THE INDEPENDENT
INSTITUTE OF
IIE EDUCATION

MODULE NAME:	MODULE CODE:
COMPUTER NETWORKS 1B	CONE5112
NETWORK ENGINEERING 1B	NWEG5122

ASSESSMENT TYPE: ASSIGNMENT 1 (PAPER ONLY)

TOTAL MARK ALLOCATION: 100 MARKS

TOTAL HOURS: 10 HOURS

By submitting this assignment, you acknowledge that you have read and understood all the rules as per the terms in the registration contract, in particular the assignment and assessment rules in The IIE Assessment Strategy and Policy (IIE009), the intellectual integrity and plagiarism rules in the Intellectual Integrity and Property Rights Policy (IIE023), as well as any rules and regulations published in the student portal.

INSTRUCTIONS:
1. ***No material may be copied from original sources, even if referenced correctly, unless it is a direct quote indicated with quotation marks. No more than 10% of the assignment may consist of direct quotes.***
2. ***Save a copy of your assignment before submitting it.***
3. *Assignments must be typed unless otherwise specified.*
4. *All work must be adequately and correctly referenced.*
5. *This is an individual assignment.*

Referencing Rubric

Providing evidence based on valid and referenced academic sources is a fundamental educational principle and the cornerstone of high-quality academic work. Part of achieving this quality is referencing in a way that is consistent and congruent with the requirements of the referencing style being used.

Therefore, inconsistent and/or incongruent referencing will result in a penalty of **a maximum of ten percent** being deducted from the overall percentage awarded to your assessment submission.

Please note that **evidence of plagiarism** in the form of copied or unreferenced work, absent reference lists, or exceptionally poor referencing **may result in action being taken in accordance with The IIE's Intellectual Integrity and Property Rights Policy (IIE023)**. Similarly, **evidence of excessive AI usage may result in action being taken in accordance with The IIE's Student Conduct, Discipline and Safety Policy (IIE015)**.

Markers are required to provide feedback to students by **circling/underlining the information in the table below that best describes the student's work and by adding constructive commentary where appropriate**. The examples provided are not exhaustive but illustrate the errors.

Deductions

- Where the student's work contains **five or more errors** aligned to the **minor errors column** below, **deduct 5% from the overall percentage.**

- Where the student's work contains **five or more errors** aligned to the **major errors column** below, **deduct 10% from the overall percentage.**

- **Where both minor and major errors** (e.g. two minor and three major, etc.) are present, **deduct 10% only** (and not 5% or 15%) from the overall percentage.

