JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA–533003,Andhra Pradesh, India
B.Tech CSE – Internet of Things (IoT)
(R23 – III[rd] YEAR COURSE STRUCTURE & SYLLABUS)

B.Tech. – III Year I Semester

S.No.	Category	Title	L	T	P	Credits
1	ProfessionalCore	Internet of Things	3	0	0	3
2	ProfessionalCore	Database Management Systems	3	0	0	3
3	ProfessionalCore	Embedded Systems	3	0	0	3
4	Professional Elective-I	1. Software Engineering 2. Wireless Sensor Networks 3. Artificial Intelligence 4. Cryptography & Network Security 5. 12-week MOOC Swayam/NPTEL course recommended by the BoS	3	0	0	3
5	Open Elective- I	OR Entrepreneurship Development & Venture Creation	3	0	0	3
6	Professional Core	Internet of Things and Embedded Systems Lab	0	0	3	1.5
7	Professional Core	Database Management Systems Lab	0	0	3	1.5
8	Skill Enhancement Course	Full Stack Development-2	0	1	2	2
9	Engineering Sciences	UI Design-FlutterLab	0	0	2	1
10	Evaluation of Community ServiceInternship		-	-	-	2
		Total	**15**	**1**	**10**	**23**

MC	Minor Course (Student may select from the same specialized minors pool)	3	0	3	4.5
MC	Minor Course through SWAYAM / NPTEL (Minimum 12 Week, 3 credit course)	3	0	0	3
HC	Honors Course (Student may select from the same Honors pool)	3	0	0	3
HC	Honors Course (Student may select from the same Honors Pool)	3	0	0	3

Remarks :
1. In professional elective -I included12week MOOC Swayam/NPTEL course recommended by the BoS.
2.In place of tinkering lab the BOS member suggested Ui Design-Flutter in above sl.no : 09.

B.Tech.– III Year II Semester

S.No.	Category	Title	L	T	P	Credits
1	Professional Core	IoT Data Analytics	3	0	0	3
2	Professional Core	Cloud Computing	3	0	0	3
3	Professional Core	Machine Learning	3	0	0	3
4	Professional Elective-II	1.DevOps 2.IOT Security 3.Multi Agent Systems 4.Automata Theory & Compiler Design 6.12 week MOOC Swayam/NPTEL course recommended by the BoS	3	0	0	3
5	Professional Elective-III	1. Block Chain Technologies 2. Natural Language Processing 3. Security Assessment and Risk Analysis 4. Android application development. 5. 12 week MOOC Swayam/NPTEL course recommended by the BoS	3	0	0	3
6	Open Elective – III		3	0	0	3
7	Professional Core	Cloud Computing Lab	0	0	3	1.5
8	Professional Core	IOT Data Analytics Lab	0	0	3	1.5
9	Skill Enhancement Course	Soft skillsORIELTS	0	1	2	2
10	Audit Course	TechnicalPaper Writing&IPR	2	0	0	0
Total			**20**	**1**	**08**	**23**
MandatoryIndustryInternshipof 08 weeksduration duringsummervacation						
MC	Student may select from the same minors pool		3	0	3	4.5
MC	Minor Course (Student may select from the same specialized minors pool)		3	0	0	3
HC	Student may select from the same honors pool		3	0	0	3
HC	Honors Course (Student may select from the honors pool)		3	0	0	3

Remarks :

1. In place of big data analytics for IoT included IoT Data Analytics
2. In place of sensors, Actuators And Data Acquisition included Machine Learning
3. Multi Agent Systems included
4. In professional elective -III included12week MOOC Swayam/NPTEL course recommended by the BoS.
5. In place of Big Data Analytics lab included IOT Data Analytics Lab

COURSES OFFERED FOR HONOURS DEGREE IN BTech CSE(IoT)

S.No.	Code	Course Name	Contact Hours per week			Credits
			L	T	P	
1		Social Media Security	3	0		3
2		Cloud Computing Security	3	0		3
3		Machine Learning for Cyber security	3	0		3
4		IOT security	3	0		3
5		Cyber Physical Systems and Security	3	0		3
6		IOT security Lab			3	1.5
7		Cyber Physical Systems and Security Lab			3	1.5
Total						**18**

III Year I Semester	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

Course Outcome(s):

This course will help students understand basic principles and concepts of Internet-of-Things use cases, applications, architecture and technologies. Students will get an overview of an end to endIoT system encompassing the edge, cloud and application tiers. This course will build upon the foundations created in the pre-requisite courses and will equip the students to architect a complete IoT application on their own. The lab exercises will consist of hands-on experiments that will lead to building an IoT application end-to-end. Some of the specialized topics will be covered via student seminars where students are expected to research and present their findings in a seminar format.

UNIT– I

Introduction to IoT and Use cases: Understanding basic concepts of IoT, Consumer IoT vs Industrial Internet, Fundamental building blocks, Use Cases of IoT in various industry domains.

UNIT- II

Architecture: IoT reference architectures, Industrial Internet Reference Architecture, Edge Computing, IoT Gateways, Data Ingestion and Data Processing Pipelines, Data Stream Processing.

UNIT-III

Sensors and Industrial Systems: Introduction to sensors and transducers, integrating sensors to sensor processing boards, introduction to industrial data acquisition systems, industrial control systems and their functions.

UNIT–IV

Networking and Communication for IoT: Recap of OSI 7 layer architecture and mapping to IoT architecture, Introduction to proximity networking technologies (ZigBee, Bluetooth, Serial Communication), Industrial network protocols (Modbus, CANbus), Communicating with cloud applications (web services, REST, TCP/IP and UDP/IP sockets, MQTT, WebSockets, protocols. Message encoding (JSON, Protocol Buffers).

UNIT –V

IoT Data Processing and Storage: Time Series Data and their characteristics, time series databases, basic time series analytics, data summarization and sketching, dealing with noisy and missing data, anomaly and outlier detection.

IoT Seminars: Selected topics in IoTshould be handled via student seminars. Recommended that students form a group do research on at least one of the following topics and present it through seminars. They are expected to do a literature survey of the topic and present their survey paper to the class. The suggested topics are –

a) **IoT Applications**
   - Smart Cities
   - Connected Vehicles and Telematics
   - Smart Grids
   - Smart Homes

b) **IoT data visualization**
c) **Survey of cloud based IoT platforms**
d) **Low power wide area networks for IoT**
e) **IoT device management**
f) **Survey of chips, embedded modules and development boards for IoT devices**
g) **Embedded and real-time operating systems for IoT**
h) **IoT Security**
   - Security risks in IoT
   - Securing IoT endpoint devices and secure communication protocols for IoT
   - Security and Privacy of IoT data

Text Books:

1. The Internet of Things, Samuel Greengard, MIT Press Essential Knowledge Series,

Reference Books / Links:

1. Industrial Internet Reference Architecture - http://www.iiconsortium.org/IIRA.htm
2. World Economic Forum Report on Industrial Internet of Things - https://www.weforum.org/reports/industrial-internet-things
3. 50 Sensor Applications for a Smarter World - http://www.libelium.com/resources/top_50_iot_sensor_applications_ranking/
4. Visualizing Data-Exploring and Explaining Data with the Processing Environment, By Ben Fry, Publisher: O'Reilly Media
5. Raspberry Pi Computer Architecture Essentials, by Andrew K Dennis
6. Getting Started with Arduino, M. Banzi, O Reilly Media
7. GSMA IoT Security Guidelines & Assessment - https://www.gsma.com/iot/future-iot-networks/iot-security-guidelines/

III Year I Semester	DATABASE MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:
The main objectives of the course is to

- Introduce database management systems and to give a good formal foundation on the relational model of data and usage of Relational Algebra
- Introduce the concepts of basic SQLasa universal Database anguage
- Demonstrate the principles behind systematic database design approaches by covering conceptual
- design, logical design through normalization
- Provide an overview of physical design of a database system, by discussing Database indexing techniques and storage etechniques

UNIT-I
Introduction: Database system, Characteristics (Database Vs File System), Database Users,Advantages of Database systems, Database applications. Brief introduction of different Data Models; Concepts of Schema, Instance and data independence; Three tier schema architecture for data independence; Database system structure, environment, Centralized and Client Server architecture for the database.
Entity RelationshipModel: Introduction, Representation of entities, attributes, entityset, relationship, relationship set, constraints, sub classes, super class, inheritance, specialization, generalization using ER Diagrams.

UNIT-II
RelationalModel: Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Keyconstraints, integrity constraints) and their importance, Relational Algebra, Relational Calculus.
BASIC SQL: Simple Databaseschema, data types, table definitions (create, alter), different DML operations (insert, delete,update).

UNIT-III
SQL: Basic SQL querying (selectand project) using where clause, arithmetic & logical operations, SQL functions (Date and Time, Numeric, String conversion).Creating tables withrelationship, implementation of key and integrity constraints, nested queries, sub queries, grouping, aggregation, ordering, implementation of different types of joins, view (updatable and non-updatable), relational set operations.

UNIT-IV
Schema Refinement (Normalization): Purpose of Normalization or schemare finement, concept of functional dependency, normal forms based on functional dependency Lossless join and dependency preserving decomposition, (1NF, 2NF and 3NF), concept of surrogatekey, Boyce-Codd normal form (BCNF), MVD, Fourth normal form (4NF), Fifth Normal Form (5NF).

UNIT-V

Transaction Concept: Transaction State, ACID properties, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for Serializability,lockbased, time stamp based, optimistic, concurrency protocols, Deadlocks, Failure Classification, Storage, Recovery and Atomicity, Recovery algorithm.

IntroductiontoIndexingTechniques: B+Trees, operations on B+Trees, Hash Based Indexing

Text Books:

1. Data base Management Systems, 3rd edition, Raghurama Krishnan, Johannes Gehrke, TMH (For Chapters 2,3,4)
2.Database System Concepts, 5th edition, Silberschatz, Korth, Sudarsan, TMH (For Chapter1 and Chapter 5)

ReferenceBooks:

1. Introduction to Database Systems, 8th edition, CJDate, Pearson.
2. Database Management System, 6thedition, Ramez Elmasri,Shamkant B.Navathe,Pearson
3.Database Principles Fundamentals of Design Implementation and Management, Corlos Coronel, Steven Morris, PeterRobb, Cengage Learning.

Web-Resources:

1.https://nptel.ac.in/courses/106/105/106105175/
2.https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01275806667282022456_shared/overview

III Year I Semester	EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

Course Outcomes:

Upon completing this course, the student will be able to

1. To understand the selection procedure of Processors in the embedded domain.
2. Design Procedure for Embedded Firmware.
3. To visualize the role of Real time Operating Systems in Embedded Systems.
4. To evaluate the Correlation between task synchronization and latency issues

UNIT-I

Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

UNIT-II

Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

UNIT-III

Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator UNIT-, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

UNIT-IV

RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

UNIT-V

Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets,
Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, Methods to Choose an RTOS.

Text Books:

1. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.

Reference Books:

1. Embedded Systems - Raj Kamal, TMH.
2. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
3. Embedded Systems – Lyla, Pearson, 2013
4. An Embedded Software Primer - David E. Simon, Pearson Education.

III Year I Semester	SOFTWARE ENGINEERING	L	T	P	C
		3	0	0	3

CourseObjectives:

The objectives of this course are to introduce

- Software life cycle models
- Software requirements and SRS document.
- How to plan for a project.
- The quality control and how to ensure good quality software.
- Testing methods of software, use of CASE tools
- Implementation issues,validation and verification procedures.

