**Bachelor of Engineering (Computer Science and Engineering)**

**Course Code: CST 102 Course Name: Principles of Computer Networking**

**Credits: 03 L-T-P: 3-0-0**

**Total Contact Hours: 48 Hrs.**

**Course Coordinator: Dr. RamamaniTripathy**

**Course Facilitator (s): Dr. Alok Misra, Dr. UtpalShrivastava**

Assessment Components

|  |  |  |  |
| --- | --- | --- | --- |
| **Evaluation**  **Component** | **Description** | **Syllabus**  **Covered**  **(%)** | **Timeline of**  **Examination** |
| Component 02\* | Formative Assessment 02 | Will be Notified | Will be Notified by the CoC |
| Component 02\*\* | Sessional Test 01 | Lec. No. 1-24 | Will be Notified by the CoC |
| Sessional Test 02 | Lec. No. 24-48 | Will be Notified by the CoC |
| Sessional Test 03 | Lec. No 1-48 | Will be Notified by the CoC |
| Component 03 | End Term  Examination | Lec No 1-48 | Will be Notified by the CoC |
| Note: For Assessment Pattern please refer to Annexure I. | | | |

\*Out of 02FAs, the ERP system automatically picks the best 02 FAs Marks for evaluation of the FAs as final marks.

\*Out of 03 STs, the ERP system automatically picks the best 02 STs marks for evaluation of the STs as final marks.

\*\*75% attendance is compulsory to appear in End Term Examination.

**Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)**

|  |  |
| --- | --- |
| At the end of the programme, students will be able to | |
| 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, review 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 modeling 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 practice. |
| PO 9 | **Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. |
| PO10 | **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. |
| PO11 | **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. |
| PO12 | **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. |

**Course Objectives:**

The main objectives of the course are:

1. To categorize and interrelate the functions of layers of OSI and TCP/IP reference model.
2. To interpret the error detection as well as correction at Layer 2 and at Layer 3.
3. To analyze the behaviour of routing protocols.
4. To summarize the mechanism of Cellular, Satellite and MPLS Networks.
5. To interpret the rationality behind congestion in networks and quality of service.
6. To gauge the existing protocols, who carry the onus of network communication at Application layer.

**Course Outcomes:**

At the end of the course, students will possess

CLO1: Describe and analyze the hardware, software, components of a network and the interrelations.

CLO2: Explain networking protocols and their hierarchical relationship hardware and software.Compare protocol models and select appropriate protocols for a particular design.

CLO3: Explain concepts and theories of networking and apply them to various situations, classifyingnetworks, analyzing performance and implementing new technologies.

CLO4: Identify infrastructure components and the roles they serve, and design infrastructureincluding devices, topologies, protocols, systems software, management and security. Analyze performance of enterprise network systems.

CLO5: Effectively communicate technical information verbally, in writing, and in presentations.

CLO6: Describe and analyze various wan technologies: Cellular Telephone, Satellite Networks, GSM, MODEM, 3G, 4G, 5G, VoLTE, VoIP, Intelligent Devices.

**CO-PO/PSO Mapping:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Course Outcomes | Program Outcomes | | | | | | | | | | | | PSOs | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | - | - | - |
| 1 | 1 |  |  | - | - | 2 | 2 | - | - | - | - | 1 | - | - | - |
| 2 | 3 | 2 | 1 | - | 1 | 1 | - | - | - | - | - | 1 | - | - | - |
| 3 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 1 | - | - | - | 1 | - | - | - |
| 4 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 1 | - | - | - | 1 | - | - | - |
| 5 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 1 | - | - | - | 1 | - | - | - |
| 6 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 |  |  |  |

