University of Engineering & Management, Kolkata
University of Engineering & Management, Jaipur
Institute of Engineering & Management, Kolkata
B.Tech in Computer Science and Engineering
Admission Year: 2023

Semester VI (Third Year) Curriculum								
Sl. No	Type of course	Course Code	Course Name	Hours per week				Credit Points
				Lecture	Tutorial	Practical	Sessional	
Theory Papers								
1	Professional Core Course	PCCCS601	Computer Networks	3	0	0	0	3
2	Professional Elective Course	PECCS601	Introductory Cyber Security	3	0	0	0	3
3	Professional Elective Course	PECCS602	Elective-I	3	0	0	0	3
4	Professional Elective Course	PECCS603	Elective-II	3	0	0	0	3
5	Professional Core Course	PCCCS602	Cloud Computing & IoT	2	0	0	0	2
6	Humanities & Social Sciences including Management course	ESP(CS)601	Essential Studies for Professionals – VI (CS)	2	0	0	0	0.5
Total				**16**	**0**	**0**	**0**	**14.5**
Practical Papers								
1	Professional Core Course	PCCCS691	Computer Networks Laboratory	0	0	4	0	2
2	Professional Elective Course	PECCS691	Introductory Cyber Security Laboratory	0	0	4	0	2
3	Professional Core Course	PCCCS692	Cloud Computing & IoT Laboratory	0	0	4	0	2

				0	**0**	**12**	**0**	**6**
Sessional Papers								
1	Humanities & Social Sciences including Management course	SDP681	Skill Development for Professionals - VI	0	0	0	2	0.5
2	Project	PRJCS681	Project – I	0	0	0	6	3
3	Professional Core Course	PCCCS681	Generative AI	0	0	0	3	1.5
4	Humanities & Social Sciences including Management course	HSMCS681	Humanities - II (Industrial Project Management)	0	0	0	3	1.5
Total				**0**	**0**	**0**	**14**	**6.5**
Mandatory Requirements								
Sl. No	**Type of course**	**Course Code**	**Course Name**	**Hours per week**				**Score/Credit /Count**
1	Co-curricular & Extra Curricular Activities	MAR	Mandatory Additional Requirements (Score)	-	-	-	-	-
2	Honours	MOOCs	Massive Open Online Course (Credit)	-	-	-	-	-
3	Certification	IFC	Industry and Foreign Certification (Count)	-	-	-	-	-
4		SAR	Skill Activity Report	-	-	-	-	-
Total				**16**	**0**	**12**	**14**	**27**

Professional Elective

Recommended Professional Elective Courses					
Sl. No.	**Semester**	**Track: Network & Security**	**Track: Artificial Intelligence & Data Science**	**Track: Theory & Systems**	**Track: Applications**
PE-1	Sem-6	Blockchain, Cryptocurrency & NFT	Soft Computing (PECCS602B)	Graph Theory (PECCS602C)	Image Processing (PECCS602D)

		(PECCS602A)			
PE-2	Sem-6	Digital Forensics (PECCS603A)	Natural Language Processing Data (PECCS603B)	Distributed Systems (PECCS603C)	Computer Graphics (PECCS603D)

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Computer Science and Engineering

Detailed Syllabus

Course Code- PCCCS601
Course Title – Computer Networks
Credit – 3
Category – Professional Core Course
Semester – VI
L:T:P:S – 3:0:0:0
Pre-requisite – Basic knowledge of Data Structures, Digital Electronics

Relevant Links:
Study Material Coursera NPTEL Linkedin Learning Infosys Springboard 5G

COURSE OBJECTIVES:

1. Build an understanding of the fundamental concepts of computer networking.
2. Familiarize the student with the basic taxonomy and terminology of the computer networking area.
3. Introduce the student to advanced networking concepts, preparing the student for entry Advanced courses in computer networking.
4. Allow the student to gain expertise in some specific areas of networking such as the design and maintenance of individual networks.

COURSE OUTCOMES:

CO1: Students will be able to learn the general principles of data communication, topology, protocols and standards, bandwidth utilization etc.

CO2: Students will be able to learn data link layer concept where error correction, error detection mechanisms are there. Students will know the concepts of CRC, flow control, error control protocols, ARQ, ALOHA etc.

CO3: Students will be able to learn the concepts of Network Layer where switching, logical addressing and routing protocols are there. At the

same time, students will be able to learn the concepts of transport layers where TCP, UDP, congestion controls are there. Students will be able to know the concepts of leaky bucket and token bucket algorithms also.
CO4: Students will be able to know the concepts of DNS, FTP, and HTTP etc. At the same time, students will be able to learn the different concepts of Cryptography.

Module number	**Topic**	**Sub-topics**	**Mapping with Industry and International Academia**	**Lecture Hours**	**Text with chapter mapping**	**Corresponding Lab Assignment**
1	Data communication Components	Data communication Components: Representation of data and its flow Networks, Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN:	***International Academia:*** (MIT Open Courseware): https://ocw.mit.edu/courses/6-829-computer-networks-fall-2002/pages/syllabus/ ***AICTE-prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/	8	**Text book-1** **Chapters: 1 to 8** **Text book-2** **Chapters:** page no. 1 to 192 *5G Networks fundamentals* (https://www.coursera.org/learn/5g-network-fundamentals)	1. Make an Ethernet Patch Cable Using Crimper, RJ45 and Twisted Pair Cable and Test it in Cable Tester. Discuss the concept of Straight and Crossover cable. 2. Getting started with Basics of Network configurations files and Networking Commands in Linux. 3. To familiarize and understand the use and

		Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum, Bluetooth, 5G &6G networks fundamentals.	AICTE%20-%20UG%20CSE.pdf ***Industry Mapping: Wireshark, Packet Tracer, OPNET, NS3***			functioning of System Calls used for Operating system and network programming in Linux. 4. Create a simple topology of two nodes (Node1, Node2) separated by a point-to-point link using NS3 5. Program in NS3 for connecting three nodes considering one node as a central node. 6. Program in NS3 to implement a bus topology.
2	Data Link Layer and Medium Access Sub Layer	Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance,	***International Academia:*** (MIT Open Courseware): https://ocw.mit.edu/courses/6-829-computer-networks-fall-2002/pages/syllabus/ ***AICTE-prescribed syllabus:***	8	**Text book-1** **Chapters: 9 to 17** **Text book-2** **Chapters: page no. 193 to 354**	7. Implement 1D and 2D parity check. 8. Implement Checksum and CRC parity check. 9. Design ethernet network using OPNET. 10. Design token ring network using OPNET. 11. Design switched local area networks using OPNET.

		CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD, CDMA/CA	https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf ***Industry Mapping: Wireshark, Packet Tracer, OPNET, NS3***			
3	Network layer and transport layer	Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP	***International Academia:*** (MIT Open Courseware): Internetworking and Routing Packet Switching, The Internetworking Problem, IP/TCP Split Connections	14	**Text book-1** **Chapters: 18 to 24** **Text book-2** **Chapters: page no. 355 to 610**	12. Design a Network with Different Users, Hosts, and Services using OPNET. 13. Draw diagram to configure 3 pcs, with a Switch and 2 laptops Hubs send packets to each other in Packet Tracer. Specify the difference between Hub and Switch in Simulation Mode.

		and DHCP–Delivery, Forwarding and Unicast Routing protocols. Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.	Scaling IP, Scaling IP, Routers: Forwarding and Routing, IP Forwarding Path, Unicast Internet Routing: Intra- and Inter-Domain Routing, Intro to the ns2 Network Simulator, Router Design and Implementation https://ocw.mit.edu/courses/6-829-computer-networks-fall-2002/pages/syllabus/ ***AICTE-prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf ***Industry Mapping: Wireshark, Packet Tracer, OPNET, NS3***			14. Draw diagram to configure 2 pc with a router and send packets to each other in Packet Tracer. Discuss the Gateway Concept of a Network. 15. Draw diagram to configure one network from the router and connect with 2 switches, 1 hub and 6 Pcs. 16. Draw diagram to configure 3 pcs, 1 switch, 1 router with 3 pcs, 1 switch, 1 router, 1 server (using DNS Configuration). Set the IP of each pc dynamically using DHCP Configuration. 17. Configure Access Control List and RIP using packet tracer. 18. Configure OSPF using packet tracer. 19. Program in NS3 for connecting multiple routers and nodes and building a hybrid topology. 20. Configuration of Intra VLAN and Inter VLAN using packet tracer. 21. Configure NAT, PAT and SAT in a network with public and private IP

						addresses and port numbers for data communication. 22. To design and implement TCP sockets at server and client site. 23. To design and implement UDP sockets at server and client site 24. Using Wireshark observe Three Way Handshaking Connection Establishment, Data Transfer and Three Way Handshaking Connection Termination in client server communication using TCP. 25. Implement programs for Inter-Process-Communication using PIPE, Message Queue and Shared Memory. 26. Implement a multi user chat server using TCP as transport layer protocol.
4	Application layer	Application Layer: Domain Name Space (DNS), DDNS,	***International Academia:*** (MIT Open Courseware):	6	**Text book-1**	27. Design and configure a network with multiple subnets with wired and

		TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Firewalls, Basic concepts of Cryptography.	https://ocw.mit.edu/courses/6-829-computer-networks-fall-2002/pages/syllabus/ ***AICTE-prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf ***Industry Mapping: Wireshark, Packet Tracer, OPNET, NS3***		**Chapters: 25 to 29** **Text book-2** **Chapters: 611 to 762**	wireless LANs using required network devices. Configure the following services in the network- TELNET, SSH, FTP server, Web server, File server, DHCP server and DNS server. 28. Install network simulator GNS3 in any of the Linux operating system and simulate wired and wireless scenarios. 29. Firewall configuration using packet tracer. 30. End-to-end testing using Free5GC and UERANSIM. 31. Project

Text Books:

1. B. A. Forouzan – "Data Communications and Networking (4th Ed.)" – TMH
2. A. S. Tanenbaum – "Computer Networks (4th Ed.)" – Pearson Education/PHI

Reference Books:

1. W. Stallings – "Data and Computer Communications (5th Ed.)" – PHI/ Pearson Education
2. Zheng & Akhtar, Network for Computer Scientists & Engineers, OUP

Course Code- PCCCS602
Course Title – Cloud Computing & IoT
Credit – 2
Category – Professional Core Course
Semester – VI
L:T:P:S – 2:0:0:0
Pre-requisite – A basic understanding of Networking, public and private networks, and how to architect and implement networking solutions

Study Material | Coursera | NPTEL | LinkedIn Learning | Infosys Springboard

COURSE OBJECTIVES:

1. Understand the necessary theoretical background for computing and storage cloudsenvironments.
2. Know the methodologies and technologies for the development of applications that will be deployed and offered through AWS cloud computing environments.
3. Ability to comprehend, design, and develop cloud system using some state-of-the-art platform.
4. Cloud computing security architectural issues, Identity management and Autonomic security.

COURSE OUTCOMES:

CO 1: Articulate the main concepts, key technologies, strengths, limitations of cloud computing and the possible applications for state-of-the-art cloud computing.
CO2: Identify the architecture and infrastructure of cloud computing, including cloud delivery and deployment models.
CO3: Analyze the core issues of cloud computing such as security, privacy, and interope
CO4**:** Analyze appropriate cloud computing solutions and recommendations according to the applications used.