CourseOutcomes:

CO	Course Outcomes	Knowledge Level(K)#
CO1	Compare and analyse various process models	K1
CO2	Develop SRS document and estimate the modularity of th project	K2
CO3	Develop data flow diagrams and compare the user interfac design	K2
CO4	Compare testing strategies and analyse the software quality	K3
CO5	Apply Computer Aided Software Engineering tools and analyse th components of software maintenance and reuse.	K2

#basedonsuggestedRevisedBTL

UNIT- I

INTRODUCTION: Evolution, Software development projects, Exploratory style of software developments, Emergence of software engineering, Notable changes in software development practices, Computer system engineering.

SOFTWARE LIFE CYCLE MODELS: Basic concepts, Waterfall model and its extensions, Rapid application development, Agile development model and Spiral model.

UNIT-II

SOFTWARE PROJECT MANAGEMENT: Software project management complexities, Responsibilities of a software project manager, Metrics for project size estimation, Project estimation techniques, Empirical Estimation techniques, COCOMO, Halstead's software science, and risk management.

REQUIREMENTS ANALYSIS AND SPECIFICATION: Requirements gathering and analysis, Software Requirements Specification (SRS), Formal system specification, Axiomatic specification, Algebraic specification, Executable specification and 4GL.

UNIT- III

SOFTWARE DESIGN: Overview of the design process, How to characterise a good software design? Layered arrangement of modules, Cohesion and Coupling.approaches to software design.

FUNCTION-ORIENTED SOFTWARE DESIGN:

Overview of SA/SD methodology, Structured analysis, Developing the DFD model of a system, Structured design, Detailed design, and Design Review.

USER INTERFACE DESIGN: Characteristics of a good user interface, Basic concepts, Types of user interfaces, Fundamentals of component-based GUI development, and user interface design methodology.

UNIT-IV

CODING AND TESTING: Coding, Code review, Software documentation, Testing, Black-box testing, White-Box testing, Debugging, Program analysis tools, Integration testing, Testing object-oriented programs, Smoke testing, and Some general issues associated with testing.

SOFTWARE RELIABILITY AND QUALITY MANAGEMENT: Software reliability. Statistical testing, Software quality, Software quality management system, ISO 9000.SEI Capability maturity model. Few other important quality standards, and Six Sigma.

UNIT-V

COMPUTER-AIDED SOFTWARE ENGINEERING (CASE): CASE and its scope, CASE environment, CASE support in the software life cycle, Other characteristics of CASE tools, Towards second generation CASE Tool, and Architecture of a CASE Environment.

SOFTWARE MAINTENANCE: Characteristics of software maintenance, Software reverse engineering, Software maintenance process models and Estimation of maintenance cost.

SOFTWARE REUSE: What can be reused? Why almost no reuse so far? Basic issues in any reuse program, A reuse approach, and Reuse at organisation level.

Text Books:

1. Fundamentals of Software Engineering, Rajib Mall, Fifth Edition, PHI.

Reference Books:

1. Software Engineering A practitioner's Approach, Roger S. Pressman, Ninth Edition, Mc Graw Hill International Edition.
2. Software Engineering, Ian Sommerville, Tenth Edition, Pearson Education.
3. Software Engineering, Principles and Practices, Deepak Jain, Oxford University Press.

e-Resources:

1. https://nptel.ac.in/courses/106/105/106105182/
2. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01260589506387148827_shared/overview
3. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01338269041100390473 5_shared/overview

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III Year I Semester	WIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	0	3

CourseObjectives:

- To acquire the knowledge about various architectures and applications of Sensor Networks
- To understand issues, challenges and emerging technologies for wireless sensor networks
- To learn about various routing protocols and MAC Protocols
- To understand various data gathering and data dissemination methods
- To Study about design principals, node architectures, hardware and software required for implementation of wireless sensor networks.

CourseOutcomes: Upon completion of the course, the student will beable to:

- Analyze and compare various architectures of Wireless Sensor Networks
- Understand Design issues and challenges in wireless sensor networks
- Analyze and compare various data gathering and data dissemination methods.
- Design, Simulate and Compare the performance of various routing and MAC protocol

UNIT-I
Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks

UNIT-II
Mobile Adhoc Networks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks

UNIT-III
Routingprotocols, MACprotocols: Classificationof MACProtocols, S-MACProtocol, B-MACprotocol, IEEE 802.15.4 standard and ZigBee

UNIT-IV
Dissemination protocolforlarge sensor network.Data dissemination, data gathering, and datafusion; Quality of a sensor network; Real-time traffic support and security protocols.

UNIT-V
Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication and Internet to WSN Communication. Single –node architecture, Hardware components & designconstraints, Operating systems and execution environments, introduction to Tiny OS and nesC.

TextBooks:

1. Ad-Hoc Wireless Sensor Networks - C.Siva Ram Murthy, B.S.Manoj, Pearson
2. Principles of Wireless Networks – KavehPahLaven and P.KrishnaMurthy,2002,PE

Referencebooks:

1. Wireless Digital Communications – Kamilo Feher, 1999, PHI.
2. Wireless Communications – Andrea Gold smith, 2005 Cambridge University Press.
3. Mobile Cellular Communication – Gottapu Sasibhushana Rao,Pearson Education, 2012.
4. Wireless Communication and Networking–William Stallings, 2003, PHI.

III Year I Semester	ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

Course Outcome(s):

This course introduces students to the basic knowledge representation, problem solving, and learning methods of artificial intelligence.

UNIT–I

Introduction, Overview of Artificial intelligence: Problems of AI, AI technique, Tic - Tac - Toe problem. Intelligent Agents, Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents.

Problem Solving, Problems, Problem Space & search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.

UNIT–II

Search techniques: Problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. Heuristic search strategies Greedy best-first search, A* search, AO* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search

UNIT–III

Constraint satisfaction problems: Local search for constraint satisfaction problems. Adversarial search, Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.

UNIT–IV

Knowledge & reasoning: Knowledge representation issues, representation & mapping, approaches to knowledge representation. Using predicate logic, representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. Representing knowledge using rules, Procedural verses declarative knowledge, logic programming, forward verses backward reasoning, matching, control knowledge.

UNIT–V

Probabilistic reasoning: Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Planning Overview, components of a planning system, Goal stack planning, Hierarchical planning, other planning techniques

Expert Systems: Representing and using domain knowledge, expert system shells, and knowledge acquisition.

Home Assignments:

Assignments should include problems related to the topics covered in lectures, like heuristics, optimal search, and graph heuristics. Constraint satisfaction problems, k-nearest neighbors, decision trees, etc. can be included in home assignments.

Text Books:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach
2. Artificial Intelligence, Russel, Pearson

Reference Books:

1. Artificial Intelligence, Ritch & Knight, TMH
2. Introduction to Artificial Intelligence & Expert Systems, Patterson, PHI
3. Logic & Prolog Programming, Saroj Kaushik, New Age International
4. Expert Systems, Giarranto, VIKAS

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		L	T	P	C
III Year I Semister	**CRYPTOGRAPHY & NETWORK SECURITY**	**3**	**0**	**0**	**3**

Course Objectives:

- Explain the objectives of information security
- Explain the importance and application of each of confidentiality, integrity, authentication and availability
- Understand the basic categories of threats to computers and networks
- Discusses the Mathematics of Cryptography
- Discuss the fundamental ideas of Symmetric and Asymmetric cryptographic Algorithms
- Discusses the Network layer, Transport Layer and Application layer Protocols Enhanced security mechanisms

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

CO	Course Outcomes	Knowledg Level (K)#
CO1	Student will be able to understand security issues related to computer networks and learn different symmetric key techniques	K2
CO2	Students will be able learn mathematic of cryptography for symmetric and Asymmetric algorithms and apply this knowledge to understand the Cryptographic algorithms	K3
CO3	Students will be able learn different types of symmetric and Asymmetric algorithms	K3
CO4	Students will be able learn different algorithms of Hash functions, message authentication and digital signature and their importance to the security	K4
CO5	Students will be able learn different Enhanced security protocols of Application Layer, Transport Layer and Network layer	K4

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PPO2	PPO3	PPO4	PPO5	PPO6	PPO7	PO8	PO9	PO 10	PO 111	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	2	1	2	1	1	1	1		1		2	2	2	2
CO2	3	1	1	2	2	2	1	2		3	3	2	3	2	1
CO3	2	2	2	1	2	1	1	1		2		3	1		
CO4	3	2	3	2	3	2	1	1		2	1	2	2	1	
CO5	3	2	3	1	2	2	1	1		2	2	2	1	2	1

(Please fill the above with Levels of Correlation, viz., L-1, M-2, H-3)

UNIT- I

Security Concepts: Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security Cryptography.Classical Encryption Techniques-symmetric cipher model, Substitution techniques, Transposition techniques, Rotor Machines, Stenography.

UNIT- II

Introduction to Symmetric Cryptography: Algebraic Structures-Groups, Rings, Fields, GF(2^n) fields, Polynomials.**Mathematics of Asymmetric cryptography:** Primes, Checking For Primness, Eulers phi-functions, Fermat's Little Theorem, Euler's Theorem, Generating Primes, Primality Testing, Factorization, Chinese Remainder Theorem, Quadratic Congruence, Exponentiation And Logarithm.

UNIT-III

Symmetric key Ciphers: Block Cipher principles, DES, AES, Blowfish, IDEA, Block cipher operation, Stream ciphers: RC4, RC5. **Asymmetric key Ciphers:** Principles of public key cryptosystems, RSA algorithm, Diffie-Hellman Key Exchange, Elgamal Cryptographic system, Elliptic Curve Arithmetic, Elliptic Curve Cryptography.

UNIT-IV

Cryptographic Hash Functions: Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Hash Functions Based on Cipher Block Chaining, Secure Hash Algorithms (SHA). **Message Authentication Codes:** Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes, Security of MAC'S,MAC'S Based On Hash Functions: HMAC, MAC'S Based On Block Ciphers: DAA And CMAC.

Digital Signatures: Digital Signatures, Elgamal Digital Signature Scheme, Elliptic Curve Digital Signature Algorithm, RSA-PSS Digital Signature Algorithm.

UNIT-V

Network and Internet Security: Transport-Level Security: Web Security Considerations, Transport Level Security, HTTPS, SSH.**IP Security:** IP Security Overview, IP Security Policy, Encapsulating Security Payload, Authentication Header Protocol.**Electronic-Mail Security:** Internet-mail Security, Email Format, Email Threats and Comprehensive Email Security, S/MIME, PGP.

Text Books:

1. Cryptography and Network Security - Principles and Practice: William Stallings, Pearson Education, 7th Edition, 2017
2. Cryptography and Network Security: Behrouz A. Forouzan Debdeep, Mc Graw Hill, 3rd Edition, 2015

Reference Books:

1. Cryptography and Network Security: Atul Kahate, Mc Graw Hill, 3rd Edition
2. Introduction to Cryptography with Coding Theory: Wade Trappe, Lawrence C. Washington, Pearson.
3. Modern Cryptography: Theory and Practice ByWenbo Mao. Pearson

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III Year I Semester	INTERNET OF THINGS AND EMBEDDED SYSTEMS LAB	L	T	P	C
		0	0	3	1.5

Course Objectives:

- To learn the internal architecture and programming of an embedded processor.
- To introduce interfacing and I/O devices to the processor.
- To introduce the evolution of the Internet of Things (IoT).
- To build a small, low-cost embedded IoT system using Arduino/Raspberry Pi/open platform.
- To apply the concept of the Internet of Things in real-world scenarios.

Course Outcomes:

CO1: Explain the architecture of embedded processors.
CO2: Write embedded C programs.
CO3: Design simple embedded applications.
CO4: Compare the communication models in IoT.
CO5: Design IoT applications using Arduino/Raspberry Pi/open platform.

