University of Engineering & Management, Kolkata
University of Engineering & Management, Jaipur
Institute of Engineering & Management, Kolkata
Department of Computer Science

COURSE STRUCTURE

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 Core Course	PCCCS602	Cloud Computing & IoT	2	0	0	0	2
3	Professional Elective Course	PECCS601	Introductory Cyber Security	3	0	0	0	3
4	Professional Elective Course	PECCS602	Elective - I	3	0	0	0	3
5	Professional Elective Course	PECCS603	Elective - II	3	0	0	0	3
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 Core Course	PCCCS692	Cloud Computing & IoT Laboratory	0	0	4	0	2
3	Professional Elective Course	PECCS691	Introductory Cyber Security Laboratory	0	0	4	0	2
	Total			**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	Innovative Project	PRJCS681	Project – I	0	0	0	6	3
3	Professional Core Course	PCCCS681	Generative AI & Deep Learning	0	0	0	2	1
	Total			**0**	**0**	**0**	**10**	**4.5**
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)	-	-	-	-	-
Total				**16**	**0**	**12**	**10**	**25**

Elective Courses

Program Name	Track	Elective - I	Elective - II
B.Tech in CSE	Network & Security	Blockchain, Cryptocurrency & NFT (PECCS602A)	Digital Forensics (PECCS603A)
	Artificial Intelligence & Data Science	Soft Computing (PECCS602B)	Natural Language Processing Data (PECCS603B)
	Theory & Systems	Graph Theory (PECCS602C)	Distributed Systems (PECCS603C)
	Applications	Image Processing (PECCS602D)	Computer Graphics (PECCS603D)
B.Tech in IT	Network & Security	Information Theory & Coding (PECCS602E)	Data Communication (PECCS603F)
	Artificial Intelligence	Soft Computing (PECCS602B)	Natural Language Processing (PECCS603B)
	Theory and Algorithms	Graph Theory (PECCS602C)	Computer Graphics (PECCS603D)
	Applications	Image Processing (PECCS602D)	E-Commerce (PECCS603I)
B.Tech in CSE (IOTCSBT)	Network & Security	Blockchain, Cryptocurrency & NFT (PECCS602A)	Digital Forensics (PECCS603A)
	Artificial Intelligence	-	Big Data Analytics (PECCS603G)
	Applications	-	Wireless Sensor Network (PECCS603H)
B.Tech in CSE (IOT)	Network & Security	5G Network Technology (PECCS602H)	Data Communication (PECCS603F)
	Artificial Intelligence	Soft Computing (PECCS602B)	Big Data Analytics (PECCS603G)
	Applications	Embedded System (PECCS602J)	Wireless Sensor Network (PECCS603H)
B.Tech in CSE (AI)	Artificial Intelligence	Soft Computing (PECCS602B)	Natural Language Processing Data (PECCS603B)
	Data Science	Data Science using Python (PECCS602K)	Cognitive Computing (PECCS603E)
B.Tech in CST / CSIT	Network & Security	Blockchain, Cryptocurrency & NFT (PECCS602A)	Digital Forensics (PECCS603A)
	Artificial Intelligence	Soft Computing (PECCS602B)	Natural Language Processing (PECCS603B)
	Applications	-	Computer Graphics (PECCS603D)
B.Tech in CSE (AI & ML)	Theoretical AI	Soft Computing (PECCS602B)	Natural Language Processing (PECCS603B)
	Applied AI	Data Science using Python (PECCS602K)	Pattern Recognition (PECCS603J)
B.Tech in CSBS	Networks	Blockchain, Cryptocurrency & NFT (PECCS602A)	Wireless Sensor Network (PECCS603H)
	Applied AI	Data Science using Python (PECCS602K)	Natural Language Processing (PECCS603B)

University of Engineering and Management
Institute of Engineering & Management, Salt Lake Campus
Institute of Engineering & Management, New Town Campus
University of Engineering & Management, Jaipur

Subject Name: Computer Networks **Credit: 3** **Lecture Hours: 36**
Subject Code: PCCCS601

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

University of Engineering and Management
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Syllabus for B. Tech Admission Batch2022

Subject Name: Cloud Computing & IoT Credit: 2 Lecture Hours: 40 Subject Code: PCCCS602

Pre-requisite: A basic understanding of Networking, public and private networks, and how to architect and implement networking solutions.

Relevant Links:

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 interoperability.

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

University of Engineering and Management

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Syllabus for B.Tech Admission Batch 2022

Subject Name: Introductory Cyber Security **Credit: 3** **Tutorial: 3**

Subject Code: PECCS601

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 is and how it behaves | LinkedIn Learning*	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

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 based attacks (rogue WLAN) etc.	Provide students idea about how to look for signs of these rogue WLAN, evil twins, public Wi-Fi etc.	3	Expert Lecture

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/ethical-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		

University of Engineering and Management
Institute of Engineering & Management, Salt Lake Campus
Institute of Engineering & Management, New Town Campus
University of Engineering & Management, Jaipur

Syllabus for B.Tech Admission Batch 2022

Subject Name: BLOCKCHAIN, CRYPTOCURRENCY & NFT **Credit: 3** **Lecture Hours: 32**
Subject Code: PECCS602A

Course Objective:

Obj 1: The objective of this course is to provide conceptual understanding of how block chain technology
Obj 2: How blockchain can be used to innovate and improve business processes

Prerequisites: Computer Network, Cryptography basics

Study Material Coursera NPTEL Linkedin Learning Infosys Springboard

Course Outcome:

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.

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment	Book Chapter Mapping
1	**Introduction**	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 hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography, A basic cryptocurrency	**International Academia** https://ocw.mit.edu/courses/15-s12-blockchain-and-money-fall-2018/pages/syllabus/ **AICTE- prescribed Syllabus** chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.aicte-india.org/sites/default/files/UG_Emerging.pdf	**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://github.com/hyperledger/ https://docs.docker.com/get-started/https://console.ng.bluemix.net/docs/services/block chain/index.html	1. Chandramoli - Chapter 1, 2 2. Saurabh - Chapter 1, 2, 3, 6 3. Choudhari - Chapter 1, 2
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, Hashcash 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** https://ocw.mit.edu/courses/15-s12-blockchain-and-money-fall-2018/pages/syllabus/ **AICTE- prescribed Syllabus** chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.aicte-india.org/sites/default/files/UG_Emerging.pdf	**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/)	1. Chandramoli - Chapter 2, 3, 4 2. Saurabh - Chapter 4, 8 3. Choudhari - Chapter 2, 3

3	**Understanding Block chain for Enterprises**	Permissioned Block chain: Permissioned model and use cases, Design issues for 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	**International Academia** https://ocw.mit.edu/courses/15-s12-blockchain-and-money-fall-2018/pages/syllabus/ **AICTE- prescribed Syllabus** chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.aicte-india.org/sites/default/files/UG_Emerging.pdf	**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/)	1. Chandramoli - Chapter 2, 3, 6, 10 2. Saurabh - Chapter 4, 10 3. Choudhari - Chapter 4, 7
4	**ETHEREUM AND BLOCKCHAIN APPLICATIONS**	Ethereum - Ethereum Virtual Machine, (EVM) - Wallets for Ethereum - Solidity - Smart Contracts	**International Academia** https://ocw.mit.edu/courses/15-s12-blockchain-and-money-fall-2018/pages/syllabus/ **AICTE- prescribed Syllabus** chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.aicte-india.org/sites/default/files/UG_Emerging.pdf **Industry Mapping** SOLIDITY	**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/)	1. Chandramoli - Chapter 4, 5 2. Saurabh - Chapter 5, 7 3. Choudhari - Chapter 5
		.	**Total Hr:**	**32**		

Text book:

T1: S. Chandramouli, Asha A George, Abhilash K A, Meena Karthikeyan, "Blockchain Technology", Universities Press

T2: Kumar Saurabh, Ashutosh Saxena, "Blockchain Technology: Concepts and Applications", Wiley

T3: Ambadas Tulajadas Choudhari, Arshad Sarfarz Ariff, Sham M R, "Blockchain for Enterprise Application Developers", Wiley

Reference Books:

R1: Melanie Swan, “Block Chain: Blueprint for a New Economy”, O’Reilly, 2015

R2: Josh Thompsons, “Block Chain: The Block Chain for Beginners- Guide to Block chain Technology and Leveraging Block Chain Programming”

R3: Daniel Drescher, “Block Chain Basics”, Apress; 1stedition, 2017

R4: Anshul Kaushik, “Block Chain and Crypto Currencies”, Khanna Publishing House, Delhi.

Syllabus for B.Tech Admission Batch 2022

Subject Name: Soft Computing **Credit:** 3 **Lecture Hours:** 40
Subject Code: **PECCS602B**

Prerequisites: Mathematics, Data structure and Algorithms, Boolean Algebra

Relevant Links:

Study Material NPTEL Coursera

Course Objective:

Obj1: Fuzzy logic and its applications.
Obj2: Artificial neural networks and its applications.
Obj3: Solving single-objective optimization problems using GAs.
Obj4: Solving multi-objective optimization problems using Evolutionary algorithms (MOEAs).
Obj5: Solving problems using bio inspired algorithm.

Course Outcome:

After completion of course, students would be able to:

CO 1: Understand, Identify and describe soft computing techniques and their roles in real life problems
CO 2: Apply a soft computing methodology for a particular problem
CO 3: Annalise and compare various soft computing approaches for a given problem
CO 4: Formulate soft computing solutions for various problems.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	3	3	3	2	1	0	0	0	0	0	0	1		3	2	1
CO2	2	2	3	2	2	0	0	0	0	1	0	1		3	1	1
CO3	2	3	2	2	2	0	0	0	0	0	0	1		3	2	1
CO4	2	2	3	2	2	1	0	0	0	1	0	1		3	1	1

Module Number	Topic	Sub-Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Problems
1	Introduction to Soft Computing	Concept of computing systems. "Soft" computing vs. "Hard" computing, Characteristics of Soft computing, Some applications of Soft computing techniques	AICTE: https://www.aicte-india.org/sites/default/files/Vol.%201_PG.pdf Industry Mapping: Python, R, Fispro, Matlab, Kappalab,	1	Evaluate the applicability of hard computing versus soft 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.

Neuro-Fuzzy and Soft computing, Jang, Sun, Mizutani, PHI ,Chapter 1

Module Number	Topic	Sub-Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Problems
2	Fuzzy logic	Introduction to 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;	AICTE: https://www.aicte-india.org/sites/default/files/Vol.%201_PG.pdf Industry Mapping: Python, R, Fispro, Matlab, Kappalab,	8	Design a fuzzy 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 binary control system. Propose possible improvements or extensions to your design to enhance its efficiency and adaptability.

Neuro-Fuzzy and Soft computing, Jang, Sun, Mizutani, PHI Chapter 2, 3, 4

Module Number	Topic	Sub-Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Problems
3	Artificial Neural Networks	Biological neurons 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.	AICTE: https://www.aicte-india.org/sites/default/files/Vol.%201_PG.pdf Industry Mapping: Python, R, Fispro, Matlab, Kappalab,	8	Design a 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.

Neuro-Fuzzy and Soft computing, Jang, Sun, Mizutani, PHI ,Chapter 8, 9

Module Number	Topic	Sub-Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Problems
4	Genetic Algorithms	Concept of "Genetics" and "Evolution" and its application to probabilistic search techniques; Basic GA framework and different GA architectures; GA operators: Encoding, Crossover, Selection, Mutation, etc.; Solving single-objective optimization problems using GAs.	AICTE: https://www.aicte-india.org/sites/default/files/Vol.%201_PG.pdf Industry Mapping: Python, R, Fispro, Matlab, Kappalab,	8	Develop a genetic algorithm to solve a vehicle routing 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.

