

# **COURSE STRUCTURE (R20) AND DETAILED SYLLABUS (III YEAR)**

## **COMPUTER SCIENCE & ENGINEERING**

**For  
B.Tech., Four Year Degree Course  
(Applicable for the batches admitted from 2020-21)**



## **LENDI INSTITUTE OF ENGINEERING AND TECHNOLOGY**

An Autonomous Institution

Approved by AICTE & Permanently Affiliated to JNTUK, Kakinada  
Accredited by NAAC with "A" Grade and NBA (CSE, ECE, EEE & ME)

Jonnada (Village), Denkada (Mandal), Vizianagaram Dist – 535 005

Phone No. 08922-241111, 241112

E-Mail: [lendi\\_2008@yahoo.com](mailto:lendi_2008@yahoo.com)

Website: [www.lendi.org](http://www.lendi.org)

**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (CSE)**  
**B. Tech III-Year Course Structure and Syllabus –R20**

<b>III Year - I Semester</b>							
<b>S. No</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
<b>1</b>	R20CSE-PC3101	Formal Languages and Automata Theory	PC	3	0	0	3
<b>2</b>	R20CSE-PC3102	Data Mining and Data Warehousing	PC	3	0	0	3
<b>3</b>	R20CSE-PC3103	Object Oriented Analysis& Design(OOAD)	PC	3	0	0	3
<b>4</b>	R20ECE-OE3104 R20CSE-OE3105 R20CSE-OE3106	<b>Open Elective Course /Job oriented Elective Course-1:</b> 1. Micro Processors & Interfacing 2. Advanced Java Programming 3. DevOps	OE	3	0	0	3
<b>5</b>	R20CSE-PE3101.1 R20CSE-PE3101.2 R20CSE-PE3101.3 R20CSE-PE3101.4	<b>Professional Elective courses-1:</b> 1. Artificial Intelligence 2. Principles of Programming Languages 3. Advanced Data Structures 4. Advanced Operating Systems	PE	3	0	0	3
<b>6</b>	R20CSE-PC3104	Data Mining and Data Warehousing (DMDW) Lab	PC	0	0	3	1.5
<b>7</b>	R20CSE-PC3105	Object Oriented Analysis& Design (OOAD) Lab	PC	0	0	3	1.5
<b>8</b>	R20BSH-SC3102	Employability Skills-2 (soft skill course)	SC	0	1	2	2
<b>9</b>	R20CSE-SI3101	Summer Internship - 1 (Evaluation)	SI	0	0	0	1.5
			<b>Total</b>	<b>17</b>	<b>0</b>	<b>8</b>	<b>21.5</b>
<b>Honors Course -2</b>							
<b>Track No.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
<b>1</b>	R20CSE-HN3101	TCP/IP Protocol Suite(Track-1)	HN	3	1	0	4
<b>2</b>	R20CSE-HN3102	Secure Coding(Track-2)	HN	3	1	0	4
<b>3</b>	R20CSE-HN3103	Angular JS Framework (Track-3)	HN	3	1	0	4
<b>4</b>	R20CSE-HN3104	Mathematical Essential For Data Science(Track-4)	HN	3	1	0	4
<b>Minor Course-2</b>							

