Course Specification
(Bachelor)

Course Title:	**Wireless Networks**
Course Code:	CS1762
Program:	Computer Science
Department:	Computer Science and Engineering
College:	Computer Science and information technology
Institution:	Al-Baha University
Version:	T104 – V1
Last Revision Date:	February 11, 2023

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A. General information about the course:

1. Course Identification

1. Credit hours: (3)					
2. Course type					
A.	☐University	☐College	☐Department	☐Track	☐Others
B.	☐Required		☒ Elective		
3. Level/year at which this course is offered: (Level 9 / 3rd Year)					
4. Course general Description:					

Lecture:
Wireless networks play an increasingly important role in the world of communications. This course provides an introduction to various current and next generation wireless networking technologies, and undertakes a detailed exploration of fundamental architectural and design principles used at all layers. Related protocols and their performance are studied using formal analytical tools and realistic simulations.

5. Pre-requirements for this course (if any):

Network Switching and Routing
(CS1758)

6. Co-requirements for this course (if any):

None

7. Course Main Objective(s):

The main purpose for this course is to:

- 1. Understand the architecture and applications of current and next generation wireless networks: Cellular, WLANs, sensor networks, mobile ad-hoc networks and intermittently connected mobile networks.
- 2. Get a basic introduction to the key concepts and techniques underlying modern physical layer wireless and mobile communications: radio propagation modeling; performance of digital modulation schemes and coding techniques in fading environments; CDMA and OFDM; diversity and MIMO. (These topics are all explored in much greater detail in EE 535, the goal here is to provide a sufficient survey of this topics so that the higher layer protocols are wellgrounded and motivated.)

- 3. Learn how to design and analyze various medium access and resource allocation techniques such as power control for fixed-rate and rate-adaptive systems, Aloha and CSMAbased randomized medium access, scheduling for TDMA/FDMA/CDMA-based wireless networks.
- 4. Learn how to design and analyze network layer routing protocols, along with key component mechanisms, such as link metric estimation and neighborhood table management for proactive and reactive routing protocols, opportunistic routing, backpressure routing, network coding, cooperative routing, routing with mobility and intermittent contacts.
- 5. Learn to design and analyze transport layer protocols, with an emphasis on congestion control, including TCP over wireless, congestion sharing mechanisms, explicit and precise rate control, utility optimization-based approaches, and backpressure-based utility optimization.
- 6. Learn how to evaluate MAC and network protocols using network simulation software tools such as NS-2 or Qualnet..

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	33	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning	33	100%

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	33
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		33

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Understand the architecture and applications of current and next generation wireless networks: Cellular, WLANs, sensor networks, mobile ad-hoc networks and intermittently connected mobile networks.	**K1**	• Lecture /Slide Presentations • Exercises • Assignments	• Midterm exam • Quiz • Final Exam • Rubric
1.2	Get a basic introduction to the key concepts and techniques underlying modern physical layer wireless and mobile communications: radio propagation modeling; performance of digital modulation schemes and coding techniques in fading environments; CDMA and OFDM; diversity and MIMO. (These topics are all explored in much greater detail in EE 535, the goal here is to provide a sufficient survey of this topics so that the higher layer protocols are wellgrounded and motivated.)	**K1**	• Lecture /Slide Presentations	• Midterm exam • Quiz • Final Exam • Rubric
1.3	Learn how to design and analyze various medium access and resource allocation techniques such as power control for fixed-rate and rate-adaptive systems, Aloha and CSMAbased randomized medium access, scheduli	**K2**	• Lecture /Slide Presentations • Exercises • Assignments	• Midterm exam • Quiz • Final Exam • Rubric

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
2.0	**Skills**			
2.1	How to design and analyze network layer routing protocols, along with key component mechanisms, such as link metric estimation and neighborhood table management for proactive and reactive routing protocols, opportunistic routing, backpressure routing, network coding, cooperative routing, routing with mobility and intermittent contacts	**S1**	• Lecture /Slide Presentations • Exercises • Assignments	• Midterm exam • Quiz • Final Exam • Rubric
2.2	Learn to design and analyze transport layer protocols, with an emphasis on congestion control, including TCP over wireless, congestion sharing mechanisms, explicit and precise rate control, utility optimization-based approaches, and backpressure-based utility optimization.	**S2**	• Lecture /Slide Presentations • Exercises • Assignments	• Midterm exam • Quiz • Final Exam • Rubric
2.3	Learn how to evaluate MAC and network protocols using network simulation software tools such as NS-2 or Qualnet	**S3**	• Lecture /Slide Presentations • Exercises • Assignments	• Midterm exam • Quiz • Final Exam • Rubric
3.0	**Values, autonomy, and responsibility**			
3.1	Work both independently and collaboratively	**V1**	• Oral Presentations	• Project evaluation form (Rubric)
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C. Course Content