Required: Consistent and congruent referencing	Minor errors Deduct 5% from overall percentage. Example: if the response receives 70%, deduct 5%. The final mark is 65%.	Major errors Deduct 10% from the overall percentage. Example: if the response receives 70%, deduct 10%. The final mark is 60%.
Consistency • The **correct referencing style** for the **discipline** – i.e., either **Harvard**, OR **APA** (for Psychology**)**, OR **Law**, OR **IEEE** (for ICT/Engineering) – has been used consistently for all in-text references and in the bibliography/reference list. • **Concepts** and **ideas** that are **quoted** and/or **paraphrased** are referenced consistently throughout. • **Position of the in-text reference**: an in-text reference is positioned consistently where appropriate for every quote and paraphrase.	**Minor inconsistencies:** • The referencing style used is generally consistent with what is required, but there are one or two changes/errors in the format of in-text referencing and/or in the bibliography/reference list. • For example, page numbers for direct quotes in-text have been provided for one source, but not in another. Or, two book chapters in the bibliography/reference list have been referenced in two different formats. Or, the publication year has been placed after the author name in one bibliography/reference list entry, and after the source title in another, etc. • Concepts and ideas in quotes and/or paraphrases are typically referenced, but a full in-text reference is missing or incomplete from one or two small sections of the work. • Position of the references: in-text references are only given at the beginning and/or end of every paragraph.	**Major inconsistencies:** • Poor and wholly inconsistent referencing style used in-text and/or in the bibliography/reference list. • Multiple referencing styles for the same source types have been used. • For example, the format for direct quotes in-text and/or book chapters in the bibliography/reference list and/or year of publication in the bibliography/reference list is different across multiple instances. • Concepts and ideas in quotes and/or paraphrases are haphazardly referenced in-text. • Position of the references: in-text references are only given at the beginning or end of large sections of work.
Feedback on referencing consistency:		
Congruency • **Each source** reflected within **in-text references** is included accurately in the **bibliography/reference list.** • All **bibliography/reference list** entries are in the **required order** for the referencing style used (e.g. alphabetical, alphabetical under subheadings, numerical). • All **direct quotes** and **paraphrases** have been **integrated appropriately** into the text using introductory phrases, accurate grammar, etc.	**Minor incongruences:** • There is largely a match between the sources presented in-text and those in the bibliography/reference list, but one or two sources that appear in-text do not appear in the bibliography/reference list, or vice versa. Or key source information is missing from one or two in-text references or bibliography/reference list entries only (e.g. publication year, city of publication, URL date accessed, etc.). • There is a clear and largely accurate ordering of sources in the bibliography/reference list as required by the referencing style used, but with one or two references out of order. • An attempt has been made for source integration into the text using appropriate introductory phrases and grammar, but one or two quotes or paraphrases do not flow as clearly or logically within the sentence structure as they could.	**Major incongruences:** • No relationship/several incongruencies between the in-text referencing and the bibliography/reference list. • For example, multiple sources are included in-text, but not in the bibliography, and/or vice versa. Key source information is missing from multiple in-text references and/or reference list entries. A URL link, rather than the actual reference, is provided in the bibliography. Sources are repeated in the reference list, etc. • Most sources are listed in a haphazard order throughout the bibliography/reference list. • Few to no appropriate introductory phrases or rules of grammar have been applied, and many direct quotes and/or paraphrases feel disconnected from the flow of the text.
Feedback on referencing congruency:		
Overall feedback on referencing, with suggested improvements:		

Question 1   **(Marks: 15)**

Read the scenario below and answer the questions that follow:

Scenario:
Network Performance Challenges in an E-Learning Platform

ABC University has recently implemented an **e-learning platform** that allows students to attend **live online lectures** and submit assignments through the university's network. However, students frequently report **video buffering issues, high latency, and slow file uploads**.

The university's IT department investigates the problem, identifying **queuing delay, packet loss, and end-to-end delay** as contributing factors. Additionally, they examine how **protocol encapsulation** affects the transmission of data between students and the e-learning server.

As part of a **network performance optimization project**, the university's **network administrators** need to analyse the **causes and impacts** of these delays and propose **efficient solutions** to ensure smooth data transmission across the university's Internet infrastructure.

Describe how queuing delay, packet loss, and end-to-end delay affect the performance of an e-learning platform. **In your response, use examples to:**

Q.1.1	Explain queuing delay and packet loss, including their causes and impact on data transmission.	(4)
Q.1.2	Describe the concept of end-to-end delay and its components in network communication.	(3)
Q.1.3	**Illustrate the process of encapsulation** in data transmission and discuss its role in efficient packet delivery.	(3)

MARKING RUBRIC: QUESTION 1					Mark Allocation
Criteria	Excellent (5 Marks)	Good (3 – 4 Marks)	Satisfactory (2 Marks)	Needs Improvement (1 Marks)	
Q.1.1 Explanation of Queuing Delay and Packet Loss	Clearly defines and explains queuing delay and packet loss with **causes and network impact** in an e-learning system.	Defines and explains queuing delay and packet loss but lacks clarity on their impact.	Provides a basic definition but lacks depth in causes and impact.	Fails to define or explain queuing delay and packet loss correctly.	/4
Q.1.2 Description of End-to-End Delay	**Excellent (5 Marks)**	**Good (3 – 4 Marks)**	**Satisfactory (2 Marks)**	**Needs Improvement (1 Marks)**	/3
	Clearly explains end-to-end delay and its **components** in a well-structured manner.	Provides a reasonable explanation but lacks some key components.	Identifies the concept but does not break down the components effectively.	Fails to describe end-to-end delay or its components accurately.	
Q.1.3 Illustration of Encapsulation in Data Transmission	**Excellent (5 Marks)**	**Good (3 – 4 Marks)**	**Satisfactory (2 Marks)**	**Needs Improvement (1 Marks)**	/3
	Provides a **well-explained and clear** illustration of encapsulation and its role in network communication.	Explains encapsulation but lacks a **clear real-world application**.	Identifies encapsulation but does not discuss its importance effectively.	Fails to illustrate or explain encapsulation properly.	
Examples and Application of Theory	**Excellent (5 Marks)**	**Good (3 – 4 Marks)**	**Satisfactory (2 Marks)**	**Needs Improvement (1 Marks)**	/5
TOTAL					/15
FEEDBACK/ COMMENT					