III Year - II Semester							
S. No	Course Code	Course Title	Category	L	T	P	Credits
1	R20CSE-PC3201	Computer Networks	PC	3	0	0	3
2	R20CSE-PC3202	Compiler Design	PC	3	0	0	3
3	R20CSE-PC3203	Design and Analysis Algorithms	PC	3	0	0	3
4	R20CSE-PE3201.1 R20CSE-PE3201.2 R20CSE-PE3201.3 R20CSE-PE3201.4	<b>Professional Elective courses-2:</b> 1. Distributed Systems 2. Web Services 3. Human Computer Interaction 4. Speech Processing	PE	3	0	0	3
5	R20ECE-OE3203 R20CSE-OE3206 R20ECE-OE3204	<b>Open Elective Course/Joboriented Elective-2:</b> 1. VLSI 2. Sales Force 3. Industrial Internet of Things(IoT)	OE	3	0	0	3
6	R20CSE-PC3204	Computer Networks Lab	PC	0	0	3	1.5
7	R20CSE-PC3205	Compiler Design Lab	PC	0	0	3	1.5
8	R20CSE-PC3206	Design and Analysis Algorithms Lab	PC	0	0	3	1.5
9	R20BSH-SC3201	DJango Framework (Soft skill course)	SC	0	1	2	2
10	R20BSH-MC3203	Intellectual Property Rights & Patents (Mandatory course)	MC	2	0	0	0
<b>Total</b>				<b>17</b>	<b>1</b>	<b>11</b>	<b>21.5</b>
Honors Course -3							
Track No.	Course Code	Course Title	Category	L	T	P	Credits
1	R20CSE-HN3201	Wireless Sensor Networks (Track-1)	HN	3	1	0	4
2	R20CSE-HN3202	Blockchain Technologies (Track-2)	HN	3	1	0	4
3	R20CSE-HN3203	.Net Frame work (Track-3)	HN	3	1	0	4
4	R20CSE-HN3204	Natural Language Processing (Track-4)	HN	3	1	0	4
Minor Course-3							
Summer Internship-2 (After Second Year & Evaluated in IV-I Semester)							

## **HONOR DEGREE IN COMPUTER SCIENCE AND ENGINEERING**

### **Track-I (Networks)**

S.No	Year & Semester	Course Code	Subject Title	Category	L	T	P	C
1	II-II	R20CSE-HN2201	Data Communication	HN	3	0	2	4
2	III-I	R20CSE-HN3101	TCP/IP Protocol Suite	HN	3	0	2	4
3	III-II	R20CSE-HN3201	Wireless Sensor Networks	HN	3	0	2	4
4	IV-I	R20CSE-HN4101	Internet of Things	HN	3	0	2	4
5	II Year to IV Year	R20CSE-HNMS01.1	Honors MOOCS-1	HN	0	0	0	2
6	II Year to IV Year	R20CSE-HNMS01.2	Honors MOOCS-2	HN	0	0	0	2
<b>Total</b>								<b>20</b>

### **Track- II (Cyber Security)**

S.No	Year & Semester	Course Code	Subject Title	Category	L	T	P	C
1	II-II	R20CSE-HN2202	Information Security	HN	3	0	2	4
2	III-I	R20CSE-HN3102	Secure Coding	HN	3	0	2	4
3	III-II	R20CSE-HN3202	Blockchain Technologies	HN	3	0	2	4
4	IV-I	R20CSE-HN4102	Vulnerability Assessment & Penetration Testing	HN	3	0	2	4
5	II Year to IV Year	R20CSE-HNMS02.1	Honors MOOCS-1	HN	0	0	0	2
6	II Year to IV Year	R20CSE-HNMS02.2	Honors MOOCS-2	HN	0	0	0	2
<b>Total</b>								<b>20</b>

### **Track III (Web Frameworks)**

S.No	Year & Semester	Course Code	Subject Title	Category	L	T	P	C
1	II-II	R20CSE-HN2203	Web UI Framework	HN	3	0	2	4
2	III-I	R20CSE-HN3103	Angular Framework	HN	3	0	2	4
3	III-II	R20CSE-HN3203	.Net Framework	HN	3	0	2	4
4	IV-I	R20CSE-HN4103	J2EE Framework	HN	3	0	2	4
5	II Year to IV Year	R20CSE-HNMS03.1	Honors MOOCS-1	HN	0	0	0	2
6	II Year to IV Year	R20CSE-HNMS03.2	Honors MOOCS-2	HN	0	0	0	2
<b>Total</b>								<b>20</b>

### **Track IV (Data Science)**

S.No	Year & Semester	Course Code	Subject Title	Category	L	T	P	C
1	II-II	R20CSE-HN2203	Advanced Python Programming	HN	3	0	2	4
2	III-I	R20CSE-HN3103	Mathematical Essential For Data Science	HN	3	1	0	4
3	III-II	R20CSE-HN3203	Natural Language Processing	HN	3	0	2	4
4	IV-I	R20CSE-HN4103	Deep Learning	HN	3	0	2	4
5	II Year to IV Year	R20CSE-HNMS03.1	Honors MOOCS-1	HN	0	0	0	2
6	II Year to IV Year	R20CSE-HNMS03.2	Honors MOOCS-2	HN	0	0	0	2
<b>Total</b>								<b>20</b>