**Session-Wise Plan:**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Module** | **Session** | **Topic** | **Readings and References** | **Pedagogy/ Activity Planned** | **CO** | **Mode of Delivery** | **Link for Offline resource** |
|  | 1 | Introduction: Uses of Computer networks | Data Communications and Networking’ by Forouzan, 5TH edition. | Visual Learning and Group Discussion | CO1 | Offline Synchronous  PPT and Discussion | https://www.javatpoint.com/types-of-computer-network |
|  | 2 | Components of Computer Network | Data Communications and Networking’ by Forouzan, 5TH edition. | Visual Learning and Group Discussion | CO1 | Offline Synchronous  PPT and Discussion | https://www.javatpoint.com/computer-network-components |
|  | 3 | Network hardware and physical Topology | Computer Networks’ By Andrew S. Tannenbaum Fourth edition, Pearson Education | Visual Learning and Group Discussion | CO1 | Offline Synchronous  PPT and Discussion | https://beginnersbook.com/2019/03/computer-network-topology-mesh-star-bus-ring-and-hybrid/ |
|  | 4 | Mode of Data transmission, types of connection | Data Communications and Networking’ by Forouzan, 5TH edition. | Visual Learning and Group Discussion | CO1 | OfflineSynchronous  PPT and Discussion | https://www.javatpoint.com/computer-network-transmission-modes |
|  | 5 | Network software (protocols and standards) | Data Communications and Networking’ by Forouzan, 5TH edition. | Visual Learning | CO1, CO2 | Offline Synchronous | https://www.geeksforgeeks.org/protocol-and-standard-in-computer-networks/ |
|  | 6 | Network devices : Hub, Switches, Bridge, Router, Repeater, Modem, Gateway | Data Communications and Networking’ by Forouzan, 5TH edition. | Visual Learning | CO1, CO2 | Offline Synchronous | https://mycstutorial.in/computer-network-devices-modem-repeater-hub-switch-bridge-router-gateway/ |
|  | 7 | Seven-Layer OSI architecture of ISO, Concepts of Layer  Protocols and Layer interfaces | Data Communications and Networking’ by Forouzan, 5TH edition. | Visual Learning | CO1, CO2 | Offline Synchronous | https://www.geeksforgeeks.org/layers-of-osi-model/ |
|  | 8 | TCP/IP Layer | Data Communications and Networking’ by Forouzan, 5TH edition. | Pictionary | CO1, CO2 | PPT and Discussion | https://www.geeksforgeeks.org/tcp-ip-model/ |
|  | 9 | Switching Techniques: circuit switching, Packet switching, Message Switching | Data Communications and Networking’ by Forouzan, 5TH edition. | Pictionary | CO1, CO2 | PPT and Discussion | https://www.javatpoint.com/computer-network-switching-techniques |
|  | 10 | Introduction to MAC Address | Data Communications and Networking’ by Forouzan, 5TH edition. | Blended Learning | CO1, CO2 | Offline Synchronous | https://www.geeksforgeeks.org/introduction-of-mac-address-in-computer-network/ |
|  | 11 | IP Address, Classes, subnet ID, subnet mask | Computer Networks’ By Andrew S. Tannenbaum Fourth edition, Pearson Education | Visual Learning | CO1, CO2 | Offline Synchronous | https://avinetworks.com/glossary/subnet-mask/ |
|  | 12 | MAC Layer: Random Access, Controlled Access and Channelization | Computer Networks’ By Andrew S. Tannenbaum Fourth edition, Pearson Education | Visual Learning | CO1, CO2 | Offline Synchronous | https://www.geeksforgeeks.org/multiple-access-protocols-in-computer-network/ |
|  | 13 | Data Link Control: Framing, Flow and Error Control, Error Detection and Correction, HDLC and PPP. | Computer Networks’ By Andrew S. Tannenbaum Fourth edition, Pearson Education | Visual Learning | CO1, CO2 | Offline Synchronous | https://www.geeksforgeeks.org/error-control-in-data-link-layer/ |
|  | 14 | Link Layer Addressing: Link Address, ARP, Frame Format :     Ethernet frame. | Computer Networks’ By Andrew S. Tannenbaum Fourth edition, Pearson Education | Visual Learning | CO1, CO2 | PPT and Discussion | https://www.rcet.org.in/uploads/academics/rohini\_81835791715.pdf |
|  | 15 | Link Layer Protocols. Ethernet Protocols: IEEE 802, Fast Ethernet, Gigabit Ethernet | Computer Networks’ By Andrew S. Tannenbaum Fourth edition, Pearson Education | Visual Learning and Implementation of Problems | CO1 | PPT and Discussion | https://www.tutorialspoint.com/ieee-802-3-and-ethernet |
