

## MANIPAL UNIVERSITY JAIPUR

Department of Data Science and Engineering

### Course Hand-out

#### A. Basic Details:

Programme Name:	CSE-DS
Course Name:	Computer Networks
Course Code:	DSE2202
LTPC ( <i>Lecture Tutorial Practical Credits</i> ):	4
Session:	Jan-June 2025
Class:	DS, IV Sem
Course Coordinator:	Dr. Shitanshu Jain
Course Instructor(s):	Dr. Pooja Gupta, Dr. Neha V Sharma, Dr. Ginika Mahajan, Dr. Malvinder S Bali, Dr. Srikanta Pradhan
Additional Practitioner(s) – if any ( <i>Industry Fellow/ Visiting Faculty/ Adjunct Faculty, etc.</i> ):	Nil

**B. Introduction:** The course on **Computer Networks** provides a comprehensive understanding of the fundamental concepts, principles, and practices involved in the design, implementation, and management of computer networks. It explores how devices communicate with each other, the architecture of networks, and the protocols that govern data transmission. This course is designed to provide both theoretical knowledge and practical skills, enabling students to develop, analyze, and troubleshoot computer networks effectively.

The main objective of this course is to familiarize students with modern computer networks, focusing on the TCP/IP model and its layered structure, which serves as the foundation for today's networking systems.

### C. Course Outcomes:

<i>CO Statement</i>	<i>CO</i>	<i>Level</i>	<i>Target Attainment %</i>	<i>Target Attainment level</i>
Recognise the layered communication architectures based on TCP/IP.	1	2	75%	2
Understand the various Routing Protocols/Algorithms and addressing.	2	2	75%	2
Apply the principles of congestion control and trade-offs in fairness and efficiency.	3	2	75%	2
Attribute the concepts of data transfer in UDP & TCP.	4	2	75%	2
Know the key Application Layer protocols such as DNS, HTTP, SNMP, SMTP, FTP.	5	2	75%	2

Information about attainment levels:

<b>Attainment (%)</b>	<b>Level</b>
< 60 %	0
≥ 60% < 70%	1
≥ 70% < 80%	2
≥ 80	3

### D. Program Outcomes and Program Specific Outcomes

[PO.1]. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

[PO.2]. Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

[PO.6]. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

[PO.9]. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

[PO.10]. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12]. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

## **PROGRAM SPECIFIC OUTCOMES**

[PSO.1]. Understand the role of mathematics, statistics, and AI techniques in the field of data science & engineering.

[PSO.2]. Apply the acquired knowledge and expertise to perform data analytics tasks for multidimensional data sets.

[PSO.3]. Develop effective and scalable industrial solutions for real-world socio-economic problems using data analytics tools and techniques.

## **PROGRAM EDUCATIONAL OBJECTIVES**

[PEO.1]. Acquire and improve data science abilities to compete in a potential job as a data scientist and analyst.

[PEO.2]. Establish entrepreneurial skills to provide new and scalable solutions for tackling real-life complex data processing methodologies, paving the way for startups and self-employment.

[PEO.3]. Pursue higher studies to carry out research and development in the fields of advanced data science and artificial intelligence.

[PEO.4]. Integrate sensitivity towards all facets of ethical, environmental, and social concerns with holistic development.

#### E. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Mid-Term Examination (Close/ Open Book)	30
	Class Work Sessional (CWS): Quiz, MOOC, Research work Assignment, Video Assignment, etc.	30
End Term Exam (Summative)	End Term Exam (Close/ Open Book)	40
	Total	100

#### F. Syllabus:

**Introduction to Computer Networking Concepts:** Layered Architectures, OSI Reference Model, TCP/IP Protocol Suite. **Physical Layer:** Basics of communications- Physical Topology, Physical media types and their important bandwidth and bit-error-rate characteristics- Wired and Wireless media including copper cables, optical fibre and wireless. **Data Link Layer:** Logical Link Control (LLC) sub-layer- Framing, Error control, reliable transmission, and Automatic Repeat Request (ARQ) protocols including Stop-and-Wait, Go-back-N, Selective Repeat, MAC sublayer: Media access protocol. **Network layer:** Addressing, Subnetting, Internet Protocol (IP) suite- IPv4 and IPv6 headers, Routing protocols- Distance-vector and Link-state Approaches- Interior and Exterior Gateway Protocol, ICMP, NAT, ARP, and RARP. **Transport layer:** UDP, TCP- Connection establishment and termination, sliding window, flow and congestion control. **Application Layer:** Introduction to DNS, SMTP, SNMP, FTP, and HTTP.

#### Textbook:

1. Forouzan, B. A. (2017). TCP/IP protocol suite (6th ed.). McGraw-Hill Education.
2. Tanenbaum, A. S., & Wetherall, D. J. (2018). Computer networks (6th ed.). Pearson.