### III-I Semester

SubjectCode	SubjectName	L	T	P	C
R20CSE-PC3101	Formal Languages&Automata Theory	3	0	0	3

Course Objectives:

This course is designed to:

1. Introduce the student to the concepts of **Theory of Computation** in computer science.
2. The students should acquire insights into the relationship among **formal languages**, **Formal Grammars**, and **automata**.
3. Analysis of **Finite State Machine**, its representation and automation. Description of finite automata, variants in it, and their equivalence.
4. Minimization, optimization of finite automata, **regular expressions**, and equivalence of finite automata and regular expressions.
5. Illustration about **grammars**, classification and simplification of grammars, **Transducers**, and **PDA**.
6. Understand the designing techniques of **Turing machines** and differentiate between **Decidable** and **Undecidable Problems**, grouping them into **NP-Complete** and **NP-Hard**.

Course Outcomes:

Students will be able to:

1. Illustrate the concept of finite automata for the design of **Finite State Machines**.
2. Analyze the given problem and use the properties of regular expressions to design a regular expression.
3. Design a **CFG** for the given languages and simplify the CFGs.
4. Design a **Push Down Automata** for some set of languages.
5. Design a **Turing Machine** for the given language and understand the concepts of **Undecidability**.

UNIT-I: Finite Automata

Why Study Automata Theory? The Central Concepts of Automata Theory, Automation, Finite Automation, Transition Systems, Acceptance of a String by a Finite Automation, **DFA**, Design of DFAs, **NFA**, Design of NFA, Equivalence of DFA and NFA, Conversion of NFA into DFA, Finite Automata with E-Transition, Minimization of Finite Automata, **Mealy** and **Moore Machines**, Applications and Limitations of Finite Automata.

Learning Outcomes:

Students will be able to:

- Distinguish DFA and NFA (L4)
- Construct DFA for an input string (L6)
- Perform minimization of Automata (L3)
- Compare Moore and Mealy Machines (L4)

### **UNIT–II: Regular Expressions**

Regular Expressions, Regular Sets, Identity Rules, Equivalence of Two Regular Expressions, Manipulations of Regular Expressions, Finite Automata, and Regular Expressions, Interconversion, Equivalence Between Finite Automata and Regular Expressions, Pumping Lemma, Closure Properties, Applications of Regular Expressions, Finite Automata and Regular Grammars, Regular Expressions and Regular Grammars.

Learning Outcomes:

Students will be able to:

- Build regular expressions for the given Finite Automata (L3)
- Construct finite automata for the given regular expression (L6)
- Apply closure properties on regular expressions (L3)

### **UNIT–III: Context Free Grammars**

Formal Languages, Grammars, Classification of Grammars, Chomsky Hierarchy Theorem, Context Free Grammar, Leftmost and Rightmost Derivations, Parse Trees, Ambiguous Grammars, Simplification of Context Free Grammars - Elimination of Useless Symbols, E-Productions and Unit Productions, Normal Forms for Context Free Grammars - Chomsky Normal Form and Greibach Normal Form, Pumping Lemma, Closure Properties, Applications of Context Free Grammars.

Learning Outcomes:

Students will be able to:

- Define Context Free Grammar (L1)
- Differentiate between Chomsky Normal Form and Greibach Normal Form (L4)
- Apply Pumping Lemma theorem on Context Free Grammar (L3)

### **UNIT–IV: Pushdown Automata**

Pushdown Automata, Definition, Model, Graphical Notation, Instantaneous Description Language Acceptance of Pushdown Automata, Design of Pushdown Automata, Deterministic and Non-Deterministic Pushdown Automata, Equivalence of Pushdown Automata and Context Free Grammars Conversion, Two Stack Pushdown Automata, and Application of Pushdown Automata.

