Program Elective IV

COURSE TITLE: Security Assessment and Risk Analysis

Course Code:			**CSE-242051EIS**			**Examination Scheme**	
Total number of Lecture Hours:						**External**	**80**
						Internal	**20**
Lecture (L):	**4**	**Practicals(P):**	4	**Tutorial (T):**	-	**Total Credits**	6

Course Objectives

- Describe the concepts of risk management
- Define and differentiate various Contingency Planning components
- Integrate the IRP, DRP, and BCP plans into a coherent strategy to support sustained organizational operations.
- Define and be able to discuss incident response options, and design an Incident Response Plan for sustained organizational operations.

Course Content	**TEACHING HOURS**
UNIT 1: Security Basics and Operation Security	**- 14 Hrs**
Information Security (INFOSEC) Overview: critical information characteristics – availability information states – processing security counter measures education, training and awareness, critical information characteristics – confidentiality critical information characteristics – integrity, information states – storage, information states – transmission, security counter measures policy, procedures and practices, threats, vulnerabilities. Operations Security (OPSEC): OPSEC surveys/OPSEC planning INFOSEC: computer security – audit, cryptographyencryption (e.g., pointtopoint, network, link), cryptographykey management (to include electronic key), cryptographystrength (e.g., complexity, secrecy, characteristics of the key).	
UNIT 2: Threats to and Vulnerabilities of Systems	**- 14 Hrs**
Definition of terms (e.g., threats, vulnerabilities, risk), major categories of threats (e.g., fraud, Hostile Intelligence Service (HOIS), malicious logic, hackers, environmental and technological hazards, disgruntled employees, careless employees, HUMINT, and monitoring), threat impact areas, Countermeasures: assessments (e.g., surveys, inspections), Concepts of Risk Management: consequences (e.g., corrective action, risk assessment), cost/benefit analysis of controls, implementation of cost effective controls, monitoring the efficiency and effectiveness of controls (e.g., unauthorized or inadvertent disclosure of information), threat and vulnerability assessment	
UNIT 3: Security Planning	**-14 Hrs**
Directives and procedures for policy mechanism, Risk Management: acceptance of risk (accreditation), corrective actions information identification, risk analysis and/or vulnerability assessment components, risk analysis results evaluation, roles and responsibilities of all the players in the risk analysis process, Contingency Planning/Disaster Recovery: agency response procedures and continuity of operations, contingency plan	

components, determination of backup requirements, development of plans for recovery actions after a disruptive event, development of procedures for off-site processing, emergency destruction procedures, guidelines for determining critical and essential workload, team member responsibilities in responding to an emergency situation	
UNIT 4: Policies and Procedures	**14 Hrs**
Physical Security Measures: alarms, building construction, cabling, communications centre, environmental controls (humidity and air conditioning), filtered power, physical access control systems (key cards, locks and alarms) Personnel Security Practices and Procedures: access authorization/verification (needtoknow), contractors, employee clearances, position sensitivity, security training and awareness, systems maintenance personnel, Administrative Security Procedural Controls: attribution, copyright protection and licensing , Auditing and Monitoring: conducting security reviews, effectiveness of security programs, investigation of security breaches, privacy review of accountability controls, review of audit trails and logs	

Textbooks

Security Risk Management: Building an Information Security Risk Management Program, Evan Wheeler, Elsevier, 1st Edition (2011)

Reference Books

Principles of Incident Response and Disaster Recovery, Whitman & Mattord, Course Technology ISBN: 141883663X

COURSE OUTCOMES (CO):

Four to Six course outcomes to be listed by the course instructor

After completion of course, students would be:

CO1: Capable of recommending contingency strategies including data backup and recovery and alternate site selection for business resumption planning
CO2: Skilled to be able to describe the escalation process from incident to disaster in case of security disaster
CO3: Capable of Designing a Disaster Recovery Plan for sustained organizational operations
CO4: Capable of Designing a Business Continuity Plan for sustained organizational operations

LEVEL OF CO-PO MAPPING TABLE

	POs											
COs	**1**	**2**	**3**	**4**	**5**	**6**	7	**8**	**9**	**10**	**11**	**12**
1	3	2	2	1	2	1	-	1	-	-	2	3
2	2	2	1	-	-	1	1	-	-	2	2	3
3	2	1	1	1	-	-	2	-	1	1	1	3
4	-	2	1	-	-	2	-	-	2	-	-	3

To be effective from year-2024

COURSE TITLE: Secure Coding								
Course Code:				**CSE-242052EIS**		**Examination Scheme**		
Total number of Lecture Hours:						**External**	**80**	
						Internal	**20**	
Lecture (L):	**4**	**Practicals(P):**	**4**	**Tutorial (T):**	**-**	**Total Credits**	**6**	

Course Objectives

- Understand the basics of secure programming.
- Understand the most frequent programming errors leading to software vulnerabilities.
- Identify and analyze security problems in software.
- Understand and protect against security threats and software vulnerabilities.
- Effectively apply their knowledge to the construction of secure software systems

