Self-Study Report (SSR) - Criterion-1

Information to be submitted by Departments/Directorates/Centres for Each Programme Offered

1	Department/Directorate/Centre/Institute:	Department of Computer Science, University of Kashmir
2	Name of the Programme Offered:	M.Tech CS
3	Departmental website link of the complete/updated syllabus:	https://cs.uok.edu.in/Files/79755f07-9550-4aeb-bd6f-5d802d56b46d/Custom/Updated%20M.Tech%20Full%20syllabus%20.pdf
4	M.Tech-7 courses for 1st & 2nd semesters - 6 courses in 3rd semester - 5 courses in project(4th) semester credit/semester =24	
5A	M.Tech -03 1. Embedded Systems 2. Software Reliability Engineering 3. Network Security	

5B List of New Courses introduced since 2019:

Course Code	*Course Title*	*Brief Description*	
CSE20511	Embedded systems	M.Tech	The purpose of embedded systems is to control a specific function within a device. They are usually designed to only perform this function repeatedly, but more developed embedded systems can control entire operating systems.

	CSE205262	Software Reliability Engineering	M.Tech	to determine whether or not a system or program is able to meet the specifications and perform the functions expected by users
	CSE20521	Network Security & Cryptography	M.Tech	identify and classify particular examples of attacks. define the terms vulnerability, threat and attack. identify physical points of vulnerability in simple networks. compare and contrast symmetric and asymmetric encryption systems and their vulnerability to attack, and explain the characteristics of hybrid systems.

5C	Departmental website link in support of New Courses introduced in the Programme since **2019**.	https://cs.uok.edu.in/Files/79755f07-9550-4aeb-bd6f-5d802d56b46d/Custom/Doc11233.pdf			
6A	Dates of syllabus revisions during the last five years. (2019-2023)	2018	2019	2020	2021
6B	Departmental website link in support of syllabus revisions.	https://cs.uok.edu.in/Files/79755f07-9550-4aeb-bd6f-5d802d56b46d/Custom/BOS%2025-9-2020.pdf			
7	Are Programme Outcomes (POs) clearly mentioned in the syllabus? **(Y/N) Y** **https://cs.uok.edu.in/Main/ViewPage.aspx?Page=Programme_Outcome**				
8	Are the Course Outcomes (COs) mentioned for each course of the programme? **(Y/N) N**				
9A	**Does POs & COs have relevance to local, regional & global developmental needs? (Y/N) Y** **https://cs.uok.edu.in/Files/79755f07-9550-4aeb-bd6f-5d802d56b46d/Menu/Programme_Relevance_a9db5414-ffe1-47c2-bd74-a65248fb1351.pdf**				

9B	List of courses addressing **Local Needs:**		
	Course Code	*Course Title*	*Brief Justification*
	CSE205161	Advanced Database Management System	Enhancing local data management practices to support efficient decision-making and resource allocation.

	CSE20525	Machine Learning	Applying predictive models to solve local challenges in agriculture, healthcare, and urban development.
	CSE205351	Cloud Computing	Leveraging cloud technologies to improve local businesses' scalability and accessibility.
	CSE20533	Real Time Operating System	Developing real-time solutions for local industries requiring precise timing and high reliability.

9C	List of courses addressing **Regional Needs:**		
	Course Code	*Course Title*	*Brief Justification*
	CSE205353	Natural Language Processing	Enabling regional languages' digital transformation through advanced text and speech processing.
	CSE205351	Cloud Computing	Empowering regional businesses with scalable, cost-effective cloud solutions for enhanced collaboration and growth.
	CSE20511	Embedded systems	Designing region-specific embedded solutions to optimize local manufacturing and automation processes.
	CSE20533	Real Time Operating System	Implementing real-time systems tailored to the region's industrial and technological demands for precision and reliability.
9D	List of courses addressing **Global Needs:**		
	Course Code	*Course Title*	*Brief Justification*
	CSE205161	Advanced Data communications	Innovating global communication networks to support faster, more reliable data transfer across borders.
	CSE20525	Machine Learning	Developing globally impactful AI solutions that drive advancements in healthcare, finance, and environmental sustainability.
	CSE20511	Embedded systems	Creating globally integrated embedded technologies for smart devices and IoT applications across industries.

	CSE20533	Real Time Operating System	Engineering real-time systems that meet the global demand for high-performance, reliable computing in critical applications.
	CSE20521	Network Security and Cryptography	Strengthening global cybersecurity through advanced encryption and secure communication protocols.
10 A	**Does the Programme offer focus on Employability/ Entrepreneurship/ Skill development courses? (Y/N)**		
10 B	List of **Employability Courses**:		
	Course Code	*Course Title*	*Brief Justification*
	CSE20511	Embedded Systems	Preparing graduates to design and implement embedded technologies for cutting-edge hardware applications.
	CSE20525	Machine Learning	Equipping students with in-demand skills to develop AI-driven solutions across various industries.
	CSE205164	Object Oriented Methods and Design	Training professionals in object-oriented principles for scalable and maintainable software development.
	CSE205352	Internet of Things	Providing expertise in IoT technologies to meet the growing demand for smart and connected solutions.
	CSE20521	Network Security and Cryptography	Developing crucial skills in cybersecurity to protect digital assets and secure communications.
10 C	List of **Entrepreneurship Development Courses**:		
	Course Code	*Course Title*	*Brief Justification*
	CSE205352	Internet of Things	IoT offers vast opportunities for entrepreneurs to create smart devices, solutions for automation, and connected ecosystems.
	CSE205351	Cloud Computing	Empowering entrepreneurs to create scalable, cloud-based solutions that drive innovation and business growth in the digital economy.

10 D	List of **Skill development Courses:**		
	Course Code	*Course Title*	*Brief Justification*
	CSE20511	Embedded Systems	Building hands-on expertise in embedded systems to excel in hardware and software integration roles.
	CSE20515	Artificial Intelligence	Cultivating practical skills in AI and data-driven decision-making for career advancement in technology.
	CSE205164	Object Oriented Methods and Design	Mastering object-oriented design techniques to create robust and scalable software solutions.
	CSE205352	Internet of Things	Developing the ability to design, implement, and manage IoT systems for smart applications.
	CSE20521	Network Security and Cryptography	Enhancing proficiency in securing networks and implementing cryptographic solutions to protect sensitive data.
			Enhancing proficiency in securing networks and implementing cryptographic solutions to protect sensitive data.

11 A	**Does the programme have courses addressing Professional ethics/ gender/ human values/ environment/ sustainability & other value framework enshrined in NEP2020/etc. (Y/N) Y**								
11 B	List of courses addressing **Professional Ethics:**								
	Course Code	*Course Title*	*Brief Justification*						
	N/A	N/A	N/A						
	N/A	N/A	N/A						
11 C	List of courses addressing **Gender Issues:**								
	Course Code	*Course Title*	*Brief Justification*						
	N/A	N/A	N/A						
11 D	List of courses addressing **Human Value Issues:**								
	Course Code	*Course Title*	*Brief Justification*						
	N/A	N/A	N/A						
11 E	List of courses addressing **Environment Issues**:								
	Course Code	*Course Title*	*Brief Justification*						
	N/A	N/A	N/A						
11 F	List of courses addressing **Sustainability issues**:								
	Course Code	*Course Title*	*Brief Justification*						
	N/A	N/A	N/A						
11 G	List of courses addressing **Other Value Framework** enshrined **in NEP2020/etc.**:								
	Course Code	*Course Title*	*Brief Justification*						
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