Evolutionary Optimization Algorithms Dan Simon Wiley, Chapter 3, 4

Module Number	Topic	Sub-Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Problems
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 approaches to solve MOOPs; NSGAII	AICTE: 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. 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

Evolutionary Optimization Algorithms Dan Simon Wiley, Chapter 20

Module Number	Topic	Sub-Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Problems
6	Swarm intelligence	Ant colony optimization, Ant-based routing; Swarm intelligence: bees, flocks of birds, shoals of fish, Particle Swarm Optimization	AICTE: 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 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

Evolutionary Optimization Algorithms Dan Simon Wiley, Chapter 11, 12

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.

Online Resource:

1. https://archive.nptel.ac.in/courses/106/105/106105173/
2. https://www.coursera.org/videos/build-regression-classification-clustering-models/PAQnY?query=genetic+algorithm&source=search
3. https://www.coursera.org/programs/iem-uem-program-2024-2dvv9/learn/neural-networks-deep-learning?source=search
4. https://www.coursera.org/videos/cpsc-8400-design-and-analysis-of-algorithms/cS1l4?query=multi%20objective%20optimization%20&source=search

List of Assignments

Fuzzy Logic

1.	**Fuzzification of Sepal Length**: Given the sepal lengths in the Iris dataset, construct fuzzy sets for three categories: **Short**, **Medium**, and **Long**. Assume Sepal Length values range from 4.3 to 7.9 cm. Define fuzzy membership functions using triangular or trapezoidal shapes for these categories. For a sepal length of 5.5 cm, calculate the membership values for each fuzzy set.
2.	**Fuzzy Classification of Iris Species:** Use fuzzy rules based on sepal length and petal length to classify an iris flower. Define rules like: a. If Sepal Length is Short and Petal Length is Short, then Species is Iris-setosa. b. If Sepal Length is Long and Petal Length is Long, then Species is Iris-virginica For a flower with a Sepal Length of 5.2 cm and a Petal Length of 3.8 cm, calculate the degree of membership for each species.
3.	**Fuzzy Intersection (AND operation):** Define two fuzzy sets: Sepal Length = Medium and Petal Width = Medium. For a flower with Sepal Length = 5.8 cm and Petal Width = 1.5 cm, calculate the fuzzy membership values for both sets and find the intersection (minimum operator).

4.	**Fuzzy Union (OR operation):** Define two fuzzy sets: Petal Length = Short and Sepal Width = Narrow. For a flower with Petal Length = 3.0 cm and Sepal Width = 2.8 cm, calculate the fuzzy membership values for both sets and find the union (maximum operator).
5.	**Fuzzy Complement:** Consider a fuzzy set Petal Width = Wide. Define its membership function over the Petal Width range of 0.1 to 2.5 cm. For a flower with Petal Width = 1.8 cm, calculate the membership value for the Wide set and the complement (not wide).
6.	**Defuzzification Using Centroid Method:** Using fuzzy sets for Short, Medium, and Long Sepal Length, and given a fuzzy output of membership degrees {Short = 0.2, Medium = 0.7, Long = 0.1}, calculate the defuzzified (crisp) Sepal Length using the centroid method.
7.	**Fuzzy Rule Base for Iris Classification:** Construct a fuzzy rule base with rules such as: a. If Sepal Length is Long and Petal Width is Wide, then Species is Iris-virginica. b. If Sepal Length is Short and Petal Width is Narrow, then Species is Iris-setosa. Given a flower with Sepal Length = 6.1 cm and Petal Width = 1.9 cm, evaluate the fuzzy rules and compute the degree of membership for each species.

8.	**Fuzzy Aggregation (OR operation in rule evaluation): Assume you have two fuzzy rules:** **a. If Sepal Width is Wide, then Species is Iris-versicolor.** **b. If Petal Length is Medium, then Species is Iris-versicolor.** **Given Sepal Width = 3.2 cm and Petal Length = 4.5 cm, calculate the aggregated membership for Iris-versicolor using the maximum operator.**
9.	**Fuzzy Inference for Petal Width:** Create a fuzzy inference system for Petal Width based on Sepal Length and Petal Length. Define fuzzy sets for Narrow, Medium, and Wide petal widths. For a flower with Sepal Length = 5.4 cm and Petal Length = 4.1 cm, infer the degree of membership for each Petal Width fuzzy set.
10.	**Comparison of Fuzzy and Crisp Classifications:** Classify a sample from the Iris dataset using a crisp classifier (e.g., based on threshold values of Sepal and Petal dimensions) and compare it to a fuzzy logic-based classification for the same sample. For example, classify a flower with Sepal Length = 6.3 cm, Sepal Width = 3.3 cm, Petal Length = 4.7 cm, and Petal Width = 1.6 cm using both methods.

Neural Network

1.	**Input and Output Representation:** Given the Iris dataset has 4 input features (Sepal Length, Sepal Width, Petal Length, and Petal Width) and 3 possible classes (Iris-setosa, Iris-versicolor, Iris-virginica), represent the input vector for a sample with Sepal Length = 5.1, Sepal Width = 3.5, Petal Length = 1.4, and Petal Width = 0.2. How would the output be encoded using one-hot encoding for the class Iris-setosa?
2.	**Neuron Activation (Single Neuron):** A neuron in a neural network has weights $w_1 = 0.5, w_2 = -0.3, w_3 = 0.8$ *and* $w_4 = -0.2$ and a bias b=0.1. For an input vector [5.1,3.5,1.4,0.2], calculate the weighted sum (net input) before applying the activation function.
3.	**Sigmoid Activation Function:** Using the net input calculated in Question 2, apply the sigmoid activation function $\sigma(x) = \frac{1}{1+e^{-x}}$. What is the output of the neuron after applying the activation function?
4.	**Feedforward in a Single Layer Neural Network:** Consider a single-layer neural network with 4 inputs (Sepal Length, Sepal Width, Petal Length, and Petal Width) and 3 output neurons (one for each Iris species). The weight matrix W is: $\boldsymbol{w} = \begin{bmatrix} \mathbf{0.2} & \mathbf{-0.1} & \mathbf{0.4} & \mathbf{0.5} \\ \mathbf{-0.3} & \mathbf{0.8} & \mathbf{-0.2} & \mathbf{-0.1} \\ \mathbf{0.6} & \mathbf{0.3} & \mathbf{0.2} & \mathbf{0.4} \end{bmatrix}$ and the bias vector b=[0.1,−0.2,0.3]. For the input vector [5.1,3.5,1.4,0.2], calculate the output of the network before applying any activation function.

5.	**Softmax Function for Classification:** Given the outputs from Question 4 as [1.2,0.8,−0.5], apply the softmax function to convert these raw outputs into probabilities. What is the predicted class?
6.	**Backpropagation:** A neural network with one hidden layer has two neurons in the hidden layer and one output neuron. The input to the hidden layer is [1.2,0.5], and the weights connecting the hidden layer to the output are w_1=0.7 and w_2=−0.4. If the output is 0.6 and the target is 1, calculate the error signal for the output neuron using the squared error loss. Then compute the gradient of the loss with respect to w_1 and w_2 .

Genetic Algorithm

1.	**Chromosome Representation:** In a genetic algorithm, each individual (solution) can be represented as a chromosome. For the Iris dataset, consider a chromosome that represents feature selection for a classifier. If there are 4 features (Sepal Length, Sepal Width, Petal Length, Petal Width), represent a chromosome as a binary string where each bit indicates whether the corresponding feature is selected or not. For example, [1,0,1,0]. How many different chromosomes (solutions) can be generated for this feature selection problem?
2.	**Fitness Calculation:** Assume you are using a genetic algorithm to evolve a classifier for the Iris dataset. The fitness of a solution is defined as the accuracy of the classifier on a validation set. If the accuracy for three individuals (chromosomes) is 80%, 75%, and 90%, what are the fitness values for these individuals?
3.	Selection Probability (Roulette Wheel Selection): Using the fitness values from Question 2 (80%, 75%, and 90%), calculate the selection probability for each individual using roulette wheel selection.
4.	**Crossover Operation:** Consider two parent chromosomes for feature selection: Parent 1: [1,0,1,1] Parent 2: [0,1,0,1. Perform single-point crossover at the second position and generate the offspring. **Mutation Operation:** A chromosome for feature selection is represented as [1,1,0,0]. If the mutation probability is 0.1, what is the likelihood that at least one gene (bit) will mutate in this chromosome?

6.	**Population Diversity:** Consider a population of 5 individuals with the following chromosomes representing feature selection:[1,0,0,1],[1,1,0,0],[0,1,1,1],[1,0,1,0],[0,0,1,1]. Calculate the Hamming distance between the first chromosome [1,0,0,1] and the other chromosomes in the population.
7.	**Convergence Criterion:** In a genetic algorithm, a typical convergence criterion is when the population reaches a certain fitness threshold. If the threshold is set at 95% accuracy, and after 50 generations, the top individuals have fitness values of 88%, 90%, 94%, and 95%, has the algorithm converged? Justify your answer based on the fitness values.
8.	**Generational Progress:** Assume a genetic algorithm starts with a population where the average fitness is 70%. After 10 generations, the average fitness is 85%. If the average fitness increases by 1.5% per generation on average, in how many more generations would you expect the average fitness to reach 95%?

Multi-Objective Optimization

1.	Find the Pareto front based on minimizing Sepal Length and Sepal Width from the Iris dataset. Plot the results and highlight the Pareto-optimal solutions.
2.	**Weighted Sum Approach for Two Objectives:** Create a weighted sum function that combines two objectives: minimizing Sepal Length and Petal Length from the Iris dataset. Allow the user to set different weights for the two objectives and find the sample with the lowest weighted score.
3.	**Multi-Objective Genetic Algorithm (GA):** Implement a multi-objective genetic algorithm to perform feature selection in the Iris dataset. The objectives are to maximize classification accuracy and minimize the number of selected features.
4.	**NSGA-II Optimization for Multi-Objective Iris Classification:** Implement the NSGA-II algorithm to optimize both Sepal Width and Petal Width using the Iris dataset. Find the Pareto-optimal solutions and visualize the results.
5.	**Multi-Objective Optimization with Crossover and Mutation Rates:** Write a Python program to optimize two objectives, minimizing Sepal Length and maximizing Petal Length, by implementing genetic operations such as crossover and mutation. Adjust the crossover and mutation rates dynamically and observe the impact on optimization results.

Swarm intelligence

1.	Create a novel Swarm Intelligence-based clustering algorithm (e.g., a PSO-based clustering method) to classify the Iris dataset into its three species. The swarm algorithm should adaptively partition the dataset based on feature similarity, and evaluate the clustering results using metrics like Silhouette Score and Davies-Bouldin Index.
2.	Design and implement a Bee Colony-based clustering algorithm for the Iris dataset. The algorithm should simulate a bee colony searching for optimal cluster centroids that minimize the intra-cluster distance and maximize the inter-cluster distance. Implement a mechanism for the bees to dynamically adjust their position in the feature space based on their fitness evaluation.
3.	Ant Colony Optimization (ACO)-based algorithm to cluster the Iris dataset into its three species. The algorithm should simulate ants searching for the optimal positions of centroids, using fitness functions such as intra-cluster compactness and inter-cluster separation. Evaluate the effectiveness of your clustering algorithm

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Syllabus for B.Tech Admission Batch 2024

Subject Name: Graph Theory

Credit: 3

Lecture Hours: 36

Subject Code: PECCS602C

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:

1. Graph Theory: F.Harary (1969) Addison-Wesley.

2. Graph Theory: R. Diestel (2006) Springer .

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Syllabus for B.Tech Admission Batch 2022

Subject Name: Image Processing **Credit: 3** **Lecture Hours: 48**

Subject Code: PECCS602D

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 transformations, 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/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-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	**Morphological 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/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/morphological-filtering.html	10L	• NA

5	**Object Representation & Recognition (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/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/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.