Module number	Topic	Sub-topics	Text Book Name & Chapter Number	Mapping with Industry and International Academia	Lecture Hours	Corresponding LabAssignment

1	**Fundamentals of Cloud Computing and AWS**	Cloud Computing basics: Introduction to cloud computing, Advantages of Cloud computing, public, private & hybrid cloud, SAAS, PAAS & IAAS. Global Infrastructure: Backbone network, Regions & Availability zone Identity & Access Management: Users, Groups, Roles, Policies, Custom Policies, Multi Factor Authentication, API Key EC2: Virtualization in AWS, EC2 Instance Types, EC2 Instance Families, EC2 Purchasing Options: (On Demand, Spot, Reserved, Dedicated), Creating AMI Images. Elastic Block Storage: EBS Types, EBS vs Instance Storage, Volume, EBS Snapshots, Backups & Replications, Mounting EBS Volumes, Elastic File Storage, Managing EFS File Systems, Mounting EFS File Systems, EFS vs EBS. Load balancers: HA and Scalability Intro, ELB overview, Classic Load balancer, Application Load Balancer, Network Load Balancer, Load Balancer Sticky sessions, Cross zone load balancing, SSL		***International Academia:*** (https://web.stanford.edu/class/cs349d/) ***AICTE-prescribed syllabus:*** (https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf) ***Industry Mapping:*** Amazon, Microsoft, Google	10	

		Certificates				

2	**AWS Database Services and Analytics**	Amazon Relational Database Services: Overview of Relational Databases: RDS Instances and RDS Instance Sizes, Supported Databases, Option Groups, Subnet Groups, Parameter Groups, Why Aurora Database? Snapshots, Automated Backups, Reserved Instances, Replications, Encryption, DynamoDB, NoSQL Overview, DynamoDB Concepts, Tables, Backups, Reserved Capacity, Indexes, Transactions, DocumentDB, Elastic Cache. Simple Storage Service (S3):Architectural Overview, Buckets, Objects and Folders, Storage Tiers, Lifecycle policies, Versioning, Locking, Access to S3 Buckets, Static Website Hosting, S3 Cross Region Replications, S3 Bucket Policies,Storage classes + Glacier,Lifecycle rules, events notifications and hands on. CDN, CloudFront and Global Accelerator: Cloud Front overview, CloudFront Signed URL/Cookies, CloudFront Advanced Concepts, AWS Global Accelerator, AWS Global Accelerator. Serverless: Serverless Intro, Lambda overview, Lambda, Lambda Limits and Edge, DynamoDB overview, API Gateway Overview, API Gateway Security, Cognito overview. Monitoring Auditing, CloudWatch Metrics, CloudWatch Custom Metric,		**International Standards** :(https://web.stanford.edu/class/cs349d/)	10	

		CloudWatch Dashboard and logs. CloudWatch agent and CloudWatch log agent, Cloud Formation.				

				AICTE prescribed syllabus: (https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf) ***Industry Mapping:*** Amazon		
3	**Neworking and Monitoring Services**	VPC : CIDR, Private and Public IP , Default VPC Overview, Subnet overview, Internet gateway and route tables , NAT Instance and Gateways, DNS resolution and Route53 Private zones, NACL and SG , VPC peering , VPC Endpoints , VPC Flow Logs, Bastion hosts, Site to Site VPN, Virtual Private Gateway, and Customer gateway, Direct connect and direct connect gateway , Transit Gateway.		***International Standards***: (https://web.stanford.edu/class/cs349d/) ***AICTE prescribed syllabus:*** (https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf) ***Industry Mapping:*** CISCO, GE Digital, AWS	10	

4	**Internet of Things & Its Applications**	Internet of Thing (IoT): Overview, conceptual framework, architecture, major components, common applications Design principles for connected devices: Modified OSI Model for IoT/M2M systems, ETSI M2M Domains and High-level capabilities, wireless communication technologies - NFC, RFID, Bluetooth BR/EDR and Bluetooth low energy, ZigBee, WiFi, RF transceiver and RF modules. Data enrichment, data consolidation & device management at gateway.		***International Standards:*** (https://web.stanford.edu/class/cs349d/) ***AICTE prescribed syllabus:*** (https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf) ***Industry Mapping:*** Intel, IBM, Samsara	10	

TEXT BOOK:

T1. R. Buyya, C. Vecchiola and S. Thamarai Selvi, Mastering Cloud Computing: Foundations and Applications Programming, Morgan Kaufmann, Elsevier, 2013.

T2. Barrie Sosinsky, "Cloud Computing Bible" John Wiley & Sons, 2010

T3. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill Higher Education

REFERENCEBOOKS:

1. Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, "Distributed and Cloud Computing from Parallel Processing to the Internet of Things", Morgan Kaufmann, Elsevier, 2012
2. P. K. Pattnaik, M. R. Kabat and S. Pal, Fundamentals of Cloud Computing, Vikas Publishing House Pvt. Ltd., 2015.
3. Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010 •
4. Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online - Michael Miller - Que 2008

Course Code- PECCS601
Course Title – Introductory Cyber Security
Credit – 3
Category – Professional Elective Course
Semester – VI
L:T:P:S – 3:0:0:0
Pre-requisite – Basic knowledge of Data Structures, Digital Electronics

Course Outcome:

CO1: Understand the importance of cyber security (data confidentiality, Integrity, and Availability) and various recent attacks on important Digital systems such as banking, e-commerce systems, e-governance systems etc.

CO2: Understand basic cryptography concepts – symmetric vs. asymmetric cryptography, Public Key Crypto Infrastructure (PKI), Symmetric Ciphers, Hashing, and Digital Signatures.

CO3: Understand methods and tools for authentication, authorization, privilege, and their needs in securing an organization's IT system, Intrusion Detection (network and host intrusion detection) and perimeter security (firewall).

CO4: Understand the basic malware functions and indicators of compromise as well as common vulnerabilities in applications, web applications, network, and the Internet Infrastructure.

Desirable/Advanced Outcome:

1. **Understand basic mobile application security issues and android platform architecture for securing app execution.**
2. **Understand wireless LAN security issues.**

Module number	Topic	Sub-topics	Mapping with Industry And International Academia	Tutorial	Corresponding Practical (Hands On) Questions

1	**Introduction and basic terminology**	Cyber Security and CIA Triad, basic cyber threats to CIA, cyber-attack surfaces, recent cyber-security incidents and their high-level analysis	*International Academia:* *Syllabus | Network and Computer Security | Electrical Engineering and Computer Science | MIT OpenCourseWare* *AICTE-prescribed syllabus:* *Industry Mapping:* *https://www.linkedin.com/learning/cybersecurity-foundations-22006082*	3	1. Example Driven Lectures with examples drawn from most recent incidents Assignment 1: Google Dorking - Here we see how we gather information using Browser Assignment 2: Setup Cybersecurity Lab - Here we setup kali linux machine on our windows. Assignment 3: Learning Basic Linux commands. - Here we can see how we can use Linux. Assignment 4: Identify Your Digital Footprint. - Learn about personal cybersecurity risks. Tools: Google, DuckDuckGo, VMware, Kali Linux.

2	**Basic Cryptography**	Role of Cryptography in ensuring confidentiality for data at rest, data in motion, and data in process. Symmetric and Asymmetric Cryptography, their needs as complementary of each other, some basic symmetric and asymmetric algorithm outlines (RSA, DH, DES, AES) Role of cryptography in data integrity, non-repudiation	*International Standards:* *Advanced Topics in Cryptography | Electrical Engineering and Computer Science | MIT OpenCourseWare* *AICTE prescribed syllabus:* *Industry*	6	1. Using library functions to use RSA, AES, and SHA 256 and show the result of encryption, Hashing etc. 2. Taking apart a digital certificate and show the various components and their significance. Assignment 1: Symmetric Encryption and Decryption - Understand how symmetric key
		Hashing and Digital Signature and some example hash function outlines (MD5, SHA-256), understanding digital signature and its role. Digital Certificate and PKI. Importance of the role of a proper Pseudo Random Number Generator.	*Mapping:* *Keeping information safe | LinkedIn Learning*		encryption works using tools like OpenSSL or Python. Assignment 2: Hashing and Integrity Verification- Learn to generate and verify file hashes using hashing algorithms like MD5, SHA-256. Tools: Kali linux, Cyber Chef

3	**Authentication, Authorization and Privilege**	Importance of strong Authentication, distinction between authentication and authorization, importance of authorization, access control, Mandatory and Discretionary Access control, role based authorization, privilege and privilege escalation	*International Standards:* *Computer Systems Security | Electrical Engineering and Computer Science | MIT OpenCourseWare* *AICTE prescribed syllabus:* *Industry Mapping:* *Verify identity and access privileges | LinkedIn Learning*	3	1. Lab on 2 factor authentication, 2. Lab on privilege escalation example Assignment1: Privilege Escalation Lab setup. - Here we setup our own privilege exclamation lab. Assignment 2: Kioptrix lab setup and Box Hacking - Here we can see how can we gain access with a system Assignment 3: Blu box Hacking - Here we see how we gain access to a WIN7 machine by exploiting a well-known vulnerability. Assignment 4: Mr. Robot Box Hacking - Here we see how we gain a access to a machine and how can we gain access. Assignment 5: Linux Privilage Exclaration Here we can see some basic privilege technics of linux Tools: Kali linux, Metasploite, nmap

4	**Application Security**	Basic application vulnerabilities (Buffer overflow, Integer Overflow, format string vulnerability), Basic mitigations of buffer overflow – platform bases, compiler based, secure programming practice Web Client Security, Same Origin Principle, DOM, Java Script Vulnerability, Cookies and Cookie Attributes Secure, http only, Concept of session and session ID, Session hijacking vulnerability, http vs. https and SSL/TLS and version issue Web Server Security – XSS, CSRF, SQL Injection, Command Injection concepts, examples of each and mitigation techniques	*International Standards Computer Systems Security | Electrical Engineering and Computer Science | MIT OpenCourseWare* *AICTE prescribed syllabus:* *Industry Mapping Learn to secure applications | LinkedIn Learning*	15	2. Buffer overflow, integer overflow and format string vulnerability testing in vulnerable applications. 2. DVWA based command injection. SQL injection, XSS and CSRF Assignment 1: Burp Suite Setup - Here we can see how we can capture a request or response using burpsuite Assignment 2: Lab setup (Metasploitable 2) Here we setup a web hacking box Assignment 3: Broken authentication - Here we see how to perform a broken authentication vulnerability in a website Assignment 4: SQL Injection - Here we see how to perform a SQL Injection vulnerability in a website Assignment 5: CSRF - Here we see how to perform a CSRF vulnerability in a website Assignment 6: XSS - Here we see how to perform a

					XSS Vulnerability in a website Tools: Burpsuite, Webgoat, Nessus, OpenVas

5	**Perimeter protection and Intrusion Detection**	Host Intrusion Detection techniques, what are the indicators to look for and how an SIEM tool can consolidate such indicators into a management console Network Intrusion Detection – signature based vs. behavior based, Snort Firewall vs. Intrusion Detection tool, Firewall rules and customization techniques	*International Standards* *Computer Systems Security | Electrical Engineering and Computer Science | MIT OpenCourseWare* *AICTE prescribed syllabus:* *Industry Mapping* *Securing the network | LinkedIn Learning*	6	1. Students are asked to install Wazuh and monitor a host. 2. Students are asked to install snort and monitor a network on their local network Assignment 1: wireshark - Here we see how network traffic flows Tools: kali linux, Wireshark
6	**Basic Malware Analysis**	Various malware classes and their characteristics Difference between static analysis and dynamic analysis Signature vs. behavioral detection techniques	*International Standards* *Network and Computer Security | Electrical Engineering and Computer Science | MIT OpenCourseWare* *AICTE prescribed syllabus:* *Industry Mapping:* *Understanding what malware*	3	1. US static analysis tools to find how an executable can be analyzed. Assignment 1: Making a Malware - Here we make a basic malware Assignment 2: Windows hack using a Malware - Here we hack our own windows machine using a malware Tools: Kali Linux, Metaspolite

			is and how it behaves | LinkedIn Learning		

Detailed Contents for Desirable Learning Outcomes (optional, <= 3 modules):

Module Number	Topics	Sub-topics	Pedagogy teaching suggestions	Tutorial	Corresponding Practical (Hands On) Questions
7	**Mobile Application Security**	Basic mobile attack surface and the ideas of permissions, and their abuse Execution model of mobile apps in Android (Sandboxing) and communication	Provide intuition on mobile malware and how they work, give example of mobile malware attacks, provide intuition of execution model of Android and demonstrate Mandatory Access	3	Expert Lecture
			Control idea in action, SE Linux being part of Android		
8	**WLAN Security**	Some common ways WLAN are compromised including weak cipher such as WEP, evil twin attack, unauthorized access point	Provide students idea about how to look for signs of these rogue	3	Expert Lecture

		based attacks (rogue WLAN) etc.	WLAN, evil twins, public Wi-Fi etc.		