#### References books:

1. Stallings, W. (2021). Data and computer communications (11th ed.). Pearson.
2. Kurose, J. F., & Ross, K. W. (2024). Computer networking: A top-down approach (8th ed.). Pearson.

**G. Lecture Plan:**

<b>Le ct ur e No .</b>	<b>Topic</b>	<b>Session Outcome</b>	<b>Correspon ding CO</b>	<b>Mode of delivery</b>	<b>Mode of assessing CO</b>
1	Introduction of course	Understanding of Course objectives evaluation	DSE2202.1	Lecture	Mid-Term, End-Term and Quiz
2	Introduction of Computer Networks	Understanding of computer networking, importance, and applications.	DSE2202.1	Lecture	Mid-Term, End-Term and Quiz
3	Layered architecture, principles, and OSI model overview (7 layers)	Understanding of Concept of layered architecture and the functionality of each OSI layer.	DSE2202.1	Lecture	Mid-Term, End-Term and Quiz
4	Overview of TCP/IP protocol suite and its	Understanding of Structure and functionality of the TCP/IP protocol stack.	DSE2202.1	Lecture	Mid-Term, End-Term and Quiz
5	Comparison of the OSI model and TCP/IP Model	Understanding of the comparison of OSI and TCP/IP Model	DSE2202.1	Lecture	Mid-Term, End-Term and Quiz
6	Introduction to physical topologies (bus, star, ring, mesh, hybrid).	Understanding of different network topologies and their advantages/disadvantages.	DSE2202.1	Lecture	Mid-Term, End-Term and Quiz
7	Copper cables, fiber optics, and wireless media types.	Understanding properties and uses of different physical media types.	DSE2202.1	Lecture	Mid-Term, End-Term and Quiz
8	Importance of bandwidth and bit-error rate in communication	Understanding of how bandwidth and error rate affect network performance	DSE2202.1	Lecture	Mid-Term, End-Term and Quiz
9	Purpose and responsibilities of the data link layer.	Understanding of role of the data link layer in networking	DSE2202.2	Lecture	Mid-Term, End-Term and Quiz

10	Framing, error control, and reliable transmission	Understanding of how LLC ensures reliable communication.	DSE2202.2	Lecture	Mid-Term, End-Term and Quiz
11	Automatic Repeat Request (ARQ) Protocols	Understanding of how Stop-and-Wait ensures reliable transmission	DSE2202.2	Lecture	Mid-Term, End-Term and Quiz
12	Concepts and mechanisms of Go-back-N and Selective Repeat ARQ	Understanding of Difference between various ARQ protocols.	DSE2202.2	Lecture	Mid-Term, End-Term and Quiz
13	The Concept of MAC sublayer	Understanding of MAC sublayer	DSE2202.2	Lecture	Mid-Term, End-Term and Quiz
14	Media access protocols and their role in communication	Understanding MAC protocols manage access to the shared medium.	DSE2202.2	Lecture	Mid-Term, End-Term and Quiz
15	Network Layer Responsibilities:	Understanding of key responsibilities of the network layer.	DSE2202.3	Lecture	Mid-Term, End-Term and Quiz
16	Addressing, routing, and forwarding.	Understanding of Addressing, routing, and forwarding.	DSE2202.3	Lecture	Mid-Term, End-Term and Quiz
17	Structure and classes of IPv4 addresses.	Understanding how IPv4 addressing works.	DSE2202.3	Lecture	Mid-Term, End-Term and Quiz
18	Structure and classes of IPv6 addresses.	Understanding how IPv6 addressing works.	DSE2202.3	Lecture	Mid-Term, End-Term and Quiz
19	Comparison of IPv4 and IPv6 headers.	Understanding of structure and significance of IP headers.	DSE2202.3	Lecture	Mid-Term, End-Term and Quiz
20	Subnet masks and IP address partitioning.	Understanding of perform subnetting to optimize IP usage.	DSE2202.3	Lecture	Mid-Term, End-Term and Quiz
21	Working of distance-vector routing protocols.	Understanding of routing protocols like RIP.	DSE2202.3	Lecture	Mid-Term, End-Term and Quiz
22	Working of link-state routing protocols.	Understanding of protocols like OSPF.	DSE2202.3	Lecture	Mid-Term, End-Term and Quiz
23	Interior and Exterior Gateway Protocols	Understanding of the scope of IGP and EGP protocols.	DSE2202.3	Lecture	Mid-Term, End-Term and Quiz
24	Functions of ICMP	Understanding of Functions of ICMP	DSE2202.3	Lecture	Mid-Term, End-Term and Quiz
25	Functions of NAT	Understanding of Functions of NAT	DSE2202.3	Lecture	Mid-Term, End-Term and Quiz

