DADI INSTITUTE OF ENGINEERING & TECHNOLOGY (A)

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING ANAKAPALLE - 531002, A.P

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Academic Regulations (DR23) for B. Tech. (Regular-Full time)

(Effective for the students admitted into I year from the Academic Year 2023-24 onwards)

&

Academic Regulations (DR23) for B.Tech.(Lateral Entry Scheme)

(Effective for the students admitted into II year through Lateral Entry Scheme from the Academic Year 2024 - 25 onwards)

HONOR DEGREE IN COMPUTER SCIENCE AND ENGINEERING

(I) Computer Networks

S.No	Subject Title	L	T	P	C
1	Data Communication	3	0	0	3
2	Internetworking with TCP/IP	3	0	0	3
3	Network Programming	3	0	0	3
4	Wireless Network Technologies	3	0	0	3
5	03 MOOCS courses @ 2credits each (8 weeks course) 02 MOOCS courses @ 3credits each (12 weeks course) (Any CSE/IT related **Program Core subject** from NPTEL/SWAYAM course other than the courses listed above needs to be taken)				6
				Total	**18**

(II) Cyber Security

S.No	Subject Title	L	T	P	C
1	Cyber Security Essentials	3	0	0	3
2	Secure Coding	3	0	0	3
3	Vulnerability Assessment & Penetration Testing	3	0	0	3
4	Malware Analysis	3	0	0	3
5	03 MOOCS courses @ 2credits each (8 weeks course) 02 MOOCS courses @ 3credits each (12 weeks course) (Any CSE/IT related **Program Core subject** from NPTEL/ SWAYAM course other than the courses listed above needs to be taken)				6
				Total	**18**

(III) Pattern Recognition

S.No	Subject Title	L	T	P	C
1	Mathematics for Image Processing	3	0	0	3
2	Biometrics	3	0	0	3
3	Speech Processing	3	0	0	3
4	Advanced Computer Vision	3	0	0	3
5	03 MOOCS courses @ 2credits each (8 weeks course) 02 MOOCS courses @ 3credits each (12 weeks course) (Any CSE/IT related **Program Core subject** from NPTEL/ SWAYAM course other than the courses listed above needs to be taken)				6
				Total	**18**

(IV) Data Science

S.No	Subject Title	L	T	P	C
1	Mathematical Essential for Data Science	3	0	0	3
2	Introduction to Data Science	3	0	0	3
3	Data Analytics and Visualization	2	0	2	3
4	Python for Data Science	2	0	2	3
5	03 MOOCS courses @ 2credits each (8 weeks course) 02 MOOCS courses @ 3credits each (12 weeks course) (Any CSE/IT related **Program Core subject** from NPTEL/ SWAYAM course other than the courses listed above needs to be taken)				6
				Total	**18**

Note: Students who have registered for honors program can opt a maximum of two (02) courses per semester.

	Honor Course	L	T	P	C
		3	1	0	4
DATA COMMUNICATION					

Course Objectives:

1. To have a detailed study of various analog and digital modulation and demodulation techniques
2. To have a thorough knowledge of various multiplexing schemes and Data communication protocols
3. To know about the standards and mechanisms of television systems.

Course Outcomes:

By the end of this course, the student will be able to

1. Have the knowledge of working of basic communication systems
2. Explore about the Transmission media
3. Know about Digital Transmission and Multiplexing
4. Know about Wireless Communication systems
5. Have in-depthknowledge about Telephone Instruments and Cellular Systems

UNIT- I

INTRODUCTION TO DATA COMMUNICATIONS AND NETWORKING: Standards Organizations for Data Communications, Layered Network Architecture, Open Systems Interconnection, Data Communications Circuits, Serial and parallel Data Transmission, Data communications Networks, Alternate Protocol Suites.

SIGNALS, NOISE, MODULATION, AND DEMODULATION: Signal Analysis, Electrical Noise and Signal-to-Noise Ratio, Analog Modulation Systems, Information Capacity, Bits, Bit Rate, Baud, and M-ary Encoding, Digital Modulation.

UNIT-II

METALLIC CABLE TRANSMISSION MEDIA: Metallic Transmission Lines, Transverse Electromagnetic Waves, Characteristics of Electromagnetic Waves

OPTICAL FIBER TRANSMISSION MEDIA: Advantages of Optical Fiber cables, Disadvantages of Optical Fiber Cables, Electromagnetic spectrum, Optical Fiber Communications System Block Diagram, Optical Fiber construction, Propagation of Light Through an Optical fiber Cable, Optical Fiber Modes and Classifications, Optical Fiber Comparison, Losses in Optical Fiber Cables, Light sources, Light Detectors, Lasers.

UNIT-III

DIGITAL TRANSMISSION: Pulse Modulation, Pulse code Modulation, Dynamic Range, Signal Voltage to- Quantization Noise Voltage Ratio, Linear Versus Nonlinear PCM Codes, Companding, PCM Line Speed, Delta Modulation PCM and Differential PCM.

MULTIPLEXING AND T CARRIERS: Time- Division Multiplexing, T1 Digital Carrier System,

Digital Line Encoding, T Carrier systems, Frequency- Division Multiplexing, Wavelength- Division Multiplexing, Synchronous Optical Network.

UNIT- IV

WIRELESS COMMUNICATIONS SYSTEMS: Electromagnetic Polarization, Electromagnetic Radiation, Optical Properties of Radio Waves, Terrestrial Propagation of Electromagnetic Waves, Skip Distance, Free-Space Path Loss, Microwave Communications Systems, Satellite Communications Systems.

UNIT-V

TELEPHONE INSTRUMENTS AND SIGNALS: The Subscriber Loop, Standard Telephone Set, Basic Telephone Call Procedures, Call Progress Tones and Signals, Cordless Telephones, Caller ID, Electronic Telephones, Paging systems.

CELLULAR TELEPHONE SYSTEMS: First- Generation Analog Cellular Telephone, Personal Communications system, Second-Generation Cellular Telephone Systems, N-AMPS, Digital Cellular Telephone, Interim Standard, Global system for Mobile Communications.

Text Books

1. Introduction to Data Communications and Networking, Wayne Tomasi, Pearson Education.

Reference Books

1. Data Communications and Networking, Behrouz A Forouzan, Fourth Edition.TMH.
2. Data and Computer communications, 8/e, William Stallings, PHI.
3. Computer Communications and Networking Technologies, Gallow, Second Edition Thomson
4. Computer Networking and Internet, Fred Halsll, Lingana Gouda Kulkarni, Fifth Edition, Pearson Education.

	Honor Course	L	T	P	C
		3	1	0	4
INTERNETWORKING WITH TCP/IP					

Course Objectives:

1. To understand the fundamental concepts in Internetworking, Internet Addressing, IP, UDP, and TCP Protocols, Routing Architecture, Network Virtualization and Software Defined Networking
2. Analyze the benefits and challenges of SDN
3. Describe the role and functionality of OpenFlow protocol

Course outcomes:

By the end of this course, the student will be able to Understand

1. Explain the fundamentals of computer networking**,** including basic concepts, evolution, and the significance of internetworking in modern communication systems.
2. Analyze the structure and purpose of Internet Control Message Protocol (ICMP) and its role in error reporting and network diagnostics.
3. Compare and contrast different intra-domain routing protocols
4. Describe the principles of label switching and MPLS (Multiprotocol Label Switching)**,** and evaluate their roles in efficient packet forwarding and traffic engineering.
5. Explain the architecture and principles of Software Defined Networking (SDN)

UNIT – I:

Introduction and Overview, Overview of Underlying Network Technologies, Internetworking Concept and Architectural Model, Protocol Layering Internet Addressing, Mapping Internet Addresses To Physical Addresses (ARP), Internet Protocol: Connectionless Datagram Delivery (IPv4, Ipv6) CIDR Sub netting.

UNIT – II:

Internet Protocol: Forwarding IP Datagram's, Internet Protocol: Error and Control Messages (ICMP), User Datagram Protocol (UDP)

UNIT – III:

Reliable Stream Transport Service (TCP) Routing Architecture: Cores, Peers, and Algorithms, Routing Among Autonomous Systems (BGP), Routing Within An Autonomous System (RIP, RIPng, OSPF, IS-IS).

UNIT – IV:

Internet Multicasting , Label Switching, Flows, And MPLS, Packet Classification, Mobility And Mobile IP, Network Virtualization: VPNs, NATs, And Overlays Bootstrap And Auto configuration (DHCP, NDP, Ipv6-ND), Voice And Video Over IP (RTP, RSVP, QoS)

UNIT – V:

Software Defined Networking (SDN, OpenFlow)

Text Books:

1. Behrouz A Forouzan, “TCP/IP Protocol Suite”, TMH, 3rd Edition
2. B.A. Forouzan, “Data communication & Networking”, TMH, 4th Edition.

References:

1. Mahbub Hasan & Raj Jain, ” High performance TCP/IP Networking”, PHI -2005
2. Douglas. E.Comer, “Internetworking with TCP/IP “, Volume I PHI
3. Larry L. Perterson and Bruce S. Davie , “Computer Networks- A Systems Approach”, 2011, Morgan Kaufmann
4. Jochen Schiiler, “Mobile Communications”, Pearson, 2nd Edition.
5. Douglas E Comer, “Internetworking with TCP/IP Principles, Protocol, and Architecture” , Volume I, 6th Edition, Pearson Education, 2013
6. William Stallings, “Data and Computer Communications”, 9th Edition, Pearson Education, 2011

	Honor Course	L	T	P	C
		3	1	2	4
NETWORK PROGRAMMING					

Course Objectives:

1. To understand to Linux utilities
2. To understand file handling, signals
3. To understand IPC, network programming in Java

Course Outcomes:

By the end of this course, the student will be able to

1. Write socket API based programs
2. Design and implement client-server applications using TCP and UDP sockets
3. Analyze network programs
4. Design and implement client/server programs using a variety of protocols and platforms.
5. Implement specific network programming constructs on UNIX platforms to create robust real-world sockets-based applications.

UNIT – I

Introduction to Network Programming: OSI model, UNIX standards, TCP and UDP & TCP connection establishment and Format, Buffer sizes and limitation, standard internet services, Protocol usage by common internet application.

Sockets: Address structures, value – result arguments, Byte ordering and manipulation function and related functions Elementary TCP sockets – Socket, connect, bind, listen, accept, fork and exec function, concurrent servers. Close function and related function.

UNIT – II

TCP client server: Introduction, TCP Echo server functions, Normal startup, terminate and signal handling server process termination, Crashing and Rebooting of server host shutdown of server host.

Elementary UDP sockets: Introduction UDP Echo server function, lost datagram, summary of UDP example, Lack of flow control with UDP, determining outgoing interface with UDP.

I/O Multiplexing: I/O Models, select function, Batch input, shutdown function, poll function, TCP Echo server,

UNIT – III

Socket options: getsockopt and setsockopt functions. Socket states, Generic socket option IPV6 socket option ICMPV6 socket option IPV6 socket option and TCP socket options.

Advanced I/O Functions-Introduction, Socket Timeouts, recv and send Functions,readv and writev Functions, recvmsg and sendmsg Functions, Ancillary Data, How Much Data Is Queued, Sockets and Standard I/O, T/TCP: TCP for Transactions.

UNIT – IV

Elementary name and Address conversions: DNS, gethost by Name function, Resolver option, Function and IPV6 support, uname function, other networking information.

Daemon Processes and inetdSuperserver –Introduction, syslogd Daemon, syslog Function, daemon_init Function, inetd Daemon, daemon_inetd Function

Broadcasting-Introduction, Broadcast Addresses, Unicast versus Broadcast, dg_cli Function Using Broadcasting, Race Conditions

Multicasting-Introduction, Multicast Addresses, Multicasting versus Broadcasting on A LAN, Multicasting on a WAN, Multicast Socket Options, mcast_join and Related Functions, dg_cli Function Using Multicasting, Receiving MBone Session Announcements, Sending and Receiving, SNTP: Simple Network Time Protocol, SNTP (Continued)

UNIT-V:

Raw Sockets-Introduction, Raw Socket Creation, Raw Socket Output, Raw Socket Input, Ping Program, Traceroute Program, An ICMP Message Daemon, Datalink Access- Introduction, BPF: BSD Packet Filter, DLPI: Data Link Provider Interface, Linux: **SOCK_PACKET, libpcap:** Packet Capture Library, Examining the UDP Checksum Field. Remote Login: Terminal line disciplines, Pseudo-Terminals, Terminal modes, Control Terminals, rlogin Overview, RPC Transparency Issues.

Text Books:

1. UNIX Network Programming, by W. Richard Stevens, Bill Fenner, Andrew M. Rudoff, Pearson Education
2. UNIX Network Programming, 1st Edition, - W. Richard Stevens. PHI.

References:

1. UNIX Systems Programming using C++ T CHAN, PHI.
2. UNIX for Programmers and Users, 3rd Edition Graham GLASS, King abls, Pearson Education
3. Advanced UNIX Programming 2nd Edition M. J. ROCHKIND, Pearson Education

	Honor Course	L	T	P	C
		3	0	1	4
WIRELESS NETWORK TECHNOLOGIES					

Course Objectives:

1. Introduce the OSI Network Model and explain the functions of each layer
2. Explain the functionalities of the 802.11 MAC and PHY layers
3. Explain the mechanisms for supporting voice and Quality of Service (QoS) in WiMAX networks, and assess their performance in real-time communication.

Course Outcomes:

1. At the end of this course, students will be able to
2. Understand Cellular communication concepts
3. Study the mobile radio propagation
4. Study the wireless network different type of MAC protocols
5. Demonstrate wireless Local and Wide area networks and their specifications.