12 A	**Does the Department/Directorate/Institute/ Centre offer Diploma Programme?** (Y/N) N								
12 B	Details of the **Diploma Programmes** offered by the institutions where the students of the institution have enrolled and successfully completed during the last five years (2019-2023)								
	Programme Code	*Name of Diploma Programme*	*Mode of Programme (Online/Offline)*	*Year of Offering/enrolment*	*Contact hours of course*	*Number of students enrolled in the year*	*Number of Students completing the course in the year*	*Departmental website link to the relevant document*	*Number of students enrolled in the year*
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13 A	**Does the Department/Directorate/Institute/ Centre offer Certificate Courses? (Y/N) N**								
13 B	Details of the **Certificate Courses** offered by the institutions where the students of the institution have enrolled and successfully completed during the last five years (2019-2023)								
	Course Code	*Name of Certificate Course*	*Mode of Course (Online/Offline)*	*Year of Offering/enrolment*	*Contact hours of course*	*Number of students enrolled in the year*	*Number of Students completing the course in the year*	*Departmental website link to the relevant document*	*Number of students enrolled in the year*
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14 A	**Does the Department/Directorate/Institute/ Centre offer Value-Added Courses? (Y/N) N**								

14 B Details of the **Value Added Courses** offered by the institutions where the students of the institution have enrolled and successfully completed during the last five years (2019-2023)

Course Code	*Name of Value-Added Course*	*Mode of Course (Online/Offline)*	*Year of Offering/enrolment*	*Contact hours of course*	*Number of students enrolled in the year*	*Number of Students completing the course in the year*	*Departmental website link to the relevant document*	*Number of students enrolled in the year*
MCA24001OE	Digital & Technological Solutions	*Offline*	2024	28	3	-	https://cs.uok.edu.in/Files/79755f07-9550-4aeb-bd6f-5d802d56b46d/Menu/New_Doc_10-01-2024_10_6113df29-fc08-4645-9155-a7ec003798d6.pdf	2024

15 A	**Does the Department/Directorate/Institute/ Centre offer Online Courses of MOOCs, SWAYAM/e-PG Pathshala/ NPTEL and other recognized platforms? (Y/N)**	Y

15 B Details of **Online Courses of MOOCs, SWAYAM/e-PG Pathshala/ NPTEL and other recognized platforms** where the students of the institution have enrolled and successfully completed during the last five years (2019-2023)

Course Code	*Name of the Course*	*Mode of the Course-offered by the HEI or Online (Specify the platform like MOOCS, SWAYAM, etc.)*	*Year of Offering/enrolment*	*Contact hours of course*	*Number of students enrolled in the year*	*Number of Students completing the course in the year*	*Departmental website link to the relevant document*	*Number of students enrolled in the year*
Design and Analysis of Algorithms	Design and Analysis of Algorithms	SWAYAM 2	2020-2023	48 hours	N/A	8883	https://onlinecourses.swayam2.ac.in/cec20_cs03/preview	

16 A	**Does the programme have Field Projects/ Research Projects /Internship in the programme? (Y/N) Y**				
16 B	Details of components of **Field Projects / Research Projects / Internships implemented** during last five years **(2019-2023)**				
	Course Code	*Name of the course pertaining to field projects/ Research Projects /Internship*	*Number of Credits*	*Number of students undertaking course*	*Departmental website link to the relevant document*
	CSE20541	Major Project Problem Identification	2	22	https://cs.uok.edu.in/Files/79755f07-9550-4aeb-bd6f-5d802d56b46d/Alert/Project_Allocation_1995a35e-7caa-44e1-b55c-c811895f6a2a.pdf
	CSE20542	Major Project Problem Analysis	4		
	CSE20543	Major Project Software Develpmnt	6		
	CSE20544	Major Project Research Component	6		
	CSE20545	Major Project Dissertation	6		
17	**Any other Relevant Information:**				

COURSE TITLE: Embedded Systems

Course Code:			**CSE20511**			**Examination Scheme**	
Total number of Lecture Hours: 52						**External**	**80**
						Internal	**20**
Lecture (L):	**4**	**Practicals(P):**	**0**	**Tutorial (T):**	**0**	**Total Credits**	**4**

Course Objectives

- Understand the fundamental concepts and design challenges of Embedded Systems and Cyber-Physical Systems, including their classification and application areas.
- Describe the architecture and memory organization of the 8051 microcontroller, including its special function registers (SFRs) and I/O ports.
- Program the 8051 microcontroller to handle interrupts, including timer interrupts, external hardware interrupts, and serial communication interrupts.
- Develop skills in interfacing the 8051 microcontroller with external devices, such as LCDs,

keyboards, DACs, ADCs, and stepper motors.	
Course Content	**TEACHING HOURS**
UNIT 1: Introduction.	**13 Hrs**
Embedded systems and Cyber Physical Systems: Definition, Characteristics, Design Challenges, Classification, Application areas. Embedded Hardware Architecture: General Purpose Processor, Microprocessor Design Options,Microcontroller, Digital Signal Processor, ASIC, PLDs, COTS; Embedded Systems Memory; Other Hardware Components: I/O Subsystem, Timers and counters, Interrupt Subsystem, UART, PWM andAnalog-Digital Conversion, Sensors and Actuators. Embedded Software Architectures: Round Robin, Round Robin with Interrupts, Function Queue Scheduling, Real-time Operating System (RTOS); Programming Languages and Tools; EmbeddedIDE; Debugging.	
UNIT 2: The 8051 Microcontroller.	**13 Hrs**
Microcontroller: Introduction, Criteria for choosing a microcontroller; Overview of 8051 Microcontroller family: Architecture, Memory Organization of 8051, SFRs, I/O Ports, Addressing modes. Basic Assembly Language programming concepts: 8051 Instruction set, Assembler Directives, Subroutine, Stack. Time delay generations and calculations, Programming of 8051 Timers, Counter Programming,WatchDog Timer,Real Time clock.	
UNIT 3: 8051 Communication and Interrupts.	**13 Hrs**
Basics of Communication: Overview of RS-232, I^2C Bus, UART, USB; Communication with 8051:Using I/O Ports, 8051 Serial Port, 8051 connections to RS232. 8051 interrupts: Interrupt vectors and interrupt processing, Level triggered and edge triggered, Masking and priorities; Programming of 8051 Timer interrupts, Programming of External hardware interrupts, Programming of the serial communication interrupts.	

UNIT 4: 8051 Interfacing.	13 Hrs
Basic Concepts of Interfacing: Introduction; 8051 Interfacing to external memory and AccessingExternal data Memory and External Code Memory. Interfacing to LCD/Keyboard, DAC/ADC, Sensors, Stepper Motor, 8255.	

Textbooks
1. Shibu K V. *Introduction to Embedded Systems*, TMH. **2.** M.A. Mazidi and J. G. Mazidi. *The 8051 Microcontroller and Embedded Systems*, PHI. **3.** Raj Kamal. *Embedded Systems*, TMH.
Reference Books
COURSE OUTCOMES (CO): **CO1:** Demonstrate the ability to identify and classify different types of embedded systems and cyber-physical systems, and explain their role in various application areas. **CO2:** Apply knowledge of 8051 microcontroller architecture to develop basic assembly language programs, effectively utilizing its instruction set and addressing modes. **CO3:** Implement communication protocols like RS-232 and I2C with the 8051 microcontroller, and manage interrupt-driven tasks to optimize system performance. **CO4:** Successfully interface the 8051 microcontroller with a variety of external devices, ensuring accurate data exchange and control, thereby enhancing practical hardware integration skills.

COURSE TITLE: Lab Embedded Systems		
Course Code:	**CSE20512**	**Examination Scheme**

Total number of Lab Hours:						**External**	**40**
						Internal	**10**
Lecture (L):	**0**	**Practicals(P):**	**4**	**Tutorial (T):**	**0**	**Total Credits**	**2**

Course Objectives:

Two to three course objectives to be listed by the course instructor

- Develop proficiency in designing and simulating embedded systems hardware schematics, including interfacing LEDs, switches, relays, keypads, 7-segment displays, and LCDs with the 8051 microcontroller using Proteus.
- Gain hands-on experience in writing and debugging assembly or C code for the 8051 microcontroller, focusing on controlling peripheral devices such as LEDs, relays, keypads, 7-segment displays, and DC motors.
- Enhance problem-solving skills by implementing real-time embedded solutions, such as creating an automated irrigation system controlled by the 8051 microcontroller, integrating sensors, actuators, and LCD displays for monitoring and control.