Question 2   **(Marks: 15)**

Read the scenario below and answer the questions that follow:

Scenario:
Evaluating the Transition from 4G LTE to 5G in Smart City Development

The city of Metrotech is undergoing a **digital transformation initiative** to become a **fully connected smart city**. The current infrastructure relies heavily on **4G LTE networks**, supporting applications such as **traffic monitoring, smart meters, and public Wi-Fi hotspots**. However, city planners have noticed **increasing network congestion** and **latency issues**, particularly in densely populated areas.

To address these challenges, the city's technology department is **considering an upgrade to 5G technology**. They expect **higher data rates, ultra-low latency, and improved capacity** to support emerging applications such as **autonomous vehicles, remote healthcare, and smart grids**.

As part of the **network assessment**, IT professionals must evaluate the **architectural differences between 4G LTE and 5G, their operational principles, and the potential impact on mobile data communication**.

Compare the architecture of 4G LTE and 5G cellular networks and explain how the transition to 5G can enhance mobile data communication in a smart city environment. In your response:

Q.2.1	Describe the fundamental elements of 4G LTE architecture and its operational principles.	(4)
Q.2.2	Explain key features and improvements introduced in 5G networks.	(4)
Q.2.3	Discuss potential applications of 5G in a smart city and its implications for urban infrastructure.	(4)

MARKING RUBRIC: QUESTION 2					Mark Allocation
Criteria	Excellent (4 Marks)	Good (3 Marks)	Satisfactory (2 Marks)	Needs Improvement (1 Marks)	
Description of 4G LTE Architecture and Operational Principles	Clearly defines and explains the **architecture, key components, and functions** of 4G LTE with real-world examples.	Provides a reasonable description of **4G LTE architecture** but lacks **depth in operational details**.	Identifies key components of **4G LTE** but does not fully explain its **architecture or functions**.	Fails to accurately describe **4G LTE architecture** and its operational principles.	/4
Explanation of 5G Key Features and Enhancements	**Excellent (4 Marks)**	**Good (3 Marks)**	**Satisfactory (2 Marks)**	**Needs Improvement (1 Marks)**	/4
	Provides a **detailed explanation** of the **improvements in 5G**, including speed, latency, and reliability.	Explains key **5G features** but lacks clear differentiation from **4G LTE**.	Mentions **5G advancements** but lacks depth and clarity.	Does not accurately explain the **improvements of 5G over 4G LTE**.	
Discussion of 5G Applications and Implications in a Smart City	**Excellent (4 Marks)**	**Good (3 Marks)**	**Satisfactory (2 Marks)**	**Needs Improvement (1 Marks)**	/4
	Effectively discusses **how 5G enhances smart city infrastructure** with specific use cases (e.g., IoT, autonomous vehicles).	Discusses **5G applications** but lacks **clear examples or implications** for smart cities.	Identifies **basic applications** of 5G but does not elaborate on their impact.	Fails to link **5G technology** with **smart city applications**.	
Examples and Application of Theory	**Good (3 Marks)**	**Good (2 Marks)**	**Satisfactory (1 Marks)**	**Needs Improvement (0 Marks)**	/3
TOTAL					/15
FEEDBACK/ COMMENT:					

Question 3	**(Marks: 30)**

Read the scenario below and answer the questions that follow:

Scenario:
Evaluating Traditional Routing vs. SDN in an Enterprise Network

TechConnect, a growing enterprise, has been experiencing **network congestion and inefficiencies** in handling increasing traffic loads. The company's **traditional routing infrastructure** relies on **distributed routing protocols** to manage network traffic across its various branches. However, the IT team has noted several challenges, including **slow response times to network changes**, **complex configuration requirements**, and **limited flexibility in traffic management**.

