

Minor Stream: Network Security

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CS32	Cyber Security Essentials	FC	2		1	3	50	50	100	-
2501CS30	Information Security Analysis & Audit	FC	2			2	50	50	100	-
2501CS23	Cloud Computing	FC	2		2	4	50	50	100	-
2501CS24	Wireless Networks	IC	2		1	3	50	50	100	-
2501CS25	Cloud IoT & Edge ML	AC	2		1	3	50	50	100	-
2501CS28	Ethical Hacking	AC	2		2	4	50	50	100	-
2501CS27	Digital Forensics	AC	2		1	3	50	50	100	-
2501CS26	Block Chain Technologies	AC	2		2	4	50	50	100	CSE
2501CS31	Cyber Laws	AC	2		1	3	50	50	100	-
2501CS33	Secure Coding Techniques	AC	2		1	3	50	50	100	-
Total			20		12	32				

Cyber Security Essentials
(Common to CSE, IT, AIML & CSE (DS))

Course Code: 2501CS32	L	T	P	C
	2	0	1	3

Course Outcomes:

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

- CO1:** Describe the basic concepts of Cyber security issues and challenges
- CO2:** Analyze the cybercrimes and cyber laws.
- CO3:** Demonstrate various privacy and security concerns on social media
- CO4:** Illustrate the concepts related to E-Commerce and digital payments.
- CO5:** Summarize tools and technologies to protect communication devices.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	1	-	-	-	-	2	-	-	-	-
CO2	2	3	-	2	1	-	-	1	1	-	-
CO3	1	2	-	2	1	1	-	1	1	-	1
CO4	1	2	3	1	1	-	1	1	-	1	1
CO5	2	1	-	-	-	-	3	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	3	-
CO4	2	1
CO5	2	-

UNIT – I

Introduction to Cyber security: Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Internet infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security.

Practice:

1. Study on how to register a Cyber Crime Complaint through online.
(https://cybercrime.gov.in/Webform/Crime_AuthoLogin.aspx)

UNIT – II

Cyber crime and Cyber law: Classification of cyber crimes, Common cyber crimes- cyber crime targeting computers and mobiles, cyber crime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click

attacks, Legal perspective of cyber crime, IT Act 2000 and its amendments, Cyber crime and offences, Organisations dealing with Cyber crime and Cyber security in India.

Practice:

1. Reporting on types of phishing emails.
2. Demonstration of email phishing attack and preventive measures

UNIT – III

Social Media Overview and Security: Introduction to Social networks. Types of Social media, Social media platforms, Social media monitoring, Hashtag, Viral content, Social media marketing, Social media privacy, Challenges, opportunities and pitfalls in online social network, Security issues related to social media, Laws regarding posting of inappropriate content.

Practice:

1. Basic checklist, privacy and security settings for popular Social media platforms.

UNIT – IV

E-Commerce and Digital Payments: Definition of E- Commerce, Main components of E-Commerce, Elements of E-Commerce security, E-Commerce threats, E-Commerce security best **Practices**, Introduction to digital payments, Modes of digital payments- Banking Cards, Unified Payment Interface (UPI), e-Wallets, Unstructured Supplementary Service Data (USSD), Aadhar enabled payments, Digital payments related common frauds and preventive measures.

Practice:

1. Configuring security settings in Mobile Wallets and UPIs

UNIT – V

Digital Devices Security, Tools and Technologies for Cyber Security: End Point device and Mobile phone security, Password policy, Security patch management, Data backup, Downloading and management of third party software, Device security policy, Cyber Security best **Practices**, Significance of host firewall and Ant-virus, Management of host firewall and Anti-virus, Wi-Fi security, Configuration of basic security policy and permissions.

Practice:

1.
 - a. Setting and configuring two factor authentication in the Mobile phone.
 - b. Security patch management and updates in Computer and Mobiles.

Text Books:

- 1 Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd, ISBN: 978-8126521791

- 2 Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform, ISBN: 978-1516821020

Reference Books:

- 1 Data Privacy Principles and **Practice** by Natraj Venkataramanan and Ashwin Shriram, CRC Press, ISBN: 978-1498721042
- 2 Information Security Governance, Guidance for Information Security Managers by W. KragBrothy, Wiley Publication, 1st Edition, ISBN: 978-1933284736
- 3 Auditing IT Infrastructures for Compliance By Martin Weiss, Michael G. Solomon, Jones Bartlett Learning, 2nd Edition, ISBN: 978-1284090703

Web Links:

- 1 <https://www.coursera.org/specializations/cyber-security>.
- 2 <https://www.nptel.ac.in/courses/106105031/>.
- 3 CERT-In Guidelines- <http://www.cert-in.org.in/>

Information Security Analysis & Audit
(Common to CSE, IT, AIML & CSE (DS))

Course Code: 2501CS30	L	T	P	C
	2	0	0	2

Course Outcomes:

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

- CO1:** Demonstrate fundamental concepts of information security and systems auditing
- CO2:** Analyze latest trend in management control framework
- CO3:** Identify security operations in management control framework.
- CO4:** Distinguish data evidence collection techniques.
- CO5:** Analyze data evidence evaluation in audit.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	-	-	-	-	-	-	1
CO2	2	2	-	-	-	-	2	-	-	-	2
CO3	1	3	-	1	-	1	-	1	-	-	2
CO4	1	2	-	-	-	-	1	1	-	1	1
CO5	1	3	-	2	1	-	2	2	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	1	-
CO5	1	-

UNIT – I

Overview of Information System Auditing: Effect of Computers on Internal Controls, Effects of Computers on Auditing, Foundations of information Systems Auditing, Conducting an Information Systems Audit.

UNIT – II

The management Control Framework-I: Introduction, Evaluating the planning Function, Leading Function, Controlling Function, Systems Development Management Controls, Approaches to Auditing Systems Development, Programming Management Controls, Data Resource Management Controls.

UNIT – III

The Management Control Framework-II: Security Management Controls, Operations

management Controls Quality assurance Management Controls, Case Studies

UNIT – IV

Evidence Collection: Audit Software, Code Review, Test Data, and Code Comparison, Concurrent Auditing techniques, Interviews, Questionnaires, and Control Flowcharts. Performance Management tools- Case Studies.

UNIT – V

Evidence Evaluation: Evaluating Asset Safeguarding and Data Integrity, Evaluating System, Effectiveness, Evaluating System Efficiency, Information Systems Audit and Management: Managing the Information Systems Audit Function.

Text Books:

- 1 Information Systems Control and Audit, Ron Weber, Pearson Education, 1st Edition, ISBN: 978-8131704721
- 2 Cryptography Engineering: Design Principles and Practical Applications ,Niels Ferguson, Bruce Schneier, and Tadayoshi Kohno, John Wiley & Sons, ISBN: 978-0470474242

Reference Books:

- 1 Information System Audit and Assurance, D P Dube, TMH, New Delhi, ISBN: 978-0070585690
- 2 Computer Forensics, Computer Crime Investigation by John R. Vacca, Firewall Media, New Delhi, ISBN: 978-8170083412

Web Links:

- 1 <https://www.coursera.org/learn/introduction-cybersecurity-cyber-attacks>
- 2 <https://computersecurity.stanford.edu/free-online-video>[Free Online Videos]
- 3 CERT-In Guidelines- <http://www.cert-in.org.in/>

Cloud Computing
 (Common to CSE, IT, AIML & CSE (DS))

Course Code: 2501CS23	L	T	P	C
	2	0	2	4

Course Outcomes:

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

- CO1:** Explain basic concepts and terminologies of Cloud Computing and Virtualization.
- CO2:** Demonstrate Cloud deployment models, Service models and Architectures
- CO3:** Analyze Cloud services, Applications and Capacity Planning.
- CO4:** Use different PaaS application frameworks to construct Cloud applications
- CO5:** Develop web applications through Google, Microsoft and Amazon web services for Realtime application.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	-	-	1	-	-	1	1	-	1
CO2	2	2	-	-	1	-	-	1	1	-	1
CO3	3	1	-	-	1	-	-	2	1	-	1
CO4	2	2	-	-	1	-	-	2	1	-	1
CO5	2	2	-	-	1	-	-	2	1	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	-
CO2	1	-
CO3	2	-
CO4	2	-
CO5	2	-

UNIT – I

Fundamental Cloud Computing and Virtualization Cloud Computing: Origin and influences, Basic concepts and terminology, Goals and benefits, Risks and challenges, Roles and boundaries and Cloud characteristics.

Introduction to Virtualization: Characteristics, Taxonomy of virtualization technologies, Pros and cons of virtualization, Virtualization Technologies: Xen, VMware and Hyper-V.

Practice:

1. Introduction to Cloud Computing
2. Overview of cloud computing concepts
3. Hands-on: Setting up a free-tier account on AWS/Azure/GCP

UNIT - II

Understanding Cloud Models and Architectures Cloud Models: NIST model, Cloud Cube model, Deployment models: Public, Private, Hybrid and Community; Service models: IaaS, PaaS and SaaS. **Understanding Cloud Architecture:** Exploring the Cloud Computing Stack: Composability, Infrastructure, Platforms, Virtual Appliances, Communication Protocols, Applications; **Connecting to the Cloud:** The Jolicloud Netbook OS and Chromium OS - The Browser as an Operating System.

Practice:

1. Virtual Machines and Computer Services
 - a. Creating and managing virtual machines
 - b. Hands-on: Launching and configuring EC2 instances on AWS

UNIT – III

Understanding Cloud Services, Applications and Capacity Planning: Understanding Cloud Services and Applications Infrastructure as a Service (IaaS): IaaS workloads, Pods, aggregation, and silos; Platform as a Service (PaaS), Software as a Service (SaaS): SaaS characteristics, Open SaaS and SOA, Salesforce.com and CRM SaaS; Identity as a Service (IDaaS): Identity, Networked identity service classes, Identity system codes of conduct, IDaaS interoperability; Compliance as a Service (CaaS). **Capacity Planning:** Defining Baseline and Metrics: Baseline measurements, System metrics, Load Testing, Resource ceilings, Server and instance types; Network Capacity and Scaling.

Practice:

1. Storage Solutions
 - a. Exploring different storage options(S, EBS, Glacier)
 - b. Hands-on: Implementing S3 buckets and managing data

UNIT – IV

Exploring Platform as A Service (PaaS): PaaS Application Frameworks: Drupal, Eccentex AppBase 3.0, Long Jump, Squarespace, Wavemaker and Wolf Frameworks. **Exploring Platform as a Service using Google Web Services:** Surveying the Google Application Portfolio, Google Toolkit and Working with the Google App Engine. **Exploring Platform as a Service using Microsoft Cloud Services:** Exploring Microsoft Cloud Services, Microsoft Azure- Live Essentials, Live Home and Live for Mobile.

Practice:

1. Networking in the Cloud
 - a. Configuring virtual private clouds (VPC), subnets, and security groups.
 - b. Hands-on: Setting up a VPC and deploying instances within it.

UNIT -V

Exploring Infrastructure As A Service (IaaS): Understanding Amazon Web Services, Amazon Web Service Components and Services, Working with the Elastic Compute Cloud (EC2): Amazon Machine Images, Pricing models, System images and software, Creating an

account and instance on EC2; Working with Amazon Storage Systems: Amazon Simple Storage System (S3), Amazon Elastic Block Store (EBS) and CloudFront; Understanding Amazon Database Services: Amazon SimpleDB, Amazon Relational Database Service (RDS) and Choosing a database for AWS.

Practice:

1. Database Services
 - a. Understanding cloud-based database services (RDS, DynamoDB).
 - b. Hands-on: Setting up and querying a relational database in AWS RDS.

Text Books:

- 1 Cloud Computing Bible, Barrie Sosinsky, Wiley India Pvt Ltd, ISBN: 978-8126529803
- 2 Cloud Computing- Concepts, Technology and Architecture, Thomas Erl and Ricardo Puttini, Pearson, ISBN: 978-0138052256

Reference Books:

- 1 Mastering Cloud Computing, Rajkumar Buyya, Christian Vecchiloa and S Thamarai Selvi, McGraw Hill Education, ISBN: 978-0-12-411454-8
- 2 Cloud Application and Architectures, George Reese, O'Reilly, ISBN: 9780596156367
- 3 Enterprise Cloud Computing Technology Architecture Applications, Gautam Shroff, Cambridge university press; 1 edition, ISBN:978-0521137355.

Web Links:

- 1 https://onlinecourses.nptel.ac.in/noc24_cs17/preview
- 2 <https://docs.aws.amazon.com/>
- 3 <https://learn.microsoft.com/en-us/training/azure/>

Wireless Networks
(Common to CSE, IT, AIML & CSE (DS))

Course Code: 2501CS24	L	T	P	C
	2	0	1	3

Course Outcomes:

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

- CO1:** Describe evolution of wireless networks and wireless communication technologies.
- CO2:** Simulate Wireless Communication network for analyzing packet transmission using NS3.
- CO3:** Discuss IEEE 802.11 Standards and Protocols.
- CO4:** Explain evolution and architecture of cellular networks.
- CO5:** Summarize Emerging Trends such as cognitive radio networks, VANETs.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	2	-	-	1	-	-	1	1	-	-
CO2	2	1	2	-	2	-	-	1	1	-	-
CO3	2	1	-	-	1	-	-	1	1	-	-
CO4	2	-	2	-	2	-	-	1	1	-	-
CO5	2	2	1	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	-
CO2	2	-
CO3	1	-
CO4	1	-
CO5	1	-

UNIT – I

Introduction to Wireless Networks: Evolution of Wireless Networks, Basic Wireless Communication Concepts, Wireless Spectrum and Regulations, Wireless Network Architectures, Infrastructure Networks, Ad-Hoc Networks, Wireless Standards: IEEE 802.11, Bluetooth, Zigbee.

Practice:

1. Simulate an ad-hoc network using NS3.

UNIT – II

Wireless Communication Technologies: Radio Propagation Models, Modulation Techniques, Multiple Access Techniques: TDMA, FDMA, CDMA, OFDM Antennas and Diversity Techniques, MIMO (Multiple Input Multiple Output) Systems.

Practice:

1. Create multiple nodes, establish peer to peer connections, and analyze packet transmission using NS3.

UNIT – III

Wireless LANs and PANs: IEEE 802.11 Standards and Protocols, WI-FI Network Design and Deployment, Bluetooth and Zigbee Protocols, Security in Wireless LANs: WEP, WPA, WPA2, QoS (Quality of Service) in Wireless Networks.

Practice:

1. Simulate a basic GSM network using NS3.

UNIT – IV

Cellular Networks: Evolution from 1G to 5G, GSM, CDMA, and LTE Architectures, 5G Network Architecture and Key Technologies, Handoff and Roaming, Cellular Network Planning and Optimization.

Practice:

1. Set up and configure a Wi-Fi network using Wireshark.
2. Explore the signal strength and coverage area of a Wi-Fi network.

UNIT – V

Emerging Trends and Future Directions: Internet of Things (IoT) and Wireless Sensor Networks (WSNs), Cognitive Radio Networks, Vehicular Ad-hoc Networks (VANETs), Wireless Mesh Networks, Security and Privacy Challenges in Wireless Networks.

Text Books:

- 1 Wireless Communications: Principles and **Practice** by Theodore S. Rappaport, Prentice Hall 2nd Edition, ISBN: 9780130422323.
- 2 Wireless Communications by Andrea Goldsmith, Cambridge University Press, ISBN: 9780521837163.

Reference Books:

- 1 Principles of Wireless Access and Localization"by Kaveh Pahlavan and Prashant Krishnamurthy. Wiley-IEEE Press, ISBN: 9780470697085
- 2 802.11 Wireless Networks: The Definitive Guide by Matthew S. Gast, O'Reilly Media 2nd Edition, ISBN: 9780596100520
- 3 Wireless Communications, A. Molisch, Wiley, 2005 Haykin & Moher, Modern Wireless Communications, Pearson 2011 (Indian Edition)

Web Links:

- 1 https://onlinecourses.nptel.ac.in/noc22_ee85/preview/
- 2 Wireshark Network Protocol Analyzer [Wireshark](<https://www.wireshark.org/>)
- 3 NS3 Network Simulator [NS3] (<https://www.nsnam.org/>)

Cloud IoT & Edge ML
(Common to CSE, IT, AIML & CSE (DS))

Course Code: 2501CS25	L	T	P	C
	2	0	1	3

Course Outcomes:

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

- CO1:** Explain technologies behind the communication and management of fog and edge resources.
- CO2:** Discuss techniques for storage and computation in fog, edge, 5G and cloud
- CO3:** Implement Internet of Everything (IoE) applications through fog computing architecture.
- CO4:** Illustrate optimization strategies in fog and Edge Architectures.
- CO5:** Summarize applications in Fog and Edge Computing.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	1	2	-	-	2	-	-	2	2	-	2
CO2	2	2	-	-	2	-	-	2	2	-	2
CO3	1	2	3	-	2	-	-	2	2	-	2
CO4	2	1	1	3	2	-	-	2	2	-	2
CO5	2	1	1	-	2	-	-	2	2	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	-
CO2	1	-
CO3	1	-
CO4	-	2
CO5	-	2

UNIT – I

Internet of Things (IoT) and New Computing Paradigms: Introduction, Relevant Technologies, Fog and Edge Computing Completing the Cloud, Hierarchy of Fog and Edge Computing, Business Models, Edge Computing Platforms, Opportunities and Challenges.

Practice:

1. Building a Simple Edge Computing Application with Data Processing and Cloud Integration.

UNIT – II

Challenges in Federating Edge Resources: Introduction, Methodology, Integrated C2F2T Literature by Modeling Technique, Integrated C2F2T Literature by Use Case Scenarios,

Integrated C2F2T Literature by Metrics, Threads, Standards.

Practice:

1. Setting Up a Simple IoT Device with Edge Computing

UNIT – III

Orchestration of Network Slices in Fog, Edge, and Clouds: Introduction, Background, Network Slicing, Network Slicing in Software, Defined Clouds, Network Slicing Management in Edge and Fog, Internet of Vehicles (IoV): Architecture, Protocols and Seven-layer security model architecture for Internet of Vehicles, IoV: Network Models, Challenges and future aspects.

Practice:

1. Implementing a Simple Network Slicing Scenario for Internet of Vehicles (IoV) Using Edge and Fog Computing.

UNIT – IV

Optimization Problems in Fog and Edge Computing: Preliminaries, The Case for Optimization in Fog Computing, Formal Modeling Framework for Fog Computing, Metrics, Further Quality Attributes, Optimization Opportunities along the Fog Architecture, Optimization Opportunities along the Service Life Cycle, Toward a Taxonomy of Optimization Problems in Fog Computing.

Practice:

1. Optimizing Task Scheduling in Fog Computing

UNIT – V

Applications of Fog and Edge Computing: Exploiting Fog Computing in Health Monitoring-Smart Surveillance Video Stream Processing at the Edge for Real - Time Human Objects Tracking-Fog Computing Model for Evolving Smart Transportation Applications - Testing Perspectives of Fog - Based IoT Applications - Legal Aspects of Operating IoT Applications in the Fog.