Week 1

- Design the schematic to connect an LED to 8051 on proteus via a pullupresistor.
- Write assembly or C code to make the LED blink on a pre specified Duty Cycle.

Week 2

- Design the schematic to add a push down switch to schematic designed in **week 1** via a pulldown resistor.
- Write assembly or C code to toggle an LED on the push of the button.

Week 3

- Design the schematic to interface a relay with 8051 for controlling a bulb.
- Write assembly or C code to control the on/off of a bulb via a relay on thepush of the button.

Week 4

- Design the schematic to interface a 4 x 4 key pad with 8051.
- Write assembly or C code to detect and decode a keypress from the 4 x 4 keypad with

8051.

Week 5

- Design the schematic to interface a 7-segment display with 8051.
- Write assembly or C code to detect and decode a keypress from the 4 x 4 keypad with 8051 and display it on the 7-segment display.

Week 6

- Design the schematic and write assembly or C code to blink an LED using 8051timers.

Week 7

- Design the schematic and write assembly or C code to display the number ofbutton presses on 3-segment displays using 8051 counters.

Week 8

- Design the schematic and write assembly or C code to control a dc motor using8051 via an H-Bridge. Use two buttons for forward and reverse.

Week 9

- Design the schematic and write assembly or C code to read and display valuefrom a variable resistor on a 7-segment display using an ADC.

Week 10

- Design the schematic and write assembly or C code to interface a 16 x 2 LCDwith 8051 for displaying “Hello World”.

Week 11

- Design the schematic and write assembly or C code to interface a 16 x 2 LCDwith 8051 for displaying a real time clock.

Week 12

- Design the schematic and write assembly or C code to interface two 8051 microcontrollers via the serial port for interchanging data at 9600bps. Use 16 x2 LCD to display the received data.

Week 13

- Design an **embedded** solution for automatically controlling the irrigation

systemof a green house. Your job is to control the sprinklers depending upon the temperature of the green house. The LCD should display the current temperature and the last time when the sprinklers where on.

COURSE OUTCOMES (CO):

CO1: Demonstrate the ability to integrate multiple peripheral devices with the 8051 microcontroller in a cohesive embedded system, effectively using hardware design and software programming to accomplish tasks such as controlling LEDs, relays, keypads, and displays.

CO2: Develop a comprehensive understanding of real-time embedded system applications by designing and implementing complex projects, such as an automated irrigation system, which involve interfacing with sensors, actuators, and display components while ensuring functional and reliable system performance.

COURSE TITLE: Software Reliability Engineering

Course Code:			**CSE205262**			**Examination Scheme**	
Total number of Lecture Hours: 46						**External**	**80**
						Internal	**20**
Lecture (L):	**46**	**Practicals(P):**	**0**	**Tutorial (T):**	**0**	**Total Credits**	**4**

Course Objectives:

- To introduce fundamental reliability concepts and measures, including reliability analysis techniques like block diagrams, fault tree analysis, and Monte Carlo simulation.
- To explore advanced reliability models such as Nonhomogeneous Poisson Processes (NHPP) and their application in software reliability modeling.
- To study various execution time and debugging models, focusing on reliability in software systems, including imperfect debugging and modular software models.

• To analyze different S-shaped NHPP models and other advanced reliability models to assess fault complexity, error removal, and system performance.	
Course Content	**TEACHING HOURS**
UNIT 1:	**12 Hrs**
BASIC RELIABILITY CONCEPTS: Reliability Measures (Definition of reliability, Mean time to failure (MTTF), Failure rate function, Maintainability and availability), Common Techniques in Reliability Analysis (Reliability block diagram, Network diagram, Fault tree analysis, Monte Carlo simulation), Markov Process Fundamentals (Stochastic processes, Standard Markov models, General procedure of Markov modelling	
UNIT 2:	**12 Hrs**
Nonhomogeneous Poisson Process (NHPP) Models (General formulation, Reliability measures and properties, Parameter estimation); MODELS FOR SOFTWARE RELIABILITY: Basic Markov Model (Model description, Parameter estimation). Execution Time models: Basic execution time model, logarithmic Poisson model;	
UNIT 3:	**12 Hrs**
: Imperfect debugging models (Monotonous death process, Birth-death process, Imperfect debugging model considering multi-type failure), Modular Software Systems: The Littlewood semiMarkov model; Software NHPP Models: Calender time models: Goel-Okumoto (GO) model, Hyperexponential model, exponential fault categorization model;	
UNIT 4:	**12Hrs**
S-shaped NHPP models: Delayed S-shaped NHPP model, Inflected S-shaped NHPP model; Failure rate dependent flexible model, SRGM for error removal phenomenon, SRGM defining Complexity of faults, generalized SRGM(Erlang model), Incorporating fault complexity considering learning phenomenon; Some other NHPP models: Duane model-Log-power model, Musa-Okumoto model	

Textbooks

- Musa, Iannino, Okumoto, “Software Reliability: Measurement, Prediction, Application”, McGrawHill, 1987.
- Min Xie Yuan-Shun Dai and Kim-Leng Poh, “Computing System Reliability: Models and Analysis “ KLUWER ACADEMIC PUBLISHERS, 2004

Reference Books

- P. K. Kapur, H. Pham, A. Gupta, P. C. Jha,“Software Reliability Assessment with OR Applications”, Springer-Verlag London Limited 2011
- Hoang Pham, “system software reliability”, Springer, 2006
- Michael R. Lyu, “Handbook of software reliability engineering-IEEE Computer Society Press_
- McGraw Hill (1996)”.
- M. Lyu, ed. ”Handbook of Software Reliability Engineering”, McGraw-Hill and IEEE Computer Society Press, 1996 7. Pham, H. (2000). ‘Software Reliability’, Springer-Verlag, Singapore.

COURSE OUTCOMES (CO):

- Students will be able to apply reliability measures and analysis techniques, such as Markov processes and fault tree analysis, to evaluate system reliability.
- Students will gain knowledge of NHPP models and their application in software reliability, including the estimation of parameters and prediction of system performance.
- Students will acquire skills in modeling software reliability using various debugging models, execution time models, and modular software approaches.
- Students will demonstrate the ability to analyze and implement advanced NHPP models for software reliability, incorporating fault complexity, error removal, and learning phenomena in real-world systems.

COURSE TITLE: Network Security and Cryptography

Course Code:			**CSE20521**			**Examination Scheme**	
Total number of Lecture Hours: 46						**External**	**80**
						Internal	**20**
Lecture (L):	**46**	**Practicals(P):**	**0**	**Tutorial (T):**	**0**	**Total Credits**	**4**

Course Objectives:

- To understand the OSI Security Architecture and identify common types of security threats, vulnerabilities, and controls.
- To learn about core security services such as confidentiality, integrity, availability, authentication, access control, and non-repudiation.
- To introduce fundamental concepts in cryptography, including number theory, encryption techniques, and cryptographic algorithms.
- To explore advanced topics in network security such as IP security, intrusion detection systems, and defense mechanisms against DDoS attacks.