LinkedIn Learning Courses:

1. Introductory Cyber Security: Nail Your Cybersecurity Interview | LinkedIn Learning
2. Cyber Security Foundations: https://www.linkedin.com/learning/cybersecurity-foundations-22006082
3. Malware Analysis: Ethical Hacking: The Complete Malware Analysis Process | LinkedIn Learning
4. Cyber Security: Building the Ultimate Cybersecurity Lab and Cyber Range | LinkedIn Learning
5. Cryptography: Keeping information safe | LinkedIn Learning
6. Web Security: Verify identity and access privileges | LinkedIn Learning
7. Application Security: Learn to secure applications | LinkedIn Learning
8. Malware Analysis: Understanding what malware is and how it behaves | LinkedIn Learning

Coursera Courses:

1. Foundations of Cyber Security: Introduction to Cybersecurity Tools & Cyberattacks | Coursera
2. Cyber Security (by Google): Google Cybersecurity Professional Certificate | Coursera
3. Cyber Security Analyst: Microsoft Cybersecurity Analyst Professional Certificate | Coursera

InfosysSpringBoard Courses:

1. TOC - Introduction to Cyber Security | Infosys Springboard

Study Material Link:

Textbooks:

1. Cyber Security, Nina Godbole & Sumit Belapure, WILEY
2. Ross J. Anderson, Security Engineering, Third Edition, Wiley, Nov 2020
3. Cyber Crime and its Prevention in Easy Steps, Debtoru Chatterjee, Khanna Publishing House, 2022.

Reference Books:

1. Cyber Attacks and Counter-Measures Made Simple, Debtoru Chatterjee, Khanna Publishing House, 2022
2. The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws 2nd Edition by D Stuttard and M Pinto
3. Cryptography and Network Security by William Stallings.

4. The Hacker Playbook: Practical Guide to Penetration Testing (vol. 1 and 2) by Peter Kim.
5. Introduction to Security of Cyber-Physical Systems, Jeeva Jose, Khanna Publishing.
6. Mastering Hacking, Harsh Bothra, Khanna Book Publishing House.
7. Cyber Security, Godbole, belapure, WILEY

The Discipline Graduate Attributes (GAs) to which this course contributes significantly: CS1, CS3, and CS6

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Tutorial	Corresponding Practical (HandsOn) Questions
1	**Introduction and Basic Terminology**	Cyber Security and CIA Triad, basic cyber threats to CIA, cyber-attack surfaces, recent cyber-security incidents and their high-level analysis	*International Academia: Syllabus | Networkand Computer Security | Electrical Engineering and Computer Science |MIT OpenCourseWare* *AICTE-prescribed syllabus:* *Industry Mapping: https://www.linkedin.com/learning/cybersecurity-foundations-22006082*	3	1. Example Driven Lectures with examples drawn from most recentincidents Assignment 1: Google Dorking - Here wesee how we gather information using Browser Assignment 2: Setup Cybersecurity Lab -Here we setup Kali Linux machine on our windows. Assignment 3: Learning Basic Linux commands. - Here we can see how we canuse Linux. Assignment 4: Identify Your DigitalFootprint. - Learn about personal cybersecurity risks. Tools use: Google, DuckDuckGo,VMware, Kali Linux.

2	**Basic Cryptography**	Role of Cryptography in ensuring confidentiality for data at rest, data inmotion, and data in process. Symmetric and Asymmetric Cryptography, their needs as complementary of each other, somebasic symmetric and asymmetric algorithm outlines (RSA, DH, DES, AES) Role of cryptography in data integrity,non-repudiation Hashing and Digital Signature and someexample hash function outlines (MD5,	*International Standards:* *Advanced Topics inCryptography | Electrical Engineeringand Computer Science | MIT OpenCourseWare* *AICTE prescribed syllabus:* *Industry Mapping:* *Keeping information safe |*	6	1. Using library functions to use RSA, AES,and SHA 256 and show the result of encryption, Hashing etc. 2. Taking apart a digital certificate and showthe various components and their significance. Assignment 1: Symmetric Encryption and Decryption - Understand how symmetric key encryption works using tools like OpenSSL orPython. Assignment 2: Hashing and Integrity Verification- Learn to generate and verify filehashes using hashing algorithms like MD5,

		SHA-256), understanding digitalsignature and its role. Digital Certificate and PKI. Importance of the role of a proper Pseudo Random Number Generator.	*LinkedIn Learning*		SHA-256. Tool use: Kali linux, Cyber Chef
3	**Authentication, Authorization and Privilege**	Importance of strong Authentication, distinction between authentication and authorization, importance of authorization, access control, Mandatory and Discretionary Access control, role based authorization, privilege and privilege escalation	*International Standards: Computer Systems Security | Electrical Engineering and Computer Science | MIT OpenCourseWare* *AICTE prescribed syllabus:* *Industry Mapping: Verify identityand access privileges | LinkedIn Learning*	3	1. Lab on privilege escalation 2. How to get into any machine with rootaccess Assignment1: Privilege Escalation Lab setup. - Here we setup our own privilege Escalation lab. Assignment 2: Linux Privilage Exclaration - Here we can see some basic privilege technics of linux Tool use: Kali linux, Metasploite, nmap

4	**Application Security**	Basic application vulnerabilities (Buffer overflow, Integer Overflow, format string vulnerability), Basic mitigations of buffer overflow – platform bases, compiler based, secureprogramming practice Web Client Security, Same Origin Principle, DOM, Java Script Vulnerability, Cookies and Cookie Attributes Secure, http only, Conceptof session and session ID, Session hijacking vulnerability, http vs. httpsand SSL/TLS and version issue Web Server Security – XSS, CSRF,SQL Injection, Command Injectionconcepts, examples of each and mitigation techniques	International Standards Computer Systems Security | Electrical Engineering and Computer Science | MIT OpenCourseWare AICTE prescribed syllabus: Industry Mapping Learn to secure applications | LinkedInLearning	15	2. Buffer overflow, integer overflow andformat string vulnerability testing in vulnerable applications. 2. DVWA based command injection. SQLinjection, XSS and CSRF Assignment 1: Burp Suite Setup - Here we cansee how we can capture a request or response using burpsuite Assignment 2: Lab setup (Metasploitable 2) -Here we setup a web hacking box Assignment 3: Broken authentication - Herewe see how to perform a broken authentication vulnerability in a website Assignment 4: SQL Injection - Here we see how to perform a SQL Injection vulnerabilityin a website Assignment 5: CSRF - Here we see how toperform a CSRF vulnerability in a website Assignment 6: XSS - Here we see how toperform a XSS Vulnerability in a website Tool use: Burpsuite, Webgoat, Nessus,OpenVas

5	**Ethical Hacking and Social Engineering**	Ethical Hacking and Social Engineering: Ethical Hacking Concepts and Scopes, Threats and Attack Vectors, Information Assurance, Threat Modeling, Enterprise Information Security Architecture, Vulnerability Assessment, and Penetration Testing, Types of Social Engineering, Insider Attack, Preventing Insider Threats, Social Engineering	International Standards Computer Systems Security | Electrical Engineering and Computer Science | MIT OpenCourseWare AICTE prescribed syllabus: Industry Mapping https://www.linkedin.com/learning/ethic al-hacking-introduction-to- ethical-hacking	6	Assignment 1: Kioptrix lab setup and Box Hacking - Here we can see how can we gainaccess with a system Assignment 2: Blu box Hacking - Here we seehow we gain access to a WIN7 machine by exploiting a well-known vulnerability. Assignment 3: Mr. Robot Box Hacking - Herewe see how we gain access to a machine andhow can we gain access Tool use: Kali linux, Metasploite, nmap

6	**Basic Malware Analysis**	Various malware classes and theircharacteristics Difference between static analysis anddynamic analysis Signature vs. behavioral detection techniques	International StandardsNetwork and Computer Security | Electrical Engineering and Computer Science | MIT OpenCourseWare AICTE prescribed syllabus: Industry Mapping: Understanding	3	1. US static analysis tools to findhow an executable can be analyzed. Assignment 1: Making a Malware - Here wemake a basic malware Assignment 2: Windows hack using a Malware - Here we hack our own windowsmachine using a malware Tool Use: Kali Linux, Metaspolite

			what malware is and how it behaves | LinkedIn Learning		

Course Code- HSMCS581
Course Title – Industrial Project Management
Credit – 1.5
Category – Sessional Course
Semester – VI
L:T:P:S – 0:0:0:3
Pre-requisite – Basic project management concepts

Course Outcomes:

CO1	**Students will be able to define the common characteristics of an agile development process. List and contrast the state of practice of agile methodologies.**
CO2	**Students will be able to create the requirements and drive estimation for Agile projects**
CO3	**Students will be able to iteratively plan an Agile project in Scrum and use different tracking mechanisms of Agile projects**
CO4	**Students will be able to plan and implement a small-scale software project using the Scrum process methodology.**

Study Material	**Coursera**	**NPTEL**	**Linkedin Learning**	**Infosys Springboard 5G**

Module No.	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignments	Textbook Mapping
1	**Agile Principles**	Introduction to Agile Project Management: • The shift from Waterfall to Agile and due to the increasing need for flexibility, speed, and responsiveness. Agile Methodology Overview: • The Agile Manifesto and its guiding values. • 12 principles of Agile	***Industry Mapping:*** *https://www.coursera.org/programs/iem-faculty-learning-program-rtyr7/learn/agile-development-and-scrum?source=search&collectionId=skill~agile-methodology*	8	This is a highly industry-aligned course where students will gain hands-on experience in executing a small development project using the Agile methodology. For Agile, Scrum	**Main reading:** "**Succeeding With Agile: Software Development Using Scrum**" by Mike Cohn, published by Addison Wesley