Practice:

1. Real-Time Human Object Tracking Using Fog Computing in a Smart Surveillance System

Text Books:

- 1 Fog and Edge computing: Principles and Paradigms ,Buyya, Rajkumar, and Satish Narayana Srirama, John Wiley & Sons, USA, 1st edition, 2019, ISBN: 978-1-119-52498-4.
- 2 Internet of Things –From Research and Innovation to Market Deployment, OvidiuVermesan, Peter Friess, “River Publishers, India, 1st edition, ISBN: 978-8793102941

Reference Books:

- 1 Cloud computing: A hands-on approach, Bahga, Arshdeep, and Vijay Madisetti , CreateSpace Independent Publishing Platform, USA, 2nd edition, ISBN: 978-1494435141

Web Links:

- 1 https://onlinecourses.nptel.ac.in/noc24_cs66/preview

Ethical Hacking
(Common to CSE, IT, AIML & CSE (DS))

Course Code: 2501CS28	L	T	P	C
	2	0	2	4

Course Outcomes:

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

- CO1:** Describe the concepts and types of Ethical hacking
- CO2:** Apply tools and techniques for Social Engineering.
- CO3:** Illustrate concepts of data security for various networking systems
- CO4:** Analyze techniques to protect Web servers and Communication Systems
- CO5:** Demonstrate ethical laws and tests related to ethical hacking

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	1	-	-	-	-	-	1	1	-	1
CO2	2	2	-	1	2	-	-	1	1	-	2
CO3	2	2	-	2	-	-	-	1	1	-	1
CO4	2	2	-	-	1	-	-	1	1	-	2
CO5	2	2	-	-	-	-	2	1	1	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

UNIT – I

Ethical Hacking: Types of Data Stolen From the Organizations, Elements of Information Security, Authenticity and NonRepudiation, Security Challenges, Effects of Hacking, Hacker – Types of Hacker, Ethical Hacker, Hacktivism - Role of Security and Penetration Tester, Penetration Testing Methodology, Networking & Computer Attacks – Malicious Software (Malware), Protection Against Malware, Intruder Attacks on Networks and Computers, Addressing Physical Security – Key Loggers and Back Doors.

Practice:

1. Create a social networking website login page using phishing techniques
2. Sniffing tools to analyze traffic on a network and dissect information.

UNIT – II

Foot Printing And Social Engineering: Web Tools for Foot Printing, Conducting

Competitive Intelligence, Google Hacking, Scanning, Enumeration, Trojans & Backdoors, Virus & Worms, Proxy & Packet Filtering, Denial of Service, Sniffer, Social Engineering – shoulder surfing, Dumpster Diving, Piggybacking.

Practice:

1. Social Engineering Countermeasures
2. Tools for Foot Printing

UNIT – III

Data Security: Physical Security – Attacks and Protection, Steganography – Methods, Attacks and Measures, Cryptography– Methods and Types of Attacks, Wireless Hacking, Windows Hacking, Linux Hacking.

Practice:

1. Write a code to demonstrate DoS attacks
2. Windows ,Linux OS hacking

UNIT – IV

Network Protection System & Hacking Web Servers: Routers, Firewall & Honeypots, IDS & IPS, Web Filtering, Vulnerability, Penetration Testing, Session Hijacking, Web Server, SQL Injection, Cross Site Scripting, Exploit Writing, Buffer Overflow, Reverse Engineering, Email Hacking, Incident Handling & Response, Bluetooth Hacking, Mobiles Phone Hacking.

Practice:

1. Write a script or code to demonstrate SQL injection attacks
2. Setup a honey pot and monitor the honey pot on network

UNIT – V

Ethical Hacking Laws And Tests: An introduction to the particular legal, professional and ethical issues likely to face the domain of ethical hacking, ethical responsibilities, professional integrity and making appropriate use of the tools and techniques associated with ethical hacking – Social Engineering, Host Reconnaissance, Session Hijacking, Hacking - Web Server, Database, Password Cracking.

Practice:

1. Study of Techniques uses for Web Based Password Capturing
2. Study on how to register a Cyber Crime Complaint through online.(https://cybercrime.gov.in/Webform/Crime_AuthoLogin.aspx)

Text Books:

- 1 Hands-On Ethical Hacking and Network Defense, Corley, Michael T. Simpson, Kent Backman, James E., CENGAGE Learning, ISBN: 1133169031
- 2 Penetration Testing and Network Defense ,Whitaker & Newman , Cisco Press, Indianapolis, ISBN: 1-58705-208-3

Reference Books:

- 1 Official Certified Ethical Hacker Review Guide, Steven DeFino, Barry Kaufman, Nick Valenteen, CENGAGE Learning, ISBN: 978-1435488533.
- 2 The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy, Patrick Engebretson, Syngress Basics Series – Elsevier, ISBN: 978-0124116443.

Web Links:

- 1 <https://www.springboard.com/blog/cybersecurity/7-free-sources-to-learn-ethical-hacking-from-scratch/>
- 2 <https://hackernoon.com/top-resources-to-learn-ethical-hacking3>
- 3 https://onlinecourses.nptel.ac.in/noc22_cs13/preview

Digital Forensics
(Common to CSE, IT, AIML & CSE (DS))

Course Code: 2501CS27	L	T	P	C
	2	0	1	3

Course Outcomes:

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

- CO1:** Apply forensic analysis tools to recover evidence for identifying crime.
- CO2:** Discuss next-generation computer crime investigations.
- CO3:** Apply digital evidences for data acquisition.
- CO4:** Illustrate processing crimes and incident scenes through digital evidence.
- CO5:** Identify current computer forensic tools for various digital usages.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	3	-	3	-	-	-	2	1	-	1
CO2	2	2	-	3	-	-	-	2	1	-	1
CO3	2	3	-	3	-	-	-	1	1	-	1
CO4	2	2	-	3	-	-	-	2	1	-	1
CO5	2	2	-	3	3	-	-	3	1	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	2	-

UNIT – I

Computer forensics fundamentals, Benefits of forensics, computer crimes, computer forensics evidence and courts, legal concerns and private issues.

Practice:

1. Study of Computer Forensics and different tools used for forensic investigation

UNIT – II

Understanding Computing Investigations – Procedure for corporate High-Tech investigations, understanding data recovery work station and software, conducting and investigations.

Practice:

1. Live Forensics Case Investigation using Autopsy.

UNIT – III

Data acquisition- understanding storage formats and digital evidence, determining the best acquisition method, acquisition tools, validating data acquisitions, performing RAID data acquisitions.

Practice:

1. How to Recover Deleted Files using Forensics Tools?

UNIT – IV

Processing crimes and incident scenes, securing a computer incident or crime, seizing digital evidence at scene, storing digital evidence, obtaining digital hash, reviewing case.

Practice:

1. How to view last activity of your PC?
2. How to Collect Email Evidence in Victim PC?

UNIT – V

Current computer forensics tools- software, hardware tools, validating and testing forensic software. E-Mail investigations- investigating email crime and violations, understanding E-Mail servers, specialized E-Mail forensics tool.

Practice:

1. Study the steps for hiding and extract any text file behind an image file/ Audio file using Command Prompt.
1. Data extraction from call logs using Sleuth Kit.

Text Books:

- 1 Computer Forensics: Incident Response Essentials, Warren G. Kruse II and Jay G. Heiser, Addison Wesley, ISBN 10: 0201707195 ISBN 13: 9780201707199
- 2 Guide to Computer Forensics and Investigations, Nelson, B, Phillips, A, Enfinger, F, Stuart, C., “Thomson Course Technology, 2nd ed., ISBN: 0-619-21706-5.

Reference Books:

- 1 Computer Forensics, Computer Crime Scene Investigation, Vacca, J, Charles River Media, 2nd Ed, ISBN: 1-58450-389.
- 2 Digital Forensics, Andre Arnes, Wiley, 2018, ISBN: 978-1119262381.
- 3 The basics of digital Forensics (Latest Edition) – The primer for getting started in digital forensics by John Sammons – Elsevier Syngress Imprint, ISBN: 978-1597496612
- 4 Cybersecurity – Understanding of cybercrimes, computer forensics and Legal perspectives by Nina Godbole and Sunit Belapure – Wiley India Publication, ISBN: 9788126521791
- 5 Practical Digital Forensics – Richard Boddington [PACKT] Publication, Open source community, ISBN: 9781785887109.

Web Links:

- 1 https://onlinecourses.swayam2.ac.in/cec20_lb06/preview
- 2 https://onlinecourses.swayam2.ac.in/nou24_cs05/preview
- 3 https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0135015538612879367592/

Block Chain Technologies
(Common to CSE, IT, AIML & CSE (DS))

Course Code: 2501CS26	L	T	P	C
	2	0	2	4

Course Outcomes:

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

- CO1:** Demonstrate blockchain and crypto currency basics
- CO2:** Compare and contrast permissioned and permissionless blockchains
- CO3:** Explain different types of crypto currency wallets
- CO4:** Explain how to compile and deploy smart contracts using Ethereum
- CO5:** Illustrate Hyperledger fabric and use cases of block chain technologies

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11
CO1	3	1	-	-	-	-	-	-	-	-	2
CO2	2	3	1	2	-	-	-	-	-	-	2
CO3	2	3	1	1	-	-	-	-	-	-	2
CO4	2	2	3	2	-	-	-	-	-	-	2
CO5	2	2	3	2	-	-	-	-	-	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	3
CO5	-	3

UNIT – I

Introduction: Overview of Block chain, History of Blockchain, Real-world applications, Peer to Peer Network, Smart Contract, Wallet, Digital Currency, Ledgers, Types of Blockchain Platforms.

Practice:

1. Creating Merkle tree

UNIT – II

Consensus Mechanism: Permissioned Blockchain, Permissionless Blockchain, Different Consensus Mechanisms- Proof of Work, Proof of Stake, Proof of Activity, Proof of Burn, Proof of Elapsed Time, Proof of Authority, Proof of Importance, voting-based consensus algorithms, and federated consensus.

Practice:

1. Creation of Block.

UNIT – III

Crypto currency and Wallet: Types of Wallet, Desktop Wallet, App based Wallet, Browser based wallet, Metamask, Creating an account in Metamask, Use of faucet to fund wallet, transfer of cryptocurrency in meta mask, Merkle tree, hard and soft forks, network models and properties of secure state machine replication (SMR)

Practice:

1. Block chain Implementation Programming code

UNIT – IV

Smart contract and Ethereum: Overview of Ethereum, Writing Smart Contract in Solidity, Remix IDE , Different networks of ethereum, understanding blocks practically at blockchain.com, how to compile and deploy smart contract in remix

Practice:

1. Java code to implement blockchain in Merkle Trees

UNIT – V

Understanding Hyperledger Fabric: Hyperledger Fabric- Architecture, Identities and Policies, Membership and Access Control, Channels, Transaction Validation, Writing smart contracts using Hyperledger Fabric.

Use Cases: Cross border payments, Know Your Customer (KYC), Food Security, Block chain enabled Trade, Anti-Money Laundering (AML)

Practice:

1. Creating a Crypto-currency Wallet

Text Books:

- 1 Blockchain: Blueprint for a New Economy, Melanie Swan, O'Reilly, ISBN:9781491920473
- 2 Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks by Imran Bashier, Packt publishing, ISBN: 9781787125445

Reference Books:

- 1 Mastering Ethereum: Building Smart Contracts and DApps by Andrews, ISBN:978-1491971949
- 2 Mastering Bitcoin: Programming the Open Blockchain, by Andreas M. Antonopoulos, O'Reilly, ISBN: 9781491954362

Web Links:

- 1 https://onlinecourses.swayam2.ac.in/aic21_ge01/
- 2 <https://github.com/blockchainedindia/resources>
- 3 <https://github.com/HyperledgerHandsOn/trade-finance-logistics>

Cyber Laws
(Common to CSE, IT, AIML & CSE (DS))

Course Code: 2501CS31	L	T	P	C
	2	0	1	3

Course Outcomes:

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

- CO1:** Identify the needs of IT Act.
- CO2:** Summarize IT Act 2000 and its relevance.
- CO3:** Discuss digital signatures and E-governance.
- CO4:** Analyze traditional computer crime and early hacker.
- CO5:** Demonstrate Identity theft and Identity fraud.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	-	-	-	-	-	2	1	-	-	2
CO2	2	2	-	-	-	-	3	-	-	1	2
CO3	2	3	-	1	1	1	2	1	1	-	2
CO4	2	2	-	-	-	2	3	1	-	-	2
CO5	1	2	-	-	-	-	3	-	-	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	1	-
CO3	2	-
CO4	1	-
CO5	1	-

UNIT – I

The IT Act, 2000: A Critique: Crimes in this Millennium, Section 80 of the IT Act,2000 – A Weapon or a Farce?, Forgetting the Line between Cognizable and Non-Cognizable Officers, Arrest for “About to Commit” an Offence Under the IT Act.

Practice:

1. Create awareness on sections in IT Act 2000 and how they can be related to each illegal activity

UNIT – II

Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000: Concept of Cyber Crime and, Hacking, Teenage Web Vandals, Cyber fraud and Cyber Cheating, Virus on Internet Deformation,Harassment and E-mail Abuse Cyber Pornography, Other IT Offences, Monetary Penalties, Adjudication and Appeals Under IT Act 2000,

Network Service Providers, Jurisdiction and Cyber Crimes, Nature of Cyber Criminality Strategies to Tackle Cyber Crime and Trends, Criminal Justice in India and Implications.

Practice:

1. Installation and configuration of Computer Host Firewall to protect system from unauthorized activities.

UNIT – III

Digital Signatures, Certifying Authorities and E-Governance: Digital Signatures, Digital Signature Certificate, Certifying Authorities and Liability in the Event of Digital Signature compromise, E-Governance in the India. A Warning to Babudom, Are Cyber Consumers Covered under the Consumer Protection, Goods and Services, Consumer Complaint Defect in Goods and Deficiency in Services Restrictive and Unfair Trade Practices .

Practice:

1. Study on how to register a Consumer Complaint through online. (<https://consumerhelpline.gov.in/>)

UNIT – IV

Traditional Computer Crime: Early Hacker and Theft of Components: Traditional problems, Recognizing and Defining Computer Crime, Phreakers: Yesterday's Hackers, Hacking, Computers as Commodities, Theft of intellectual Property Web Based Criminal Activity, Interference with Lawful Use of Computers, Malware, DoS (Denial of Service) and DDoS (Distributed Denial of Service) Attacks, Ransomware and Kidnapping of Information, Theft of Information, Data Manipulation, and Web Encroachment , Dissemination of Contraband or Offensive materials, Online Gambling Online Fraud, Securities Fraud.

Practice:

1. Study on how to file a complaint against web based activity through online. (<https://cybercrime.gov.in/>)

UNIT – V

Identity Theft and Identity Fraud: Typologies of Internet Theft/Fraud, Prevalence and Victimology, Physical Methods of Identity Theft, Virtual and Internet Facilitated methods, Crimes facilitated by Identity theft/fraud, Organized Crime and Technology Protection of Cyber consumers in India Cyber-consumer act Consumer, Goods and service, consumer compliant, restricted and unfair trade Practices.

Practice:

1. Wi-Fi security management in computer and create awareness on illegal cyber activities.

Text Books:

- 1 Cyber Law Simplified, VivekSood, Tata McGraw Hill, 4th edition, ISBN: 978-0070435063

- 2 Computer Forensics and Cyber Crime, Marjie T. Britz, Pearson, 3rd edition, ISBN 978-0132677714

Reference Books:

- 1 Cyber Laws Texts and Cases, Ferrera, CENGAGE India, 3rd sediton, ISBN: 978-8131517925
- 2 Cyber Law by PavanDuggal, Universal law publishing, 2nd edition, ISBN: 978-8131253663

Web Links:

- 1 <http://www.cyberlawsindia.net/>
- 2 <http://meity.gov.in/content/cyber-laws5>
- 3 <https://www.coursera.org/learn/cyber-conflicts>

Secure Coding Techniques
 (Common to CSE, IT, AIML & CSE (DS))

Course Code: 2501CS33	L	T	P	C
	2	0	1	3

Course Outcomes:

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

- CO1:** Describe the objectives and services of Cyber security.
- CO2:** Analyze importance of OWASP and Security risks.
- CO3:** Outline importance of SDLC and Design Principles. .
- CO4:** Summarize reasons and impact of Common security flaws in C and C++
- CO5:** Apply secure coding best practices in Python programming language.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1:	3	2	2	2	1	-	-	3	3	-	-
CO2:	3	3	2	2	3	-	-	3	3	-	-
CO3:	3	2	2	2	3	-	-	3	3	-	-
CO4:	3	2	2	2	3	-	-	3	3	-	-
CO5:	3	2	2	2	2	-	-	3	3	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1:	-	1
CO2:	-	3
CO3:	-	3
CO4:	-	3
CO5:	-	3

UNIT – I

Network and Cyber Security Fundamentals: Network Basics, Network Components, Types of Networks, Networking Models, Introduction to Cyber Security, Why Cyber Security is important, Objectives and Services of Cyber Security, various Security Attacks, Types of Cyber threats, Cyber Security Challenges .

Practice:

1. Practical learning - Installation and working with Wireshark tool
2. Practical learning - Wireshark Lab: Ethernet and ARP

UNIT – II

OWASP Top 10-2021: Importance of OWASP Top 10 , OWASP Top 10 Application Security Risks – 2021: Broken Access Control Risk Root Causes and its Mitigation,

Cryptographic Failures Risk Root Causes and its Mitigation, Injection Risk Root Causes and its Mitigation , Vulnerable and Outdated Components Risk Root Causes and its Mitigation , Identification and Authentication Failures Risk Root Causes and its Mitigation, Software and Data Integrity Failures Risk Root Causes and its Mitigation, Security Misconfiguration Risk Root Causes and its Mitigation, Security Logging and Monitoring Failures Risk Root Causes and its Mitigation, Server-Side Request Forgery Risk Root Causes and its Mitigation .

Practice:

1. Practical learning – How to find and exploit different types of SQLi vulnerabilities.
2. Practical learning – Burp Suite **Practice** How to find vulnerabilities.

UNIT – III

Secure Coding Best Practices: Secure Design Principles, Password Management, Access Control, Error Handling and Logging, system Configuration, Threat Modeling, Cryptography **Practices**, Input and Output Sanitization, Tokenizing and Sandboxing, Static and dynamic testing, vulnerability scanning and penetration testing, Microsoft SDL Tool .

Practice:

1. Practical learning – How to conduct penetration testing
2. Practical learning – Microsoft SDL Tool **Practice**

UNIT – IV

Secure coding Practices in C/C++: Common security flaws in C and C++, Buffer Overflows and Code Injections: Stack Overflows attacks, Array indexing attacks Format strings attacks, Integer Overflows.

Practice:

1. Practical learning – How to handle Buffer Overflows risks
2. Practical learning – **Practice** to find Code Injections attacks

UNIT – V

Secure coding Practices in Python: Basics of Python, Version of Python, Upgrade, update, patch, use a Virtual Environment Python, Sanitize inputs, String Formatting, Handle Python HTTP Requests Safely, Handling Data Deserialization Safely.

Practice:

1. Practical learning – Identifying supported HTTP methods with Burp Suite
2. Practical learning – How to prevent CSRF attacks with Burp Suite

Text Books:

- 1 Networking Fundamentals, Packt, Author: Gordon Davies, 2019 edition, ISBN: 978-1838643508
- 2 OWASP 2017 Handbook

Reference Books:

- 1 Secure coding in C and C++ by Robert C. Seacord, Pearson , Second Edition, ISBN: 978-0321822130 .
- 2 Secure Coding Guidelines for Python by Zádrapa Jan 2021

Web Links:

- 1 <https://www.stealthlabs.com/blog/infographic-top-15-cybersecurity-myths-vs-reality/>
- 2 <https://www.microsoft.com/en-us/securityengineering/sdl/threatmodeling>
- 3 <https://www.checkpoint.com/cyber-hub/threat-prevention/what-is-sandboxing/>

Minor Stream: Cognitive Analytics

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CS34	Fundamentals of Data Science	IC	2		1	3	50	50	100	-
2501AI26	Information Retrieval Systems	IC	2		1	3	50	50	100	-
2501AI14	Soft Computing	IC	2		1	3	50	50	100	AI
2501AI07	Computer Vision	IC	2		1	3	50	50	100	DAE
2501AI24	API & Micro Services	IC	2		2	4	50	50	100	JP
2501AI15	AI Chatbots	IC	2			2	50	50	100	AI
2501AI19	Data Visualization	AC	2		2	4	50	50	100	DAE
2501CS06	Mobile & IoT Analytics	AC	2		1	3	50	50	100	-
2501AI13	Recommender Systems	AC	2		2	4	50	50	100	-
2501AI08	Expert Systems	AC	2		1	3	50	50	100	-
Total			20		12	32				

Fundamentals of Data Science
(Common to All, Except CSE, IT, AIML & CSE (DS))

	L	T	P	C
Course Code: 2501CS34	2	0	1	3

Course Outcomes:

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

- CO1:** Explain fundamental concepts of Data Science.
- CO2:** Implement Data Collection and Preprocessing Techniques.
- CO3:** Demonstrate Proficiency in Data Loading, Storage, and File Handling
- CO4:** Conduct Exploratory Data Analysis (EDA) using Visualization and Statistical Techniques.
- CO5:** Make use of Neo4j, Cypher tools to manage and analyze graph data.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	3	-	-	-	-	-	-	2	2	-
CO2	2	-	-	-	-	-	-	-	1	2	-
CO3	2	2	2	-	-	-	-	-	2	2	-
CO4	2	2	-	-	2	-	-	-	2	1	-
CO5	3	-	-	-	-	-	-	-	1	1	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	1	-
CO3	2	-
CO4	2	-
CO5	1	-

UNIT – I

Introduction To Data Science: Definition and Scope of Data Science, History and Evolution of Data Science, Applications of Data Science, Data Science Lifecycle, Data Types and Structures, Tools and Technologies in Data Science.