Course Content	**TEACHING HOURS**
UNIT 1: Unit Heading	**12 Hrs**
Unit 1: Part 1: The OSI Security Architecture, Security Attack – Threats, Vulnerabilities, and Controls, Types of Threats (Attacks) Part 2: Security Services – Confidentiality, Integrity, Availability, Authentication, Access Control and Non repudiation; Security Mechanism. Part 3: Introduction to Number Theory: Prime Number Generation and Testing for Primality, Fermat's and Euler's Theorems, Modular Arithmetic, Euclidean and Extended Euclidean Algorithm, Euler's Phi Function.	
UNIT 2: Unit Heading	**12 Hrs**

Part 1: Introduction to Cryptology. Types of Encryption Systems – Based on Key, Based on Block; Confusion and Diffusion; One-time pad, Block Ciphers and Data Encryption Standard. Part 2: Block Cipher Modes of operation, Advanced Encryption Standard. Stream Ciphers, Random Number Generation. Shift Register based stream Ciphers, RC4. Part 3: Public-Key Cryptography. RSA Cryptosystem	
.	**12 Hrs**
Part 1: Double and Triple Encryption. Key Management, Diffie-Hellman Key ExchangePart 2: Digital Signatures, The RSA signature scheme, Hash Functions, The Secure Hash Algorithm SHA-1. Part 3: Message Authentication Codes, HMAC and CBC-MAC, Message Digest	
UNIT 4: Unit Heading	**12Hrs**
Part 1: IP Security, Authentication Header, Encapsulating Security Payload, Electronic Mail Security.Part 2: Network intrusion Detection system using machine learning: Supervised and Unsupervised.General IDS model and Taxonomy. IDS Signatures. Part 2: DDoS Attacks. Specification and rate based DDoS. Defending against DoS attacks in scout: signature based solutions.	

Textbooks

- Paar, Christof, and Jan Pelzl. Understanding cryptography: a textbook for students and practitioners.Springer Science & Business Media, 2009.
- William, S., and Cryptography Stalling. "Network Security, 4/E." Prentice Hall. (2006).

Reference Books

- Forouzan, Behrouz A., and Debdeep Mukhopadhyay. Cryptography and network security (Sie).
- McGraw-Hill Education, 2011.
- Endorf, C., Schultz E and Mellander J, “Intrusion Detection and prevention”. McGraw Hill. 2003

COURSE OUTCOMES (CO):

- Students will be able to identify and analyze various security threats and vulnerabilities in a system.
- Students will demonstrate knowledge of different encryption systems and apply cryptographic algorithms for securing data.
- Students will gain proficiency in key management techniques, digital signatures, and message authentication codes.
- Students will be able to design and implement solutions for network security, including intrusion detection systems and defense strategies against cyber-attacks.

COURSE TITLE: Lab Network Security and Cryptography

Course Code:			**CSE20522**			**Examination Scheme**	
Total number of Lab Hours:26 hrs						**External**	**40**
						Internal	**10**
Lecture (L):	**-**	**Practicals(P):**	**4**	**Tutorial (T):**	**-**	**Total Credits**	**2**

Course Objectives:

- To gain practical knowledge of network security tools and techniques for monitoring and protecting computer networks.
- To learn how to analyze network traffic and detect potential threats using tools like Wireshark and SNORT.
- To develop skills in performing cryptographic operations using classical encryption techniques and modern algorithms.
- To understand and implement various methods of network penetration testing and vulnerability assessments.

- **Week 1 :** Experiment 1: Using Wireshark, Demonstrate Packet Sniffing for Router Traffic
- **Week 2:** Experiment 2: Demonstrate Intrusion Detection System using SNORT
- **Week 3:** Experiment 3: Perform Wireless Audit of an Access Point and Decrypt WEP and WPA
- **Week 4:** Experiment 4: Using KF Sensor, Setup a Honey Pot and Monitor the Honeypot on Network.
- **Week 5:** Experiment 5: Using NMAP,
  Find • Open Ports on a system • Machine that are Active • Version of operating System
- **Week 6:** Experiment 6: Implement Ceaser Cipher Encryption Decryption
- **Week 7:** Experiment 7: Implement Hill Cipher Encryption Decryption
- **Week 8:** Experiment 8: Implement Playfair Cipher Encryption Decryption
- **Week 9:** Experiment 9: Implement Vigenere Cipher Experiment
- **Week 10:** Experiment10: Implement Rail Fence (Row Column Transformation)
- **Week 11:** Experiment 1: Implement RSA Algorithm.

COURSE OUTCOMES (CO):

- Students will be able to use packet sniffing tools to monitor and analyze network traffic and detect suspicious activities.
- Students will demonstrate the ability to configure and deploy intrusion detection systems and honeypots for network security.
- Students will acquire hands-on experience in implementing various cryptographic algorithms, including classical ciphers and public-key encryption.
- Students will be able to perform network scans, identify open ports, and assess vulnerabilities in a networked environment using tools like NMAP.

COURSE TITLE: Advanced Database Management Systems

Course Code:			**CSE205162**			**Examination Scheme**	
Total number of Lecture Hours: 52						**External**	**80**
						Internal	**20**
Lecture (L):	**4**	**Practicals(P):**	**0**	**Tutorial (T):**	**0**	**Total Credits**	**4**

Course Objectives

- Understand and apply object-oriented concepts, including object identity, complex data types, and type hierarchies, in the design and implementation of object-based database systems.
- Develop proficiency in modeling temporal data and relationships, applying temporal constraints, and using temporal query languages to manage and retrieve temporal data effectively.
- Analyze and implement parallel processing techniques, such as partitioning, intra-operator, and inter-operator parallelism, to optimize query execution in parallel database systems.
- Design and manage distributed databases, focusing on data fragmentation, replication, and allocation techniques, while understanding the challenges and solutions related to concurrency control, recovery, and the use of NOSQL databases.

Course Content	**TEACHING HOURS**

UNIT 1: Object Based Database Systems	**14 Hrs**
Object Database Concepts Overview: Object Oriented Concepts and Features, Object Identity, Complex data types, Encapsulation of Operations and Object Persistence, Type Hierarchies and Inheritance. Object Based Extensions to SQL: User-Defined Types using CREATE TYPE and Complex ObjectsODMG Object Model and the Object Definition Language.	
UNIT 2: Temporal Database Systems	**13 Hrs**
Temporal Data model: Conceptual Objects, Temporal Objects, temporal Constraints, Temporal and Non Temporal Attributes, Conceptual Relationships, Temporal Relationships and constraints among relationships. The Temporal Query Language: Temporal Projection, Temporal Selection, Temporal VersionRestriction Operators, Temporal Scope Operators.	
UNIT 3: Parallel Database Systems	**13 Hrs**
I/O Parallelism: Partitioning Techniques, Managing Skew. Interquery Parallelism and Intraquery Parallelism, Intra-operator Parallelism (Parallel Sort and ParallelJoin). Inter-operator Parallelism: Pipelined Parallelism and Independent ParallelismQuery Optimization.	
UNIT 4: Distributed Database Systems	**13 Hrs**
Distributed Database Concepts. Data Fragmentation, Replication and Allocation Techniques For Distributed Database Design, Concurrency Control and Recovery. NOSQL Databases: Introduction, the CAP theorem, Document based NOSQL systems and MongoDB, NOSQL Key-Value Stores, Column Based NOSQL Systems, NOSQL Graph Databases and Neo4j.	

Textbooks

1. Advanced Database Systems by Nabil R. Adam and Bharat K . Bhargava, ISBN 3-540-57507-3 Springer-Verlag Berlin Heidelberg New York

Reference Books

1. Ramez Elmasri and Shamkant B. Navathe, "Fundamentals of Database Systems", 7th Edition,Pearson Education, 2017
2. ADVANCED DATABASE SYSTEMS by Dr.John Kandiri
3. Abraham Silberschatz, Henry F. Korth, S.Sudarshan, "Database System Concepts", 6th Edition,2014

COURSE OUTCOMES (CO):

CO1: Evaluate and compare the effectiveness of object-based extensions to SQL in handling complex data structures and operations within modern database systems.

CO2: Critically analyze temporal relationships and constraints within temporal databases to ensure accurate and efficient data management over time.

CO3: Assess the impact of various parallelism strategies on query performance and scalability in large-scale database systems.

CO4: Investigate the trade-offs and challenges associated with data fragmentation, replication, and concurrency control in distributed and NOSQL database environments.