UNIT – I:

Wireless Network Architecture:

The OSI Network Model, Network Layer Technologies, Data Link Layer Technologies, Physical Layer Technologies, Operating System Considerations

Wired Network Topologies – A Refresher, Wireless Network Topologies, Wireless LAN Devices, Wireless PAN Devices, Wireless MAN Devices.

UNIT – II:

Wireless Communication:

Radio Communication Basics: The RF Spectrum, Spread Spectrum Transmission, Wireless Multiplexing and Multiple Access Techniques, Digital Modulation Technique, RF Signal Propagation and Reception, Ultra Wideband Radio, MIMO Radio ,Near Field Communications

Infrared Communication Basics: The Ir Spectrum, Infrared Propagation and Reception

UNIT – III:

Wireless LAN Standards:

The 802.11 WLAN Standards, the 802.11 MAC Layer, 802.11 PHY Layer, 802.11 Enhancements, Other WLAN Standards.

Implementing Wireless LANs: Evaluating Wireless LAN Requirements, Planning and Designing the Wireless LAN, PilotTesting, Installation and Configuration, Operation and Support

UNIT – IV:

Wireless PAN Implementation:

Introduction, Bluetooth (IEEE 802.15.1), Wireless USB, Contents vii ZigBee (IEEE 802.15.4) ,IRDA, Near Field Communications

Implementing Wireless PANs:
Wireless PAN Technology Choices, Pilot Testing ,Wireless PAN Security
UNIT – V:
Wireless MANs (WiMaX):
802.16 standards, Voice and QoS support
Trends: Overlay networks
The Future of Wireless Networking Technology:
Wireless Mesh Network Routing, Network Independent Roaming, Gigabit Wireless LANs, Cognitive Radio

Text Books:

1. Wireless Networking Technology: From Principles to Successful Implementation -Steve Rackley
2. Principles of Wireless Networks, K. Pahlavan and P. Krishnamurthy, Pearson Education, 2002.
3. Wireless Communication and Networks, W. Stallings, Pearson Education, 2002.
4. Mobile Communications, Jochen Schiller, Addison Wesley, 2003.

References:

1. Wireless Communications and Networking, Vijay Garg, Elsevier Publications, 2007.
2. Wireless Communications-Andrea Goldsmith, Cambridge University Press, 2005.
3. Ad Hoc Wireless Networks: Architectures and Protocols-C. Siva ram Murthy and B.S. Manoj, 2004, PHI.
4. Wireless Communications-Theodore. S. Rapport, Pearson Education, 2nd Edn., 2002.

	Honor Course	L	T	P	C
		3	1	0	4
CYBER SECURITY ESSENTIALS					

Course Objective:

1. To introduce information security concepts to undergraduate engineering students, so they can defend their personal and organizational information from probable security attacks and incidents.
2. Classify and analyze various categories of network attacks
3. Describe and compare various cryptographic algorithms,

Course Outcomes:

By the end of this course, the student will be able to

1. Understand the basics and need for information security
2. Identify, analyze, and evaluate infrastructure and network vulnerabilities.
3. Understand and analyze different access control and authentication methods.
4. Identify and assess current and anticipated security risks and vulnerabilities with vulnerability assessment and auditing methods.
5. Learn the fundamentals of cryptography and how cryptography serves as the central language of information security.

UNIT-I:

Introduction to Security: Challenges of Securing Information, Definition of Information Security, Attackers, Attacks and Defenses.

Systems Threats and Risks: Software-Based Attacks, Hardware-Based Attacks, Attacks on Virtualized Systems, Hardening the Operating System, Preventing Attacks that Target the Web Browser, Hardening Web Servers, Protecting Systems from Communications-Based Attacks, Applying Software Security Applications.

UNIT-II:

Network Vulnerabilities and Attacks: Network Vulnerabilities, Categories of Attacks, Methods of Network Attacks.

Network Defenses: Crafting a Secure Network, Applying Network Security Devices, Host and Network Intrusion Prevention Systems (HIPS/NIPS), Protocol Analyzers, Internet Content Filters, Integrated Network Security Hardware.

UNIT-III:

Access Control: Access Control Models and Practices, Logical Access Control Methods, Physical Access Control.

Authentication: Definition of Authentication, Authentication Credentials, Extended Authentication Protocols, Remote Authentication and Security.

UNIT-IV:

Vulnerability Assessment: Risk Management, Assessment, and Mitigation, Identifying Vulnerabilities.

Security Audit: Privilege Auditing, Usage Auditing, Monitoring Methodologies and Tools.

UNIT-V:

Cryptography: Introduction to Cryptography, Cryptographic Algorithms, Using Cryptography on Files and Disks, Digital Certificates, Public Key Infrastructure, Key Management.

Text Book:

i. Security+ Guide to Network Security Fundamentals, Third Edition, Mark Ciampa, Cengage Learning.

References:

i. Principles of Information Security, Michael E. Whitman and Herbert J. Mattord, Cengage Learning.
ii. Information Security: The Complete Reference, Rhodes-Ousley, Mark, Second Edition, McGraw-Hill.
iii. Information Security: Principles and Practices, Mark S. Merkow, Jim Breithaupt, 2nd Edition, Pearson Education.

	Honor Course	L	T	P	C
		3	0	2	4
SECURE CODING					

Course Objectives:

1. Understanding of the various security attacks and knowledge to recognize and remove common coding errors that lead to vulnerabilities.
2. Knowledge of outline of the techniques for developing a secure application.
3. Recognize opportunities to apply secure coding principles.

Course Outcomes:

At the end of the course, student will be able to

1. List of secure systems and various security attacks
2. Demonstrate the development of process of software leads to secure coding practices
3. Apply Secure programs and various risk in the software's
4. Classify various errors that lead to vulnerabilities
5. Design Real time software and vulnerabilities

UNIT–I: Introduction-Need for secure systems, Proactive security development process, Security principles to live by and threat modeling.

UNIT–II: Secure Coding in C-Character strings- String manipulation errors, String Vulnerabilities and exploits Mitigation strategies for strings, Pointers, Mitigation strategies in pointer based vulnerabilities Buffer Overflow based vulnerabilities

UNIT–III: Secure Coding in C++ and Java-Dynamic memory management, Common errors in dynamic memory management, Memory managers, Double –free vulnerabilities, Integer security, Mitigation strategies

UNIT–IV: Database and Web Specific Input Issues-Quoting the Input, use of stored procedures, Building SQL statements securely, XSS related attacks and remedies

UNIT–V: Software Security Engineering-Requirements engineering for secure software: Misuse and abuse cases, SQUARE process model Software security practices and knowledge for architecture and design

Text Book:

1. Michael Howard, David LeBlanc, "Writing Secure Code", Microsoft Press, 2nd Edition, 2003.

References:

1. Robert C. Seacord, “Secure Coding in C and C++”, Pearson Education, 2nd edition, 2013.
2. Julia H. Allen, Sean J. Barnum, Robert J. Ellison, Gary McGraw, Nancy R. Mead, “Software Security Engineering: A guide for Project Managers”, Addison-Wesley Professional, 2008.

	Honor Course	L	T	P	C
		3	1	0	4
VULNERABILITY ASSESSMENT & PENETRATION TESTING					

Course Objectives:

1. To identify security vulnerabilities and weaknesses in the target applications.
2. To identify how security controls can be improved to prevent hackers gaining access to operating systems and networked environments.
3. To test and exploit systems using various tools.

Course Outcomes:

By the end of this course, the student will be able to

1. Explain Penetration testing phases
2. Illustrate information gathering methodologies
3. Apply System Hacking Techniques in real time applications
4. Explore advanced System hacking
5. Describe Bypassing WLAN Authentication

UNIT-I: Introduction-Penetration Testing phases/Testing Process, types and Techniques, Blue/Red Teaming, Strategies of Testing, Non-Disclosure Agreement Checklist, Phases of hacking, Open-source/proprietary Pentest Methodologies

UNIT -II - Information Gathering and Scanning-

Information gathering methodologies- Foot printing, Competitive Intelligence- DNS Enumerations- Social Engineering attacks, Port Scanning-Network Scanning- Vulnerability Scanning- NMAP scanning tool- OS Fingerprinting-Enumeration.

UNIT-III -System Hacking

Password cracking techniques- Key loggers- Escalating privileges- Hiding Files, Double Encoding, Steganography technologies and its Countermeasures. Active and passive sniffing- ARP Poisoning, MAC Flooding- SQL Injection - Error- based, Union-based, Time-based, Blind SQL, Out-of-band. Injection Prevention Techniques.

UNIT- IV – AdvancedSystemHacking:

Broken Authentication, Sensitive Data Exposure, XML External Entities, Broken Access Code, XSS - Stored, Reflected, DOM Based

UNIT-V –WirelessPen test:

Wi-Fi Authentication Modes, Bypassing WLAN Authentication, Types of Wireless Encryption, WLAN Encryption Flaws, AP Attack, Attacks on the WLAN Infrastructure, DoS-Layer1, Layer2, Layer 3, DDoS Attack, Client Misassociation, Wireless Hacking Methodology, Wireless Traffic Analysis

Text Books:

1. Kali Linux 2: Windows Penetration Testing, By Wolf Halton, Bo Weaver , June 2016 Packt Publishing

References:

1. Mastering Modern Web Penetration Testing By Prakhar Prasad,October 2016 Packt Publishing.
2. SQL Injection Attacks and Defense 1st Edition, by Justin Clarke-Salt, Syngress Publication

	Honor Course	L	T	P	C
		3	0	2	4
MALWARE ANALYSIS					

Course Objectives:

1. To understand the purpose of computer infection program.
2. To implement the covert channel and mechanisms.
3. To test and exploit various malware in open-source environment.

Course Outcomes:

At the end of the course, student will be able to

1. Explain the characteristics of Malware and its effects on Computing systems.
2. Predict the given system scenario using the appropriate tools to Identify the vulnerabilities and to perform Malware analysis.
3. Analyze the given Portable Executable and Non-Portable Executable files using Static and dynamic analysis techniques.
4. Demonstrate the Malware functionalities.
5. How to apply anti-reverse engineering in different Applications

UNIT–I: Malware Basics- General Aspect of Computer infection program, Non Self Reproducing Malware, How does Virus Operate, Virus Nomenclature, Worm Nomenclature, Recent Malware Case Studies.

UNIT– II: Basic Analysis- Antivirus Scanning, x86 Disassembly, Hashing, Finding Strings, Packed Malware, PE File Format, Linked Libraries & Functions, PE Header File &Section.

UNIT–III: Advanced Static & Dynamic Analysis-IDA Pro, Recognizing C code constructs, Analyzing malicious windows program, Debugging, OllyDbg, Kernel Debugging with WinDbg, Malware Focused Network Signatures.

UNIT–IV: Malware Functionalities-Malware Behavior, Covert Malware Launch, Data Encoding, Shell code Analysis.

UNIT–V: Reverse Engineering Malware (REM): REM Methodology, Resources for Reverse-Engineering Malware (REM) Understanding Malware Threats, Malware indicators, Malware Classification, Examining Clam AV-Signatures.

Text books:

1. Michael Sikorski, Andrew Honig "Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software" publisher Williampollock

References:

1. ErciFiliol, "Computer Viruses: from theory to applications", Springer, 1st edition, 2005.

	Honor Course	L	T	P	C
		3	1	0	4
DIGITAL IMAGE PROCESSING					

Course Objectives:

The objective of this course is to

1. Comprehend the relation between human visual system and machine perception and processing of digital images.
2. Provide a detailed approach towards image processing applications like enhancement, Segmentation, and compression.
3. Explain edge linking and boundary detection techniques

Course Outcomes:

At the end of the course, the students will be able to:

1. Apply the spatial and frequency domain image transforms
2. Apply image enhancement techniques.
3. Understand restoration of images
4. Understand segmentation of images.
5. Apply image compression techniques and evaluate the basic compression algorithms.

UNIT - I

Digital Image Fundamentals & Image Transforms: Digital Image Fundamentals, Sampling and Quantization, Relationship between Pixels.

Image Transforms: 2-D FFT, Properties, Walsh Transform, Hadamard Transform, Discrete Cosine Transform, Haar Transform, Slant Transform, Hotel ling Transform.

UNIT - II

Image Enhancement (Spatial Domain): Introduction, Image Enhancement in Spatial Domain,

Enhancement through Point Processing, Types of Point Processing, Histogram Manipulation, Linear andNon – Linear Gray Level Transformation, Local or Neighborhood criterion, Median Filter, SpatialDomain High-Pass Filtering.

Image Enhancement (Frequency Domain): Filtering in Frequency Domain, Low Pass (Smoothing) andHigh Pass (Sharpening) Filters in Frequency Domain.

UNIT - III

Image Restoration: Degradation Model, Algebraic Approach to Restoration, Inverse Filtering, Least Mean Square Filters, Constrained Least Squares Restoration, Interactive Restoration.

UNIT – IV

Image Segmentation: Detection of Discontinuities, Edge Linking and Boundary Detection, thresholding, Region Oriented Segmentation.

Morphological Image Processing: Dilation and Erosion: Dilation, Structuring Element Decomposition,

Erosion, Combining Dilation and Erosion, Opening and Closing, Hit or Miss Transformation.

UNIT - V

Image Compression: Redundancies and their Removal Methods, Fidelity Criteria, Image CompressionModels, Huffman and Arithmetic Coding, Error Free Compression, Lossy Compression, Lossy andLossless Predictive Coding, Transform Based Compression, JPEG 2000 Standards.

Text Books:

1. Digital Image Processing - Rafael C. Gonzalez, Richard E. Woods, 3rd Edition, Pearson.
2. Digital Image Processing- S Jayaraman, S Esakkirajan, T Veerakumar- MC GRAW HILL EDUCATION.