LIST OF EXPERIMENTS:

1. Write 8051 Assembly Language experiments using a simulator.
2. Test data transfer between registers and memory.
3. Perform ALU operations.
4. Write basic and arithmetic programs using Embedded C.
5. Introduction to Arduino platform and programming.
6. Explore different communication methods with IoT devices (Zigbee, GSM, Bluetooth).
7. Introduction to Raspberry Pi platform and Python programming.
8. Interface sensors with Raspberry Pi.
9. Communicate between Arduino and Raspberry Pi using any wireless medium.
10. Set up a cloud platform to log the data.

11. Log data using Raspberry Pi and upload to the cloud platform.
12. Design an IoT-based system.

III Year I Semester	DATABASE MANAGEMENT SYSTEMS LAB	L	T	P	C
		0	0	3	1.5

Course Objectives: This Course will enable students to:

- Populate and query a database using SQL DDL/DML Commands.
- Declare and enforce integrity constraints on a database.
- Write queries using advanced concepts of SQL.
- Program PL/SQL including procedures, functions, cursors, and triggers.

Experiments covering the topics:

- DDL, DML, DCL commands.
- Queries, nested queries, built-in functions.
- PL/SQL programming-control structures.
- Procedures, Functions, Cursors, Triggers.
- Database connectivity-ODBC/JDBC.

Sample Experiments:

1. Creation, altering, and dropping of tables and inserting rows into a table (use constraints while creating tables). Examples using SELECT command.
2. Queries (along with sub-queries) using ANY, ALL, IN, EXISTS, NOT EXISTS, UNION, INTERSECT, Constraints. Example: Select the roll number and name of the student who secured the fourth rank in the class.
3. Queries using Aggregate functions (COUNT, SUM, AVG, MAX, and MIN), GROUP BY, HAVING, and Creation and dropping of Views.
4. Queries using Conversion functions (to_char, to_number, to_date), string functions (Concatenation, lpad, rpad, ltrim, rtrim, lower, upper, initcap, length, substr, instr), date functions (Sysdate, next_day, add_months, last_day, months_between, least, greatest, trunc, round, to_char, to_date).
5. i.Create a simple PL/SQL program which includes declaration section, executable section, and exception-handling section (Ex. Student marks can be selected from the table and printed for those who secured first class and an exception can be raised if no records were found).

ii. Insert data into student table and use COMMIT, ROLLBACK, and SAVEPOINT in PL/SQL block.

6. Develop a program that includes the features NESTED IF, CASE, and CASE expression. The program can be extended using the NULLIF and COALESCE functions.
7. Program development using WHILE LOOPS, numeric FOR LOOPS, nested loops using ERROR Handling, BUILT-IN Exceptions, USER-defined Exceptions, RAISE-APPLICATION ERROR.
8. Program development using creation of procedures, passing parameters IN and OUT of PROCEDURES.
9. Program development using creation of stored functions, invoke functions in SQL Statements, and write complex functions.
10. Develop programs using features parameters in a CURSOR, FOR UPDATE CURSOR, WHERE CURRENT OF clause, and CURSOR variables.
11. Develop Programs using BEFORE and AFTER Triggers, Row and Statement Triggers, and INSTEAD OF Triggers.
12. Create a table and perform the search operation on table using indexing and non-indexing techniques.
13. Write a Java program that connects to a database using JDBC.
14. Write a Java program to connect to a database using JDBC and insert values into it.
15. Write a Java program to connect to a database using JDBC and delete values from it.

Textbooks/Suggested Reading:

- Oracle: The Complete Reference by Oracle Press.
- Nilesh Shah, "Database Systems Using Oracle," PHI, 2007.
- Rick F. Vander Lans, "Introduction to SQL", Fourth Edition, Pearson Education, 2007.

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III Year I Semester	FULL STACK DEVELOPMENT – 2	L	T	P	C
		0	1	2	2

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Make use of router, template engine and authentication using sessions to develop applicatio in Express JS.
CO2: Build a single page application using RESTful APIs in Express JS.
CO3: Make use of components, props, stats and render data in ReactJS.
CO4: Apply router and hooks in designing ReactJS application.
CO5: Make use of MongoDB queries to perform CRUD operations on document database.

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	2	3		2				2	2		2
CO	2	3	2		2				2	2		2
CO	2	2	3		2				2	2		2
CO	2	3	2		2				2	2		2
CO	2	2	3		2				2	2		2

List of Experiments:

Experiment 1: Node.js

a. Write a program to show the workflow of JavaScript code executable by creating web server in Node.js.
b. Write a program to transfer data over http protocolusing http module.
c. Create a text file src.txt and add the following content to it. (HTML, CSS, Javascript, Typescript, MongoDB, Express.js, React.js, Node.js)
d. Write a program to parse an URL using URL module.
e. Write a program to create an user-defined module and show the workflow of Modularization of application using Node.js

Experiment 2: Typescript

a. Write a program to understand simple and special types.
b. Write a program to understand function parameter and return types.
c. Write a program to show the importance with Arrow function. Use optional, default and REST parameters.
d. Write a program to understand the working of typescript with class, constructor, properties, methods and access specifiers.
e. Write a program to understand the working of namespaces and modules.
f. Write a program to understand generics with variables, functions and constraints.

Experiment 3-15:

Augmented Programs: (Any 2 must be completed from Experiment 3-5)

1. Write a CSS program, to apply 2D and 3D transformations in a web page.
2. a web page with new features of HTML5 and CSS3.
3. Design a to-do list application using JavaScript.

Experiment 6:

ExpressJS – Routing, HTTP Methods, Middleware

a. Write a program to define a route, Handling Routes, Route Parameters, Query Parameters and URL building.
b. Write a program to accept data, retrieve data and delete a specified resource using http methods.
c. Write a program to show the working of middleware.
d.

Experiment 7:

ExpressJS – Templating, Form Data

a. Write a program using templating engine.
b. Write a program to work with form data.

Experiment 8:

ExpressJS – Cookies, Sessions, Authentication

a. Write a program for session management using cookies and sessions.
b. Write a program for user authentication

Experiment 9:

ExpressJS – Database, RESTful APIs

a. Write a program to connect MongoDB database using Mangoose and perform CRUD operations.
b. Write a program to develop a single page application using RESTful APIs

Experiment 10:

ReactJS – Render HTML, JSX, Components – function & Class

a. Write a program to render HTML to a web page.
b. Write a program for writing markup with JSX.
c. Write a program for creating and nesting components (function and class).

Experiment 11:

ReactJS – Props and States, Styles, Respond to Events

a. Write a program to work with props and states.
b. Write a program to add styles (CSS & Sass Styling) and display data.
c. Write a program for responding to events.

Experiment 12:

ReactJS – Conditional Rendering, Rendering Lists, React Forms

a. Write a program for conditional rendering.
b. Write a program for rendering lists.
c. Write a program for working with different form fields using react forms

Experiment 13:

ReactJS – React Router, Updating the Screen

a. Write a program for routing to different pages using react router.
b. Write a program for updating the screen.

Experiment 14:

ReactJS – Hooks, Sharing data between Components

a.Write a program to understand the importance of using hooks.

b.Write a program for sharing data between components

Experiment 15:

ReactJS Applications – To-do list and Quiz

a. Design to-do list application

Experiment 16:

MongoDB – Installation, Configuration, CRUD operations

a. Install MongoDB and configure ATLAS
b. B.Write MongoDB queries to perform CRUD operations on document using insert(), find(), update(), remove()

Experiment 17:

MongoDB – Databases, Collections and Records

a. Write MongoDB queries to Create and drop databases and collections.
b. Write MongoDB queries to work with records using find(), limit(), sort(), createIndex(), aggregate()

Experiment 18-20:

Augmented Programs: (Any 2 must be completed)

18. Design a to-do list application using NodeJS and ExpressJS.
19. Design a Quiz app using ReactJS.
20. Complete the MongoDB certification from MongoDB University website.

Text Books:

1.Programming the World Wide Web, 7th Edition, Robet W Sebesta, Pearson, 2013.

2.Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Vasan Subramanian, 2nd edition, A Press, O'Reilly.

Web Links:

1.ExpressJS - https://www.tutorialspoint.com/expressjs

2.ReactJS - https://www.w3schools.com/REACT (and) https://react.dev/learn#

3.MongoDB - https://learn.mongodb.com/learning-paths/introduction-to-mongodb

III Year I Semester	UI DESIGN-FLUTTER LAB	L	T	P	C
		0	0	2	1

Course Objectives:

- Learns to Implement Flutter Widgets and Layouts
- Understands Responsive UI Design and with Navigation in Flutter
- Knowledge on Widges and customize widgets for specific UI elements, Themes
- Understand to include animation apart from fetching data

List of Experiments:

Students need to implement the following experiments

1. a) Install Flutter and Dart SDK.
b) Write a simple Dart program to understand the language basics.

2. a) Explore various Flutter widgets (Text, Image, Container, etc.).
b) Implement different layout structures using Row, Column, and Stack widgets.

3. a) Design a responsive UI that adapts to different screen sizes.
b) Implement media queries and breakpoints for responsiveness.

4. a) Set up navigation between different screens using Navigator.
b) Implement navigation with named routes.

5. a) Learn about stateful and stateless widgets.
b) Implement state management using set State and Provider.

6. a) Create custom widgets for specific UI elements.
b) Apply styling using themes and custom styles.

7. a) Design a form with various input fields.

b) Implement form validation and error handling.

8. a) Add animations to UI elements using Flutter's animation framework.

b) Experiment with different types of animations (fade, slide, etc.).

9. a) Fetch data from a REST API.

b) Display the fetched data in a meaningful way in the UI.

10. a) Write UNIT- tests for UI components.

b) Use Flutter's debugging tools to identify and fix issues.

Text Book:

1. Marco L. Napoli, Beginning Flutter: A Hands-on Guide to App Development.
2. Rap Payne, Beginning App Development with Flutter: Create Cross-Platform Mobile Apps 1st Edition, Apres

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III Year II Semester	IOT DATA ANALYTICS	L	T	P	C
		3	0	0	3

CourseObjectives:

- To learn the concepts of big data analytics
- To learn the concepts about Internet of things
- To understand and implement smart systems

Course Outcomes:

- Understand the different types of Big Data platforms
- Familiar with the fog computing concepts
- Understanding the cloud computing concepts

UNIT-I

BIG DATA PLATFORMS FOR THE INTERNET OF THINGS

Big Data Platforms for the Internet of Things: network protocol- data dissemination –current state of art- Improving Data and Service Interoperability with Structure, Compliance, Conformance and Context Awareness: interoperability problem in the IoT context- Big Data Management Systems for the Exploitation of Pervasive Environments - Big Data challenges and requirements coming from different Smart City applications

UNIT-II

RFID FALSE AUTHENTICATIONS: On RFID False Authentications: YA TRAP – Necessary and sufficient condition forfalse authentication prevention - Adaptive Pipe lined Neural Network Structure in Self-aware Internet of Things: self-healing systems- Role of adaptive neural network-Spatial Dimensions of Big Data: Application of Geographical Concepts and Spatial Technology to the Internet of Things- Applying spatial relationships, functions, and models

UNIT-III

FOG COMPUTING : Fog Computing: A Platform for Internet of Things and Analytics: massively distributed number of sources - Big Data Metadata Management in Smart Gric semantic inconsistencies – role of metadata

UNIT-IV

WEB ENHANCED BUILDING : Toward Web Enhanced Building Automation System heterogeneity between existing installations and native IP devices - loosely-coupled Web protoc stack –energy saving in smart building- Intelligent Transportation Systems and Wireless Access Vehicular Environment Technology for Developing Smart Cities: advantages and achievement Emerging Technologies in Health Information Systems: Genomics Driven Wellness Tracking a Management System (GO-WELL) – predictive care –personalized medicine

UNIT-V

SUSTAINABILITY DATA AND ANALYTICS : Sustainability Data and Analytics in Cloud-Bas M2M Systems – potential stakeholders and their complex relationships to data and analyti applications – Social Networking Analysis - Building a useful understanding of a social network Leveraging Social Media and IoT to Bootstrap Smart Environments : lightweight Cyber Physic Social Systems - citizen actuation

Text Books:

1. Stackowiak, R., Licht, A., Mantha, V., Nagode, L.," Big Data and The Internet of Things Enterpri Information Architecture for A New Age", Apress, 2015.