26	Function of ARP	Understanding of Function of ARP	DSE2202.3	Lecture	Mid-Term, End-Term and Quiz
27	Function of RARP	Understanding of Function of RARP	DSE2202.3	Lecture	Mid-Term, End-Term and Quiz
<b>Mid Term Examination</b>					
28	Overview of Transport Layer	Understanding of transport layer's role in communication.	DSE2202.4	Lecture	Mid-Term, End-Term and Quiz
29	Elements of Transport Protocols, Addressing,	Understanding of elements of transport protocols	DSE2202.4	Lecture	Mid-Term, End-Term and Quiz
30	Working of User Datagram Protocol (UDP).	Understanding of features and use cases of UDP.	DSE2202.4	Lecture	Mid-Term, End-Term and Quiz
31	TCP Basics	Understanding of TCP connection lifecycle.	DSE2202.4	Lecture	Mid-Term, End-Term and Quiz
32	TCP Service Model, TCP Protocol	Understanding of Understanding of TCP	DSE2202.4	Lecture	Mid-Term, End-Term and Quiz
33	Sliding window protocol in TCP.	Understanding how sliding windows ensure efficient data flow.	DSE2202.4	Lecture	Mid-Term, End-Term and Quiz
34	Mechanisms for managing flow and congestion in TCP.	Understanding how TCP ensures reliable communication.	DSE2202.4	Lecture	Mid-Term, End-Term and Quiz
35	TCP Connection Establishment, TCP Connection Release	Understanding of TCP connection establishment and Release	DSE2202.4	Lecture	Mid-Term, End-Term and Quiz
36	TCP Transmission Policy, Window Management-1	Understanding of TCP Transmission Policy	DSE2202.4	Lecture	Mid-Term, End-Term and Quiz
37	Overview of Application Layer	Understanding of interaction of applications with the network.	DSE2202.5	Lecture	Mid-Term, End-Term and Quiz
38	Client Server Model	Understanding of Learning Client Server	DSE2202.5	Lecture	Mid-Term, End-Term and Quiz
39	Structure of DNS.	Understanding of how DNS translates domain names to IP addresses.	DSE2202.5	Lecture	Mid-Term, End-Term and Quiz
40	Hierarchy of DNS	Understanding of Hierarchy of DNS	DSE2202.5	Lecture	Mid-Term, End-Term and Quiz

41	Working of DNS	Understanding of Working of DNS	DSE2202.5	Lecture	Mid-Term, End-Term and Quiz
42	Working of SMTP for email communication	Understanding of how emails are sent using SMTP	DSE2202.5	Lecture	Mid-Term, End-Term and Quiz
43	Working of SNMP for managing devices on a network.	Understanding of how SNMP monitors and manages networks.	DSE2202.5	Lecture	Mid-Term, End-Term and Quiz
44	File transfer operations using FTP.	Understanding of functionality of FTP.	DSE2202.5	Lecture	Mid-Term, End-Term and Quiz
45	Working of HTTP for web communication.	Understanding of how data is exchanged over the web.	DSE2202.5	Lecture	Mid-Term, End-Term and Quiz
<b>End Term Examination</b>					

### Important Update:

1. As per NAAC Reforms 2024- Binary Accreditation Stakeholder Consultation (University), the mode of delivery should include the followings:

- |                                    |                                      |
|------------------------------------|--------------------------------------|
| 1. Lecture based teaching-learning | 7. Expeditionary learning            |
| 2. Group- teaching and learning    | 8. Technology based learning         |
| 3. Individual learning/ self-study | 9. Peer teaching                     |
| 4. Inquiry based learning          | 10. Learning through problem-solving |
| 5. Kinaesthetic learning           | 11. Flipped Classroom, etc.          |
| 6. Game Based learning             |                                      |

*Course coordinators should include at least 5 pedagogical approaches from the pedagogical approaches as specified above and mention the same in respective lecture types / Mode of delivery.*

*It is expected that, MUJ-TEC will conduct workshops on these pedagogical in the coming time for more clarity.*

2. In addition, some lectures should be marked as \* that indicates the lectures to be covered by additional practitioners (Industry Fellow/ Visiting Faculty/ Adjunct Faculty, etc.)



## H. Course Articulation Matrix:

CO	Statement	Correlation with Program Outcomes												Correlation with Program Specific Outcomes		
		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
DSE2202.1	Recognize the layered communication architecture based on TCP/IP.	2	1	1			2		3				3	3	2	
DSE2202.2	Understand the various Routing Protocols/Algorithms and addressing.	2	1	1			2		3				3	3	2	
DSE2202.3	Apply the principles of congestion control and trade-offs in fairness and efficiency.	2	1	1			2		3				3	3	2	
DSE2202.4	Attribute the concepts of data transfer in UDP & TCP.	2	1	1			2		3				3	3	2	
DSE2202.5	Know the key Application Layer protocols such as DNS, HTTP, SNMP, SMTP, FTP.	2	1	1			2		3				3	3	2	