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Subject Name: Information Theory & Coding **Credit: 3** **Lecture Hours: 36**

Subject Code: PECCS602E

Course Outcome:

After studying this course, students will be able to:

1. Explain the concept of Dependent & Independent Source, a measure of information, Entropy, Rate of information and Order of a source

2 Represent the information using Shannon Encoding, Shannon Fano, Prefix, and Huffman Encoding Algorithms

3. Model the continuous and discrete communication channels using input, output and joint probabilities

4. Determine a code word comprising of the check bits computed using Linear Block codes, cyclic codes & convolutional codes and also can design the encoding and decoding circuits for Linear Block codes, cyclic codes, convolutional codes, BCH and Golay codes.

Module number	Topic	Sub-topics	Mapping with Industryand International Academia	Lecture Hours	Chapter from Text Book	Corresponding Lab Assignment
1	**Information Theory**	Information Theory: Introduction, Measure of information, Information content of message, Average Information content of symbols in Long Independent sequences, Average Information content of symbols in Long dependent sequences, Markov Statistical Model for Information Sources, Entropy and Information rate of Mark off Sources	***International Academia:*** Information and Entropy | Electrical Engineering and Computer Science | MIT OpenCourseWare ***AICTE-prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf ***Industry Mapping:*** Information Theory | Coursera	8	*Text Book 1: Page 11-24*	*A. Entropy and Information Content* 1. Calculate the entropy of a given data source: ○ Implement a function to compute Shannon entropy H(X)=−∑p(x)log⁡2p(x)H(X) = -\sum p(x) \log_2 p(x)H(X)=−∑p(x)log2 p(x). ○ Analyze the effect of different probability distributions on entropy. 2. Measure the joint and conditional entropy of two random variables. ○ H(X,Y)H(X, Y)H(X,Y) and H(X|Y)H(X|Y)H(X|Y). *B. Mutual Information* 3. Compute the mutual information I(X;Y)=H(X)+H(Y)−H(X,Y)I(X; Y) = H(X) + H(Y) - H(X, Y)I(X;Y)=H(X)+H(Y)−H(X,Y). 4. Analyze how mutual information reflects the dependency between two variables. *C. Source Coding* 5. Huffman Coding: 6. Implement Huffman coding for a given dataset. 7. Measure the average code length and compare it with entropy. 8. Arithmetic Coding: 9. Perform arithmetic encoding and decoding for a dataset.

						10. Compare its efficiency to Huffman coding. *D. Channel Capacity* 11. Compute the channel capacity for a discrete memoryless channel (DMC): 12. Use C=max⁡p(x)I(X;Y)C = \max_{p(x)} I(X; Y)C=maxp(x) I(X;Y), where I(X;Y)I(X; Y)I(X;Y) is mutual information. 13. Simulate a binary symmetric channel (BSC) and calculate its capacity: 14. C=1−H(p)C = 1 - H(p)C=1−H(p), where ppp is the error probability. *E. Rate-Distortion Theory (Optional Advanced Task)* 15. Explore the trade-off between compression rate and distortion. 16. Use distortion metrics (e.g., mean squared error) for quantifying the loss.
2	**Source Coding**	Source Coding: Encoding of the Source Output, Shannon's Encoding Algorithm, Shannon Fano Encoding Algorithm Source coding theorem, Prefix Codes, Kraft McMillan Inequality property- KMI, Huffinan codes, The Lempel-Ziv Algorithm	***International Academia:*** Information Theory | Electrical Engineering and Computer Science | MIT OpenCourseWare ***AICTE-prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf ***Industry Mapping:*** Information Theory | Coursera	5	*Text Book 1: Page 25-52*	*A. Data Preparation* • Select a sample dataset (e.g., text, images, or audio files) to compress. • Compute the frequency distribution of symbols in the dataset. *B. Huffman Coding* • Implement Huffman coding. • Generate Huffman trees based on the probability distribution of the symbols.

						• Encode the dataset and decode it to verify lossless compression. *C. Arithmetic Coding* • Implement arithmetic coding for the same dataset. • Compare its performance with Huffman coding. *D. Lempel-Ziv Algorithm* • Implement a basic version of the LZ77 or LZ78 algorithm. • Compare its performance with Huffman and arithmetic coding. *E. Performance Metrics* • Calculate the compression ratio for each method. • Analyze the execution time for encoding and decoding. • Evaluate the effectiveness of each algorithm for the dataset.
3	**Information Channels**	Information Channels: Communication Channels, Discrete Communication channels Channel Matrix, Joint probabilty Matrix, Binary Symmetric Channel, System Entropies. Mutual Information, Channel Capacity, Channel Capacity of Binary Symmetric Channel, Binary Erasure Channel, Muroga's Theorem	***International Academia:*** Information Theory | Electrical Engineering and Computer Science | MIT OpenCourseWare ***AICTE-prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model Curriculum/AICTE%20-%20UG%20CSE.pdf ***Industry Mapping:*** Information Theory | Coursera	6	*Text Book 1: Page 72-98*	*Channels* • Calculate Capacity and Mutual Information • Analyze the Gaussian Distribution and the Gaussian and Erasure Channels • Evaluate the Parity Product Code • Find BER • Heuristic Decoding of the Parity Product Code Plotting in MATLAB

4	**Error Control Coding**	Error Control Coding: Introduction, Examples of Error control coding, methods of Controlling Errors, Types of Errors, types of Codes, Linear Block Codes: matrix description of Linear Block Codes, Error detection & Correction capabilities of Linear Block Codes, Single error correction Hamming code, Table lookup Decoding using Standard Array. Binary Cyclic Codes: Algebraic Structure of Cyclic Codes, Encoding using an (n-k) Bit Shift register, Syndrome Calculation, Error Detection and Correction	***International Academia:*** Information Theory | Electrical Engineering and Computer Science | MIT OpenCourseWare ***AICTE-prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf ***Industry Mapping:*** Information Theory | Coursera	6	*Text Book 1: Page 119-233*	*Error Control Coding* • Representing Probabilities, Equality Nodes • Representing Probabilities, Parity Nodes • The Binary Erasure Channel and Analysis of LDPC on BEC. Making the Analysis Rigorous on Trees Using the Polynomials • Capacity Estimation
5	**Convolution Codes**	Convolution Codes: Convolution Encoder, Time domain approach, Transform domain approach, Code Tree, Trellis and State Diagram, The Viterbi Algorithm)	***International Academia:*** Information Theory | Electrical Engineering and Computer Science | MIT OpenCourseWare Lecture Notes | Error-Correcting Codes Laboratory | Mathematics | MIT OpenCourseWare ***AICTE-prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf ***Industry Mapping:*** Information Theory | Coursera	4	*Text Book 1: Page 277-315*	*Convolutional Codes* • Trellis Representation • Decoding Convolutional Codes • Turbo Codes

Coursera Courses:

1. Information Theory | Coursera
2. Cryptography and Information Theory | Coursera

Study Material Link:

Textbooks:

1. “Information Theory, Coding and Cryptography" by Ranjan Bose
2. “Elements of Information Theory" by Thomas M. Cover and Joy A. Thomas

Reference Books:

1. Digital Communications" by Simon Haykin
2. "Error Control Coding" by Shu Lin and Daniel J. Costello
3. "Modern Coding Theory" by Tom Richardson and Rudiger Urbanke

Basic Concepts and Algorithms

1. Huffman Coding for Text Compression
2. Run-Length Encoding (RLE) for Image Compression
3. Shannon Entropy Calculation for Data Analysis
4. Source Encoding and Decoding System
5. Binary Symmetric Channel Simulation
6. Data Compression using Arithmetic Coding
7. Lempel-Ziv-Welch (LZW) Compression Algorithm
8. LZ77 Compression Algorithm Implementation
9. Lossless Image Compression using Huffman Coding
10. Adaptive Huffman Coding Implementation

Error Detection and Correction

11. Cyclic Redundancy Check (CRC) Implementation
12. Hamming Code for Error Detection and Correction
13. Reed-Solomon Error Correction for Data Storage
14. Error Detection using Parity Bits
15. Viterbi Algorithm for Error Correction in Communication

16. Implementation of Turbo Codes for Error Correction
17. Golay Codes for Error Detection
18. BCH Codes for Error Correction in Data Transmission
19. Implementation of LDPC (Low-Density Parity-Check) Codes
20. Simulating a Noisy Channel and Error Correction Techniques

Channel Capacity and Information Theory

21. Channel Capacity Calculation for Different Communication Channels
22. Simulating Communication Channels with Noise (AWGN Channel)
23. Data Transmission Simulation Using the Shannon-Hartley Theorem
24. Study of Mutual Information in Information Theory
25. Maximizing Data Transfer Rate using Shannon's Capacity Formula
26. Implementation of Source Coding Theorem
27. Error-free Communication in the Presence of Noise
28. Entropy of a Communication Channel under Different Conditions
29. Simulation of BPSK Modulation and Channel Noise
30. Simulating the Capacity of a Noisy Binary Channel

Applications of Coding Theory

31. Voice Compression using Huffman and Run-Length Encoding
32. Image Compression using Discrete Cosine Transform (DCT) and Huffman Coding
33. Data Integrity Verification Using Checksums and CRC
34. Simulation of Data Transmission using Turbo Codes
35. Secure Data Transmission Using Error-Correcting Codes
36. Compression and Error Correction in Wireless Networks
37. Building a File Compression Tool with Huffman and Arithmetic Coding
38. Real-time Data Transmission System with Error Correction
39. Multimedia Data Transmission with Error Detection
40. Cryptographic Application of Coding Theory (e.g., Secure Code for Communication)

Syllabus for B.Tech Admission Batch 2022

Subject Name:	5G Network Technology	**Credit:**	3	**Lecture Hours:**	40
Subject Code:	**PECCS602H**				

Prerequisites: Mathematics, Computer Network, Data Communication

Relevant Links:

Study Material NPTEL Coursera Linkedin Learning

Course Objective:

Obj1: Discuss the current and future wireless mobile communication system.

Obj2: Describe in detail various technological components which will be instrumental to realize next generation wireless communication system.

Obj3: Develop and ability to understand wireless communication channel and channel models for the next generation wireless mobile communication.

Obj4: Explain transmission techniques and multiple access techniques to realize next generation communication system

Course Outcome:

CO1. Understand and explain the channel models of 5G and the use cases for 5G

CO2. Analyse use of MIMO in 5G and its techniques.

CO3. Draw and explain 5G architecture, its components and functional criteria and understand device to device (D2D) communication and standardization.

CO4. Study the in-depth functioning of 5G radio access technologies and understand interference management, mobility management and security issues in 5G.

CO-PO-PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	3	2	3	2	1	1	1	0	0	0	1	2		3	3	3
CO2	3	2	3	2	2	1	1	0	1	1	1	2		3	3	3
CO3	3	3	2	2	2	1	1	0	1	1	1	2		3	3	3
CO4	3	3	3	2	2	1	1	1	1	1	1	2		3	3	3

Module Number	Topic	Sub-Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Problems
1	**5G channel modelling and use cases:**	Modelling requirements and scenarios, Channel model requirements, Propagation scenarios, Relaying multi-hop and cooperative communications: Principles of relaying, fundamentals of relaying, Cognitive radio: Architecture, spectrum sensing, Software Defined Radio (SDR)	Introduction to 5G NPTL UDEMY	5	https://nptel.ac.in/courses/108105134

Module Number	Topic	Sub-Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Problems
2	The 5G architecture:	Introduction, NFV and SDN, Basics about RAN architecture, High-level requirements for the 5G architecture, Functional architecture and 5G flexibility, Functional split criteria, Functional split alternatives, Functional optimization for specific applications, Integration of LTE and new air interface to fulfill 5G Requirements, Enhanced Multi-RAT coordination features, Physical architecture and 5G deployment.	NPTL UDEMY	10	Design an innovative application or system that leverages the high-speed, low-latency capabilities of 5G technology to transform a specific industry (e.g., healthcare, automotive, entertainment, etc.). Describe how your solution works, the key features it offers, and how 5G enhances its functionality compared to previous networks.