COURSE TITLE: Machine Learning

Course Code:			**CSE20525**			**Examination Scheme**	
Total number of Lecture Hours: 40						**External**	**80**
						Internal	**20**
Lecture (L):	**40**	**Practicals(P):**	**0**	**Tutorial (T):**	**0**	**Total Credits**	**4**

Course Objectives:

- To provide a comprehensive understanding of clustering algorithms and techniques for evaluating cluster validity.
- To explore the principles and applications of Support Vector Machines (SVMs) for solving linear and non-linear classification problems.
- To introduce dimensionality reduction techniques such as Principal Component Analysis (PCA) and Fisher Linear Discriminant for feature extraction and data analysis.
- To study advanced topics in neural networks, including Convolutional Neural Networks (CNNs), and their applications in image recognition and other fields.

Course Content	**TEACHING HOURS**
UNIT 1:	**10 Hrs**
Clustering Algorithms, Euclidean and Mahalanobis Distances, Basic Sequential Algorithm Scheme, K-Means Algorithm, Fuzzy C-Means Clustering, Clustering with Gaussian Probability Density Function. Cluster Validity index. Compactness Cluster Measure, Distinctness Cluster Measure, Validity Index Using Standard Deviation, Point Density Based Validity Index, Validity index using Local and Global Data Spread,	
UNIT 2:	**10 Hrs**
Support Vector Machines. Binary Linear Support Vector Machines, Optimal Hyperplane, Canonical Form, Kernel Functions, Solving Non-linear Classification problems with Linear Classifier. Multiclass Suport Vector Machines, Directed Acyclic Graph Support Vector Machines. Application of Support Vector Machines.	
UNIT 3:	**10 Hrs**

Dimensionality Reduction, Principal Component Analysis, Fisher Linear Discriminant, Multiple Discriminant Analysis. Watershed Based Clustering. Sub-Space Grid Based Approach. Coarse and Fie Rule Extraction using Sub-Space Grid Based Approach for Clustering.	
UNIT 4:	**10Hrs**
Convolutional Neural Network Architectures and applications.	

Textbooks

- Machine Learning by Tom M. Mitchel, McGraw-Hill publication
- Pattern Classification by Duda and Hart. John Wiley publication
- Introduction to Machine Learning by EthemAlpaydin, The MIT Press.
- Machine Learning: An Algorithmic Perspective by Stephen Marsland, Chapman and Hall/CRC.

Reference Books

- Advances in Deep Learning, M. Arif Wani,
- The Elements of Statistical Learning: Data Mining, Inference, and Prediction by Trevor Hastie,
- Robert Tibshirani, Jerome Friedman, Springer.
- Learning From Data, Yaser S. Abu-Mostafa, Hsuan-Tien Lin, Malik Magdon-Ismail, AML Book.

COURSE OUTCOMES (CO):

- Students will gain proficiency in implementing clustering algorithms like K-Means and Fuzzy C-Means and evaluate clustering performance using various validity indices.
- Students will be able to apply Support Vector Machines to binary and multi-class classification problems and understand how kernel functions can solve non-linear classification challenges.
- Students will acquire knowledge of dimensionality reduction techniques and apply methods like PCA and Fisher Linear Discriminant for feature selection and data compression.
- Students will develop practical skills in designing and applying Convolutional Neural Networks for solving real-world problems, especially in image processing and pattern recognition.

COURSE TITLE: Cloud Computing

Course Code:			**CSE205351**			**Examination Scheme**	
Total number of Lecture Hours: 46						**External**	**80**
						Internal	**20**
Lecture (L):	**46**	**Practicals(P):**	**0**	**Tutorial (T):**	**0**	**Total Credits**	**4**

Course Objectives:

- To understand the fundamental concepts of cloud computing, including different cloud deployment models (public, private, hybrid) and service models (IaaS, PaaS, SaaS).
- To explore the technologies and processes involved in deploying and managing cloud-based applications and web services.
- To analyze the management aspects of cloud services, including reliability, availability, scalability, and the economic factors influencing cloud platform choices.
- To gain practical knowledge in cloud-based application development and service creation environments, focusing on the benefits and challenges of cloud architecture.

Course Content	**TEACHING HOURS**
UNIT 1:	**12 Hrs**
CLOUD COMPUTING FUNDAMENTALS (8 hours) Cloud Computing definition; , private, public and hybrid cloud. Cloud types; IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public vs private clouds, role of virtualization in enabling the cloud; Business Agility: Benefits and challenges to Cloud architecture. Application availability, performance, security and disaster recovery; next generation Cloud Applications.	
UNIT 2:	**12 Hrs**
CLOUD APPLICATIONS (6 hours) Technologies and the processes required when deploying web services; Deploying a web service from inside and outside a cloud architecture, advantages and disadvantages.	

UNIT 3:	**12 Hrs**
MANAGEMENT OF CLOUD SERVICES (12 hours) Reliability, availability and security of services deployed from the cloud. Performance and scalability of services, tools and technologies used to manage cloud services deployment; Cloud Economics: Cloud Computing infrastructures available for implementing cloud based services. Economics of choosing a Cloud platform for an organization, based on application requirements, economic constraints and business needs (e.g Amazon, Microsoft and Google, Salesforce.com, Ubuntu and Redhat)	
UNIT 4:	**12Hrs**
APPLICATION DEVELOPMENT (10 hours) Service creation environments to develop cloud based applications. Development environments for service development; Amazon, Azure, Google App.	

Textbooks

- Gautam Shroff, “Enterprise Cloud Computing Technology Architecture Applications”, Cambridge University Press; 1 edition, [ISBN: 9780521137355], 2010.
- Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing, A Practical Approach”

Reference Books

- McGraw-Hill Osborne Media; 1 edition [ISBN: 0071626948], 2009.
- Dimitris N. Chorafas, “Cloud Computing Strategies” CRC Press; 1 edition [ISBN:
- 1439834539],2010.

COURSE OUTCOMES (CO):

- Students will be able to describe the key concepts of cloud computing, distinguish between various cloud models, and understand the role of virtualization in cloud architecture.
- Students will develop skills in deploying and managing cloud-based applications, both from within and outside a cloud architecture, while evaluating the advantages and disadvantages.
- Students will acquire the ability to assess the reliability, availability, and security of cloud services and make informed decisions on cloud platform selection based on economic and business needs.
- Students will demonstrate the capability to develop cloud-based applications, utilizing service creation environments and understanding the performance, security, and disaster recovery aspects.

COURSE TITLE: Real-Time Operating Systems

Course Code:				**CSE20533**		**Examination Scheme**	
Total number of Lecture Hours: 46						**External**	**80**
						Internal	**20**
Lecture (L):	**46**	**Practicals(P):**	**0**	**Tutorial (T):**	**0**	**Total Credits**	**4**

Course Objectives:

- Develop a comprehensive understanding of real-time systems, including their fundamental principles, architectures, and the distinctions between hard and soft real-time applications.
- Explore and classify real-time scheduling algorithms, focusing on both clock-driven and priority-driven approaches, to ensure timely and predictable task execution in real-time environments.
- Understand the challenges of resource sharing and synchronization in real-time systems, and study protocols to manage priority inversion and ensure task coordination.
- Investigate the features, standards, and performance benchmarks of real-time operating systems (RTOSs), including case studies and practical applications in various domains.

Course Content	**TEACHING HOURS**
UNIT 1: Introduction	**12 Hrs**
Basic OS Principles and Structures review; Real-Time Systems – Basic Model, Characteristics, Hard vs. Soft, Applications; Real-Time Reference Model – Tasks and Types; Software Architectures – Petri nets, RTOS Architecture, Real-Time Kernels.	
UNIT 2: Real Time Task Scheduling	**12 Hrs**
Classification of Real-Time Scheduling Algorithms; Common Approaches; Clock Driven; Priority Driven – Earliest Deadline First, Rate Monotonic, Deadline Monotonic; Overview of Real-Time Multiprocessor Scheduling.	