References:

1. Digital Image Processing and Analysis-Human and Computer Vision Application with using CVIPTools - ScotteUmbaugh, 2nd Ed, CRC Press, 2011
2. Digital Image Processing using MATLAB – Rafael C. Gonzalez, Richard E Woods and Steven L.Eddings, 2nd Edition, MC GRAW HILL EDUCATION, 2010.
3. Digital Image Processing and Computer Vision – Somka, Hlavac, Boyle- Cengage Learning (Indianedition) 2008.
4. Introductory Computer Vision Imaging Techniques and Solutions- Adrian low, 2008,2 nd Edition.

	Honor Course	L	T	P	C
		3	1	0	4
BIO METRICS					

Course Objective:

1. To understand the technologies of fingerprint, iris, face and speech recognition
2. To understand the general principles of design of biometric systems and theunderlying trade-offs.
3. To recognize personal privacy and security implications of biometrics basedidentification of technology.

Course Outcomes:

At the end of the course, the students will be able to:

1. Understand basic concepts of biometric technology.
2. Analyze fingerprint technology
3. Analyze face recognition systems
4. Understand voice based biometric recognition
5. Understand Multi-biometric systems

UNIT-I: INTRODUCTION TO BIOMETRICS

Introduction and background – biometric technologies – passive biometrics – activebiometrics - Biometrics Vs traditional techniques – Benefits of biometrics - Operation of abiometric system– Key biometric processes: verification, identification and biometricmatching – Performance measures in biometric systems: FAR, FRR, FTE rate, FTA rate andrate- Need for strong authentication – Protecting privacy and biometrics and policy –Biometric applications.

UNIT-II: FINGERPRINT IDENTIFICATION TECHNOLOGY

Fingerprint Patterns, Fingerprint Features, Fingerprint Image, width between two ridges -Fingerprint Image Processing - Minutiae Determination - Fingerprint Matching: FingerprintClassification, Matching policies.

UNIT-III: FACE RECOGNITION

Introduction, components, Facial Scan Technologies, Face Detection, Face Recognition, Representation and Classification, Kernel- based Methods and 3D Models, Learning the Face Spare, Facial Scan Strengths and Weaknesses, Methods for assessing progress in Face Recognition.

UNIT-IV: VOICE SCAN

Introduction, Components, Features and Models, Addition Method for managing Variability, MeasuringPerformance, Alternative Approaches, Voice Scan Strengths and Weaknesses,NIST Speaker

Recognition Evaluation Program, Biometric System Integration.

UNIT-V: FUSION IN BIOMETRICS

Introduction to Multibiometric - Advantages of multimodal system, Information Fusion in Biometrics - Issues in Designing a Multibiometric System - Sources of Multiple Evidence -Levels of Fusion in Biometrics – Sensor level, Feature level, Rank level, Decision levelfusion - Score level Fusion. Examples –gait based biometric systems.

Text Books:

1. James Wayman, Anil Jain, Davide Maltoni, Dario Maio, ―Biometric Systems,Technology Design and Performance Evaluation‖, Springer.
2. David D. Zhang, ―Automated Biometrics: Technologies and Systems‖, KluwerAcademic Publishers, New Delhi.
3. Arun A. Ross , Karthik Nandakumar, A.K.Jain, ―Handbook of Multibiometrics‖,Springer, New Delhi.

References:

1. Paul Reid, ―Biometrics for Network Security‖, Pearson Education, 2004.
2. Nalini K Ratha, Ruud Bolle, ―Automatic fingerprint Recognition System‖, Springer.
3. L C Jain, I Hayashi, S B Lee, U Halici, ―Intelligent Biometric Techniques in Fingerprint and Face Recognition‖ CRC Press, 1999.
4. John Chirillo, Scott Blaul, ―Implementing Biometric Security‖, John Wiley, 2003.
5. S.Y. Kung, S.H. Lin, M.W.Mak, ―Biometric Authentication: A Machine Learning Approach‖Prentice Hall, 2005

	Honor Course	L	T	P	C
		3	1	0	4
SPEECH PROCESSING					

Course Objectives:

The objective of this course is to

1. The aim of the course is to make the students to understand the basic characteristics of the speech
2. Signalabout the production and perception of speech by humans.
3. To describe the basic techniques and practical aspects of speech analysis.

Course Outcomes:

At the end of the course, the students will be able to:

1. Understand and describe the mechanisms of speech production.
2. Determine the speech sounds from the acoustic characteristics.
3. Analyze the speech signal in time and frequency domains
4. Analyze the speech signal in terms of the parameters of a source-filter model.
5. Design a simple speaker recognition system.

UNIT - I

Fundamentals of Digital Speech Processing: Anatomy & Physiology of Speech Organs, The process of Speech Production, Acoustic Phonetics, Articulatory Phonetics, The Acoustic Theory of Speech Production- Uniform Lossless Tube Model, Effect of Losses In Vocal Tract, Effect of Radiation at Lips, Digital Models for Speech Signals.

UNIT - II

Time Domain Models for Speech Processing: Introduction, Window Considerations, Short-Time-Energy and Average Magnitude Short Time Average Zero Crossing Rate, Speech Vs Silence Discrimination Using Energy and Zero Crossing, Pitch Period Estimation using a Parallel Processing Approach, The Short Time Autocorrelation Function, The Short Time Average Magnitude DifferenceFunction, Pitch Period Estimation using The Autocorrelation Function.

UNIT - III

Linear Predictive Coding (LPC) Analysis: Basic Principles of Linear Predictive Analysis, The Autocorrelation Method, The Covariance Method, Solution of LPC Equations: Cholesky DecompositionSolution for Covariance Method, Durbin’s Recursive Solution For the Autocorrelation Equations, Comparison between the Methods of Solution of the LPC Analysis Equations, Applications of LPCParameters: Pitch Detection Using LPC Parameters, Formant Analysis Using LPC Parameters.

UNIT - IV

Automatic Speech & Speaker Recognition: Basic Pattern Recognition Approaches, Parametric Representation of Speech, Evaluating the Similarity of Speech Patterns, Isolated Digit Recognition System, Continuous Digit Recognition System Hidden Markov Model (HMM) For Speech: Hidden Markov Model (HMM) for Speech Recognition, Viterbi algorithm, Training and Testing using HMMS.

UNIT - V

Speaker Recognition: Recognition techniques, Features That Distinguish Speaker, Speaker RecognitionSystems: Speaker Verification System, Speaker Identification System. Overview of speechEnhancement, speech synthesis.

Textbooks:

1. Digital Processing of Speech Signals: L.R Rabinar and R W Jhaung, Pearson Education.
2. Digital Processing of Speech Signals: L.R. Rabiner and S. W. Schafer, Pearson Education.
3. Speech Communications: Human & Machine - Douglas O' Shaughnessy, 2nd Ed., WileyIndia.

References:

1. Discrete Time Speech Signal Processing: Principles and Practice, Thomas F. Quateri, 1stEdition, Pearson Education.
2. Speech & Audio Signal Processing: Ben Gold & Nelson Morgan, 1st Edition, Wiley.

	Honor Course	L	T	P	C
		3	0	2	4
ADVANCED COMPUTER VISION					

Course Objectives:

1. Able to apply the core theories and algorithms of computer vision and video processing
2. Understand the state-of-the-art of computer vision and image/video processing,
3. Apply the applications such as vision-based modeling and interaction.

Course Outcomes:

At the end of the course, the students will be able to:

1. Identify basic concepts, terminology, theories, models and methods in the field of computer vision.
2. Able to know principles of human visual system.
3. Understanding theadvanced methods of computer vision related to GAN, RNN, Deep Dream implementation, LeNet and MNIST etc...
4. Apply a design of a computer vision system for a specific problem.
5. Apply applications of RNN in real time applications.

UNIT – I:

Introduction to Deep Learning, Tensor flow and Keras:

What is Deep learning? Why Deep learning, Advantages, and limitations of Deep learning.Tensor flow basics, how to build Deep learning models with Keras and Tensor flow as backend. Tensor board for visualizations.

UNIT - II:

CNN for Vision Tasks:

Introduction to CNN, Deep Convolutional networks, LeNet, VGG16Net, and Classification of MNIST hand written digits by CNN and FCNN models.

UNIT - III: Generative AdversalNetworks(GAN's):

What is GAN?,DGAN,Some interesting GAN structures,SRGAN,Cycle GAN, info GAN.MNIST using GAN in Tensor flow.

UNIT - IV: Recurrent Neural Networks:

The basic RNN, RNN Cell, RNN variants, RNN topologes, Example applications of RNN. Image captioning and Annotation.

UNIT - V: Deep Dream and Neural Style Transfer:

How the Deep dream algorithm works, Deepdeam implementation in keras and tensor flow. Neural Style Transfer: Content loss, Style loss, Totalvarianlosses, network training.

Text Books:

1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systemsby AurélienGéron,Orielly.
2. Deep Learning with Python 1st Edition by François Chollet,MannigPublicatons.
3. Mastering Computer Vision with TensorFlow 2.x: Build advanced computer vision applications using machine learning and deep learning techniquesby Krishnendu Kar ,Packt Publications.
4. Deep Learning with TensorFlow 2 and Keras: Regression, ConvNets, GANs, RNNs,NLP, and more with TensorFlow 2 and the Keras API, 2nd Edition

References:

1. Richard Szeliksy "Computer Vision: Algorithms and Applications" (http://szeliski.org/Book/)
2. Haralick& Shapiro, "Computer and Robot Vision", Vol II
3. G_erardMedioni and Sing Bing Kang "Emerging topics in computer vision"
4. Emanuele Trucco and AllessandroVerri "Introductory Techniques for 3-D Computer Vision", Prentice Hall, 1998.
5. Olivier Faugeras, "Three-Dimensional Computer Vision", The MIT Press, 1993

	Honor Course	L	T	P	C
		3	1	0	4
MATHEMATICAL ESSENTIAL FOR DATA SCIENCE					

Course Objectives:

1. Recall the basics of sets, natural numbers, integers, rational numbers, and real numbers.
2. Learn to use the coordinate system, and plot straight lines.
3. Identify the properties and differences between linear, quadratic, polynomial, exponential, and logarithmic functions.

Course Outcomes:

At the end of the course, the students will be able to:

1. Demonstrate understanding of basic mathematical concepts in data science, relating to linear algebra, probability, and calculus.
2. Employ methods related to these concepts in a variety of data science applications.
3. Apply logical thinking to problem-solving in context.
4. Use appropriate technology to aid problem-solving and data analysis.
5. Demonstrate skills in writing mathematics.

UNIT – 1:

Set Theory - Number system, Sets and their operations

Relations and functions - Relations and their types, Functions and their types, Rectangular coordinate system

UNIT – 2:

Straight Lines- Slope of a line, Parallel and perpendicular lines, Representations of a Line, General equations of a line, Straight-line fit

Quadratic Functions - Quadratic functions, Minima, maxima, vertex, and slope, Quadratic Equations

UNIT – 3:

Algebra of Polynomials - Addition, subtraction, multiplication, and division, Algorithms

UNIT – 4:

Graphs of Polynomials - X-intercepts, multiplicities, end behavior, and turning points, Graphing & polynomial creation

Functions - Horizontal and vertical line tests, Exponential functions, Composite functions, Inverse functions

Logarithmic Functions - Properties, Graphs, Exponential equations, Logarithmic equations

UNIT – 5:

Graph Theory - Representation of graphs, Breadth-first search, Depth-first search, Applications of BFS and DFS

Directed Acyclic Graphs - Complexity of BFS and DFS, Topological sorting and longest path, Transitive closure, Matrix multiplication

Graph theory Algorithms - Single source shortest paths, Dijkstra's algorithm, Bellman-Ford algorithm, All-pairs shortest paths, Floyd–Warshall algorithm, Minimum cost spanning trees, Prim's algorithm, Kruskal's algorithm

Text Book:

1. Introductory Algebra: a real-world approach (4th Edition) - by Ignacio Bello

References:

1. Mathematical Foundations Of Data Science Using Rby Emmert-Streib Frank.

	Honor Course	L	T	P	C
		3	1	0	4
INTRODUCTION TO DATA SCIENCE					

Course Objectives:

1. The course teaches critical concepts and skills in computer programming and statistical inference, in conjunction with hands-on analysis of real-world datasets, including economic data, document collections, geographical data, and social networks.
2. It delves into social issues surrounding data analysis such as privacy and design.
3. Explain out-of-sample evaluation metrics

Course Outcomes:

At the end of the course, the students will be able to:

1. Apply dimensionality reduction tools such as principle component analysis
2. Evaluate outcomes and make decisions based on data
3. Understand how to Use exploratory tools such as clustering and visualization tools to analyze data.
4. Apply dimensionality reduction tools such as principle component analysis
5. Able to know how to perform basic analysis of network data.

UNIT – I: INTRODUCTION

Introduction to Data Science – Evolution of Data Science – Data Science Roles – Stages in aData Science Project – Applications of Data Science in various fields – Data Security Issues.

UNIT – II: DATA COLLECTION AND DATA PRE-PROCESSING

Data Collection Strategies – Data Pre-Processing Overview – Data Cleaning – DataIntegration and Transformation – Data Reduction – Data Discretization.

UNIT – III: EXPLORATORY DATA ANALYTICS

Descriptive Statistics – Mean Standard Deviation, Skewness and Kurtosis – Box Plots – Pivot Table – Heat Map Correlation Statistics – ANOVA.

UNIT – IV: MODEL DEVELOPMENT

Simple and Multiple Regression – Model Evaluation using Visualization – Residual Plot –Distribution Plot – Polynomial Regression and Pipelines – Measures for In-sampleEvaluation – Prediction and Decision Making.