2. Dr. John Bates , "Thingalytics - Smart Big Data Analytics for the Internet of Things", john Bate 2015.6) Web Hosting for Dummies, Peter Pollock, John Wiley Brand

Reference Books:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things",Cisco Press, 2017
2. Olivier Hersent, David Boswarthick ,OmarElloum,"The Internet of Things–Key applications and Protocols", Wiley,2012.
3. Michael Miller,"The Internet of Things",Pearson Education,2015.

III Year II Semester	CLOUD COMPUTING	L	T	P	C
		3	0	0	3

Course Objectives:

- To explain the evolving utility computing model called cloud computing.
- To introduce the various levels of services offered by cloud.
- To discuss the fundamentals of cloud enabling technologies such as distributed computing, service-oriented architecture and virtualization.
- To emphasize the security and other challenges in cloud computing.
- To introduce the advanced concepts such as containers, serverless computing and cloud-centric Internet of Things.

UNIT–I

Introduction to Cloud Computing Fundamentals: Cloud computing at a glance, defining a cloud, cloud computing reference model, types of services (IaaS, PaaS, SaaS), cloud deployment models (public, private, hybrid), utility computing, cloud computing characteristics and benefits, cloud service providers (Amazon Web Services, Microsoft Azure, Google AppEngine).

UNIT-II

Cloud Enabling Technologies: Ubiquitous Internet, parallel and distributed computing, elements of parallel computing, hardware architectures for parallel computing (SISD, SIMD, MISD, MIMD), elements of distributed computing, Inter-process communication, technologies for distributed computing, remote procedure calls (RPC), service-oriented architecture (SOA), Web services, virtualization.

UNIT-III

Virtualization and Containers: Characteristics of virtualized environments, taxonomy of virtualization techniques, virtualization and cloud Computing, pros and cons of virtualization, technology examples (XEN, VMware), building blocks of containers, container platforms (LXC, Docker), container orchestration, Docker Swarm and Kubernetes, public cloud VM (e.g. Amazon EC2) and container (e.g. Amazon Elastic Container Service) offerings.

UNIT-IV

Cloud computing challenges: Economics of the cloud, cloud interoperability and standards, scalability and fault tolerance, energy efficiency in clouds, federated clouds, cloud computing security, fundamentals of computer security, cloud security architecture, cloud shared responsibility model, security in cloud deployment models.

UNIT–V

Advanced concepts in cloud computing : Serverless computing, Function-as-a-Service, serverless computing architecture, public cloud (e.g. AWS Lambda) and open-source (e.g. OpenFaaS) serverless platforms, Internet of Things (IoT), applications, cloud-centric IoT and layers, edge and fog computing, DevOps, infrastructure-as-code, quantum cloud computing.

Text Books:

1. Mastering Cloud Computing, 2nd edition, RajkumarBuyya, Christian Vecchiola, ThamaraiSelvi, ShivanandaPoojara, Satish N. Srirama, Mc Graw Hill, 2024.
2. Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier, 2012.

Reference Books:

1. Cloud Computing, Theory and Practice, Dan C Marinescu, 2nd edition, MK Elsevier, 2018.
2. Essentials of cloud Computing, K. Chandrasekhran, CRC press, 2014.
3. Online documentation and tutorials from cloud service providers (e.g., AWS, Azure, GCP)

III Year II Semester	MACHINE LEARNING	L	T	P	C
		3	0	0	3

Course Objectives:
The objectives of the course is to

- Define machine learning and its different types (supervised and unsupervised) and understand their applications.
- Apply supervised learning algorithms including decision trees and k-nearest neighbours (k-NN).
- Implement unsupervised learning techniques, such as K-means clustering.

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

- Enumerate the Fundamentals of Machine Learning
- Build Nearest neighbour based models
- Apply Models based on decision trees and Bayes rule
- Make use of Linear discriminants for machine Learning
- Choose appropriate clustering technique

UNIT-I

Introduction to Machine Learning: Evolution of Machine Learning, Paradigms for ML,Learning by Rote, Learning by Induction, Reinforcement Learning, Types of Data, Matching, Stages in Machine Learning, Data Acquisition, Feature Engineering, Data Representation, Model Selection, Model Learning, Model Evaluation, Model Prediction, Search and Learning, Data Sets.

UNIT-II

Nearest Neighbor-Based Models: Introduction to Proximity Measures, Distance Measures, Non-Metric Similarity Functions, Proximity Between Binary Patterns, Different Classification Algorithms Based on the Distance Measures ,K-Nearest Neighbor Classifier, Radius Distance NearestNeighbor Algorithm, KNN Regression, Performance of Classifiers, Performance of Regression Algorithms.

UNIT-III

Models Based on Decision Trees: Decision Trees for Classification, Impurity Measures, Properties, Regression Based on Decision Trees, Bias–Variance Trade-off, Random Forests for Classification and Regression.**The Bayes Classifier:**Introduction to the Bayes Classifier, Bayes' Rule and Inference, The Bayes Classifier and its Optimality, Multi-Class Classification | Class Conditional Independence and Naive Bayes Classifier (NBC)

UNIT-IV

Linear Discriminants for Machine Learning: Introduction to Linear Discriminants, Linear Discriminants for Classification, Perceptron Classifier, Perceptron Learning Algorithm, Support Vector Machines, Linearly Non-Separable Case, Non-linear SVM, Kernel Trick, Logistic Regression, Linear Regression, Multi-Layer Perceptrons (MLPs), Backpropagation for Training an MLP.

UNIT-V

Clustering :Introduction to Clustering, Partitioning of Data, Matrix Factorization | Clustering of Patterns, Divisive Clustering, Agglomerative Clustering, Partitional Clustering, K-Means Clustering, Soft Partitioning, Soft Clustering, Fuzzy C-Means Clustering, Rough Clustering, Rough K-Means Clustering Algorithm, Expectation Maximization-Based Clustering, Spectral Clustering.

Text Books:

1.“Machine Learning Theory and Practice”, M N Murthy, V S Ananthanarayana, Universities Press (India), 2024

Reference Books:

1.“Machine Learning”, Tom M. Mitchell, McGraw-Hill Publication, 2017

2.“Machine Learning in Action”,Peter Harrington, DreamTech

3.“Introduction to Data Mining”, Pang-Ning Tan, Michel Stenbach, Vipin Kumar, 7th Edition, 2019.

III Year II Semester	DEVOPS	L	T	P	C
		3	0	0	3

Course Objectives:

- Describe the agile relationship between development and IT operations.
- Understand the skill sets and high-functioning teams involved in DevOps and related methods to reach a continuous delivery capability.
- Implement automated system update and DevOps lifecycle.

UNIT-I

Introduction to DevOps: Introduction to SDLC, Agile Model. Introduction to Devops. DevOps Features, DevOps Architecture, DevOps Lifecycle, Understanding Workflow and principles, Introduction to DevOps tools, Build Automation, Delivery Automation, Understanding Code Quality, Automation of CI/ CD. Release management, Scrum, Kanban, delivery pipeline, bottlenecks, examples

UNIT-II

Source Code Management (GIT): The need for source code control, The history of source code management, Roles and code, source code management system and migrations. What is Version Control and GIT, GIT Installation, GIT features, GIT workflow, working with remote repository, GIT commands, GIT branching, GIT staging and collaboration. UNIT- TESTING - CODE COVERAGE: JUNIT-, nUNIT-& Code Coverage with Sonar Qube, SonarQube - Code Quality Analysis.

UNIT-III

Build Automation - Continuous Integration (CI): Build Automation, What is CI Why Cl is Required, CI tools, Introduction to Jenkins (With Architecture), jenkins workflow, jenkins master slave architecture, Jenkins Pipelines, PIPELINE BASICS - Jenkins Master, Node, Agent, and Executor Freestyle Projects & Pipelines, Jenkins for Continuous Integration, Create and Manage Builds, User Management in Jenkins Schedule Builds, Launch Builds on Slave Nodes.

UNIT-IV

Continuous Delivery (CD): Importance of Continuous Delivery, CONTINUOUS DEPLOYMENT CD Flow, Containerization with Docker: Introduction to Docker, Docker installation, Docker commands, Images & Containers, DockerFile, Running containers, Working with containers and publish to Docker Hub.

Testing Tools: Introduction to Selenium and its features, JavaScript testing.

UNIT-V

Configuration Management - ANSIBLE: Introduction to Ansible, Ansible tasks, Roles, Jinjatemplating, Vaults, Deployments using Ansible.

CONTAINERIZATION USING KUBERNETES(OPENSHIFT): Introduction to Kubernetes Namespace & Resources, CI/CD - On OCP, BC, DC &ConfigMaps, Deploying Apps on Openshift Container Pods. Introduction to Puppet master and Chef.

Text Books:

1. Joyner, Joseph.,Devops for Beginners: Devops Software Development Method Guide for Software Developers and It Professionals, 1st Edition MihailsKonoplows, 2015.
2. Alisson Machado de Menezes., Hands-on DevOps with Linux,1st Edition, BPB Publications, India, 2021.

Reference Books:

1. Len Bass, Ingo Weber, Liming Zhu. DevOps: A Software Architect's Perspective. Addison Wesley; ISBN-10
2. Gene Kim Je Humble, Patrick Debois, John Willis. The DevOps Handbook, 1st Edition, IT Revolution Press, 2016.
3. Verona, Joakim Practical DevOps, 1stEdition, Packt Publishing, 2016.
4. Joakim Verona. Practical Devops, Ingram short title; 2ndedition (2018). ISBN10: 1788392574
5. Deepak Gaikwad, Viral Thakkar. DevOps Tools from Practitioner's Viewpoint. Wiley publications. ISBN: 9788126579952

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III Year II Semester	IOT SECURITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To learn about the secwity issues in IoT and cloud computing.
- To learn about the cryptography solutions and issues in IoT.
- To learn about the security measures taken in IoT and Cloud systems to improve security.

COURSEOUTCOMES

On completion of the course, student will be able to

COI- Understand the fundamental security issues in Intenet of things.
CO2- Demonstrate different Frameworks and Hardware Architecture of IoTD evice.
CO3- Analyze different loT Protocols and Layer Functioning.
CO4-Protect and secure the network connecting IoT devices to back-endsystems on the internet.
CO5-Demonstrate different authentication mechanism such as digital certificates, biometrics,etc.
CO6- Demonstrate collecting, aggregating, monitoring, and normalizing data from loT devices and providing actionable reporting and alerting on specific activities or whenactivities fall outside established policies.

UNIT-I

FUNDAM.ENTALSOFIoTECOSYSTEM

loTsecurity issues, howto design an IoTsystem,Hardware,softwareand networksecurity related to loT systems - Basicsof cryptogrnphic solutions to loT systems.

UNIT–II

OVERVIEWOFCLOUDCOMPUTINGANDITSSERVICES

CloudComputingFundamental:Cloudcomputingdefinition,private,publicandhybridcloud.Cloud types; IaaS, PaaS, SaaS.

UNIT–III

CHALLENGESINCLOUDCOMPUTING

Benefits andchallengesof cloud computing-Public vs. Privateclouds,Role ofvirtualizationinenabling thecloud.

UNIT-IV

SECURITYCONCEPTSINCONTEXTTOJoTDEVICES

Security Concepts, Confidentiality, privacy, integrity, authentication, non-repudiation,Virtualization

UNIT-VIoT SECURITYTHREATSANDCOUNTERMEASURES

System-Specific Attacks: Guest hopping, attacks on the VM (delete the **VM,** attack on the control of the **VM,** codeorfile injection into the virtualized file structure), **VM** migration attack, hyper jacking.

