Course Specification
— (Bachelor)

Course Title: Advanced Network Infrastructure Technologies
Course Code: CNET 451
Program: Bachelor of Computer & Network Engineering
Department: Department of Electrical & Electronics Engineering
College: College of Engineering & Computer Science
Institution: Jazan University, Jazan
Version: 13
Last Revision Date: 2024/09/22

Table of Contents

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-7/Year-4)

4. Course General Description:

This module offers the opportunity to learn and critically reflect on the skills needed for Wide Area Networks (WANs) and infrastructure. The course provides an introduction to WAN technologies, design, and ATM concepts. It also covers advanced infrastructure topics such as IoT, edge computing, and Software-Defined Networking (SDN). Building on foundational networking knowledge and theory, this module reviews the requirements for large-scale network deployment and engineering.

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

CNET 341, Data Communication -1

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

None

7. Course Main Objective(s):

This course will develop the student's ability to learn:

- Describe the WAN technologies concept according to the OSI model layers and services.
- Analysis of WAN topology, traffic, and connection for WAN communications
- Describe and differentiate the various advanced technologies of WAN.
- Explain the fundamental concepts and architecture of the Internet of Things, including its key components and technologies.
- Explain the concept of edge computing and its significance in modern network architectures.
- Describe the architecture of SDN, including its key components such as the control plane, data plane, and application layer.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	60	100%
2	E-learning	--	--
3	Hybrid • Traditional classroom • E-learning	--	--

No	Mode of Instruction	Contact Hours	Percentage
4	Distance learning	--	--

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	26
2.	**Laboratory/Studio**	26
3.	**Field**	--
4.	**Tutorial**	--
5.	**Others (specify)**	8
Total		60

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

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Explain various types of WAN and Evolving Network Models.	K2	➢ Lectures ➢ Classroom discussions ➢ Lab exercises	➢ Mid-Term Exam ➢ Assignments ➢ Final Exam
1.2	Describe the concept of latest WAN technologies and various connection options.	K3	➢ Lectures ➢ Classroom discussions ➢ Lab exercises	➢ Assignments ➢ Lab Exam ➢ Final Exam
2.0	**Skills**			
2.1	Evaluate and design WAN technology models for network infrastructure.	S2	➢ Lectures ➢ Classroom discussion ➢ Lab Exercises	➢ Final Exam ➢ Mini Project ➢ Assignments
2.2	Analyze the different WAN connection options and their impact on network performance.	S5	➢ Lectures ➢ Classroom discussion ➢ Lab Exercises	➢ Assignments ➢ Mini Project ➢ LAB Exam

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.3	Apply the key components to the IoT architecture using latest applications, including sensors, actuators, and network connectivity.	S3	➤ Lectures ➤ Classroom discussion ➤ Lab Exercises	➤ Assignments ➤ Mini Project ➤ LAB Exam
2.4	Solve complex problems of the edge computing and deployment models, standards & technologies.	S1	➤ Lectures ➤ Classroom discussion ➤ Lab Exercises	➤ Final Exam ➤ Mini Project ➤ Assignments ➤ LAB Exam
3.0	**Values, autonomy, and responsibility**			
3.1	Demonstrate network design with professional & ethical responsibilities and make inform the judgments.	V3	➤ Lectures ➤ Classroom discussion	➤ Mini Project ➤ LAB Assessment

C. Course Content

No	List of Topics	Contact Hours
1.	**Chapter -1 Concepts of WAN** Introduction WANs ● What is WAN? ● Why Are WANs Necessary? The Evolving Enterprise ● Businesses and Their Networks ● Branch (WAN) ● Distributed (Global) The Evolving Network Model ● The Hierarchical Design Model The Enterprise Architecture	4T + 4P
2.	**Chapter 2: WAN Technology & Connection** WAN Technology Concepts ● WAN Technology Overview ● WAN Physical Layer Concepts ● WAN Data Link Layer Concepts ● WAN Switching Concepts WAN Connection Options ● WAN Link Connection Options ● Dedicated Connection Link Options ● Circuit-Switched Connection Options	4T + 4P
3.	**Chapter-3: WAN Communications and Traffic** ● WAN Communications ● Steps in WAN Design ● WAN Traffic Considerations ● WAN Topology Considerations ● WAN Connection Technologies ● WAN Bandwidth Considerations	4T + 4P