UNIT – V: MODEL EVALUATION

Generalization Error – Out-of-Sample Evaluation Metrics – Cross Validation – Over fitting –Under Fitting and Model Selection – Prediction by using Ridge Regression – TestingMultiple Parameters by using Grid Search.

Text Books:

1. Data Science for Beginners, by Andrew Park
2. The Art of Data Science — A Guide for Anyone Who Works With Data, by Roger D. Peng and Elizabeth Matsui.

References:

1. JojoMoolayil, “Smarter Decisions : The Intersection of IoT and Data Science”,PACKT, 2016.
2. Cathy O’Neil and Rachel Schutt , “Doing Data Science”, O'Reilly, 2015.
3. David Dietrich, Barry Heller, Beibei Yang, “Data Science and Big data Analytics”,EMC 2013
4. Raj, Pethuru, “Handbook of Research on Cloud Infrastructures for Big DataAnalytics”, IGI Global.

	Honor Course	L	T	P	C
		3	1	0	4
DATA ANALYTICS AND VISUALIZATION					

Course Objectives:

1. To demonstrate expert knowledge of data analysis, statistics, tools, techniques and technologies of data analytics and Visualization.
2. To enable learners to develop knowledge and skills in current and emerging areas of data analytics and Visualization.
3. To formulate and implement a novel research idea and conduct research in the field of data analytics and Visualization.

Course Outcomes:

After completing the course, student will be able to:

1. Present data with visual representations for your target audience, task, anddata;
2. Identify appropriate data visualization techniques given particular requirements imposed by the data;
3. Display types, Geospatial displays, Interactivity
4. Data Definitions and Analysis Techniques
5. Implement the analytic algorithms and Basic analysis techniques

UNIT -1: INTRODUCTION AND TABLEAU PRIMER:

Introduction to data visualization Data for data graphics Tableau introduction

UNIT-2: DESIGN PRINCIPLES

Design principles Categorical, time series, and statistical data graphics

UNIT-3: Display types, Geo spatial displays, Interactivity

Storytelling Multivariate displays, Geospatial displays, Dashboards, interactive and animated displays

UNIT-4: Data Definitions and Analysis Techniques:

Elements, Variables, and Data categorization, Levels of Measurement, Data management and indexing, Introduction to statistical learning.

Descriptive Statistics:

Measures of central tendency, Measures of location of dispersions.

UNIT-5: Basic analysis techniques

Statistical hypothesis generation and testing, Chi-Square test,t-Test,Analysis of variance, Correlation analysis, Maximum likelihood test.

Text Books:

1. Sosulski, K. (2018). Data Visualization Made Simple: Insights into BecomingVisual. New York: Routledge.
2. Probability & Statistics for Engineers & Scientists (9th Edn.), Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Prentice Hall Inc.
3. The Elements of Statistical Learning, Data Mining, Inference, and Prediction (2nd Edn.), Trevor Hastie Robert Tibshirani Jerome Friedman, Springer, 2014

References:

1. An Introduction to Statistical Learning: with Applications in R, G James, D. Witten, T Hastie, and R. Tibshirani, Springer, 2013
2. Software for Data Analysis: Programming with R (Statistics and Computing), John M. Chambers, Springer
3. Mining Massive Data Sets, A. Rajaraman and J. Ullman, Cambridge University Press, 2012
4. Advances in Complex Data Modeling and Computational Methods in Statistics, Anna Maria Paganoni and Piercesare Secchi, Springer, 2013

Optional readings:

1. Few, S. (2012). Show me the numbers: Designing tables and graphs toenlighten. Burlingame, CA: Analytics Press.
2. Few, S. (2006). Information dashboard design: The effective visualcommunication of data. Sebastopol: O'Reilly.
3. Ware, C & Kaufman, M. (2008). Visual thinking for design. Burlington: MorganKaufmann Publishers.
4. Wong, D. (2011). The Wall Street Journal guide to information graphics: The dosand don'ts of presenting data, facts and figures. New York: W.W. Norton& Company.
5. Yau, N. (2011). Visualize This: The FlowingData Guide to Design, Visualization,and Statistics. Indianapolis: O'Reilly.
6. Yau, N. (2013). Data Points: Visualization that means something. Indianapolis: O'Reilly.

	Honor Course	L	T	P	C
		3	0	2	4
PYTHON FOR DATA SCIENCE					

Course Objectives:

1. The course aims at equipping participants to be able to use python programming for solving data science problems
2. Develop proficiency in using Pandas Data Frames
3. Analyze and interpret results from classification case studies

Course Outcomes:

At the end of the course, the students will be able to:

1. Understand how to work in Jupiter Notebook.
2. Know how to import data in Python.
3. Ability to learnpandas library, the main methods for Data Frames.
4. Able to applythe Basic Data types, Operators, how to clean and merge datasets.
5. Apply Classification and Regression case studies in real time environment.

UNIT-I

Introduction to Python for Data Science, Introduction to Python, Introduction to Spyder - Part 1,Introduction to Spyder - Part 2, Variables and Datatypes, Operators,

UNIT-II

Jupyter setup, Sequence_data_part_1, Sequence_data_part_2, Sequence_data_part_3, Numpy

UNIT-III

Reading Data, Pandas Data framesI, Pandas Data framesII, Pandas DataframesIII, Control Srtuctures and Functions, Explonatory Data Analysis, Data visualization Part-I,Data visualization Part-II, Dealing with Missing Data

UNIT-IV

Introduction to Classification. Case Study on Classification Part I, Case Study on Classification Part II

UNIT-V

Introduction to Regression. Case Study on Regression Part I, Case Study on Regression Part II

Text Books:

1. Python Data Science Handbook: Essential Tools for Working with Data-Oreilly Publication-author by Jake Vander Plus.
2. Python for Data Science For Dummies authors by Luca Massaron John Paul Mueller.

References:

1. https://nptel.ac.in/courses/106/106/106106212/

MINOR DEGREE IN COMPUTER SCIENCE AND ENGINEERING

(For Non CSE Students)

Minor Degree in Computer Science and Engineering

S.No	Subject Title	L	T	P	C
1	Data Structures	2	0	2	3
2	Database Management Systems	2	0	2	3
3	Operating Systems	3	0	0	3
4	Computer Networks	3	0	0	3
5	03 MOOCS courses @ 2credits each (8 weeks course) 02 MOOCS courses @ 3credits each (12 weeks course) (Any CSE/IT related **Program Core subject** from NPTEL/ SWAYAM course other than the courses listed above needs to be taken)				6
				Total	**18**

(I) Artificial Intelligence

S.No	Subject Title	L	T	P	C
1	Introduction to Artificial Intelligence	3	0	0	3
2	Mathematics for Machine Learning	3	0	0	3
3	Machine Learning	3	0	0	3
4	Deep Learning	3	0	0	3
5	03 MOOCS courses @ 2credits each (8 weeks course) 02 MOOCS courses @ 3credits each (12 weeks course) (Any CSE/IT related **Program Core subject** from NPTEL/ SWAYAM course other than the courses listed above needs to be taken)				6
				Total	**18**

(II) Computer Security

S.No	Subject Title	L	T	P	C
1	Cyber Security	3	0	0	3
2	Cyber Crime Investigation and Digital Forensics	3	0	0	3
3	Cryptography and Applications	3	0	0	3
4	Blockchain Technology	3	0	0	3
5	03 MOOCS courses @ 2credits each (8 weeks course) 02 MOOCS courses @ 3credits each (12 weeks course) (Any CSE/IT related **Program Core subject** from NPTEL/SWAYAM course other than the courses listed above needs to be taken)				6
				Total	**18**

(III) Programming and Web Development

S.No	Subject Title	L	T	P	C
1	Object Oriented Programming through Java	2	0	2	3
2	Basic Web Designing	2	0	2	3
3	Advanced Web Technologies	2	0	2	3
4	Mobile Application Development	2	0	2	3
5	03 MOOCS courses @ 2credits each (8 weeks course) 02 MOOCS courses @ 3credits each (12 weeks course) (Any CSE/IT related **Program Core subject** from NPTEL/SWAYAM course other than the courses listed above needs to be taken)				6
				Total	**18**

(IV) Advanced Computing

S.No	Subject Title	L	T	P	C
1	Computer Organization and Architecture	3	0	0	3
2	Distributed Systems	3	0	0	3
3	Cloud Computing	3	0	0	3
4	Quantum Computing	3	0	0	3
5	03 MOOCS courses @ 2credits each (8 weeks course) 02 MOOCS courses @ 3credits each (12 weeks course) (Any CSE/IT related **Program Core subject** from NPTEL/SWAYAM course other than the courses listed above needs to be taken)				6
				Total	**18**

Note: Students who have registered for minors program can opt a maximum of two (02) courses per semester.

	Minor Course	L	T	P	C
		3	1	0	4
DATA STRUCTURES					

Course Objectives:

1. To teach efficient storage mechanisms of data for an easy access.
2. To design and implementation of various basic and advanced data structures.
3. To introduce various techniques for representation of the data in the real world.

Course Outcomes:

At the end of the course, the students will be able to:

1. Analyze time and space complexity to evaluate the efficiency of algorithms and data structure operations
2. Implement stacks using both array-based and linked list-based representations
3. Explain the basic operations and characteristics of queues, including their role in managing data flow.
4. Compare and evaluate the performance of different sorting and searching methods
5. Perform and implement binary tree traversals, including in-order, pre-order, and post-order

UNIT-I

Time and space complexity, Data Structures – Introduction to Data Structures, abstract data types,Linear list – singly linked list implementation, insertion, deletion and searching operations on linearlist, circular linked list implementation, Double linked list implementation, insertion, deletion andsearching operations. Applications of linked lists.

UNIT –II

Stacks-Operations, array and linked representations of stacks, stack applications -infix to postfixconversion, postfix expression evaluation, recursion implementation.

UNIT-III

Queues-operations, array, and linked representations. Circular Queue operations, Dequeues,applications of queues.

UNIT-IV

Searching and Sorting – Sorting- selection sort, bubble sort, insertion sort, quick sort,merge sort, shell sort, radix sort, Searching-linear and binary search methods, comparisonof sorting and searching methods.

UNIT-V

Trees – Definitions, tree representation, properties of trees, Binary tree,Binary tree representation, binary tree properties, binary tree traversals,binary tree implementation, applications of trees.

Text Books:

i. Fundamentals of Data structures in C, 2nd Edition, E.Horowitz, S.Sahniand Susan Anderson-Freed, Universities Press.
ii. Data structures A Programming Approach with C, D.S.Kushwaha and A.K.Misra, PHI.

References:

i. Data structures: A Pseudocode Approach with C, 2nd edition,
ii. R.F.Gilberg andB.A.Forouzan, CengageLearning.
iii. Data structures and Algorithm Analysis in C, 2nd edition, M.A.Weiss, Pearson.
iv. Data Structures using C, A.M.Tanenbaum,Y. Langsam, M.J.Augenstein, Pearson.
v. Data structures and Program Design in C, 2nd edition, R.Kruse, C.L.TondoandB.Leung,Pearson

	Minor Course	L	T	P	C
		3	1	0	4
DATABASE MANAGEMENT SYSTEMS					

Course Objectives:

1. To learn the principles of systematically designing and using large scale Database Management Systems for various applications.
2. Explain the significance of null values and relational constraints,
3. Explain various constraints and data abstraction mechanisms

Course Outcomes:

At the end of the course, the students will be able to:

1. Describe a relational database and object -oriented database.
2. Create, maintain, and manipulate a relational database using SQL
3. Describe ER model and normalization for database design.
4. Examine issues in data storage and query processing and can formulate appropriate solutions.
5. Understand the role and issues in management of data such as efficiency, privacy, security, ethical responsibility, and strategic advantage and Design and build database system for a given real world problem

UNIT -I: INTRODUCTION -Database system, Characteristics (Database Vs File System), Database Users(Actors on Scene, Workers behind the scene), Advantages of Data base systems, Database applications. Brief introduction of different Data Models; Concepts of Schema, Instance and data independence; Three tier schema architecture for data independence; Database system structure, environment, Centralized and Client Server architecture for the database.

UNIT -II: RELATIONAL MODEL: Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Key constraints, integrity constraints) and their importance BASIC SQL: Simple Database schema, data types, table definitions (create, alter), different DML operations (insert, delete, update), basic SQL querying (select and project) using where clause, arithmetic& logical operations, SQL functions (Date and Time, Numeric, String conversion).

UNIT -III: ENTITY RELATIONSHIP MODEL: Introduction, Representation of entities, attributes, entity set, relationship, relationship set, constraints, sub classes, super class, inheritance, specialization, generalization using ER Diagrams. SQL: Creating tables with relationship, implementation of key and integrity constraints, nested queries, sub queries, grouping, aggregation , ordering, implementation of different types of joins, view(updatable and non - updatable), relational set operations.

UNIT -IV: SCHEMA REFINEMENT (NORMALIZATION): Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional

dependency(1NF, 2NF and 3 NF), concept of surrogate key, Boyce -codd normal form(BCNF), Lossless join and dependency preserving decomposition, Fourth normal form(4NF).

UNIT V: TRANSACTION CONCEPT: Transaction State, Implementation of atomicity and durability, Concurrent Executions, Serializability, Recoverability , Implementation of Isolation, Testing for Serializability, Failure Classification, Storage, Recovery and Atomicity, Recovery algorithm.