UNIT 3: Real-Time Resource Sharing/Synchronization	**12 Hrs**
Resource Sharing among Real-Time Tasks – Contention and Control; Priority Inversion; Priority Inheritance Protocol; Highest Locker Protocol; Priority Ceiling Protocol.	
UNIT 4: Real World RTOSs	**12Hrs**
Features of RTOSs; UNIX and Windows as RTOSs – Pros and; POSIX Standard; Survey of Contemporary RTOSs – Case Study of any one, Porting to a Target; RTOS Benchmarking; RTOS Application Domains.	

Textbooks

- Andrew S. Tanenbaum, Modern Operating Systems (Third Edition), Pearson Education.
- David E. Simon, An Embedded Software Primer, Pearson Education.

Reference Books

- Laplante, P., Real-Time Systems Design and Analysis (Third Edition), IEEE/Wiley Interscience.
- Rajib Mall, Real-Time Systems: Theory and Practice (Second Edition), Pearson Education.
- Jane W.S. Liu, Real-Time Systems (Sixth Edition), Pearson Education.
- Raj Kamal, Embedded Systems: Architecture, Programming and Design (Third Edition), Tata McGraw-Hill Education

COURSE OUTCOMES (CO):

- Demonstrate a solid understanding of real-time system characteristics, models, and architectures, and apply this knowledge to analyze and design real-time systems.
- Implement and evaluate real-time scheduling algorithms, ensuring the ability to select and apply appropriate scheduling techniques for different real-time system requirements.
- Develop strategies for resource sharing and synchronization among real-time tasks, effectively managing issues such as priority inversion using appropriate protocols.
- Analyze and compare different RTOSs, including their standards and performance metrics, and apply this understanding to practical scenarios, including RTOS porting and benchmarking.

COURSE TITLE: Natural Language Processing

Course Code:			**CSE205353**			**Examination Scheme**	
Total number of Lecture Hours: 46						**External**	**80**
						Internal	**20**
Lecture (L):	**46**	**Practicals(P):**	**0**	**Tutorial (T):**	**0**	**Total Credits**	**4**

Course Objectives:

- To provide a comprehensive understanding of Natural Language Processing (NLP), its applications, and the fundamental levels of language analysis, including grammar and sentence structure.
- To explore various parsing techniques and grammar models used in NLP, including deterministic parsers, probabilistic grammars, and part-of-speech tagging.
- To introduce semantic analysis concepts such as word sense disambiguation, speech acts, semantic interpretation, and the use of feature systems for lexical and grammatical representation.
- To examine advanced semantic filtering techniques, statistical methods for word sense disambiguation, and the integration of multiple approaches for semantic analysis and interpretation.

Course Content	**TEACHING HOURS**
UNIT 1:	**12 Hrs**
Introduction to Natural Language Processing, Applications of NLP, Different levels of Language Analysis, Representation and Understanding, Linguistic Background, Grammar and sentence structure, Top down parser, Bottom up chart parser, Transition Network Grammars, Finite state Models and Morphological Processing. Feature Systems and Augmented Grammars, Morphological Analysis and Lexicon.	
UNIT 2:	**12 Hrs**

Grammars for Natural Language, Encoding uncertainty : Shift Reduce Parsers, A deterministic parser, Partial Parsing, Ambiguity resolution , Part of speech tagging, Probabilistic Context free grammars, Best first parsing	
UNIT 3:	**12 Hrs**
Semantics and logical form, word sense and ambiguity, Speech acts and embedded sentences, defining semantic structure Semantic Interpretation an compositionality, A simple grammar and lexicon with semantic interpretation, Lexicalized semantic interpretation and semantic roles, Semantic interpretation using feature unification.	
UNIT 4:	**12Hrs**
Selectional restrictions, Semantic filtering, semantic networks, statistical word sense disambiguation, statistical semantic preferences, Combining approaches to disambiguation. Grammatical relations, Semantic grammars, template matching, semantically driven parsing techniques, scooping phenomenon, co-reference and binding constraints.	

Textbooks

- Allen, James, Natural Language Understanding, Second Edition, Benjamin/Cumming. Charniack, Eugene, Statistical Language Learning, MIT Press,.
- Jurafsky, Dan and Martin, James, Speech and Language Processing, Second Edition, Prentice Hall, 2008.
-

Reference Books

- Manning, Christopher and Heinrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press.

COURSE OUTCOMES (CO):

- Students will be able to explain the key concepts of NLP, including language representation, grammar models, and different parsing strategies like top-down and bottom-up parsers.
- Students will gain skills in implementing various parsing techniques and part-of-speech tagging, along with understanding ambiguity resolution in natural language processing.
- Students will acquire knowledge of semantic interpretation, including word sense disambiguation, compositionality, and the role of semantic roles in lexicalized interpretation.
- Students will demonstrate proficiency in applying semantic filtering techniques, statistical approaches to word sense disambiguation, and the combination of various methods for effective natural language understanding.

COURSE TITLE: Embedded Systems

Course Code:			**CSE20511**			**Examination Scheme**	
Total number of Lecture Hours: 52						**External**	**80**
						Internal	**20**
Lecture (L):	**4**	**Practicals(P):**	**0**	**Tutorial (T):**	**0**	**Total Credits**	**4**

Course Objectives

- Understand the fundamental concepts and design challenges of Embedded Systems and Cyber-Physical Systems, including their classification and application areas.
- Describe the architecture and memory organization of the 8051 microcontroller, including its special function registers (SFRs) and I/O ports.
- Program the 8051 microcontroller to handle interrupts, including timer interrupts, external hardware interrupts, and serial communication interrupts.
- Develop skills in interfacing the 8051 microcontroller with external devices, such as LCDs, keyboards, DACs, ADCs, and stepper motors.

Course Content	**TEACHING HOURS**
UNIT 1: Introduction.	**15 Hrs**
Embedded systems and Cyber Physical Systems: Definition, Characteristics, Design Challenges, Classification, Application areas. Embedded Hardware Architecture: General Purpose Processor, Microprocessor Design Options,Microcontroller, Digital Signal Processor, ASIC, PLDs, COTS; Embedded Systems Memory; Other Hardware Components: I/O Subsystem, Timers and counters, Interrupt Subsystem, UART, PWM andAnalog-Digital Conversion, Sensors and Actuators. Embedded Software Architectures: Round Robin, Round Robin with Interrupts, Function Queue Scheduling, Real-time Operating System (RTOS); Programming Languages and Tools; EmbeddedIDE; Debugging.	
UNIT 2: The 8051 Microcontroller.	**13 Hrs**

Microcontroller: Introduction, Criteria for choosing a microcontroller; Overview of 8051 Microcontroller family: Architecture, Memory Organization of 8051, SFRs, I/O Ports, Addressing modes. Basic Assembly Language programming concepts: 8051 Instruction set, Assembler Directives, Subroutine, Stack. Time delay generations and calculations, Programming of 8051 Timers, Counter Programming,WatchDog Timer,Real Time clock.	
UNIT 3: 8051 Communication and Interrupts.	**13 Hrs**
Basics of Communication: Overview of RS-232, I^2C Bus, UART, USB; Communication with 8051:Using I/O Ports, 8051 Serial Port, 8051 connections to RS232. 8051 interrupts: Interrupt vectors and interrupt processing, Level triggered and edge triggered, Masking and priorities; Programming of 8051 Timer interrupts, Programming of External hardware interrupts, Programming of the serial communication interrupts.	
UNIT 4: 8051 Interfacing.	**13 Hrs**
Basic Concepts of Interfacing: Introduction; 8051 Interfacing to external memory and AccessingExternal data Memory and External Code Memory. Interfacing to LCD/Keyboard, DAC/ADC, Sensors, Stepper Motor, 8255.	

Textbooks

4. Shibu K V. *Introduction to Embedded Systems*, TMH.
5. M.A. Mazidi and J. G. Mazidi. *The 8051 Microcontroller and Embedded Systems*, PHI.
6. Raj Kamal. *Embedded Systems*, TMH.