Course Content	TEACHING HOURS
UNIT 1:	**14 Hrs**
Introduction to software security, Managing software security risk, Selecting software development technologies, An open source and closed source, Guiding principles for software security, Auditing software, Buffet overflows, Access control, Race conditions, Input validation, Password authentication. Applied cryptography, Randomness and determinism	
UNIT 2:	**14 Hrs**
Buffer Overrun, Format String Problems, Integer Overflow, and Software Security Fundamentals SQL Injection, Command Injection, Failure to Handle Errors, and Security Touchpoints.	
UNIT 3:	**14 Hrs**
Information Leakage, Race Conditions, Poor usability, Failing to protect network traffic, improper use of PKI, trusting network name resolution. Anti-tampering, Protecting against denial of service attack, Copy protection schemes, Client-side security, Database security.	
UNIT 4:	**14 Hrs**
Cross Site Scripting, Magic URLs, Weak Passwords, Case study of Cross Site Scripting, Magic URLs, Weak Passwords Buffet overflows, Access control, Race conditions.	

Textbooks

1. J. Viega, M. Messier. Secure Programming Cookbook, O'Reilly.

Reference Books

1. M. Howard, D. LeBlanc. Writing Secure Code, Microsoft
2. J. Viega, G. McGraw. Building Secure Software, Addison Wesley

COURSE OUTCOMES (CO):

CO1: Write secure programs and various risk in the softwares.
CO2: Eliminate security problems in the open source software.
CO3: Real time software and vulnerabilities associated with them.
CO4: Interrelate security and software engineering.

LEVEL OF CO-PO MAPPING TABLE

	POs											
COs	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	2	1	2	1	-	3	2	2	2	3
2	2	1	2	1	2	1	-	3	2	2	2	3
3	2	1	2	1	1	1	-	3	2	2	2	3
4	2	2	2	1	2	1	-	3	2	2	2	3

Secure Coding Lab Manual

1. Auditing Software for Security Flaws
2. Implementing Secure Password Authentication
3. Preventing Buffer Overflows in C
4. Randomness vs. Determinism in Cryptography
5. Exploiting and Patching a Buffer Overflow
6. SQL Injection Testing and Mitigation
7. Secure Error Handling in Web Applications
8. Command Injection Attack and Prevention
9. Simulating a Race Condition Attack
10. Securing Network Traffic with TLS/SSL
11. PKI and Digital Certificates Implementation
13. Database Security Measures
14. Cross-Site Scripting (XSS) Attack and Prevention
15. Weak Password Analysis and Strengthening Strategies

COURSE TITLE:INTRUSION DETECTION

Course Code:				**CSE-241043EIS**		**Examination Scheme**			
Total number of Lecture Hours: 56						**External**	**80**		
						Internal	**20**		
Lecture (L):	**4**	**Practicals(P):**	**4**	**Tutorial (T):**	**-**	**Total Credits**			**6**

Course Objectives

- To understand the foundational concepts of computer and network security, including threat landscapes and limitations of security solutions.
- To examine various classes of cyber-attacks across network, application, and human layers and understand the different types of attackers.
- To explore anomaly detection systems and algorithms, focusing on network and host-based anomaly detection techniques.
- To analyze advanced malware detection methods, including attack trees, botnet autopsy, polymorphism, and zero-day threat detection.

Course Content	TEACHING HOURS
UNIT 1:	**14Hrs**
The state of threats against computers, and networked systems-Overview of computer security solutions and why they fail-Vulnerability assessment, firewalls, VPN's -Overview of Intrusion Detection and Intrusion Prevention	
UNIT 2:	**14Hrs**
Classes of attacks - Network layer: scans, denial of service, -Application layer: software exploits, code injection-Human layer: identity theft, Hesitated groups-Automated: Drones, Worms, Viruses	
UNIT 3:	**14Hrs**
Anomaly Detection Systems and Algorithms-Network Behavior Based Anomaly Detectors (rate based)-Host-based Anomaly Detectors-Software Vulnerabilities State transition, Immunology, Payload Anomaly Detection	
UNIT 4:	**14Hrs**
Attack trees and Correlation of alerts-Autopsy of Worms and Botnets-Malware detection-Obfuscation, polymorphism, Email/IM security issues-Viruses/Spam-From signatures to thumbprints to zero day detection-Insider Threat issues-Taxonomy-Masquerade and Impersonation	

Textbooks

- Crimeware, Understanding New Attacks and Defenses, Markus Jakobsson and Zulfikar Ramzan, Symantec Press, ISBN: 978-0-321-50195-0 2008

Reference Books

- The Art of Computer Virus Research and Defense, Peter Szor, Symantec Press ISBN 0-321 30545-3

COURSE OUTCOMES (CO):

CO1: Demonstrate an understanding of the primary threats to computer and network systems and the limitations of current security measures.

CO2: Identify and classify various types of cyber-attacks and attackers across different layers, including network, application, and human aspects.

CO3: Apply anomaly detection techniques to recognize abnormal behavior in network and host systems.

CO4: Analyze and evaluate malware detection strategies, including signature and behavioral-based methods, for defending against advanced and zero-day threats.