		Popular Agile Frameworks: • Scrum: ceremonies (Sprint Planning, Daily Standup, Sprint Review, Sprint Retrospective), and artifacts (Product Backlog, Sprint Backlog, Increment). • Kanban: Visualization of work, flow management, and continuous delivery. • Lean: Principles of Lean thinking applied to Agile, focusing on eliminating waste, optimizing processes, and delivering value faster.			methodology will be used. Jira will be used for overall Agile project tracking.	*Chapter 2 - ADAPTing to Scrum* How to introduce and spread Scrum, how to get people to let go of doing a big design at the start of the project, how to deliver software that works by the end of each sprint, what managers do?
2	**Agile Requirements and Estimation**	Agile Techniques and Tools: • User Stories, Epics, and Story Mapping. • Agile estimation (poker card), Story points, velocity, and burn-down charts. Agile project management tool overview: Jira	***Industry Mapping:*** *https://www.coursera.org/programs/iem-faculty-learning-program-rtyr7/learn/agile-development-and-scrum?source=search&collectionId=skill~agile-methodology*	10	This is a highly industry-aligned course where students will gain hands-on experience in executing a small development project using the Agile methodology. For Agile, Scrum methodology will be used. Jira will be used for overall Agile project tracking.	**Reading:** "**Scrum: The Art of Doing Twice the Work in Half the Time**" by Jeff Sutherland, published by Random House Business *Chapter 1: The way the world works is broken* The

						traditional way of executing projects, especially the waterfall method, was slow, unpredictable, and often resulted in products that people wanted or would buy. To overcome those faults, Scrum was invented, which radically changed the perspective from a top-down to a bottom-up approach.
3	**Agile Planning**	Velocity, Iterative planning – Release planning, Sprint planning, and Daily planning. Sprint backlog, task level estimation, and work allocation.	***Industry Mapping:*** *https://www.coursera.org/programs/iem-faculty-learning-program-rtyr7/learn/agile-development-and-scrum?source=search&collectionId=skill~agile-*	10	This is a highly industry-aligned course where students will gain hands-on experience in executing a small development project using the	Main reading: "Learning Agile: Understanding Scrum, XP, Lean, and Kanban", by Andrew

			methodology		Agile methodology. For Agile, Scrum methodology will be used. Jira will be used for overall Agile project tracking.	Stellman, Jennifer Greene, Shroff/O'Reilly Chapter 5 - Scrum Planning and Collective Commitment Act V: Not Quite Expecting the Unexpected User Stories, Velocity, and Generally Accepted Scrum Practices Act VI: Victory Lap Scrum Values Revisited
4	**Agile Tracking**	Burn down, Burn up, Kanban board, Retrospective, Mastering Jira	***Industry Mapping:*** *https://www.coursera.org/programs/iem-faculty-learning-program-rtyr7/learn/agile-development-and-scrum?source=search&collectionId=skill~agile-methodology*	8	This is a highly industry-aligned course where students will gain hands-on experience in executing a small development project using the Agile methodology. For Agile,	"Succeeding With Agile: Software Development Using Scrum" by Mike Cohn, published by Addison Wesley Chapter 21:

					Scrum methodology will be used. Jira will be used for overall Agile project tracking.	Seeing How Far You've Come Adopting Scrum is a complex process, and answering how you're doing at it will require a complex answer. Fortunately, many early-adopter companies have experimented with ways of doing this, and a handful of suitable approaches have been documented and are available.

Textbooks:

1. Succeeding With Agile, Software Development Using Scrum, Mike Cohn, Addison-Wesley
2. Agile Development with Scrum, Ken Schwaber & Mike Beedle, Prentice Hall,

Reference books:

1. Agile Software Development – The Cooperative Game (2nd Edition), Alistair Cockburn
2. Scrum: The Art of Doing Twice the Work in Half the Time", Jeff Sutherland, J.J.Sutherland

Course Code- PCCCS681
Course Title – Generative AI
Credit – 1.5
Category – Professional Core Course (Sessional)
Semester – VI
L:T:P:S – 0:0:0:3
Pre-requisite – Artificial Intelligence. Neural Network and Deep Learning

Course Outcome:

1) **To acquire concepts related to deep neural network.**
2) **To acquire concepts related to CNN and sequential models like RNN, LSTM, etc.**
3) **To acquire concepts related to Generative AI.**
4) **To acquire concepts related to LLMs and prompt crafting.**

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture hour	Corresponding Practical (Hands-On) Questions

1	Introductio n to Deep Learning	Basics of Neural Network: Understanding biological neurons and artificial neurons; Perceptron, XOR problem, multi-layered perceptron, Types of activation functions; Architectures of neural network; Learning process in ANN. Training Deep Neural Network: Backpropagation and mathematics behind it, Weight initialization in a neural network, Batch, mini-batch, and stochastic gradient descent, Optimization algorithms,	*AICTE-prescribed syllabus: https://www.aicte-india.org/sites/default/files/ Model_Curriculum/CS%20(AI&ML).pdf* *International Academia: https://www.coursera.org/specializations/deep-learning*	6	Introduction to TensorFlow Keras, PyTorch https://www.coursera.org/learn/intro duction-tensorflow (i) Experiment that exposes the GD and BP in simple neural networks. Show the learning process (graphs) and performances. (ii) Experiment that uses a modern library and implementation of a deep neural network, expose computational graphs,
		Regularization, and Normalization.	*Industry Mapping:* TensorFlow, Keras, PyTorch		expose the generalized way of appreciating BP as a learning algorithm in Deep Neural Networks
Textbook: Deep Learning by Ian Goodfellow, Yoshua Bengio, Aaron Courville (Chapters 5,6, 7 and8) Reference book: Deep Learning by Amit Kumar Das, Saptarsi Goswami, Pabitra Mitra and Amlan Chakrabarti (Chapters 4, 5)					

2	Convolutional Neural Network	Basic concept of computer vision; Challenges faced by traditional ANN to deal with image data; Convolutional neural network concepts – kernel, stride, padding, pooling; Building a CNN; Popular CNN architectures – LeNet, AlexNet, GoogLeNet, ResNet, Inception network, UNET; Object detection – bounding box, YOLO, landmark detection, Transfer learning.	*AICTE-prescribed syllabus:* *https://www.aicte-india.org/sites/default/files/Model_Curriculum/CS%20(AI&ML).pdf* *International Academia:* *https://www.coursera.org/learn/convolutional- neural-networks*	6	(i) Experiment that uses a popular CNN architecture for practical application (say image classification).
Textbook: Deep Learning by Ian Goodfellow, Yoshua Bengio, Aaron Courville (Chapter 9) Reference book: Deep Learning by Amit Kumar Das, Saptarsi Goswami, Pabitra Mitra and Amlan Chakrabarti (Chapter 6)					
3	Sequence-Based Models	Introduction to sequence data; Recurrent neural network; Vanishing Gradient Problem and RNN; Long Short-term Memory (LSTM); Gated Recurrent Units (GRU); Bi-directional Models;	*AICTE-prescribed syllabus:* *https://www.aicte-india.org/sites/default/files/Model_Curriculum/CS%20(AI&ML).pdf*	6	(i) Use of popular architectures for pre-trained features and transfer learning (ii) Use of RNNs in learning "language models" in large text corpus (charRNN) (iii) LSTM to generate
			International Academia: *https://www.coursera.org/learn/nlp-sequence-models*		large texts

Textbook: Deep Learning by Ian Goodfellow, Yoshua Bengio, Aaron Courville (Chapter 10)
Reference book: Deep Learning by Amit Kumar Das, Saptarsi Goswami, Pabitra Mitra and Amlan Chakrabarti (Chapter 8)

4	Introduction to Generative Models	The Concept of Generative Modelling, Comparison with Discriminative Models, Taxonomy of Generative Models (Probabilistic vs. Non-Probabilistic), Applications of Generative Models (Image Generation, Text Creation, etc.), Benefits and Challenges, Generative Adversarial Networks (GANs): Architecture, Training Process, Applications (Deepfakes, Style Transfer) - Variational Autoencoders (VAEs): Architecture, Training Process, Applications (Anomaly Detection, Data Augmentation) - Autoregressive Models, Transformer- Based Models, Attention Mechanisms - Diffusion Models, Multi-modal models: Fundamentals	*AICTE-prescribed syllabus:* *https://www.aicte-india.org/sites/default/files/Model_Curriculum/CS%20(AI&ML).pdf* *International Academia:* *https://www.coursera.org/learn/generative-ai- introduction-and- applications?*	6	(i) Use of Transformer for generating synthetic datasets (ii) Use of stable diffusion model in converting black and white images to color or transforming low-resolution images to high-resolution images (iii) Voice and media processing
Textbook: Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play by David Foster (Chapter 1, 3, 4, 5, 8, 9) - Handouts					
5	Large Language Models (LLMs)	- Introduction to Language Models (LMs) - Benefits and Capabilities of LLMs - Text Generation with LLMs (Creative Writing, Code Generation, Chatbots) - Machine Translation with LLMs - Text Summarization with LLMs - Question Answering with LLMs - Sentiment Analysis and NER with LLM - Hallucination in Generative	*International Academia:* *https://www.coursera.org/learn/generative-ai- with-llms*	4	(i) A project to demonstrate how to use one of the LLMs like Llama, GPT, or Gemini (ii) The objective is to provide hands-on experience in fine-tuning, API integration, and user interface building on top of an LLM

		Models: Understanding and Mitigating Untrue or Unrealistic Outputs - Fine-tuning LLMs with domain-specific information (introduce the concepts of matrix multiplication, LORA, etc.)			
Textbook: Prompt Engineering for Generative AI by James Phoenix and Mike Taylor (Chapters 2, 3) - Handouts					

6	Prompt Engineering Techniques for LLMs	- The Power of Prompts in LLM Performance - Other Issues like Zero-Shot and Few Shot, Cross-Lingual NLP, Real-Time NLP - Effective Prompt Design Strategies - Techniques for Fine-tuning LLMs with Prompts - Common pitfalls and best practices based on real-world experiences - Python API for LLMs (GPT, Huggingface) - Recent Advances in Generative NLP Models: RAG (Retrieval-Augmented Generation), LangChain (Multi-stage Generation with Human-in-the-Loop) - GUI for LLM based app development (using Streamlit)	*International Academia: https://www.coursera.org/specializations/prompt-engineering?*	8	(i) End-to-end project using prompts to generate codes, test cases, and documentation for a software development project. (ii) Fine-tune the code and demonstrate the working software.
Textbook: Prompt Engineering for Generative AI by James Phoenix and Mike Taylor (Chapters 1, 2, 3, 4, 7) - Handouts					
7	Ethical Considerations in Generative AI and LLMs	- Bias and Fairness in Generative Models and LLMs - Explainability and Transparency - Societal Impact and Potential Risks of Generative AI - Case studies on misuse and strategies for mitigation	*International Academia: https://www.coursera.org/learn/generative-ai-ethical-considerations-and-implications?*	2	NA
- Handouts					

Course Code- PECCS602A
Course Title – Blockchain, Cryptocurrency & NFT
Credit – 3
Category – Professional Elective Course
Semester –VI
L:T:P:S – 3:0:0:0
Pre-requisite – Computer Network, Cryptography basics Course

Outcomes:

CO1	**Understand block chain technology.**
CO2	**Develop block chain based solutions and write smart contract using Hyperledger Fabric and Ethereum frameworks.**
CO3	**Build and deploy block chain application for on premise and cloud based architecture.**
CO4	**Integrate ideas from various domains and implement them using block chain technology in different perspectives.**

Study Material	**Coursera**	**NPTEL**	**Linkedin Learning**	**Infosys Springboard**

Module No.	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignments	Textbook Mapping