To enhance **network performance, scalability, and security**, the IT team is considering a transition to **Software-Defined Networking (SDN)**, which separates the **control plane from the data plane**. The network engineers must assess the **roles of forwarding and routing**, the **limitations of traditional control plane architectures**, and how **SDN improves traffic control and management**.

Compare traditional routing with Software-Defined Networking (SDN) and explain how SDN improves network control and management in an enterprise environment. In your response:

Q.3.1	Describe the role of forwarding and routing in the network layer.	(10)
Q.3.2	Explain the key components and functionalities of traditional routing protocols.	(5)
Q.3.3	Evaluate the limitations of traditional control plane architectures and discuss how SDN addresses these limitations.	(10)

MARKING RUBRIC: QUESTION 3					Mark Allocation
Criteria	**Excellent (9 – 10 Marks)**	**Good (6 – 8 Marks)**	**Satisfactory (3 – 5 Marks)**	**Needs Improvement (1 – 2 Marks)**	
Description of Forwarding and Routing	Clearly and accurately defines **forwarding** and **routing**, explaining their distinct roles in the **network layer** with relevant examples.	Provides a good definition of **forwarding and routing**, but with minor omissions or lacks examples.	Identifies **forwarding and routing**, but the explanation is unclear or lacks depth.	Fails to correctly define or distinguish **forwarding and routing**.	**/10**
Explanation of Traditional Routing Protocols	**Excellent (5 Marks)**	**Good (3 – 4 Marks)**	**Satisfactory (2 Marks)**	**Needs Improvement (1 Marks)**	**/5**
	Thoroughly explains **routing protocols** (e.g., RIP, OSPF, BGP), their components, and how they function.	Provides a reasonable explanation of **routing protocols**, but lacks in-depth discussion of their components.	Mentions **routing protocols**, but does not clearly explain their functions or importance.	Fails to describe the role of **traditional routing protocols**.	
Evaluation of Traditional Control Plane vs. SDN	**Excellent (9 – 10 Marks)**	**Good (6 – 8 Marks)**	**Satisfactory (3 – 5 Marks)**	**Needs Improvement (1 – 2 Marks)**	**/10**
	Clearly evaluates **the limitations** of traditional control plane architectures and effectively explains how **SDN addresses these issues** with relevant examples.	Discusses **limitations of traditional control planes** and **SDN benefits**, but lacks depth or examples.	Mentions **limitations** of traditional control planes and **SDN**, but does not clearly explain the differences.	Fails to differentiate between **traditional control planes** and **SDN**.	
Examples and Application of Theory	**Excellent (5 Marks)**	**Good (3 – 4 Marks)**	**Satisfactory (2 Marks)**	**Needs Improvement (1 Marks)**	**/5**
TOTAL					**/30**
FEEDBACK/ COMMENT					

Question 4	(Marks: 30)

Read the scenario below and answer the questions that follow:

Scenario:

Control Plane and OSPF Routing in Enterprise Networking

XYZ Corporation, a large enterprise with multiple branches, is experiencing **inefficient routing and slow convergence times** in its network. The network administrator is reviewing **control plane operations** to optimize network performance.

The company currently relies on **distance-vector routing** for inter-branch communication, but **slow convergence and routing loops** have led to connectivity issues. The IT team is now considering **Open Shortest Path First (OSPF)**, a **link-state protocol**, to improve **route calculation efficiency, fault tolerance, and load balancing**.

As part of this transition, the IT team must:

- **Define the control plane** and its role in routing.
- **Describe how the control plane manages network resources.**
- **Explain route advertisement and distance calculation in distance-vector routing.**
- **Evaluate the benefits of OSPF over traditional distance-vector protocols.**
- **Analyse how routing policies impact network performance.**

Describe the role of the control plane in network architecture and explain how OSPF improves route selection in intra-domain routing. In your response:

Q.4.1	Define the control plane and explain its functions in managing network resources.	(10)
Q.4.2	Describe the process of route advertisement and distance calculation in distance-vector routing.	(5)
Q.4.3	Explain the OSPF routing process, including the roles of routers and the exchange of link-state information.	(5)
Q.4.4	Discuss how routing policies influence route selection and overall network performance.	(5)