Module Number	Topic	Sub-Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Problems
3	Device-to-device (D2D) communications:	D2D: from 4G to 5G, D2D standardization: 4G LTE D2D, D2D in 5G: research challenges, Radio resource management for mobile broadband D2D, RRM techniques for mobile broadband D2D, RRM and system design for D2D, 5G D2D RRM concept: an example, Multi-hop D2D communications for proximity and emergency, services, National security and public safety requirements in 3GPP and METIS, Device discovery without and with network assistance..	NPTL UDEMY	10	Develop a conceptual design for a smart city infrastructure that utilizes massive MIMO technology to improve urban connectivity and manage large-scale data transmission. Consider how the technology enhances efficiency in high-density environments, and propose specific applications for transportation systems, public safety, or smart energy management. Justify the role of massive MIMO in addressing the unique challenges of these applications.

Module Number	Topic	Sub-Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Problems
4	**Channel models for next generation wireless communication**	Wireless mobile environment and its challenges, wireless channel parameters, types of wireless mobile channel, mmWave MIMO channel model, Massive MIMO channel model, Model for Terahertz Communication, Role of machine learning in channel modelling, Deep leaning based MIMO CSI compression.	AICTE: https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf	10	Design a new channel model for a specific 5G use case (e.g., urban high-rise areas, rural environments, or underwater communication). Explain how your model accounts for the unique propagation challenges in that environment, such as signal blockage, reflections, or mobility. Highlight the key parameters that your model considers and discuss how it improves upon existing 5G channel models to enhance communication reliability and efficiency.

Module Number	Topic	Sub-Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Problems
5	**Current state and Challenges ahead**	5G penetration in developed countries; deployment challenges in low-middle income countries, stronger backhaul requirements, dynamic spectrum access and usage of unlicensed spectrum, contrasting radio resource requirements; large cell usage: LMLC; possible solutions for connectivity in rural areas (BharatNet, TVWS, Long-range WiFi, FSO); non-terrestrial fronthaul/backhaul solutions: LEOs, HAP/UAV. 6G Overview	AICTE: https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf	8	Design a hybrid communication network that integrates Low Earth Orbit Satellites (LEOs), High-Altitude Platforms (HAPs), and Unmanned Aerial Vehicles (UAVs) to provide seamless connectivity in remote and disaster-affected areas. Describe how these technologies complement each other, the challenges your design addresses (e.g., latency, coverage gaps, energy efficiency), and the key technical innovations that make your solution viable for real-world implementation.

Text Books:				
Sr. No.	Title	Authors	Publisher	Edition
T1.	5G Mobile and Wireless Communications Technology	Afif Osseiran, Jose F. Monserrat, Patrick Marsch	Cambridge University Press	Second Edition
T2	5G: 2020 and beyond	Ramjee Prasad	River publishers, Denmark	First Edition
References:				
R1.	5G NR: The Next Generation Wireless Access Technology	Erik Dahlman, Stefan Parkvall, Johan Sko¨ld	Elsevier	First Edition
R2.	Fundamentals of 5G Mobile Networks	Jonathan Rodriguez	Wiley	First Edition

Online References:

Sr. No.	Website Name	URL
1	NPTEL	https://nptel.ac.in/courses/108/105/108105134/
2	Udemy	https://www.udemy.com/course/5g-mobile-networks-modern-wireless-communication-technology
3.	Linkedin Learning	https://www.linkedin.com/learning/introduction-to-5g

List of Assignments

1.	A URLLC system requires a data rate of 500 Mbps for a mission-critical application. The signal-to-noise ratio (SNR) is measured to be 15 dB. Using Shannon's capacity theorem, calculate the minimum bandwidth required to support this data rate. Given: Data rate R=500 Mbps SNR SNR_{dB}=15 dB
2.	A URLLC system requires a 99.9999% reliability (outage probability Poutage=10^{-6}) when transmitting packets of 128 bits. The system uses a modulation scheme with a target BLER of 10^3 per transmission attempt. If Automatic Repeat Request (ARQ) is used, how many retransmissions are needed on average to achieve the required reliability? Given: • Packet size: 128 bits • Required reliability: Poutage=10^{-6} • Target BLER per transmission: P_e=10^{-3}
3.	In a CoMP-enabled system, a user at the cell edge is served by two base stations using joint transmission. Each base station provides a data rate of 50 Mbps if serving the user independently. However, due to joint transmission with perfect coordination, the user can effectively use both channels simultaneously. Calculate the total throughput experienced by the user when CoMP joint transmission is applied. Given: • Data rate per base station (independently): 50 Mbps • Number of base stations in joint transmission: 2

4.	Given: A 2x2 MIMO system with two transmit antennas and two receive antennas. The channel matrix for the MIMO system is: $H = \begin{bmatrix} 1 & 0.5 \\ 0.3 & 1.2 \end{bmatrix}$ The signal-to-noise ratio (SNR) per antenna is 10 dB. Find the channel capacity for this MIMO system.
5.	Given: A 4x4 MIMO-OFDM system with 4 transmit and 4 receive antennas. There are 64 subcarriers in the OFDM system. The total transmitted power P_{total} is 1 W. Find the optimal power allocation for each subcarrier assuming equal power allocation across subcarriers.
6.	Given: A 5G network with small cells in a dense urban environment. Each small cell supports 100 users. The available bandwidth per small cell is 100 MHz. The data rate per user is 10 Mbps. Find the total capacity of the 5G small cell network in terms of data rate.
7.	Given: The end-to-end latency requirement for a 5G network is 1 ms. The RAN latency accounts for 0.4 ms. The core network latency accounts for 0.3 ms. The backhaul latency is 0.2 ms. Find the maximum latency allowed in the air interface (radio access network) in 5G.

8.	Given: A SCMA system uses 4 subcarriers with 4 users. Each user is assigned a 4-dimensional sparse codebook. The signal-to-noise ratio (SNR) per user is 12 dB. The codebook has 16 possible codewords. Find the total capacity of the SCMA system for these 4 users.
9.	Given: A SCMA system with 3 users, each using a 4-dimensional codebook. The received signal at the receiver is $y=h\cdot x+n$, where: x is the transmitted codeword, h is the channel gain vector, n is the noise vector. The SIC decoder uses a decision rule based on the channel gains and SNR of each user. Find the probability of successful SIC decoding when the SNR per user is 10 dB.
10.	Given: A SCMA system uses a 4-user scenario, each user utilizing a 4-dimensional sparse codebook. The SNR per user is 14 dB. The codebook has 16 codewords. Find the Bit Error Rate (BER) for the system using SCMA when each user transmits a 4-bit symbol.

11.	Given: A MIMO system with 4 transmit antennas and 4 receive antennas. The transmitter sends a signal with a power of 20 W (43 dBm). The channel loss between the antennas is 100 dB. The receiver's antenna gain is 12 dBi, and the transmitter's antenna gain is 15 dBi. Find the received signal power (in dBm).
12.	Given: A 2x2 MIMO system. The received signal vector at the receiver is y=[3,4]. The transmitted signal vector is x=[1,2]. The noise vector is n=[0.5,0.8]n=[0.5,0.8]. Find the signal-to-noise ratio (SNR) for this MIMO system.

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Syllabus for B.Tech Admission Batch 2022

Subject Name: Embedded Systems **Subject Code: PECCS602J**
Credit:3 **Lecture Hours: 36**

Pre-requisite:

1. Computer organization and architecture
2. Operating system
3. Concepts of assembly language

Course Outcome:

1. Students will gain knowledge of the basic functions, structure, concepts and applications of embedded systems.
2. Students will learn designing and programming embedded systems for real-time applications.
3. Students will understand and apply the concept of operating system in real-time applications.
4. Students will gain knowledge of basic communication protocols, real time operating systems (RTOS), sensors, memory interface and communication interface.

Relevant Links:

Study Material Coursera NPTEL LinkedIn Learning

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
1	Introduction to embedded systems	Definition of embedded system and its features, embedded systems vs general computing systems, classification of embedded systems, embedded hardware units, embedded software, applications and examples of embedded systems, characteristics and quality attributes of embedded systems. ***Raj Kamal, "Embedded Systems: Architecture, Programming and Design," Second Edition, Tata McGraw-Hill. – Chapter 1*** ***Shibu, K. V. "Introduction to embedded systems," Second Edition, Tata McGraw-Hill Education. – Chapter 1***	International Academia: https://web.stanford.edu/class/cs240e/ AICTE-prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_ECE.pdf Industry Mapping: https://mu.microchip.com/page/embedded-system-design	6	1. Study of 8051 microcontroller / ARM processor and familiarization with all functional components.
2	The typical embedded system	Core concepts of embedded system, embedded processors - generic structure and features, choice of microcontroller, ARM microcontroller, RISC-V for embedded systems, field-programmable gate arrays (FPGAs), and application-specific integrated circuits (ASICs), embedded memory, input and output devices, communication interface (SPI, I2C, AMBA, USB, UART etc.), timer and counting devices, power supply, embedded firmware, and other system components.	International Academia: https://web.stanford.edu/class/cs240e/ AICTE-prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model%20Curriculum%20for%20Minor%20Degree%20for%20UG%20Degree%20Courses%20in%20Engineering%20&%20Technology.pdf Industry Mapping: https://www.arm.com/architecture/cpu	10	2. Interfacing ADC and DAC with ARM processor. 3. Interfacing real time clock – DS1307 with ARM processor. 4. Interfacing keyboard and LCD with ARM processor to display text. 5. Interfacing EPROM with ARM processor to write and read data.