1	Introductio n	Overview of Block chain, Public Ledgers, Bitcoin, Smart Contracts, Block in a Block chain, Transactions, Distributed Consensus, Public vs Private Block chain, Understanding Crypto currency to Block chain, Permissioned Model of Block chain, Overview of Security aspects of Block chain Basic Crypto Primitives: Cryptographic Hash Function, Properties of a	***International Academia: AICTE-prescribed syllabus: Industry Mapping:***	6	Install and understand Docker container, Node.js, Java and Hyperledger Fabric, Ethereum and perform necessary software installation on local machine/create instance on Cloud to run. *https://docs.docker.com/getstarted/https://console.ng.bluemix.net/*	**Textbook-1** Chapters: 1, 2 **Textbook-2** Chapters: 1, 2, 3, 6 **Textbook-3** Chapters: 1, 2
		hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography, A basic cryptocurrency				

2	Understanding Block chain with Crypto currency	Bitcoin and Block chain: Creation of coins, Payments and double spending, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay. Working with Consensus in Bitcoin: Distributed consensus in open environments, Consensus in a Bitcoin network, Proof of Work (PoW) – basic introduction, Hash cash PoW, Bitcoin PoW, Attacks on PoW and the monopoly problem, Proof of Stake, Proof of Burn and Proof of Elapsed Time, The life of a Bitcoin Miner, Mining Difficulty, Mining Pool.	***International Academia: AICTE-prescribed syllabus: Industry Mapping:***	10	Create and deploy a block chain network using Hyperledger Fabric SDK for Java Set up and initialize the channel, install and instantiate chaincode, and perform invoke and query on your block chain network *https://developer.ibm.com/patterns/create-and-deploy-block chain-network using-fabric-sdk-java/*	**Textbook-1** Chapters: 2, 3, 4 **Textbook-2** Chapters: 4, 8 **Textbook-3** Chapters: 2, 3
3	Understanding Block chain for Enterprises	Permissioned Block chain: Permissioned model and use cases, Design issues for	***International Academia: AICTE-prescribed syllabus:***	10	Interact with a block chain network. Execute transactions and requests against a block chain network by creating an app to test the network and its rules *https://developer.ibm.com/patterns/interacting-with-a-block chain-network/*	**Textbook-1** Chapters: 2, 3, 6, 10

		Permissioned block chains, Execute contracts, State machine replication, Overview of Consensus models for permissioned block chain- Distributed consensus in closed environment, Paxos, RAFT Consensus, Byzantine general problem, Byzantine fault tolerant system, Lamport-Shostak-Pease BFT Algorithm, BFT over Asynchronous systems. Enterprise application of Block chain: Cross border payments, Know Your Customer (KYC), Food Security, Mortgage over Block chain, Block chain enabled Trade, We Trade – Trade Finance Network, Supply Chain Financing, Identity on Block chain	***Industry Mapping:***			**Textbook-2** Chapters: 4, 10 **Textbook-3** Chapters: 4, 7
4	ETHEREUM AND BLOCKCHAIN APPLICATIONS	Ethereum - Ethereum Virtual Machine, (EVM) - Wallets for Ethereum - Solidity - Smart Contracts	***International Academia: AICTE-prescribed syllabus: Industry Mapping:***	6	Deploy an asset-transfer app using block chain. Learn app development within a Hyperledger Fabric network *https://developer.ibm.com/patterns/deploy-an-asset-transfer-app-using-block chain/*	**Textbook-1** Chapters: 4, 5 **Textbook-2**

						Chapters: 5, 7 **Textbook-3** Chapters: 5

Textbooks:

1. S. Chandramouli, Asha A George, Abhilash K A, Meena Karthikeyan, "Blockchain Technology", Universities Press (Textbook-1)
2. Kumar Saurabh, Ashutosh Saxena, "Blockchain Technology: Concepts and Applications", Wiley (Textbook-2)
3. Ambadas Tulajadas Choudhari, Arshad Sarfarz Ariff, Sham M R, "Blockchain for Enterprise Application Developers", Wiley (Textbook-3)

Reference books:

1. Melanie Swan, “Block Chain: Blueprint for a New Economy”, O’Reilly, 2015
2. Josh Thompsons, “Block Chain: The Block Chain for Beginners- Guide to Block chain Technology and Leveraging Block Chain Programming”
3. Daniel Drescher, “Block Chain Basics”, Apress; 1stedition, 2017
4. Anshul Kaushik, “Block Chain and Crypto Currencies”, Khanna Publishing House, Delhi.

Course Code- PECCS602B
Course Title – Soft Computing
Credit – 3
Category – Professional Elective Course
Semester – VI
L:T:P:S – 3:0:0:0
Pre-requisite – Mathematics, Data structure and Algorithms, Boolean Algebra
Course Outcomes:

CO1	**Understand, Identify and describe soft computing techniques and their roles in real life problems.**
CO2	**Apply a soft computing methodology for a particular problem.**
CO3	**Analyse and compare various soft computing approaches for a given problem.**
CO4	**Formulate soft computing solutions for various problems.**

Study Material	NPTEL	Coursera

Module No.	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignments	Textbook Mapping
1	**Introduction to Soft Computing**	Concept of computing systems. "Soft" computing vs. "Hard" computing,	***AICTE-prescribed syllabus:*** *https://www.aicte- india.org/sites/default/files/Vol.%201_PG.pdf* ***Industry Mapping:*** *Python,*	1	Evaluate the applicability of hard computing	**Textbook-1** Chapter: 1

		Characteristics of	*R, Fispro, Matlab, Kappalab*		versus soft	
		Soft computing, Some applications of Soft computing techniques			computing approaches for solving real-world optimization problems. In your assessment, compare their effectiveness, scalability, and flexibility in handling uncertainty, imprecision, and complex non-linear systems. Provide specific examples where each approach might be preferred and justify your reasoning.	
2	**Fuzzy logic**	Introduction to	***AICTE-prescribed syllabus:*** *https://www.aicte- india.org/sites/defau*	8	Design a fuzzy	**Textb**

		Fuzzy logic; Fuzzy sets and membership functions; Operations on Fuzzy sets; Fuzzy relations, rules, propositions, implications and inferences. Fuzzification & Defuzzification techniques; Fuzzy Inference System- Mamdani Fuzzy Models Sugeno Fuzzy Models;	*lt/files/Vol.%201_PG.pdf* ***Industry Mapping:*** *Python, R, Fispro, Matlab, Kappalab*		logic-based control system for managing the temperature of a smart home. Define the fuzzy sets, membership functions, and inference rules required for the system. Explain how your system handles uncertainties and imprecise inputs and compare its performance to a traditional	**ook-1** Chapters: 2, 3, 4
					binary control system. Propose possible improvements or extensions to your design to enhance its efficiency and adaptability.	
3	**Artificial**	Biological neurons	***AICTE-prescribed syllabus:*** *https://www.aicte- india.org/sites/defau*	8	Design a	**Textb**

	Neural Networks	and its working; Simulation of biological neurons to problem solving; Different ANNs architectures. Training techniques for ANNs; Applications of ANNs to solve some real-life problems. Feed forward Networks, Back Propagation NN, Supervised Learning Neural Networks.	*lt/files/Vol.%201_PG.pdf* ***Industry Mapping:*** *Python, R, Fispro, Matlab, Kappalab*		neural network model to predict stock market trends. Specify the architecture of your network, including the number of layers, type of neurons, activation functions, and training algorithm. Explain how you would preprocess the data, select features, and handle issues like overfitting or vanishing gradients. Justify your design choices and propose enhancements to improve the model's accuracy and generalization capabilities.	**ook-1** Chapters: 8, 9
4	**Genetic Algorithms**	Concept of "Genetics" and "Evolution" and its application to probabilistic search	***AICTE-prescribed syllabus:*** *https://www.aicte- india.org/sites/defaul* *lt/files/Vol.%201_PG.pdf*	8	Develop a genetic algorithm to solve a vehicle routing	**Textbook-2** Chapters: 3, 4

		techniques; Basic GA framework and different GA architectures; GA operators: Encoding, Crossover, Selection, Mutation, etc.; Solving single-objective optimization problems using GAs.	***Industry Mapping:*** *Python, R, Fispro, Matlab, Kappalab*		problem (VRP) for optimizing delivery routes in a logistics company. Define the chromosome representation, fitness function, selection method, crossover, and mutation strategies. Explain how your algorithm handles constraints such as vehicle capacity, time windows, and fuel efficiency. Propose potential improvements to enhance the algorithm's performance, such as hybrid approaches or adaptive mutation rates, and justify your design decisions.	
5	**Multi-objective Optimization**	Concept of multi-objective optimization problems (MOOPs) and issues of solving them; Multi Objective Evolutionary Algorithm (MOEA); Non Pareto approaches to solve MOOPs; Pareto based	***AICTE-prescribed syllabus:*** *https://www.aicte- india.org/sites/default/files/Vol.%201_PG.pdf* ***Industry Mapping:*** *Python, R, Fispro, Matlab, Kappalab*	8	Design a multi-objective optimization algorithm for balancing cost, environmental impact, and production efficiency in a manufacturing process.	**Textbook-2** Chapter: 20

		approaches to solve MOOPs; NSGAII			Specify the objectives, constraints, and how you would model the trade-offs between conflicting goals. Choose and justify the selection of a specific multi-objective optimization technique (e.g., NSGA- II, Pareto-based methods). Explain how you would evaluate the performance of your algorithm, handle scalability, and adapt it for dynamic changes in the manufacturing environment. Propose possible improvements to enhance its robustness and adaptability.	
6	**Swarm intelligence**	Ant colony optimization, Ant based routing; Swarm intelligence: bees, flocks of birds, shoals of fish, Particle Swarm Optimization	***AICTE-prescribed syllabus:*** *https://www.aicte- india.org/sites/default/files/Vol.%201_PG.pdf* ***Industry Mapping:*** *Python, R, Fispro, Matlab, Kappalab*	7	Develop a swarm intelligence-based algorithm (e.g., Particle Swarm Optimization or Ant Colony Optimization) to optimize the energy consumption	**Textbook-2** Chapter: 11, 12

					of a smart city's street lighting system. Describe the agent behaviors, communication mechanisms, and the fitness evaluation process for your algorithm. Explain how your system adapts to changing environmental conditions, such as weather or pedestrian traffic. Justify your choice of swarm intelligence technique, and propose enhancements to improve scalability, convergence speed, and adaptability to real-time data inputs	

Text Book:

1. Neuro-Fuzzy and Soft computing, Jang, Sun, Mizutani, PHI
2. Evolutionary Optimization Algorithms Dan Simon Wiley, 2013
3. Genetic Algorithms in search, Optimization & Machine Learning by David E. Goldberg

Reference Book:

1. S. N. Sivanandam and S. N. Deepa, Principles of soft computing-Wiley India

2. Fuzzy logic with engineering applications, Timothy J. Ross, John Wiley and Sons.
3. Neural Networks, Fuzzy Logic and Genetic Algorithms, S. Rajasekaran and G. A. V. Pai, PHI
4. Fuzzy Sets and Fuzzy Logic: Theory and Applications, George J. Klir and Bo Yuan, Prentice Hall
5. Neural Networks: A Comprehensive Foundation (2nd Edition), Simon Haykin, Prentice Hall
6. Foundations of Neural Networks, Fuzzy Systems, and Knowledge Engineering, Nikola K. Kasabov, MIT Press.

