

**DATA COMMUNICATION AND COMPUTER NETWORK****Course Code : 314318**

**Programme Name/s** : Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Cloud Computing and Big Data/ Computer Technology/ Computer Engineering/ Computer Science & Engineering/ Data Sciences/ Computer Hardware & Maintenance/ Information Technology/ Computer Science & Information Technology/ Computer Science

**Programme Code** : AI/ AN/ BD/ CM/ CO/ CW/ DS/ HA/ IF/ IH/ SE

**Semester** : Fourth

**Course Title** : DATA COMMUNICATION AND COMPUTER NETWORK

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**I. RATIONALE**

Data communication and computer networks are essential components of modern computing infrastructure, enabling seamless exchange of information and facilitating collaboration across various devices and locations. By considering various applications, students should be able to choose, classify, install, troubleshoot, and maintain various data communication networks. This course provides the important concepts and techniques related to networking and offer students to have valuable insights into technology behind network communication.

**II. INDUSTRY / EMPLOYER EXPECTED OUTCOME**

The aim of this course is to help the student to attain the following industry identified Outcome through various teaching learning experiences:

- Manage Data Communication and Computer Network

**III. COURSE LEVEL LEARNING OUTCOMES (COS)**

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Analyze the functioning of Data Communication and Computer Network.
- CO2 - Select relevant Transmission Media and Switching Techniques as per need.
- CO3 - Analyze the Transmission Errors with respect to IEEE standards.
- CO4 - Configure different TCP/IP services.
- CO5 - Implement relevant Network Topology using Networking Devices.

**IV. TEACHING-LEARNING & ASSESSMENT SCHEME**

| Course Code | Course Title                            | Abbr | Course Category/s | Learning Scheme          |     |     |     |     | Credits | Paper Duration | Assessment Scheme |     |     |                  |     |       |     |             |    |    | Total Marks |
|-------------|---|------|-------------------|--------------------------|-----|-----|-----|-----|---------|----------------|-------------------|-----|-----|------------------|-----|-------|-----|-------------|----|----|-------------|
|             |   |      |                   | Actual Contact Hrs./Week |     |     | SLH | NLH |         |                | Theory            |     |     | Based on LL & TL |     |       |     | Based on SL |    |    |             |
|             |   |      |                   | CL                       | TL  | LL  |     |     |         |                | Practical         |     |     | FA-PR            |     | SA-PR |     | SLA         |    |    |             |
|             |   |      |                   | Max                      | Max | Max | Min | Max |         |                | Min               | Max | Min | Max              | Min | Max   | Min |             |    |    |             |
| 314318      | DATA COMMUNICATION AND COMPUTER NETWORK | DCN  | DSC               | 3                        | -   | 4   | 1   | 8   | 4       | 3              | 30                | 70  | 100 | 40               | 25  | 10    | 25@ | 10          | 25 | 10 | 175         |

**DATA COMMUNICATION AND COMPUTER NETWORK****Course Code : 314318****Total IKS Hrs for Sem. : 0 Hrs**

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, \*# On Line Examination , @\$ Internal Online Examination  
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.\* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. \* Self learning hours shall not be reflected in the Time Table.
7. \* Self learning includes micro project / assignment / other activities.

**V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT**

| Sr.No | Theory Learning Outcomes (TLO's) aligned to CO's.   | Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.   | Suggested Learning Pedagogies.                                 |
|-------|---|---|--|
| 1     | <p>TLO 1.1 Describe the role of the given component in the process of data communication.</p> <p>TLO 1.2 Compare the characteristics of analog and digital signals on the given parameter.</p> <p>TLO 1.3 Explain the process of data communication using the given mode.</p> <p>TLO 1.4 Classify computer networks on the specified parameter.</p> | <p><b>Unit - I Fundamentals of Data Communication and Computer Network</b></p> <p>1.1 Process of data communication and its components: Transmitter, Receiver, Medium, Message, Protocol</p> <p>1.2 Protocols, Standards, Standard organizations, Bandwidth, Data Transmission Rate, Baud Rate and Bits per second</p> <p>1.3 Modes of Communication (Simplex, Half duplex, Full Duplex)</p> <p>1.4 Analog Signal and Digital Signal, Analog and Digital Transmission: Analog To Digital, Digital To Analog Conversion</p> <p>1.5 Fundamental Of Computer Network: Definition And Need Of Computer Network, Applications, Network Benefits</p> <p>1.6 Classification Of Network: LAN, WAN,MAN</p> | Lecture Using Chalk-Board, Presentations, Video Demonstrations |