		Raj Kamal, "Embedded Systems: Architecture, Programming and Design," Second Edition, Tata McGraw-Hill. – Chapters 2, 3 & 4 ***Shibu, K. V. "Introduction to embedded systems," Second Edition, Tata McGraw-Hill Education. – Chapters 2, 3 & 5*** ***Das, Lyla B. "Embedded systems: An integrated approach," Pearson Education India. – Chapters 2, 11, 16.***	https://mu.microchip.com/arm-cortex-m-architecture-overview https://www.micron.com/content/dam/micron/educatorhub/intro-to-memory/MicronIntroduction-to-Memory-Presentation.pdf https://www.intel.com/content/www/us/en/docs/programmable/683277/current/serial-peripheral-interface-master-in.html		
3	Embedded firmware design and development	Embedded firmware design, embedded firmware development languages, programming in embedded C. ***Raj Kamal, "Embedded Systems: Architecture, Programming and Design," Second Edition, Tata McGraw-Hill. – Chapter 5*** ***Shibu, K. V. "Introduction to embedded systems," Second Edition, Tata McGraw-Hill Education. – Chapters 7 & 9*** ***Das, Lyla B. "Embedded systems: An integrated approach," Pearson Education India. – Chapter 9.***	International Academia: https://web.stanford.edu/class/cs240e/ AICTE-prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_ECE.pdf Industry Mapping: https://www.nxp.com/docs/en/user-guide/FXTH87xx02FWUG.pdf	6	6. Interface the DC motor with ARM processor for speed control operation. 7. Interface a stepper motor with an ARM processor and rotate it in clockwise and anti-clockwise directions. 8. Flash LEDs with ARM processor.
4	RTOS based embedded system design	Operating system basics, types of operating systems, need of real-time operating system, features of a real-time operating system,	International Academia: https://web.stanford.edu/class/cs240e/	6	9. Determine digital output for a given analog input using the internal ADC of the ARM controller.

		commercial real-time operating systems, tasks, process, threads, multiprocessing and multitasking, architecture of kernel, real-time task scheduling, threads-processes-scheduling, task communication, task synchronization, device drivers, memory management, interrupt service mechanism, context switching. ***Raj Kamal, "Embedded Systems: Architecture, Programming and Design," Second Edition, Tata McGraw-Hill. – Chapters 8, 11 & 12.*** ***Shibu, K. V. "Introduction to embedded systems," Second Edition, Tata McGraw-Hill Education. – Chapter 10.*** ***Das, Lyla B. "Embedded systems: An integrated approach," Pearson Education India. – Chapters 7 & 8.***	AICTE-prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_ECE.pdf Industry Mapping: https://moschip.com/blog/semiconductor/real-time-operating-systems-rtos-in-embedded-systems/		
5	Integration and testing of embedded hardware and firmware	Integration of hardware and firmware - out of circuit programming, in system programming, in application programming; Board bring up ***Raj Kamal, "Embedded Systems: Architecture, Programming and Design," Second Edition, Tata McGraw-Hill. – Chapter 13.*** ***Shibu, K. V. "Introduction to embedded systems," Second Edition, Tata McGraw-Hill Education. – Chapter 12.***	International Academia: https://web.stanford.edu/class/cs240e/ AICTE-prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_ECE.pdf Industry Mapping: https://www.nxp.com/docs/en/user-guide/FXTH87xx02FWUG.pdf https://mu.microchip.com/arm-cortex-m-architecture-overview	4	10. Display the Hex digits 0 to F on a 7-segment LED interface with appropriate delay. 11. Demonstrate the use of an external interrupt to toggle an LED On/Off.

6	The embedded system development environment	The integrated development environment (IDE), types of files generated on cross-compilation, disassembler/decompiler, simulators, emulators and debugging, target hardware debugging, boundary scan. ***Raj Kamal, "Embedded Systems: Architecture, Programming and Design," Second Edition, Tata McGraw-Hill. – Chapter 14.*** ***Shibu, K. V. "Introduction to embedded systems," Second Edition, Tata McGraw-Hill Education. – Chapter 13.*** ***Das, Lyla B. "Embedded systems: An integrated approach," Pearson Education India. – Chapters 17 & 18.***	International Academia: https://web.stanford.edu/class/cs240e/ AICTE-prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_ECE.pdf Industry Mapping: https://www.intel.com/content/www/us/en/software/programmable/soc-eds/overview.html	4	12. Temperature control using ATmega16 microcontroller.

Text Books:

1. Rajkamal, "Embedded Systems: Architecture, Programming and Design," Second Edition, Tata McGraw-Hill.
2. Shibu, K. V. "Introduction to embedded systems," Second Edition, Tata McGraw-Hill Education.
3. Das, Lyla B. "Embedded systems: An integrated approach," Pearson Education India.

Reference Books:

1. Vahid, Frank, and Tony D. Givargis. "Embedded system design: a unified hardware/software introduction," John Wiley & Sons.
2. David E. Simon, "An Embedded Software Primer," Pearson Education Asia, First Indian Reprint 2000.
3. Vahid, Frank, and Tony D. Givargis. "Embedded system design: a unified hardware/software introduction," John Wiley & Sons, 2001.

List of Assignments:

1. Study of 8051 microcontroller / ARM processor and familiarization with all functional components.
2. Interfacing ADC and DAC with ARM processor.
3. Interfacing real time clock – DS1307 with ARM processor.
4. Interfacing keyboard and LCD with ARM processor to display text.
5. Interfacing EPROM with ARM processor to write and read data.
6. Interface the DC motor with ARM processor for speed control operation.
7. Interface a stepper motor with an ARM processor and rotate it in clockwise and anti-clockwise directions.
8. Flash LEDs with ARM processor.
9. Determine digital output for a given analog input using the internal ADC of the ARM controller.
10. Display the Hex digits 0 to F on a 7-segment LED interface with appropriate delay.
11. Demonstrate the use of an external interrupt to toggle an LED On/Off.
12. Temperature control using ATmega16 microcontroller.

Final Project:

1. Implementation of password based door lock system using 8051 microcontroller.

University of Engineering and Management
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Course Name: Data Science Using Python

Course Code: PECCS602K
Semester: VI
Contact Hours: 36
Credit: 3
Prerequisites: Familiarity with Python programming, including basic concepts like loops, conditional statements, and functions.
Students will be able to Learn

1. Techniques for handling missing values, encoding, normalization, feature selection, and dimensionality reduction.
2. Create and interpret visualizations using Matplotlib and Seaborn to explore data distributions and relationships.
3. Perform hypothesis testing, ANOVA, and chi-squared tests to validate assumptions and extract insights.
4. Develop models like K-Means, KNN, SVM, and Neural Networks for clustering and classification tasks.

Syllabus	Mapping with Industry and International Academia	Contact Hours	Assignment Question Mapped with the Module	Reference Textbooks

Module 1: Data Preprocessing 1. Handling Missing Values: Mean/Median/Mode Imputation 2. Label Encoding 3. One-Hot Encoding 4. Data Normalization (Min-Max Scaling) 5. Feature Selection and Engineering	- Industry: Data Cleaning and Preparation jobs in analytics roles - Academia: Relevant topics covered in NPTEL Data Science and MIT OpenCourseWare Data Analytics	**9**	1. Impute missing values using statistical methods or ML 2. Encode categorical variables using Label Encoding and One-Hot Encoding 3. Normalize data using Min-Max scaling	1. "Python for Data Analysis" by Wes McKinney 2. "Data Science from Scratch" by Joel Grus
External Resources: NPTEL: Data Science for Engineers, https://onlinecourses.nptel.ac.in/noc21_cs69/preview MIT OCW: Data Analysis for Social Scientists https://ocw.mit.edu/courses/14-310x-data-analysis-for-social-scientists-spring-2023/				

Module 2: Data Visualization and Exploratory Data Analysis (EDA) 1. Skewness and Kurtosis 2. Outlier Detection 3. Matplotlib Basics: Histograms, Box Plots, Line Plots, Scatter Plots, Bar Plots 4. Seaborn: DisPlot, CatPlot, RelPlot 5. Visualizing different datasets	- Industry: Skills in visualization and analysis for roles like BI Analyst - Academia: Topics overlap with NPTEL and MIT OCW EDA courses	**9**	1. Analyze skewness and kurtosis of datasets 2. Visualize data using box plots and scatter plots 3. Compare data distributions with histograms and KDE plots	1. "Practical Statistics for Data Scientists" by Peter Bruce 2. "Python Data Science Handbook" by Jake VanderPlas
External Resources: NPTEL: Applied Data Science with Python, https://onlinecourses.nptel.ac.in/noc22_cs32/preview MIT OCW: Introduction to Computational Thinking and Data Science https://ocw.mit.edu/courses/18-s191-introduction-to-computational-thinking-fall-2020/				

Module 3: Statistical Data Analysis 1. Population vs Samples 2. Central Limit Theorem 3. Hypothesis Testing: Null and Alternate Hypotheses 4. Type I and II Errors 5. Z-tests, T-tests (one and two sample, paired), ANOVA 6. Goodness of Fit Test (GOF), Chi-squared Test	- Industry: Statistical Analysis roles in data science and finance - Academia: Foundations in NPTEL and MIT OCW statistics courses	**9**	1. Perform hypothesis tests and interpret p-values 2. Conduct ANOVA to test group differences 3. Apply Chi-squared test for contingency tables	1. "Introduction to the Practice of Statistics" by David S. Moore 2. "Statistics in Plain English" by Timothy C. Urdan
External Resources: NPTEL: Statistics for Data Science https://onlinecourses.nptel.ac.in/noc24_ma64/preview MIT OCW: Probability and Statistics https://ocw.mit.edu/courses/6-041-probabilistic-systems-analysis-and-applied-probability-fall-2010/				

Module 4: Machine Learning Foundations 1. Supervised Learning: K-Nearest Neighbors (KNN), Support Vector Machine (SVM) 2. Unsupervised Learning: K-Means 3. Introduction to Artificial Neural Networks (ANN)	- Industry: Foundational knowledge for ML Engineer roles - Academia: Introduced in NPTEL Machine Learning and MIT OCW AI courses	**9**	1. Implement K-Means clustering and analyze results 2. Build a classifier using SVM 3. Train a simple ANN model on labeled data	1. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron 2. "Deep Learning" by Ian Goodfellow
External Resources: NPTEL: Machine Learning, https://onlinecourses.nptel.ac.in/noc23_cs18/preview MIT OCW: Introduction to Deep Learning https://introtodeeplearning.com/				

Books

1. Practical Statistics for Data Scientists, 2nd Edition, Peter Bruce, Andrew Bruce and Peter Gedeck, May 2020.
2. Data Science from Scratch by Joel Grus, 2nd edition, O′Reilly .
3. Hands-On Data Analysis with Pandas: A Python data science handbook for data collection, wrangling, analysis, and visualization, 2nd Edition by Stefanie Molin and Ken Jee.

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Syllabus and Lesson Plan for B.Tech Admission Batch 2022

Subject Name: Digital Forensics **Credit: 3** **Lecture Hours: 36**

Subject Code: PECCS602A

Maximum: 100 marks (Internal: 30 marks; External: 70 marks)

List of Faculty Members handling the Subject –

1. Prof. Soumya Sen (UEM, Jaipur)
2.
3.

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/openlearn/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 – 18).	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_2020-3.pdf ***Industry Mapping:*** EnCase, FTK Imager	8	1. Email Analysis 2. Keyword Search and Analysis

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 and Investigations, 4th Edition, Course Technology, 2010	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_2020-3.pdf ***Industry Mapping:*** MailXaminer, Magnet AXIOM	14	

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.

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Syllabus for B.Tech Admission Batch 2022

Subject Name: Natural Language Processing **Credit: 3** **Lecture Hours: 36**

Subject Code: PECCS603B

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

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Syllabus for B.Tech Admission Batch 2022

Subject Name: Distributed Systems **Credit: 3** **Lecture Hours: 36**

Subject Code: PECCS603C

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/courses/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-Server Model 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 - Lamport's mutual exclusion algorithm, Token-based algorithms	***International Academia:*** (https://ocw.mit.edu/courses/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 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/courses/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/courses/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 align with distributed system principles. 3. Create a diagram to demonstrate the interaction between the master server, chunk servers, and clients in GFS.

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.

University of Engineering and Management
Institute of Engineering & Management, Salt Lake Campus
Institute of Engineering & Management, New Town Campus
University of Engineering & Management, Jaipur

Subject Name: Computer Graphics

Subject Code: PECCS603D

Credit: 3

Learning Outcomes of the course (i.e., statements on students' understanding and skills at the end of the course the student shall have):

Students will gain knowledge of computer graphics fundamentals, algorithms, transformations, 3D visualization, and shading, applying these skills to create and optimize graphical systems.

1.Understand graphics systems, raster scan conversion, and filling of basic geometric objects.
2.Apply 2D and 3D transformations to graphics objects.
3.Analyze viewing, clipping methods, and surface detection techniques.
4.Represent 3D objects using curves, shading, and color models.