|  | 16 | VLAN, P2P, SONET, Switching Networks | Computer Networks’ By Andrew S. Tannenbaum Fourth edition, Pearson Education | Visual Learning and Implementation of Problems | CO1 | PPT and Discussion | https://www.cisco.com/c/en/us/td/docs/optical/15000r4\_6/ethernet/454/guide/r46mlios/swtunl.html |
|  | 17 | Introduction to Network Layer: Services | Computer Networks’ By Andrew S. Tannenbaum Fourth edition, Pearson Education | Visual Learning and Implementation of Problems | CO1 | PPT and Discussion | https://www.geeksforgeeks.org/network-layer-services-packetizing-routing-and-forwarding/ |
|  | 18 | Congestion, Router,  Protocol: IPv4, Unicast and Multicast Routing, IPv6, ICMPv4 vs ICMPv6, Network Classes: A, B, C, D, E | Computer Networks’ By Andrew S. Tannenbaum Fourth edition, Pearson Education | Visual Learning and Implementation of Problems | CO1 | PPT and Discussion | https://www.geeksforgeeks.org/introduction-of-classful-ip-addressing/ |
|  | 19 | Basic Transport Layer Protocols: Simple Protocol, Stop and Wait, Sliding window concept | Computer Networks’ By Andrew S. Tannenbaum Fourth edition, Pearson Education | Visual Learning and Implementation of Problems | CO3 | PPT and Discussion | https://www.geeksforgeeks.org/stop-and-wait-arq/ |
|  | 20 | Go Back N, Selective Repeat, Bi Directional. Internet Transport Layer Protocol. | Computer Networks’ By Andrew S. Tannenbaum Fourth edition, Pearson Education | Visual Learning and Implementation of Problems | CO3 | PPT and Discussion | https://web.cse.ohio-state.edu/~champion.17/3461/Part3\_Transport.pdf |
|  | 21 | Transport Layer: TCP Services and Features, Process to Process Delivery, Segmentation, Connections, State Transition Diagram | Computer Networks’ By Andrew S. Tannenbaum Fourth | Visual Learning and Implementation of Problems | CO3 | PPT and Discussion | https://www.geeksforgeeks.org/transport-layer-responsibilities// |
|  | 22 | Basics of Routing,Staticvs Dynamic Routing | Data Communications and Networking’ by Forouzan, 5TH edition | Visual Learning and Implementation of Problems | CO4 | PPT and Discussion | <https://www.tutorialspoint.com/what-is-a-routing-algorithm-in-computer-network> |
|  | 23 | Distance Vector Routing,Count to infinity Problem,solution to count to infinity problem, | Data Communications and Networking’ by Forouzan, 5TH edition | Visual Learning and Implementation of Problems | CO4 | PPT and Discussion | <https://www.tutorialspoint.com/what-is-a-routing-algorithm-in-computer-network> |
|  | 24 | Link state Routing,Dijkstra,Bellman Ford Algorithm | Data Communications and Networking’ by Forouzan, 5TH edition | Visual Learning and Implementation of Problems | CO4 | PPT and Discussion | <https://www.tutorialspoint.com/what-is-a-routing-algorithm-in-computer-network> |
|  | 25 | RIP,OSPF,BGP | Data Communications and Networking’ by Forouzan, 5TH edition | Visual Learning and Implementation of Problems | CO4 | PPT and Discussion | <https://www.tutorialspoint.com/what-is-a-routing-algorithm-in-computer-network> |
|  | 26 | TCP Layer Overview, ,PortNumber,UDP,UDP header | Computer Networks’ By Andrew S. Tannenbaum Fourth | Visual Learning | CO4 | PPT and Discussion | https://www.geeksforgeeks.org/what-is-transmission-control-protocol-tcp/ |
|  | 27 | UDP: User Datagram, UDP Services, UDP Applications | Computer Networks’ By Andrew S. Tannenbaum Fourth | Visual Learning and Implementation of Problems | CO3 | PPT and Discussion | https://www.javatpoint.com/udp-protocol |
|  | 28 | TCP header,TCP connection,Three way handshaking | Computer Networks’ By Andrew S. Tannenbaum Fourth | Visual Learning | CO4 | PPT and Discussion | https://www.geeksforgeeks.org/what-is-transmission-control-protocol-tcp/ |
|  | 29 | TCP data transferr,TCP connection Termination,TCP sliding window | Computer Networks’ By Andrew S. Tannenbaum Fourth | Visual Learning | CO4 | PPT and Discussion | https://www.geeksforgeeks.org/what-is-transmission-control-protocol-tcp/ |
|  | 30 | TCP, Flow Control and Error Control, Timers. | Computer Networks’ By Andrew S. Tannenbaum Fourth | Visual Learning and Implementation of Problems | CO3 | PPT and Discussion | https://www.geeksforgeeks.org/error-control-in-tcp/ |
|  | 31 | Congestion Control Algorithms | Computer Networks’ By Andrew S. Tannenbaum Fourth | Visual Learning and Implementation of Problems | CO3 | Offline Synchronous | https://www.geeksforgeeks.org/congestion-control-techniques-in-computer-networks/ |