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|-------|---|---|--|
| 2     | <p>TLO 2.1 Explain with sketches the construction of a given type of cable.</p> <p>TLO 2.2 Explain with sketches the characteristics of the given type of unguided transmission media.</p> <p>TLO 2.3 Explain with sketches the working of the given Multiplexing technique.</p> <p>TLO 2.4 Describe with sketches the working principle of the given Switching technique.</p> <p>TLO 2.5 Compare different Switching techniques on the given parameter.</p>                | <p><b>Unit - II Transmission Media And Switching</b></p> <p>2.1 Communication Media: Guided Transmission Media<br/>Twisted-Pair Cable, Coaxial Cable, Fiber-Optic Cable</p> <p>2.2 Unguided Transmission Media: Radio Waves, Microwaves, Infrared, Satellite</p> <p>2.3 Line-of-Sight Transmission, Point-to-Point, Broadcast</p> <p>2.4 Multiplexing: Frequency-Division Multiplexing ,Time - Division Multiplexing</p> <p>2.5 Switching: Circuit-switched network, Packet switched network</p>  | <p>Lecture Using Chalk-Board, Presentations, Video Demonstrations</p>                    |
| 3     | <p>TLO 3.1 Explain working of the given error detection and correction method.</p> <p>TLO 3.2 Explain features of the given IEEE communication standard.</p> <p>TLO 3.3 Explain characteristics of the given layer in IEEE 802.11 architecture.</p> <p>TLO 3.4 Explain with sketches the process of creating a Bluetooth environment using the given architecture.</p> <p>TLO 3.5 Compare the specified generations of mobile telephone systems on the given parameter.</p> | <p><b>Unit - III Error Detection and Correction</b></p> <p>3.1 Types of Errors, Forward Error Correction Versus Retransmission</p> <p>3.2 Framing: Fixed Sized and Variable Sized Framing</p> <p>3.3 Error Detection: Repetition codes, Parity bits, Checksums, CRC</p> <p>3.4 Error Correction: Automatic Repeat Request (ARQ), Hamming Code</p> <p>3.5 Wireless LAN IEEE 802.11 standard Architecture, Features of IEEE 802.11 versions:<br/>802.11,802.11a,802.11b,802.11g,802.11n,802.11p</p> <p>3.6 Bluetooth Architecture: Piconet, Scatternet</p> <p>3.7 Mobile Generations: 3G, 4G and 5G</p> | <p>Lecture Using Chalk-Board, Presentations, Video Demonstrations, Flipped Classroom</p> |

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|-------|--|--|---|
| 4     | <p>TLO 4.1 Identify functions and features of the given layer of OSI Reference model.</p> <p>TLO 4.2 Compare the specified service on the given parameters.</p> <p>TLO 4.3 Classify IP Addresses on the basis of its class from the given set of addresses.</p> <p>TLO 4.4 Distinguish between IPv4 and IPv6 on the given parameters.</p> <p>TLO 4.5 Describe with sketches the procedure to configure the given TCP/IP service.</p> | <p><b>Unit - IV Network Communication Models</b></p> <p>4.1 THE OSI MODEL: Layered Architecture, Encapsulation</p> <p>4.2 Layers in OSI Model(Functions of each layer)-Physical Layer,Data-Link Layer,Network Layer,Transport Layer,Session Layer,Presentation Layer,Application Layer</p> <p>4.3 TCP/IP Layers and their functions: Host To Network Layer,Internet Layer,Transport Layer,Application Layer</p> <p>4.4 Protocols: Host To Network Layer-SLIP,PPP, Internet Layer-IP,ARP,RARP,ICMP, Transport Layer-TCP and UDP, Application Layer-FTP,HTTP,SMTP,TELNET,BOOTP,DHCP</p> <p>4.5 Addressing: Physical Address, Logical Address, Port Address</p> <p>4.6 IP Address-Concept, Notation, Address Space</p> <p>4.7 IPv4 Addressing: Classful and Classless Addressing ,subnet mask,supernetting,subnetting</p> <p>4.8 IPV6 Addressing scheme and basic structure</p> | Lecture Using Chalk-Board, Presentations, Case Study, Flipped Classroom |
| 5     | <p>TLO 5.1 Compare different computing models on the given parameter.</p> <p>TLO 5.2 Identify relevant network topology for the given situation.</p> <p>TLO 5.3 Compare different topologies on the given parameter.</p> <p>TLO 5.4 Select network connecting device for the given situation.</p> <p>TLO 5.5 Describe with sketches the procedure to configure the given networking device.</p>                                      | <p><b>Unit - V Network Topologies And Network Devices</b></p> <p>5.1 Network Computing Model: Peer To Peer, Client Server</p> <p>5.2 Network Topologies: Introduction, Definition, Selection criteria, Types of Topology- Star ,Mesh, Tree, Hybrid</p> <p>5.3 Network Connecting Devices: Switch, Router, Repeater, Bridge, Gateways and Modem</p>   | Lecture Using Chalk-Board, Video Demonstrations, Flipped Classroom      |

**VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.**

| Practical / Tutorial / Laboratory Learning Outcome (LLO)              | Sr No | Laboratory Experiment / Practical Titles / Tutorial Titles                                  | Number of hrs. | Relevant COs |
|---|-------|---|----------------|--------------|
| LLO 1.1 Implement Amplitude Shift Keying(ASK)                         | 1     | * Amplitude Shift Keying(ASK) using any simulator   | 2              | CO1          |
| LLO 2.1 Implement Frequency Shift Keying(FSK)                         | 2     | Frequency Shift Keying(FSK) using any simulator   | 2              | CO1          |
| LLO 3.1 Implement Phase Shift Keying(PSK)                             | 3     | Phase Shift Keying(PSK) using any open source simulation software                           | 2              | CO1          |
| LLO 4.1 Create standard network straight cable by using cable tester. | 4     | *Create and Test standard straight network cable(Universal Colour Code) using crimping tool | 2              | CO2          |
| LLO 5.1 Create standard Cross network cable by using cable tester.    | 5     | Create and Test standard Cross network cable(Universal Colour Code) using crimping tool     | 2              | CO2          |

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| <b>Practical / Tutorial / Laboratory Learning Outcome (LLO)</b>   | <b>Sr No</b> | <b>Laboratory Experiment / Practical Titles / Tutorial Titles</b>   | <b>Number of hrs.</b> | <b>Relevant COs</b> |
|---|--------------|---|-----------------------|---------------------|
| LLO 6.1 Use basic programming skills to simulate communication systems.<br>LLO 6.2 Debug and execute the program for Time Division Multiplexing(TDM). | 6            | * Generate a Time Division Multiplexing(TDM) signal using relevant simulation software  | 2                     | CO2                 |
| LLO 7.1 Transfer data using Bluetooth.  | 7            | *Create a Hybrid Network Using Bluetooth  | 2                     | CO3                 |
| LLO 8.1 Identify different error detection methods.<br>LLO 8.2 Detect errors using Checksum.  | 8            | *Locate the error bit in the given data string by applying checksum error detection method  | 2                     | CO3                 |
| LLO 9.1 create WI-FI environment.   | 9            | *Implement Wireless network   | 2                     | CO3                 |
| LLO 10.1 Draw block diagram for parity check.<br>LLO 10.2 Implement parity check with examples.   | 10           | Write a 'C' program for parity check error detection  | 2                     | CO3                 |
| LLO 11.1 Implement C Program for CRC  | 11           | *Write a 'C' program for Cyclic Redundancy Check(CRC) error detection   | 2                     | CO3                 |
| LLO 12.1 Implement Hamming code in any suitable programming language.   | 12           | *Write a 'C' program for error correction using Hamming code  | 2                     | CO3                 |
| LLO 13.1 Use IP address and appropriate subnet mask for given problem statement.  | 13           | *Configure static IP address in operating system along with appropriate subnet mask for given problem   | 2                     | CO4                 |
| LLO 14.1 Implement IP addresses for intranet in Class A, Class B, Class C.  | 14           | * Implement Classful Address in a given network node<br>i)Identify range of IP Address in various classes ii)Justify the reason to choose various IP address classes for creating given network | 2                     | CO4                 |
| LLO 15.1 Troubleshoot computer network using commands.  | 15           | *Execute TCP/IP network commands:ipconfig,ping,tracert  | 2                     | CO4                 |
| LLO 16.1 Troubleshoot computer network using commands.  | 16           | *Execute TCP/IP network commands: netstat, pathping, route  | 2                     | CO4                 |
| LLO 17.1 Use wireshark packet sniffer software.   | 17           | *1) Install Wireshark and configure as packet sniffer-<br>i)Capture IP,TELNET, FTP packets using Wireshark  | 2                     | CO4                 |
| LLO 18.1 Measure various types of Delay by using Wireshark.   | 18           | Capture TCP and UDP packet using Wireshark  | 2                     | CO4                 |
| LLO 19.1 Filter ARP and ICMP packet Traffic using Wireshark.  | 19           | Capture ARP and ICMP packet Traffic using Wireshark   | 2                     | CO4                 |
| LLO 20.1 Install server operating system  | 20           | Install Operating System Linux/Windows/Any other Server   | 2                     | CO4                 |
| LLO 21.1 Create FTP Server  | 21           | Use FTP protocol to transfer file from one system to another system   | 2                     | CO4                 |
| LLO 22.1 Implement IPv6 addressing scheme on a network.   | 22           | Create IPv6 environment in a small network using simulator  | 2                     | CO4                 |