Practice:

- a. Importing and Exploring Datasets - Loading datasets using libraries and performing basic exploration.
- b. Basic Data Structures - Working with data structures such as arrays, lists, data frames, and matrices.

UNIT – II

Data Collection and Preprocessing: Data Collection Methods, Data Cleaning and Handling Missing Values, Data Transformation: Normalization and Standardization, Feature

Engineering and Feature Scaling, Data Integration and Aggregation.

Practice:

1. Computing summary statistics like mean, median, mode, and standard deviation for a sample dataset.
2. Handling missing values and outliers in a dataset using techniques like imputation and filtering.

UNIT – III

Data Loading, Storage, and File Formats : Reading and Writing Data in Text Format, Reading Text Files in Pieces, Writing Data Out to Text Format, Manually Working with Delimited Formats, JSON Data, XML and HTML: Web Scraping, Binary Data Formats, Using HDF5 Format, Reading Microsoft Excel Files, Interacting with Databases, Storing and Loading Data in Mongo DB.

Practice:

1. Read data from a JSON file into a DataFrame using Pandas (pd.read_json) or R (jsonlite). Parse nested JSON structures and convert them into a flat table format.
2. Perform web scraping on an HTML page using BeautifulSoup in Python or rvest in R. Extract data from HTML tables and convert it into a DataFrame.

UNIT – IV

Exploratory Data Analysis (EDA): Descriptive Statistics, Data Visualization Techniques, Correlation and Covariance Analysis, Univariate, Bivariate, and Multivariate Analysis, Pattern Detection and Anomaly Identification.

Practice:

1. Plotting histograms and box plots to understand the distribution of a single variable.
2. Creating scatter plots and calculating correlation coefficients to study the relationship between two variables.

UNIT – V

Data Science Tools: Neo4j for dealing with graph databases, graph query language Cypher, libraries like nltk and SQLite for handling Text mining and analytics.

Practice:

1. Get hands-on experience with Neo4j to understand how to manage and query graph databases.
2. Practice writing Cypher queries to interact with graph data in Neo4j.

Text Books:

- 1 Python for Data Analysis, Wes McKinney, O'REILLY, 1st edition, ISBN:978-1-449-31979-3
- 2 Doing Data Science, Rachel Schutt & O'neil, O'REILLY, 1st edition, ISBN:978-1-449-35865-5

Reference Books:

- 1 Data Science from Scratch: First Principles with Python, Joel Grus, O'Reilly Media, ISBN: 9781492041139.
- 2 Learning the Pandas Library: Python Tools for Data Munging, Analysis, and Visualization, Matt Harrison, O'Reilly, ISBN: 9781787123137

Web Links:

- 1 https://onlinecourses.nptel.ac.in/noc24_cs133/preview
- 2 https://onlinecourses.nptel.ac.in/noc24_cs68/preview
- 3 <https://www.geeksforgeeks.org/how-to-become-a-data-analyst-complete-roadmap/>

Information Retrieval Systems
(Common to CSE, IT, AIML & CSE (DS))

Course Code: 2501AI26	L	T	P	C
	2	0	1	3

Course Outcomes:

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

- CO1:** Explain the Information Storage and Retrieval Systems
- CO2:** Explain Basic Concepts of Data Structures and Implementation of Algorithms
- CO3:** Apply retrieval systems for Signature Files, Searching and evaluation of Search Engines
- CO4:** Evaluate retrieval systems for New Indices for Text and its classification.
- CO5:** Implement retrieval systems for Stemming Algorithms, Thesaurus Construction and Web Search tasks.

Mapping of Course Outcomes with Program Outcomes:

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	1	-	2	-	-	1	1	-	-
CO2	2	3	1	-	2	-	-	1	1	-	-
CO3	3	2	2	-	2	-	2	1	1	-	1
CO4	2	2	2	1	2	-	2	1	1	-	1
CO5	2	2	2	1	2	-	2	1	1	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/ PSO	PSO1	PSO2
CO1	1	-
CO2	1	-
CO3	2	1
CO4	2	2
CO5	2	2

UNIT – I

Introduction to Information Storage and Retrieval System: Introduction, Domain Analysis of IR systems and other types of Information Systems, IR System Evaluation. Retrieval process – Architecture – Boolean retrieval; IR Models: Taxonomy and characterization of IR models; Models for Browsing; Retrieval Evaluation: Performance evaluation

Processing Text: Text Statistics, Document Parsing, Tokenizing, Stopping, Stemming, Phrases, Document Structure, Link Extraction, more detail on Page Rank, Internationalization.

Practice:

1. To Find the Weights of specific Term in a given Documents Using Python.

2. Implement handson experience store, and retrieve information from www using semantic approaches.

UNIT – II

Introduction to Data Structures and Algorithms related to Information Retrieval: Basic Concepts, Data structures, Algorithms. Ngram data structure, PAT data structure.

Inverted Files: Introduction, Structures used in Inverted Files, Building Inverted file using a sorted array, Modifications to Basic Techniques.

Practice:

1. Implement how to analyze ranked retrieval of a very large number of documents with hyperlinks between them
2. Implement how Ngrams are used for detection and correction of spelling errors.

UNIT – III

Signature Files: Introduction, Concepts of Signature Files, Compression, Vertical Partitioning, Horizontal Partitioning.

Searching: Sequential searching – Pattern matching; Searching the Web: Characterizing the Web – Search engines – Browsing – Searching using hyperlinks.

Practice:

1. Implement Text Pattern Matching and Searching Algorithm using python.
2. Implement Compression of Text Files using python.

UNIT – IV

New Indices for Text: PAT Trees and PAT Arrays: Introduction, PAT Tree structure, algorithms on the PAT Trees, Building PAT trees as PATRICA Trees, PAT representation as arrays.

Text Classification: Test collections, Query logs, Averaging and interpolation, focusing on the top documents. Training, Testing, and Statistics: Significance tests, setting parameter values for Classification and Clustering.

Practice:

1. Implementation of various classification algorithm on text using python.
2. Implementation of various Clustering algorithm on text using python.

UNIT – V

Thesaurus Construction: Introduction, Features of Thesauri, Thesaurus Construction, Thesaurus construction from Texts, Merging existing Thesauri

APPLICATIONS & XML Retrieval – Multimedia IR – Parallel and Distributed IR – Digital Libraries – Social Media Retrieval – Contentbased Image Retrieval.

Practice:

1. Implement how to analyze ranked retrieval of a very large number of documents with hyperlinks between them.

2. Case Study on: Demonstrate Information visualization technologies like Cognition and perception in the Internet or Web search engine.

Text Books:

- 1 Introduction to Information Retrieval, Christopher D.Manning, Prabhakar Raghavan, Hinrich Schutze, Cambridge University Press, ISBN: 978-0-521-86571-5
- 2 Information Retrieval Data Structures and Algorithms, Frakes, W.B., Ricardo BaezaYates, Prentice Hall, ISBN: 978-0134638379
- 3 Modern Information Retrieval. BaezaYates Ricardo and Berthier Ribeiro Neto., AddisonWesley, 2nd edition, ISBN: 978-8131709771

Reference Books:

- 1 Modern Information Retrieval, Ricardo BaezaYates, Neto, PEA, ISBN: 978-0321416919
- 2 Information Storage and Retrieval Systems: Theory and Implementation, Kowalski, Gerald, Mark Academic Press, ISBN: 978-0792379249
- 3 Information Retrieval: Algorithms and Heuristics, Grossman, OphirFrieder, 2/e, Springer, ISBN: 978-1461375326

Web Links:

- 1 <https://nptel.ac.in/courses/106101007>
- 2 <https://www.geeksforgeeks.org/what-is-information-retrieval/>

Soft Computing
(Common to CSE, IT & AIML)

Course Code: 2501AI14	L	T	P	C
	2	0	1	3

Course Outcomes:

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

CO1: Compare intelligent systems and knowledge based systems

CO2: Explain fuzzy sets and fuzzy operations

CO3: Discuss neuro systems and neural network applications

CO4: Apply genetic algorithm and operators

CO5: Compare and contrast Swarm Intelligence based algorithms

Mapping of Course Outcomes with Program Outcomes:

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	2	2	-	1	-	-	1	1	-	2
CO2	2	2	3	-	2	-	-	2	2	-	2
CO3	2	2	3	-	1	-	-	2	2	-	2
CO4	2	2	3	-	1	-	-	2	2	-	2
CO5	2	2	3	-	1	-	-	2	2	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/ PSO	PSO1	PSO2
CO1	-	1
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

UNIT – I

Introduction to Intelligent systems and soft computing: Intelligent systems, Knowledge based systems, Knowledge representation and processing, Soft computing techniques.

Practice:

1. Text summarization using a simple sequence to sequence model with LSTM (Long Short Term Memory) layers.
2. Apply networkx library to represent and process knowledge

UNIT – II

Fundamentals of fuzzy logic systems: Introduction , Background ,Evolution of fuzzy logic, Popular applications, Stages of development of an intelligent product, Use of fuzzy logic in expert systems, Fuzzy sets , Fuzzy logic operations

Practice:

1. Learn the fundamentals of the fuzzy logic ,experiment the basic operations of fuzzy logic (Virtual Labs)
2. Learn about the Fuzzy inference system (FIS) with an example (Virtual Labs)

UNIT – III

Fundamentals of artificial neural networks: Introduction Learning and acquisition of knowledge , Symbolic learning , Numerical learning, Features of artificial neural networks , Neural network topologies, Neural network activation functions, Neural network learning algorithms, Fundamentals of connectionist modeling

Practice:

1. Implement Neural Networks and Perceptron with an example (Virtual Labs)
Virtual Labs
2. Study Multilayer Perceptron apply it for image classification

UNIT – IV

Genetic algorithms and evolutionary programming: Introduction, Genetic algorithms, Procedures of genetic algorithms, working of genetic algorithms, genetic algorithm operators, Issues in GAs.

Practice:

1. Implement a genetic algorithm for finding the maximum value of a function.
2. Implement Crossover and Mutation in genetic algorithms

UNIT – V

Swarm Intelligent systems: Introduction, Swarm Intelligence based algorithms – Ant Algorithms; Bee Algorithms; Particle Swarm Optimization, Background of Ant intelligent system, ant colony systems Importance, development, applications, working of ant colony systems, Artificial Bee Colony (ABC) Optimization Behavior of real bees, ABC Algorithm, Variations of ABC: Abcgbest and Abcgbestdist.

Practice:

1. Implement Particle Swarm Optimization algorithm
2. Implement ABC with GBest Algorithm:And GBestDist Algorithm

Text Books:

- 1 Soft Computing and Intelligent Systems Design Theory, Tools and Applications, Fakhreddine O. Karray and Clarence de Silva, ISBN: 978-8131723241
- 2 Artificial Intelligence and Intelligent Systems, N. P. Padhy, Oxford University press, ISBN: 9780195671544

Reference Books:

- 1 Fuzzy Logic: A Practical approach, F. Martin, , Mc neill, and Ellen Thro, AP Professional, ISBN: 978-0124859654
- 2 An Introduction to Genetic Algorithms, Melanie Mitchell, MIT Press, ISBN: 9780262280013

Web Links:

- 1 <https://nptel.ac.in/courses/106105174/>
- 2 <https://www.kdnuggets.com/>
- 3 <https://www.import.io/post/datascientistsvsdataanalystswhythedistinctionmatters/>

Computer Vision
(Common to CSE, IT, AIML & CSE (DS))

Course Code: 2501AI07	L	T	P	C
	2	0	1	3

Course Outcomes:

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

- CO1:** Explain the Fundamentals of Computer Vision and Comprehend Image Formation and Photometric Concepts.
- CO2:** Apply the principles of feature detection and matching.
- CO3:** Analyze basic methods of computer vision related to Structure and Motion.
- CO4:** Evaluate Computational Photography Techniques and Achieve SuperResolution and Blur Removal and Synthesize Textures.
- CO5:** Implement the design of a computer vision system for a 3D Reconstruction, Albedos, image based rendering views and depths.

Mapping of Course Outcomes with Program Outcomes:

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	2	-	2	-	-	1	1	-	-
CO2	2	2	1	-	2	-	-	1	1	-	-
CO3	2	2	1	-	2	-	-	1	1	-	-
CO4	2	2	1	-	2	-	-	1	1	-	-
CO5	2	2	1	-	2	-	-	1	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/ PO	PSO1	PSO2
CO1	1	-
CO2	2	1
CO3	2	-
CO4	1	2
CO5	1	2

UNIT – I

Introduction to Computer Vision and Transformation: What is computer vision, A brief history, Applications, Geometric Primitives, Photometric Image Formation, Digital Camera, Image Processing: Point Operators, Linear Filtering, Global Optimization.

Transformation: Orthogonal, Euclidean, Affine, Projective, etc., Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing, Geometric Transformations.

Practice:

1. Implement contrast adjustment of an image. Implement Histogram processing and equalization.
2. Use of Fourier transform for filtering the image.

UNIT – II

Feature Detection and Matching: Points and Patches, Edges, Lines, Segmentation: Active Contours, Split and Merge, Mean Shift and Mode Finding, Normalized Cuts, Feature detectors, Feature descriptors, Feature matching, Feature tracking.

Practice:

1. Implementing image processing operations in python/mat lab/openCV: Reading image, writing image, conversion of images, and complement of an image.
2. Write a program to display of color image.

UNIT – III

Structure and Motion: Triangular, Twoframe Structure from Motion, Factorization, Bundle Adjustment, Constrained Structure and Motion.

Dense Motion Estimation: Translation Alignment, Parametric Motion, Spline Based Motion.

Practice:

1. Write a program to apply morphological algorithms on an image.
2. Write a program to perform segmentation on an image.

UNIT – IV

Image Stitching: Motion Analysis, Motion Models, Global Alignment, Composing

Computational Photography: Photometric Calibration, High Dynamic Range Imaging, Super Resolution and Blur Removal, image Matting and Compositing, Texture Analysis and Synthesis.

Practice:

1. Utilization of Texture Analysis and Synthesis.
2. Performing/Implementing Blur Removal and Image Matting using python.

UNIT – V

3D Reconstruction & Recognition: Shape From X, Active Range Finding, Surface Representation, point based Representation, Volumetric Representation.

Image based Rendering: View Interpolation, Layered Depth Images, Light Fields and Lumi graphs, Environment Mattes.

Recognition: Object detection, Face detection, Pedestrian detection, Face recognition, Eigenfaces, Active appearance and 3D shape models.

Practice:

1. Write a program to detect edges of an image using Operators.
2. Write a program to apply 2D DFT and DCT on an image and display the result.

Text Books:

- 1 Computer Vision: Algorithms and Applications, Richard Szeliski, Springer, ISBN:

978-3-030-34372-9

- 2 Digital Image Processing, Rafael C. Gonzalez, Pearson Education; Fourth edition, 2018, ISBN: 978-9353062989

Reference Books:

- 1 Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall, ISBN:978-9332550117
- 2 Computer and Robot Vision, Haralick & Shapiro, Vol II, ISBN: 978-0201569438
- 3 Computer Vision and Image Processing, S. Nagabhushana, New Age International Pvt Ltd; First edition, ISBN: 978-8122416428

Web Links:

- 1 https://onlinecourses.nptel.ac.in/noc22_ee48/preview
- 2 <https://www.geeksforgeeks.org/computer-vision/>

API & Micro Services
(Common to CSE, IT, AIML & CSE (DS))

Course Code: 2501AI24	L	T	P	C
	2	0	2	4

Course Outcomes:

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

CO1: Apply Dependency Injection principles using Constructor and Setter Injection.

CO2: Analyze Spring Boot fundamentals and Spring AOP

CO3: Apply transaction management and custom repository implementation

CO4: Explain web services using SOAP and REST

CO5: Evaluate the importance of exception handling and data validation in RESTful services

Mapping of Course Outcomes with Program Outcomes:

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	2	3	-	1	-	-	1	1	-	-
CO2	3	2	2	-	1	-	-	1	1	-	-
CO3	2	2	2	-	1	-	-	1	1	-	-
CO4	2	2	2	-	1	-	-	1	1	-	-
CO5	2	2	3	-	1	-	-	1	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/ PSO	PSO1	PSO2
CO1	2	-
CO2	1	-
CO3	2	-
CO4	1	-
CO5	1	-

UNIT – I

Spring 5 Basics: Why Spring, What is Spring Framework, Spring Framework - Modules, Configuring IoC container using Java-based configuration, Introduction To Dependency Injection, Constructor Injection, Setter Injection, What is Auto Scanning

Practice:

1. Setting up Spring Framework
 - a. Create a new Spring project using Spring Initializr.
 - b. Configure the project structure and dependencies.
 - c. Write a simple "Hello World" application using Spring
2. Spring Modules
 - a. Explore Spring Framework modules (e.g., Core, Data Access, Web).
 - b. Implement a simple data access application using Spring JDBC.

- c. Create a web application using Spring MVC.

UNIT – II

Spring Boot: Creating a Spring Boot Application, Spring Boot Application Annotation, What is Auto wiring, Scope of a bean, Logger, Introduction to Spring AOP, Implementing AOP advices, Best Practices: Spring Boot Application

Practice:

1. Creating a Spring Boot Application with Auto Wiring and Logging
 - a. Create a new Spring Boot project using Spring Initializr.
 - b. Define two classes: Employee and EmployeeService.
 - c. Annotate EmployeeService with `@Service` and Employee with `@Component`.
 - d. Use `@Autowired` to inject Employee into EmployeeService.
 - e. Configure logging using Logback.
 - f. Write a test class to verify auto-wiring and logging.
2. Implementing AOP Advices in Spring Boot
 - a. Create a new Spring Boot project using Spring Initializr.
 - b. Define two classes: Student and StudentService.
 - c. Annotate StudentService with `@Service` and Student with `@Component`.
 - d. Implement AOP advice using `@Aspect` and `@Before`.
 - e. Apply AOP advice to StudentService methods.
 - f. Write a test class to verify AOP functionality.