Reference Books
COURSE OUTCOMES (CO): **CO1:** Demonstrate the ability to identify and classify different types of embedded systems and cyber-physical systems, and explain their role in various application areas. **CO2:** Apply knowledge of 8051 microcontroller architecture to develop basic assembly language programs, effectively utilizing its instruction set and addressing modes. **CO3:** Implement communication protocols like RS-232 and I2C with the 8051 microcontroller, and manage interrupt-driven tasks to optimize system performance. **CO4:** Successfully interface the 8051 microcontroller with a variety of external devices, ensuring accurate data exchange and control, thereby enhancing practical hardware integration skills.

COURSE TITLE: Advanced Data Communication

Course Code:			**CSE205161**			**Examination Scheme**	
Total number of Lecture Hours: 52						**External**	**80**
						Internal	**20**
Lecture (L):	**4**	**Practicals(P):**	**0**	**Tutorial (T):**	**0**	**Total Credits**	**4**

Course Objectives

- Understand and quantify channel capacity for both noiseless and noisy channels, applying Nyquist and Shannon's laws to real-world communication systems such as digital telephone networks.
- Explore WAN technologies, including traditional packet and circuit switching, and understand the principles of transmission media, with a focus on the advantages and applications of optical networks.
- Analyze various data encoding and modulation techniques, including NRZ, ASK, FSK, PSK, and PCM, to comprehend their applications in modern communication systems.
- Learn and apply error detection and correction techniques, such as parity checks and CRC, and understand the concepts of multiplexing and spread spectrum techniques to ensure reliable data transmission.

Course Content	**TEACHING HOURS**
UNIT 1: Fundamentals of Communication Systems	**16 Hrs**
Bandwidth and Channel Capacity. Quantifying Channel Capacity for noiseless channel(Nyquist Law) and noisy channel(Shannon's Law). Example of a digital telephone system to explain basic concepts of analog signals, digital signals, sampling. Data Rate versus Baud Rate. Nyquist Criterion for Sampling. Signal-to-Noise ratio. Local area network(LAN) concepts and characteristics.	
UNIT 2: Wide Area Networks and Transmission Media	**13 Hrs**

Wide area networks(WANs). WAN technologies (traditional packet and circuit switching, Frame Relay, ATM). ISDN(narrowband) concepts and services. Overview of the OSI model. Transmission media – factors affecting distance and data rate. Guided transmission media: Twisted-Pair, Co-axial Cable. Principles and advantages of optical networks. Types of optical fibers and lasers.	
UNIT 3: Data Encoding and Modulation Techniques	**13 Hrs**
Unguided transmission media: Terrestrial Microwave & Satellite Microwave systems and applications. Data encoding. Difference between modulation and encoding. NRZ-L, NRZ-I encoding.Multilevel Binary and Biphase Coding techniques and their implementations. ASK,FSK,PSK and QPSK. PCM concepts: sampling, quantization. Amplitude Modulation.	
UNIT 4: Reliable Data Transmission and Multiplexing	**13 Hrs**
Reliable transmission of data: Asynchronous and Synchronous transmission. Error detection: Parity- based, CRC-based. FCS computation. Error control and recovery techniques. Concept of ARQ standard and its versions. Concept of Multiplexing. FDM. Synchronous and Statistical TDM. Spread Spectrum Techniques: Direct Sequence and Frequency Hopping.	

Textbooks

1. William Stallings, "Data and Computer Communications", 8th Edition, Pearson Education.
2. Behrouz Fourouzan " Data Communications & Networking", 4th Edition, TMH.

Reference Books

4. Andrew Tanenbaum, "Computer Networks", Pearson Education 4/e.
5. Ulysses Black, "Principles of Data Communications ", PHI.
3. Morley, Gelber, "The Emerging Digital Future", Addison-Wesley.

COURSE OUTCOMES (CO):

CO1: Demonstrate the ability to calculate and compare the data rate and baud rate for various communication systems, applying the Nyquist sampling criterion and understanding its impact on signal transmission.

CO2: Critically evaluate different WAN technologies and their underlying principles, such as Frame Relay and ATM, in terms of their suitability for specific communication scenarios, including factors like distance and data rate.

CO3: Analyze and differentiate between various encoding techniques like NRZ, ASK, and PSK, and demonstrate their practical implementation in communication systems, understanding their advantages and limitations.

CO4: Apply error detection and correction methods such as CRC and ARQ in practical communication scenarios, ensuring reliable data transmission across different types of networks and understanding the principles of multiplexing techniques like FDM and TDM.

COURSE TITLE: Object Oriented Methods & Design

Course Code:			**CSE205164**			**Examination Scheme**	
Total number of Lecture Hours: 52						**External**	**80**
						Internal	**20**
Lecture (L):	**4**	**Practicals(P):**	**0**	**Tutorial (T):**	**0**	**Total Credits**	**4**

Course Objectives

- Understand and apply the foundational concepts of Object-Oriented Analysis and Design (OOAD), including the Unified Process (UP) framework and iterative development methodologies, to initiate and manage software development projects.
- Develop comprehensive use case models by identifying primary actors, goals, and writing use cases in a UI-free style to capture functional requirements, ensuring alignment with the project's objectives and scope.
- Create and interpret System Sequence Diagrams (SSDs) and Domain Models to accurately represent system behavior, interactions, and conceptual classes, enhancing the design and analysis phases of software development.
- Apply GRASP (General Responsibility Assignment Software Patterns) principles and GoF (Gang of Four) Design Patterns in the creation of interaction diagrams, sequence diagrams, and class diagrams, ensuring a robust and scalable software architecture.

Course Content	**TEACHING HOURS**
UNIT 1: Introduction to OOAD and UML	**17 Hrs**
OOAD – Introduction, Applying UML and Patterns in OOAD, Assigning Responsibilities, what is analysis and Design, An Example, The UML, Iterative Development–a Unified Process idea, Additional UP Best Practices and Concepts, The UP Phases and Schedule oriented Terms, The UP disciplines. Process Customization and the development case. The Agile UP. The Sequential Waterfall Lifecycle. Inception. Artifacts that may start in inception, Understanding requirements, types of requirements.	

UNIT 2: Use Case Modeling and Requirement Analysis	**13 Hrs**
Use –case Model, Writing requirements in context, goals and stories, background, use cases and adding value, use cases and functional requirements, use case types and formats. Goal and scope of ause case, Finding primary actors, goals and use cases, writing use cases in an essential UI-free style, Actors, Use Case Diagrams, Use Cases writing the UP, Case Study. Identifying other requirements. From inception to elaboration.	
UNIT 3: System Sequence Diagrams and Domain Modeling	**13 Hrs**
Use Case Model: Drawing System Sequence Diagrams. Example of an SSD. Inter System SSDs, SSDs and Use Cases, System Events and the System Boundary, Name System Events and Operations, Showing Use Case Text, SSDs within the UP. Domain Model: Visualizing Concepts, Domain Models, Conceptual Class Identification, Candidate Conceptual classes, Adding Associations, The UML association notation, NextGen POS Domain Model Associations, NextGen POS Domain Model, Adding Attributes, Non Primitive Data Type Classes, Adding Detail with Operation Contracts, Contract Sections, Post Conditions, Contracts, Operations and the UML. Operation Contracts withinthe UP.	
UNIT 4: T ransitioning from Requirements to Design with GRASP and Design Patterns	**13 Hrs**
From Requirements to Design, Interaction Diagram Notation, Sequence and Collaboration Diagrams,GRASP, Responsibilities and methods, interactions diagrams, Patterns, GRASP: Pattern of General Principles in Assigning Responsibilities, Information Expert, creator, Low Coupling, High Cohesion, Controller, Object Design and CRC Cards, Design Model: Use Case Realization with GRASP Patterns, Determining Visibility, Creating Design Class Diagrams, Mapping Design to Code. GRASP: More Patterns , Polymorphism , Pure Fabrication , Indirection , Protected Variations , GoF Design Patterns : Adapter , Factory , Singleton , Strategy , Façade , Observer / Publish-Subscribe / DelegationEvent Model ,Relating Use Cases , Modeling Generalization , Refining the Domain Model , Adding New SSDs and Contracts , Modeling Behaviour in Statechart Diagrams.	