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| <b>Practical / Tutorial / Laboratory Learning Outcome (LLO)</b>   | <b>Sr No</b> | <b>Laboratory Experiment / Practical Titles / Tutorial Titles</b>   | <b>Number of hrs.</b> | <b>Relevant COs</b> |
|---|--------------|---|-----------------------|---------------------|
| LLO 23.1 Configure HTTP server on given operating system.   | 23           | *Create HTTP server   | 2                     | CO5                 |
| LLO 24.1 Use star topology for a given situation.   | 24           | *Create computers using Star topology with wired media  | 2                     | CO5                 |
| LLO 25.1 Use Network simulator CISCO packet tracer.   | 25           | Create Tree topology using CISCO packet tracer software   | 2                     | CO5                 |
| LLO 26.1 Implement remote login feature.  | 26           | Configure TELNET for remote login   | 2                     | CO5                 |
| LLO 27.1 Survey existing network infrastructure.  | 27           | *Visit your computer laboratory-<br>i)Identify the type of topology<br>ii)Identify types of connecting devices with specifications<br>iii)Identify types of cables with specifications<br>iv)List the type of network applications commonly used in the laboratory<br>iv)Draw the layout of installed network | 4                     | CO5                 |
| LLO 28.1 Transfer a file from one computer to another.<br>LLO 28.2 Print documents from remote system in a network.   | 28           | Share folder and printer in a network   | 2                     | CO5                 |
| <b>Note : Out of above suggestive LLOs -</b> <ul style="list-style-type: none"> <li>• '*' Marked Practicals (LLOs) Are mandatory.</li> <li>• Minimum 80% of above list of lab experiment are to be performed.</li> <li>• Judicial mix of LLOs are to be performed to achieve desired outcomes.</li> </ul> |              |   |                       |                     |

## **VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)**

### **Assignment**

- Solve an assignment on any relevant topic given by the Teacher
- For a trading firm an organization with 10users, draw network architecture design of wireless LAN.
- Identify appropriate network topology and network connecting devices for following requirement. Draw network design for proposed network. An organization having its office in a building of 5 floor. Each floor it needs 20 machines. There is one File server. Each floor has 2 print servers to facilitate printer capacity using Tree topology.

### **Micro project**

- Install and configure NIC and find MAC Address of Device
- Design a network using any topology and do fault identification
- Create a tool that monitors network bandwidth usage in real-time

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- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicious mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

**VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED**

| Sr.No | Equipment Name with Broad Specifications  | Relevant LLO Number |
|-------|---|---------------------|
| 1     | Desktop Computer with basic configuration   | All                 |
| 2     | Network Tool Kit: Crimping Tool for RJ-45 connector ,3in 1 modular crimping tool for RJ-45 UTP CAT-5/CAT-6 Networking Cable,LAN Cutter 8P/6pP/4P All-in-One or similar,Cable Tester/LAN Tester(Specification: Network Cable Tester for LAN RJ-45/CAT5/CAT6 UTP Wire Test Tool or similar) | All                 |
| 3     | Network Accessories: RJ45 connector, UTP cable, optical fibre cable, Coaxial cable, various connectors,1000Mbps NIC   | All                 |
| 4     | UPS 6 KVA online  | All                 |
| 5     | Ethernet Switch- 4/8/16/24/32   | All                 |
| 6     | Router-256MB Memory storage capacity, compatible with Desktop and Laptop, Rack Mountable, Wireless Connectivity   | All                 |
| 7     | Printer   | All                 |
| 8     | Wireshark( <a href="https://www.wireshark.org/download.html">https://www.wireshark.org/download.html</a> )or any other Packet Analyzer Tool   | All                 |
| 9     | Simulation Software: CISCO Packet Tracer, CORE Network Emulator or Similar  | All                 |

**IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)**

| Sr.No              | Unit | Unit Title  | Aligned COs | Learning Hours | R-Level   | U-Level   | A-Level   | Total Marks |
|--------------------|------|---|-------------|----------------|-----------|-----------|-----------|-------------|
| 1                  | I    | Fundamentals of Data Communication and Computer Network | CO1         | 10             | 4         | 8         | 4         | 16          |
| 2                  | II   | Transmission Media And Switching                        | CO2         | 10             | 4         | 4         | 6         | 14          |
| 3                  | III  | Error Detection and Correction                          | CO3         | 8              | 4         | 4         | 6         | 14          |
| 4                  | IV   | Network Communication Models                            | CO4         | 12             | 4         | 6         | 8         | 18          |
| 5                  | V    | Network Topologies And Network Devices                  | CO5         | 5              | 2         | 2         | 4         | 8           |
| <b>Grand Total</b> |      |   |             | <b>45</b>      | <b>18</b> | <b>24</b> | <b>28</b> | <b>70</b>   |

**X. ASSESSMENT METHODOLOGIES/TOOLS****Formative assessment (Assessment for Learning)**

- Continuous assessment based on process and product related performance indicators.
- Each practical will be assessed considering 60% weightage to process, 40% weightage to product.
- A continuous assessment based term work.

**Summative Assessment (Assessment of Learning)**

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- End semester examination, Lab performance, Viva-voce

**XI. SUGGESTED COS - POS MATRIX FORM**

| Course Outcomes (COs) | Programme Outcomes (POs)                     |                       |                                       |                        |  |                         |                         | Programme Specific Outcomes* (PSOs) |       |       |
|-----------------------|--|-----------------------|---------------------------------------|------------------------|--|-------------------------|-------------------------|-------------------------------------|-------|-------|
|                       | PO-1 Basic and Discipline Specific Knowledge | PO-2 Problem Analysis | PO-3 Design/ Development of Solutions | PO-4 Engineering Tools | PO-5 Engineering Practices for Society, Sustainability and Environment | PO-6 Project Management | PO-7 Life Long Learning | PSO-1                               | PSO-2 | PSO-3 |
| CO1                   | 1  | -                     | 2                                     | 1                      | -  | -                       | 1                       |                                     |       |       |
| CO2                   | 1  | 1                     | 2                                     | 1                      | -  | 1                       | 1                       |                                     |       |       |
| CO3                   | 1  | 2                     | 1                                     | 1                      | -  | -                       | 1                       |                                     |       |       |
| CO4                   | 1  | 2                     | 2                                     | 1                      | -  | 1                       | 1                       |                                     |       |       |
| CO5                   | -  | 2                     | 2                                     | 1                      | 1  | 1                       | 1                       |                                     |       |       |

Legends :- High:03, Medium:02,Low:01, No Mapping: -  
\*PSOs are to be formulated at institute level

**XII. SUGGESTED LEARNING MATERIALS / BOOKS**

| Sr.No | Author               | Title  | Publisher with ISBN Number   |
|-------|----------------------|--|--|
| 1     | Behrouz A. Forouzan  | Data Communication and Networking              | McGraw-Hill Higher Education ISBN-13 978-0-07-296775-3             |
| 2     | Behrouz A. Forouzan: | TCP/IP Protocol Suit                           | McGraw Hill Education ISBN-13 978-0073376042                       |
| 3     | A.S. Tanenbaum       | Computer Networks                              | PRENTICE HALL ISBN-10: 0-13-212695-8 ,ISBN-13:978-0-13-212695-3    |
| 4     | Godbole Achyut       | Data Communication and Networks                | McGraw Hill Education ISBN-10 9780071077705,ISBN-13 978-0071077705 |
| 5     | Comer Douglas E.     | TCP/IP Principles, Protocols and Architectures | PEARSON ISBN 10: 0-13-608530-X ISBN 13: 978-0-13-608530-0          |

**XIII. LEARNING WEBSITES & PORTALS**

| Sr.No | Link / Portal   | Description  |
|-------|---|--|
| 1     | <a href="https://www.geeksforgeeks.org/data-communication-definition-components-types-channels/">https://www.geeksforgeeks.org/data-communication-definition-components-types-channels/</a> | Data Communication-Definition, Components, Types, Channels |
| 2     | <a href="https://www.tutorialspoint.com/data_communication_computer_network/index.htm">https://www.tutorialspoint.com/data_communication_computer_network/index.htm</a>                     | Data Communication and Computer Network                    |
| 3     | <a href="https://nptel.ac.in/courses/106105081">https://nptel.ac.in/courses/106105081</a>   | Computer Networks  |
| 4     | <a href="https://nptel.ac.in/courses/106105183">https://nptel.ac.in/courses/106105183</a>   | Computer Networks and Internet Protocol                    |
| 5     | Introduction To Computer Networks   Studytonight  | Introduction To Computer Networks                          |

**Note :**

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students