensor data fusion

- Sensor data fusion techniques
- Big data in IoT
- Lab session: Internet of Things Cloud Platform Experiment

Week 13: IoT Security

- Advanced Encryption Standard (AES)
- Counter (CTR) mode encryption
- Cipher Block Chaining (CBC) mode encryption
- ZigBee security
- System level protection - Denial of Service (DoS)
- Lab session: IOT Intelligent Parking Training Experiment

Week 14: Big Data

- Big Data value chains
- Data integration
- Visualization
- Hadoop
- HDFS and MapReduce
- Lab session: IOT Intelligent Environment Training Experiment

Week 15: Indoor Location Tracking

- Localization methods
- Localization and tracking systems
- ZigBee based RTLS
- Lab session: IOT Shared bicycle Training Experiment

Week 16: Logistics Management & Revision

- RFID, sensors and WSNs
- Integrated RFID and wireless sensor networks
- Case studies
- Summary & Revision
- Lab session: Revision, Q&A.



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18. 教材及其它参考资料 Textbook and Supplementary Readings

- Monograph 'Wireless sensor networks principle, design, and application' by Shuang-Hua Yang. 2014, Springer, ISBN 978-1-4471-5504-1.
- 中译本, 杨双华, 2015
- IEEE E-learning tutorial
- Any other wireless networks textbooks (Wireless networks, by P. Nicopolitidis, M.S. Obaidat, G.I. Papadimitriou, and A.S. Pomportsis, Wiley)
- David Feinleib. Big Data Bootcamp -- What Managers Need to Know to Profit from the Big Data Revolution. ISBN: 978-1-4842-0041-4 (Print) 978-1-4842-0040-7 (Online), Springer, 2014
- Zikopoulos P, deRoos D, Bienko C, Buglio R, Andrews M (2015) Big Data Beyond the Hype, McGrawHill Kitchin R (2014), The Data Revolution

- Research papers published in recent years

课程评估 ASSESSMENT

19. 评估形式 Type of Assessment	评估时间 Time	占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes
出勤 Attendance		10%		
课堂表现 Class Performance				
小测验 Quiz				
课程项目 Projects		30%		实验室课题报告与演示
平时作业 Assignments				
期中考试 Mid-Term Test				
期末考试 Final Exam		60%		闭卷考试 closed paper based examination
期末报告 Final Presentation				
其它（可根据需要 改写以上评估方式） Others (The above may be modified as necessary)				

20. 记分方式 GRADING SYSTEM

- A. 十三级等级制 Letter Grading
 B. 二级记分制（通过/不通过） Pass/Fail Grading

课程审批 REVIEW AND APPROVAL

21. 本课程设置已经过以下责任人/委员会审议通过
 This Course has been approved by the following person or committee of authority