UNIT – III

Spring Data JPA with Boot: Limitations of JDBC API, Why Spring Data JPA, Spring Data JPA with Spring Boot, Spring Data JPA Configuration, Pagination and Sorting, Query Approaches, Named Queries and Query, Why Spring Transaction, Spring Declarative Transaction, Update Operation in Spring Data JPA, Custom Repository Implementation, Best Practices-Spring Data JPA

Practice:

1. Setting up Spring Data JPA with Spring Boot
 - a. Create a new Spring Boot project.
 - b. Add Spring Data JPA dependency.
 - c. Configure database connection properties.
 - d. Create an entity class (e.g., User).
 - e. Create a repository interface (e.g., UserRepository).
 - f. Test CRUD operations
2. Pagination and Sorting with Spring Data JPA
 - a. Create a repository interface with pagination methods.
 - b. Use Pageable and Sort to implement pagination and sorting.
 - c. Test pagination and sorting functionality.
 - d. Implement custom sorting using `@Query`

UNIT – IV

Web Services: Why Web services, SOA-Service Oriented Architecture, What are Web

Services, Types of Web Services, SOAP based Web Services, REST ful Web Services, How to create REST ful Services

Practice:

1. Creating a Simple RESTful Web Service
 - a. Create a new Spring Boot project.
 - b. Define a resource class (e.g., User).
 - c. Create a REST controller (e.g., UserController).
 - d. Implement CRUD operations.
 - e. Test using Postman or curl.
2. SOAP-based Web Service with Spring Boot
 - a. Create a new Spring Boot project.
 - b. Define a service interface (e.g., UserService).
 - c. Implement service using @Service.
 - d. Create a WSDL file.
 - e. Test using SoapUI.

UNIT – V

Spring REST: Spring REST - An Introduction, Creating a Spring REST Controller, @RequestBody and Response Entity, Parameter Injection, Usage of @PathVariable, @RequestParam and @MatrixVariable, Exception Handling, Data Validation, Creating a REST Client, Versioning a Spring REST endpoint, Enabling CORS in Spring REST, Securing Spring REST endpoints

Practice:

1. Creating a Simple Spring REST Controller
 - a. Create a new Spring Boot project.
 - b. Define a resource class (e.g., User).
 - c. Create a REST controller (e.g., UserController).
 - d. Implement CRUD operations.
 - e. Test using Postman or curl.
2. Using @RequestBody and ResponseEntity
 - a. Create a REST controller.
 - b. Use @RequestBody to accept JSON data.
 - c. Use ResponseEntity to return HTTP responses.
 - d. Test using Postman or curl.

Note: The student must Complete & Submit Spring5 Basics with Spring Boot, Spring DataJPA with Boot, SpringREST Certificate Course offered by Infosys Spring Board at the end of the Practice Session.

Text Books:

- 1 Spring in action, 5th Edition, Author: Craig Walls, Ryan Breidenbach, Manning, ISBN: 978-1617294945

Web Reference:

- 1 Dependency Injection in spring-javat point

- 2 Auto wiring in Spring- javat point
- 3 <https://docs.spring.io/spring-boot/docs/2.0.x/reference/html/using-boot-using-spring-boot-application-annotation.html>
- 4 Auto wiring in Spring – javat point,<https://www.baeldung.com/spring-bean-scopes>
- 5 Spring Boot Logging|How does logging works inspring boot with example (educba.com)
- 6 Spring AOP Tutorial|Aspect Oriented Programming-javat point
- 7 Spring Boot Best Practices(javaguides.net)
- 8 Introduction to Spring Data JPA | SpringHow
- 9 <https://asbnotebook.com/spring-data-jpa-crud-example/>,<https://www.bezkoder.com/spring-boot-jpa-crud-rest-api/>
- 10 Pagination and Sorting using Spring Data JPA – Paging And Sorting Repository (javaguides.net)
- 11 <https://www.javaguides.net/2018/11/spring-data-jpa-query-creation-from-method-names.html>,<https://www.javaguides.net/2022/02/spring-data-jpa-namedqueries-example.html>
- 12 <https://javadeveloperzone.com/spring/spring-declarative-transaction-management/>
- 13 <https://javadeveloperzone.com/spring/spring-declarative-transaction-management/>
- 14 <https://javabeat.net/spring-data-custom-repository/>
- 15 <https://www.jrebel.com/blog/jpa-application-performance-best-practices>
- 16 <https://www.javatpoint.com/service-oriented-architecture>,<https://www.javatpoint.com/web-services-tutorial>
- 17 <https://www.javatpoint.com/soap-web-services>,<https://www.javatpoint.com/restful-web-services>
- 18 RESTful Web Services - javatpoint
- 19 <https://www.javatpoint.com/restful-web-services-spring-boot>
- 20 <https://www.javatpoint.com/restful-web-services-spring-boot><https://dzone.com/articles/lifecycle-of-a-request-response-process-for-a-spring>
- 21 <https://www.ibm.com/docs/en/was/8.5.5?topic=applications-defining-uri-patterns-resources-in-restful>
- 22 <https://www.baeldung.com/exception-handling-for-rest-with-spring>
- 23 <https://howtodoinjava.com/spring-boot2/resttemplate/spring-restful-client-resttemplate-example/>
- 24 <https://www.javatpoint.com/restful-web-services-versioning>

Web Links:

- 1 https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01296689056211763272_shared/overview[Spring5BasicswithSpringBoot]
- 2 https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_4313461831752789500_shared/overview[Spring DataJPAwithBoot]
- 3 https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012731900963905536190_shared/overview[SpringREST]

AI Chatbots
(Common to CSE, IT & AIML)

Course Code: 2501AI15

L	T	P	C
2	0	0	2

Course Outcomes:

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

- CO1:** Explore the benefits and challenges of deploying chatbots for business use cases.
- CO2:** Evaluate a fully-functional and interactive chatbot using a commercial platform.
- CO3:** Deploy the finished chatbot for public use and interaction.
- CO4:** Distinguish between the NLP and NLU Tools
- CO5:** Demonstrate Microsoft Bot Framework, RASA and third party API's

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	3	-	-	-	-	1	1	-	-
CO2	2	2	3	-	1	-	-	1	1	-	-
CO3	1	1	2	-	1	-	-	1	1	-	-
CO4	1	2	-	-	2	-	-	1	1	-	-
CO5	2	2	2	-	2	-	-	1	1	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	-	2
CO4	2	-
CO5	3	-

UNIT-I

Introduction: Benefits from Chatbots for a Business, A Customer-Centric Approach in Financial Services, Chatbots in the Insurance Industry, Conversational Chatbot Landscape,
Identifying the Sources of Data: Chatbot Conversations, Training Chatbots for Conversations, Personal Data in Chatbots, Introduction to the General Data Protection Regulation (GDPR)

UNIT-II

Chatbot Development Essentials: Customer Service-Centric Chatbots, Chatbot Development Approaches, Rules-Based Approach, AI-Based Approach, Conversational Flow, Key Terms in Chatbots, Utterance, Intent, Entity, Channel, Human Takeover, Use Case: 24x7 Insurance Agent

UNIT-III

Building a Chatbot Solution: Business Considerations, Chatbots Vs Apps, Growth of Messenger Applications, Direct Contact Vs Chat, Business Benefits of Chatbots, Success Metrics, Customer Satisfaction Index, Completion Rate, Bounce Rate, Managing Risks in Chatbots Service, Generic Solution Architecture for Private Chatbots

UNIT-IV

Natural Language Processing, Understanding, and Generation: Chatbot Architecture, Popular Open Source NLP and NLU Tools, Natural Language Processing, Natural Language Understanding, Natural Language Generation, Applications.

UNIT-V

Introduction to Microsoft Bot, RASA, and Google Dialog flow: Microsoft Bot Framework, Introduction to QnA Maker, Introduction to LUIS, Introduction to RASA, RASA Core, RASA NLU, Introduction to Dialog flow

Chatbot Integration Mechanism: Integration with Third-Party APIs, Connecting to an Enterprise Data Store, Integration Module

Text Books:

- 1 Artificial Intelligence Based Chat Bot Design, Nazneen Akhter Shaikh, Khan Samrin Syed Zebanaaz, Saniya Raheen Patel, Lambert Publication, ISBN: 978-6202786713

Reference Books:

- 1 Hands-On Chatbots and Conversational UI Development: Build Chatbots and Voice User Interfaces with Chatfuel, Dialogflow, Microsoft Bot Framework, Twilio, and Alexa Skills, Packt publication, ISBN: 9781788294669

Web Links:

- 1 https://onlinecourses.nptel.ac.in/noc22_ge29/preview
- 2 <https://www.geeksforgeeks.org/nlp-vs-nlu-vs-nlg/>
- 3 <https://dev.botframework.com/>

Data Visualization
(Common to CSE, IT, AIML & CSE (DS))

	L	T	P	C
Course Code: 2501AI19	2	0	2	4

Course Outcomes:

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

- CO1:** Explain the various types of data and principles of data visualization
- CO2:** Apply visualization techniques to a problem and its associated dataset
- CO3:** Apply structured approach to create effective visualizations
- CO4:** Outline the valuable insights from the massive dataset using visualization.
- CO5:** Build visualization dashboard to support decision making

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	2	-	-	1	-	-	1	-	-	2
CO2	2	2	-	-	2	-	-	1	-	-	2
CO3	2	2	3	-	1	-	-	1	-	-	2
CO4	2	2	3	-	1	-	-	1	1	-	1
CO5	2	2	3	-	1	-	-	1	1	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	1
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

UNIT – I

Introduction to Visualization:

Introduction to Data Visualizations and Perception: Introduction to visualization and visual perception, visual representation of data, Gestalt principles, Information overload.

Practice:

1. Introduction to various Data Visualization tools
2. Basic Visualization in Python

UNIT – II

Visual Representations: Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications.

Practice:

1. Basic Visualization in R
2. Introduction to Tableau and Installation

UNIT – III

Classification of Visualization Systems: Classification of visualization systems, Interaction and visualization techniques misleading, Visualization of one, two and multidimensional data, text and text documents.

Practice:

1. Connecting to Data and preparing data for visualization in Tableau
2. Data Aggregation and Statistical functions in Tableau

UNIT – IV

Visualization of Groups: Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization. Various visualization techniques, data structures used in data visualization.

Practice:

1. Data Visualizations in Tableau

UNIT – V

Visualization of Volumetric Data And Evaluation of Visualizations: Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information, GIS systems, collaborative visualizations, evaluating visualizations

Practice:

1. Basic Dashboards in Tableau

Text Books:

- 1 Interactive Data Visualization: Foundations, Techniques, and Applications, Ward, Grinstein, Keim, Natick, A K Peters, Ltd, 2nd edition, ISBN: 978-1482257373

Reference Books:

- 1 Visualization Analysis & Design, Tamara Munzner, AK Peters Visualization Series, 1st edition, ISBN: 978-1466508910
- 2 Interactive Data Visualization for the Web, Scott Murray, 2nd Edition, ISBN: 978-1491921289

Web Links:

- 1 <https://elearn.nptel.ac.in/shop/iit-workshops/completed/data-visualization-with-r/?v=c86ee0d9d7ed>
- 2 <https://www.udemy.com/course/mastering-datavisualization/?couponCode=NVDIN35>

Mobile & IoT Analytics

Course Code: 2501CS06

L	T	P	C
2	0	1	3

Course Outcomes:

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

- CO1:** Identify the challenges involved in the design of IoT Analytics systems.
- CO2:** Illustrate analytics of mobile applications in IoT platforms
- CO3:** Understand the devices, protocols and standards involved in IoT systems.
- CO4:** Learn various real world systems involving IoT sensor.
- CO5:** Explore the smart applications development using IoT sensors and systems.

Mapping of Course Outcomes with Program Outcomes:

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	2	1	-	-	-	1	1	-	-	-
CO2	2	-	1	2	-	-	1	1	-	-	-
CO3	2	1	-	2	-	-	1	1	-	-	-
CO4	2	-	1	2	-	-	1	1	-	-	-
CO5	2	2	1	-	-	-	1	1	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/ PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	1	-
CO4	1	-
CO5	2	-

UNIT – I

Defining IoT Analytics and Challenges: The situation Defining IoT analytics Defining analytics Defining the Internet of Things The concept of constrained IoT analytics challenges The data volume Problems with time Problems with space Data quality Analytics challenges Business value concerns.

Practice:

1. Control any two actuators connected to the development board using Bluetooth.

UNIT – II

Sensor For Mobile And Handheld Devices: Temperature sensors, Proximity sensor, IR sensors, Image sensors, Motion detection sensors, Accelerometer sensors, Gyroscope sensors, Optical sensors.

Practice:

1. Develop an android application to demonstrate LED Blinking using raspberry pi.

UNIT – III

IoT Devices, Networking Protocols and Standards for Internet of Things: IoT Devices Health care Manufacturing Transportation and logistics Retail Oil and gas Home automation or monitoring Wearables Sensor types IoT Data Link Protocols Network Layer Routing Protocols Network Layer Encapsulation Protocols Session Layer Protocols IoT .

Practice:

1. Create any cloud platform account, explore IoT services and register a thing on the platform.

UNIT – IV

IoT Sensing, Mobile and Cognitive Systems: Sensing Technologies for Internet of Things IoT Interactions with GPS, Clouds and Smart Machines Radio Frequency Identification (RFID) Sensors, Wireless Sensor Networks and GPS Systems Cognitive Computing Technologies and Prototype Systems – Problems.

Practice:

1. Develop an android application to Control an LED by a button using Arduino.

UNIT – V

Smart Applications IoT with Data Analytics: Defragmenting Intelligent Transportation: A Practical Case Study Connected and Autonomous Vehicles Transit Hub: A Smart Decision Support System for Public Transit Operations – Smart Home Services Using the Internet of Things.

Practice:

1. Read data from sensor and send it to a requesting client.

Text Books:

- 1 IoT Product Development with Programming: Stepwise programming approach with Particle Development board Kindle Edition by Mahesh Jadhav and Tejas Sarang Patil. ISBN: 9798893630923

Reference Books:

- 1 Parallel Computing Architectures and APIs: IoT Big Data Stream Processing, Kale, Vivek. CRC Press, 1st Edition, 2019, ISBN: 978-1138553910
- 2 IoT Product Development with Programming: Stepwise programming approach with Particle Development board Kindle Edition by Mahesh Jadhav and Tejas Sarang Patil, ISBN: 7978893630923

Web Links:

- 1 https://onlinecourses.nptel.ac.in/noc18_cs46/preview
- 2 <http://www.courseera.org/specializations/iot>

Recommender Systems
(Common to CSE, IT, AIML & CSE (DS))

	L	T	P	C
Course Code: 2501AI13	2	0	2	4

Course Outcomes:

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

- CO1:** Explain the basic concepts of Recommender systems
- CO2:** Design and implement of Content based recommendation systems, hybrid recommendation
- CO3:** Implementation of Collaborative filtering techniques
- CO4:** Analyze attack resistant recommender systems and neighbourhood based recommender systems
- CO5:** Evaluate recommender systems effectively, assess their performance using appropriate analysis of design and metrics.

Mapping of Course Outcomes with Program Outcomes:

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	-	-	-	1	2	-	1	1	-	-
CO2	3	-	2	-	1	-	-	1	1	-	-
CO3	3	-	-	-	1	-	-	1	1	-	-
CO4	3	2	-	-	1	-	-	1	1	-	-
CO5	-	3	-	2	1	-	-	1	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/ PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	3	3
CO5	3	3

UNIT – I

Introduction and basic taxonomy of recommender systems : Traditional and non personalized Recommender Systems Overview of data mining methods for recommender systems similarity measures Dimensionality reduction – Singular Value Decomposition (SVD).

Introduction : Overview of Information Retrieval, Retrieval Models, Search and Filtering Techniques: Relevance Feedback, User Profiles, Recommender system functions, Matrix operations, covariance matrices, Understanding ratings, Applications of recommendation systems, Issues with recommender system.

Practice:

1. Programs on Python, Numpy and Pandas.

2. Implement Data similarity measures using Python.

UNIT – II

Content Based Recommendation Systems: High level architecture of contentbased systems Item profiles, Representing item profiles, Methods for learning user profiles, Similarity based retrieval, and Classification algorithms.

Hybrid recommendation approaches: Opportunities for hybridization, Monolithic hybridization design, parallelized hybridization design, pipelined hybridization design.

Practice:

1. Implement dimension reduction techniques for recommender systems
2. Implement Hybrid Recommendation

UNIT – III

Collaborative Filtering: A systematic approach, Nearest neighbour collaborative filtering (CF), user based and item based CF, components of neighbourhood methods (rating normalization, similarity weight computation, and neighbourhood selection).

Practice:

1. Implement collaborative filter techniques
2. Implement user profile learning

UNIT – IV

Attack Resistant Recommender Systems : Introduction – Types of Attacks – Detecting attacks on recommender systems – Individual attack –Group attack – Strategies for robust recommender design Robust recommendation algorithms.

Neighbourhood Based Recommender Systems : Formal definition, components of neighbourhood methods: Rating normalization, Similarity weight computation, neighbourhood selection, dimensionality reduction, graph based methods.

Practice:

1. Build Model for Attack resistant Social media recommender systems
2. Create an attack for tampering with recommender systems

UNIT – V

Evaluating Recommender System: Introduction, General properties of evaluation research, Evaluation designs: Accuracy, Coverage, confidence, novelty, diversity, scalability, serendipity, Evaluation on historical datasets, Offline evaluations, accuracy metrics in offline evaluation: RMSE, MAE, Limitations of evaluation metrics.

Practice:

1. Implement accuracy metrics like Receiver Operated Characteristic curves
2. Analyze evaluation metrics using KNearest Neighbors for Movie recommender systems

Text Books:

- 1 Recommender Systems: The Textbook, Charu C. Aggarwal, Springer, ISBN: 978-3319296579
- 2 Recommender Systems Handbook, Francesco Ricci, Lior Rokach, and Bracha Shapira, Springer, First Edition, ISBN: 978-1441995790

Reference Books:

- 1 Recommender Systems Handbook, Ricci F., Rokach L., Shapira D., Kantor B.P., Springer, 1st ed, ISBN: 978-0387858203
- 2 Recommender Systems For Learning, Manouselis N., Drachsler H., Verbert K., Duval E., Springer, 1st ed, ISBN: 978-1461443610

Web Links:

- 1 NPTEL, Websites etc. [https://www.coursera.org/specializations/recommender systems](https://www.coursera.org/specializations/recommender%20systems).
- 2 MOOC on NPTEL :<https://nptel.ac.in/courses/>, NPTEL / Swayamwww.edx. com
www.coursera.com

Expert Systems
(Common to CSE, IT, AIML & CSE (DS))

Course Code: 2501AI08	L	T	P	C
	2	0	1	3

Course Outcomes:

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

- CO1:** Identify the major characteristics of expert systems.
- CO2:** Illustrate the types of problems in expert systems can solve.
- CO3:** Recognize the types of errors attributed to uncertainty.
- CO4:** Describe the development stages of an expert system.
- CO5:** Utilize different knowledge representation methods.

Mapping of Course Outcomes with Program Outcomes:

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	-	-	2	1	-	-	2	2	-	1	3
CO2	-	1	1	-	1	-	-	1	-	-	3
CO3	-	-	3	-	2	1	-	-	1	-	3
CO4	1	2	1	1	2	-	-	-	1	1	-
CO5	-	2	-	1	-	3	-	1	2	-	3

Mapping of Course Outcomes with Program Specific Outcomes:

CO/ PO	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	3
CO5	-	3

UNIT – I

Introduction to Expert System, general stages in the development of an expert system, Major characteristics of Expert System, Types of applications of Expert Systems, relationship of Expert Systems to Artificial Intelligence and to Knowledge Based Systems, Components of Expert System, Conventional Systems vs. Expert Systems, Benefits of using an Expert System.

Practice:

1. Building a Rule Based Expert System for Diagnosis
2. Implementing a Recommender System using Knowledge Based Inference

UNIT – II

Architecture of Expert System, types of problems handled by expert systems, Utilization and functionality of expert systems, Rule Based Expert System, Non Production System, Expert System Development Life Cycle, Basic forms of

inference: abduction; deduction; induction.