LEVEL OF CO-PO MAPPING TABLE

	POs											
COs	1	2	3	4	5	6	7	8	9	10	11	12
1	3	3	-	-	-	2	-	1	3	1	-	2
2	3	3	2	-	2	2	1	2	3	-	-	2
3	2	3	3	3	3	-	-	-	2	-	2	2
4	2	3	3	2	3	3	2	-	1	-	3	2

Program Elective V

COURSE TITLE: Data Warehousing & Mining

Course Code:	CSE-243011EIS	Examination Scheme	T	P
Total number of Lecture Hours:56 Total number of Practical Hours:-		External	80	
		Internal	20	

Lecture (L):	4	Practicals(P):	-	Tutorial (T):	-	Total Credits	4

Course Objectives:

- To understand the fundamental concepts of data warehousing and data mining, including techniques for pattern discovery, classification, and clustering.
- To explore methodologies for mining and analyzing time-series data, including periodicity and trend analysis.
- To learn techniques for mining dynamic data streams and conducting social network analysis, with a focus on classification and handling class imbalance.
- To examine advanced web mining and distributed data mining techniques, including web structure mining and recent trends in distributed data warehousing.

Course Content	TEACHING HOURS
UNIT 1: Introduction to Data Warehousing and Data Mining Techniques	**-14 Hrs**
Introduction to Data Warehousing; Data Mining: Mining frequent patterns, association and correlations; Sequential Pattern Mining concepts, primitives, scalable methods; Classification and prediction; Cluster Analysis – Types of Data in Cluster Analysis, Partitioning methods, Hierarchical Methods; Transactional Patterns and other temporal based frequent patterns	
UNIT 2: Time-Series Data Mining and Analysis Techniques	**- 14 Hrs**
Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis;.	
UNIT 3: Data Stream Mining and Social Network Analysis	**-14 Hrs**
Mining Data Streams, Methodologies for stream data processing and stream data systems, Frequent pattern mining in stream data, Sequential Pattern Mining in Data Streams, Classification of dynamic data streams, Class Imbalance Problem; Graph Mining; Social Network Analysis	
UNIT 4: Web Mining and Distributed Data Mining Techniques	**-14 Hrs**
Web Mining, Mining the web page layout structure, mining web link structure, mining multimedia data on the web, Automatic classification of web documents and web usage mining; Distributed Data Mining. Recent trends in Distributed Warehousing and Data Mining, Class Imbalance Problem; Graph Mining; Social Network Analysis	

Textbooks

- **Data Mining: Concepts and Techniques** (4th Edition) by Jiawei Han, Micheline Kamber, and Jian Pei, 2022, Morgan Kaufmann.
- Data Warehousing in the Real World: A Practical Guide for Building Decision Support Systems.

Reference Books

- **Mining of Massive Datasets** (3rd Edition) by Jure Leskovec, Anand Rajaraman, and Jeff Ullman, 2020, Cambridge University Press.
- **Introduction to Data Mining** (2nd Edition) by Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, and Vipin Kumar, 2019, Pearson.
- **Time Series Analysis and Its Applications: With R Examples** (4th Edition) by Robert H. Shumway and David S. Stoffer, 2017, Springer.
- **Social Network Analysis: Methods and Applications** by Stanley Wasserman and Katherine Faust, 1994, Cambridge University Press.

COURSE OUTCOMES (CO):

- **CO1**: Understand and apply data warehousing and data mining techniques to identify patterns and associations within large datasets.
- **CO2**: Analyze time-series data for periodic trends and similarities, using advanced mining techniques.
- **CO3**: Conduct mining on dynamic data streams and social networks to extract frequent patterns and address data challenges like class imbalance.
- **CO4**: Apply web mining and distributed data mining methods to gain insights from web structures and multimedia data in real-world scenarios

LEVEL OF CO-PO MAPPING TABLE

	POs											
COs	1	2	3	4	5	6	7	8	9	10	11	12
1	3	3	2	2	2	-	-	-	-	1	-	2
2	3	3	2	2	-	-	-	-	-	1	-	2
3	3	3	3	3	2	-	-	-	1	2	2	3
4	3	3	3	3	2	1	-	-	1	2	-	3

COURSE TITLE: Web Search and Information Retrieval							
Course Code:				**CSE-243012EIS**		**Examination Scheme**	
Total number of Lecture Hours:						**External**	**80**
						Internal	**20**
Lecture (L):	**4**	**Practicals(P):**	**-**	**Tutorial (T):**	**-**	**Total Credits**	**4**

Course Objectives

- The objective of the course is to introduce information retrieval models and query languages. Application of web search and information retrieval in social networks is also included.

Course Content	**TEACHING HOURS**
UNIT 1:	**14 Hrs**
Information retrieval model, Information retrieval evaluation, Searching the Web	
UNIT 2:	**14 Hrs**
Document Representation, Query languages and query operation, Meta-data search, Indexing and searching, Scoring and ranking feature vectors	
UNIT 3:	**14 Hrs**
Ontology, domain specific search, parallel and distributed information retrieval. Text and multimedia languages, Social networks	
UNIT 4:	**14 Hrs**
Recent trends in Web search and Information retrieval techniques.	

Textbooks

1. C. D. Manning, P. Raghavan and H. Schütze, Introduction to Information Retrieval, Cambridge University Press, 2008 (available at http://nlp.stanford.edu/IR-book).

