



SCHOOL OF COMPUTING AND ENGINEERING SCIENCES
BACHELOR OF SCIENCE IN COMPUTER NETWORKS AND
CYBERSECURITY

CNS 3201 – Internetworking Communication Systems

FINAL EXAMINATION

DATE: 28th APRIL 2026

TIME: 2 Hours

INSTRUCTIONS

**ANSWER YOUR QUESTIONS IN THE ANSWER BOOKLET PROVIDED.
THIS EXAMINATION CONSISTS OF FIVE QUESTIONS. ANSWER QUESTION ONE [COMPULSORY] AND ANY OTHER TWO QUESTIONS.**

QUESTION ONE (COMPULSORY – 30 MARKS)

A private university is modernising its digital infrastructure to support hybrid learning, remote teaching, research collaboration, online administration, and secure access to internal services. The university plans to deploy:

- SIP-based voice and video communication,
- VLAN-based segmentation across faculties,
- centralized authentication using RADIUS integrated with Active Directory,
- IEEE 802.1X for secure wired and wireless access,
- SNMPv3 and syslog for secure monitoring and logging,
- VPN access for remote staff and lecturers,
- web services for student and learning platforms,
- LDAP, Single Sign-On (SSO), and OAuth 2.0 for identity and access management.

- (a) Explain, step by step, how the Session Initiation Protocol (SIP) establishes, manages, and terminates a multimedia communication session between two users in the university environment. [5 marks]
- (b) Explain how VLAN segmentation, centralized RADIUS authentication, and IEEE 802.1X work together to improve both **security** and **network manageability** in the university network. [6 marks]
- (c) State and explain **two** security advantages of using SNMPv3 instead of earlier versions of SNMP. Also state the role of **syslog** in network operations. [4 marks]
- (d) Recommend **one** suitable VPN technology for lecturers and staff working remotely, and justify your choice in terms of security and usability. [4 marks]
- (e) Compare **REST** and **SOAP** as communication models for the university's web-based systems. Your answer should refer to architecture, message format, overhead, and scalability. [5 marks]
- (f) Describe how **LDAP**, **Single Sign-On (SSO)**, and **OAuth 2.0** can be combined in one enterprise identity solution for the university. Clearly distinguish the role of each technology. [6 marks]

QUESTION TWO (15 MARKS): DNS, Geo-DNS and Content Delivery Networks

- (a) Explain the main functions of the Domain Name System (DNS) in the Internet. In your answer, distinguish clearly between:
 - (i) domain name resolution,
 - (ii) hierarchical naming, and
 - (iii) resource records.
 [5 marks]
- (b) Describe, step by step, how a client resolves the domain name **www.example.com** when the answer is not already available in the local DNS cache. [4 marks]
- (c) Explain what is meant by **Geo-DNS**. How does Geo-DNS improve user experience and service delivery in large-scale Internet applications? [3 marks]
- (d) Explain the role of a **Content Delivery Network (CDN)** in modern Internet services. [3 marks]

QUESTION THREE (15 MARKS): Web Services and API Communication

- (a) Explain the key architectural principles of REST. [4 marks]
- (b) Explain the main characteristics of SOAP-based web services. [4 marks]
- (c) Compare REST and SOAP with respect to:
 - (i) data representation,

- (ii) communication style,
- (iii) overhead, and
- (iv) scalability.

[4 marks]

- (d) State **one** practical situation where SOAP would be preferred over REST, and **one** situation where REST would be preferred over SOAP. [3 marks]

QUESTION FOUR (15 MARKS): Directory Services, SSO and OAuth 2.0

- (a) Explain the primary function of LDAP in an enterprise authentication and directory system. [4 marks]
- (b) Describe how Single Sign-On (SSO) improves both user experience and administrative control in a multi-application environment. [4 marks]
- (c) Using a clear workflow, explain the main components of OAuth 2.0, distinguishing between:
- (i) the Resource Owner,
 - (ii) the Client Application,
 - (iii) the Authorization Server, and
 - (iv) the Resource Server.

[4 marks]

- (d) Explain one practical way in which LDAP and OAuth 2.0 may be integrated in an organization. [3 marks]

QUESTION FIVE (15 MARKS): Secure Campus Network Design and Management

- (a) Explain how VLANs improve network performance, administration, and security in a campus network environment. [5 marks]
- (b) Discuss **two** advantages of using a centralized RADIUS server integrated with Active Directory instead of using local user accounts on each network device. [4 marks]
- (c) Explain the role of IEEE 802.1X in secure network access control. [3 marks]
- (d) State **three** reasons why secure monitoring and logging are necessary in modern enterprise networks, making reference to SNMPv3 and syslog. [3 marks]

End of Examination