Text/ReferenceBooks:

1. David Etter, "loT Security: Practical guide book "Create Space,1st Edition, 2016.
2. Drew Van Duren, Brian Russell, "Practical Internet of Things Security", Packt, 1st Edition,2016.
3. Sean Smith, "The Internet of Risky Things",O'Reilly Media,1st Edition, 2017.
4. Brian Russell, Drew Van Duren,"Practical Internet of Things Security: Designa security framework for an Internet connected ecosystem", 2nd Edition, 2018.

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III Year II Semester	MULTI AGENT SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

By the end of this course, students will be able to:

- Understand the fundamental concepts of agents, agent-based systems, and their applications.
- Analyze and design intelligent agent architectures.
- Explore multi-agent interactions, coordination, and communication mechanisms.
- Understand multi-agent decision-making, game-theoretic principles, and computational social choice.
- Apply logical foundations and practical approaches to multi-agent resource allocation and negotiation.

UNIT-I

Introduction to Agent Systems: what is an agent? agents and objects; agents and expert systems; agents and distributed systems; typical application areas for agent systems

UNIT-II

Intelligent Agents: Abstract Architectures for Agents, Tasks for Agents, Designing Intelligent Agents, Reasoning Agents, Reactive Agents, Hybrid Agents, Layered Agents.

UNIT-III

Multi-Agent Systems and Communication: Ontologies: OWL, KIF, RDF. Interaction Languages and Protocols, Speech Acts, KQML/KIF, The FIPA Framework. Cooperation in Multi-Agent Systems- Cooperative Distributed Problem Solving (CDPS), Partial Global Planning, Coherence and Coordination, Applications of Multi-Agent Systems.

UNIT-IV

Multi-Agent Decision-Making: Multi-Agent Interactions and Solution Concepts-Nash Equilibria (Pure and Mixed Strategies), Pareto Efficiency, Cooperative vs. Non-Cooperative Strategies, Zero-Sum and Other Interactions. Cooperation Models- The Prisoner's Dilemma and Axelrod's Experiments, Program Equilibria. Computational Social Choice-Voting Protocols, Arrow's Theorem, Gibbard-Satterthwaite Theorem, Strategic Manipulation and Complexity Prevention. Coalition Formation-The Core, The Shapley Valuem, Coalition Structure Generation.

UNIT-V

Resource Allocation, Bargaining, and Logical Foundations: Allocating Scarce Resources, Auction Types (English, Dutch, Vickrey), Combinatorial Auctions and Winner Determination, The VCG Mechanism, Bargaining Strategies- The Alternating Offers Protocol, Task-Oriented Negotiation, Resource Allocation via Bargaining. Logical Foundations of Multi-Agent Systems- Modal Logics for Epistemic Reasoning, Reasoning about Mental States, Cooperation Logics and Their Applications, Model Checking and Verification.

Textbooks:

1. **Michael Wooldridge** – An Introduction to Multi-Agent Systems, Wiley, 2009.
2. **Yoav Shoham, Kevin Leyton-Brown** – Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, Cambridge University Press, 2009.

Reference Books:

1. **Stuart Russell, Peter Norvig** – Artificial Intelligence: A Modern Approach, Pearson, 3rd Edition, 2015.
2. **Gerhard Weiss** – Multiagent Systems: A Modern Approach to Distributed Artificial Intelligence, MIT Press, 2000.
3. **Jeffrey S. Rosenschein, Michael Wooldridge** – Reasoning About Rational Agents, MIT Press, 2000.

III Year II Semester	AUTOMATA THEORY & COMPILER DESIGN	L	T	P	C
		3	0	0	3

Course Outcomes
At the end of the course the student will be able to:

CO1. Acquire fundamental understanding of the core concepts in automata theory and Theory of Computation
CO2. Design and develop lexical analyzers, parsers and code generators
CO3. Design Grammars and Automata (recognizers) for different language classes and become knowledgeable about restricted models of Computation (Regular, Context Free) and their relative powers.
CO4. Acquire fundamental understanding of the structure of a Compiler and Apply concepts automata theory and Theory of Computation to design Compilers
CO5. Design computations models for problems in Automata theory and adaptation of such model in the field of compilers

UNIT- I
Introduction to Automata Theory: Central Concepts of Automata theory, Deterministic Finite Automata(DFA), Non- Deterministic Finite Automata(NFA) ,Epsilon- NFA, NFA to DFA Conversion, Minimization of DFA. **Introduction to Compiler Design:**Language Processors, Phases of Compilers

UNIT-II
Regular Expressions and Languages: Regular Expressions, Finite Automata and Regular Expressions, Proving Languages Not to Be Regular. **Lexical Analysis Phase of compiler Design:**Role of Lexical Analyzer, Input Buffering, Specification of Token, Recognition of Token.

UNIT-III
Context Free Grammars: Definition and designing CFGs, Derivations Using a Grammar, Parse Trees, Ambiguity and Elimination of Ambiguity, Elimination of Left Recursion, Left Factoring.**Syntax Analysis Phase of Compilers:part-1:**Role of Parser , Top-Down Parsing

UNIT- IV
Push Down Automata: Definition of the Pushdown Automata, The Languages of a PDA.
Syntax Analysis Phase of Compilers: Part-2: Bottom-up Parsing, Introduction to LR Parsing: SLR, More Powerful LR parsers

UNIT-V
Introduction to Turing Machine: Problems that Computers Cannot Solve, The Turing machine, problems, Programming Techniques for Turing Machine, Extensions to the Basic Turing Machine**Undecidability :**A language That Is Not Recursively Enumerable, An Undecidable Problem That Is RE.**Other Phases of**

Compilers: Syntax Directed Translation- Syntax-Directed Definitions, Evaluation Orders for SDD's. Intermediate-Code Generation- Variants of Syntax Trees, Three-Address Code.**Code Generation-**Issues in the Design of a Code Generator

Textbooks

1. John E Hopcroft, Rajeev Motwani, Jeffrey D. Ullman,“ Introduction to Automata Theory, Languages and Computation”, Third Edition, Pearson.
2. Alfred V.Aho, Monica S.Lam,RaviSethi, Jeffrey D. Ullman, “ Compilers Principles, Techniques and Tools”, Second Edition,Perason.

Reference:

1. Elain Rich, “Automata,Computability and complexity”, 1st Edition, Pearson Education,2018.
2. K.L.P Mishra, N Chandrashekaran , 3rd Edition , ‘Theory of Computer Science”,PHI,2012.
3. Peter Linz, “An introduction to Formal Languages and Automata “, 3rd Edition, Narosa Publishers,1998.
4. K Muneeswaran, ”Compiler Design”, Oxford University Press 2013.

III Year II Semester	BLOCKCHAIN TECHNOLOGIES	L	T	P	C
		3	0	0	3

Course Objectives:

1. To learn the fundamentals of Block Chain and various types of block chain and consensus mechanism.
2. To understand public block chain system, Private block chain system and consortium block chain.
3. Able to know the security issues of blockchain technology.

UNIT-I

Fundamentals of Blockchain: Introduction, Origin of Blockchain, Blockchain Solution, Components of Blockchain, Block in a Blockchain, The Technology and the Future.

Blockchain Types and Consensus Mechanism: Introduction, Decentralization and Distribution, Types of Blockchain, Consensus Protocol.

Cryptocurrency: Bitcoin, Altcoin and Token: Introduction, Bitcoin and the Cryptocurrency, Cryptocurrency Basics, Types of Cryptocurrencies, Cryptocurrency Usage.

UNIT – II

Public Blockchain System: Introduction, Public Blockchain, Popular Public Blockchains, The Bitcoin Blockchain, Ethereum Blockchain.

Smart Contracts: Introduction, Smart Contract, Characteristics of a Smart Contract, Types of Smart Contracts, Types of Oracles, Smart Contracts in Ethereum, Smart Contracts in Industry.

UNIT-III

Private Blockchain System: Introduction, Key Characteristics of Private Blockchain, Private Blockchain, Private Blockchain Examples, Private Blockchain and Open Source, E- commerce Site Example, Various Commands (Instructions) in E-commerce Blockchain, Smart Contract in Private Environment, State Machine, Different Algorithms of Permissioned Blockchain, Byzantine Fault, Multichain.

Consortium Blockchain: Introduction, Key Characteristics of Consortium Blockchain, Need of Consortium Blockchain, Hyperledger Platform, Overview of Ripple, Overview of Corda.

Initial Coin Offering: Introduction, Blockchain Fundraising Methods, Launching an ICO, Investing in an ICO, Pros and Cons of Initial Coin Offering, Successful Initial Coin Offerings, Evolution of ICO, ICO Platforms.

UNIT-IV

Security in Blockchain: Introduction, Security Aspects in Bitcoin, Security and Privacy Challenges of Blockchain in General, Performance and Scalability, Identity Management and Authentication, Regulatory Compliance and Assurance, Safeguarding Blockchain Smart Contract (DApp), Security Aspects in Hyperledger Fabric.

Applications of Blockchain: Introduction, Blockchain in Banking and Finance, Blockchain in Education, Blockchain in Energy, Blockchain in Healthcare, Blockchain in Real-estate, Blockchain in Supply Chain, The Blockchain and IoT. Limitations and Challenges of Blockchain.

UNIT– V

Blockchain Case Studies:
Case Study 1 – Retail,
Case Study 2 – Banking and Financial Services,
Case Study 3 – Healthcare,
Case Study 4 – Energy and Utilities.

Blockchain Platform using Python: Introduction, Learn How to Use Python Online Editor, Basic Programming Using Python, Python Packages for Blockchain.
Blockchain platform using Hyperledger Fabric: Introduction, Components of Hyperledger Fabric Network, Chain codes from Developer.ibm.com, Blockchain Application Using Fabric Java SDK.

Text book:

1. "Block chain Technology", Chandramouli Subramanian, Asha A.George, Abhilasj K A and Meena Karthikeyan , Universities Press.

Reference Books:

1. Blockchain Blue print for Economy, Melanie Swan, SPD Oreilly.
2. Blockchain for Business, Jai Singh Arun, Jerry Cuomo, Nitin Gauar, Pearson Addition Wesley

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III Year II Semester	NATURAL LANGUAGE PROCESSING	L	T	P	C
		3	0	0	3

Course Objectives:
This course introduces the fundamental concepts and techniques of natural language processing (NLP).

- Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information.
- The course examines NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.
- Enable students to be capable to describe the application based on natural language processing and to show the points of syntactic, semantic and pragmatic processing.

Course Outcomes:
After completion of this course

- Demonstrate a given text with basic Language features
- To design an innovative application using NLP components
- Explain a rule based system to tackle morphology/syntax of a language
- To design a tag set to be used for statistical processing for real-time applications
- To compare and contrast the use of different statistical approaches for different types of NLP applications.

UNIT- I

INTRODUCTION: Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance.

UNIT- II

WORD LEVEL ANALYSIS: Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part- of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.

UNIT- III

SYNTACTIC ANALYSIS: Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures

UNIT- IV

SEMANTICS AND PRAGMATICS: Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.

UNIT- V

DISCOURSE ANALYSIS AND LEXICAL RESOURCES: Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).

Text Books:

1. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, 2nd Edition, Daniel Jurafsky, James H. Martin - Pearson Publication,2014.
2. Natural Language Processing with Python, First Edition, Steven Bird, Ewan Klein and Edward Loper, OReilly Media,2009.

Reference Books:

1. Language Processing with Java and Ling Pipe Cookbook, 1st Edition, Breck Baldwin, Atlantic Publisher, 2015.
2. Natural Language Processing with Java, 2nd Edition, Richard M Reese, OReilly Media,2015.
3. Handbook of Natural Language Processing, Second, Nitin Indurkhya and Fred J. Damerau, Chapman and Hall/CRC Press, 2010.Edition
4. Natural Language Processing and Information Retrieval, 3rd Edition, Tanveer Siddiqui, U.S. Tiwary, Oxford University Press,2008.