Reference Books

1. Chakrabarti, S. (2002). Mining the web: Mining the Web: Discovering knowledge from hypertext data. Morgan-kaufman.
2. B. Croft, D. Metzler, T. Strohman, Search Engines: Information Retrieval in Practice, Addison-Wesley, 2009 (available at http://ciir.cs.umass.edu/irbook/).
3. 3. R. Baeza-Yates, B. Ribeiro-Neto, Modern Information Retrieval, Addison-Wesley, 2011 (2nd Edition).

COURSE OUTCOMES (CO):

CO1: To identify basic theories and analysis tools as they apply to information retrieval.
CO2: To develop understanding of problems and potentials of current IR systems.
CO3: To learn and appreciate different retrieval algorithms and systems.
CO4: To apply various indexing, matching, organizing, and evaluating methods to IR problem.
CO5: To become aware of current experimental and theoretical IR research.

LEVEL OF CO-PO MAPPING TABLE												
	POs											
COs	1	2	3	4	5	6	7	8	9	10	11	12
1	1	2	3	4	5	6	7	8	9	10	11	12
2	1	1	2	1	2	1	-	3	2	2	2	3
3	2	1	2	1	2	1	-	3	2	2	2	3
4	2	1	2	1	1	1	-	3	2	2	2	3
5	2	1	2	1	1	1	-	3	2	2	2	3

COURSE TITLE: Database Security and Access Control

Course Code:			**CSE-243013EIS**			**Examination Scheme**	
Total number of Lecture Hours:						**External**	**80**
						Internal	**20**
Lecture (L):	**4**	**Practicals(P):**	**-**	**Tutorial (T):**	**-**	**Total Credits**	**4**

Course Objectives

- To understand the fundamental concepts, purpose, and policies of access control systems in secure information management.
- To explore and analyze different access control models, including Discretionary Access Control (DAC), Non-Discretionary Access Control, and Mandatory Access Control (MAC).
- To evaluate advanced access control models like Role-Based Access Control (RBAC) and examine their application and limitations within enterprise IT infrastructures.
- To investigate emerging access control technologies, such as smart card-based security systems, and their role in enhancing database and information security.

Course Content	**TEACHING HOURS**
UNIT 1: Fundamentals of Access Control	**15 Hrs**
Introduction to Access Control, Purpose and fundamentals of access control, brief history, Policies of Access Control, Models of Access Control, and Mechanisms, Discretionary Access Control (DAC), Non- Discretionary Access Control , Mandatory Access Control (MAC). Capabilities and Limitations of Access Control Mechanisms: Access Control List (ACL) and Limitations, Capability List and Limitations.	
UNIT 2: Role-Based Access Control (RBAC) and Comparative Analysis	**14 Hrs**
Role-Based Access Control (RBAC) and Limitations, Core RBAC, Hierarchical RBAC, Statically Constrained RBAC, Dynamically Constrained RBAC, Limitations of RBAC. Comparing RBAC to DAC and MAC Access control policy,	
UNIT 3: Integrity Models and Role Hierarchies in Enterprise Systems	**14 Hrs**
Biba'sintrigity model, Clark-Wilson model, Domain type enforcement model , mapping the enterprise view to the system view, Role hierarchies- inheritance schemes, hierarchy structures and inheritance forms, using SoD in real system, Temporal Constraints in RBAC, MAC AND DAC. Integrating RBAC with enterprise IT infrastructures: RBAC for WFMSs, RBAC for UNIX and JAVA environments Case study: Multi line Insurance Company.	
UNIT 4: Smart Card-Based Security and Emerging Access Control Mechanisms	**14 Hrs**
Smart Card based Information Security, Smart card operating system fundamentals, design and implantation principles, memory organization, smart card files, file management, atomic operation, smart card data transmission ATR,PPS Security techniques- user identification , smart card security, quality assurance and testing , smart card life cycle-5 phases, smart card terminals. Recent trends in Database security and access control mechanisms. Case study of Role-Based Access Control (RBAC) systems.	

Textbooks

2. Role Based Access Control: David F. Ferraiolo, D. Richard Kuhn, RamaswamyChandramouli.

Reference Books

2. http://www.smartcard.co.uk/tutorials/sct-itsc.pdf : Smart Card Tutorial.

COURSE OUTCOMES (CO):

CO1: Students will be able to identify and differentiate between key access control models (DAC, MAC, RBAC) and discuss their use cases and limitations.

CO2: Students will be able to analyze the mechanisms and challenges of implementing Role-Based Access Control in various IT infrastructures.

CO3: Students will demonstrate understanding of integrity models such as Biba's and Clark-Wilson's, applying them to real-world enterprise environments.

CO4: Students will be able to discuss the architecture and security features of smart card-based systems and assess their impact on modern access control.