Practice:

1. Rule Based Expert System for Restaurant Recommendation
2. Basic Forms of Inference Demonstration

UNIT – III

The representation and manipulation of knowledge in a computer, Rule based representations (with backward and forward reasoning), Knowledge Acquisition and Knowledge Representation, difficulties, in knowledge acquisition methods of knowledge acquisition, The meaning of uncertainty and theories devised to deal with it, Sources of uncertainty, types of errors attributed to uncertainty.

Practice:

1. Rule Based Representation with Forward Reasoning
2. Dealing with Uncertainty using Fuzzy Logic

UNIT – IV

Basic components of an expert system, How to select an appropriate problem, the development of an expert system, types of errors to expect in the development stages, Generation of explanations. Handling of uncertainties. Truth Maintenance Systems.

Practice:

1. Selecting an Appropriate Problem for an Expert System
2. Handling Uncertainty using Fuzzy Logic

UNIT – V

Building Expert Systems, Methodologies for building expert systems: knowledge acquisition and elicitation; formalisation; representation and evaluation. Knowledge Engineering tools, Case Study

Practice:

1. Knowledge Elicitation and Representation using Decision Trees
2. Knowledge Engineering Tool Rule Based System Development

Text Books:

- 1 Expert Systems Principles and Programming, J. Giarratano and G. Riley, 4th Edition, PWS Publishing Company, ISBN: 978-0534384470
- 2 Introduction to Expert Systems, P Jackson, Addison Wesley (2nd Edition), ISBN: 978-0201876864

Reference Books:

- 1 Artificial Intelligence: A modern approach, Stuart Russel and Peter Norvig, Pearson Education Inc, 2nd ed, ISBN: 978-8120323827

Web Links:

- 1 https://onlinecourses.swayam2.ac.in/aic21_ge01/
- 2 <https://www.geeksforgeeks.org/expertsystems/>
- 3 <https://github.com/mikeroyal/ExpertSystemsGuide>

Minor Stream: Mobile Application Development

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501IT12	Flutter Fundamentals	FC			2	2	50	50	100	-
2501IT14	Web Technologies	FC	2		2	4	50	50	100	JP
2501IT15	Software Testing	IC	2		1	3	50	50	100	ASE
2501IT16	Software Project Management	IC	2		1	3	50	50	100	ASE
2501IT17	Mobile Operating System	IC	2		1	3	50	50	100	-
2501CS24	Wireless Networks	IC	2		1	3	50	50	100	-
2501AI24	API & Micro Services	IC	2		2	4	50	50	100	JP
2501CS25	Cloud IoT & Edge ML	AC	2		1	3	50	50	100	-
2501CS28	Ethical Hacking	AC	2		2	4	50	50	100	-
2501IT22	Software Quality Assurance	AC	2		1	3	50	50	100	ASE
Total			18		14	32				

Flutter Fundamentals
(Common to CSE, IT, AIML & CSE(DS))

Course Code: 2501IT12 **L T P C**
0 0 2 2

Course Outcomes:

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

- CO1:** Identify the steps to set up the Flutter development environment and recall the purpose of basic widgets and layout structures
- CO2:** Demonstrate the use of fundamental Flutter widgets including images, buttons, icons, lists, and forms.
- CO3:** Design and develop user interfaces using responsive layouts and implement navigation, gestures, and animations
- CO4:** Integrate state management techniques (like Provider, BLoC, Riverpod) and handle real-time user input and data changes effectively
- CO5:** Develop a complete Flutter application using backend integration with Firebase and REST APIs, demonstrating optimization, testing, and deployment skills.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	2	1	3	-	-	-	-	-	2
CO2	3	2	3	1	2	-	-	-	-	-	2
CO3	3	2	3	2	3	-	-	-	-	-	2
CO4	3	3	3	2	3	-	-	-	-	-	2
CO5	3	3	3	3	3	-	-	-	-	-	3

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

Practice:

1. Introduction to Flutter

- a. **Setup Environment:** Set up the Flutter development environment on both Windows and Mac OS.
- b. **First App:** Create and run your first Flutter application in Android Studio.
- c. **Hello World:** Create a simple "Hello World" Flutter application and run it on an Android emulator.
- d. **Understanding Structure:** Modify the main Dart file to understand the structure of a Flutter app.
- e. **Hot Reload and Restart:** Practice using the hot reload and hot restart features to see how changes reflect instantly.

2. Flutter Basics

- a. **Button Widgets:** Create a Flutter app with various button widgets (Flat Button, Elevated Button,

- Icon Button).
- b. **Image Widget:** Create an app that displays an image using the Image widget and customize its properties.
- c. **Icon Widgets:** Use Icon widgets to display different icons in a Flutter app.
- d. **Counter App:** Build a simple counter app that increases a number each time a button is pressed using set State.
- e. **Gesture Detector:** Implement a gesture detector that changes the color of a container when tapped.

3. Flutter Basics Continued

- a. **List of Items:** Create an app with a list of items where each item can be clicked to display a toast message.
- b. **Input Validation:** Implement form input validation to ensure correct data entry.
- c. **Dialogs:** Use Alert Dialog to show a dialog box when a button is pressed.

4. Introduction to Layouts

- a. **Basic Layouts:** Create a layout using Column, Row, and Stack widgets.
- b. **Responsive Layout:** Implement a responsive layout using the Flex widget.
- c. **Single and Multiple Child Widgets:** Build a layout with a combination of single child and multiple child widgets.
- d. **Nested Layouts:** Design a complex UI using nested layouts (e.g., rows inside columns).
- e. **Gesture Detection:** Use Gesture Detector to detect various gestures (tap, double-tap).

5. Layouts Continued

- a. **Navigation:** Implement navigation between two screens using the Navigator widget.
- b. **Grid View:** Create a layout using Grid View to display items in a grid.
- c. **List View:** Use List View to display a list of dynamic items.
- d. **Scrolling:** Implement scrolling for a long list of items using List View and Scroll View

6. State Management (Basic)

- a. **Stateful and Stateless Widgets:** Create a simple app to toggle between stateful and stateless widgets and observe the behavior.
- b. **Form Input and Display:** Build an app with a form that takes user input and displays it on the same screen using set State.
- c. **Responsive Layout with Media Query:** Create a responsive layout that adapts to different screen sizes using Media Query.
- d. **To-Do List App:** Create a to-do list app where users can add and remove items dynamically.

7. Animation in Flutter

- a. **Animated Container:** Create a simple animation using Animated Container.
- b. **Fade Transition:** Implement a basic fade transition using Animated Opacity.
- c. **Physics-based Animation:** Develop an app that uses a physics-based animation like Draggable.
- d. **Hero Animation:** Implement a hero animation for navigating between screens.

8. Advanced Animations

- a. **Animated Builder:** Use Animated Builder to create complex animations.
- b. **Animation Controller:** Create animations with fine control using Animation Controller.
- c. **Staggered Animations:** Implement staggered animations to animate multiple widgets in sequence.
- d. **Curved Animations:** Use Curved Animation to create non-linear animations.

9. State Management (Advanced)

- a. **Provider Package:** Use the Provider package for state management.
- b. **BLoC Pattern:** Use the BLoC (Business Logic Component) pattern for managing state.
- c. **River pod:** Explore and use the River pod package for state management.

10. Networking in Flutter

- a. **HTTP Requests:** Use the http package to make GET and POST requests.
- b. **JSON Parsing:** Parse JSON data received from an API.
- c. **Fetching Data:** Fetch and display data from a remote API.
- d. **Handling Errors:** Implement error handling for network requests.
- e. **REST API:** Create an app that interacts with a REST API

11. Firebase Integration

- a. **Firestore Setup:** Set up Firestore for a Flutter project.
- b. **Authentication:** Implement user authentication using Firebase Auth.
- c. **Firestore:** Use Firestore to store and retrieve data.
- d. **Firestore Storage:** Upload and download files using Firestore Storage

12. Project Week

- a. **Project Planning:** Plan a small project incorporating concepts learned.
- b. **Project Development:** Develop the project with proper state management, layout, and networking.
- c. **Testing:** Test the project for bugs and ensure all functionalities work as expected.
- d. **Optimization:** Optimize the app for performance and responsiveness

Additional Practice:

1. Create a Flutter app that displays a list of items using List View. builder and allows users to add new items dynamically.
2. Develop a Flutter app that uses a Bottom Navigation Bar to navigate between different screens.
3. Create a Flutter app that implements basic form validation with input fields for name, email, and password.

Reference Books:

- 1 Beginning Flutter: A Hands-On Guide to App Development by Marco L. Napoli, ISBN:1119550823
- 2 Flutter in Action by Eric Windmill, 2020, ISBN:1617296147
- 3 Flutter for Beginners: An introductory guide to building cross-platform mobile applications with Flutter and Dart 2 by Alessandro Biessek, ISBN: 1788996089

Web Links:

- 1 <https://flutter.dev/docs>
- 2 <https://dart.dev/guides>
- 3 <https://codelabs.developers.google.com/?cat=flutter>

Web Technologies
(Common to CSE, IT, AIML & CSE(DS))

	L	T	P	C
Course Code: 2501IT14	2	0	2	4

Course Outcomes:

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

CO1: Develop static web pages using HTML and CSS.

CO2: Apply JavaScript for Client side validations and Node.JS to learn server side applications using JavaScript.

CO3: Make use of Angular JS for developing dynamic and responsive web pages.

CO4: Utilize React JS for developing dynamic and responsive web pages.

CO5: Create and deploy secure, usable database driven web applications using PHP and MySQL/MongoDB.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	-	3	-	-	-	-	1	1	-	-
CO2	3	2	2	-	2	-	-	1	1	-	-
CO3	2	2	3	-	2	-	-	1	-	-	-
CO4	2	3	2	-	-	-	-	1	-	-	-
CO5	2	-	2	-	3	-	-	1	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	-
CO2	1	-
CO3	1	-
CO4	1	-
CO5	1	-

UNIT-I

HTML, HTML5, CSS, CSS3 HTML: Basic Syntax, Standard HTML Document Structure, Basic Text Markup, HTML styles, Elements, Attributes, Heading, Layouts, HTML Media, Iframes, Images, Links, Lists, Tables, Forms, GET and POST method, HTML 5, Dynamic HTML. CSS: Cascading style sheets, Levels of Style Sheets, Style Specification Formats, Selector Forms, Box Model, Conflict Resolution, CSS3.

UNIT-II

JavaScript & XML Javascript - Introduction, Primitives, Variables – var, let, const, Operations and Expressions, Control Statements, Functions, Objects (Predefined - String, Number, Array, Date, Math, Random, RegExp, User Defined – Definition, Properties, Methods, Display, Accessors, Constructors), Events, Pattern Matching using Regular Expressions, Working with XML:

Document type Definition (DTD), XML schemas, XSLT, XML and CSS, Document object model, Parsers - DOM and SAX .

UNIT-III

Node JS & Angular JS Node.js- Introduction, Advantages, Process Model, Modules, HTTP Module, File system, URL module, NPM, Events, Upload Files, Email. Angular JS – Introduction, Expressions, Modules, Directives, Model, Data Binding, Controllers, Scopes, Filters, Services, HTTP, Tables, Select, Events, Forms, Validation, API, W3.CSS, Includes, Routing, SQL, DOM, Application.

UNIT-IV

React JS React JS – Introduction, Displaying “Welcome React”, Introducing JSX, Rendering Elements, Components and Props, State and Lifecycle, Handling Events, Conditional Rendering, Lists and Keys, Forms, Lifting State Up, Composition vs Inheritance, Thinking in React.

UNIT-V

PHP PHP Programming - Introduction, Creating and Running PHP Script. Variables, Constants, Datatypes, Operators. Controlling Program Flow - Conditional and Loop statements, Arrays, Functions, Client-Server Scripting – XAMPP/LAMP Introduction, Running PHP Script in XAMPP, Super Globals, Working with Form Data, Database Connectivity – MySQL Introduction using XAMPP in Command Mode and GUI, Working with MySQL Queries, Integrating PHP and MySQL to work with Form Data. No SQL Database - MongoDB Introduction, Create and Drop Database, Create and Drop Collection, Data Types, Insert, Query, Update, Delete, Integrating PHP with MongoDB.

Text Books:

- 1 Programming the World Wide Web, 7th Edition, Robert W Sebesta, Pearson, ISBN: 978-9332518827
- 2 Pro Mean Stack Development, 1st Edition, Elad Elrom, Apress O’Reilly, ISBN: 9781484220443.
- 3 React Explained, 2020 Edition, Zac Gordon, OS Training, 2020, ISBN: 978-1798752982
- 4 MongoDB – The Definitive Guide, 2nd Edition, Kristina Chodorow, O’Reilly, ISBN: 9781449344689

Reference Books:

- 1 Web Technologies, HTML, JavaScript, PHP, Java, JSP, XML and AJAX, Black book, 1st Edition, Dream Tech, ISBN: 978-8177229974
- 2 An Introduction to Web Design, Programming, 1st Edition, Paul S Wang, Sanda S Katila, Cengage Learning, ISBN: 978-0534395285

Web Links:

- 1 <https://www.reactjs.org/docs/getting-started.html>
- 2 <https://www.university.mongodb.com/>

Software Testing
(Common to CSE, IT, AIML & CSE(DS))

Course Code: 2501IT15	L	T	P	C
	2	0	1	3

Course Outcomes:

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

- CO1:** Explain the fundamentals of software testing.
- CO2:** Summarize verification and validation activities.
- CO3:** Design the test cases using different testing strategies.
- CO4:** Outline the importance of static testing and various levels of software testing.
- CO5:** Discuss about various Automation Testing tools.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1:	2	3	-	-	-	-	-	-	-	-	-
CO2:	1	3	-	-	-	-	-	-	-	-	-
CO3:	3	2	-	-	-	-	-	-	1	-	-
CO4:	2	-	3	-	-	-	-	-	-	-	-
CO5:	3	2	-	-	-	-	-	-	-	1	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	1	-
CO3	2	-
CO4	1	-
CO5	2	-

UNIT – I

Software Testing: Introduction, Evolution, Myths & Facts, Goals, Psychology, Definition, Model for testing, Effective Vs Exhaustive Software Testing.

Software Testing Terminology and Methodology: Software Testing Terminology, Software Testing Life Cycle, relate STLC to SDLC, Software Testing Methodology.

Practice:

1. A program written in JAVA language for Matrix Addition ‘Introspect the causes for its failure and write down the possible reasons for its failure.
2. “A program written in JAVA language for Matrix Multiplication fails” Introspect the causes for its failure and write down the possible reasons for its failure.

UNIT – II

Verification and Validation: Verification & Validation Activities, Verification,

Verification of Requirements, High level and low-level designs, how to verify code, Validation.

Dynamic Testing I: Black Box testing techniques: Boundary Value Analysis, Equivalence class Testing, State Table based testing, Decision table-based testing, Cause-Effect Graphing based testing, Error guessing.

Practice:

1. A Program demonstrates the next date in the calendar. Its input is entered in the form of with the following range: $1 \leq mm \leq 12$ $1 \leq dd \leq 31$ $1900 \leq yyyy \leq 2025$ Its output would be the next date or it will display 'invalid date'. Design test cases for this program using BVC, robust testing, and worst-case testing methods.
2. A program reads three numbers, A, B, and C, with a range [1, 50] and prints the largest number. Design test cases for this program using equivalence class testing technique.

UNIT – III

Dynamic Testing II: White-Box Testing: need, Logic coverage criteria, Basis path testing, Graph matrices, Loop testing, data flow testing, mutation testing

Static Testing: Inspections, Structured Walkthroughs, Technical reviews.

Practice:

1. Design, develop, code and run the program in any suitable language to solve the commission problem. Analyze it from the perspective of decision table-based testing, derive different test cases, execute these test cases, and discuss the test results.
2. Design, develop, code and run the program in any suitable language to solve the commission problem. Analyze it from the perspective of dataflow testing, derive different test cases, execute these test cases and discuss the test results.

UNIT – IV

Validation activities: Unit testing, Integration Testing, Function testing, system testing, acceptance testing. **Regression testing:** Progressives Vs regressive testing, Regression testability, Objectives of regression testing, when regression testing done? Regression testing types, Regression testing techniques.

Practice:

1. Write the test cases for any known application (e.g. Banking application)
2. Take any system (e.g. ATM system) and study its system specifications and report the various bugs.

UNIT – V

Software Testing Tools: Introduction to Testing, need for Automation, Categorization, Selection, Cost incurred in Testing tools, Guidelines for Automated testing, Introduction to list of tools like Win runner, Load Runner, JMeter, Selenium.

Practice:

1. Case Study of any web testing tool (e.g., Selenium)
2. Write an Automation Script for LOGIN Form (Using Selenium Tool)

Text Books:

- 1 Software Testing, Principles and Practices, Naresh Chauhan, Oxford 2nd Edition, ISBN: 978-0199465873
- 2 Software Testing Tools, Dr.KVKKPrasad, Dream tech press, ISBN : 978-8177225327

Reference Books:

- 1 Software Testing- Yogesh Singh, Cambridge, ISBN: 978-1107652781.
- 2 Software Testing, Principles, techniques and Tools, MGL imaye, TMH, ISBN : 978-0070139909
- 3 Effective Methods for Software testing, Willian E Perry, Wiley, ISBN: 978-8126508938

Web Links:

- 1 <https://www.guru99.com/software-testing-lifecycle>
- 2 <http://www.softwaretestinghelp.com/what-is-verification-and-validation/>
- 3 <http://nptel.ac.in/courses/106105150/>
- 4 <http://www.cigniti.com/blog/top-3-regression-testing-types-how-to-execute>
- 5 <https://www.utest.com/search-result/tag/Tools>

Software Project Management
(Common to CSE, IT, AIML & CSE(DS))

Course Code: 2501IT16	L	T	P	C
	2	0	1	3

Course Outcomes:

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

- CO1:** Explain Software Project Management fundamentals and Planning activities.
- CO2:** Compare SDLC models in project framework.
- CO3:** Apply various Effort estimation techniques and tools in real time applications
- CO4:** Discuss various Risk categories, Project Monitoring Control and Resource Allocation.
- CO5:** Demonstrate the concept Software Quality.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	2	2	3	-	-	-	-	2	-	2
CO2	2	2	2	2	-	-	-	-	3	-	3
CO3	2	2	3	2	-	-	-	-	2	-	2
CO4	2	2	2	3	-	-	-	-	2	-	2
CO5	2	2	2	2	-	-	-	-	2	3	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	2	-

UNIT – I

SPM concepts- Definition – components of SPM – challenges and opportunities – tools and techniques – managing human resource and technical resource – costing and pricing of projects – training and development – project management techniques.

Case Study: Managing Human and Technical Resources in the Development of Microsoft Windows 10

UNIT – II

Software Measurements- Monitoring & measurement of SW development – cost, size and time metrics – methods and tools for metrics – issues of metrics in multiple projects. Activity planning– project schedules – sequencing and scheduling projects – Network planning model – AON and AOA-identifying critical activities.

Case Study: Activity Planning and Scheduling in the Development of the Boeing 787 Dreamliner's Software Systems

UNIT – III

Software Quality- Quality in SW development – quality assurance – quality standards and certifications – the process and issues in obtaining certifications – the benefits and implications for the organization and its customers – change management

Case Study: Achieving ISO 9001 Certification at Infosys

UNIT – IV

Risk Issues- The risk issues in SW development and implementation – identification of risks – resolving and avoiding risks – tools and methods for identifying risk management.

Case Study: Risk Management in the Development of the London Ambulance Service System

UNIT – V

SPM Tools- Software project management using Primavera & Redmine and case study on SPM tools.