MARKING RUBRIC: QUESTION 4					
Criteria	Excellent (9 – 10 Marks)	Good (6 – 8 Marks)	Satisfactory (3 – 5 Marks)	Needs Improvement (1 – 2 Marks)	Mark Allocation
Definition of Control Plane and its Functions	Clearly defines the **control plane**, its role in network architecture, and its functions in **managing routing tables, policy enforcement, and decision-making**.	Defines the **control plane** with some explanation of its role but lacks depth in **network resource management**.	Provides a **basic definition** of the control plane but lacks clarity on its **functions and importance**.	Fails to define the **control plane** or provides an incorrect explanation.	**/10**
Explanation of Distance-Vector Routing	**Excellent (5 Marks)**	**Good (3 – 4 Marks)**	**Satisfactory (2 Marks)**	**Needs Improvement (1 Marks)**	**/5**
	Thoroughly describes **route advertisement, distance calculation, and convergence challenges** in distance-vector protocols (e.g., RIP).	Explains **distance-vector routing** with some mention of **route advertisement** but lacks a deep discussion of **distance calculation**.	Provides a **basic explanation** of distance-vector routing but **misses key concepts** such as **route advertisement and distance calculation**.	Fails to describe **distance-vector routing** or provides an incorrect explanation.	
Explanation of OSPF Routing Process	**Excellent (5 Marks)**	**Good (3 – 4 Marks)**	**Satisfactory (2 Marks)**	**Needs Improvement (1 Marks)**	**/5**
	Clearly explains **OSPF functionality, link-state advertisement (LSA), shortest-path calculation, and router roles (e.g., DR, BDR)** with examples.	Describes **OSPF routing**, but the explanation lacks clarity on **LSA exchange and router roles**.	Mentions **OSPF**, but the discussion is unclear or lacks **critical details**.	Fails to explain **OSPF** or provides an incorrect explanation.	

Impact of Routing Policies on Network Performance	Excellent (5 Marks)	Good (3 – 4 Marks)	Satisfactory (2 Marks)	Needs Improvement (1 Marks)	/5
	Thoroughly explains how **routing policies** influence **route selection, traffic engineering, and security** with relevant examples.	Describes routing policies but lacks examples or depth in discussing **their impact on network performance**.	Mentions **routing policies** but does not **connect them to route selection and performance**.	Fails to explain **routing policies** or provides an incorrect explanation.	
Examples and Application of Theory	Excellent (5 Marks)	Good (3 – 4 Marks)	Satisfactory (2 Marks)	Needs Improvement (1 Marks)	/5
TOTAL					/30

Question 5   **(Marks: 10)**

REFLECTION REPORT

Write a reflective report (not more than one page) about your overall experience completing this assignment. Save the Report in PDF format.

Draft your report in the following format or headings:

A.   Introduction

- Short (approximately three sentences each) description of the tasks/ activities (scenario and questions)
- Short description of your own evaluation (how you planned to execute/ complete the tasks? What were the challenges?
- What did you like most about the tasks?

B.   List of hard skills Learnt (and a very brief explanation (one sentence).

C.   List of soft skills learned (and a very brief explanation (one sentence).

D.   List of technologies and software used

E.   Conclusion.

Self-Reflection Report (Question 5.0)					
0-2 **Does Not Meet Standard**	**3-4** **Approaching standard**	**5-6** **Meets standard**	**7-8** **Above standard**	**9-10** **Exceeds Standard: Excellent to Exceptional**	**Mark out of 10**
A poor effort was made to reflect on the students' learning while completing the Assignment.	Minimal effort was made to reflect on the students' learning while completing the Assignment.	The report meets the standard, and a good effort was made to reflect on the students' learning while completing the Assignment.	The report is adequate and is above standard and an above average effort was made to reflect on the students learning.	The report exceeds the standard and the student articulately and an immaculate effort was made to reflect on the students' learning while completing the Assignment.	**/10**
TOTAL					**/10**
FEEDBACK/ COMMENT					

[TOTAL: 100 MARKS]