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III Year II Semester	SECURITY ASSESSMENT AND RISK ANALYSIS	L	T	P	C
		3	0	0	3

Course Objectives:

1. The course takes a software development perspective to the challenges of engineering software systems that are secure.
2. This course addresses design and implementation issues critical to producing secure software systems.
3. The course deals with the question of how to make the requirements for confidentiality, integrity, and availability integral to the software development process.
4. Secure software requirements gathering to design, development, configuration, deployment, and ongoing maintenance
5. Security of enterprise information systems.

Course Outcomes:

1. Understand various aspects and principles of software security.
2. Devise security models for implementing at the design level.
3. Identify and analyze the risks associated with s/w engineering and use relevant models to mitigate the risks.
4. Understand the various security algorithms to implement for secured computing and computer networks
5. Explain different security frameworks for different types of systems including electronic systems.

UNIT-I

Defining computer security, the principles of secure software, trusted computing base, etc, threat modeling, advanced techniques for mapping security requirements into design specifications. Secure software implementation, deployment and ongoing management.

UNIT-II

Software design and an introduction to hierarchical design representations.Difference between high-level and detailed design.Handling security with high-level design. General Design Notions. Security concerns designs at multiple levels of abstraction, Design patterns, quality assurance activities and strategies that support early vulnerability detection, Trust models, security Architecture & design reviews .

UNIT-III

Software Assurance Model: Identify project security risks & selecting risk management strategies, Risk Management Framework, Security Best practices/ Known Security Flaws, Architectural risk analysis, Security Testing & Reliability (Penn testing, Risk- Based Security Testing

UNIT-IV

Security in Enterprise Business: Identification and authentication, Enterprise Information Security, Symmetric and asymmetric cryptography, including public key cryptography, data encryption standard (DES), advanced encryption standard (AES), algorithms for hashes and message digests. Authentication, authentication schemes , access control models, Kerberos protocol, public key infrastructure (PKI), protocols specially designed for e-commerce and web applications, firewalls and VPNs.

UNIT-V

Security development frameworks. Security issues associated with the development and deployment of information systems, including Internet-based e-commerce, e-business, and e-service systems.

Text Books:

1. W. Stallings, Cryptography and network security: Principles and practice, 5 th Edition, Upper Saddle River, NJ: Prentice Hall., 2011
2. C. Kaufman, r. Perlman, & M. Speciner, Network security: Private communication in a public world, 2 nd Edition, Upper Saddle River, NJ:PrenticeHalL, 2002
3. C. P. Pfleeger, S. L. Pfleeger, Security in Computing, 4 th Edition, Upper Saddle River, NJ:Prentice Hall, 2007
4. T. M. Merkow, & J. Breithaupt, Information security: Principles and practices. Upper Saddle River, NJ:Prentice Hall, 2005

Reference Books:

1. Gary McGraw, Software Security: Building Security In, Addison-Wesley, 2006

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III Year II Semester	ANDROID APPLICATION DEVELOPMENT	L	T	P	C
		3	0	0	3

Course Objectives: This course provides a thorough understanding of mobile platforms, including attack surfaces, risk landscape & more.

Course Outcomes:

1. Understand common mobile application security vulnerabilities.
2. Define the security controls of multiple mobile operating systems.
3. Understand and analyze Blue tooth technology.
4. Understand and analyze over view of SMSsecurity and Enterprise security.

UNIT-I

Top Mobile Issues and Development Strategies: Top Issues Facing Mobile Devices, PhysicalSecurity , Secure Data Storage (on Disk), Strong Authentication with Poor Keyboards , Multiple-UserSupport with Security, Safe Browsing Environment , Secure Operating Systems, Application Isolation, Information Disclosure, Virus, Worms, Trojans, Spyware, and Malware , Difficult Patching/Update Process, Strict Use and Enforcement of SSL, Phishing, Cross-Site Request Forgery(CSRF), Location Privacy/Security, In secure Device Drivers, Multi Factor Authentication,Tips for Secure Mobile Application Development.

UNIT-II

WAP and Mobile HTML Security WAP and Mobile HTML Basics, Authenticationon WAP/Mobile HTML Sites, Encryption, Application Attacks on Mobile HTML Sites, Cross-Site Scripting, SQL Injection,Cross-Site Request Forgery, HTTP Redirects, Phishing, Session Fixation, Non-SSL Login, WAP andMobile Browser Weaknesses, Lack ofHTTPOnly Flag Support, Lack of SECURE Flag Support, Handling Browser Cache, WAPLimitations.

UNIT-III

Bluetooth Security Overview of the Technology, History and Standards, Common Uses, Alternatives, Future, Bluetooth Technical Architecture, Radio Operation and Frequency, Bluetooth Network Topology , Device Identification , Modes of Operation , Bluetooth Stack ,Bluetooth Profiles, BluetoothSecurity Features , Pairing , Traditional Security Services in Bluetooth, Security “Non-Features” ,Threats to Bluetooth Devices and Networks, Bluetooth Vulnerabilities, Bluetooth Versions Priortov1.2, Bluetooth Versions Priortov2.1.

UNIT-IV

SMSSecurity Overview ofShort MessageService, Overview of Multimedia MessagingService,Wireless Application Protocol (WAP), Protocol Attacks, Abusing Legitimate Functionality, AttackingProtocol Implementations, Application Attacks, iPhone Safari, Windows Mobile MMS, Motorola RAZRJPG Over flow,Walk throughs,Sending PDUs,Converting XML toWBXML.

UNIT-V

Enterprise Security on the Mobile OS Device Security Options, PIN, Remote, 346 Secure Local Storage, Apple iPhone and Keychain, Security Policy Enforcement, Encryption, Full Disk Encryption, E-mail Encryption, File Encryption, Application Sand boxing, Signing, and Permissions, ApplicationS and boxing, Application Signing, Permissions, Buffer Over flow Protection, Windows Mobile, iPhone, Android, BlackBerry, Security Feature Summary.

Text Book:

1.Mobile Application Security, Himanshu Dwivedi, Chris Clark,David Thiel, TATA McGraw Hill.

ReferenceBooks:

1. Mobile and Wireless Network Security and Privacy,Kami S.Makki,etal,Springer.
2. Android Security Attacks Defenses, AbhishekDubey, CRCPress.

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III Year II Semester	CLOUD COMPUTING LAB	L	T	P	C
		0	0	3	1.5

Course Objectives:

- To introduce the various levels of services offered by cloud.
- To give practical knowledge about working with virtualization and containers.
- To introduce the advanced concepts such as serverless computing and cloud simulation.

Course Outcomes: At the end of the course, the student should be able to

- Demonstrate various service types, delivery models and technologies of a cloud computing environment.
- Distinguish the services based on virtual machines and containers in the cloud offerings.
- Assess the challenges associated with a cloud-based application.
- Discuss advanced cloud concepts such as serverless computing and cloud simulation.
- Examine various programming paradigms suitable to solve real world and scientific problems using cloud services.

List of Experiments:

1. Lab on web services
2. Lab on IPC, messagaging, publish/subscribe
3. Install VirtualBox/VMware Workstation with different flavours of Linux or windows OS on top of windows8 or above.
4. Install a C compiler in the virtual machine created using VirtualBox and execute Simple Programs.
5. Create an Amazon EC2 instance and set up a web-server on the instance and associate an IP address with the instance. In the process, create a security group allowing access to port 80 on the instance.
6. OR
7. Do the same with OpenStack
8. Install Google App Engine. Create a hello world app and other simple web applications using python/java.
9. Start a Docker container and set up a web-server (e.g. apache2 or Python based Flask micro web framework) on the instance. Map the host directory as a data volume for the container.
10. Find a procedure to transfer the files from one virtual machine to another virtual machine. Similarly, from one container to another container.
11. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
12. Install Hadoop single node cluster and run simple applications like word count.
13. Utilize OpenFaaS – Serverless computing framework and demonstrate basic event driven function invocation.
14. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.

Text Books:

1. Mastering Cloud Computing, 2nd edition, RajkumarBuyya, Christian Vecchiola, ThamaraiSelvi, ShivanandaPoojara, Satish N. Srirama, McGraw Hill, 2024.
2. Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier, 2012.

Reference Books:

1. Cloud Computing, Theory and Practice, Dan C Marinescu, 2nd edition, MK Elsevier, 2018.
2. Cloud Computing: Principles and Paradigms by RajkumarBuyya, James Broberg and Andrzej M. Goscinski, Wiley, 2011.
3. Online documentation and tutorials from cloud service providers (e.g. AWS, Google App Engine)
4. Docker, Reference documentation, https://docs.docker.com/reference/
5. OpenFaaS, Serverless Functions Made Simple, https://docs.openfaas.com/

III Year II Semester	IOT DATA ANALYTICS LAB	L	T	P	C
		0	0	3	1.5

Software Requirements:

1. **Hadoop:** https://hadoop.apache.org/release/2.7.6.html
2. **Java :**https://www.oracle.com/java/technologies/javase/javase8u211-later-archive-downloads.html
3. **Eclipse:** https://www.eclipse.org/downloads/

List of Experiments:

Experiment 1: Week 1, 2:

1. Implement the following Data structures in Java
a)Linked Lists b) Stacks c) Queues d) Set e) Map

Experiment 2: Week 3:

2.(i)Perform setting up and Installing Hadoop in its three operating modes: Standalone, Pseudo distributed, Fully distributed
(ii)Use web based tools to monitor your Hadoop setup.

Experiment 3: Week 4:

3.Implement the following file management tasks in Hadoop:

- Adding files and directories
- Retrieving files
- Deleting files

Hint: A typical Hadoop workflow creates data files (such as log files) elsewhere and copies them into HDFS using one of the above command line utilities.

Experiment 4: Week 5:

4. Run a basic Word Count MapReduce program to understand MapReduce Paradigm**.**

Experiment 5: Week 6:

5. Write a map reduce program that mines weather data.

Weather sensors collecting data every hour at many locations across the globe gather a large volume of log data, which is a good candidate for analysis with Map Reduce, since it is semi structured and record-oriented.

Experiment 6: Week 7:

6. Use MapReduce to find the shortest path between two people in a social graph.

Hint: Use an adjacency list to model a graph, and for each node store the distance from the original node, as well as a back pointer to the original node. Use the mappers to propagate the distance to the original node, and the reducer to restore the state of the graph. Iterate until the target node has been reached.

Experiment 7: Week 8:

7. Implement Friends-of-friends algorithm in MapReduce.

Hint: Two MapReduce jobs are required to calculate the FoFs for each user in a social network .The first job calculates the common friends for each user, and the second job sorts the common friends by the number of connections to your friends.

Experiment 8: Week 9:

8. Implement an iterative PageRank graph algorithm in MapReduce.

Hint: PageRank can be implemented by iterating a MapReduce job until the graph has converged. The mappers are responsible for propagating node PageRank values to their adjacent nodes, and the reducers are responsible for calculating new PageRank values for each node, and for re-creating the original graph with the updated PageRank values.

Experiment 9: Week 10:

9. Perform an efficient semi-join in MapReduce.

Hint: Perform a semi-join by having the mappers load a Bloom filter from the Distributed Cache, and then filter results from the actual MapReduce data source by performing membership queries against the Bloom filter to determine which data source records should be emitted to the reducers.

Experiment 10: Week 11:

10. Install and Run Pig then write Pig Latin scripts to sort, group, join, project, and filter your

data.