Textbooks

1. Craig Larman,"Applying UML and Patterns", PHI

Reference Books

1. James Rumbaugh, "Object Oriented Models and Design" Pearson Education 2/e Harrington."
2. C & Object Oriented Paradigm" John Viley & sons Publication
3. Ali Bahrani "Object Oriented Systems Development" McGraw -Hill 1999
4. Lafore Robert, "Object Oriented Programming in C++", Galgotia Publications.
5. Balagurusami, E, "Object Oriented with C++", Tata McGraw-Hill.

COURSE OUTCOMES (CO):

CO1: Students will be able to critically analyze and compare different software development lifecycle models, including iterative and agile methodologies, to determine their suitability for various project requirements.

CO2: Students will demonstrate the ability to effectively communicate functional requirements through well-structured use case models, ensuring clarity in software design documentation.

CO3: Students will be able to interpret and construct system sequence diagrams and domain models, identifying key system events and operations essential for accurate system design.

CO4: Students will gain the ability to apply GRASP principles and design patterns to solve complex object-oriented design problems, enhancing their skills in creating scalable and maintainable software architectures.

COURSE TITLE: Internet of Things

Course Code:		**CSE205352**			**Examination Scheme**		
Total number of Lecture Hours: 46					**External**	**80**	
					Internal	**20**	
Lecture (L):	**46**	**Practicals(P):**	**0**	**Tutorial (T):**	**0**	**Total Credits**	**4**

Course Objectives:

- To understand the fundamental concepts of cloud computing, including different cloud deployment models (public, private, hybrid) and service models (IaaS, PaaS, SaaS).
- To explore the technologies and processes involved in deploying and managing cloud-based applications and web services.
- To analyze the management aspects of cloud services, including reliability, availability, scalability, and the economic factors influencing cloud platform choices.
- To gain practical knowledge in cloud-based application development and service creation environments, focusing on the benefits and challenges of cloud architecture.

Course Content	**TEACHING HOURS**
UNIT 1:	**12 Hrs**
Definition & Characteristics of Iot, Physical Design of Iot, Things in Iot, Iot Protocols; Logical Design Of Iot: Iot Functional Blocks, Iot Communication Models, Iot Communication APIs; IoT Levels and Templates [8 Lectures] Domain Specific IoTs – Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle [4 Lectures]	
UNIT 2:	**12 Hrs**
Wireless Sensor Networks, Cloud Computing, Big Data Analytic, Communication Protocols, Machine to Machine, Difference between IoT and M2M, Software define Network, Embedded Systems [6 Lectures] Design challenges, Development challenges, Security challenges, Other challenges [6 Lectures].	
UNIT 3:	**12 Hrs**

Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. [4 Lectures] Real-World Design Constraints- Introduction, Technical Design constraints-hardware is popular again [2 Lectures] Data representation and visualization, Interaction and remote control. Industrial Automation- Serviceoriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things [6 Lectures]	
UNIT 4:	**12Hrs**
Setting up the Arduino development environment: Options for Internet connectivity, Interacting with basic sensors, Interacting with basic actuators, Configuring Arduino for the IoT [4 Lectures] Grabbing the content from a web page, Sending data to the cloud, Monitoring sensor data from a cloud dashboard, Monitoring several Arduino boards at, Storing data on Google Drive [4 Lectures] Basic local M2M interactions, Cloud M2M with IFTTT; Case Study: IoT based Flood Monitoring and Alert System [4 Lectures]	

Textbooks

- Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, 1stEdition, VPT, 2014. (ISBN-13: 978-8173719547)
- Schwartz, Marco. “Internet of Things with Arduino Cookbook”. Packt Publishing Ltd, 2016.

Reference Books

- Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of
- Intelligence”, 1st Edition, Academic Press, 2014. (ISBN-13: 978-0124076846)
- The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World, Michael Miller

COURSE OUTCOMES (CO):

- Students will be able to describe and differentiate between key IoT enabling technologies, such as Wireless Sensor Networks, Cloud Computing, and M2M communication, while understanding the role of software-defined networks and embedded systems.
- Students will gain knowledge of the challenges in IoT design and development, including security and technical constraints, and propose solutions to overcome these issues.
- Students will acquire skills in designing and analyzing IoT architecture, considering various views like functional, information, and deployment, and apply these concepts to industrial automation and real-world applications.
- Students will develop practical skills in using Arduino for IoT projects, including setting up the environment, connecting to sensors and actuators, and implementing cloud-based data monitoring and M2M interactions.

COURSE TITLE: Artificial Intelligence

Course Code:			CSE20515		**Examination Scheme**		
Total number of Lecture Hours: 52					**External**	**80**	
					Internal	**20**	
Lecture (L):	**4**	**Practicals(P):**	**0**	**Tutorial (T):**	**0**	**Total Credits**	**4**

Course Objectives

- Understand the structure and function of biological neural networks and their analogy to artificial neural networks (ANN), including the concepts of perceptrons and multilayer neural networks, and their applications.
- Explore various inductive learning algorithms such as ID3, AQ, and RULES, and learn how to apply these algorithms for rule extraction and solving real-world problems.
- Gain a solid understanding of fuzzy logic principles, including fuzzification, fuzzy set operations, and fuzzy inferencing techniques, and their applications in handling uncertainty in complex systems.
- Apply artificial intelligence techniques to enhance the accuracy and efficiency of biometric recognition systems, specifically in fingerprint, face, and iris recognition.

Course Content	**TEACHING HOURS**
UNIT 1: Introduction to Artificial Neural Networks (ANN)	**18 Hrs**
Introduction to biological neural networks. Artificial neural networks (ANN). Analogy between biological and artificial neural networks. Neuron as a basic building element of an ANN. Activation functions. Perceptron. Learning with a perceptron. Limitations of a perceptron. Multilayer neural networks. Learning with a multilayer perceptron. Backpropagation algorithm. Synergistic neural networks. Distributed neural networks. Distributed and synergistic neural networks. Applications of ANNs.	
UNIT 2: Inductive Learning Algorithms	**13 Hrs**

Inductive learning algorithms. Categories of inductive learning algorithms. Rule extraction with inductive learning algorithms. ID3 algorithm. AQ algorithm. RULES algorithms. SAFARI algorithm.Applications of inductive learning algorithms.	
UNIT 3: Fuzzy Logic and Uncertainty	**13 Hrs**
Fuzzy logic and uncertainty. Fuzzification. Linguistic terms. Fuzzy sets. Hedges. Fuzzy Hedge Operations. Fuzzy set operations. Fuzzy vector matrix multiplication. Fuzzy Max-Min inferencing. Fuzzy Max-Product inferencing. Multiple premise fuzzy inferencing. Fuzzy multiple rule aggregation. De-fuzzification. Applications of fuzzy logic.	
UNIT 4: Artificial Intelligence in Biometric Recognition	**13 Hrs**
Artificial intelligence techniques in fingerprint, face, and iris recognition	

Textbooks
7. Artificial Intelligence: A Modern Approach by Stuart Russell.
Reference Books
2. Artificial Intelligence: A Guide to Intelligent Systems by Michael Negnevitsky 3. Machine Learning by Tom Mitchell 4. Selected Journal and Conference Papers
COURSE OUTCOMES (CO): **CO1:** Apply backpropagation and other learning algorithms to train multilayer neural networks for pattern recognition tasks, improving the network's predictive accuracy. **CO2:** Evaluate and compare the effectiveness of different inductive learning algorithms like ID3 and AQ in terms of rule extraction quality and computational efficiency in various datasets. **CO3:** Design and implement fuzzy inference systems to solve complex decision-making problems in uncertain environments, enhancing system robustness and flexibility. **CO4:** Analyze and optimize AI-based biometric recognition systems to improve the accuracy and reliability of fingerprint, face, and iris recognition technologies in real-world applications.