Learning Outcomes:

Students will be able to:

- List the applications of Pushdown Automata (L1)
- Build Pushdown Automata for context free grammar (L6)

### **UNIT–V: Turing Machine**

Turing Machine, Definition, Model, Representation of Turing Machines - Instantaneous Descriptions, Transition Tables and Transition Diagrams, Language of a Turing Machine, Design of Turing Machines, Techniques for Turing Machine Construction, Types of Turing Machines, Church's Thesis, Universal Turing Machine Decidable and Undecidable Problems Post's Correspondence Problem, Classes of P and NP, NP hard and NP-Complete Problems.

Learning Outcomes:

Students will be able to:

- List the applications of Turing machine (L1)
- Design Turing machine for context free grammar (L6)
- List types of Turing Machines (L1)
- Design Turing Machine (L6)
- Formulate decidability and undecidability problems. (L2)

Text Books:

1. Introduction to Automata Theory, Languages and Computation by J.E. Hopcroft, R. Motwani and J.D. Ullman, 3rd Edition, Pearson, 2008.
2. Theory of Computer Science - Automata, Languages and Computation by K.L.P. Mishra and N. Chandrasekaran, 3rd Edition, PHI, 2007.

Reference Books:

1. Formal Language and Automata Theory by K.V.N. Sunitha and N. Kalyani, Pearson, 2015.
2. Introduction to Automata Theory, Formal Languages and Computation by Shyamalendu Kandar, Pearson, 2013.
3. Theory of Computation by V. Kulkarni, Oxford University Press, 2013.
4. Theory of Automata, Languages and Computation by Rajendra Kumar, McGraw Hill, 2014.
5. [https://en.wikipedia.org/wiki/Automata\\_theory](https://en.wikipedia.org/wiki/Automata_theory)
6. <https://nptel.ac.in/courses/111103016/>

SubjectCode	SubjectName	L	T	P	C
R20CSE-PC3102	DataMiningandDataWarehousing	3	0	0	3

### **COURSE OBJECTIVES:**

- Students will be enabled to understand and implement classical models and algorithms in data warehousing and data mining.
- They will learn how to analyze the data, identify the problems, and choose the relevant models and algorithms to apply.
- They will further be able to assess the strengths and weaknesses of various methods and algorithms and analyze their behavior.

### **COURSE OUTCOMES:**

1. Understand the process of knowledge discovery from data.
2. Analyze the Data Pre-processing techniques.
3. Apply classification techniques to various data sets.
4. Apply the association rule mining to real-time applications.
5. Apply the clustering algorithms to various data sets.

### **UNIT-I:**

**Introduction:** Why Data Mining? What Is Data Mining? What Kinds of Data Can Be Mined? What Kinds of Patterns Can Be Mined? Which Technologies Are Used? Which Kinds of Applications Are Targeted? Major Issues in Data Mining. Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity and Dissimilarity.

#### **Learning Outcomes:**

Students should be able to:

- Summarize the process of Data mining. (L2)
- Classify various kinds of Data Mining techniques. (L2)
- Memorize different visualization techniques. (L1)
- Differentiate a data warehouse with data mining. (L4)

### **UNIT-II:**

**Data Pre-processing:** Data Preprocessing: An Overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization.

#### **Learning Outcomes:**

Students should be able to:

- Recognize various steps in Data Preprocessing. (L1)
- Identify the process of handling noisy data. (L1)

### **UNIT-III:**

**Classification:** Basic Concepts, General Approach to solving a classification problem, Decision Tree Induction: Working of Decision Tree, building a decision tree, methods for expressing an attribute test conditions, measures for selecting the best split, Algorithm for decision tree induction.

**Classification:** Alternative Techniques, Bayesian Classifier: Bayes theorem, using Bayes theorem for classification, Naive Bayes Classifier: Bayes error rate, Bayesian Belief Networks: Model representation, model building (Tan).

#### **Learning Outcomes:**

Students should be able to:

- Summarize the process of classification. (L2)
- Apply the process of classification on sample data. (L3)
- Construct a decision tree for any sample data. (L3)
- Calculate Bayes probability for any given data. (L3)
- Calculate Naïve Bayes probability. (L3)



#### **UNIT–IV:**

**Association Analysis:** Basic Concepts and Algorithms: Problem definition, Frequent Item Set generation, Rule generation, compact representation of frequent itemsets, FP-Growth Algorithm. (Tan & Vipin).