Case Study: Using Primavera in the Construction of Dubai's Burj Khalifa

Text Books:

- 1 Software Engineering – Concepts and Practices: Ugrasen Suman, Cengage Learning, ISBN: 978-8131519301
- 2 Fundamentals of Software Engineering, Rajib Mall, Prentice Hall India, ISBN: 978-9388028028

Reference Books:

- 1 Software Engineering: A Primer, Waman S Javadekar, Tata McGraw-Hill, ISBN: 978-0070667631
- 2 Software Engineering, Principles and Practices, Deepak Jain, Oxford University Press, ISBN: 978-0195694840

Web Links:

- 1 https://www.tutorialspoint.com/software_engineering/
- 2 <https://www.coursera.org/learn/software-processes-and-agile-practices>

Mobile Operating System
(Common to CSE, IT, AIML & CSE(DS))

Course Code: 2501IT17	L	T	P	C
	2	0	1	3

Course Outcomes:

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

- CO1:** Classify types of Mobile Operating Systems.
- CO2:** Demonstrate characteristics of Real-Time Operating System
- CO3:** Analyze and understand Mobile Operating Systems and their components
- CO4:** Evaluate Mobile issues and development strategies
- CO5:** Design a case study of Mobile OS

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	2	2	-	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	1	-	-
CO3	2	2	2	1	-	-	-	-	-	-	-
CO4	3	2	3	-	-	-	-	1	-	-	-
CO5	2	2	3	-	1	-	-	-	1	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	-
CO2	2	-
CO3	1	-
CO4	1	-
CO5	2	-

UNIT – I

Fundamentals of Operating System: Overview, Synchronization Mechanisms, Processes and Threads, Process Scheduling, Deadlocks: Detection, Prevention and Recovery – Models of Resources – Memory Management Techniques

Case Study: Process Scheduling in Windows vs. Linux

UNIT – II

Type of Mobile Operating Systems: Introduction, Type of Mobile OS Android OS (Google Inc.), Bada (Samsung Electronics), Black Berry OS (Research In Motion), iPhone OS / iOS (Apple), MeeGo OS (Nokia and Intel) Palm OS (Garnet OS), Windows Mobile (Windows Phone 7)

Case Study: Evolution of Android OS

UNIT – III

Real Time and Mobile Operating Systems:

Basic Model of Real Time Systems - Characteristics- Applications of Real Time Systems
– Real Time Task Scheduling - Handling Resource Sharing - Mobile Operating Systems
–Micro Kernel Design - Client Server Resource Access – Processes and Threads -
Memory Management - File system through interfaces.

Case Study: Real-Time Operating Systems in Automotive Applications

UNIT – IV

Mobile Issues and Development Strategies: Issues facing Mobile devices, Securing mobile application development, Android Securable IPC Mechanism, Android Security Model, Intents, Activities, Services, Android Security tools

Case Study: Security Challenges in Mobile Banking Applications

UNIT – V

Advanced Topics in Mobile Operating Systems: Mobile Application Development: Development Tools and IDEs, Platform-Specific Development, Cross-Platform Development

Future Directions in Mobile OS: Trends and Predictions, Potential Challenges and Solutions.

Case Study: Cross-Platform Mobile Application Development Using Flutter

Text Books:

- 1 Advanced Concepts in Operating Systems – Distributed, Database, and Multiprocessor Operating Systems Mukesh Singhal and Niranjana G. Shivaratri, Tata McGraw-Hill, ISBN : 978-0070472686
- 2 Operating System Concepts, Abraham Silberschatz; Peter Baer Galvin; Greg Gagne, John Wiley & Sons, Seventh Edition, ISBN: 978-0471694663

Reference Books:

- 1 Daniel P Bovet and Marco Cesati, “Understanding the Linux kernel”, 3rd edition, O’Reilly, ISBN: 978-0596005658
- 2 Mobile Application Security, Himanshu Dwivedi, Chris Clark, David Thiel, Tata McGraw Hill, 1st Edition, ISBN: 978-0070701922

Web Links:

- 1 developer.android.com
- 2 wiki.linuxfoundation.org/realtime/

Wireless Networks
(Common to CSE, IT, AIML & CSE (DS))

Course Code: 2501CS24	L	T	P	C
	2	0	1	3

Course Outcomes:

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

- CO1:** Describe evolution of wireless networks and wireless communication technologies.
- CO2:** Simulate Wireless Communication network for analyzing packet transmission using NS3.
- CO3:** Discuss IEEE 802.11 Standards and Protocols.
- CO4:** Explain evolution and architecture of cellular networks.
- CO5:** Summarize Emerging Trends such as cognitive radio networks, VANETs.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	2	-	-	1	-	-	1	1	-	-
CO2	2	1	2	-	2	-	-	1	1	-	-
CO3	2	1	-	-	1	-	-	1	1	-	-
CO4	2	-	2	-	2	-	-	1	1	-	-
CO5	2	2	1	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	-
CO2	2	-
CO3	1	-
CO4	1	-
CO5	1	-

UNIT – I

Introduction to Wireless Networks: Evolution of Wireless Networks, Basic Wireless Communication Concepts, Wireless Spectrum and Regulations, Wireless Network Architectures, Infrastructure Networks, Ad-Hoc Networks, Wireless Standards: IEEE 802.11, Bluetooth, Zigbee.

Practice:

2. Simulate an ad-hoc network using NS3.

UNIT – II

Wireless Communication Technologies: Radio Propagation Models, Modulation Techniques, Multiple Access Techniques: TDMA, FDMA, CDMA, OFDM Antennas and Diversity Techniques, MIMO (Multiple Input Multiple Output) Systems.

Practice:

2. Create multiple nodes, establish peer to peer connections, and analyze packet transmission using NS3.

UNIT – III

Wireless LANs and PANs: IEEE 802.11 Standards and Protocols, WI-FI Network Design and Deployment, Bluetooth and Zigbee Protocols, Security in Wireless LANs: WEP, WPA, WPA2, QoS (Quality of Service) in Wireless Networks.

Practice:

2. Simulate a basic GSM network using NS3.

UNIT – IV

Cellular Networks: Evolution from 1G to 5G, GSM, CDMA, and LTE Architectures, 5G Network Architecture and Key Technologies, Handoff and Roaming, Cellular Network Planning and Optimization.

Practice:

3. Set up and configure a Wi-Fi network using Wireshark.
4. Explore the signal strength and coverage area of a Wi-Fi network.

UNIT – V

Emerging Trends and Future Directions: Internet of Things (IoT) and Wireless Sensor Networks (WSNs), Cognitive Radio Networks, Vehicular Ad-hoc Networks (VANETs), Wireless Mesh Networks, Security and Privacy Challenges in Wireless Networks.

Text Books:

- 1 Wireless Communications: Principles and **Practice** by Theodore S. Rappaport, Prentice Hall 2nd Edition, ISBN: 9780130422323.
- 2 Wireless Communications by Andrea Goldsmith, Cambridge University Press, ISBN: 9780521837163.

Reference Books:

- 1 Principles of Wireless Access and Localization"by Kaveh Pahlavan and Prashant Krishnamurthy. Wiley-IEEE Press, ISBN: 9780470697085
- 2 802.11 Wireless Networks: The Definitive Guide by Matthew S. Gast, O'Reilly Media 2nd Edition, ISBN: 9780596100520
- 3 Wireless Communications, A. Molisch, Wiley, 2005 Haykin & Moher, Modern Wireless Communications, Pearson 2011 (Indian Edition)

Web Links:

- 1 https://onlinecourses.nptel.ac.in/noc22_ee85/preview/
- 2 Wireshark Network Protocol Analyzer [Wireshark](<https://www.wireshark.org/>)
- 3 NS3 Network Simulator [NS3] (<https://www.nsnam.org/>)

API & Micro Services
(Common to CSE, IT, AIML & CSE (DS))

Course Code: 2501AI24	L	T	P	C
	2	0	2	4

Course Outcomes:

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

- CO1:** Apply Dependency Injection principles using Constructor and Setter Injection.
- CO2:** Analyze Spring Boot fundamentals and Spring AOP
- CO3:** Apply transaction management and custom repository implementation
- CO4:** Explain web services using SOAP and REST
- CO5:** Evaluate the importance of exception handling and data validation in RESTful services

Mapping of Course Outcomes with Program Outcomes:

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	2	3	-	1	-	-	1	1	-	-
CO2	3	2	2	-	1	-	-	1	1	-	-
CO3	2	2	2	-	1	-	-	1	1	-	-
CO4	2	2	2	-	1	-	-	1	1	-	-
CO5	2	2	3	-	1	-	-	1	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/ PSO	PSO1	PSO2
CO1	2	-
CO2	1	-
CO3	2	-
CO4	1	-
CO5	1	-

UNIT – I

Spring 5 Basics: Why Spring, What is Spring Framework, Spring Framework - Modules, Configuring IoC container using Java-based configuration, Introduction To Dependency Injection, Constructor Injection, Setter Injection, What is Auto Scanning

Practice:

1. Setting up Spring Framework
 - a. Create a new Spring project using Spring Initializr.
 - b. Configure the project structure and dependencies.
 - c. Write a simple "Hello World" application using Spring
2. Spring Modules
 - a. Explore Spring Framework modules (e.g., Core, Data Access, Web).
 - b. Implement a simple data access application using Spring JDBC.
 - c. Create a web application using Spring MVC.

UNIT – II

Spring Boot: Creating a Spring Boot Application, Spring Boot Application Annotation, What is Auto wiring, Scope of a bean, Logger, Introduction to Spring AOP, Implementing AOP advices, Best Practices: Spring Boot Application

Practice:

1. Creating a Spring Boot Application with Auto Wiring and Logging
 - a. Create a new Spring Boot project using Spring Initializr.
 - b. Define two classes: Employee and EmployeeService.
 - c. Annotate EmployeeService with `@Service` and Employee with `@Component`.
 - d. Use `@Autowired` to inject Employee into EmployeeService.
 - e. Configure logging using Logback.
 - f. Write a test class to verify auto-wiring and logging.
2. Implementing AOP Advices in Spring Boot
 - a. Create a new Spring Boot project using Spring Initializr.
 - b. Define two classes: Student and StudentService.
 - c. Annotate StudentService with `@Service` and Student with `@Component`.
 - d. Implement AOP advice using `@Aspect` and `@Before`.
 - e. Apply AOP advice to StudentService methods.
 - f. Write a test class to verify AOP functionality.

UNIT – III

Spring Data JPA with Boot: Limitations of JDBC API, Why Spring Data JPA, Spring Data JPA with Spring Boot, Spring Data JPA Configuration, Pagination and Sorting, Query Approaches, Named Queries and Query, Why Spring Transaction, Spring Declarative Transaction, Update Operation in Spring Data JPA, Custom Repository Implementation, Best Practices-Spring Data JPA

Practice:

1. Setting up Spring Data JPA with Spring Boot
 - a. Create a new Spring Boot project.
 - b. Add Spring Data JPA dependency.
 - c. Configure database connection properties.
 - d. Create an entity class (e.g., User).
 - e. Create a repository interface (e.g., UserRepository).
 - f. Test CRUD operations
2. Pagination and Sorting with Spring Data JPA
 - a. Create a repository interface with pagination methods.
 - b. Use Pageable and Sort to implement pagination and sorting.
 - c. Test pagination and sorting functionality.
 - d. Implement custom sorting using `@Query`

UNIT – IV

Web Services: Why Web services, SOA-Service Oriented Architecture, What are Web Services, Types of Web Services, SOAP based Web Services, REST ful Web Services, How to create REST ful Services

Practice:

1. Creating a Simple RESTful Web Service
 - a. Create a new Spring Boot project.
 - b. Define a resource class (e.g., User).
 - c. Create a REST controller (e.g., UserController).
 - d. Implement CRUD operations.
 - e. Test using Postman or curl.
2. SOAP-based Web Service with Spring Boot
 - a. Create a new Spring Boot project.
 - b. Define a service interface (e.g., UserService).
 - c. Implement service using @Service.
 - d. Create a WSDL file.
 - e. Test using SoapUI.

UNIT – V

Spring REST: Spring REST - An Introduction, Creating a Spring REST Controller, @RequestBody and Response Entity, Parameter Injection, Usage of @PathVariable, @RequestParam and @MatrixVariable, Exception Handling, Data Validation, Creating a REST Client, Versioning a Spring REST endpoint, Enabling CORS in Spring REST, Securing Spring REST endpoints

Practice:

1. Creating a Simple Spring REST Controller
 - a. Create a new Spring Boot project.
 - b. Define a resource class (e.g., User).
 - c. Create a REST controller (e.g., UserController).
 - d. Implement CRUD operations.
 - e. Test using Postman or curl.
2. Using @RequestBody and Response Entity
 - a. Create a REST controller.
 - b. Use @RequestBody to accept JSON data.
 - c. Use Response Entity to return HTTP responses.
 - d. Test using Postman or curl.

Note: The student must Complete & Submit Spring5 Basics with Spring Boot, Spring DataJPA with Boot and Spring REST Certificate Course offered by Infosys Spring Board at the end of the Practice Session.

Text Books:

- 1 Spring in action, 5th Edition, Author: Craig Walls, Ryan Breidenbach, Manning, ISBN: 978-1617294945

Web Reference:

- 1 Dependency Injection in spring-javat point
- 2 Auto wiring in Spring- javat point
- 3 <https://docs.spring.io/spring-boot/docs/2.0.x/reference/html/using-boot-using-spring-boot-application-annotation.html>

- 4 Auto wiring in Spring – javat point,<https://www.baeldung.com/spring-bean-scopes>
- 5 Spring Boot Logging|How does logging works inspring boot with example (educba.com)
- 6 Spring AOP Tutorial|Aspect Oriented Programming-javat point
- 7 Spring Boot Best Practices(javaguides.net)
- 8 Introduction to Spring Data JPA | SpringHow
- 9 <https://asbnotebook.com/spring-data-jpa-crud-example/>,<https://www.bezkoder.com/spring-boot-jpa-crud-rest-api/>
- 10 Pagination and Sorting using Spring Data JPA – Paging And Sorting Repository (javaguides.net)
- 11 <https://www.javaguides.net/2018/11/spring-data-jpa-query-creation-from-method-names.html>,<https://www.javaguides.net/2022/02/spring-data-jpa-namedqueries-example.html>
- 12 <https://javadeveloperzone.com/spring/spring-declarative-transaction-management/>
- 13 <https://javadeveloperzone.com/spring/spring-declarative-transaction-management/>
- 14 <https://javabeat.net/spring-data-custom-repository/>
- 15 <https://www.jrebel.com/blog/jpa-application-performance-best-practices>
- 16 <https://www.javatpoint.com/service-oriented-architecture>,<https://www.javatpoint.com/web-services-tutorial>
- 17 <https://www.javatpoint.com/soap-web-services>,<https://www.javatpoint.com/restful-web-services>
- 18 RESTful Web Services - javatpoint
- 19 <https://www.javatpoint.com/restful-web-services-spring-boot>
- 20 <https://www.javatpoint.com/restful-web-services-spring-booth><https://dzone.com/articles/lifecycle-of-a-request-response-process-for-a-spri>
- 21 <https://www.ibm.com/docs/en/was/8.5.5?topic=applications-defining-uri-patterns-resources-in-restful>
- 22 <https://www.baeldung.com/exception-handling-for-rest-with-spring>
- 23 <https://howtodoinjava.com/spring-boot2/resttemplate/spring-restful-client-resttemplate-example/>
- 24 <https://www.javatpoint.com/restful-web-services-versioning>

Web Links:

- 1 https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01296689056211763272_shared/overview[Spring5BasicswithSpringBoot]
- 2 https://infyspringboard.onwingspan.com/en/app/toc/lex_4313461831752789500_shared/overvi ew[Spring DataJPAwithBoot]
- 3 https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01273190096390553619_0_shared/overview[SpringREST]

Cloud IoT & Edge ML
(Common to CSE, IT, AIML & CSE (DS))

Course Code: 2501CS25	L	T	P	C
	2	0	1	3

Course Outcomes:

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

- CO1:** Explain technologies behind the communication and management of fog and edge resources.
- CO2:** Discuss techniques for storage and computation in fog, edge, 5G and cloud
- CO3:** Implement Internet of Everything (IoE) applications through fog computing architecture.
- CO4:** Illustrate optimization strategies in fog and Edge Architectures.
- CO5:** Summarize applications in Fog and Edge Computing.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	1	2	-	-	2	-	-	2	2	-	2
CO2	2	2	-	-	2	-	-	2	2	-	2
CO3	1	2	3	-	2	-	-	2	2	-	2
CO4	2	1	1	3	2	-	-	2	2	-	2
CO5	2	1	1	-	2	-	-	2	2	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	-
CO2	1	-
CO3	1	-
CO4	-	2
CO5	-	2

UNIT – I

Internet of Things (IoT) and New Computing Paradigms: Introduction, Relevant Technologies, Fog and Edge Computing Completing the Cloud, Hierarchy of Fog and Edge Computing, Business Models, Edge Computing Platforms, Opportunities and Challenges.

Practice:

2. Building a Simple Edge Computing Application with Data Processing and Cloud Integration.

UNIT – II

Challenges in Federating Edge Resources: Introduction, Methodology, Integrated C2F2T Literature by Modeling Technique, Integrated C2F2T Literature by Use Case Scenarios, Integrated C2F2T Literature by Metrics, Threads, Standards.

Practice:

2. Setting Up a Simple IoT Device with Edge Computing

UNIT – III

Orchestration of Network Slices in Fog, Edge, and Clouds: Introduction, Background, Network Slicing, Network Slicing in Software, Defined Clouds, Network Slicing Management in Edge and Fog, Internet of Vehicles (IoV): Architecture, Protocols and Seven-layer security model architecture for Internet of Vehicles, IoV: Network Models, Challenges and future aspects.

Practice:

2. Implementing a Simple Network Slicing Scenario for Internet of Vehicles (IoV) Using Edge and Fog Computing.

UNIT – IV

Optimization Problems in Fog and Edge Computing: Preliminaries, The Case for Optimization in Fog Computing, Formal Modeling Framework for Fog Computing, Metrics, Further Quality Attributes, Optimization Opportunities along the Fog Architecture, Optimization Opportunities along the Service Life Cycle, Toward a Taxonomy of Optimization Problems in Fog Computing.

Practice:

2. Optimizing Task Scheduling in Fog Computing

UNIT – V

Applications of Fog and Edge Computing: Exploiting Fog Computing in Health Monitoring-Smart Surveillance Video Stream Processing at the Edge for Real - Time Human Objects Tracking-Fog Computing Model for Evolving Smart Transportation Applications - Testing Perspectives of Fog - Based IoT Applications - Legal Aspects of Operating IoT Applications in the Fog.

Practice:

2. Real-Time Human Object Tracking Using Fog Computing in a Smart Surveillance System

Text Books:

- 1 Fog and Edge computing: Principles and Paradigms ,Buyya, Rajkumar, and Satish Narayana Srirama, John Wiley & Sons, USA, 1st edition, 2019, ISBN: 978-1-119-52498-4.
- 2 Internet of Things –From Research and Innovation to Market Deployment, OvidiuVermesan, Peter Friess, “River Publishers, India, 1st edition, ISBN: 978-8793102941

Reference Books:

- 1 Cloud computing: A hands-on approach, Bahga, Arshdeep, and Vijay Madisetti , CreateSpace Independent Publishing Platform, USA, 2nd edition, ISBN: 978-1494435141

Web Links:

- 1 https://onlinecourses.nptel.ac.in/noc24_cs66/preview

Ethical Hacking
(Common to CSE, IT, AIML & CSE (DS))

Course Code: 2501CS28	L	T	P	C
	2	0	2	4

Course Outcomes:

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

- CO1:** Describe the concepts and types of Ethical hacking
- CO2:** Apply tools and techniques for Social Engineering.
- CO3:** Illustrate concepts of data security for various networking systems
- CO4:** Analyze techniques to protect Web servers and Communication Systems
- CO5:** Demonstrate ethical laws and tests related to ethical hacking

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	1	-	-	-	-	-	1	1	-	1
CO2	2	2	-	1	2	-	-	1	1	-	2
CO3	2	2	-	2	-	-	-	1	1	-	1
CO4	2	2	-	-	1	-	-	1	1	-	2
CO5	2	2	-	-	-	-	2	1	1	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

UNIT – I

Ethical Hacking: Types of Data Stolen From the Organizations, Elements of Information Security, Authenticity and NonRepudiation, Security Challenges, Effects of Hacking, Hacker – Types of Hacker, Ethical Hacker, Hactivism - Role of Security and Penetration Tester, Penetration Testing Methodology, Networking & Computer Attacks – Malicious Software (Malware), Protection Against Malware, Intruder Attacks on Networks and Computers, Addressing Physical Security – Key Loggers and Back Doors.