|  | 32 | Data Traffic, Open loop and close loop congestion | Computer Networks’ By Andrew S. Tannenbaum Fourth | Visual Learning and Implementation of Problems | CO3 | Offline Synchronous | https://www.geeksforgeeks.org/congestion-control-in-computer-networks/ |
|  | 33 | QoS: Flow Characteristics and Flow Classes. Scheduling: Techniques to improve QoS | Computer Networks’ By Andrew S. Tannenbaum Fourth | Visual Learning and Implementation of Problems | CO3 | PPT and Discussion | https://www.geeksforgeeks.org/techniques-for-achieving-good-quality-of-serviceqos/ |
|  | 34 | Traffic shaping, Integrated and Differentiated Services. QoS in switched networks. | Computer Networks’ By Andrew S. Tannenbaum Fourth | Visual Learning and Implementation of Problems | CO3 | PPT and Discussion | https://www.tutorialride.com/computer-network/quality-of-service-qos-in-computer-network.htm |
|  | 35 | Session Layer: Services, Features. Protocols | Computer Networks’ By Andrew S. Tannenbaum Fourth | Visual Learning and Implementation of Problems | CO3 | Offline Synchronous | https://www.geeksforgeeks.org/session-layer-in-osi-model/ |
|  | 36 | SMTP, its uses and Applications | Computer Networks’ By Andrew S. Tannenbaum Fourth | Visual learning | CO4, CO5 | Offline Synchronous | https://www.javatpoint.com/simple-mail-transfer-protocol |
|  | 37 | DNS,  HTTP, HTTPS | CCNA Cisco Certified Network Associate Study Guide', by Todd Lammle, Wiley, 7th edition | Visual learning | CO5, CO6 | Offline Synchronous | https://www.makeuseof.com/what-is-dns-over-https/ |
|  | 38 | VPN, TELNET, SSH | CCNA Cisco Certified Network Associate Study Guide', by Todd Lammle, Wiley, 7th edition | Visual learning | CO5, CO6 | Offline Synchronous | https://www.guru99.com/telnet-vs-ssh.html |
|  | 39 | Wireless WAN | CCNA Cisco Certified Network Associate Study Guide', by Todd Lammle, Wiley, 7th edition | Visual Learning and Implementation of Problems | CO6 | PPT and Discussion | https://www.geeksforgeeks.org/overview-of-wireless-wide-area-network-wwan/ |
|  | 40 | Cellular Telephone, Satellite Networks | CCNA Cisco Certified Network Associate Study Guide', by Todd Lammle, Wiley, 7th edition | Visual Learning and Implementation of Problems | CO6 | PPT and Discussion | https://examradar.com/cellular-telephone-satellite-networks-short-notes/ |
|  | 41 | GSM, MODEM | CCNA Cisco Certified Network Associate Study Guide', by Todd Lammle, Wiley, 7th edition | Visual Learning and Implementation of Problems | CO6 | PPT and Discussion | https://nowsms.com/faq/what-is-a-gsm-modem |
|  | 42 | 3G Technology, 4G Technology | CCNA Cisco Certified Network Associate Study Guide', by Todd Lammle, Wiley, 7th edition | Visual Learning and Implementation of Problems | CO6 | PPT and Discussion | https://www.geeksforgeeks.org/difference-between-3g-and-4g-technology/ |
|  | 43 | 5G Technology  6G Technology | Data Communications and Networking’ by Forouzan, 5TH edition | Visual Learning and Implementation of Problems | CO6 | PPT and Discussion | https://www.rantcell.com/how-is-6g-mobile-network-different-from-5g.html |
|  | 44 | Intelligent Devices: Intelligent Hub, Intelligent Router etc. | Data Communications and Networking’ by Forouzan, 5TH edition | Visual Learning and Implementation of Problems | CO6 | PPT and Discussion | https://www.coursehero.com/file/p3tdtlr/Routers-Router-is-intelligent-device-which-routes-data-to-destination-computers/ |
|  | 45 | Introduction to Cloud Network,Google Cloud Networking | Data Communications and Networking’ by Forouzan, 5TH edition | Visual Learning and Implementation of Problems | CO1, CO4 | PPT and Discussion | https://www.javatpoint.com/introduction-to-cloud-computing |
|  | 46 | Network Security | Data Communications and Networking’ by Forouzan, 5TH edition | Visual Learning and Implementation of Problems | CO1, CO4 | PPT and Discussion | https://www.geeksforgeeks.org/network-security/ |
|  | 47 | Cryptography | Data Communications and Networking’ by Forouzan, 5TH edition | Group Discussion | CO6 | Offline Synchronous | https://www.tutorialspoint.com/what-is-cryptography-in-computer-network |
|  | 48 | Public Key Encryption,Private Key Encryption | Data Communications and Networking’ by Forouzan, 5TH edition | Group Discussion | CO6 | Offline Synchronous | https://www.geeksforgeeks.org/public-key-encryption/ |

