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| **Course Code** | **Elements of Network Simulation** | **L** | **T** | **P** | **C** |
|  |  | **1** | **0** | **1** | **2** |
| **Pre Requisite:** | Basic of networking and Programming |  | | | |

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| **Course Objectives** |
| * Build an understanding of the fundamental concepts of computer networking, protocols, architectures, and applications * Understand the basics of Network Simulation. * Gather the knowledge on how to design, analyse and code network elements for basic wired and wireless networking. * Measure the performance metrics of various networking configurations. |
| **Course Outcomes** |
| After successfully completing the course the student should be able to   * Describe the layered structure of a typical networked architecture * Design a network using any GUI or Code based on any simulation software * Analyse a packet, an application or a protocol. * Measure the performance of a network. * Design a network simulation using ns3 objects and modules. |
| **Student Learning Outcomes: 2,5,7** |
| 2. Having a clear understanding of the subject related concepts and of contemporary issues 5. Having design thinking capability 7. Having computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning) |

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| **Module 1** | **Introduction to Computer Networks** | **6 Hours** | **SLO : 2** |
| Introduction to Computer Networks - Topologies - Protocols and Standards - ISO / OSI model – IEEE 802.3, 802.11, 802.15.X – Basics of Point to Point, CSMA. | | | |
| **Module 2** | **Basics of Network Simulations** | **3 Hours** | **SLO: 2,5** |
| Why Network Simulator – Types of Simulators - Discrete Event Simulators – Simulation Vs Emulation – Introduction to Network Simulator 3 | | | |
| **Module 3** | **Network Simulator 3** | **9 Hours** | **SLO: 5,7** |
| Network Simulator 3 – Libraries – Installation – Network Entities like Nodes -Topology Helpers, Applications – Channels – Net Device – Third Party tools for ns3 – Wireshark Packet Analyser – NetAnim (Network Animator) – Tracing (ASCII and Packet Capture pcap) – Flow Monitor – GNUPLOT (Plotting Software) | | | |
| **Module 4** | **Network Performance Metrics** | **6 hours** | **SLO: 2,5** |
| Performance Metrics like throughput, End to End Delay, response time, latency, IO characteristics – Packet Drop, Packet Loss, Packet Delivery Ratio, Jitter | | | |
| **Module 5** | **Wireless Network Simulation** | **6 hours** | **SLO: 5,7** |
| Basics of Wireless Adhoc Network – Wireless Network Simulation using ns3 – Protocols like AODV, DSDV, DSR and OLSR and its simulations – Comparison of Various Routing protocols of Wireless Networks – Suitability of TCP protocol in Wireless Networks. | | | |
| **Total Lecture Hours: 30 hours** | | | |
| **Teaching Pedagogy**  Online Learning Materials, Video Lectures and Case Studies  Evaluation Criteria : Online Quiz, Practical Exercises, Term End Examination. | | | |
| **Reference Books:**  Behrouz A Forouzan, Data Communications and Networking, Tata Mc-Grawhill, 2015.  Riley, G.F. and Henderson, T.R., 2019. The ns-3 network simulator. In *Modeling and tools for network simulation* (pp. 15-34). Springer, Berlin, Heidelberg.  Jack L. Burbank, An Introduction to Network Simulator 3 Hardcover, Wiley Publishers – 2016.  Ns3 documentation and ns3 model library - <https://www.nsnam.org/docs/release/3.30/manual/ns-3-manual.pdf> | | | |