#### **Learning Outcomes:**

Students should be able to:

- Apply the Apriori algorithm on any sample data. (L3)
- Construct an FP-tree for any sample data. (L3)

#### **UNIT–V:**

**Cluster Analysis:** Basic Concepts and Algorithms: Overview: What Is Cluster Analysis? Different Types of Clustering, Different Types of Clusters; K-means: The Basic K-means Algorithm, K-means Additional Issues, Bisecting K-means, Strengths and Weaknesses; Agglomerative Hierarchical Clustering: Basic Agglomerative Hierarchical Clustering Algorithm; DBSCAN: Traditional Density Center-Based Approach, DBSCAN Algorithm, Strengths and Weaknesses. (Tan & Vipin).

#### **Learning Outcomes:**

Students should be able to:

- Identify the data objects and partition them into different clusters. (L2)
- Apply the different clustering techniques on sample data. (L3)
- Acquire knowledge of the strengths and weaknesses of clustering algorithms. (L2)

#### **TEXTBOOKS:**

1. Introduction to Data Mining: Pang-Ning Tan & Michael Steinbach, Vipin Kumar, Pearson.
2. Data Mining Concepts and Techniques, 3/e, Jiawei Han, Michel Kamber, Elsevier.

#### **REFERENCE BOOKS:**

1. Data Mining Techniques and Applications: An Introduction, Hongbo Du, Cengage Learning.
2. Data Mining: Vikram Pudi and P. Radha Krishna, Oxford.
3. Data Mining and Analysis - Fundamental Concepts and Algorithms; Mohammed J. Zaki, Wagner Meira Jr., Oxford.
4. Data Warehousing Data Mining & OLAP, Alex Berson, Stephen Smith, TMH.

SubjectCode	SubjectName	L	T	P	C
R20CSE-PC3103	ObjectOrientedAnalysis&Design(OOAD)	3	0	0	3

### **COURSE OBJECTIVES:**

1. To focus on design issues rather than implementation.
2. To introduce Unified Process and showcase how UML can be used within the process.
3. To experience case studies with emphasis on architecture, analysis, and design.
4. To provide programmatic interactions using UML diagrams and OOP.

### **COURSE OUTCOMES:**

1. Apply the basic concepts of object-oriented modeling in framing and designing the model.
2. Apply qualitative techniques to develop case diagrams.
3. Design class diagrams of domain and design models of a software system.
4. Design interaction diagrams that model the dynamic aspects of a software system.
5. Design logical architecture with layers pattern for real-time applications.

### **UNIT I: Introduction**

Introduction to OOAD, Introduction to iterative development and the Unified Process, Case Study: The Next Gen POS System, Architectural Layers, and Case Study Emphasis.

#### **Learning Outcomes:**

- Define object-oriented analysis and design (OOA/D).
- Illustrate a brief example (Next Gen POS System).
- Define fundamental concepts in the Unified Process.

### **UNIT II: Inception**

Introduction to inception, artifacts in inception, Understanding requirements – the FURPS model, Understanding Use case model – introduction, use case types and formats, Writing use cases – goals and scope of a use case, elements/sections of a use case, Use case diagrams, Use cases in the UP context and UP artifacts, Identifying additional requirements, Writing requirements for the case study in the use case model.

#### **Learning Outcomes:**

- Define the FURPS+ model.
- Relate types of requirements to UP artifacts.
- Use the brief, casual, and fully dressed formats in an essential style.

### **UNIT III: Elaboration**

System sequence diagrams for use case model, Domain model: identifying concepts, adding associations, adding attributes, Interaction Diagrams, Design Class diagrams in each MVC layer Mapping Design to Code, Design class diagrams for case study and skeleton code.

#### **Learning Outcomes:**

- Create system sequence diagrams for use cases.
- Identify conceptual classes related to the current iteration requirements.
- Distinguish between need-to-know and comprehension-only associations.

### **UNIT IV: More UML Diagrams**

State-Chart diagrams, Activity diagrams, Component Diagrams, Deployment diagrams, Object diagrams.

#### **Learning Outcomes:**

- Create state chart diagrams for classes and use cases.
- Create object diagrams and state diagrams.
- Create activity, component, and deployment diagrams.