	● Common WAN Implementations Issues	

4.	**Chapter-4: Internet of Things (IoT): A Comprehensive Overview**
	● Introduction to IoT
	● Importance and Impact on Various Industries
	● Key Components of IoT
	● IoT Platforms and Middleware
	● IoT Architecture
	● IoT Architecture Layers
	    ✔ Physical/Perception Layer
	    ✔ Network Layer
	    ✔ Support Layer
	    ✔ Application Layer
	● Stages of IoT Architecture
	    ✔ Sensors and Actuators
	    ✔ Gateways and Data Acquisition Systems
	    ✔ Edge IT Data Processing
	    ✔ Data Center and Cloud
	How to build a successful IoT Architecture?
		4T + 4P

5.	**Chapter – 5: Edge Computing: Empowering the Future Frame**
	● Evolution of Computing
	    ✔ Traditional centralized computing
	    ✔ Distributed Computing
	    ✔ Edge Computing
	● Components of Edge Computing
	● Edge Computing Deployment Models
	● Edge Computing Standards
	● Edge Computing Market Trends
	● Edge Computing Challenges
	    ✔ Latency
	    ✔ Connectivity
	    ✔ Security
	● Edge Computing Technologies
	    ✔ Software-Defined Networking (SDN)
	    ✔ Network Function Virtualization (NFV)
	    ✔ Containerization (e.g., Docker, Kubernetes)
	● Edge Computing in 5G Networks
	● Integration of Edge Computing with 5G Networks
	Enabling Ultra-Reliable Low-Latency Communication (URLLC)
		5T + 5P

6.	**Chapter 6: Software Defined Networks**
	● Introduction to SDN
	● Why SDN?
	● Data center needs
	    ✔ Automation
	    ✔ Scalability
	    ✔ Multipathing
	    ✔ Multitenancy
	    ✔ Network virtualization
	● How SDN works?
	    ✔ SDN operation
	    ✔ SDN devices
	    ✔ SDN software switches
		5T + 5P

	✓ Hardware SDN devices ● SDN controller ● SDN applications ● SDN futures SD-WAN	
7.	Review of all course contents	2T + 2P
8.	Final Exam	2T+2P
Total		

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Assignments-1	4th week	10%
2.	Mini project	6th week	10%
3.	Mid-Term Exam	7th - 8th week	20%
4.	Lab Exam	14th week	20%
5.	Final Exam	15th week	40%

*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	1. CCNA 200-301 Official Cert Guide Library, ISBN: 978-1-58714-714-2, By Cisco Networking Academy, Published Jul 14, 2020, by Cisco Press 2 2. (Wiley series on parallel and distributed computing) Buyya, Rajkumar_ Srirama, Satish Narayana - Fog and edge computing_ principles and paradigms-John Wiley & Sons (2019) 3. Software Defined Networks_ A Comprehensive Approach Second Edition ISBN: 978-0-12-804555-8 by Paul Göransson Chuck Black Timothy Culver, published 2016 by Elsevier.
Supportive References	1. Introduction to Networks Companion Guide (CCNAv7), ISBN: 978-0-13-663366-2, By Cisco Networking Academy, Published Jul 14, 2020, by Cisco Press. 2. Introduction to Networks Labs and Study Guide (CCNAv7) ISBN: 978-0-13-663445-4, By Allan Johnson, Cisco Networking Academy, Published Jun 17, 2020, by Cisco Press.
Electronic Materials	https://www.cisco.com https://www.netacad.com/

	https://www.networklearning.org/
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	**One lecture room equipped with a white board projector or smart board and sufficient seating arrangements for a maximum of 30 students at a time.**
Technology equipment (projector, smart board, software)	**Whiteboards and projectors/smart board for classroom and lab** **Following software for lab work:** ● **Cisco Packet Tracer 8.2** ● **GNS3** ● **Wireshark**
Other equipment (depending on the nature of the specialty)	**--**

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	**Students, HOD**	**Indirect, Direct**
Effectiveness of Students assessment	**CT / CC / HoD**	**Direct**
Quality of learning resources	**TL / CRC / PQC**	**Indirect, Direct**
The extent to which CLOs have been achieved	**CT / CC /TL / PQC**	**Indirect, Direct**
Other		

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

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**DEPARTMENT COUNCIL**
REFERENCE NO.	**ENGCSEEE2411**
DATE	**10/10/24**