

<p style="text-align: center;"><b>Savitribai Phule Pune University</b>  <b>Minor Course offered by BOS in Electronics Science for all UG Programs under Faculty of Science &amp; Technology except B. Sc. (Electronic Science) and allied programs</b>  <b>or</b>  <b>for all UG programs under any Faculty other than Faculty of Science &amp; Technology for SEM III ONLY</b>  <b>ES – 241 - MN: Data Communications (2024 Pattern)</b></p>		
<b>Teaching Scheme:</b> <b>TH: 02 Hours/Week</b>	<b>Credits</b> <b>02</b>	<b>Examination Scheme:</b> <b>Continuous Evaluation: 15 Marks</b> <b>End-Semester : 35 Marks</b>
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>To understand the fundamental concepts of data communication, networking standards, protocols and technologies.</li> <li>To be familiar with OSI and TCP/IP Models, signals, transmission impairments and performance</li> <li>To study different techniques for framing, error detection, access control and channelization</li> </ul>		
<b>Course Outcomes:</b> After successful completion of this course, learner will be able to- <ul style="list-style-type: none"> <li>Define basic concepts in data communication and applications of Computer Network</li> <li>Compare and contrast OSI and TCP/IP models</li> <li>Determine Bandwidth and delays</li> <li>Demonstrate understanding and need of Data-link layer protocols</li> </ul>		
<b>Course Contents</b>		
<b>Unit I</b>	<b>Introduction to Data Communications</b>	<b>7Hrs</b>
Data communications, Characteristics of Data Communication Data Representation – Text, Numbers, Images, Audio, Video Types of Data flow – Simplex, Half Duplex, Full Duplex Computer Networks applications –Business Application, Home Application, Mobile User Broadcast and point-to-point networks Network Topologies - Bus, Star, Ring, Mesh Network Types- LAN, MAN, WAN, Wireless Networks, Home Networks, internetworks Protocols and standards – Definition of a Protocol, Protocol standards: De facto and De jure, RFC		
<b>Unit II</b>	<b>Network Models</b>	<b>7 Hrs</b>
OSI Model – layered architecture, peer-to-peer processes, encapsulation TCP/IP Model – layers and Protocol Suite Addressing-Physical, Logical, Port addresses, Specific addresses		
<b>Unit III</b>	<b>Signals, Transmission &amp; Performance</b>	<b>8 Hrs</b>

Analog and Digital data, Analog and Digital signals, Digital Signals-Bit rate, Bit length  
 Baseband Transmission, Broadband Transmission  
 Transmission Impairments– Attenuation, Distortion and Noise  
 Data Rate Limits– Noiseless channel: Nyquist's bit rate, noisy channel : Shannon's law  
 Performance of the Network Bandwidth, Throughput, Latency (Delay), Bandwidth – Delay Product, Jitters  
 Line Coding Characteristics, Line Coding Schemes–Unipolar -NRZ, Polar-NRZ-I, NRZ-L, RZ, Manchester and Differential Manchester, Problems  
 Transmission Modes, Parallel Transmission and Serial Transmission– Asynchronous and Synchronous  
 Multiplexing, FDM and TDM  
 Switching-Circuit Switching, Message Switching and Packet Switching.

<b>Unit IV</b>	<b>Framing, Error Detection, Channelization</b>	<b>8 Hrs</b>
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Framing – Concept, Methods – Character Count, Flag bytes with Byte Stuffing, Starting & ending Flags with Bit Stuffing  
 Error detection codes – Hamming Distance, CRC  
 Elementary data link protocols - Simplex stop & wait protocol, Simplex protocol for noisy channel, PPP, HDLC  
 Sliding Window Protocols – 1-bit sliding window protocols, Pipelining – Go-Back N and Selective Repeat  
 Random Access Protocols - ALOHA– pure and slotted, CSMA-1- persistent, p-persistent and non-persistent CSMA/CD, CSMA/CA  
 Controlled Access - Reservation, Polling and Token Passing  
 Channelization – Definitions – FDMA, TDMA and CDMA

**Text Books:**

1. Data Communications and Networking by Behrouz Forouzan, Fifth Edition, ISBN 978-0-07-337622-6 McGraw Hill.
2. Computer Networks, ANDREW S. Tanenbaum, Fifth Edition, ISBN-13: 978-0-13-212695-3, Pearson

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<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>To become familiar with various network devices</li> <li>To study protocols for serial and parallel communications and data-link layer</li> </ul>																				
<b>Course Outcomes:</b> After successful completion of this course, learner will be able to - <ul style="list-style-type: none"> <li>Use networking devices</li> <li>Implement Serial and Parallel communication protocols</li> <li>Implement Data link Layer protocols</li> </ul>																				
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	communication		
6	Implement Simple stop and wait protocol	01	
7	Implement 1-bit Sliding window protocol	01	
8	Program to generate a series of random numbers using, say, a formula $N_{i+1} = (5 + N_i) \bmod 19 - 1$	01	
9	Program to print a text file using parallel communication	01	
10	Measuring upload and download speeds	01	
11	Program to simulate error detection using Hamming Distance	01	
12	Finding type of address (unicast, multicast or broadcast) from the given Ethernet destination address, say, 05:01:02:03:04:05	01	
13	Program to carry out given operations on given polynomials	01	
<b>Total Number of Sessions per Batch</b>		<b>13</b>	