Practice:

3. Create a social networking website login page using phishing techniques
4. Sniffing tools to analyze traffic on a network and dissect information.

UNIT – II

Foot Printing And Social Engineering: Web Tools for Foot Printing, Conducting Competitive Intelligence, Google Hacking, Scanning, Enumeration, Trojans & Backdoors,

Virus & Worms, Proxy & Packet Filtering, Denial of Service, Sniffer, Social Engineering – shoulder surfing, Dumpster Diving, Piggybacking.

Practice:

3. Social Engineering Countermeasures
4. Tools for Foot Printing

UNIT – III

Data Security: Physical Security – Attacks and Protection, Steganography – Methods, Attacks and Measures, Cryptography– Methods and Types of Attacks, Wireless Hacking, Windows Hacking, Linux Hacking.

Practice:

3. Write a code to demonstrate DoS attacks
4. Windows ,Linux OS hacking

UNIT – IV

Network Protection System & Hacking Web Servers: Routers, Firewall & Honeypots, IDS & IPS, Web Filtering, Vulnerability, Penetration Testing, Session Hijacking, Web Server, SQL Injection, Cross Site Scripting, Exploit Writing, Buffer Overflow, Reverse Engineering, Email Hacking, Incident Handling & Response, Bluetooth Hacking, Mobiles Phone Hacking.

Practice:

3. Write a script or code to demonstrate SQL injection attacks
4. Setup a honey pot and monitor the honey pot on network

UNIT – V

Ethical Hacking Laws And Tests: An introduction to the particular legal, professional and ethical issues likely to face the domain of ethical hacking, ethical responsibilities, professional integrity and making appropriate use of the tools and techniques associated with ethical hacking – Social Engineering, Host Reconnaissance, Session Hijacking, Hacking - Web Server, Database, Password Cracking.

Practice:

3. Study of Techniques uses for Web Based Password Capturing
4. Study on how to register a Cyber Crime Complaint through online.(
https://cybercrime.gov.in/Webform/Crime_AuthoLogin.aspx)

Text Books:

- 1 Hands-On Ethical Hacking and Network Defense, Corley, Michael T. Simpson, Kent Backman, James E., CENGAGE Learning, ISBN: 1133169031
- 2 Penetration Testing and Network Defense ,Whitaker & Newman , Cisco Press, Indianapolis, ISBN: 1-58705-208-3

Reference Books:

- 1 Official Certified Ethical Hacker Review Guide, Steven DeFino, Barry Kaufman, Nick Valenteen, CENGAGE Learning, ISBN: 978-1435488533.
- 2 The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy, Patrick Engebretson, Syngress Basics Series – Elsevier, ISBN: 978-0124116443.

Web Links:

- 1 <https://www.springboard.com/blog/cybersecurity/7-free-sources-to-learn-ethical-hacking-from-scratch/>
- 2 <https://hackernoon.com/top-resources-to-learn-ethical-hacking3>
- 3 https://onlinecourses.nptel.ac.in/noc22_cs13/preview

Software Quality Assurance
(Common to CSE, IT, AIML & CSE(DS))

Course Code: 2501IT22	L	T	P	C
	2	0	1	3

Course Outcomes:

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

- CO1:** Know role of software quality and its challenges.
- CO2:** Implement quality plans in software development.
- CO3:** Apply strategies in project life cycle
- CO4:** Implement necessary testing techniques for quality assurance.
- CO5:** Choose quality metrics for quality assurance.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1:	3	-	-	-	1	-	-	1	-	-	-
CO2:	3	1	-	1	-	-	-	1	-	-	-
CO3:	1	3	-	1	-	-	-	1	1	-	-
CO4:	3	-	1	-	-	-	-	1	1	-	3
CO5:	-	1	-	-	-	-	-	1	1	-	3

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1:	2	-
CO2:	1	-
CO3:	1	-
CO4:	2	-
CO5:	1	-

UNIT – I

Introduction to software Quality and Assurance: The software quality challenge, Software quality, Software quality factors Management and its role in software quality assurance.

Case Study: NASA's Mars Climate Orbiter

UNIT – II

Components of SQA: The components of the software quality assurance system – overview
Pre-project Software Quality Components: Contract review, Development and quality plans.

Case Study: Boeing 787 Dreamliner Development

UNIT – III

SQA Components in the Project Life Cycle and Strategies: Integrating quality activities in

the project life cycle, Reviews, Software testing – strategies

Case Study: Agile Development at Spotify

UNIT – IV

Software Testing – Implementation: Software Quality Implementation, Assuring the quality of software maintenance components, Assuring the quality of external participants' contributions, CASE tools and their effect on software quality.

Case Study: Google's Software Maintenance and External Contributions

UNIT – V

Software Quality Infrastructure Components: Procedures and work instructions, Staff training and certification, Corrective and preventive actions, Documentation control

Software Quality Metrics: Software Quality metrics, Cost of Quality.

Case Study: Toyota's Software Quality in Automotive Systems

Text Books:

- 1 Software Quality Assurance, Daniel Galin, Pearson Publication, ISBN: 978-0201709452

Reference Books:

- 1 Kshirsagar Naik and Priyadarshi Tripathy, Software Testing & Quality Assurance Theory and Practice, Wiley Student edition, ISBN: 978-0471789116
- 2 William E. Perry, Effective Methods for Software Testing, WILEY . 3rd Edition, ISBN: 978-8126508938
- 3 Alan C. Gillies, “Software Quality: Theory and Management”, International Thomson Computer Press, ISBN: 9781850323129

Web Links:

- 1 <https://www.geeksforgeeks.org/software-engineering-software-quality-assurance/>
- 2 <https://nptel.ac.in/courses/106105218>

Minor Stream: Cloud Infrastructure (Certification Programs - CISCO, Red hat, Oracle, AWS, Google & Microsoft)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CS68	Enterprise Linux Fundamentals	FC			2	2	50	50	100	-
2501CS58	Linux System Administration	FC			3	3	50	50	100	-
2501CS59	Introduction to Cloud Networking	FC	1		3	4	50	50	100	-
2501CS60	Routing & Switching Essentials	FC			3	3	50	50	100	-
2501CS62	Advanced Cloud Networking	IC	1		3	4	50	50	100	-
2501CS67	Introduction to Cloud Computing Core Concepts	IC			3	3	50	50	100	-
2501CS61	Cloud Architecture & Platform Services	FC			3	3	50	50	100	-
2501CS63	Enterprise Cloud Infrastructure	IC			3	3	50	50	100	-
2501CS69	Cloud Security	IC	1		3	4	50	50	100	-
2501CS64	Machine Learning Services on Cloud	IC			3	3	50	50	100	-
Total			3		29	32				

Enterprise Linux Fundamentals
(Common to CSE, IT, AIML & CSE(DS))

Course Code: 2501CS68	L	T	P	C
	0	0	2	2

Course Outcomes:

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

- CO1:** Apply basic and advanced Linux commands to install RHEL, manage files, and edit text using the command line.
- CO2:** Explain how to manage users, processes, services, and network settings in a Linux environment.
- CO3:** Describe how file permissions work and how software packages are managed in a Linux system.
- CO4:** Analyze system performance and configure basic network services in a Linux environment.
- CO5:** Implement remote administration and system maintenance tasks to ensure security and stability in a Linux environment.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	-	2	-	3	-	-	-	-	-	2
CO2	3	2	2	-	2	-	-	-	-	-	2
CO3	3	-	2	-	2	-	-	-	-	-	1
CO4	3	3	2	2	2	-	-	-	-	-	2
CO5	3	2	2	-	3	-	-	-	-	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	1
CO4	-	2
CO5	-	1

Practice:

- 1. Installation and Basic Commands**
 - a. Install RHEL: Set up RHEL on your system, configure installation options, and create user accounts.
 - b. Execute Basic Commands: commands like `ls`, `cd`, `pwd`, and `man`
- 2. File Management and Text Editing**
 - a. File and Directory Management: Explore `mkdir`, `cp`, `mv`, and `rm`.
 - b. Text Editing: Use `nano` or `vim` to create and modify text files.
- 3. Advanced Command Line Operations**

- a. Redirection and Pipes: Understand ``>``, ``>>``, ``|``.
 - b. Wildcards: Learn about ``*``, ``?``.
4. **User and Group Management**
 - a. User Accounts: Create, modify, and delete users.
 - b. Groups and Permissions: Understand ownership and permissions.
 5. **Process and Service Management**
 - a. Process Management: Explore ``ps``, ``top``, and ``kill``.
 - b. Services^{**}: Start, stop, and manage services (daemons).
 6. **Network Configuration and Security**
 - a. Network Interfaces: Configure network settings (`ifconfig`, `ip`).
 - b. Firewalls and Security: Learn about `firewalld` and network services.
 7. **File System Permissions**
 - a. File Permissions: Master `chmod`, `chown`.
 - b. Access Control Lists (ACLs): Understand extended permissions.
 8. **Software Packages and Updates**
 - a. Package Management: Use `yum` or `dnf` to install, update, and remove software.
 - b. Repositories and Dependencies: Explore package sources.
 9. **Server Analysis and Support**
 - a. Performance Analysis: Use tools like `top`, `htop`, and system logs.
 - b. Seeking Support: Understand how to get help from Red Hat or the community.
 10. **Network Services Configuration**
 - a. Static IP Addresses: Configure networking.
 11. **Remote Administration with SSH**
 - a. SSH: Secure remote access using key-based authentication.
 - b. Secure Communication: Understand encryption.
 12. **System Maintenance and Security**
 - a. Maintenance Tasks: Perform backups, log rotation, and routine maintenance.
 - b. Security Updates: Regularly apply patches and keep the system secure.

Additional Practice

1. **Basic Shell Commands Practice**

Objective: Familiarize yourself with basic shell commands by performing file operations, navigating directories, and manipulating text files.

Skills: Command-line proficiency, file management, text processing.
2. **User and Group Management**

Objective: Learn to manage users and groups on a Linux system by adding, modifying, and removing users, and setting permissions.

Skills: User account management, permission setting, group policies.
3. **Package Management**

Objective: Learn to use the package manager of your Linux distribution to install, update, and remove software packages.

Skills: Familiarity with apt, yum, or pacman, software lifecycle management.

Text books:

- 1 Redhat Enterprise Linux 9, Vishesh kumar, Gitanjali Mehra

Reference Books:

- 1 The Linux Command Line: A complete Introduction 1st Edition by William E. Shotts
- 2 Linux command Line and Shell Scripting Bible 4th Edition by Richard Blum, Christine Bresnahan
- 3 Linux Administration: A Beginner's Guide, Eighth Edition by Wale Soyinka
- 4 Red Hat System Administration I (RH 124) by Red Hat Press

Web Links:

- 1 <https://www.redhat.com/en/topics/linux>
- 2 <https://www.freecodecamp.org/news/manage-users-and-groups-in-rhel/>
- 3 https://access.redhat.com/documentation/en-us/red_hat_enterprise_linux/9/html-single/configuring_and_managing_networking/index
- 4 https://access.redhat.com/documentation/en-us/red_hat_enterprise_linux/9/html/configuring_basic_system_settings/managing-file-system-permissions_configuring-basic-system-settings
- 5 <https://www.cyberciti.biz/faq/redhat-network-interface-configuration/>
- 6 <https://www.koenig-solutions.com/red-hat-enterprise-linux-diagnostics-troubleshooting-training-certification>

Linux System Administration
(Common to CSE, IT, AIML & CSE(DS))

Course Code: 2501CS58	L	T	P	C
	0	0	3	3

Course Outcomes:

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

- CO1:** Explain different network topologies and transmission types, and access network settings in Windows and Linux.
- CO2:** Implement tools like Packet Tracer and Wireshark to design networks and analyze traffic and device details
- CO3:** Identify network device addresses, build switch/router networks, and calculate and design IPv4 subnet schemes using FLSM.
- CO4:** Configure IP addressing using VLSM and IPv6, and verify network connectivity and DNS resolution.
- CO5:** Secure network devices by researching threats and configuring encrypted remote access using SSH.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	-	-	-	2	-	-	-	1	-	-
CO2	2	2	2	-	3	-	-	-	1	-	-
CO3	2	-	3	-	2	-	-	-	1	-	-
CO4	3	2	2	-	2	-	-	-	1	-	-
CO5	3	-	-	-	2	1	-	-	2	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	1
CO3	-	2
CO4	-	2
CO5	-	1

Practice:

1.
 - a. Navigate the IOS by Using Tera Term for Console Connectivity
 - b. Working with network topologies.
2.
 - a. Basic Switch and End Device Configuration
 - b. Unicasting vs Multicasting vs Broadcasting
3.
 - a. Understand and explore Half duplex and full duplex devices.
 - b. Accessing Network settings in Windows and Linux OS
4.
 - a. Install and work with Cisco Packet tracer

- b. Design a Communications System
5.
 - a. Install and configure Wireshark.
 - b. Use Wireshark to Monitor Network Traffic
6.
 - a. View Wired and Wireless NIC Information
 - b. Use Wireshark to Examine Ethernet Frames
7.
 - a. View Network Device and Switch MAC Addresses
 - b. Build a Switch and Router Network
8.
 - a. Calculate IPv4 Subnets
 - b. Design and Implement a FLSM Addressing Scheme
9.
 - a. Design and Implement a VLSM Addressing Scheme
 - b. Identify and configure IPv6 Addresses
10.
 - a. Use Ping and Traceroute to Test Network Connectivity
 - b. Understand and observe DNS Resolution
11.
 - a. Research Network Security Threats
 - b. Configure Network Devices with SSH
12.
 - a. SSH vs Telnet connections
 - b. Secure Network Devices

Additional Practice:

1. Test Network Latency with Ping and Traceroute
2. Troubleshoot Connectivity Issues
3. Design and Build a Small Network

Text Books:

- 1 CCNA Routing and Switching study guide, Todd Lammle, ISBN: 978-1119288282

Reference Books:

- 1 CCNA 200-301 Official Cert Guide Network Simulator, Wendell Odom & Sean Wilkins from Cisco Press, ISBN: 978-0137837748

Web Links:

- 1 <https://learningnetwork.cisco.com/s/ccna>
- 2 <https://netacad.com>

Introduction to Cloud Networking
(Common to CSE, IT, AIML & CSE(DS))

Course Code: 2501CS59	L	T	P	C
	1	0	3	4

Course Outcomes:

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

- CO1:** Execute basic Bash scripts to automate simple tasks.
- CO2:** Schedule and manage automated tasks using cron jobs, systemd timers, and the at command.
- CO3:** Configure time synchronization and secure file transfer, and apply performance monitoring tools to optimize system operations
- CO4:** Analyze SELinux policies and network storage configurations to evaluate and improve system security and accessibility
- CO5:** Implement firewall rules and deploy containerized applications to ensure system security and scalability

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	3	2	-	2	-	-	-	-	-	1
CO2	2	3	2	-	3	-	-	-	-	-	1
CO3	2	2	3	-	3	-	-	-	-	-	1
CO4	2	2	3	-	2	-	-	-	-	-	1
CO5	2	3	3	-	3	-	-	-	-	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	1
CO2	-	2
CO3	-	2
CO4	-	1
CO5	-	1

Practice:

1. Bash Scripting Basics

- Learn basic Bash scripting syntax and commands.
- a. Write a simple Bash script.

2. Advanced Bash Scripting

- a. Explore functions, loops, and conditionals in Bash.
- b. Automate directory backup with timestamped archive file.

3. Regular Expressions and Text Processing

- Understand regular expressions and their use in text processing.
- a. Parse log files and extract information using regular expressions.

- 4. Cron Jobs and Scheduled Tasks**
 - a. Learn and understand the importance of Cron Jobs
 - b. Exercise: Schedule a cron job to clean up temporary files.
- 5. Systemd Timers and At Command**
 - a. Compare systemd timers with cron jobs.
 - b. Use systemd timers for recurring tasks and at command for one-time tasks.
- 6. Log Analysis with Syslog and Journalctl**
 - a. Analyze system logs using syslog and journalctl.
 - b. Troubleshoot common system issues using log analysis tools.
- 7. Time Synchronization and Secure File Transfer**
 - a. Configure NTP for time synchronization.
 - b. Set up SSH for secure file transfer using SCP or SFTP.
- 8. Performance Monitoring and Tuning**
 - a. Monitor system performance with tools like top, iotop, or vmstat.
 - b. Identify bottlenecks and optimize system performance.
- 9. SELinux Policies and Contexts**
 - a. Configure SELinux for enhanced security.
 - b. Troubleshoot SELinux denials and configure policies.
- 10. Network Configuration with NFS or Samba**
 - a. Set up network storage using NFS or Samba.
 - b. Verify connectivity and access permissions for NAS.
- 11. Firewall Management**
 - a. Manage server firewalls with firewalld or iptables.
 - b. Define rules for traffic management and ensure network security.
- 12. Container Deployment with Docker or Podman**
 - a. Deploy containers using Docker or Podman.
 - b. Create containerized applications and manage container images.

Additional Practice:

1. Disk Usage Analysis Script

Objective: Write a script that analyzes disk usage by directories and outputs a report of the top 5 directories consuming the most disk space.

Skills: Bash scripting, disk usage commands (du, sort, head), output formatting

2. System Backup and Recovery

Objective: Set up an automated system backup process using tools like rsync or tar, and test system recovery from the backup.

Skills: Backup tools, cron scheduling, disaster recovery planning

3. File System Management

Objective: Experiment with different Linux file systems (e.g., ext4, xfs, btrfs) by creating, mounting, and managing file system volumes, and compare their performance and features.