LEVEL OF CO-PO MAPPING TABLE

	POs											
COs	1	2	3	4	5	6	7	8	9	10	11	12
1	3	3	3	2	2	1	-	-	2	1	1	1
2	3	3	3	3	2	2	2	1	-	1	-	-
3	3	3	2	2	2	1	1	2	1	-	-	-
4	3	3	2	3	2	2	1	-	-	-	1	-

Specialization: Internet of Things (IT)

Program Elective-I

COURSE TITLE: Data Science									
Course Code:				**CSE-241041EIT**		**Examination Scheme**			
Total number of Lecture Hours: 48						**External**	**80**		
						Internal	**20**		
Lecture (L):	**4**	**Practicals(P):**	**-**	**Tutorial (T):**	**-**	**Total Credits**	**4**		

Course Objectives

- Introduce core data science concepts and processes.
- Teach effective data collection, cleaning, and management.
- Develop skills in statistical analysis and basic machine learning.
- Enable creation of clear, impactful data visualizations

Course Content	TEACHING HOURS
UNIT 1:	**12 Hrs**
Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.	
UNIT 2:	**12 Hrs**
Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources.	
UNIT 3:	**12 Hrs**
Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.	
UNIT 4:	**12 Hrs**
Data visualization: Introduction, Types of data visualization, Data for visualizations: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.	

Textbooks

- Doing Data Science: Straight Talk from the Frontline – Cathy O'Neil & Rachel Schutt, 2nd Ed., O'Reilly, 2023.
- Mining of Massive Datasets – Jure Leskovec, Anand Rajaraman & Jeffrey Ullman, 3rd Ed., Cambridge, 2022.
- "Data Science and Analytics" by V.K. Jain, Khanna Publishing, 1st Edition, 2020. Covers fundamental data science techniques and applications.

Reference Books

4. Data Science for Business – Foster Provost & Tom Fawcett, 2nd Ed., O'Reilly, 2021.
5. Introduction to Data Mining – Pang-Ning Tan, Michael Steinbach & Vipin Kumar, 2nd Ed., Pearson, 2020.
6. Practical Data Science with R – Nina Zumel & John Mount, 3rd Ed., Manning, 2023.

COURSE OUTCOMES (CO):

- **CO1**: Apply core data science concepts and processes.
- **CO2**: Collect, clean, and manage data from various sources.
- **CO3**: Use statistics and machine learning to analyze data.
- **CO4**: Create and interpret data visualizations effectively.

LEVEL OF CO-PO MAPPING TABLE

	POs											
COs	1	2	3	4	5	6	7	8	9	10	11	12
1	3	2	-	-	3	-	-	-	-	-	-	-
2	-	3	-	2	-	-	-	3	-	-	-	-
3	-	2	-	2	-	-	-	-	-	-	-	-
4	-	-	3	-	2	-	-	-	-	-	-	-

COURSE TITLE: Wireless Access Technologies

Course Code:				**CSE-241042EIT**		**Examination Scheme**			
Total number of Lecture Hours: 56						**External**		**80**	
						Internal		**20**	
Lecture (L):	**4**	**Practicals(P):**	**-**	**Tutorial (T):**	**-**	**Total Credits**		**4**	

Course Objectives

- Understand the fundamentals, advantages, and limitations of wireless networking and connectivity.
- Explore different types of wireless access networks and communication link configurations.
- Analyze the standards and technologies for wireless access networks across various bandwidths.
- Learn the processes involved in planning, designing, and securing wireless networks.

Course Content	TEACHING HOURS
UNIT 1: Introduction to Wireless Networking and Connectivity	**17 Hrs**
Necessity for wireless terminals connectivity and networking. Wireless networking advantages and disadvantages, Overview of wireless access technologies. Narrowband and broadband networks, fixed and nomadic networks. Wireless local loop (WLL), Public Switched Telephone Network (PSTN) interfaces.	
UNIT 2: Fixed Wireless Access Networks and Communication Links	**14 Hrs**
Fixed wireless access (FWA) networks, frequency bands for different networks. Criterions for frequency bands allocation, Network topologies, hotspot networks. Communication links: point-to-point (PTP), pointto-multipoint (PMP), multipoint-to-multipoint (MTM).	
UNIT 3: Standards for Wireless Access Networks and Network Services	**14 Hrs**
Standards for most frequently used wireless access networks: WPAN (802.15, Bluetooth, DECT, IrDA), UWB (Ultra-Wideband), WLAN (802.11, Wi-Fi, HIPERLAN, IrDA), WMAN (802.16, WiMAX, HIPERMAN, HIPERACCESS), WWAN (802.20), Other technologies for broadband wireless access, Local Multipoint Distribution Service (LMDS), Multichannel Multipoint Distribution Service (MMDS). Ad Hoc networks, Network services. Services types based on carrier frequency and bandwidth.	
UNIT 4: Wireless Network Planning, Design, and Security Considerations	**14 Hrs**
Wireless access networks planning, design and installation. Services provision, legislative and technical aspects, Technical and economical factors for network planning: expenses, coverage, link capacity, network complexity and carrier-to-interference ratio (C/I). Base station or access point allocation. Base station and access point equipment. Terminal mobility issues regarding wireless access to Internet. Wireless networking security issues.	