Desirable/Advanced:

1. Ability to implement basic matrix programming.
2. Understanding of the fundamentals of image processing .

Syllabus	Mapping with Industry and International Academia	Contact Hours	Lab Assignment Mapping
Module 1: Introduction to Computer Graphics & Graphics Systems ***Overview of Computer Graphics*** *Definition, representing pictures, visualization & image processing.* *RGB color model, direct coding, lookup table.* *Graphics Devices* *Storage tube graphics display, raster scan display, 3D viewing devices.* *Active & passive graphics devices; computer graphics software.* *Scan Conversion*	**International Academia:** ***Industry Mapping:*** *Hackerrank,TCS Codevita projects, GitHub platform. NetBeans and Eclipse IDE may be used.*	10	

Point and line generation: DDA algorithm, Bresenham's line algorithm. *Circle and ellipse generation algorithms.* *Polygon fill algorithms: Scan line, boundary fill, flood fill* **MIT Link:** **Overview of Computer Graphics**: MIT OCW - Coordinates and Transformations https://ocw.mit.edu/courses/16-07-dynamics-fall-2009/resources/mit16_07f09_lec03/ **Graphics Devices**: https://ocw.mit.edu/courses/6-837-computer-graphics-fall-2012/ ***Scan Conversion:*** https://ocw.mit.edu/courses/6-837-computer-graphics-fall-2012/53d96abf747a3c82fd3497d2fea540f5_MIT6_837F12_Lec21.pdf			
Raster Scan Displays and Color Models: Explains raster scan displays, RGB color models, and direct coding.- MIT OCW			
Module 2: 2D & 3D Transformations and Viewing *2D Transformations* *Translation, rotation, scaling; Matrix representation, homogeneous coordinates.* *Reflection, shear, transformations of points, lines, and polygons.* *Viewing Pipeline* *Window to viewport transformation, point, and line clipping.* *Algorithms: Cohen-Sutherland, Sutherland-Hodgeman, Cyrus-Beck.* *3D Transformations* *Translation, rotation, scaling, shear.* *General parallel projection transformation, clipping, and viewport clipping.* *3D viewing concepts.* **MIT Link:** **2D Transformation** https://dspace.mit.edu/bitstream/handle/1721.1/36891/1-00Spring2002/OcwWeb/Civil-and-Environmental-Engineering/1-00Spring2002/LectureNotes/detail/class18.htm **NPTEL** **3D Transformation** https://archive.nptel.ac.in/courses/106/102/106102065/	**International Academia:** ***Industry Mapping:*** *Hackerrank,TCS Codevita projects, GitHub platform. NetBeans and Eclipse IDE may be used.*	14	
2D and 3D Geometric Transformations" explains the basics of 2D transformations using matrices and homogeneous coordinates. - MIT OCW			

Module 3: Curves & Hidden Surfaces **Curve Representation** Bezier curves, B-Spline curves, rational B-spline curves, end conditions. **Hidden Surface Elimination** Depth comparison, Z-buffer, back face detection, BSP tree, Painter's algorithm. Scan-line algorithm, hidden line elimination, wireframe methods, fractal geometry. **MIT Link:** **Bézier Curves and Splines** https://ocw.mit.edu/courses/6-837-computer-graphics-fall-2012/aba8735cf2cf7c71ca5d29b46873309a_MIT6_837F12_Lec01.pdf	**International Academia:** ***Industry Mapping:*** *Hackerrank,TCS Codevita projects, GitHub platform. NetBeans and Eclipse IDE may be used.*	10	
Module 4: Color & Shading Models Light & Color Models Human vision and color perception. **MIT Link:** https://groups.csail.mit.edu/graphics/classes/6.837/F00/Lecture16/lecture16.pdf		2	

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.

Syllabus for B.Tech Admission Batch 2022

Subject Name: Cognitive Computing **Credit:** 3 **Lecture Hours:** 40

Subject Code: **PECCS603E**

Prerequisites: Statistics, Artificial Intelligence, Machine Learning,

Relevant Links:

Study Material NPTEL Coursera Linkedin Learning

Course Objective

1. Cognitive computing is an effort to develop algorithms that use AI and machine learning along with human interaction and feedback to help humans make choices/decisions
2. Cognitive computing presents an appealing new model or paradigm for application development.
3. To ingesting data from inside and outside the enterprise, and leveraging functionality to identify and evaluate patterns and complex relationships in large and sometimes unstructured datasets, such as natural language text in journals, books, and social media, or images and sounds.
4. Describe various case studies related to cognitive computing.

Course Outcome

1. **Understand applications in Cognitive Computing.**
2. **Understand Natural language processor role in Cognitive computing.**
3. **Learn future directions of Cognitive Computing.**
4. **Evaluate the process of taking a product to market.**

CO-PO-PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	3	2	3	2	1	1	1	0	0	0	1	2		3	3	3
CO2	3	2	3	2	2	1	1	0	1	1	1	2		3	3	3
CO3	3	3	2	2	2	1	1	0	1	1	1	2		3	3	3
CO4	3	3	3	2	2	1	1	1	1	1	1	2		3	3	3

Module Number	Topic	Sub-Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Problems
1	Foundation of Cognitive Computing	Cognitive computing as a new generation, the uses of cognitive systems, system cognitive, gaining insights from data, Artificial Intelligence as the foundation of cognitive computing, understanding cognition	https://www.aicte-india.org/sites/default/files/Model_Curriculum/CS%20(AI&ML).pdf	6	Analyze how the integration of AI in cognitive computing systems can enhance decision-making in healthcare.

Hurwitz, Kaufman, and Bowles, "Cognitive Computing and Big Data Analytics", Chapter -1

Module Number	Topic	Sub-Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Problems
2	Design Principles for Cognitive Systems	Components of a cognitive system, building the corpus, bringing data into cognitive system, machine learning, hypotheses generation and scoring-presentation and visualization services	https://www.aicte-india.org/sites/default/files/Model_Curriculum/CS%20(AI&ML).pdf	6	Discuss the challenges involved in integrating diverse data sources into a cognitive system. In your answer, elaborate on the role of structured, semi-structured, and unstructured data, and explain how these data types are ingested, processed, and utilized by cognitive systems to improve decision-making.

Hurwitz, Kaufman, and Bowles, "Cognitive Computing and Big Data Analytics", Chapter -2

Module Number	Topic	Sub-Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Problems
3.	Natural Language Processing in support of a Cognitive System	The Role of NLP-The Importance of Context, Connecting Words for Meaning, Understanding Linguistics, Language Identification and Tokenization, Phonology, Morphology, Lexical Analysis, Syntax and Syntactic Analysis, Construction Grammars, Discourse Analysis, Semantic Web-Applying Natural Language Technologies to Business Problems	https://www.aicte-india.org/sites/default/files/Model_Curriculum/CS%20(AI&ML).pdf	10	Build a cognitive agent that can read, understand, and classify legal documents (contracts, terms of service) to identify key clauses or potential risks.

Hurwitz, Kaufman, and Bowles, "Cognitive Computing and Big Data Analytics", Chapter -3

Module Number	Topic	Sub-Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Problems
4.	Representing knowledge in Taxonomies and Ontologies	Representing knowledge, Defining Taxonomies and Ontologies, knowledge representation, models for knowledge representation, implementation considerations	https://www.aicte-india.org/sites/default/files/Model_Curriculum/CS%20(AI&ML).pdf	06	Design an ontology to represent diseases, symptoms, treatments, and patient demographics for a healthcare application.

Hurwitz, Kaufman, and Bowles, "Cognitive Computing and Big Data Analytics", Chapter -5

Module Number	Topic	Sub-Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Problems
5.	Relationship between Big Data and Cognitive Computing	Dealing with human-generated data, defining big data, architectural foundation, analytical data warehouses, Hadoop, data in motion and streaming data, integration of big data with traditional data	https://www.aicte-india.org/sites/default/files/Model_Curriculum/CS%20(AI&ML).pdf	6	Develop a cognitive system for financial institutions that uses big data to predict and manage financial risks (e.g., fraud detection, market shifts).

Hurwitz, Kaufman, and Bowles, "Cognitive Computing and Big Data Analytics", Chapter -6

Module Number	Topic	Sub-Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Problems
6	Applying Advanced Analytics to cognitive computing	Advanced analytics is on a path to cognitive computing, Key capabilities in advanced analytics, using advanced analytics to create value, Impact of open source tools on advanced analytics	https://www.aicte-india.org/sites/default/files/Model_Curriculum/CS%20(AI&ML).pdf	6	Develop a cognitive system that uses advanced analytics to process and analyze social media data (e.g., sentiment analysis, topic modeling) to manage brand reputation and customer engagement.

Hurwitz, Kaufman, and Bowles, "Cognitive Computing and Big Data Analytics", Chapter -6

TEXTBOOK

1. Hurwitz, Kaufman, and Bowles, "Cognitive Computing and Big Data Analytics", Wiley, 2005, ISBN: 978-1-118-89662-4.

Reference Books

1. Jerome R. Busemeyer, Peter D. Bruza, “Quantum Models of Cognition and Decision”, Cambridge University Press.
2. Emmanuel M. Pothos, Andy J. Wills, “Formal Approaches in Categorization”, Cambridge University Press.
3. Nils J. Nilsson, “The Quest for Artificial Intelligence”, Cambridge University Press.
4. Neil Stillings, Steven E. Weisler, Christopher H. Chase and Mark H. Feinstein, “Cognitive Science: An Introduction”, MIT Press.

ONLINE RESOURCES:

https://ocw.mit.edu/courses/res-9-003-brains-minds-and-machines-summer-course-summer-2015/
https://onlinecourses.nptel.ac.in/noc22_ee122/preview
https://www.coursera.org/learn/computational-thinking-problem-solving
https://www.linkedin.com/learning/cognitive-technologies-the-real-opportunities-for-business/the-future-of-cognitive-technologies

Syllabus for B.Tech Admission Batch 2022

Subject Name: Data Communication **Credit:** 3 **Lecture Hours:** 40

Subject Code: **PECCS603F**

Prerequisites: Mathematics, Analog and Digital Systems, Boolean Algebra

Relevant Links:

Study Material NPTEL Coursera

Course Objective:

Obj1: To learn the basic concepts of data communications.
Obj2: To understand the fundamental concepts of encoding techniques
Obj3: To familiarize with various multiplexing techniques
Obj4: To understand the importance of error correcting codes in data transmission

Course Outcome:

After completion of course, students would be able to:

CO 1: Understand the basic concepts of data encoding and data transmission.
CO2: Explain different Data link control techniques like, error detection, correction, flow control and error control.
CO3: Demonstrate different multiplexing schemes and their practical application.
CO4: Compare the performance of different switching techniques.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	3	2	3	2	1	1	1	0	0	0	1	2		3	3	3
CO2	3	2	3	2	2	1	1	0	1	1	1	2		3	3	3
CO3	3	3	2	2	2	1	1	0	1	1	1	2		3	3	3
CO4	3	3	3	2	2	1	1	1	1	1	1	2		3	3	3

Module Number	Topic	Sub-Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Problems
1	Data Communications and Networking Overview	A Communications Model, Data Communications, Data Communication Networking, The Need for Protocol Architecture, A Simple Protocol Architecture, OSI, The TCP/IP Protocol Architecture, Data Transmission Concepts and Terminology, Analog and Digital Data Transmission, Transmission Impairments, Channel Capacity.	AICTE: https://www.aicte-india.org/education/model-syllabus **Industry and International Academia Mapping**: L-SIM LAN protocol analyzer and simulator software CISCO Packet Tracer	8	Design a robust communication system based on the TCP/IP protocol architecture that can efficiently handle high-latency and high-loss environments, such as deep space communications or disaster recovery networks. Define the role of each layer of the TCP/IP model in your system and how you would modify or enhance protocols (e.g., TCP, UDP) to manage data transmission issues like packet loss, delays, and congestion. Propose strategies for optimizing data throughput, ensuring reliability, and maintaining network performance under adverse conditions.