Skills: File system operations, performance benchmarking, feature comparison

Reference Books:

- 1 The Linux Command Line: A Complete Introduction 1st Edition by William E. Shotts, ISBN: 978-1593273897
- 2 Advanced Bash Scripting Guide – Volume 1: An in-depth exploration of the art of shell scripting by Mendel Cooper, ISBN: 978-1706400394
- 3 Linux Debugging and Performance Tuning: Tips and Techniques by Steve Best, ISBN: 978-0131492479
- 4 Podman in Action: Secure, rootless containers for Kubernetes, microservices, and more by Daniel Walsh, ISBN: 978-1633439689

Web Links:

- 1 <https://www.gnu.org/software/bash/manual/>
- 2 <https://hackersvanguard.com/establishing-persistence-systemd-timers/>
- 3 <https://www.pcmatic.com/blog/how-to-secure-your-linux-server/>
- 4 https://access.redhat.com/documentation/en-us/red_hat_enterprise_linux/4/html/reference_guide/index
- 5 <https://docs.azul.com/prime/RHEL-Performance-Tuning-Options>
- 6 https://access.redhat.com/documentation/en-us/red_hat_enterprise_linux/8/html-single/building_running_and_managing_containers/index

Routing & Switching Essentials
(Common to CSE, IT, AIML & CSE(DS))

Course Code: 2501CS60	L	T	P	C
	0	0	3	3

Course Outcomes:

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

- CO1:** Explain how switches and routers are connected and configured in a basic network setup.
- CO2:** Implement static and dynamic routing, VLANs, and trunking to enable efficient network communication.
- CO3:** Recall the concepts of Inter-VLAN routing, EtherChannel, and Spanning Tree Protocol used in network configuration
- CO4:** Explain the concepts of port security, DHCP configuration, and switch security in a network environment.
- CO5:** Implement remote access, wireless networks, and static routing using IPv4 and IPv6 for secure and efficient network communication.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	-	-	2	-	-	-	-	-	-
CO2	3	2	3	2	3	-	-	-	-	-	2
CO3	2	1	-	-	2	-	-	-	-	-	-
CO4	3	2	2	-	2	-	-	-	-	-	-
CO5	3	2	3	-	3	-	-	-	-	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	1
CO3	-	1
CO4	-	2
CO5	-	1

Practice:

1.
 - a. Basic Switch Configuration
 - b. Connecting switches to network

2.
 - a. Switch cabling and topology
 - b. Configure Basic Router Settings

3.
 - a. Connecting router to network
 - b. Router connections and setup

4.
 - a. Static routing configuration

- b. Configure and setup dynamic routing
5.
 - a. Understanding Dynamic Trunking Protocol
 - b. Configure VLANs and Trunking
6.
 - a. Implement VLANs and Trunking
 - b. Implement Inter-VLAN Routing
7.
 - a. Configuring Inter-VLAN using Router on Stick
 - b. Working with router sub interfaces
8.
 - a. Implementing Etherchannel
 - b. Configure and Setup Spanning Tree Protocol
9.
 - a. Port security in switches
 - b. Configuring DHCPv6
10.
 - a. Implementing DHCPv4
 - b. Switch Security Configuration
11.
 - a. Remote connections to switches.
 - b. Configure a Wireless Network
12.
 - a. Configure IPv4 and IPv6 Static and Default Routes
 - b. Wireless security setup and implementation

Additional Practice:

1. Troubleshoot Inter-VLAN Routing
2. Troubleshoot IPv4 and IPv6 Static and Default Routes
3. Troubleshoot wireless issues

Textbooks:

- 1 CCNA Routing and Switching study guide, Todd Lammle, ISBN : 978-1119288282

Reference Books:

- 1 CCNA 200-301 Official Cert Guide Network Simulator, Wendell Odom & Sean Wilkins from Cisco Press, ISBN: 978-0137837748

Web Links:

- 1 <https://learningnetwork.cisco.com/s/ccna>
- 2 <https://netacad.com>

Advanced Cloud Networking
(Common to CSE, IT, AIML & CSE(DS))

	L	T	P	C
Course Code: 2501CS62	1	0	3	4

Course Outcomes:

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

- CO1:** Recall basic routing concepts and OSPF configurations used in network communication.
- CO2:** Explain EIGRP, OSPF, and BGP protocols, and describe basic network security threats.
- CO3:** Describe IPv4 ACLs, NAT configuration, and explain broadband access and network monitoring tools.
- CO4:** Manage router configuration files using Tera Term, TFTP, Flash, and USB tools.
- CO5:** Apply QoS techniques, enterprise network designs, and configure eBGP and VPNs with proper documentation.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	-	-	1	-	-	-	-	-	2
CO2	3	2	-	-	2	-	-	-	-	-	2
CO3	3	2	-	-	3	-	-	-	-	-	2
CO4	2	3	2	-	3	-	-	-	-	-	2
CO5	2	3	3	2	3	-	-	-	2	2	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	1
CO2	-	2
CO3	-	1
CO4	-	1
CO5	-	2

Practice:

1.
 - a. Understanding challenges in Routing Information Protocol
 - b. Static vs Dynamic vs Default routes

2.
 - a. Understanding Router IDs, AS numbers and Routing tables
 - b. Configure Single-Area OSPFv2

3.
 - a. Configure Multi area OSPFv2
 - b. Implementing OSPFv3 with IPv6

4.
 - a. Configure and setup EIGRP
 - b. OSPF stages and troubleshooting

5.
 - a. Troubleshooting EIGRP issues
 - b. OSPF vs EIGRP vs BGP protocols
6.
 - a. Analyze Social Engineering Attack vector
 - b. Explore DNS Traffic
7.
 - a. Configure and Verify Extended IPv4 ACLs
 - b. Configure NAT for IPv4
8.
 - a. Research Broadband Internet Access Technologies
 - b. Research Network Monitoring Software
9.
 - a. Use Tera Term to Manage Router Configuration Files
 - b. Use TFTP, Flash, and USB to Manage Configuration Files
10.
 - a. Research Password Recovery Procedures
 - b. Understanding software defined networking
11.
 - a. Quality of Service mechanisms for secure remote access
 - b. Enterprise network design and implementation
12.
 - a. Configuring eBGP and VPN in Cisco routers
 - b. Network documentation methodologies

Additional Practice:

1. Configure CDP, LLDP, and NTP
2. Install GNS3 and create routing topologies
3. Troubleshooting routing issues

Textbooks:

- 1 CCNA Routing and Switching study guide, Todd Lammle, ISBN: 978-1119288282

Reference Books:

- 1 CCNA 200-301 Official Cert Guide Network Simulator, Wendell Odom & Sean Wilkins from Cisco Press, ISBN: 978-0137837748

Web Links:

- 1 <https://learningnetwork.cisco.com/s/ccna>
- 2 <https://netacad.com>

Introduction to Cloud Computing Core Concepts
(Common to CSE, IT, AIML & CSE(DS))

Course Code: 2501CS67	L	T	P	C
	0	0	3	3

Course Outcomes:

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

- CO1:** Apply cloud cost estimation, user management, and security concepts using AWS tools and services.
- CO2:** Explain the components and configuration of Virtual Private Cloud (VPC) and its security features in AWS.
- CO3:** Describe how network access control, EC2 instances, and VPC peering are used to manage and secure cloud networks
- CO4:** Implement serverless functions, website deployment, and storage services using AWS tools.
- CO5:** Apply AWS services like EC2 snapshots, autoscaling, load balancing, and CloudFormation to manage cloud infrastructure.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	-	2	-	3	1	-	-	1	-	2
CO2	2	-	-	-	2	-	-	-	1	-	2
CO3	2	1	2	-	2	-	-	-	1	-	2
CO4	2	-	3	-	3	-	-	-	1	-	2
CO5	3	2	3	-	3	-	-	-	1	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	1
CO2	-	1
CO3	-	2
CO4	-	2
CO5	-	1

Practice:

1.
 - a. Calculate Total Cost of Ownership
 - b. Use AWS Pricing calculator to estimate multiple pricing models.
2.
 - a. Differentiate between AWS and customer responsibilities using Shared Responsibility Model
 - b. User Management using Identity and Access Management
3.
 - a. Securing IAM user accounts.
 - b. IPv4 and IPv6 implementation in cloud

4.
 - a. Design Virtual Private Cloud
 - b. Configure NAT gateway.
5.
 - a. Implementing Internet Gateway in AWS Cloud
 - b. Working with bastion host.
6.
 - a. Create and manage Private & Public subnets.
 - b. Secure VPC using Security Groups
7.
 - a. Implement Network Access Control lists to control traffic.
 - b. Build VPC and launch a web server.
8.
 - a. Launch EC2 instances in two different regions and connect.
 - b. Create multiple VPCs and peer them using VPC peering.
9.
 - a. Create and trigger AWS Lambda functions.
 - b. Use AWS lambda to automate EC2 instance behavior.
10.
 - a. Website deployment using AWS Elastic Beanstalk
 - b. Working with Elastic Block Storage
11.
 - a. Creating and working with EC2 snapshots.
 - b. Configure autoscaling for application deployed in AWS Cloud
12.
 - a. Load balance application deployed in AWS Cloud
 - b. Basic implementation of Infrastructure as Code using AWS CloudFormation

Additional Practice:

1. Working with Elastic File System
2. Working with S3 Buckets and Objects
3. Build a database server

Textbooks:

- 1 AWS Certified Cloud Practitioner study guide, Ben Piper & David Clinton, ISBN: 978-1119490708

Reference Books:

- 1 AWS Certified Cloud Practitioner cert guide, Anthony J Sequeira, by Pearson Education, ISBN: 978-9353945367

Web Links:

- 1 <https://skillbuilder.aws/>
- 2 <https://aws.amazon.com/training/awsacademy/>

Cloud Architecture & Platform Services (Common to CSE, IT, AIML & CSE(DS))

Course Code: 2501CS61	L	T	P	C
	0	0	3	3

Course Outcomes:

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

- CO1:** Identify basic concepts of virtualization, cloud computing, and virtual machine setup using Azure and Linux.
- CO2:** Recognize the basic functions of virtual networks, storage accounts, and load balancers in a cloud environment.
- CO3:** Recall the basic concepts of auto scaling and resource monitoring in Azure.
- CO4:** Explain the use of app services, databases, and Active Directory for managing cloud applications and access.
- CO5:** Implement backup, site recovery, and ARM templates to manage cloud infrastructure and protect data.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	-	2	-	2	-	-	-	-	-	-
CO2	3	-	2	-	2	-	-	-	-	-	-
CO3	2	-	2	-	2	-	-	-	-	-	-
CO4	3	2	2	-	2	-	-	-	-	-	-
CO5	3	2	3	-	3	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	1
CO2	-	2
CO3	-	2
CO4	-	1
CO5	-	1

Practice:

1.
 - a. Introduction to Virtualization
 - b. Oracle virtual box installation and setup ubuntu
 - c. Operating systems introduction and Linux commands
 - d. Networking fundamentals & Storage classes

2. Basics of Cloud Computing
 - a. Cloud introduction & overview
 - b. Azure global infrastructure
 - c. Cloud deployment models & services

3. Virtual Machines
 - a. Microsoft Azure account creation.
 - b. Azure VM's exploration.
 - c. Ubuntu VM creation and working
 - d. Static website hosting using linux os
4. Virtual Networking
 - a. Virtual Network setup
 - b. Virtual Network peering with different regions
 - c. Nat gateway setup
 - d. Security groups creation
5. Storage Accounts
 - a. Introduction to storage
 - b. Storage Accounts creation
 - c. Static website hosting in SA
 - d. Working with file shares
6. Load Balancers
 - a. Setting up Regional Load Balancer among different vm's
 - b. Setting up Global Load Balancer among different Regions
7. Auto Scaling
 - a. Creating auto scale set vm for the application by using load balancers.
8. Monitoring
 - a. Monitor the resources using azure monitor.
 - b. Creating notifications using notification services.
9. App Services & Databases
 - a. Creation of serverless service apps.
 - b. Creating SQL database
 - c. Creating cosmos database
10. Active Directory
 - a. IAM users' creation .
 - b. Accessing services with AD.
11. Backup & Site recovery
 - a. Data backup concepts & implementation.
 - b. Site recovery with Azure.
12. ARM Templates
 - a. Creation of vm's with arm templates .
 - b. Creation of vnet's with arm templates

Reference Books:

- 1 Microsoft Azure Fundamentals AZ-900 Exam Reference, Jim Cheshire, Microsoft Press, **ISBN: 9780137905923**

Web Links:

- 1 <https://azure.microsoft.com/en-in/get-started/azure-portal>

Enterprise Cloud Infrastructure
(Common to CSE, IT, AIML & CSE(DS))

Course Code: 2501CS63	L	T	P	C
	0	0	3	3

Course Outcomes:

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

- CO1:** Recall the basic concepts of cloud computing, Oracle Cloud Infrastructure, and its core networking components.
- CO2:** Identify basic concepts of Oracle Cloud and its main networking parts.
- CO3:** Explain the basics of Oracle database services, backup and security features in Oracle Cloud Infrastructure.
- CO4:** Describe how monitoring, alerts, and security features like MFA are used in Oracle Cloud
- CO5:** Implement infrastructure automation and resource optimization using Terraform and Oracle Cloud tools.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	-	2	-	2	-	-	-	-	-	-
CO2	3	-	2	-	2	-	-	-	-	-	-
CO3	3	2	2	-	2	-	-	-	-	-	-
CO4	3	2	2	-	2	-	-	-	-	-	-
CO5	3	2	3	2	3	-	-	-	-	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

Practice:

1.
 - a. Introduction to Cloud Computing and Oracle Cloud Infrastructure (OCI).
 - b. Understanding Cloud Service Models: IaaS, PaaS, SaaS.
2.
 - a. Oracle Cloud Global Infrastructure: Regions and Availability Domains.
 - b. Core Concepts: Tenancy, Compartments, and Resource Management
3.
 - a. Networking in Oracle Cloud: Virtual Cloud Networks (VCNs)
 - b. Configuring and Managing Subnets, Gateways, and Route Tables
4.
 - a. Identity and Access Management (IAM) in Oracle Cloud
 - b. Implementing Policies and Managing Access

5.
 - a. Compute Services: Managing Virtual Machines and Bare Metal Instances
 - b. Auto Scaling and Load Balancing in Oracle Cloud
6.
 - a. Storage Solutions in Oracle Cloud: Block, Object, and File Storage
 - b. Configuring and Managing Storage Volumes
7.
 - a. Database Services: Oracle Autonomous Database, Oracle DB Systems
 - b. Backup, Recovery, and High Availability in Oracle Databases
8.
 - a. Security in Oracle Cloud: Understanding Security Zones and Policies
 - b. Data Encryption and Key Management in OCI
9.
 - a. Monitoring and Logging in Oracle Cloud
 - b. Setting Up Alerts and Notifications for Resource Management
10.
 - a. Oracle Cloud Identity and Security Operations
 - b. Implementing Multi-Factor Authentication (MFA) and Secure Access
11.
 - a. Managing and Orchestrating Cloud Resources with Terraform on OCI
 - b. Automating Infrastructure Deployment using OCI Resource Manag
12.
 - a. Oracle Cloud Governance: Budgets, Cost Management, and Tags
 - b. Using Oracle Cloud Advisor for Resource Optimization

Additional Practice:

1. Configuring and Managing an Oracle Autonomous Database
2. Implementing a Secure VCN in Oracle Cloud
3. Automating Resource Deployment with Terraform on Oracle Cloud

Textbooks:

1. Oracle Cloud Infrastructure Foundations, Rohit Gupta, by Packt Publishing

Reference Books:

1. Oracle Cloud Infrastructure Architect Associate, Roopesh Ramklass, by Oracle Press, ISBN: 978-126045259

Web Links:

1. <https://www.oracle.com/cloud/>
2. <https://cloud.oracle.com/tryit>

Cloud Security
(Common to CSE, IT, AIML & CSE(DS))

Course Code: 2501CS69	L	T	P	C
	1	0	3	4

Course Outcomes:

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

- CO1:** Explain basic cloud security principles, attack vectors, and access control methods in cloud environments.
- CO2:** Illustrate IAM roles, policies, and resource-based permissions used to secure cloud infrastructure.
- CO3:** Apply AWS security services and configurations to monitor, protect, and manage cloud network resources.
- CO4:** Implement data protection methods and access controls to secure cloud storage and network resources using AWS services.
- CO5:** Analyze monitoring, vulnerability assessment, and threat protection techniques to secure applications and resources in AWS.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	-	-	-	2	1	-	-	1	-	2
CO2	2	1	-	-	2	1	-	-	1	-	2
CO3	3	2	2	-	3	-	-	-	1	-	2
CO4	3	2	2	-	3	-	-	-	1	-	2
CO5	3	3	2	-	3	-	-	-	2	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	1
CO4	-	1
CO5	-	2

Practice:

1.
 - a. Analyze cloud security design principals
 - b. Implementation of shared responsibility model in cloud
2.
 - a. Understanding attack vectors on cloud resources
 - b. Case studies on Cloud security and compliance
3.
 - a. Securing access to cloud resources.
 - b. Configuring IAM Authentication
4.
 - a. Authorize with Identity and Access Management

- b. Amazon S3 Cross-Account Resource-Based Policy
5.
 - a. Using Resource-Based Policies to Secure an S3 Bucket
 - b. Implementing IAM assume role in AWS.
6.
 - a. Securing infrastructure in cloud.
 - b. Testing IAM policies with IAM policy simulator
7.
 - a. Using AWS Cloud Trail to log and track actions.
 - b. Threat Intelligence with Amazon guard Duty
8.
 - a. Setting up private and public subnets.
 - b. Securing VPC Resources by Using Security Groups
9.
 - a. Working with Network Access Control Lists
 - b. Best practices for protecting data in Amazon S3
10.
 - a. Understanding client-side and server-side encryption
 - b. Encrypting Data at Rest by Using AWS KMS
11.
 - a. Monitoring and Alerting CloudWatch
 - b. Using Amazon Inspector to assess application vulnerabilities.
12.
 - a. Securing web applications in AWS using Web Application Firewall
 - b. Protecting cloud resources from DDoS attacks using AWS Shield

Additional Practice:

1. Remediating an Incident by Using AWS Config and Lambda
2. Best practices for handling an incident
3. Responding to and Managing an Incident

Textbooks:

- 1 AWS Certified security study guide, Marcello Zillo Neto, Gustavo AA Santana, by Sybex Press, ISBN : 978-1119658818

Reference Books:

- 1 AWS Certified Security exam guide, Stuart Scott, by O'REILLY press

Web Links:

- 1 <https://skillbuilder.aws/>
- 2 <https://aws.amazon.com/training/awsacademy/>

Machine Learning Services on Cloud
(Common to CSE, IT, AIML & CSE(DS))

Course Code: 2501CS64	L	T	P	C
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Course Outcomes:

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

- CO1:** Describe machine learning challenges, problem formulation, and data preparation using AWS SageMaker.
- CO2:** Recall basic AWS services for model training, forecasting, image analysis, and NLP tasks
- CO3:** Apply machine learning techniques for text extraction, sentiment analysis, and NLP tasks.
- CO4:** Describe information extraction and topic modeling using NLP tools and Amazon Comprehend.
- CO5:** Use AWS services and LLMs to develop multi-lingual NLP solutions for translation, transcription, and text generation

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	-	-	2	-	-	-	-	-	2
CO2	3	2	-	-	2	-	-	-	-	-	2
CO3	3	3	2	2	3	-	-	-	1	2	2
CO4	3	2	-	-	2	-	-	-	-	-	2
CO5	3	3	2	2	3	-	-	-	1	2	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	1
CO3	-	1
CO4	-	2
CO5	-	1

Practice:

1.
 - a. Solving business problems with machine learning
 - b. Exploring Machine Learning challenges
2.
 - a. Machine Learning with AWS Sagemaker
 - b. Formulating Machine Learning problems
3.
 - a. Creating and Importing data with Amazon Sagemaker
 - b. Encoding categorical data
4.
 - a. Training a Model with AWS Services

- b. Creating a Forecast with Amazon Forecast
- 5.
 - a. Video analysis with Amazon Rekognition
 - b. Labelling images with Amazon Ground Truth
- 6.
 - a. Facial Recognition with AWS Services
 - b. Understanding common Natural Language Processing tasks.
- 7.
 - a. Applying ML to an NLP problem.
 - b. Extracting text from web
- 8.
 - a. Implementing sentiment analysis
 - b. Understanding types of information extraction
- 9.
 - a. Implementing information extraction
 - b. Working with entities
- 10.
 - a. Implementing topic modelling with Amazon Comprehend
 - b. Implementing topic modelling NTM
- 11.
 - a. Detecting and translating languages
 - b. Transcribing and vocalizing text with AWS Services
- 12.
 - a. Implementing a multi-lingual solution
 - b. Using LLMs to perform NLP tasks

Additional Practice:

- 1. NLP with Amazon Comprehend and Polly
- 2. Create a chatbot using Amazon Lex
- 3. Creating a Linear Regression Model Using Amazon Code Whisperer

Text Books:

- 1. AWS Certified Machine Learning study guide, S Subramanian, by Sybex Press, ISBN: 978-1119821007

Reference Books:

- 1. AWS Certified Machine learning Speciality certification guide, Somanath Nanda, Wesley Moura, by O'REILLY press

Web Links:

- 1 <https://skillbuilder.aws/>
- 2 <https://aws.amazon.com/training/awsacademy/>