Textbooks

- M. P. Clark, Wireless Access Networks: Fixed Wireless Access and WLL networks -- Design and Operation, John Wiley & Sons, Chichester
- D. H. Morais, Fixed Broadband Wireless Communications: Principles and Practical Applications, Prentice Hall, Upper Saddle River

Reference Books

- R. Pandya, Introduction to WLLs: Application and Deployment for Fixed and Broadband Services, IEEE Press, Piscataway

COURSE OUTCOMES (CO):

CO1: Explain the need for wireless connectivity and the types of wireless networks.

CO2: Identify different wireless network topologies and evaluate suitable communication links.

CO3: Compare wireless network standards and services, such as WLAN, WPAN, and WMAN.

CO4: Plan and design wireless access networks, addressing technical, economic, and security considerations.

LEVEL OF CO-PO MAPPING TABLE

	POs											
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	2	3	3	1	2	2	2	1	1	2	2	3
2	2	3	2	1	1	1	3	3	3	-	2	3
3	3	3	3	3	2	2	2	2	1	1	1	2
4	3	2	2	2	3	3	3	2	1	2	3	3

COURSE TITLE: Mobile Applications and Services

Course Code:				**CSE-241043EIT**			**Examination Scheme**		
Total number of Lecture Hours: 48							**External**	**80**	
							Internal	**20**	
Lecture(L):	**4**	**Practicals(P):**	**0**	**Tutorial(T):**	**0**		**Total Credits**	**4**	

Course Objectives

1. This course presents the three main mobile platforms and their ecosystems, namely Android, iOS, and PhoneGap/WebOS.
2. It explores emerging technologies and tools used to design and implement feature-rich mobile applications for smartphones and tablets.
3. It also takes into account both the technical constraints relative to storage capacity, processing capacity, display screen, communication interfaces, and the user interface, context and profile.

Course Content	TEACHING HOURS
UNIT 1:	**-Hrs**
Introduction to Mobile Computing, Introduction to Android Development Environment, Factors in Developing Mobile Applications, Mobile Software Engineering, Frameworks and Tools, Generic UI Development Android User	**12**
UNIT 2:	**- Hrs**
More on Uis: VUIs and Mobile Apps, Text-to-Speech Techniques, Designing the Right UI, Multichannel and Multimodal Uis. Storing and Retrieving Data, Synchronization and Replication of Mobile Data, Getting the Model Right, Android Storing and Retrieving Data, Working with a Content Provider.	**12**
UNIT 3:	**- Hrs**
Communications via Network and the Web: State Machine, Correct Communications Model, Android Networking and Web, Telephony Deciding Scope of an App, Wireless Connectivity and Mobile Apps, Android Telephony. Android Notifications and Alarms, Graphics, Performance and Multithreading, Graphics and UI Performance, Android Graphics.	**12**
UNIT 4:	**- Hrs**
Packaging and Deploying, Performance Best Practices, Android Field Service App, Location Mobility and Location Based Services Android Multimedia: Mobile Agents and Peer-to-Peer Architecture, Android Multimedia. Recent trends in Communication protocols for IOT nodes, mobile computing techniques in IOT, agents based communications in IOT.	**12**

Textbooks

11. Wei-Meng Lee, Beginning Android™ 4 Application Development, 2012 by John Wiley & Sons.
12. Phillips, Bill, Chris Stewart, and Kristin Marsicano. Android Programming: The Big Nerd Ranch Guide. 4th ed., Big Nerd Ranch, 2019.
13. Keur, Christian, and Aaron Hillegass. iOS Programming: The Big Nerd Ranch Guide. 7th ed., Big Nerd Ranch, 2020.

Reference Books

1. Sarwar, Imran. Mobile Application Development with Ionic. Packt Publishing, 2018.
2. Ray, Shashank. Flutter for Beginners: An introductory guide to building cross-platform mobile applications with Flutter. 1st ed., Packt Publishing, 2020.
3. Adamson, David. Learning React Native: Building Native Mobile Apps with JavaScript. O'Reilly Media, 2015.

COURSE OUTCOMES(CO):

CO1: Identify the target platform and users and be able to define and sketch a mobile application.

CO2: Understand the fundamentals, frameworks, and development lifecycle of mobile application platforms including iOS, Android, and PhoneGap.

CO3: Design and develop a mobile application prototype in one of the platform (challenge project)

LEVEL OF CO-PO MAPPING TABLE

	POs											
COs	1	2	3	4	5	6	7	8	9	10	11	12
1	3	3	2	2	2	2	1	1	2	2	1	2
2	3	3	2	3	3	2	1	1	2	2	2	3
3	3	3	3	3	3	2	1	1	2	3	2	3

Program Elective-II

COURSE TITLE: Machine Learning									
Course Code:				CSE-241051EIT		Examination Scheme			
Total number of Lecture Hours: 52						External	80		
						Internal	20		
Lecture (L):	4	Practicals(P):	4	Tutorial (T):	-	Total Credits	6		

Course Objectives

- To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various nodes.
- To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
- Explore supervised and unsupervised learning paradigms of machine learning.
- To explore Deep learning technique and various feature extraction strategies.