Subject Name: Graph Theory
Subject Code: PECCS602C
Credit: 3
Category – Professional Elective Course
Semester – VI
L:T:P:S – 3:0:0:0
Pre-requisite – Mathematics and Data structure and Algorithms

NPTEL

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Chapter Mapping
1	**Fundamental Concepts of graph theory**	Graphs, isomorphism, subgraphs, matrix representations, degree, operations on graphs, degree sequences, Walks, trails, paths, connected graphs, distance, cut vertices, cut edges, blocks, weighted graphs, connectivity, Dijkstra's shortest path algorithm, Floyd Warshall shortest path algorithm.	MIT OCW: https://ocw.mit.edu/courses/6-042j-mathematics-for-computer-science-fall-2010/video_galleries/video-lectures/	10	***Introduction to Graph Theory: D.B. West (2001) Prentice Hall*** ***Chapter 1***

2	**Trees**	Characterization of trees, rooted and binary trees, spanning trees and their properties, spanning trees in weighted graphs, minimum spanning tree, algorithms for minimum spanning tree.	MIT OCW: https://ocw.mit.edu/courses/6-042j-mathematics-for-computer-science-fall-2010/video_galleries/video-lectures/	10	***Introduction to Graph Theory: D.B. West (2001) Prentice Hall*** ***Chapter 2***

3	**Coloring of Graphs**	Coloring: Basic equations, matchings in bipartite graphs, perfect; Vertex-colourings; Chromatic number and cliques, greedy coloring algorithm, coloring of chordal graphs, Brook's theorem; Edge colorings.	MIT OCW: https://ocw.mit.edu/courses/6-042j-mathematics-for-computer-science-fall-2010/video_galleries/video-lectures/	10	***Introduction to Graph Theory: D.B. West (2001) Prentice Hall*** ***Chapter 5***

4	**Planar graphs, Directed graphs**	Basic concepts, Euler's formula for planar graphs, characterizations, planarity testing, 5-color-theorem; Directed graph, underlying graph, out-degree, indegree, connectivity, orientation, Eulerian directed graphs, Hamilton directed graphs, tournaments.	MIT OCW: https://ocw.mit.edu/courses/6-042j-mathematics-for-computer-science-fall-2010/video_galleries/video-lectures/	6	***Introduction to Graph Theory: D.B. West (2001) Prentice Hall*** ***Chapter 6***

Textbooks:

1. **Introduction to Graph Theory: D.B. West (2001) Prentice Hall. References Books:**

1. **Graph Theory: F.Harary (1969) Addison-Wesley.**
2. **Graph Theory: R. Diestel (2006) Springer .**

Subject Name: Image Processing
Subject Code: PECCS602D
Category – Professional Elective Course
Semester – VI
L:T:P:S – 3:0:0:0
Pre-requisite: Basic Mathematics

Relevant Links:

Study Material Coursera NPTEL Linkedin Learning Infosys Springboard

COURSE OBJECTIVES:

1. To know the fundamentals of digital image processing
2. To learn different image enhancement and restoration techniques
3. To learn different image segmentation techniques and morphological processing
4. To learn different object representation, feature extraction and classification techniques

COURSE OUTCOMES:

CO1: Students will be able to know the fundamentals of digital image processing

CO2: Students will be able to learn different image enhancement and restoration techniques

CO3: Students will be able to learn different image segmentation techniques and morphological processing

CO4: Students will be able to learn different object representation, feature extraction and classification techniques

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment

1	**Fundamentals of Digital Image Processing (Digital Image Processing, 4/e Author(s): Rafael C. Gonzalez and Richard E. Woods, Chapter-1, and 2)**	Digital Image Representation, Fundamental steps in Image Processing, Image Acquisition: Sampling & Quantization, Storage, Processing, Compression, Communication, Display. Basic Transformation (Translation, Scaling, Rotation), Neighbour of pixels, Adjacency, Connectivity, Regions and boundaries, Distance Measures, Arithmetic/Logic Operations, Interpolation.	***International Academia:*** 1. https://ocw.mit.edu/courses/hst-582j-biomedical-signal-and-image-processing-spring-2007/pages/syllabus/ 2. https://web.stanford.edu/class/ee168/syllabus.shtml ***AICTE-prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/CS%20(AIDS).pdf ***Industry Mapping:*** https://developer.ibm.com/articles/learn-the-basics-of-computer-vision-and-object-detection/#binary-images4	8L	• NA

2	**Intensity transformati ons, Filtering & Restoration (Digital Image Processing, 4/e Author(s): Rafael C. Gonzalez and Richard E. Woods, Chapter 3, 4, and 5)**	Spatial Domain Methods, Frequency Domain Methods. Contrast Enhancement -Linear & Nonlinear Stretching, Histogram Processing. Smoothing - Image Averaging, Mean Filter, Low-pass Filtering; Image Sharpening. Highpass Filtering, Highboost Filtering, Derivative Filtering, Homomorphic Filtering. Image Degradation/Restoration model, Noise models.	***International Academia:*** 1. https://ocw.mit.edu/c ourses/hst-582j-biomedical-signal-and-image-processing-spring-2007/pages/syllabus/ 2. https://web.stanford.edu/class/ee168/syllab us.shtml ***AICTE-prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/C S%20(AIDS).pdf ***Industry Mapping:*** https://in.mathworks.com/ help/images/image-enhancement-and-restoration.html	10L	• **NA**

3	**Image Segmentation (Digital Image Processing, 4/e Author(s): Rafael C. Gonzalez and Richard E. Woods, Chapter 10)**	Detection: Point, Line, and Edge, Edge Linking & Boundary Detection– Local Processing, Global Processing via Hough Transform. Thresholding- Foundation, Simple Global Thresholding, Optimal Thresholding. Region Oriented Segmentation- Region Growing, Region Splitting & Merging.	***International Academia:*** 1. https://ocw.mit.edu/courses/hst-582j-biomedical-signal-and-image-processing-spring-2007/pages/syllabus/ 2. https://web.stanford.edu/class/ee168/syllabus.shtml ***AICTE-prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/CS%20(AIDS).pdf ***Industry Mapping:*** https://in.mathworks.com/help/images/image-segmentation.html	10L	• NA

4	**Morpholo g ical Image Processing (Digital Image Processing , 4/e Author(s): Rafael C. Gonzalez and Richard E. Woods, Chapter 9)**	Erosion, Dilation, Duality, Opening & Closing, Basic Morphological Algorithms- Boundary Extraction, Hole Filling, Convex Hull, Thinning, Thickening, Skeletons.	***International Academia:*** 1. https://ocw.mit.edu/c ourses/hst-582j-biomedical-signal-and-image-processing-spring-2007/pages/syllabus/ 2. https://web.stanford.e du/class/ee168/syllab us.shtml ***AICTE-prescribed syllabus:*** https://www.aicte-india.org/sites/default/fil es/Model_Curriculum /C S%20(AIDS).pdf ***Industry Mapping:*** https://in.mathworks.co m /help/images/morpholo gi cal-filtering.html	10L	• NA

5	**Object Representa tion & Recognitio n (Digital Image Processing, 4/e Author(s): Rafael C. Gonzalez and Richard E. Woods, Chapter 11 and 12)**	Representation: Border, Chaun Codes, Polygonal Approximation. Boundary descriptor and regional descriptor. Feature Extraction: Basic color, shape and texture features, Object classification.	***International Academia:*** 1. https://ocw.mit.edu/c ourses/hst-582j-biomedical-signal-and-image-processing-spring-2007/pages/syllabus/ 2. https://web.stanford.edu/class/ee168/syllab us.shtml ***AICTE-prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/C S%20(AIDS).pdf ***Industry Mapping:*** https://in.mathworks.com/solutions/image-video-processing/object-recognition.html	10L	• **NA**

TEXT BOOK:

1. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, 4/e, Pearson, 2019.

REFERENCE BOOKS:

1. Milan Sonka, Vaclav Hlavac, and Roger Boyle, Image Processing, Analysis, and Machine Vision, 4/e, Cengage, 2015.
2. Anil K. Jain, Fundamentals of Digital Image Processing, Pearson, 2015.
3. William K. Pratt, Digital Image Processing, 4/e, Wiley, 2007.
4. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, Digital Image Processing Using MATLAB, 3/e, Gatesmark Publishing, 2020.

Subject Name: Digital Forensics
Subject Code: PECCS603A
Category – Professional Elective Course
Semester – VI
L:T:P:S – 3:0:0:0
Pre-requisite: Basic understanding of computer systems and networks, Familiarity with operating systems

Course Objective:

1. Understand the Fundamentals of Digital Forensics.
2. Develop Skills in Forensic Tools and Techniques.
3. Analyze and Interpret Digital Evidence.
4. Understand Legal and Ethical Implications.
5. Apply Forensic Techniques to Emerging Technologies

Course Outcome:

CO 1: Students will be able to explain the process of investigating computer crime
CO 2: Perform initial decision making process
CO 3: Students will acquire a knowledge about accessing the situation
CO 4: They will be able to notify decision makers and acquire authorization
CO 5: Review Policies and Laws related to forensics investigation process.
CO 6: Report the investigation

Relevant Links:

1. **Link for Study Material:**

2. **Link for NPTEL Course: (Digital Forensics by Dr. Jeetendra Pande)**

https://onlinecourses.swayam2.ac.in/nou25_cs05/course

3. **Link for Coursera Course: (Digital Forensics Concepts)**
https://www.coursera.org/learn/digital-forensics-concepts

4. Link for LinkedIn Learning Course:

i) **Cybersecurity Foundations: Computer Forensics: https://www.linkedin.com/learning/cybersecurity-foundations-computer-forensics/computer-forensics?contextUrn=urn%3Ali%3AlyndaLearningPath%3A5f3456f7498e3c5079ec21a2&u=229219690**

ii) **The Cybersecurity Threat Landscape: https://www.linkedin.com/learning/the-cybersecurity-threat-landscape-18018064/examine-the-cybersecurity-threat-landscape?contextUrn=urn%3Ali%3AlyndaLearningPath%3A5f3456f7498e3c5079ec21a2&u=229219690**

iii) **Operating System Forensics: https://www.linkedin.com/learning/operating-system-forensics-24652677/operating-system-forensics?contextUrn=urn%3Ali%3AlyndaLearningPath%3A5f3456f7498e3c5079ec21a2&u=229219690**

iv) **Network Forensics : https://www.linkedin.com/learning/network-forensics-23931106/learning-network-forensics?contextUrn=urn%3Ali%3AlyndaLearningPath%3A5f3456f7498e3c5079ec21a2&u=229219690**

v) **Protecting your network with open source software: https://www.linkedin.com/learning/protecting-your-network-with-open-source-software-21464358/protect-your-network-with-free-and-open-source-software?contextUrn=urn%3Ali%3AlyndaLearningPath%3A5f3456f7498e3c5079ec21a2&u=229219690**

Detailed Syllabus:

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment

1	**Computer forensics fundamentals** **Text Books:** Chapter 1: B. Nelson, A. Phillips, and C. Steuart, Guide to Computer Forensics and Investigations, 4th Edition, Course Technology, 2010 John R. Vacca, "Computer Forensics: Computer Crime Scene Investigation", Cengage Learning, 2nd	Benefits of forensics, computer crimes, computer forensics evidence and courts, legal concerns and private issues.	***International Academia:*** https://www.open.edu/o penlearn/science-maths-technology/digital-forensics/?active-tab=description-tab ***AICTE-prescribed syllabus:*** ***https://www.aicte-india.org/sites/default/files/Model_Curriculum/Cyber%20Security%20Minor%20Degree_Dec_2020-3.pdf***	6	1. Creating a forensic Image 2. Live Acquisition 3. Live Forensics

	Edition, 2005. (CHAPTERS 1 – 18).				
2	**Understanding Computing Investigations** **Text Books:** Chapter 1: B. Nelson, A. Phillips, and C. Steuart, Guide to Computer Forensics and Investigations, 4th Edition, Course Technology, 2010 John R. Vacca, "Computer Forensics: Computer Crime Scene Investigation", Cengage Learning, 2nd Edition, 2005. (CHAPTERS 1	Procedure for corporate High-Tech investigations, understanding data recovery work station and software, conducting and investigations.	***AICTE prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/Cyber%20Security%20Minor%20Degree_Dec_20 20-3.pdf ***Industry Mapping:*** EnCase, FTK Imager	8	1. Email Analysis 2. Keyword Search and Analysis

	– 18).				