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<b>Teaching Scheme:</b> <b>TH: 02 Hours/Week</b>	<b>Credits</b> <b>02</b>	<b>Examination Scheme:</b> <b>Continuous Evaluation: 15 Marks</b> <b>End-Semester : 35 Marks</b>
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>To study IPV4, IPV6 addresses, mapping and Routing</li> <li>To Become familiar with TCP and UDP Protocols</li> <li>To Understand various protocols at Application Layer</li> </ul>		
<b>Course Outcomes:</b> After successful completion of this course, learner will be able to- <ul style="list-style-type: none"> <li>Compare and contrast different routing and switching techniques</li> <li>Differentiate between TCP and UDP</li> <li>Define architecture of various protocols used at Application Layer</li> </ul>		
<b>Course Contents</b>		
<b>Unit I</b>	<b>Internet Protocol, Address mapping and Routing</b>	<b>8 Hrs</b>

Review of basic concepts in Data Communication, Network models, Physical and Data Link Layers

IPv4 addresses: Address space, Notations, Classful and Classless addressing, NAT  
Internetworking – Need of Network layer, Internet as a Datagram and as a connectionless network

IPv4: Datagram, Fragmentation, checksum, options

IPv6 addresses: Structure, address space, packet format, Extension headers

Address mapping – ARP, RARP, BOOTP and DHCP

ICMP – Types and formats of messages, Error reporting, Introduction to IGMP

Direct and indirect delivery, Forwarding techniques, process and routing table

Unicast and Multicast Routing protocols

<b>Unit II</b>	<b>UDP and TCP</b>	<b>8 Hrs</b>
6.1. Process-to-Process Delivery- Client-server, Multiplexing and De-multiplexing, Connectionless Vs. Connection oriented service, Reliable Vs. unreliable service 6.2. User Datagram Protocol (UDP) – Ports, User Datagram, Checksum, UDP operations, Use of UDP 6.3. Transmission Control Protocol (TCP) - TCP Services, TCP Features, Segment, TCP Connection, Flow Control, Error Control, Congestion Control		
<b>Unit III</b>	<b>DNS, Remote Login, Email and File Transfer</b>	<b>7 Hrs</b>
Domain Name System (DNS) - Distribution of Name Space, DNS in the Internet, Resolutions, DNS Messages, Header, Records, Registers, DDNS, Encapsulation Remote Login – TELNET E-MAIL - Architecture, User Agent, Message Transfer Agent - SMTP, POP and IMAP, Web Based Mail FTP, Anonymous FTP		
	<b>WWW and HTTP</b>	<b>7 Hrs</b>
WWW – Architecture, Client, Server, URL, Cookies, WEB Documents – Static, Dynamic and Active documents HTTP - HTTP Transaction, Persistent Vs. Nonpersistent connection, Proxy Server Introduction to Simple Network Management – Management components, structure of Management information, MIB, Security		
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<b>Teaching Scheme:</b> <b>Practical: 04 HRs/Week</b>	<b>Credits</b> <b>02</b>	<b>Examination Scheme:</b> <b>Continuous Evaluation: 15 Marks</b> <b>End-Semester : 35 Marks</b>
<b>Pre-requisite Course: BCA 111</b>		
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• To study network commands</li> <li>• To understand network and transport layers</li> <li>• To Understand useful protocols at Application layer</li> </ul>		
<b>Course Outcomes:</b> After successful completion of this course, learner will be able to - <ul style="list-style-type: none"> <li>• Use Networking commands</li> <li>• Implement Socket programming using TCP and UDP</li> <li>• Apply protocols at Application layer</li> </ul>		
<p align="center"><b>Guidelines for Instructor's Manual</b></p> <p>The instructor shall frame at least 14 assignments. Manual for the Instructor consisting of University syllabus, conduction and Assessment guidelines be developed</p>		
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<b>Assignment No</b>	<b>Topics for the Assignments</b>	<b>No. of Sessions</b>
1	Using Networking commands – ping, hostname, traceroute, netstat, ifconfig, who, nmap, nslookup etc	01
2	Study of LAN Environment – IP, MAC addresses, DHCP Server	01
3	To convert the given IP addresses from binary to dotted-decimal notion	01
4	To convert the given IP addresses from dotted-decimal notion to binary notation	01
5	To find netid and hosted of the given IP addresses	01
6	To find class of the given IP addresses	01
7	UDP Based Client-Server “Echo” application using socket programming	01
8	TCP Based Client-Server “Echo” application using socket programming	01
9	Use and study important “Setting options” in GMAIL	01
10	To back up email messages in a gmail account	01
11	Explore POP and IMAP in Gmail	01
12	Use and study of FTP Command, Anonymous FTP	01
13	Using HTTP protocol and understand standard ports	01
14	Using TELNET	01
<b>Total Number of Sessions per Batch</b>		<b>14</b>