Experiment 12: Week 12:

11. Install and Run Hive then use Hive to create, alter, and drop databases, tables, views, functions, and indexes

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III Year II Semester	SOFT SKILLS or IELTS	L	T	P	C
		0	1	2	2

Course Objectives:

- To encourage all-round development of the students by focusing on soft skills.
- To make the students aware of critical thinking and problem-solving skills.
- To develop leadership skills and organizational skills through group activities.
- To function effectively with heterogeneous teams.

Course Outcomes:

- Memorize various elements of effective communicative skills.
- Interpret people at the emotional level through emotional intelligence.
- Apply critical thinking skills in problem-solving.
- Analyze the needs of an organization for team building.
- Judge the situation and take necessary decisions as a leader.
- Develop social and work-life skills as well as personal and emotional well-being.

UNIT-I

Soft Skills & Communication Skills

Introduction, meaning, significance of soft skills – definition, significance, types of communication skills – Intrapersonal & Interpersonal skills – Verbal and Non-verbal Communication.

Activities:

- Intrapersonal Skills – Narration about self, strengths, and weaknesses – clarity of thought – self-expression – articulating with felicity.
- Interpersonal Skills – Group Discussion – Debate – Team Tasks – Book and film Reviews by groups – Group leader presenting views (non-controversial and secular) on contemporary issues or on a given topic.
- Verbal Communication – Oral Presentations – Extempore – Brief addresses and speeches – Convincing – Negotiating – Agreeing and disagreeing with professional grace.
- Non-verbal communication – Public speaking – Mock interviews – Presentations with an objective to identify non-verbal clues and remedy the lapses on observation.

UNIT–II

Critical Thinking : Active Listening – Observation – Curiosity – Introspection – Analytical Thinking – Open-mindedness – Creative Thinking.

Activities:

- Gathering information and statistics on a topic – Sequencing – Assorting – Reasoning – Critiquing issues.
- Placing the problem – Finding the root cause – Seeking viable solutions – Judging with rationale – Evaluating the views of others – Case Study, Story Analysis.

UNIT–III

Problem Solving & Decision Making : Meaning & features of Problem Solving – Managing Conflict – Conflict resolution – Methods of decision-making – Effective decision-making in teams – Methods & Styles.

Activities:

- Placing a problem that involves conflict of interests, choice, and views – Formulating the problem – Exploring solutions by proper reasoning – Discussion on important professional, career, and organizational decisions and initiating debate on the appropriateness of the decision.
- Case Study & Group Discussion.

UNIT–IV

Emotional Intelligence & Stress Management: Managing Emotions – Thinking before Reacting – Empathy for Others – Self-awareness – Self-Regulation – Stress factors – Controlling Stress – Tips.

Activities:

- Providing situations for the participants to express emotions such as happiness, enthusiasm, gratitude, sympathy, confidence, and compassion in the form of written or oral presentations.
- Providing opportUNIT-ies for the participants to narrate certain crisis and stress-ridden situations caused by failure, anger, jealousy, resentment, and frustration in the form of written and oral presentations.
- Organizing Debates.

UNIT–V

Leadership Skills Team-Building – Decision-Making – Accountability – Planning – Public Speaking – Motivation – Risk-Taking – Time Management.

Activities:

- Forming groups with a consensus among the participants – Choosing a leader – Encouraging the group members to express views on leadership, democratic attitude, sense of sacrifice, sense of adjustment, vision, and accommodating nature.
- Eliciting views on successes and failures of leadership using the past knowledge and experience of the participants.
- Public Speaking, Activities on Time Management, Motivation, Decision Making, Group Discussion, etc.

Textbooks:

1. Personality Development and Soft Skills (English, Paperback, Mitra Barun K.), Publisher: Oxford University Press; Pap/Cdr edition (July 22, 2012).
2. Personality Development and Soft Skills: Preparing for Tomorrow, Dr. Shikha Kapoor, Publisher: IK International Publishing House; 0 edition (February 28, 2018).

Reference Books:

1. Soft Skills: Personality Development for Life Success by Prashant Sharma, BPB Publications, 2018.
2. Soft Skills by Alex K., Published by S. Chand.
3. Soft Skills: An Integrated Approach to Maximize Personality by Gajendra Singh Chauhan, Sangeetha Sharma, Published by Wiley.
4. Communication Skills and Soft Skills (Hardcover, A. Sharma), Publisher: Yking Books.
5. Soft Skills for a BIG IMPACT (English, Paperback, Renu Shorey), Publisher: Notion Press.
6. Life Skills (Paperback, English, Dr. Rajiv Kumar Jain, Dr. Usha Jain), Publisher: Vayu Education of India.

Online Learning Resources:

- https://youtu.be/DUlsNJtg2L8?list=PLLy_2iUCG87CQhELCytvXh0E_y-bOO1_q
- https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHlsQFwJZel_j2PUy0pwjVUgj7KlJ
- https://youtu.be/-Y-R9hDl7lU
- https://youtu.be/gkLsn4ddmTs
- https://youtu.be/2bf9K2rRWwo
- https://youtu.be/FchfE3c2jzc

III Year II Semester	TECHNICALPAPERWRITING & IPR	L	T	P	C
		2	0	0	0

Course Objective : The course will explain the basic related to writing the technical reports and understanding the concepts related to formatting and structuring the report. This will help students to comprehend the concept of proofreading, proposals and practice

UNIT- I

Introduction: An introduction to writing technical reports, technical sentences formation, using transitions to join sentences, Using tenses for technical writing.

Planning and Structuring: Planning the report, identifying reader(s), Voice, Formatting and structuring the report, Sections of a technical report, Minutes of meeting writing.

UNIT- II

Drafting report and design issues: The use of drafts, Illustrations and graphics.

Final edits: Grammar, spelling, readability and writing in plain English: Writing in plain English, Jargon and final layout issues, Spelling, punctuation and Grammar, Padding, Paragraphs, Ambiguity.

UNIT- III

Proofreading and summaries: Proofreading, summaries, Activities on summaries. **Presenting final reports:** Printed presentation, Verbal presentation skills, Introduction to proposals and practice.

UNIT- IV

Using word processor:

Adding a Table of Contents, Updating the Table of Contents, Deleting the Table of Contents, Adding an Index, Creating an Outline, Adding Comments, Tracking Changes, Viewing Changes, Additions, and Comments, Accepting and Rejecting Changes , Working with Footnotes and Endnotes, Inserting citations and Bibliography, Comparing Documents, Combining Documents, Mark documents final and make them read only., Password protect Microsoft Word documents., Using Macros,

UNIT- V

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of **Patenting and Development:** technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property

Text Books:

1. Kompal Bansal &Parshit Bansal, “Fundamentals of IPR for Beginner’s”, 1st Ed., BS Publications, 2016.
2. William S. Pfeiffer and Kaye A. Adkins, “Technical Communication: A Practical Approach”, Pearson.
3. Ramappa,T., “Intellectual Property Rights Under WTO”, 2nd Ed., S Chand, 2015.

Reference Books:

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.
2. Day R, How to Write and Publish a Scientific Paper, Cambridge University Press(2006)

E-resources:

1. https://www.udemy.com/course/reportwriting/
2. https://www.udemy.com/course/professional-business-english-and-technical-report-writing/
3. https://www.udemy.com/course/betterbusinesswriting/

	Java Programming	L	T	P	C
		3	0	0	3

Course Objectives:

The learning objectives of this course are to:

- Identify Java language components and how they work together in applications
- Learn the fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries.
- Learn how to extend Java classes with inheritance and dynamic binding and how to use exception handling in Java applications
- Understand how to design applications with threads in Java
- Understand how to use Java APIs for program development

UNIT I

Object Oriented Programming: Basic concepts, Principles, Program Structure in Java: Introduction, Writing Simple Java Programs, Elements or Tokens in Java Programs, Java Statements, Command Line Arguments, User Input to Programs, Escape Sequences Comments, Programming Style.

Data Types, Variables, and Operators :Introduction, Data Types in Java, Declaration of Variables,DataTypes,TypeCasting,ScopeofVariableIdentifier,LiteralConstants,Symbolic Constants, Formatted Output with printf() Method, Static Variables and Methods, Attribute Final,**Introduction to Operators**, Precedence and Associativity of Operators, Assignment Operator (=), Basic Arithmetic Operators, Increment (++) and Decrement (- -) Operators, Ternary Operator, Relational Operators, Boolean Logical Operators, Bitwise Logical Operators. **Control Statements**: Introduction, if Expression, Nested if Expressions, if–else Expressions, Ternary Operator ?:, Switch Statement, Iteration Statements, while Expression, do–while Loop, for Loop, Nested for Loop, For–Each for Loop, Break Statement, Continue Statement.

UNIT II

Classes and Objects: Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Accessing Private Members of Class, Constructor Methods for Class, Overloaded ConstructorMethods, NestedClasses, FinalClassandMethods, Passing ArgumentsbyValue and by Reference, Keyword this. **Methods:** Introduction, Defining Methods, Overloaded Methods, Overloaded Constructor Methods, Class Objects as Parameters in Methods, Access Control, Recursive Methods, Nesting of Methods, Overriding Methods, Attributes Final and Static.

UNIT III

Arrays: Introduction, Declaration and Initialization of Arrays, Storage ofArray in Computer Memory, Accessing Elements of Arrays, Operations on Array Elements, Assigning Array to Another Array, Dynamic Change of Array Size, Sorting of Arrays, Search for Valuesin Arrays, Class Arrays, Two-dimensional Arrays, Arrays of Varying Lengths, Three-dimensional Arrays, Arrays as Vectors. **Inheritance:** Introduction, Process of Inheritance, Types of Inheritances, Universal Super Class-Object Class, Inhibiting Inheritance of ClassUsing Final, Access Control and Inheritance, Multilevel Inheritance, Application of Keyword Super, Constructor Method and Inheritance, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces and Inheritance.**Interfaces:** Introduction, Declaration of Interface, Implementation ofInterface, Multiple Interfaces, Nested Interfaces, Inheritance of Inter faces, Default Methods in Interfaces, Static Methods in Interface, Functional Interfaces, Annotations.

UNITIV

Packages and Java Library: Introduction, Defining Package, Importing Packages and Classes into Programs, Path and Class Path, Access Control, Packages in Java SE, Java.lang Package and its Classes, Class Object, Enumeration, class Math, Wrapper Classes, Auto- boxing and Auto-unboxing, Java util Classes and Interfaces, Formatter Class, Random Class, Time Package, Class Instant (java.time.Instant), Formatting for Date/Time in Java, Temporal Adjusters Class, Temporal Adjusters Class. **Exception Handling:** Introduction, Hierarchy of Standard Exception Classes, Keywords throws and throw, try, catch, and finally Blocks, Multiple Catch Clauses, Class Throwable, Unchecked Exceptions, Checked Exceptions.

JavaI/OandFile: JavaI/OAPI, standard I/Ostreams, types, Byte streams, Character streams, Scanner class, Files in Java (Text Book 2)

UNITV

String Handling in Java: Introduction, Interface Char Sequence, Class String, Methods for Extracting Characters from Strings, Comparison, Modifying, Searching; Class String Buffer.

MultithreadedProgramming: Introduction, Need for Multiple Threads Multithreaded Programming for Multi-core Processor, Thread Class, Main Thread-Creation of New Threads, Thread States, Thread Priority-Synchronization, Deadlock and Race Situations, Inter-thread Communication-Suspending, Resuming, and Stopping of Threads .**Java Database Connectivity:**Introduction, JDBCArchitecture, Installing MySQL and MySQLConnector/J, JDBC Environment Setup, Establishing JDBC Database Connections, Result SetI nterface. **Java FX GUI:** Java FX Scene Builder, Java FX App Window Structure, displaying text and image, event handling, laying out nodes in scene graph, mouse events (Text Book 3)

Text Books:

1) JAVAonestepahead, AnithaSeth, B.L.Juneja,Oxford.
2) Joy with JAVA,Fundamentals of ObjectOrientedProgramming,DebasisSamanta, Monalisa Sarma, Cambridge, 2023.
3) JAVA9forProgrammers,PaulDeitel,HarveyDeitel,4[th]Edition,Pearson.