3	**Data acquisition:** **Text Book:** Chapter 3: B. Nelson, A. Phillips, and C. Steuart, Guide to Computer Forensics and Investigations, 4th Edition, Course Technology, 2010	Understanding storage formats and digital evidence, determining the best acquisition method, acquisition tools, validating data acquisitions, performing RAID data acquisitions, remote network acquisition tools, other forensics acquisitions tools.	***International Standards*** : ***AICTE prescribed syllabus:*** ***https://www.aicte-india.org/sites/default/files/Model_Curriculum/Cyber%20Security%20Minor%20Degree_Dec_2020-3.pdf*** ***Industry Mapping:*** *Wireshark, NetWitness Investigator*	8	1. IOT Forensics 2. Mobile Forensics Analysis
4	**Processing crimes and incident scenes:** **Text Book:** Chapter 4: B. Nelson, A. Phillips, and C. Steuart, Guide to Computer Forensics	Securing a computer incident or crime, seizing digital evidence at scene, storing digital evidence, obtaining digital hash, reviewing case. Current computer forensics tools- software, hardware tools, validating and testing forensic software, addressing data- hiding techniques, performing remote acquisitions, E-Mail investigations- investigating email crime and violations, understanding E-Mail servers, specialized E- Mail forensics tool.	***International Standards:*** ***AICTE prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/Cyber%20Security%20Minor%20Degree_Dec_20 20-3.pdf ***Industry Mapping:***	14	

	and Investigations, 4th Edition, Course Technology, 2010		MailXaminer, Magnet AXIOM		

Project : Applying Practises

Given the contents of three computers from individuals suspected to be involved in credit card fraud, find evidence connecting the three individuals to the fraud case. This involved finding discord and email caches which included hints towards conversations between the three individuals. One of the individuals was an undercover cop and had hacked another's laptop to record the keystrokes, allowing us to discover their passwords.

Write a report explaining what happened, presenting evidence and where it was found.

Text Books:

1. B. Nelson, A. Phillips, and C. Steuart, Guide to Computer Forensics and Investigations, 4th Edition, Course Technology, 2010
2. John Sammons, The Basics of Digital Forensics, 2nd Edition, Elsevier, 2014
3. John Vacca, Computer Forensics: Computer Crime Scene Investigation, 2nd Edition, Laxmi Publications, 2005.

Reference Books:

1. MariE-Helen Maras, “Computer Forensics: Cybercriminals, Laws, and Evidence”, Jones & Bartlett Learning; 2nd Edition, 2014.
2. Chad Steel, “Windows Forensics”, Wiley, 1st Edition, 2006.
3. Majid Yar, “Cybercrime and Society”, SAGE Publications Ltd, Hardcover, 2nd Edition, 2013.
4. Robert M Slade, “Software Forensics: Collecting Evidence from the Scene of a Digital Crime”, Tata McGraw Hill, Paperback, 1st Edition, 2004.

Subject Name: Natural Language Processing
Subject Code: PECCS603B
Category – Professional Elective Course
Semester – VI
L:T:P:S – 3:0:0:0

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Assignment/Project Mapping
1	Introduction	Natural Language Processing Problems and perspectives, Information Extraction and Named Entity Recognition, Text processing, Corpora and their construction. Parts of Speech Tagging. Regular Expressions and Tokenization: Regular Expression, Finite State Automata, Grammars for natural language, Word Tokenization, Normalization, Sentence Segmentation, Named Entity Recognition, Minimum Edit Distance, Computational Morphology, Morphological operations. **TextBook 1: Chapter 1, 2**	***International Academia:*** https://see.stanford.edu/Course/CS224N ***AICTE-prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/CS%20(AIDS).pdf ***Industry Mapping:*** *NLTK, Tensorflow, Spacy, TextBlob, OpenAI, Stanford CoreNLP*	8	1. Sentiment Analysis in Social Media

2	Language Modelling, Lexical Semantics	Introduction to N-grams and Part of Speech Tagging – Rule based and Machine Learning based approaches Computational. Introduction to Lexical Semantics –Homographs, and Homophones, Heteronyms and Heterographs, Polysemes, Capitonyms, Synonyms and Antonyms, Hyponyms and Hypernyms, Stemming and Lemmatization; Thesaurus – WordNet **TextBook 1: Chapters 3**	**International Standards** : https://see.stanford.edu/Course/CS224N ***AICTE prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/CS%20(AIDS).pdf ***Industry Mapping:*** *NLTK, Tensorflow, Spacy, TextBlob, OpenAI, Stanford CoreNLP*	8	1. Healthcare Information Extraction from Medical Reports
3	Text Classification, Information Retrieval, Word Embedding	Text Classification, Naïve Bayes' Text Classification, Evaluation, Sentiment Analysis Term Frequency, Inverse Document Frequency based ranking Word Embedding, Word2Vec Model, The Continuous Bag of Words (CBOW) Model, The Skip-Gram Model; **TextBook 1: Chapters 4, 6**	***International Standards*** : https://see.stanford.edu/Course/ CS224N ***AICTE prescribed syllabus:*** (https://www.aicte-india.org/sites/default/files/Model_Curriculum/CS%20%28AI&ML%29.pdf) ***Industry Mapping:*** *NLTK, Tensorflow, Spacy, TextBlob, OpenAI, Stanford CoreNLP*	10	1. Creating a News Corpus for Topic Modeling

4	Applications	Sentiment Analysis, Topic modeling, Summarization, Recommendation System, and Chatbot, **TextBook 1: Chapter 14, 15, 16** ChatGpt TextBook 1: Chapter 10	***International Standards:*** https://see.stanford.edu/Course/CS224N ***AICTE prescribed syllabus:*** (https://www.aicte-india.org/sites/default/files/Model_Curriculum/CS%20%28AI&ML%29.pdf) ***Industry Mapping:*** *NLTK, Tensorflow, Spacy, TextBlob, OpenAI, Stanford CoreNLP*	10	1. Automated Resume Screening 2. Creating a News Corpus for Topic Modeling

Textbook:

1. Speech and Language Processing". Authors: Daniel Jurafsky and James H. Martin, Pearson Publications.
2. Multilingual natural Language Processing Applications: From Theory to Practice–Daniel M.Bikel and Imed Zitouni, Pearson Publication.

Assignment List

Assignment 1: Create a Python application that tokenises a statement into individual words.

Test Case:

Input: "Hello, how are you?"
Output: ["Hello", "how", "are", "you"]

Assignment 2: Implement a Python application using a stemming algorithm (e.g., nltk's PorterStemmer) to reduce words to their root form, and validate it with the test case programming → program.

Assignment 3: Develop a Python program that utilizes a stemming algorithm, such as the one provided by the nltk library, to efficiently reduce a given word to its lexical root. Validate your implementation by testing it with the input "running" and confirming the output as "run".

Input:

programming

Expected Output:

mathematica
Copy code
Original Word: programming
Stemmed Word: program

Assignment 4: Develop a Python program leveraging a lemmatization technique (e.g., nltk's WordNetLemmatizer) to transform a given word into its canonical base form, and validate it using the input "running" to produce the output "run".

Assignment 5: Design a Python-based solution utilizing a POS tagging module (e.g., nltk's pos_tag) to accurately identify and label the part-of-speech tags for each word in a given sentence, validating it with the input "The dog chased the cat." to produce the output [("The", "DT"), ("dog", "NN"),]

Assignment 6: Develop and execute a Python-driven approach to identify named entities within a given sentence, leveraging a named entity recognition module (e.g., nltk's ne_chunk), and validate it using the input "John Smith works at Google." to produce the output [("John Smith", "PERSON"), ("Google", "ORGANIZATION")].

Assignment 7: Develop and implement a Python-based approach utilizing a sentiment analysis library (e.g., TextBlob or VADER) to determine the sentiment polarity of a given sentence, validating it with the input "I love this product!" to produce the output "Positive".

Assignment 8: Create a Python-based text preprocessing program that standardizes input by converting it to lowercase, removing punctuation, and eliminating stopwords using libraries such as nltk or re. Validate the program using the input "This is a sample text. It contains punctuation and stopwords." to produce the output "sample text contains".

Assignment 9: Develop and implement a Python program to compute the frequency distribution of words in a given text, validating it with the input "This is a sample text. This text is just a sample." to produce the output {"this": 2, "is": 2, "a": 2, "sample": 2, "text": 2}.

Assignment 10: Create a Python-based solution to calculate the semantic similarity between two sentences using techniques like cosine similarity or word embeddings, validating it with the input "This is a sample sentence." and "This sentence is just a sample." to produce a similarity score of 0.8.

Assignment 11: Develop and implement a Python-based solution to compute the Term Frequency-Inverse Document Frequency (TF-IDF)

scores for a small dataset using libraries such as sklearn, validating it with the input {'text': ['This is a sample document.', 'Another document with different content.']} to generate the TF-IDF matrix.

Assignment 12: Develop and implement a Python program that performs text operations including counting the number of words in a sentence, counting the number of characters in a string, and replacing a substring within a string, validating with inputs such as "This is a sample sentence." to output 5, "hello" to output 5, and ("hello world", "world", "universe") to output "hello universe".

Projects

1. Sentiment Analysis in Social Media
2. Healthcare Information Extraction from Medical Reports
3. Creating a News Corpus for Topic Modeling

Subject Name: Distributed Systems
Subject Code: PECCS603C
Category – Professional Elective Course
Semester – VI
L:T:P:S – 3:0:0:0
Pre-requisite: Basic knowledge of Operating Systems, Computer Networks and Database Management Systems.

Relevant Links:

Study Material | Coursera | NPTEL | Linkedin Learning | Infosys Springboard

COURSE OBJECTIVES:

1. Students will have a comprehensive understanding of distributed systems, focusing on their fundamental principles, goals.
2. To make aware of advanced concepts in distributed systems, including communication protocols, synchronization mechanisms, and distributed algorithms.
3. To provide students with a thorough understanding of distributed transactions, concurrency control mechanisms, and fault-tolerant techniques in distributed systems.

4. To provide students with a deep understanding of termination detection, message ordering, and self-stabilization techniques, as well as real-world applications.

COURSE OUTCOMES:

CO 1: Students will be able to define distributed systems, analyze their core objectives such as scalability and fault tolerance, and evaluate the role of hardware concepts and software concepts in the design and implementation of distributed systems.

CO 2: Students will be able to apply layered protocols, Remote Procedure Calls (RPC), and message-oriented communication in distributed environments.