Data Communications and Networking, 4th ed., Behrouz A. Forouzan Chapter 1,2

Module Number	Topic	Sub-Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Problems
2	**Transmission Media and Signal Encoding Techniques**	Guided Transmission Media, Wireless Transmission, Wireless Propagation, Line-of-Sight Transmission. Digital Data Digital Signals, Digital Data Analog Signals, Analog Data Digital Signals, Analog Data Analog Signals.	AICTE: https://www.aicte-india.org/education/model-syllabus **Industry and International Academia Mapping:** L-SIM LAN protocol analyzer and simulator software CISCO Packet Tracer	10	Design a hybrid communication system that integrates both wired and wireless transmission media to provide reliable, high-speed data transfer across urban and rural environments. Specify the types of transmission media (e.g., fiber optics, coaxial cables, radio waves) and signal encoding techniques (e.g., Manchester encoding, QAM) you would use for different segments of the network. Explain how your system manages challenges such as noise, interference, and bandwidth limitations. Propose improvements to enhance data integrity, signal strength, and overall efficiency of the network in diverse conditions.

Data Communications and Networking, 4th ed., Behrouz A. Forouzan Chapter 4,5

Module Number	Topic	Sub-Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Problems
3	**Digital Data Communication Techniques and Data Link Control**	Asynchronous and Synchronous Transmission, Types of Errors, Error Detection, Error Correction, Line Configurations, Interfacing, Flow Control, Error Control, High-Level Data Link Control (HDLC).	AICTE: https://www.aicte-india.org/education/model-syllabus **Industry and International Academia Mapping:** L-SIM LAN protocol analyzer and simulator software CISCO Packet Tracer	8	Design a digital data communication system that integrates advanced error detection and correction techniques along with data link control mechanisms to ensure reliable data transmission over noisy channels. Specify the digital modulation schemes (e.g., ASK, PSK, FSK) and error-control methods (e.g., CRC, Hamming code, ARQ) used at different stages of transmission. Justify your selection of data link protocols (e.g., HDLC, PPP) and explain how your system manages flow control, error recovery, and synchronization. Propose enhancements to optimize performance for high-speed or bandwidth-constrained environments.

Data Communications and Networking, 4th ed., Behrouz A. Forouzan Chapter 10, 11

Module Number	Topic	Sub-Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Problems
4	**Multiplexing, Circuit Switching and Packet Switching Multiplexing**	Frequency Division Multiplexing, Synchronous Time Division Multiplexing, Statistical Time Division Multiplexing, Switching Networks, Circuit-Switching Networks, Circuit-Switching Concepts, Control Signaling, Soft switch Architecture, Packet-Switching Principles, X.25, and Frame Relay.	AICTE: https://www.aicte-india.org/education/model-syllabus **Industry and International Academia Mapping:** L-SIM LAN protocol analyzer and simulator software CISCO Packet Tracer	8	Design a network communication system that integrates multiplexing techniques with both circuit switching and packet switching protocols. Evaluate the advantages and disadvantages of using this hybrid system for large-scale data transmission in terms of efficiency, reliability, and resource allocation. Provide a justification for the selection of multiplexing techniques (such as FDM, TDM, or WDM) in your design, considering the specific needs of the network, and propose how this system could adapt to fluctuating network traffic loads.

Data Communications and Networking, 4th ed., Behrouz A. Forouzan Chapter 8

Module Number	Topic	Sub-Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Problems
5	Asynchronous Transfer Model	Protocol Architecture, ATM Logical Connections, ATM Cells, Transmission of ATM Cells, ATM Service Categories, ATM Adaptation Layer. Routing in Switched Networks Routing in Circuit-Switching Networks, Routing in Packet-Switching Networks, Least-Cost Algorithms.	AICTE: https://www.aicte-india.org/education/model-syllabus **Industry and International Academia Mapping:** L-SIM LAN protocol analyzer and simulator software CISCO Packet Tracer	8	Design a next-generation multimedia communication system that uses Asynchronous Transfer Mode (ATM) for data transmission. Evaluate the scalability and performance of ATM when integrating it with Quality of Service (QoS) mechanisms to handle voice, video, and data traffic in a converged network. Discuss how ATM's cell-switching method can be optimized to address the challenges of high-latency applications, while also ensuring efficient bandwidth utilization. Propose innovative strategies for adapting ATM's architecture to support future technologies, such as 5G networks and IoT devices, and justify your choices.

Data Communications and Networking, 4th ed., Behrouz A. Forouzan Chapter 12, 18

Textbook:

T1. Data Communications and Networking, 4th ed., Behrouz A. Forouzan, McGraw-Hill, 2007.

Reference:

R1. Data and Computer Communications, 8th ed., William Stallings, Prentice Hall, 2006.
R2. Computer Networks, 5th ed., Andrew Tanenbaum, Prentice Hall, 2008.

Online Resource:

- https://archive.nptel.ac.in/courses/106/105/106105082/#
- https://www.coursera.org/learn/data-communication-networks

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Good Education, Good Jobs

List of Assignments

1. AM generation and detection.
2. FM generation and detection.
3. Pre-emphasis and de-emphasis circuits used in communication systems for improving signal-to-noise ratio (SNR) in FM transmissions
4. Multiplexing Techniques (FDM and TDM)
5. Sampling , PAM, PWM, and PPM generation and detection
6. Generation and Detection of Analog and Pulse modulation techniques
7. PCM generation and detection
8. Data formats / channel encoding and decoding
9. Linear and Adaptive Delta Modulation and Demodulation
10. Generation and Detection of (i) ASK, (ii) FSK and Minimum Shift Keying, (iii) Phase shift keying methods (BPSK, QPSK)
11. Generation and Detection of PCM, Delta modulation and Digital modulation Schemes (ASK. FSK, BPSK,QPSK)
12. CRC, Hamming code, ARQ

University of Engineering and Management
Institute of Engineering & Management, Salt Lake Campus

Syllabus for B.Tech Admission Batch 2021

Subject Name: Big Data Analytics **Credit: 3** **Lecture Hours: 36**

Subject Code: PECCS603G

CO1: Basic concepts of different aspects of Big Data Analytics

CO2: To understand Big Data Ecosystem

CO3: To be familiar with a set of well-known analytical model for large scale data

CO4: To explore databases for unstructured large-scale data

CO5: To Visualize the dataset after analysis

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Chapter Mapping	Corresponding Lab Assignment
1	**Introduction**	Classification of Digital Data, Introduction to Big Data, Characteristics of Data, Evolution of Big Data, Definition of Big Data, Challenges with Big Data, What is Big Data?, Why Big Data?, Traditional Business Intelligence (BI) versus Big Data, What is Big Data Analytics?	***International Academia:*** (https://web.stanford.edu/class/cs246/) ***AICTE-prescribed syllabus:*** CTE Model Curriculum for ***Industry Mapping:*** Big Data Analytics-Coursera	4	T1: Chapter 1,2,3	**Revisiting Python for Data Processing:** • Python program to perform read and write operations on a file. • Python program to copy the contents of a file to another file. • Python program to count frequency of characters in a given file. • Python program to compute the number of characters, words and lines in a file.
2	**Big Data Ecosystem**	Hadoop: HDFS, MapReduce, YARN Spark: RDD, Deploying Spark Pig: Pig Latin, Data processing operator Hive: Hive QL, Querying Data SparkSQL HBase, Zookeeper Stream processing and Spark Streaming	***International Academia:*** (https://web.stanford.edu/class/cs246/) ***AICTE-prescribed syllabus:*** CTE Model Curriculum for ***Industry Mapping:*** Big Data Analytics-Coursera	10	T2: Chapter 2,3,4,6,7,20,21 T3:Chapter 4,5,7,8,10,1213	**Deploying Hadoop and Spark for Large Scale Data:** • Install, configure and run Hadoop and HDFS as Pseudo Cluster • Install, configure and run Apache Spark and RDD as a Pseudo Cluster • Install, configure and run Hadoop and HDFS as a Physical Cluster (atleast 1 Master-2 Slave) • Install, configure and run Apache Spark

						and RDD as a Physical Cluster (atleast 1 Master-2 Slave) • Develop a MapReduce program to calculate the frequency of a given word in a given file • Develop a MapReduce program to implement Matrix Multiplication. • Install, configure and run Apache Hive
3	**Analytics for Large Scale Data**	Machine learning with Spark MLLib: Supervised Learning: SVM, Linear Regression, Logistic Regression Unsupervised Learning: K-Means, DBSCAN, Apriori Algorithm, Counting Frequent item sets in a Stream	***International Academia:*** (https://web.stanford.edu/class/cs246/) ***AICTE-prescribed syllabus:*** CTE Model Curriculum for ***Industry Mapping:*** Big Data Analytics-Coursera	12	T1: Chapter 12	**Parallelizing Machine Learning Algorithm using Spark:** • Implementation of Clustering Algorithm using Apache Spark • Implementation of Supervised learning Algorithm using Apache Spark
4	**Databases for Large Scale Data**	NoSQL, MongoDB, Cassendra	***International Academia:*** (https://web.stanford.edu/class/cs246/) ***AICTE-prescribed syllabus:*** CTE Model Curriculum for ***Industry Mapping:*** Big Data Analytics-Coursera	6	T1: Chapter 4,6,7	**Working with Databases for Large Scale Data:** • Implement an application that stores big data in MongoDB / Pig using Hadoop • Implement NoSQL Database Operations: CRUD operations, Arrays using MongoDB • Implement

						Functions: Count – Sort – Limit – Skip – Aggregate using MongoDB • Install and configure MongoDB/ Cassandra/ HBase to execute NoSQL Commands
5	**Visualization of Datasets**	Visualizations: Visual Data Analysis Techniques, Interaction Techniques; Systems and Analytics Applications, Analytics using Statistical packages, Industry challenges and application of Analytics	***International Academia:*** (https://web.stanford.edu/class/cs246/) ***AICTE-prescribed syllabus:*** CTE Model Curriculum for ***Industry Mapping:*** Big Data Analytics- Coursera	4		**Visualizing Data:** • Visualize data using basic plotting techniques in Python

Text Books:

T1: Subhashini Chellappan, Seema Acharya, Big Data and Analytics, 2ed, Wiley India
T2: Tom White " Hadoop: The Definitive Guide" Fourth Edition, O'reily Media, 2015.
T3: Matei Zaharia, **Spark: The Definitive Guide, Shroff Publishers & Distributors Pvt. Ltd.**

Reference Books:

1. Seema Acharya, **Demystifying NoSQL, Wiley.**
2. Dirk deRoos, **Hadoop for Dummies, Wiley**
3. Davy Cielen, Arno D.B. Meysman, Mohamed Ali, **Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools, Dreamtech Press**
4. **Anand Rajaraman and Jef rey David Ulman, "Mining of Massive Datasets", Cambridge University Press, 2012**
5. **"Learning Spark, 2nd Edition" by Jules S. Damji, Brooke Wenig, Tathagata Das, Denny Lee.**

Subject Name: Wireless Sensor Network **Credit:** 3 **Lecture Hours:** 40

Subject Code: **PECCS603H**

Prerequisites: Mathematics, Analog and Digital Systems, Computer Network, Data Communication

Relevant Links:

Study Material NPTEL Coursera

Course Objective:

Obj1: This course deals with the comprehensive knowledge of various techniques in wireless sensor based networks.