References Books:

1) ThecompleteReferenceJava,11[th]edition,HerbertSchildt,TMH
2) IntroductiontoJavaprogramming, 7[th]Edition, YDanielLiang, Pearson

Online Resources:

1) https://nptel.ac.in/courses/106/105/106105191/
2) https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012880464547618816347_shared/overview

	OPERATINGSYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

The main objectives of the course is to make student

- Understand the basic concepts and principles of operating systems, including process management, memory management, file systems, and Protection
- Make use of process scheduling algorithms and synchronization techniques to achieve better performance of a computer system.
- Illustrate different conditions for deadlock and their possible solutions.

UNIT-I

Operating Systems Overview: Introduction, Operating systemfunctions, Operating systems operations, Computing environments, Free and Open-Source Operating Systems **System Structures:** Operating System Services, User and Operating-System Interface, system calls, Types of System Calls, system programs, Operating system Design and Implementation, Operating system structure, Building and Booting an Operating System, Operating system debugging

UNIT-II

Processes: Process Concept, Process scheduling, Operations on processes, Inter-process communication. **Threads and Concurrency:** Multithreading models, Thread libraries, Threading issues. **CPU Scheduling:** Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple processor scheduling.

UNIT– III

Synchronization Tools: The Critical Section Problem, Peterson's Solution, Mutex Locks, Semaphores, Monitors, Classic problems of Synchronization. **Deadlocks:** system Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from Deadlock.

UNIT-IV

Memory-Management Strategies: Introduction, Contiguous memory allocation, Paging, Structure of the Page Table, Swapping. **Virtual Memory Management:** Introduction, Demand paging, Copy-on-write, Pagereplacement, Allocationofframes, Thrashing. **Storage Management:** Overview of Mass Storage Structure, HDD Scheduling.

UNIT-V

File System: File System Interface: File concept, Access methods, Directory Structure; File system Implementation: File-system structure, File-system Operations, Directory implementation, Allocation method, Free space management; File-System Internals: File- System Mounting, Partitions and Mounting, File Sharing. **Protection:** Goals of protection, Principles of protection, Protection Rings, Domain of protection, Access matrix.

Text Books:

1. Operating System Concepts, Silberschatz A, Galvin P B, Gagne G, 10th Edition, Wiley, 2018.
2. ModernOperating Systems,TanenbaumAS,4thEdition,Pearson,2016

Reference Books:

1. OperatingSystems-InternalsandDesignPrinciples,StallingsW,9thedition, Pearson, 2018
2. OperatingSystems:AConceptBasedApproach,D.MDhamdhere,3rdEdition, McGraw- Hill, 2013

OnlineLearningResources:

1. https://nptel.ac.in/courses/106/106/106106144/
http://peterindia.net/OperatingSystems.html

	DATABASEMANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

The main objectives of the course is to

- Introduce database management systems and to give a good formal foundationon the relational model of data and usage of Relational Algebra
- Introduce the conceptsofbasic SQLasa universal Database language
- Demonstrate the principles behind systematicdatabase designapproaches by covering conceptual design,logical design through normalization
- Provide an overview ofphysicaldesign ofa database system, bydiscussing Databaseindexing techniques and storage techniques

UNIT-I

Introduction: Database system, Characteristics (Database Vs File System), Database Users, Advantages of Database systems, Database applications. Brief introduction of different Data Models; Concepts of Schema, Instance and datain dependence; Threetier schema architecturefor data independence; Database system structure, environment, Centralized and Client Serverarchitecture for the database.
Entity Relationship Model: Introduction, Representation of entities, attributes,entityset, relationship, relationship set, constraints, sub classes, super class, inheritance, specialization, generalization using ER Diagrams.

UNIT-II

Relational Model: Introduction to relational model, concepts of domain, attribute,tuple, relation, importance of null values, constraints (Domain, Key constraints, integrity constraints) and their importance, Relational Algebra,RelationalCalculus.BASICSQL: Simple Databaseschema, data types, table definitions (create, alter), different DML operations (insert, delete, update).

UNIT-III

SQL: BasicSQLquerying(select andproject)usingwhere clause, arithmetic& logical operations,SQLfunctions(DateandTime,Numeric,Stringconversion).Creatingtables with relationship, implementation of key and integrity constraints, nested queries, sub queries, grouping, aggregation, ordering, implementation of different types of joins, view(updatable andnon-updatable), relational set operations.

UNIT-IV

Schema Refinement (Normalization):Purpose of Normalization or schema refinement, conceptof functional dependency, normal forms based on functional dependency Lossless join and dependency preserving decomposition,(1NF,2NFand3NF), concept of surrogatekey, Boyce-Codd normal form(BCNF), MVD, Fourth normal form(4NF), Fifth Normal Form(5NF).

UNIT-V

Transaction Concept: Transaction State, ACID properties, Concurrent Executions,Serializability, Recoverability, Implementation of Isolation, Testing for Serializability, lock based, time stamp based, optimistic, concurrency protocols, Deadlocks, Failure Classification,Storage, Recovery and Atomicity, Recovery algorithm. Introduction to Indexing Techniques: B+Trees, operations on B+Trees, Hash Based Indexing:

Text Books:

1) Database Management Systems, 3rd edition, Raghurama Krishnan, Johannes Gehrke,TMH (For Chapters 2, 3, 4)
2) Database System Concepts, 5th edition, Silberschatz, Korth, Sudarsan, TMH (For Chapter 1 and Chapter 5)

ReferenceBooks:

1) Introduction to Database Systems, 8th edition, CJ Date, Pearson.
2) Database Management System, 6th edition, Ramez Elmasri, Shamkant B. Navathe, Pearson
3) Database Principles Fundamentals of Design Implementation and Management, CorlosCoronel, Steven Morris, Peter Robb, Cengage Learning.

Web-Resources:

1) https://nptel.ac.in/courses/106/105/106105175/
2) https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012758066672820224 56_shared/overview

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA–533003,Andhra Pradesh, India
B.Tech CSE – Internet of Things (IoT)
(R23 – III[rd] YEAR COURSE STRUCTURE & SYLLABUS)

	COMPUTERNETWORKS	L	T	P	C
		3	0	0	3

Course Objectives:

- To understand the different types of networks
- To discuss the software and hardware components of a network
- To develop an understanding the principles of computer networks.
- To familiarize with OSI model and the functions of layered structure.
- To explain networking protocols, algorithms and design perspectives.

CourseOutcomes(CO): After completion of the course, students will be able to

- Identify the software and hardware components of a Computer network.(L1)
- Explain the functionality of each layer ofa computer network.(L2)
- Identify and analyze flow control, congestion control, and routing issues.(L4)
- Analyze and interpret the functionality and effectiveness of the routing protocols. (L4)
- Choose the appropriate transport protocol based on the application requirements.(L3)

UNIT-I

Introduction: Types of Computer Networks, Broadband Access Networks, Mobile and Wireless Access Networks, Content Provider Networks, Transit networks, Enterprise Networks, Network technology from local to global, Personal Area Networks, Local Area Networks, Home Networks, Metropolitan Area Networks, Wide Area Networks, Internetworks, Network Protocols, Design Goals, Protocol Layering, Connections and Reliability, Service Primitives, The Relationship ofServices to Protocols ,Reference Models, The OSI Reference Model, The TCP/IP Reference Model, A Critique of the OSI Model and Protocols, A Critique of the TCP/IP Reference Model and Protocols.

UNIT-II

The Data Link Layer: Guided Transmission Media, Persistent Storage, Twisted Pairs, CoaxialCable, PowerLines, Fiber Optics, Data Link Layer DesignIssues, Services Provided To The Network Layer, Framing Error Control, Flow Control, Error Detection And Correction, Error-Correcting Codes, Error-Detecting Codes, Elementary Data Link Protocols, Initial Simplifying Assumptions Basic Transmission And Receipt, Simplex Link-Layer Protocols, Improving Efficiency, Bidirectional Transmission, Multiple Frames In Flight, Examples Of Full-Duplex, Sliding Window Protocols, The Channel Allocation Problem, Static Channel Allocation, Assumptions For Dynamic Channel Allocation, Multiple Access Protocols, Aloha, Carrier Sense Multiple Access Protocols, Collision-Free Protocols, Limited-Contention Protocols, Wireless LAN Protocols, Ethernet, Classic Ethernet Physical Layer, Classic Ethernet Mac Sublayer Protocol, Ethernet Performance, Switched Ethernet, Fast Ethernet, Gigabit Ethernet, 10-Gigabit Ethernet,40- And 100-Gigabit Ethernet, Retrospective On Ethernet.

UNIT-III

The Network Layer: Network Layer Design Issues, Store-And-Forward Packet Switching, Services Provided To The Transport Layer, Implementation Of Connectionless Service, Implementation Of Connection-Oriented Service, Comparison Of Virtual-Circuit And Datagram Networks, Routing Algorithms In A Single Network, The Optimality Principle, Shortest Path Algorithm, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing Within a Network, Broadcast Routing, Multicast Routing, Anycast Routing, Traffic Management at The Network Layer, The Need for Traffic Management: Congestion, Approaches To Traffic Management, Internet working, Internetworks: An Overview, How Networks differ, Connecting Heterogeneous Networks, Connecting Endpoints Across Heterogeneous Networks, Internetwork Routing: Routing Across Multiple Networks Supporting Different Packet Sizes:Packet Fragmentation, The Network Layer In The Internet, The IP Version 4 Protocol, IP Addresses, IP Version 6, Internet Control Protocols, Label Switching and MPLS, OSPF—An Interior Gateway Routing Protocol, BGP—The Exterior Gateway Routing Protocol, Internet Multicasting.

UNIT-IV

The Transport Layer: The Transport Service, Services Provided To The Upper Layers, Transport Service Primitives, Berkeley Sockets, An Example Of Socket Programming: An Internet File Server, Elements Of Transport Protocols, Addressing, Connection Establishment, Connection Release, Error Control And Flow Control, Multiplexing, Crash Recovery, Congestion Control, Desirable Band width Allocation, Regulating The Sending Rate, Wireless Issues, The Internet Transport Protocols: UDP, Introduction To UDP, Remote Procedure Call, Real-Time Transport Protocols,The Internet Transport Protocols:TCP, IntroductionToTCP, The TCP Service Model, The TCP Protocol, The TCP Segment Header, TCP Connection Establishment, TCP Connection Release.

UNIT-V

The Application Layer: Electronic Mail, Architecture and Services, The User Agent, Message Formats, Message Transfer, Final Delivery, The World Wide Web, Architectural Overview, Static Web Objects, Dynamic Web Pages and Web Applications, HTTP and HTTPS, Web Privacy, Content Delivery, Content and Internet Traffic, Server Farms and Web Proxies, Content Delivery Networks, Peer-To-Peer Networks, Evolution of The Internet.

Text book:

1.Andrew Tanenbaum, Feamster Wetherall, Computer Networks, 6thEdition, Global Edition.

Reference Books:

1. Behrouz A. Forouzan, Data Communications and Networking, 5th Edition, McGraw Hill Publication, 2017.
2. JamesF.Kurose,Keith W.Ross,"Computer Networking: A Top-Down Approach",6th edition, Pearson, 2019.
3. Youlu Zheng, Shakil Akthar, "Networks for Computer Scientists and Engineers",Oxford Publishers, 2016.

Online Learning Resources:

https://nptel.ac.in/courses/106105183/25
http://www.nptelvideos.in/2012/11/computer-networks.html https://nptel.ac.in/courses/106105183/