B+ Trees: Search, Insert, Delete algorithms, File Organization and Indexing, Cluster Indexes, Primary and Secondary Indexes , Index data Structures, Hash Based Indexing: Tree base Indexing ,Comparison of File Organizations, Indexes and Performance Tuning

Text Books:

1. Data base Management Systems, 3/ e, Raghurama Krishnan, Johannes Gehrke, TMH
2. Data base System Concepts,5/ e, Silberschatz, Korth, TMH
3. Introduction to Database Systems, 8/ e C J Date, PEA.

References:

1. Database Management System,6/ e RamezElmasri, Shamkant B. Navathe, PEA
2. Database Principles Fundamentals of Design Implementation and Management, Corlos Coronel, Steven Morris, Peter Robb, Cengage Learning.

	Minor Course	L	T	P	C
		3	1	0	4
OPERATING SYSTEMS					

Course Objectives:

1. Provide knowledge about the services rendered by operating systems.
2. Present detail discussion on processes, threads and scheduling algorithms.
3. Expose the student with different techniques of process synchronization and handlingdeadlocks.

Course Outcomes:

At the end of the course, the students will be able to:

1. Understand the importance of operating systems and different types of system calls.
2. Analyze the communication between processes and various process schedulingalgorithms.
3. Understand the process synchronization, different ways for deadlocks handling.
4. Analyze various memory mapping techniques and different page replacement methods.
5. Evaluate various file allocation and disk scheduling algorithms.

UNIT-I: Operating Systems Overview:

Introduction: what is an operating system, Types of operating systems, operating systems concepts, operating systems services, Introduction to System call, System call types, Operating System Generation.

UNIT–II: Process Management:

Process concept: Process Concept, Process Scheduling, Operations on Processes, Inter process Communication.

Multithreaded Programming: Overview, Multithreading models, Threading Issues. Process scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms.

UNIT-III: Synchronization:

Process Synchronization: The Critical-Section Problem, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Monitors, Synchronization examples.

Principles of deadlock – System Model, Deadlock Characterization, Deadlock Prevention, Detection and Avoidance, Recovery from Deadlock.

UNIT-IV: Memory Management:

Memory Management strategies: Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table.

Virtual Memory Management: Virtual Memory, Demand Paging, Page-Replacement Algorithms, Thrashing.

UNIT-V: File system Interface-

The concept of a file, Access Methods, Directory and Disk structure, File system mounting.File System implementation: File system structure, allocation methods, free-spacemanagement.Mass-storage structure: Overview of Mass-storage structure, Disk scheduling, Device drivers.

Text Books:

1. Silberschatz A, Galvin P B, and Gagne G, Operating System Concepts, 9th edition,Wiley, 2013.
2. Tanenbaum A S, Modern Operating Systems, 3rd edition, Pearson Education, 2008. (forInterprocess Communication and File systems).

References:

1. Tanenbaum A S, Woodhull A S, Operating Systems Design and Implementation, 3rdedition, PHI, 2006.
2. Dhamdhere D M, Operating Systems A Concept Based Approach, 3rd edition, TataMcGraw-Hill, 2012.
3. Stallings W, Operating Systems -Internals and Design Principles, 6th edition, PearsonEducation, 2009.
4. Nutt G, Operating Systems, 3rd edition, Pearson Education, 2004.

	Minor Course	L	T	P	C
		3	1	0	4
COMPUTER NETWORKS					

Course Objectives:

1. To introduce the fundamental various types of computer networks.
2. To understand state-of-the-art in network protocols, architectures, and applications.
3. To explore the various layers of OSI Model.

Course Outcomes:

At the end of the course, the students will be able to:

1. Understand OSI and TCP/IP reference models with an emphasis to Physical Layer, DataLink Layer and Network Layer.
2. Analyze the issues related to data link, medium access and transport layers by usingchannel allocation and connection management schemes.
3. Solve problems related to Flow control, Error control, Congestion control and NetworkRouting.
4. Design and compute subnet masks and addresses for networking requirementsUnderstand how internet works.
5. Understand the Application Layer protocols

UNIT-I:

Introduction: Network Hardware and software Reference models- The OSI Reference Model-the TCP/IP Reference Model - A Comparison of the OSI and TCP/IP Reference Models,Examples of Networks: Novell Networks, Arpanet, Internet, Network Topologies WAN, LAN,MAN.

Physical Layer: Guided Transmission Media, Digital Modulation and Multiplexing: frequencydivision multiplexing, wave length division multiplexing, synchronous time divisionmultiplexing, statistical time division multiplexing.

UNIT-II:

The Data Link Layer - Design Issues, Services Provided to the Network Layer – Framing –Error Control – Flow Control, Error Detection and Correction – Error-Correcting Codes – ErrorDetecting Codes, Elementary Data Link Protocols, Sliding Window Protocols.

Channel allocation methods: TDM, FDM, ALOHA, Carrier sense Multiple access protocols, Collision Free protocols – IEEE standard 802 for LANS – Ethernet, Token Bus, Token ring, Bridges and IEEE 802.11 and 802.16. Data link layer switching, virtual LANs.

UNIT-III:

Network layer Routing Algorithms: Design Issues, Routing Algorithms-Shortest path, Flooding, Flow based Distance vector, Link state, Hierarchical, Broadcast routing, Congestion Control algorithms-General principles of congestion control, Congestion prevention polices, Choke packets, Load shedding, and Jitter Control.

Internet Working : Tunnelling, internetworking, Fragmentation, Network layer in the internet– IP protocols, IP address, Subnets, Internet control protocols, OSPF, BGP, Internet multicasting, Mobile IP, IPV6.

UNIT IV:

The Transport Layer: Elements of transport protocols – addressing, establishing a connection,releasing connection, flow control and buffering and crash recovery, End to end protocols: UDP,Real Time Tran sport Protocol.

The Internet Transport Protocol: TCP- reliable Byte Stream (TCP) end to end format,segment format, connection establishment and termination, sliding window revisited, adaptiveretransmission, TCP extension, Remote Procedure Call.

UNIT – V:

Application Layer: WWW and HTTP: Architecture- Client (Browser), Server, UniformResource Locator HTTP: HTTP Transaction, HTTP Operational Model and Client/ServerCommunication, HTTP Generic Message Format, HTTP Request Message Format, HTTPResponse Message Format.

The Domain Name System: The DNS Name Space, Resource Records, Name Servers,Electronic Mail: Architecture and Services, The User Agent, Message Formats, MessageTransfer, Final Delivery.

Text Books:

1. Data Communications and Networks – Behrouz A. Forouzan, Third Edition TMH.
2. Computer Networks, 5ed, David Patterson, Elsevier
3. Computer Networks: Andrew S Tanenbaum, 4th Edition. Pearson Education/PHI
4. Computer Networks, Mayank Dave, CENGAGE

References:

1. Tanenbaum and David J Wetherall, Computer Networks, 5th Edition, Pearson Edu,2010
2. Computer Networks: A Top Down Approach, Behrouz A. Forouzan,Firouz Mosharraf, McGraw Hill Education
3. An Engineering Approach to Computer Networks-S.Keshav, 2nd Edition, PearsonEducation
4. Understanding communications and Networks, 3rd Edition, W.A. Shay,Thomson The TCP/IP Guide, by Charles M. Kozierok,

Free online Resource:

1. http://www.tcpipguide.com/free/index.htm

	Minor Course	L	T	P	C
		3	1	0	4
INTRODUCTION TO ARTIFICIAL INTELLIGENCE					

Course Objectives:

1. To have a basic proficiency in a traditional AI language including an ability to write simple to intermediate programs and an ability to understand code written in thatlanguage
2. To understand the basic issues of knowledge representation and blind and heuristic search, as well as an understanding of other topics such as minimax, resolution, etc. that play an important role in AIprograms
3. To have a basic understanding of some of the more advanced topics of AI such as learning, natural language processing, agents and robotics, expert systems, andplanning.

Course Outcomes:

At the end of the course, the students will be able to:

1. Outline problems that are amenable to solution by AI methods, and which AI methods may be suited to solving a given problem
2. Apply the language/framework of different AI methods for a given problem
3. Implement basic AI algorithms- standard search algorithms or dynamic programming
4. Design and carry out an empirical evaluation of different algorithms on problem formalization, and state the conclusions that the evaluation supports
5. Design Expert Systems using fuzzy logic theory

UNIT- I:

Introduction: history, intelligent systems, foundations of AI, applications, tic-tac-toe game playing, development of AI languages, current trends.

UNIT -II:

Problem Solving:state-space search and control strategies: Introduction, general problem solving, characteristics of problem, exhaustive searches, heuristic search techniques, iterative deepening A*, constraintsatisfaction.

Problem reduction and game playing: Introduction, problem reduction, game playing, alpha beta pruning, two-player perfect informationgames.

UNIT –III:

Logic concepts: Introduction, propositional calculus, proportional logic, natural deduction system, axiomatic system, semantic tableau system in proportional logic, resolution refutation in proportional logic, predicate logic.

UNIT -IV:

Knowledge representation: Introduction, approaches to knowledge representation, knowledge representation using semantic network, extended semantic networks for KR, knowledge representation using frames.

Advanced knowledge representation techniques: Introduction, conceptual dependency theory, script structure, CYC theory, case grammars, semantic web

UNIT–V:

Expert system and applications: Introduction phases in building expert systems, expert system versus traditional systems Uncertainty measure: probability theory: Introduction, probability theory, Bayesian belief networks, certainty factor theory, dempster-shafer theory ,Fuzzy sets and fuzzy logic: Introduction, fuzzy sets, fuzzy set operations, types of membership functions, multi valued logic, fuzzy logic, linguistic variables and hedges, fuzzy propositions, inference rules for fuzzy propositions, fuzzy systems.

Text Books:

1. Artificial Intelligence- Saroj Kaushik, CENGAGE Learning
2. Artificial intelligence, A modern Approach , 2nded, Stuart Russel, Peter Norvig,PEA

References:

1. Artificial Intelligence- Deepak Khemani, TMH,2013
2. Introduction to Artificial Intelligence, Patterson,PHI
3. Atificial intelligence, structures and Strategies for Complex problem solving,-George F Lugar, 5thed, PEA

E-Resources:

1. https://nptel.ac.in/courses/106/105/106105077/
2. http://aima.cs.berkeley.edu/

	Minor Course	L	T	P	C
		3	1	0	4
MATHEMATICS FOR MACHINE LEARNING					

Course Objectives:

1. The purpose of this course is to provide a mathematically rigorous introduction to these developments with emphasis on methods and their analysis.
2. Explain and apply matrix decomposition techniques
3. Explain parameter estimation using the Maximum Likelihood method

Course Outcomes:

At the end of the course, the students will be able to:

1. Understand the strengths and weaknesses of many popular machine learning approaches.
2. Justify the underlying mathematical relationships within and across Machine Learning algorithms.
3. Evaluate the several areas of mathematics beyond calculus
4. Solve problems in a range of mathematical applications
5. Apply various methods to compute the probabilities of events, Analyze and interpret statistical data using appropriate probability distributions.

UNIT-1:

Linear Algebra: Systems of Linear Equations, Matrices, Solving systems of linear equations, Vector Spaces, Linear Independence, Basis and Rank, Linear Mappings.

Analytic Geometry: Norms, Inner Products, Lengths and Distances, Angles and Orthogonality, Orthonormal Basis, Orthogonal Complement, Inner Product of Functions, Orthogonal Projections.

UNIT-2:

Matrix Decompositions: Determinant and Trace, Eigen values and Eigen vectors, Cholesky Decomposition, Eigen decomposition and Diagonalization, Singular Value Decomposition, Matrix Approximation.

Vector Calculus: Differentiation of Univariate Functions, Partial differentiation and Gradients, Gradients of vector valued functions, Gradients of Matrices, Useful identities for computing gradients, Back propagation and Automatic Differentiation

UNIT-3:

Probability and Distributions: Construction of a Probability space, Discrete and Continuous probabilities, sum rule, product rule and Bayes Theorem, Summary statistics and Independence, Gaussian Distribution.

Continuous Optimization: Optimization using Gradient Descent, Constrained optimization and Lagrange Multipliers, Convex Optimization.

UNIT-4:

Linear Regression: Problem Formulation, Parameter Estimation, Bayesian Linear Regression, Maximum Likelihood as Orthogonal Projection.

Dimensionality Reduction with Principal Component Analysis: Problem setting, Maximum Variance Perspective, Projection Perspective, Eigenvector computation and Low Rank Approximations, PCA in High Dimensions, Latent Variable Perspective.

UNIT-5

Density Estimation with Gaussian Mixture Models: Gaussian Mixture Model, Parameter Learning via Maximum Likelihood, EM Algorithm, Latent-Variable Perspective.

Classification with Support Vector Machines: Separating Hyper planes, Primal Support Vector Machine, Dual Support Vector Machine, Kernels, Numerical Solution.

Text Books:

1. https://mml-book.github.io/book/mml-book.pdf - c 2021 M. P. Deisenroth, A. A. Faisal, C. S. Ong. Published by Cambridge University Press (2020).

References:

1. https://www.youtube.com/watch?v=1VSZtNYMntM

	Minor Course	L	T	P	C
		3	1	0	4
MACHINE LEARNING					

Course Objectives:

1. To learn well -known machine learning algorithms
2. To evaluate and compare the performance of various machine learning algorithms
3. Able to differentiate regression models and distance based models and ANNS.

Course Outcomes:

At the end of the course, the students will be able to:

1. Recognize the characteristics of machine learning algorithms and their applications to real world problems
2. Able to differentiate linear and logistic regressions.
3. Able to write and evaluate hypothesis
4. Understand the concepts of Artificial neural networks
5. Can apply kernel methods to solve real world problems.

UNIT I: INTRODUCTION: Well -posed learning problems, designing a learning system, Perspectives, and issues in machine learning. Concept learning and thegeneral to specific ordering – Introduction, A concept learning task, Concept learning as search, Find -S: finding a maximally specific hypothesis, Version spaces and the candidate elimination algorithm, Remarks on version spaces andcandidate elimination, Inductive bias.