### **UNIT V: Advanced Concepts in OOAD**

Use case relationships, Generalizations Domain Model refinements, Architecture, Packaging model elements.

**Applications:** Satellite-Based Navigation (system architecture): Inception, Elaboration, Construction, Post-Transition; Traffic Management (system requirements): Elaboration, Construction, Post-Transition.

**Learning Outcomes:**

- Create generalization-specialization hierarchies.
- Identify when showing a subclass is worthwhile.
- Know alternative UML package structure notation.
- Representation of System requirements and System Architecture in Case Study.

**TEXTBOOKS:**

1. *Applying UML and Patterns* by Craig Larman, Pearson.
2. *Object-Oriented Analysis and Design with Applications* by Grady Booch, Jacobson, Rumbaugh.
3. *Object-Oriented Analysis & Design with the Unified Process* by Satzinger, Jackson & Burd Cengage Learning.
4. *UML Distilled* by Martin Fowler, Addison Wesley, 2003.

**REFERENCE:**

1. O'Reilly's *Head First Design Patterns* by Eric Freeman et al., O'Reilly.
2. *UML 2 Toolkit* by Hans-Erik Eriksson et al., WILEY-Dreamtech India Pvt Ltd.

SubjectCode	SubjectName	L	T	P	C
R20ECE-OE3104	Micro Processors & Interfacing (Open Elective /Job oriented Elective Course -1)	3	0	0	3

### Course Objectives:

- To explain the working of 8086 using its architectural features.
- To show the development of 8086 based assembly programming for simple problems.
- To design different 8086 interfaces with Direct memory Access integrated Circuits.
- To design different 8086 interfaces with various peripheral IC's like 8255.
- To make use of Interrupts concept and develop the concept of interfacing PIC with 8086.

### Course Outcomes:

1. Illustrate the working of 8086 microprocessor architectural features. (L2)
2. Make use of addressing modes, instruction set and assembly language for simple programs of 8086 microprocessors. (L2)
3. Develop programming and interfacing of DMA and make use of different types of data transfer techniques in DMA(L3)
4. Develop programming and interfacing of various peripheral devices to 8086 with support of ICs 8255,ADC0808,LCD, Keypad (L3)
5. Illustrate the Concept of Interrupts and develop the interfacing program for PIC(Priority Interrupt Controller). (L3)

### Unit-1

**Introduction to Microprocessor family:** An Overview of 8085, Architecture of 8086 Micro Processor, Pin diagram of 8086, Minimum mode and Maximum mode, Special function and General purpose registers,8086 flag register and function of flag register pins.

**Applications:** Can develop 8086 based systems in minimum or maximum mode configuration.

### Learning Outcomes:

- At the end of this unit students will be able to summarize features of a 8086 microprocessor. (L2)
- At the end of this unit students will be able to understand the minimum mode and maximum mode of operations.(L2)

### Unit-2

**Instruction set of 8086:** Addressing modes of 8086, Instruction set of 8086, Assembler directives and Simple programs, Procedures and Macros, Assembly language Programs Involving Logical , Branch and Call Instructions ,Evolution of Arithmetic Expressions and String Manipulation Instructions.

**Applications:** The 8086 memory addressing modes provide flexible access to memory, allowing you to easily access variables, arrays, records, pointers, and other complex data types

### Learning Outcomes:

- At the end of this unit students will be able to Understand the different types of addressing modes. (L2)
- At the end of end of this unit student is able to develop Simple Assembly level language Programs.(L3)

### Unit 3

**Direct Memory Access:** Memory Interfacing to 8086(static RAM and EPROM),Read and Write cycle Timing Diagrams, need for DMA,DMA data transfer methods, Interfacing with 8237/8257.

**Applications:** Many hardware systems use DMA, including disk drive controllers, graphics

cards, network cards and sound cards.

**Learning Outcomes:**

- At the end of this unit students will be able to develop assembly language programs for different types of RAMs and ROMs. (L3)
- At the end of this unit students will be able to demonstrate 8257 interfacing with 8086. (L3)

**Unit 4**

**Interfacing with 8086 Micro Processor:** 8255 Various modes of Operation and Interfacing to 8086, Displays, Interfacing Keyboard, Stepper motor and Actuators and D/A and A/D converter Interfacing.