Course Content	TEACHING HOURS
UNIT 1: Supervised Learning (Regression/Classification)	**13-Hrs**
• K Nearest-Neighbor Classifier • Decision Trees (ID3, SAFARI). • Linear Regression, Logistic Regression • Support Vector Machines, Nonlinearity and Kernel Methods • Beyond Binary Classification: Multi-class Outputs.	
UNIT 2: Unsupervised Learning	**13-Hrs**
• Distance-based methods • Clustering: K-means • Dimensionality Reduction: PCA • Generative Models	
UNIT 3:	**13-Hrs**
• Ensemble Methods • Boosting • Bagging • Random Forests	
UNIT 4:	**13-Hrs**
• Semi-supervised Learning, • Active Learning, • Reinforcement Learning, • Introduction to Bayesian Learning	

Textbooks

3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.

Reference Books

7. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
8. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
9. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007

COURSE OUTCOMES (CO):

After completion of course, students would be able to:

CO1: Extract features that can be used for a particular machine learning approach in various applications.

CO2: To compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach.

CO3: To mathematically analyze various machine learning approaches and paradigms.

CO4: To discover Deep learning method and different feature extraction approaches.

LEVEL OF CO-PO MAPPING TABLE

	POs											
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	3	2	3	3	2	1	1	-	1	2	1	2
2	2	-	3	-	2	2	1	-	1	2	2	3
3	3	3	2	3	2	1	1	-	1	3	2	3
4	2	2	3	3	2	1	1	3	3	2	1	2

Lab Manual-Machine learning

Students are encouraged to perform hands-on lab exercises on the following topics:

- Implementation of Distance-Based Methods (e.g., K-Nearest Neighbors).
- Building Decision Trees for Classification and Regression (ID3).
- Linear Regression and Logistic Regression using Python/Scikit-learn.
- Training Support Vector Machines with Linear and Nonlinear Kernels.
- Implementing Multi-class Classification Techniques.
- K-means Clustering on real-world datasets (e.g., customer segmentation).
- Dimensionality Reduction using PCA and visualizing results in 2D/3D.
- Implementing Generative Models for unsupervised learning.
- Implementing Bagging and Random Forests for robust classification.
- Experimenting with Boosting Techniques (e.g., AdaBoost, Gradient Boosting).

- Hyperparameter tuning and model evaluation using Cross-Validation.
- Exploring Semi-Supervised Learning techniques.
- Implementing Active Learning strategies.
- Reinforcement Learning: Implementing Q-Learning for decision-making.
- Introduction to Bayesian Learning and probabilistic models.

COURSE TITLE: Smart Sensors and Internet of Things

Course Code:				**CSE-241052EIT**		**Examination Scheme**			
Total number of Lecture Hours: 56						**External**		**80**	
						Internal		**20**	
Lecture (L):	**4**	**Practicals(P):**	**4**	**Tutorial (T):**	**-**	**Total Credits**		**6**	

Course Objectives

- Explore the applications and research areas in smart systems, including smart cities, smart health, and big data.
- Understand IoT reference architecture and real-world design constraints for effective system development.
- Analyze industrial and commercial building automation using service-oriented architecture and case studies.
- Study hardware platforms, energy consumption, and networking protocols for IoT systems and their energy efficiency.

Course Content	TEACHING HOURS
UNIT 1: Importance of Environmental Parameters Measurement and Monitoring	**18 Hrs**
Environmental Parameters Measurement and Monitoring: Why measurement and monitoring are important, effects of adverse parameters for the living being for IOT	
UNIT 2: Sensors and Their Working Principles	**14 Hrs**
Sensors: Working Principles: Different types; Selection of Sensors for Practical Applications Introduction of Different Types of Sensors such as Capacitive, Resistive, Surface Acoustic Wave for Temperature, Pressure, Humidity, Toxic Gas etc	
UNIT 3: Sensor Characteristics and Advanced Sensing Techniques	**14 Hrs**
Important Characteristics of Sensors: Determination of the Characteristics Fractional order element: Constant Phase Impedance for sensing applications such as humidity, water quality, milk quality Impedance Spectroscopy: Equivalent circuit of Sensors and Modelling of Sensors Importance and Adoption of Smart Sensors	
UNIT 4: Architecture and Fabrication of Smart Sensors	**14 Hrs**
Architecture of Smart Sensors: Important components, their features Fabrication of Sensor and Smart Sensor: Electrode fabrication: Screen printing, Photolithography, Electroplating Sensing film deposition: Physical and chemical Vapor, Anodization, Sol-gel	

Textbooks

- Yasuura, H., Kyung, C.-M., Liu, Y., Lin, Y.-L., Smart Sensors at the IoT Frontier, Springer International Publishing

Reference Books

- Kyung, C.-M., Yasuura, H., Liu, Y., Lin, Y.-L., Smart Sensors and Systems, Springer International Publishing

COURSE OUTCOMES (CO):

CO1: Understand the vision of IoT from a global context.

CO2: Determine the Market perspective of IoT. • Use of Devices, Gateways and Data Management in IoT.

CO3: Application of IoT in Industrial and Commercial Building Automation and Real World Design Constraints.

CO4: Building state of the art architecture in IoT.