UNIT II: LINEAR REGRESSION & LOGISTIC REGRESSION:

PREDICTING NUMERICVALUES**:** REGRESSION - Finding the best fit lines with linear regression, locally weighted linear regression, Shrinking Coefficients, The bias / Variance tradeoff.

LOGISTIC REGRESSION: Classification with logistic regression and the sigmoid function, Using optimization to find the best regression coefficients.

UNIT III: ARTIFICIAL NEURAL NETWORKS: Introduction, Neural network representation, Appropriate problems for neural network learning, Perceptions, Multilayer networks and the back propagation algorithm, Remarks on the back propagation algorithm, An illustrative example face recognition, Advanced topics in artificial neural networks

UNIT IV: EVALUATION HYPOTHESES: Motivation, Estimation hypothesis accuracy, Basics of sampling theory, A general approach for deriving confidence intervals, Difference in error of two hypotheses, Comparing learning algorithms.

UNIT V: SUPPORT VECTOR MACHINES: Separating data with the maximum margin, finding the maximum margin, efficient optimization with SMO algorithm, speeding up optimization with full platt SMO, Using Kernels for more Complex data.

Text Books:

1. Machine Learning ,Tom M. Mitchell, MGH
2. Machine Learning in Action, Peter Harington, 2012, Cengage.

References:

1. Introduction to Machine Learning, EthemAlpaydin, PHI, 2004
2. A course in Machine Learning , Hall Daum'e III

	Minor Course	L	T	P	C
		3	1	0	4
DEEP LEARNING					

Course Objectives:

At the end of the course, the students will be expected to:

1. Learn deep learning methods for working with sequential data,
2. Learn deep recurrent and memory networks,
3. Learn deep Turing machines,

Course Outcomes:

At the end of the course, the students will be able to:

1. Demonstrate the basic concepts fundamental learning techniques and layers.
2. Discuss the Neural Network training, various random models.
3. Explain different types of deep learning network models.
4. Classify the Probabilistic Neural Networks and Sequence model neural networks.
5. Implement tools on Deep Learning techniques.

UNIT I:

Introduction: Various paradigms of learning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques.

Feed forward neural network: Artificial Neural Network, activation function, multi-layer neural network.

UNIT II:

Training Neural Network: Risk minimization, loss function, back propagation, regularization, model selection, and optimization.

Conditional Random Fields: Linear chain, partition function, Markov network, Belief propagation, Training CRFs, Hidden Markov Model, Entropy.

UNIT III:

Deep Learning: Deep Feed Forward network, regularizations, training deep models, dropouts, Convolution Neural Network, Recurrent Neural Network, and Deep Belief Network.

UNIT IV:

Probabilistic Neural Network: Hopfield Net, Boltzmann machine, RBMs, Sigmoid net, Auto encoders.

Sequence Modeling: LSTM, Gated RNNs & Deep Generative Models

UNIT V:

Applications: Object recognition, sparse coding, computer vision, natural language processing.

Introduction to Deep Learning Tools: Caffe, Theano, Torch.

Text Books:

1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016..
2. Bishop, C., M., Pattern Recognition and Machine Learning, Springer, 2006.

References:

1. Artificial Neural Networks, Yegnanarayana, B., PHI Learning Pvt. Ltd, 2009.
2. Matrix Computations, Golub, G.,H., and Van Loan,C.,F, JHU Press,2013.
3. Neural Networks: A Classroom Approach, Satish Kumar, Tata McGraw-Hill Education, 2004.

	Minor Course	L	T	P	C
		3	1	0	4
CYBER SECURITY					

Course Objectives:

In this course, the student will learn about

1. The essential building blocks andbasic concepts around cyber security such as Confidentiality, Integrity, Availability, Authentication, Authorization, Vulnerability, Threat & Risk and so on.
2. Analyze various browser-based attacks
3. Explore strategic network defense mechanisms

Course Outcomes:

At the end of the course, the students will be able to:

1. Illustrate the broad set of technical, social & political aspects of Cyber Security andsecurity management methods to maintain security protection
2. Appreciate the vulnerabilities and threats posed by criminals, terrorist and nation states to national infrastructure
3. Illustrate the nature of secure software development and operating systems
4. Demonstrate the role security management plays in cyber security defense and legal and social issues at play in developing solutions
5. Assess privacy concerns in data mining and web-based applications

UNIT –I:

Introduction: Introduction to Computer Security, Threats, Harm, Vulnerabilities, Controls, Authentication, Access Control, and Cryptography, Authentication, Access Control, Cryptography. Programs and Programming: Unintentional (Non-malicious) Programming Oversights, Malicious Code—Malware, Countermeasures.

UNIT –II:

Web Security: User Side, Browser Attacks, Web Attacks Targeting Users, Obtaining User or Website Data, Email Attacks.

Operating Systems Security: Security in Operating Systems, Security in the Design of Operating Systems, Rootkit.

UNIT -III:

Network Security: Network Concepts, Threats to Network Communications, Wireless Network Security, Denial of Service, Distributed Denial-of-Service Strategic Defenses: Security Countermeasures, Cryptography in Network Security, Firewalls, Intrusion Detection and Prevention Systems, Network Management .

Cloud Computing and Security: Cloud Computing Concepts, Moving to the Cloud, Cloud Security Tools and Techniques, Cloud Identity Management, Securing IaaS.

UNIT- IV:

Privacy: Privacy Concepts, Privacy Principles and Policies, Authentication and Privacy, Data Mining, Privacy on the Web, Email Security, Privacy Impacts of Emerging Technologies, Where the Field Is Headed.

Management and Incidents: Security Planning, Business Continuity Planning, Handling Incidents, Risk Analysis, Dealing with Disaster.

UNIT –V:

Legal Issues and Ethics: Protecting Programs and Data, Information and the Law, Rights of Employees and Employers, Redress for Software Failures, Computer Crime, Ethical Issues in Computer Security, Incident Analysis with Ethics Emerging Topics: The Internet of Things, Economics, Computerized Elections, Cyber Warfare.

Text Books:

1. Pfleeger, C.P., Security in Computing, Prentice Hall, 2010, 5th edition.
2. Schneier, Bruce. Applied Cryptography, Second Edition, John Wiley & Sons, 1996

References:

1. Rhodes-Ousley, Mark. Information Security: The Complete Reference, Second Edition, Information Security Management: Concepts and Practice, McGraw-Hill, 2013.
2. Whitman, Michael E. and Herbert J. Mattord. Roadmap to Information Security for IT and Infosec Managers. Boston, MA: Course Technology, 2011.

	Minor Course	L	T	P	C
		3	1	0	4
CYBER CRIME INVESTIGATION AND DIGITAL FORENSICS					

Course Objectives:

1. Able to identify security risks and take preventive steps
2. To understand the forensics fundamentals.
3. To understand the evidence capturing process.

Course Outcomes:

At the end of the course, student will be able to

1. Acquire the definition of computer forensics fundamentals.
2. Describe the types of computer forensics technology
3. Analyze various computer forensics systems.
4. Illustrate the methods for data recovery, evidence collection and data seizure.
5. Summarize duplication and preservation of digital evidence.

UNIT–I: Introduction: Introduction and Overview of Cyber Crime, Nature andScope of Cyber Crime, Types of Cyber Crime: Social Engineering, Categories ofCyber Crime, Property Cyber Crime.

UNIT–II: Cyber Crime Issues: Unauthorized Access to Computers, ComputerIntrusions, White collar Crimes, Viruses and Malicious Code, Internet Hacking andCracking, Virus Attacks, Pornography, Software Piracy, Intellectual Property, MailBombs, Exploitation ,Stalking and Obscenity in Internet, Digital laws and legislation, Law Enforcement Roles and Responses.

UNIT–III: Investigation: Introduction to Cyber Crime Investigation, InvestigationTools, e-Discovery, Digital Evidence Collection, Evidence Preservation, E-MailInvestigation, E-Mail Tracking, IP Tracking, E-Mail Recovery, Hands on Case Studies. Encryption and Decryption Methods, Search and Seizure of Computers, Recovering Deleted Evidences, Password Cracking.

UNIT–IV: Digital Forensics: Introduction to Digital Forensics, Forensic Software and Hardware, Analysis and Advanced Tools, Forensic Technology and Practices, Forensic Ballistics and Photography, Face, Iris and Fingerprint Recognition, Audio Video Analysis, Windows System Forensics, Linux System Forensics, Network Forensics.

UNIT– V: Laws And Acts: Laws and Ethics, Digital Evidence Controls, Evidence Handling Procedures, Basics of Indian Evidence ACT IPC and CrPC ,Electronic Communication Privacy ACT, Legal Policies.

References:

i. Nelson Phillips and EnfingerSteuart, “Computer Forensics andInvestigations”, Cengage Learning, New Delhi, 2009.

ii. Kevin Mandia, Chris Prosise, Matt Pepe, “Incident Response and Computer Forensics“, Tata McGraw-Hill, New Delhi, 2006.

iii. Robert M Slade,” Software Forensics”, Tata McGraw - Hill, New Delhi, 2005

	Minor Course	L	T	P	C
		3	1	0	4
CRYPTOGRAPHY AND APPLICATIONS					

Course Objective:

This course aims at training students to master the:

1. The concepts of classical encryption techniques and concepts of finite fields and number theory
2. Working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, and public key algorithms.
3. Design issues and working principles of various authentication protocols and PKI standards.

Course Outcomes:

At the end of the course, the students will be able to:

1. Identify information security goals and acquire fundamental knowledge on the concepts of finite fields and number theory
2. Compare and apply different encryption and decryption techniques to solve problems related to confidentiality and authentication
3. Apply the knowledge of cryptographic checksums and evaluate the performance of different message digest algorithms for verifying the integrity of varying message sizes.
4. Apply different digital signature algorithms to achieve authentication and create secure applications
5. Apply network security basics, analyze different attacks on networks and evaluate the performance of security protocols like SSL, IPSec, and PGP

UNIT- I:

Introduction to Security: Security Attacks, Security Services, Security Mechanisms, Fundamental Security Design Principles, Attack Surfaces and Attack Trees, a Model for Network Security

Mathematics of Cryptography: Algebraic Structures (Groups, Rings, Fields and Galois Fields), Divisibility and the Division Algorithm, The Euclidean Algorithm, Modular Arithmetic, Prime Numbers, Fermat's and Euler's Theorems, Testing for Primality, The Chinese Remainder Theorem, Discrete Logarithms

UNIT- II:

Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, Steganography

Block Ciphers: Traditional Block Cipher Structure, The Data Encryption Standard, The Strength of DES, Block Cipher Design Principles, Advanced Encryption Standard, AES Structure, AES Transformation Functions, AES Key Expansion, Multiple Encryption and Triple DES, Block Cipher Modes of Operation

UNIT- III:

Public-Key Cryptography: Principles of Public-Key Cryptosystems, The RSA Algorithm, Diffie-Hellman Key Exchange, Elgamal Cryptographic System, Elliptic Curve Cryptography, Cryptographic Hash Functions: Applications of Cryptographic Hash Functions, Requirements and Security, Secure Hash Algorithm (SHA),Message Authentication Codes: Requirements for Message Authentication Codes, HMAC, CMAC

UNIT- IV:

Digital Signatures: Digital Signatures, Elgamal Digital Signature Scheme, Schnorr Digital Signature Scheme, NIST Digital Signature Algorithm, Elliptic Curve Digital Signature Algorithm

Key Management and Distribution: Symmetric Key Distribution Using Symmetric Encryption, Symmetric Key Distribution Using Asymmetric Encryption, Distribution of Public Keys, X.509 Certificates, Public-Key Infrastructure

User Authentication: Remote User-Authentication Principles, Remote User-Authentication Using Symmetric Encryption, Kerberos, Remote User-Authentication Using Asymmetric Encryption:

UNIT -V:

Transport-Level Security: Web Security Considerations, Transport Layer Security, Secure Shell (SSH)

Electronic Mail Security: S/MIME, Pretty Good Privacy

IP Security: IP Security Overview, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange

Text Book:

1. Cryptography and Network Security, William Stallings, 8th Edition, Pearson Education

References:

1. Cryptography, Network Security and Cyber Laws, Bernard L. Menezes, Ravinder Kumar, Cengage Learning.
2. Cryptography and Network Security, Behrouz A Forouzan, DebdeepMukhopadhyaya, 3rd Edition, Mc-GrawHill.
3. Network Security Illustrated, Jason Albanese, Wes Sonnenreich, and McGraw Hill.

	Minor Course	L	T	P	C
		3	1	0	4
BLACK CHAIN TECHNOLOGY					

Course Objectives:

1. To provide conceptual understanding of the function of Blockchain as a method of securing distributed ledgers.
2. To understand the structure of a Blockchain and why/when it is better than a simple distributed database
3. To make students understand the technological underpinnings of Blockchain operations as distributed data structures and decision making systems

Course Outcomes:

At the end of the course, the students will be able to:

1. Define and explain the fundamentals of Blockchain.
2. Understand decentralization and the role of Blockchain in it.
3. Understand and analyze Bitcioin Crypto currency and underlying Block chain network.
4. Understand Etherium currency and platform, and develop applications using Solidity.
5. Understand Hyper ledger project and its components; critically analyze the challenges and future opportunities in Block chain technology.

UNIT-I:

Introduction: History and basics, Types of Blockchain, Consensus, CAP Theorem. Cryptographic Hash Functions: Properties of hash functions, Secure Hash Algorithm, Merkle trees, Patricia trees.