CO 3: Students will be able to analyze and implement flat and nested distributed transactions, apply various concurrency control methods such as locks, optimistic concurrency control, and timestamp ordering.

CO 4: students will be able to apply termination detection algorithms in distributed systems, implement message ordering protocols, and understand the principles of self-stabilization for fault recovery in distributed environments.

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding LabAssignment

1	**Basic Concept**	Definition of a distributed systems, Goals, Hardware concepts- Multiprocessors, heterogeneous multicomputer systems, homogeneous multicomputer systems, Software concepts- Distributed OS, Networked OS, Client-server model	***International Academia:*** (https://ocw.mit.edu/course s/6-824-distributed-computer-systems-engineering-spring-2006/pages/syllabus/) (https://online.stanford.edu/courses/cs244b-distributed- systems) ***Industry Mapping:*** SimGrid	10	**Assignment 1: Analyzing Distributed Systems Goals and Architecture** **Task**: Examine the goals of distributed systems and their relationship to hardware and software concepts. 1. Break down the primary goals of distributed systems, such as resource sharing, transparency, scalability, and fault tolerance. 2. Analyze how these goals influence the choice between hardware architectures (e.g., multiprocessors, heterogeneous multicomputer systems) 3. Explain how software systems like Distributed Operating Systems (Distributed OS) and Networked Operating Systems

					(Networked OS) support achieving these goals. **Instructions**: 1. Create a comparison table or chart that illustrates how different hardware concepts (multiprocessors, homogeneous systems, and heterogeneous systems) align with the goals of distributed systems. 2. Write a short analytical essay (300–400 words) explaining how software concepts, such as Distributed OS and Networked OS, enhance or limit the ability to meet the system goals. Include examples from real- world systems. **Assignment 2: Client-ServerModel in Distributed System Architectures** **Task**: Analyze the role of the client-server model in the context of distributed systems and its implementation across hardware and software layers. 1. Deconstruct the client-server model, outlining its key components and communication processes.

					2. Discuss how this model adapts to different hardware setups (multiprocessors, heterogeneous systems, and homogeneous systems).

					3. Examine the software layers, comparing the implementation of client-server models in Distributed OS and Networked OS. **Instructions**: Develop a flow diagram that illustrates the communication between clients and servers in a distributed system, considering various hardware configurations. Write a detailed report (400–500 words) analyzing how the hardware and software configurations impact the efficiency, scalability, and fault tolerance of the client- server model. Include specific examples and case studies if possible.
2	**Operating System Issues**	Layered Protocols, Remote Procedure Call, Message oriented communication. Distributed file systems - Name services, Domain name system, Directory and discovery services, Peer to peer systems, Napster file sharing system, Peer to peer middleware routing overlays – Clocks, Events and process states Clock Synchronization - Logical clocks Global states - Distributed debugging - Distributed mutual exclusion -	***International Academia:*** (https://ocw.mit.edu/course s/6-824-distributed-computer-systems-engineering-spring-2006/pages/syllabus/) (https://online.stanford.edu/courses/cs244b-distributed- systems) ***Industry Mapping:*** SimGrid	10	**Assignment 3: Investigating Synchronization and Debugging in Distributed Systems** **Objective**: Explore synchronization issues and the application of global states in debugging distributed systems. **Task Details**: 1. Examine the importance of clock synchronization in distributed systems, with a focus on logical clocks (e.g., Lamport clocks) and their role in ordering events. 2. Analyze the role of global states in distributed debugging, including their use in identifying deadlocks and

		Lamport's mutual exclusion algorithm, Token-based algorithms			inconsistencies.

					3. Compare the efficiency of Lamport's mutual exclusion algorithm and token-based algorithms in achieving distributed synchronization, identifying the ideal scenarios for their use. **Instructions**: 1. Develop a sequence diagram or timeline demonstrating how logical clocks are used to order events in a distributed system. 2. Write a 500–600 word report explaining how global states are captured and applied in distributed debugging. Include examples of tools or techniques used in practice. 3. Compare Lamport's and token-based mutual exclusion algorithms, evaluating their strengths, weaknesses, and real-world applicability. Support your analysis with practical examples. **Assignment 4: Evaluating Distributed File Systems and Name Services** **Objective**: Analyze the structure and functionality of distributed file systems, emphasizing name resolution and discovery mechanisms. **Task Details**: 1. Break down the architecture of distributed file systems, focusing on the functions of Name Services, the Domain Name System

					(DNS), and Directory and Discovery Services. 2. Compare centralized, decentralized, and peer-to-peer systems, including Napster's file-sharing system and modern peer-to-peer routing overlays. 3. Examine the challenges of ensuring consistency and availability in distributed file systems. **Instructions**: 1. Design a diagram that represents how a distributed file system operates, including the process of name resolution via DNS and discovery services. 2. Write a 500-word analysis comparing Napster's traditional file-sharing system with modern peer-to-peer routing overlays. Discuss improvements in routing mechanisms, scalability, and fault tolerance over time. 3. Use real-world examples to illustrate the significance of directory services and peer- to-peer routing systems in distributed file systems.

3	**Distributed Transaction Processing**	Transactions - Nested transactions - Locks - Optimistic concurrency control - Timestamp ordering - Flat and nested distributed transactions - Atomic commit protocols - Concurrency control in distributed transactions - Distributed deadlocks - Transaction recovery - Overview of replication, Distributed shared memory and Web services.	***International Academia:*** (https://ocw.mit.edu/course s/6-824-distributed-computer-systems-engineering-spring-2006/pages/syllabus/) (https://online.stanford.edu/courses/cs244b-distributed- systems) ***Industry Mapping:*** SimGrid	10	**Assignment 5: Applying Concurrency Control Techniques in Distributed Transactions** **Objective**: Use concurrency control techniques to ensure consistency and handle conflicts in distributed transactions. **Task Details**: 1. Apply locks, optimistic concurrency control, and timestamp ordering to manage conflicts in a distributed transaction scenario. 2. Implement strategies to detect and resolve distributed deadlocks. 3. Use a given distributed transaction example to demonstrate recovery steps, including rollback and commit. **Instructions**: 1. Given a scenario where multiple distributed transactions access shared resources, outline the steps to implement each concurrency control technique. 2. Create a flowchart showing how to detect and resolve deadlocks in a distributed system. 3. Write a 300–400 word explanation of how the recovery process works in case of a system failure during transaction

					execution.

4	**Termination Detection in Distributed System**	Termination Detection in Distributed System; Message Ordering and Group Communication; Self-Stabilization; Case Study - Content Distribution Networks (CDNs)	***International Academia:*** (https://ocw.mit.edu/course s/6-824-distributed-computer-systems-engineering-spring-2006/pages/syllabus/) (https://online.stanford.edu/courses/cs244b-distributed- systems) ***Industry Mapping:*** SimGrid	6	**Assignment 6: Applying Distributed System Concepts to the Google File System (GFS)** **Objective**: Explore how distributed system principles are applied in the Google File System (GFS). **Task Details**: 1. Identify key distributed system principles (e.g., replication, fault tolerance, and consistency) implemented in GFS. 2. Apply knowledge of distributed file systems to describe how GFS ensures scalability and reliability. 3. Explain the role of chunk servers and master servers in GFS and how they handle failures. **Instructions**: 1. Analyze a given workload scenario (e.g., large-scale data processing) and describe how GFS handles file distribution and replication to maintain performance.

					2. Write a 400-word report explaining the fault-tolerant mechanisms in GFS and how

					they princi p 3. Cr intera c server

TEXT BOOK:

1. Andrew S. Tanenbaum, Maartenvan Steen, "Distributed Systems Principles and Paradigms", 2nd ed., Pearson Education, 2006.

REFERENCE BOOKS:

1. George Coulouris, Jean Dollimore, and Tim Kindberg, "Distributed Systems Concepts and Design", 5th ed., Pearson Education, 2011.

Subject Name: Computer Graphics
Subject Code: PECCS603D
Category – Professional Elective Course
Semester – VI
L:T:P:S – 3:0:0:0
Pre-requisite: Mathematics, Physics, Basic Principles of C Programming, Design & Analysis of Algorithms

Course Outcomes (COs):
CO1: Understand graphics systems, raster scan conversion, and filling of basic geometric objects.
CO2: Apply 2D and 3D transformations to graphics objects.
CO3: Analyze viewing, clipping methods, and surface detection techniques.
CO4: Represent 3D objects using curves, shading, and color models.

Syllabus (Topics)	Mapping with Industry & Academia	Contact Hours	Assignment Questions	References + External Resources

Module 1: Introduction to Computer Graphics & Graphics Systems Overview of CG, Picture representation, RGB model, Graphics devices, Scan conversion, DDA, Bresenham, Circle/Ellipse generation, Polygon filling algorithms.	Industry: OpenGL/DirectX, Game Dev, Visualization Academia: NPTEL CG, MIT OCW CG	10	Implement DDA/Bresenham; Circle generation; Scan-line & Boundary fill.	Hearn & Baker; Xiang & Plastock; Rogers & Adams; Mukherjee. NPTEL: https://nptel.ac.in/courses/106/106/106106090/ MIT: https://ocw.mit.edu/courses/6-837-computer-graphics-fall-2012/
Module 2: 2D & 3D Transformations and Viewing 2D/3D transformations, Window-viewport, Clipping algorithms, Parallel projection, 3D viewing.	Industry: CAD, AR/VR, 3D modeling Academia: NPTEL CG & Viz, MIT rendering	14	Apply 2D transforms; Line/Polygon clipping; 3D transforms & projection.	Hearn & Baker; Rogers & Adams. NPTEL:https://nptel.ac.in/courses/106/102/106102065/ MIT: https://ocw.mit.edu/courses/4-205-analysis-of-contemporary-architecture-fall-2013/
Module 3: Curves & Hidden Surfaces Bezier, B-spline, Rational curves, Z-buffer, Back-face, BSP,	Industry: Blender/Maya, CGI Rendering Academia: NPTEL CAD, MIT Advanced Graphics	10	Bezier/B-spline implementation; Z-buffer & back-face detection; Compare Painter vs BSP.	Hearn & Baker; Foley & van Dam. NPTEL: https://nptel.ac.in/courses/112/103/112103289/ MIT: https://ocw.mit.edu/courses/6-839-advanced-computer-graphics-fall-2017/

Painter, Scan-line, Fractals.				
Module 4: Color & Shading Models Light & Color models, Human vision & perception.	Industry: Rendering, Shader programming Academia: NPTEL DIP, MIT Color Science	2	Explain RGB/HSV; Flat & Gouraud shading.	Newman & Sproull. NPTEL: https://nptel.ac.in/courses/106/105/106105216/ MIT: https://ocw.mit.edu/courses/4-205-analysis-of-contemporary-architecture-fall-2013/pages/color/

Textbooks and References

Textbooks:

Hearn & Baker – Computer Graphics (C version, 2nd Ed.) – Pearson Education.
Xiang & Plastock – Schaum's Outlines: Computer Graphics (2nd Ed.) – TMH.
D. F. Rogers & J. A. Adams – Mathematical Elements for Computer Graphics (2nd Ed.) – TMH.
Mukherjee – Fundamentals of Computer Graphics & Multimedia – PHI.

References:

Foley, Vandam, Feiner, Hughes – Computer Graphics Principles (2nd Ed.) – Pearson Education.
W. M. Newman & R. F. Sproull – Principles of Interactive Computer Graphics – TMH.