B01:  Data Communications and Networking’ by Forouzan, 5TH edition.

B02:  Data Communications and Networking’ by Forouzan,  4TH edition.

B03:  Computer Networks’ By Andrew S. Tannenbaum Fourth edition, Pearson Education

B04:  CCNA Cisco Certified Network Associate Study Guide', by Todd Lammle, Wiley, 7th edition

**Assessment Scheme:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sl. No.** | **Assessment**  **Instrument** | **Formative/ Summative** | **Frequency** | **Weightage (%)** | **CO** |
| 1. | Continuous Assessment | Formative | 03 | 40 | CO1 to CO6 |
| 2. | Semester End Test | Summative | 01 | 60 | CO1 to CO6 |
|  | **Total** |  |  | 100  (Min. Passing Marks =40%) |  |

**Proposed Course Evaluation Scheme:**

Questions for internal and ETE will be designed to evaluate cognitive skills the various educational levels (Bloom’s taxonomy) such as:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sl. No.** | **Bloom’s category** | **ST1** | **ST2** | **ST3** | **ETE** |
|  | Remember | 20 | 20 | 0 | 20 |
|  | Understand | 40 | 20 | 20 | 20 |
|  | Apply | 30 | 30 | 30 | 20 |
|  | Analyze | 10 | 30 | 30 | 20 |
|  | Evaluate | 0 | 0 | 15 | 15 |
|  | Create | 0 | 0 | 5 | 5 |

**Concept Map:**

Principles of Computer Network

Explains

* 1. Introduction of Computer Network
  2. Topology
  3. Types of network
  4. Architecture of OSI model
  5. Different Protocols

Equips you with

* 1. Error detection and correction
  2. Noisy and Noiseless channel
  3. Transmission Strategy

Equips you with

3.1 IP addressing with calculation of subnet Id and subnet mask

3.2 Routing Protocols

3.3. Numerical of

IPV4 &IPV6

Equips you with

4.1 Transport layer services

4.2 TCP & UDP header file

4.3. Congestion control

4.3 Quality of service

Helps in

5.1 Design issues of session layer

5.2. Implementation

5.3 Application layer functionality with protocols

5.4 Testing

5.5 Evaluation

|  |  |  |  |
| --- | --- | --- | --- |
| **Assessment**  **Component** | **Description** | **Assessment Pattern** | **Duration of Examination** |
| Component 02 | Formative Assessment 02 | 1 mark- 10MCQ  2 marks- 5MCQ | 60 Minutes |
| Component 01 | Sessional Test 01 | 1 Mark- 5 MCQs  2 Marks- 5 Questions  5 Marks- 3Questions  10 Mark- 1 Question | 90 Minutes |
| Sessional Test 02 | 1 Mark- 5 MCQs  2 Marks- 5 Questions  5 Marks- 3Questions  10 Mark- 1 Question | 90 Minutes |
| Sessional Test 03 | 1 Mark: 5 MCQs  2 Marks- 5 Questions  5 Marks- 3Questions  10 Mark- 1 Question | 90 Minutes |
| Component 02 | End Term  Examination | 1Marks- 5 MCQ Questions  2 Marks- 5 Questions  5 Marks- 5Questions  10 Mark- 2 Question | 180 Minutes |

Annexure I: Assessment Pattern

\*Out of 02FAs, the ERP system automatically picks the best 02 FAs Marks for evaluation of the FAs as final marks.