LEVEL OF CO-PO MAPPING TABLE

	POs											
COs	1	2	3	4	5	6	7	8	9	10	11	12
1	3	3	3	3	2	2	2	1	1	2	2	3
2	2	2	2	1	1	1	3	3	3	-	2	3
3	3	3	3	3	2	2	2	2	1	1	1	2
4	3	2	2	2	3	3	3	1	1	1	3	3

Lab Manual

The Lab should contain following topics:

- Environmental Parameters Measurement and Monitoring
- Impact of Environmental Parameters on IoT and Living Beings
- Fundamentals of Sensor Working Principles
- Practical Sensor Selection for Applications
- Capacitive, Resistive, and Surface Acoustic Wave Sensors
- Temperature, Pressure, Humidity, and Toxic Gas Sensing
- Key Characteristics of Sensors
- Determination of Sensor Performance Parameters
- Fractional Order Elements and Constant Phase Impedance
- Impedance Spectroscopy and Sensor Modeling
- Advanced Sensing Techniques for Quality Monitoring
- Architecture and Components of Smart Sensors
- Electrode Fabrication Techniques (Screen Printing, Photolithography, Electroplating)
- Sensing Film Deposition Methods (Physical/Chemical Vapor, Anodization, Sol-gel) o3-mini

COURSE TITLE: Logic & Functional Programming

Course Code:				**CSE-241053EIT**		**Examination Scheme**			
Total number of Lecture Hours: 56 L + 56 P						**External**	**120**		
						Internal	**30**		
Lecture (L):	**4**	**Practical (P):**	**4**	**Tutorial (T):**	**-**	**Total Credits**	**6**		

Course Objectives

- To further the state of the art on the theoretical and practical aspects of developing declarative programming tools in logic programming for IOT data analysis.
- To introduce basics of functional programming and constraint logic programming for nodes in IOT.
- Introduction into formal concepts used as a theoretical basis for both paradigms, basic knowledge and practical experience.

Course Content	TEACHING HOURS
UNIT 1: Foundations of Propositional Logic	**16 Hrs.**
Introduction of logic and Functional Paradigm, Propositional Concepts, Semantic Table , Problem Solving with Semantic Table. **Natural Deduction and Axiomatic Propositional Logic:** Rules of Natural Deduction, Sequent Calculus, Axiomatic Systems, Meta theorems, Important Properties of AL, Resolution, Resolving Arguments	
UNIT 2: Predicate Logic and Axiomatic Systems	**14 Hrs.**
Objects, Predicates and Quantifiers, Functions, First Order Language, Quantifiers, Scope and Binding, Substitution, An Axiomatic System for First Order Predicate Logic, Soundness and Completeness, Axiomatic Semantic and Programming	
UNIT 3: Semantic Tableaux & Resolution in Predicate Logic	**14 Hrs.**
Semantic Tableaux, Instantiation Rules, Problem-solving in Predicate Logic, Normal forms, Herbrand Universes and H-interpretation, Resolution, Unification, Resolution as a computing Tool, Nondeterministic Programming, Incomplete Data Structure, Second Order Programming in Prolog, Logic Grammars: Definite Clause Grammar, A Grammar Interpreter.	
UNIT 4: Lazy and Eager Evaluation strategies	**14 Hrs.**
Evaluation Order and strictness of function, Programming with lazy evaluation, Interactive functional program, Delay of unnecessary Computation, Infinite Data Structure, Eager Evaluation and Reasoning Recent trends in logical and functional programming, predicate logics and various evaluation strategies.	
Textbooks	
John Kelly, "The Essence of Logic", Prentice-Hall India.	
Reference Books	
Saroj Kaushik, "Logic and Prolog Programming", New Age International ltd	

COURSE OUTCOMES (CO):

After completion of course, students would be able to:

CO1: Understanding of the theory and practice of functional and logic programming for IOT.
CO2: The ability to write functional and logic programs for nodes in IOT.
CO3: The ability to solve problems in and using functional and logic programming.

LEVEL OF CO-PO MAPPING TABLE

	Pos											
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	2	1	2	3	1	3	2	3	2	3	2	2
2	2	1	1	2	1	3	1	3	2	3	1	2
3	1	1	1	3	1	2	1	3	1	3	2	1

Logic and Functional Programming (LAB)

The lab should cover the following topics:

1. Propositional Logic
2. Semantic Table
3. Rules of Natural Deduction
4. Sequent Calculus
5. Axiomatic Propositional Logic
6. Objects, Predicates, and Quantifiers
7. Substitution in Predicate Logic
8. Soundness and Completeness
9. Axiomatic Semantic and Programming
10. Semantic Tableaux Construction
11. Instantiation Rules in Predicate Logic
12. Problem Solving in Predicate Logic Using Semantic Tableaux
13. Resolution and Unification
14. Resolution in Predicate Logic
15. Unification in Predicate Logic
16. Resolution as a Computing Tool
17. Definite Clause Grammar
18. Evaluation Order and Strictness of Functions
19. Programming with Lazy Evaluation
20. Eager Evaluation in Functional Programming
21. Comparing Lazy vs Eager Evaluation

Note: By completing these labs, students will develop a strong understanding of propositional and predicate logic, functional programming paradigms, and evaluation strategies. They will be able to apply logical reasoning in programming, solve complex problems using resolution and unification, and understand the practical implications of lazy and eager evaluation in functional programming.