UNIT-II:

Decentralization: Decentralization using Blockchain, Methods of decentralization, decentralization framework, Blockchain and full ecosystem decentralization, Smart contracts, Decentralized Organizations, Platforms for decentralization.

UNIT-III:

Bitcoin: Introduction to Bitcoin, Digital keys and addresses, Transactions, Blockchain, The Bitcoin network, Bitcoin payments, Bitcoin Clients and APIs, Alternatives to Proof of Work, Bitcoin limitations.

UNIT-IV:

Etherium: Smart Contracts, Introduction to Ethereum, The Ethereum network, Components of the Ethereum ecosystem, Blocks and Blockchain, Fee schedule, Ethereum Development Environment, Solidity.

UNIT-V:

Hyperledger: Introduction, Hyperledger Projects, Protocol, Architecture, Hyperledger Fabric, Sawtooth Lake, Corda.

Challenges and Opportunities: Scalability, Privacy, Blockchain for IoT, Emerging trends

Text Book:

i. Mastering Blockchain, Imran Bashir, Second Edition, Packt Publishing.

References:

i. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, Andrea Antonopoulos, and O'Reilly.
ii. Blockchain Blueprint for a New Economy, Melanie Swan, O'Reilly.
iii. Mastering Bitcoin: Programming the Open Blockchain, Antonopoulos, Andreas M. O'Reilly.
iv. Blockchain Technology: Cryptocurrency and Applications, S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, Oxford University Press.

	Minor Course	L	T	P	C
		3	0	2	4
OBJECT ORIENTED PROGRAMMING THROUGH JAVA					

Course Objectives:

1. Implementing programs for user interface and application development using core java principles.
2. Focus on object oriented concepts and java program structure and its installation.
3. Comprehension of java programming constructs, control structures in JavaProgramming Constructs.

Course Outcomes:

At the end of the course, the students will be able to:

1. Understand Java programming concepts and utilize Java Graphical User Interface inProgram writing.
2. Write, compile, execute and troubleshoot Java programming for networking concepts.
3. Build Java Application for distributed environment.
4. Design and Develop multi-tier applications.
5. Identify and Analyze Enterprise applications.

UNIT I:

Introduction to OOP

Introduction, Need of Object Oriented Programming, Principles of Object Oriented Languages, Procedural languages Vs OOP, Applications of OOP, History of JAVA, Java Virtual Machine, Java Features, Program Structures, Installation of JDK1.6.

UNIT II:

Variables, Primitive Data types, Identifiers- Naming Conventions, Keywords, Literals, Operators-Binary, Unary and Ternary, Expressions, Precedence rules and Associativity, Primitive Type Conversion and Casting, Flow of Control-Branching, Conditional Loops.

Classes and Objects- Classes, Objects, Creating Objects, Methods, Constructors-Constructor Overloading, Cleaning up Unused Objects-Garbage Collector, Class Variable and Methods-Static Keyword, this keyword, Arrays, Command Line Arguments.

UNIT III:

Inheritance: Types of Inheritance, Deriving Classes using Extends Keyword, Method Overloading, Super Keyword, Final Keyword, Abstract Class.

Interfaces, Packages and Enumeration: Interface-Extending Interface, Interface Vs Abstract Classes, Packages-Creating Packages, Using Packages, Access Protection, java.lang Package.

Exceptions & Assertions - Introduction, Exception Handling Techniques-try...catch, throw, throws, finally block, User Defined Exception, Exception Encapsulation and Enrichment, Assertions.

UNIT IV:

Multi-Threading: java.lang.Thread, The main Thread, Creation of New Threads, Thread Priority, Multithreading- Using isAlive() and join(), Synchronization, Suspending and Resuming Threads, Communication between Threads.

Input/Output: Reading and Writing data, java.io package.

Applet: Applet Class, Applet Structure, Applet Life Cycle, Sample Applet Programs.

UNIT V:

Event Handling: Event Delegation Model, Sources of Event, Event Listeners, Adapter Classes, Inner Classes.

Abstract Window Toolkit : Importance of AWT, Java.awt.package, Components and Containers, Button, Label, Check Box, Radio Buttons, List Boxes, Choice Boxes, Text Field and Text Area, Container Classes, LayOuts, Menu, Scroll bar.

Swings: Introduction, JFrame, JApplet, JPanel, Components in Swings, Layout Managers, List and JScroll Pane, SplitPane, JTabbedPane, JTree, DialogBox, Pluggable Look and Feel.

Text Books:

1. The Complete Reference Java, 8ed, Herbert Schildt, TMH.
2. Programming in JAVA, Sachin Malhotra, Saurabh Choudhary, Oxford.
3. JAVA for Beginners, 4e, Joyce Farrell, Ankit R. Bhavsar, Cengage Learning.

References:

1. JAVA Programming, K.Rajkumar, Pearson.
2. Core JAVA, Black Book, Nageswara Rao, Wiley, Dream Tech.
3. Core JAVA for Beginners, Rashmi Kanta Das, Vikas.
4. Object Oriented Programming through JAVA , P Radha Krishna , University Press.
5. Object oriented programming with JAVA, Essentials and Applications, Raj Kumar Bhuyya,Selvi, Chu TMH.
6. Introduction to Java Programming, 7th ed, Y Daniel Liang, Pearson.

	Minor Course	L	T	P	C
		3	0	2	4
PYTHON PROGRAMMING					

Course Objectives:

1. Introduction to ScriptingLanguage
2. Exposure to various problems solving approaches of computerscience
3. Teach the use of multiple `except` blocks to handle different types of exceptions individually and appropriately.

Course Outcomes:

At the end of the course, the students will be able to:

1. Understand the fundamentals of scripting language and its learning environment.
2. Acquire the knowledge of data types, operators and control structures.
3. Understand Object oriented concepts and apply the concepts of data structures to real world data.
4. Apply the concept of modularity and implement different packages to solve complex problems. Understand Object oriented concepts and handle different errors through exceptions.
5. Develop multithreaded application using standard libraries.

UNIT-I:

Features and History of Python, Print and Input functions, variables, keywords, comments, Types: Numerical Types (int, float, complex), Strings, Boolean, Type Conversion, Operators: Arithmetic, Relational, Logical, Bitwise, Assignment, Identity, Membership, Control Flow: Indentation, if-elseif-else, while, for, break, continue, pass, else-with loops

UNIT-II:

Functions: Introduction, Required Arguments, Default Arguments, Keyword Arguments, Variable Number of Arguments, Variable Scope and Lifetime, global variables, Lambda Functions, Command Line Arguments

Object Oriented Programming: Classes and Objects, built-in class methods and attributes, 'self', constructor, destructor, inheritance, data hiding, overriding methods and overloading operators

UNIT-III:

Data Structures: Lists, Nested Lists, List Comprehensions, Tuples and Sequences, Sets, Dictionaries
File I/O: opening, closing, reading and writing.

UNIT-IV:

Exception Handling: Exceptions, Multiple Except Blocks, Multiple Exceptions in a Single Block, Except Block without Exception, the else Clause, Raising Exceptions, Built-in and User-defined Exceptions, The finally block

Introduction modules, import and from-import, Packages in Python, used defined modules and packages, PIP.

UNIT-V:

The Python Standard Library: numeric and mathematical modules, string processing, date & time, calendar, operating system, web browser

Graphics with turtle: Motion Control, Pen, Colour, Fill, multiple turtles, reset and clear

GUI design with tkinter: Button, Canvas, Check button, Entry, Frame, Label, Listbox, Menu, Menu button, Message, Radio button, Scale, Scrollbar, Text

Text Books:

1. Python Programming using problem solving approach, Reema Thareja, Oxford University Press.
2. Learning Python, Mark Lutz, O'Rielly
3. Programming Python, Fourth Edition, Mark Lutz, O'Reilly Media.

References:

1. Introduction to Computation and Programming Using Python with Application to Understanding, John V. Guttag, PHI.
2. Think Python: How to think like a Computer Scientist, Allen Downey, Green Tea Press.
3. Head First Python: A Brain-Friendly Guide, Second Edition, Paul Barry, O'Reilly
4. The Python Standard Library, Python 3.6.5 documentation (Web Resource) https://docs.python.org/3/library/

	Minor Course	L	T	P	C
		3	0	2	4
BASIC WEB DESIGNING					

Course Objectives:

The objectives of this course is to acquire knowledge on the

1. How does a website work and web related terminology.
2. Web standards and W3C elements
3. Responsive Web Designing

Course Outcomes:

At the end of the course, the students will be able to:

1. Learn the basic terminology related to web and web development.
2. Learn how to design static web pages by using HTML.
3. Should be able to create web pages with enhanced look and feel by Using CSS.
4. Learn to use Java Script for design thick clients and to design interactive responsive form design and validations.
5. Learn to design and host and publish websites in various domains.

UNIT - I: Introduction to Web and Web Design Principles:

Brief History of Internet, What is World Wide Web, Why create a web site, Web Standards, Web pages, Website, Web browsers and Web servers and Web protocols.

Basic principles involved in developing a web site, Planning process, Five Golden rules of web designing ,Designing navigation bar , Page design ,Home Page Layout ,Design concept.

UNIT - II: Introduction to HTML:

What is HTML, HTML Documents, Basic structure of an HTML document, Creating an HTML document, Mark up Tags, Heading-Paragraphs, Line Breaks, HTML Tags.

Introduction to elements of HTML, Working with Text, Working with Lists, Tables andFrames, Working with Hyperlinks, Images and Multimedia ,Working with Forms andcontrols.

UNIT - III: Introduction to Cascading Style Sheets:

Concept of CSS, Creating Style Sheet, CSS Properties, CSS Styling(Background, Text Format, Controlling Fonts), Working with block elements and objects, working with Lists and Tables, CSS Id and Class ,Box Model(Introduction, Border properties, Padding Properties, Margin properties) ,CSS Advanced(Grouping, Dimension, Display, Positioning, Floating, Align, Pseudo class, Navigation Bar, Image Sprites, Attribute sector) , CSS Color ,Creating page Layout and Site Designs.

UNIT - IV: Introduction to Java Script:

What is Java Script? Basics of Java Script: Variables, functions, and Operators, select HTML elements with Java Script, Java Script Events andEvent Handlers,Regular expressions and pattern matching in Java Script. Form validation using Java Script.

UNIT - V: Introduction to Web Publishing or Hosting:

Creating the Web Site, Saving the site, working on the web site, Creating web site structure, Creating Titles for web pages, Themes-Publishing web sites. Case study: Web publishing and hosting using Heroku cloud platform (https://www.heroku.com/).

Text Books		
Name of Authors	Title of the Book	Publisher
Kogent Learning Solutions Inc.	HTML 5 in simple steps	Dreamtech Press
	A beginner's guide to HTML	NCSA,14th May,2003
Murray,Tom/Lynchburg	Creating a Web Page and Web Site	College,2002
Reference Books		
	Web Designing & Architecture-Educational Technology Centre	University of Buffalo
Steven M. Schafer	HTML, XHTML, and CSS Bible, 5ed	Wiley India
John Duckett	Beginning HTML, XHTML, CSS, and JavaScript	Wiley India
Ian Pouncey, Richard York	Beginning CSS: Cascading Style Sheets for Web Design	Wiley India
Kogent Learning	Web Technologies: HTML, Javascript	Wiley India

	Minor Course	L	T	P	C
		3	0	2	4
ADVANCED WEB TECHNOLOGIES					

Course Objectives:

The objectives of this course is to acquire knowledge on the

1. This course is designed to introduce students with basic web programming experience to the advanced web programming languages and techniques associated with the World Wide Web.
2. The course will introduce web-based media-rich programming tools for creating interactive web pages.
3. The course will introduce Web Frame works like React JS and Angular JS for quick and efficient design and implementation of web applications.

Course Outcomes:

At the end of the course, the students will be able to:

1. Analyze a web page and Create web pages using HTML5 and Cascading Styles sheets 3 and Boot strap.
2. Build dynamic web pages using Java Script and Write simple client-side scripts using AJAX.
3. Learn to use XML for data exchange and transfer over web and XML parsing and validation techniques.
4. Build web applications using PHP.
5. Describe a java web services.

UNIT - I Introduction to HTML5, CSS3 and Boot strap:
Basic Syntax, Standard HTML Document Structure, HTML5 tags, Audio, video, 2D canvas Drawing and animations using HTML5.
CSS 3: What is SCSS, Difference between CSS and SCSS, Introduction to SASS tool and CSS template design using Bootstrap

UNIT - II: Java Script and DHTML:
DHTML: Java Script DOM, Interactive and responsive web page designing, Positioning Moving and Changing Elements.
Java Script Web Frame works: React JS, Angular JS and Vue JS, Single Page Application (SPA) Design and Development using Angular JS.

UNIT - III: XML:
Introduction to XML, XML vs HTML, Document type Definition, XML schemas, Document object model, XSLT, DOM and SAX Approaches. AJAX A New Approach: Introduction to AJAX. Request and Response mechanism of AJAX.

UNIT - IV: PHP Programming:

Introducing PHP: Creating PHP script, Running PHP script. Working with variables and constants: Using variables, Using constants, Datatypes, Operators.Controlling program flow: Conditional statements,Controlstatements,Arrays,functions.Working with forms and Databases such as MySQL.

UNIT - V: Web Services:

JAX-RPC-Concepts-Writing a Java Web Service-Writing a Java Web Service Client- Describing Web Services: WSDL- Representing Data Types: XMLSchemaCommunicating Object Data: SOAP Related Technologies-Software Installation-Storing Java Objects as Files-Databases and Java Servlets.