Obj2: The objective of this course is to facilitate the understanding of Infrastructure less networks and their importance in the future directions for wireless

Course Outcome:

After completion of course, students would be able to:

CO1: Basic concepts of different aspects of Wireless Sensor Network
CO2: Understanding and interpreting various conceptual aspects of Wireless Sensor Network
CO3: Implementation of the concepts of Wireless Sensor Network
CO4: Analyzing various concepts of Wireless Sensor Network

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	3	2	3	2	1	1	1	0	0	0	1	2		3	3	3
CO2	3	2	3	2	2	1	1	0	1	1	1	2		3	3	3
CO3	3	3	2	2	2	1	1	0	1	1	1	2		3	3	3
CO4	3	3	3	2	2	1	1	1	1	1	1	2		3	3	3

Module Number	Topic	Sub-Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Problems
1	**INTRODUCTION TO WIRELESS SENSOR NETWORKS**	Fundamentals of Wireless Communication Technology, The Electromagnetic Spectrum, Radio propagation Mechanisms, Characteristics of the Wireless Channel, mobile ad hoc networks (MANETs) and wireless sensor networks (WSNs): concepts and architectures, Applications of Ad Hoc and Sensor networks, Design Challenges in Ad hoc and Sensor Networks	**AICTE:** https://www.aicte-india.org/education/model-syllabus **Industry and International Academia Mapping:** https://ocw.mit.edu/courses/6-452-principles-of-wireless-communications-spring-2006/pages/syllabus//	10	https://web.stanford.edu/class/ee392w/EE392W_TermProject.pdf

Module Number	Topic	Sub-Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Problems
2	**SINGLE NODE AND NETWORK ARCHITECTURE**	Single node architecture: hardware and software components of a sensor node , WSN Network Architecture: typical network architectures-data relaying and aggregation strategies, Energy consumption of sensor nodes, Operating system and execution environments, sensor network scenarios, Optimization goals and figures of merit, Design principles of WSNs	**AICTE:** https://www.aicte-india.org/education/model-syllabus **Industry and International Academia Mapping:** https://ocw.mit.edu/courses/6-452-principles-of-wireless-communications-spring-2006/pages/syllabus//	7	https://web.stanford.edu/class/ee392w/EE392W_TermProject.pdf

Module Number	Topic	Sub-Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Problems
3	**MAC PROTOCOLS FOR WIRELESS SENSOR NETWORKS**	Fundamental of MAC protocols, MAC protocols for WSNs, Low duty cycle protocols and wakeup concepts, contention based and scheduled based protocols (LEACH, SMACS, and TRAMA), IEEE 802.15.4 MAC protocols, Topology control and clustering.	**AICTE:** https://www.aicte-india.org/education/model-syllabus **Industry and International Academia Mapping:** https://ocw.mit.edu/courses/6-452-principles-of-wireless-communications-spring-2006/pages/syllabus//	7	https://web.stanford.edu/class/ee392w/EE392W_TermProject.pdf

Module Number	Topic	Sub-Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Problems
4	**ROUTING AND TRANSPORT CONTROLS PROTOCOL**	Routing challenges and design issues in WSNs, Wireless network routing protocols, Energy efficient unicast routing, energy efficient broadcast /multicast routing, Geographical routing, traditional transport control protocols, Design issues of transport control protocols, CODA, ESRT, RMST, PSFQ, GRAUDA and Ad hoc Transport protocols (ATP)	**AICTE:** https://www.aicte-india.org/education/model-syllabus **Industry and International Academia Mapping:** https://ocw.mit.edu/courses/6-452-principles-of-wireless-communications-spring-2006/pages/syllabus//	10	https://web.stanford.edu/class/ee392w/EE392W_TermProject.pdf

Module Number	Topic	Sub-Topic	Mapping with Industry and International Academia	Lecture Hour	Corresponding Problems
5	**LOCALIZATION AND POSITIONING:**	Properties of localization and positioning procedures, possible approaches: Proximity, Trilateration and Triangulation, Mathematical basics for the lateration problem, single hop localization, positioning in multihop environment.	**AICTE:** https://www.aicte-india.org/education/model-syllabus **Industry and International Academia Mapping:** https://ocw.mit.edu/courses/6-452-principles-of-wireless-communications-spring-2006/pages/syllabus//	6	https://web.stanford.edu/class/ee392w/EE392W_TermProject.pdf

Text Books:

T1: Holger Karl, and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks" John Wiley & Sons Inc.
T2: Kazem Sohraby, Daniel Minoli, Taieb Znati, "Wireless Sensor Networks', John Wiley & Sons Inc.

References:

R1: Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.
R2: Thomas Haenselmann, "Sensor Networks", available online for free, 2008.

Online Resources:

- https://archive.nptel.ac.in/courses/106/105/106105160/
- https://web.stanford.edu/class/ee392w/EE392W_TermProject.pdf

University of Engineering and Management

Institute of Engineering & Management, Salt Lake Campus
Institute of Engineering & Management, New Town Campus
University of Engineering & Management, Jaipur

Syllabus for B.Tech Admission Batch 2022

Subject Name: E-Commerce Credit: 3 Subject Code: PECCS603I

Course Outcome:

1) The students will get an understanding of the key terminologies of E-Commerce

2) The students will understand the architecture and security protocols used in E-Commerce

3) The students will grasp the concepts of consumer-oriented E-Commerce applications and payment systems

4) The students will comprehend electronic data interchange standards and issues, and e-marketing techniques and will be able to build their E-Commerce application.

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

1	Overview of E-Commerce	Definitions, Advantages & Limitations of E-Commerce, Threats of E-Commerce, Rules & Regulations for Controlling E-Commerce, Cyber Laws, Business Models of E-Commerce - B2B, B2C, C2B, C2C, E-Governance.	*MAKAUT-prescribed syllabus:* *https://makautexam.net/aicte_details/Syllabus/CSE/sem8.pdf* *International academia:* *https://www.linkedin.com/learning/ecommerce-fundamentals-22614472*	4	NA
Textbook: Frontiers of Electronic Commerce, Kalakota & Whinston, Addison Wesley (Chapter 1)					
2	Architecture Framework of E-Commerce	Application Services, Brokerage and Data Management, Interface layers, Secure messaging, Middleware services and network infrastructure	*MAKAUT-prescribed syllabus:* *https://makautexam.net/aicte_details/Syllabus/CSE/sem8.pdf* *International academia:* *https://www.coursera.org/programs/iem-faculty-learning-program-rtyr7/learn/packt-advanced-react-projects-and-ecommerce-development-neuup?source=search* *https://www.coursera.org/programs/iem-faculty-learning-program-rtyr7/projects/googlecloud-exploring-your-ecommerce-dataset-with-sql-in-google-bigquery-dwh3o?source=search*	5	(i) Design the system architecture for an E-Commerce site with an Application layer (React), Data layer (SQL in Google BigQuery), Interface layers, Middleware and Secure messaging services (ii) The architecture should demonstrate the versatility and scalability of the system
Textbook: Frontiers of Electronic Commerce, Kalakota & Whinston, Addison Wesley (Chapter 6)					

3	Electronic Data Interchange (EDI)	Meaning, Benefits, Concepts, Application, EDI Model, Protocols (UN EDI FACT / GTDI, ANSI X – 12), Data Encryption (DES / RSA), Non-EDI System, Partial EDI System, Fully Integrated EDI System, Prerequisites for EDI	*MAKAUT-prescribed syllabus:* *https://makautexam.net/aicte_details/Syllabus/CSE/sem8.pdf* *International academia:* *Choosing an Ecommerce Platform for Developers | LinkedIn Learning*	6	(i) Design a fully integrated EDI system for the E-Commerce site. (ii) Choose one of the data encryption protocols and implement it.
Textbook: Frontiers of Electronic Commerce, Kalakota & Whinston, Addison Wesley (Chapter 9, 10) - Handouts					
4	Security Risk of E-Commerce	Overview, Security for E-Commerce, Security Standards, Firewall, Cryptography, Key Management, Password Systems, Digital certificates, Digital signatures, Protocols for secure messaging, Secure Electronic Transaction (SET) Protocol, Electronic cash over the internet, and Internet Security	*MAKAUT-prescribed syllabus:* *https://makautexam.net/aicte_details/Syllabus/CSE/sem8.pdf* *International academia:* *https://www.coursera.org/videos/foundations-of-information-systems-for-business/buWAu?query=ecommerce%20technology&page=2&sortBy=BEST_MATCH&skipBrowseRedirect=true&source=search*	6	(i) Set the security protocols like HTTPS, Secure messaging, and Digital Certificate for the E-Commerce site. (ii) Demonstrate the vulnerabilities that are fixed with these protocol setups.
Textbook: Frontiers of Electronic Commerce, Kalakota & Whinston, Addison Wesley (Chapter 5, 17) - Handouts					
5	Consumer-Oriented Application and E-Payment Mechanism	Consumer Oriented E-Commerce Applications, Mercantile Process Model - Consumers Perspective and Merchant's Perspective, E-Payment: Payment through card system, E – Cheque, E-Cash, E-Payment Threats & Protections	*MAKAUT-prescribed syllabus:* *https://makautexam.net/aicte_details/Syllabus/CSE/sem8.pdf* *International academia:* *https://www.linkedin.com/learning/safeguarding-customer-credit-card-data-pci-compliance-2019*	5	(i) Develop the secured payment gateway for the E-Commerce site with multiple payment types

Textbook: Frontiers of Electronic Commerce, Kalakota & Whinston, Addison Wesley (Chapter 7, 8) - Handouts					
6	Three C's of E-Commerce (Convergence, Collaborative Computing, Content Management)	Convergence: Technological Advances in Convergence – Types, Convergence and its implications, Convergence & Electronic Commerce. Collaborative Computing: Collaborative product development, contract as per CAD, Simultaneous Collaboration, and Security. Content Management: Definition of content, Authoring Tools & Content Management, Content – partnership, repositories, convergence, providers, Web Traffic & Traffic Management; Content Marketing.	*MAKAUT-prescribed syllabus:* *https://makautexam.net/aicte_details/Syllabus/CSE/sem8.pdf* *International academia:* *https://www.linkedin.com/learning/bigcommerce-essential-training/understanding-omni-commerce*	6	(i) Build and demonstrate the functional E-Commerce site using the above architecture and security protocols.
- Handouts					
7	E-Marketing Techniques	Search Engines, Directories, Registrations, Solicited targeted E-mails, Interactive sites, Banners, Advertising, E-mail, Chain letters	*MAKAUT-prescribed syllabus:* *https://makautexam.net/aicte_details/Syllabus/CSE/sem8.pdf* *International academia:* *https://www.linkedin.com/learning/marketing-foundations-ecommerce-14401600*	4	(i) Create the E-Marketing materials for the E-Commerce site built on the previous steps
- Textbook: Frontiers of Electronic Commerce, Kalakota & Whinston, Addison Wesley (Chapter 13) - Handouts					

University of Engineering and Management

Institute of Engineering & Management, Salt Lake Campus
Institute of Engineering & Management, New Town Campus
University of Engineering & Management, Jaipur

Syllabus for B.Tech. Admission Batch 2022

Subject Name: Generative AI & Deep Learning (Sessional) **Credit: 1**

Sessional: 3 **Subject Code: PCCCS681**

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	Introduction 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, Regularization, and Normalization.	*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* *Industry Mapping:* TensorFlow, Keras, PyTorch	6	Introduction to TensorFlow Keras, PyTorch https://www.coursera.org/learn/introduction-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, 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* *International Academia:* *https://www.coursera.org/learn/nlp-sequence-models*	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 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 Models: Understanding and Mitigating Untrue or Unrealistic Outputs - Fine-tuning LLMs with domain-specific information (introduce the concepts of matrix multiplication, LORA, etc.)	*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
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					