No	List of Topics	Contact Hours
1.	Introduction to wireless network architectures: cellular networks, wireless local area networks, multi-hop networks	**3**

2.	Radio propagation models, Narrowband digital modulation and Coding under wireless fading environments. Assignment 1 on network architecture and phy-layer.	3
3.	Basics of CDMA and OFDM, Diversity and MIMO, Equalization. Project 1 assigned: Simulation of coding and modulation on a single link.	3
4.	Randomized medium access 1: Unslotted and Slotted Aloha. System throughput analysis and two-user saturation rate region analysis	3
5.	Randomized medium access 2: CSMA. System throughput analysis and two-user rate region analysis for p-persistent CSMA. Bianchi's Markov chain analysis of throughput for the IEEE 802.11 CSMA protocol. Other window adaptation mechanisms. Assignment 2 on power allocation/control and randomized medium access	3
6.	Graph coloring and its application to channel allocation in (TDMA/FDMA/CDMA-based) wireless networks under the protocol model.	3
7.	Introduction to multi-hop wireless network routing. The AODV and OLSR protocols for mobile ad-hoc networks. Link estimation and neighbor management.	3
8.	Geographic routing: greedy routing and different solutions for avoiding routing holes. Routing in intermittently connected mobile networks	3
9.	Theory and Practice of Dynamic Backpressure Routing. Theory: Lyapunov drift minimization yielding the centralized maximum weight independent set matching solution. Practice: the BCP protocol for sensor networks.	3
10.	TCP over wireless networks. Congestion sharing (IFRC, WCAP). Centralized and distributed explicit and precise rate control (RCRT, WRCP)	3
11.	Optimization-based rate control with Lagrange duality and with queue backpressure. Assignment 5 on Wireless Congestion Control.	3
Total		**33**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Homework	Periodically (every two weeks)	10%
2.	Midterm exam	Week 6	20%
3.	Quiz	Week 10	10%
4.	Project	Week 12	10%
5.	Final Exam	Week 13	50%
	Total		100%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	"*Wireless* Communications and *Networks*" by *William Stallings*, Second edition.
Supportive References	Wireless Communications, Andrea Goldsmith, Cambridge University Press
Electronic Materials	• IEEE Xplore: https://ieeexplore.ieee.org/ • IEEE Communications Society (ComSoc): https://www.comsoc.org/ • ACM (Association for Computer Machinery) web site - http://www.acm.org/ • Open access course material online
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources

facilities
(Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)
	• A classroom or lecture hall with whiteboard.
	• An instructor computer station with
	  ○ High speed Internet connection
	  ○ A desktop computer with a common database managements system access
	  ○ Power outlets for instructor's laptop plug-in
	  ○ A digital image projection system with connection and switches to desktop computer and laptop computer
	  ○ All laboratories should have computers with access to at least one major database management system

Technology equipment (projector, smart board, software)	Students are supposed to have • A laptop or access to a desktop computer with access to a major database management system • High speed Internet connection • Power outlets for student's laptop plug-in
Other equipment (depending on the nature of the specialty)	• A lab with high speed internet connection and installed the last version of Android Studio

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	• Students • Faculty • Peer Reviewers • Program Leader	• Surveys (indirect). • Direct feedback from students (interview between Program leader and students).

Assessment Areas/Issues	Assessor	Assessment Methods
	• Course Coordinator	• Course evaluation by Peer Reviewers (indirect). • Class visit by Program Leader • Comprehensive Course report (where we can find information about teaching difficulties and action plan, …)
Effectiveness of Students assessment	• Students • Faculty • Peer Reviewers • Course Coordinator • Exam Evaluation Committee • Course Coordinator	• Surveys (indirect). • Direct feedback from students (interview between Program leader and students). • Assessment results (direct) • Course evaluation by Peer Reviewers (indirect). • Comprehensive Course report (where we can find information about assessment difficulties and action plan, …) • Exam evaluation by the Exam Evaluation Committee (indirect)
Quality of learning resources	• Students • Faculty • Peer Reviewers • Course Coordinator	• Surveys (indirect) • Course evaluation by Peer Reviewers (indirect). • Comprehensive Course report (where we can find information about difficulties and challenges about learning resources as well as consequences and action plan, …)
The extent to which CLOs have been achieved	• Faculty • Program Leader • Course Coordinator	• Student Results (direct) • Comprehensive Course report (where we can find the CLO assessment results)
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	
REFERENCE NO.	
DATE	

Khaled Aburas