Text Books:

1. Programming the World Wide Web, Robet W Sebesta, 7ed, Pearson.
2. Introducing HTML5 (Voices That Matter) 2nd Edition by Bruce Lawson / Remy Sharp Lawson / Sharp,Kindle publishers.
3. Web Technologies, Uttam K Roy, Oxford
4. HTML, CSS, and JavaScript All in One: Covering HTML5, CSS3, and ES6, Sams Teach Yourself 3rd Edition, by Julie Meloni and, Jennifer Kyrnin.Pearson
5. JavaScript Frameworks for Modern Web Development: The Essential Frameworks, Libraries, and Tools to Learn Right Now 2nd ed. Edition by Sufyan bin Uzayr , Nicholas Cloud , Tim Ambler.Apress.
6. Java Web Services: Up and Running: A Quick, Practical, and Thorough Introduction 2nd Edition, Kindle Edition by Martin Kalin.

References:

1. Ruby on Rails Up and Running, Lightning fast Web development, Bruce Tate, Curt Hibbs, Oreilly(2006
2. Programming Perl, 4ed, Tom Christiansen, Jonathan Orwant, Oreilly (2012)
3. Web Technologies, HTML< JavaScript, PHP, Java, JSP, XML and AJAX, Black book, Dream Tech.
4. An Introduction to Web Design, Programming, Paul S Wang, Sanda S Katila, Cengage Learning.

	Minor Course	L	T	P	C
		3	1	0	4
COMPUTER ORGANIZATION AND ARCHITECTURE					

Course Objectives:

1. To understand the structure, function and characteristics of computer system.
2. To understand the design of the various functional units and components of computers.
3. To explain the function of each element of a memory hierarchy.

Course Outcomes:

At the end of the course, the students will be able to:

1. Understand the architecture of modern computer.
2. Analyze the Performance of a computer using performance equation.
3. Understand different instruction types.
4. Calculate the effective address of an operand by addressing modes.
5. Understand how computer stores positive and negative numbers.
6. Understand how computer performs arithmetic operation of positive and negative numbers.

UNIT -I:

Basic Structure of Computers:

Functional unit, Basic Operational Concepts, Bus Structures, System Software, Performance, The History of Computer Development. Data Representation: Data Types, Complements, Fixed Point Representation, Floating Point Representation.

Basic Computer Organization and Design:

Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory – Reference Instructions, Interrupt, Design of Basic Computer, Design of Accumulator Logic.

UNIT -II:

Machine Instruction and Programs: Instruction and Instruction Sequencing: Register Transfer Notation, Assembly Language Notation, Addressing Modes, Basic Input/output Operations, Importance of Stacks and Queues in Computer Programming Equation. Component of Instructions: Logic Instructions, Shift and Rotate Instructions, Branch Instructions.

Computer Arithmetic: Addition, Subtraction, Multiplication and Division Algorithms. Floating point Arithmetic Operations and Decimal Arithmetic Operations.

UNIT -III:

The Memory System: Memory System Consideration RAM and ROM, Flash Memory, Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory and Virtual Memory, Secondary Storage: Magnetic Hard Disks, Optical Disks.

Pipeline Processing: Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline.

UNIT -IV:

Processing Unit: Fundamental Concepts: Register Transfers, Performing an Arithmetic or Logic Operation, Fetching a Word from Memory, Execution of Complete Instruction, Hardwired Control.

Micro Programmed Control: Microinstructions, Micro Program Sequencing, Wide Branch Addressing and Microinstructions with Next – Address Field.

UNIT -V:

Input / Output Organization:

Accessing I/O Devices, Interrupts: Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Direct Memory Access, Buses: Synchronous Bus, Asynchronous Bus, Interface Circuits, Standard I/O Interface: Peripheral Component Interconnect (PCI) Bus, Universal Serial Bus (USB).

Parallelism:
Instruction-Level-Parallelism – Parallel Processing Challenges – Flynn's Classification: SISD, MIMD, SIMD, SPMD and Vector Architectures, – Hardware Multithreading – Multi-Core Processors and Other Shared Memory Multiprocessors.

Text Books:

1. Computer Organization, Carl Hamacher, ZvonksVranesic, SafeaZaky, 6th Edition, McGraw Hill.
2. Computer Architecture and Organization, John P. Hayes, 3rd Edition, McGraw Hill.

References:

1. Computer Organization and Architecture – William Stallings tenth Edition, Pearson/PHI.
2. Computer System Architecture, M. Morris Mano, 3 rd Edition Pearson Education.
3. Structured Computer Organization – Andrew S.Tanenbaum, 4th Edition PHI/Pearson.
4. Fundamentals of Computer Organization and Design, Sivarama Dandamudi Springer Int.Edition.

	Minor Course	L	T	P	C
		3	1	0	4
DISTRIBUTED SYSTEMS					

Course Objectives:

1. To understand the foundations of distributed systems.
2. To learn issues related to clock Synchronization, the need for global state and remote invocation in distributed systems.
3. To learn distributed mutual exclusion and deadlock detection algorithms.

Course Outcomes:

At the end of the course, the students will be able to:

1. Understand the foundations and issues of distributed systems.
2. Illustrate the various synchronization issues, global state and remote invocation for distributed systems.
3. Develop the Mutual Exclusion and Deadlock detection algorithms in distributed systems.
4. Apply the features of peer-to-peer, distributed shared memory systems and security.
5. Analyze the distributed transactions, agreement protocols and fault tolerance mechanisms in distributed systems.

UNIT- I:

Characterization of Distributed Systems: Introduction, Examples of Distributed Systems, Resource Sharing and the Web, Challenges, Relation to Computer system Components, Motivation, Relation to Parallel Systems, Message-Passing systems versus Shared Memory systems, Primitives for Distributed Communication, Synchronous versus Asynchronous executions, Design issues and Challenges. A model of Distributed Computations: A distributed program, A model of distributed executions, Models of communication networks, Global state, Cuts, Past and future cones of an event, Models of Process Communications. Logical Time: A framework for a system of logical clocks, Scalar time, Vector time, Physical clock synchronization: NTP.

UNIT –II:

Message Ordering and Group Communication: Message ordering paradigms, Asynchronous execution with synchronous communication, Synchronous program order on an asynchronous system, Group communication, Causal order (CO), Total order.

Global state and Snapshot Recording Algorithms: Introduction, System model and definitions, Snapshot algorithms for FIFO channels. Remote Invocation: Introduction, Design Issues for RMI, Implementation of RMI, Distributed Garbage Collection, Remote Procedure Call, Events and Notifications, Case Study: JAVA RMI.

UNIT- III:

Distributed Mutual Exclusion Algorithms: Introduction, Preliminaries, Lamport's algorithm, Ricart-Agrawala algorithm, Maekawa's algorithm, Suzuki–Kasami's broadcast algorithm. Deadlock Detection in Distributed Systems: Introduction, System model, Preliminaries, Models of deadlocks,

Knapp'sClassification, Algorithms for the Single Resource Model, the AND model and the OR model.

UNIT -IV:

Peer-to-Peer Computing and Overlay Graphs: Introduction, Data indexing and overlays, Chord distributed hash table, Content addressable networks, Tapestry. Distributed Shared Memory: Abstraction and advantages, Memory consistency models, Shared Memory Mutual Exclusion.
Security: Introduction, Overview of Security Techniques, Cryptographic Algorithms, Digital Signatures, Cryptography Pragmatics.

UNIT –V:

Distributed Transactions: Introduction, Flat and Nested Distributed Transactions, Atomic commit protocols, Concurrency control in distributed transactions. Check Pointing and Rollback Recovery: Introduction, Background and definitions, Issues in Failure recovery, Checkpoint-based recovery, Log-based rollback recovery, coordinated check pointing algorithm, Algorithms for asynchronous and synchronous check pointing and recovery. Consensus and Agreement Algorithms: Problem definition, Overview of results, Agreement in a Failure-Free system (synchronous or asynchronous).

Text Books:

1. Distributed computing: Principles, algorithms, and systems, Ajay D Kshemkalyani and Mukesh Singhal, Cambridge University Press, 2011.
2. Distributed Systems Concepts and Design, George Coulouris, Jean Dollimore and TimKindberg, 5th Edition, Pearson Education, 2012.

References:

1. Distributed Operating Systems: Concepts and Design, Pradeep K Sinha, Prentice Hall ofIndia, 2007.
2. Advanced concepts in operating systems. Mukesh Singhal and Niranjan G. Shivaratri,McGraw-Hill, 1994.
3. Distributed Systems: Principles and Paradigms, Tanenbaum A.S., Van Steen M.,Pearson Education, 2007.

E-Resources:

1. https://nptel.ac.in/courses/106/106/106106168/

	Minor Course	L	T	P	C
		3	1	0	4
CLOUD COMPUTING					

Course Objective:

1. **E**xplain the evolution of computing paradigms**,**
2. Differentiate cloud computing as both a service and a platform
3. Identify and evaluate different types of applications suitable for cloud deployment,

Course Outcomes:

At the end of the course, the students will be able to:

1. Understand and analyze different computing paradigms
2. Understand the basics of cloud computing and different cloud deployment models.
3. Understand different cloud implementation and management strategies.
4. Understand and evaluate different cloud service models.
5. Identify, analyze and use different cloud services/applications/tools available from key cloud providers.

UNIT-I:

Computing Paradigms: High-Performance Computing, Parallel Computing, Distributed Computing, Cluster Computing, Grid Computing, Cloud Computing, Bio computing, Mobile Computing, Quantum Computing, Optical Computing, Nano computing.

UNIT-II:

Cloud Computing Fundamentals: Motivation for Cloud Computing, The Need for Cloud Computing, Defining Cloud Computing, Definition of Cloud Computing, Cloud Computing is a Service, Cloud Computing is a Platform, Principles of Cloud computing, Five Essential Characteristics, Four Cloud Deployment Models

UNIT-III:

Cloud Computing Architecture and Management: Cloud architecture, Layer, Anatomy of the Cloud, Network Connectivity in Cloud Computing, Applications on the Cloud, Managing the Cloud, Managing the Cloud Infrastructure, Managing the Cloud Application, Migrating Application to Cloud, Phases of Cloud Migration Approaches for Cloud Migration.

UNIT-IV:

Cloud Service Models: Infrastructure as a Service, Characteristics of IaaS. Suitability of IaaS, Pros and Cons of IaaS, Summary of IaaS Providers, Platformas a Service, Characteristics of PaaS, Suitability of PaaS, Pros and Cons of PaaS, Summary of PaaS Providers, Software as a Service, Characteristics of SaaS, Suitability of SaaS, Pros and Cons of SaaS, Summary of SaaS Providers, Other Cloud Service Models.

UNIT-V:

Cloud Providers and Applications: EMC, EMC IT, Captiva Cloud Toolkit, Google Cloud Platform, Cloud Storage, Google Cloud Connect, Google Cloud Print, Google App Engine, Amazon Web Services, Amazon Elastic Compute Cloud, Amazon Simple Storage Service, Amazon Simple Queue service, Microsoft, Windows Azure, Microsoft Assessment and Planning Toolkit, SharePoint, IBM, Cloud Models, IBM Smart Cloud, SAP Labs, SAP HANA Cloud Platform, Virtualization Services Provided by SAP, Sales force, Sales Cloud, Service Cloud: Knowledge as a Service, Rackspace, VMware, Manjra soft, Aneka Platform.

Text Book:

1. Essentials of Cloud Computing, K. Chandrasekhran, CRC press.

References:

1. Cloud Computing: Principles and Paradigms, Rajkumar Buyya, James Broberg and Andrzej M. Goscinski, Wiley.
2. Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier.
3. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, SubraKumaraswamy, ShahedLatif, O'Reilly.

	Minor Course	L	T	P	C
		3	1	0	4
QUANTUM COMPUTING					

Course Objectives

1. To introduce the fundamentals of quantum computing
2. The problem-solving approach using finite dimensional mathematics
3. Explain the principle of superposition **and the concept of** entanglement, highlighting their significance in quantum mechanics and computation.

Course Outcome

1. Understand the Basics of complex vector spaces
2. Quantum mechanics as applied in Quantum computing
3. Apply Quantum Architecture and algorithms to solve real time problems.
4. Understand and explore the models of Quantum Computer and Quantum Simulation tools
5. Analyze and implement basic quantum algorithms involving superposition, entanglement, and measurement operations.

Syllabus

UNIT-1

Introduction: Complex numbers and its geometrical representations, Complex vector spaces, inner products and Hilbert spaces, Hermitian and unitary matrices, Tensor products of vector spaces Deterministic Systems

UNIT-2

Dirac formalism, superposition of states, entanglement Bits and Qubits. Qubit operations, Hadamard Gate, CNOT Gate, Phase Gate, Z-Y decomposition, Quantum Circuit Composition, Basic Quantum circuits.

UNIT-3

Quantum Algorithm- I: Quantum parallelism, Quantum Evolution, Deutsch's Algorithm, Deutsch-Jozsa Algorithm, Simon's periodicity algorithm.

UNIT-4

Quantum Algorithm- II: Grover's search algorithm, Shor's Factoring algorithm. Application of entanglement, teleportation, superdence coding.

UNIT-5

Quantum Software Development and Programming:

Quantum programming languages, Probabilistic and Quantum computations, introduction to quantum cryptography and quantum information theory.

Text Books

i. Quantum computing explained, David McMahon, Wiley-interscience, John Wiley & Sons, 2008
ii. Quantumcomputing for computer scientists, Noson S. Yanofsky, Mirco A. Mannucci, Cambridge University Press 2008

Reference Books

i. Quantum computation and quantum information, Michael A. Nielsen and Isaac L. Chuang, Cambridge University Press 2010
ii. Introduction to Quantum Mechanics, 2nd Edition, David J. Griffiths, Prentice Hall New Jersey 1995