**Applications:** ADC converters are very useful in control and monitoring applications since most sensors in real life (e.g., temperature sensor, pressure sensor, force sensor, etc.) produce analog output voltages.

**Learning Outcomes:**

- At the end of this unit students will be able to develop assembly language programs for various problems. (L3)
- At the end of this unit students will be able to demonstrate memory & I/O interfacing with 8086. (L3)

**Unit 5**

8259 interfacing: Interrupt structure of 8086, Vector Interrupt table and Interrupt Service routine, Introduction to DOS and BIOS Interrupts, 8259 PIC Architecture and Interfacing Cascading of Interrupt controller and its importance.

**Applications:** Interrupts are commonly used to service hardware timers, transfer data to and from storage (e.g., disk I/O) and communication interfaces (e.g., UART, Ethernet), handle keyboard and mouse events, and to respond to any other time-sensitive events as required by the application system.

**Learning Outcomes:**

- At the end of this unit students will be able to develop assembly language programs for different types of External and Internal interrupts. (L3)
- At the end of this unit students will be able to demonstrate 8259 interfacing with 8086. (L3)

**Text Books**

1. Ramesh S Gaonkar, Microprocessor Architecture Programming and Applications with the 8085, 6th edition, Penram International Publishing, 2013
2. K M Bhurchandi, A K Ray, Advanced Microprocessors and Peripherals, 3rd edition, McGraw Hill Education, 2017.
3. Microcontrollers and application, Ajay. V. Deshmukh, TMGH, 2005

**References**

1. The 8085 microprocessor: Architecture, programming and interfacing- K.Uday Kumar, B.S.Umashankar, 2008
2. D.V.Hall, Microprocessors and Interfacing. TMGH, 2nd edition.
3. Barry B.Brey, "The Intel Microprocessors: Architecture, Programming and Interfacing", PHI, 6th Edition.
4. Kenneth J. Ayala, The 8051 Microcontroller, 3rd edition, Cengage Learning, 2004.
4. The 8051 microcontrollers, architecture and programming and applications-K. Uma Rao, AndhePallavi, Pearson Education, 2009

SubjectCode	SubjectName	L	T	P	C
R20CSE-OE3105	AdvancedJavaProgramming (Open Elective /Job oriented Elective Course -1)	3	0	0	3

### Course Objectives:

1. Create GUI screens for standalone applications.
2. Understand the features of lambdas and streams.
3. Understand the different driver-specific database connections.
4. Implement server-side programming using Servlets.
5. Implement server-side programming using Java Server Pages (JSP).

### Course Outcomes:

1. Design GUI-based applications using panels and components.
2. Analyze the collections using Lambdas and Streams.
3. Implement JDBC connections using Java SQL packages.
4. Develop server-side programs using Servlets.
5. Implement JSP for session tracking and database handling.

### Unit 1: GUI Programming

Basics of Swing, Swing features, components and containers, event handling, various Swing components, writing Swing applications.

**Learning Outcomes:** Student will be able to

- Understand the fundamentals of GUI programming. (L2)
- Understand components and panels for user interface. (L2)
- Create standalone GUI components using Swing components. (L4)

### Unit 2: Lambdas & Streams

Functional interface, lambda expressions, scope, streams creation, collections, filtering, pipeline, lazy invocation, reduction, collect method.

**Learning Outcomes:** Student will be able to

- Understand the functional interface and expressions. (L2)
- Apply streams and lambdas for data collectors. (L4)
- Create filters and maps for generated collection data. (L4)

### Unit 3: Java Database Programming

Basics of Java database, JDBC architecture, different types of drivers of JDBC, establishing JDBC database connections, JDBC statements, ResultSet interface, RowSet interface, JDBC batch processing, exploring `java.sql.`, `javax.sql.`

**Learning Outcomes:** Student will be able to

- Understand fundamentals of SQL and its operations. (L2)
- Create JDBC drivers for different database vendors. (L4)
- Implement JDBC connections for CRUD operations. (L4)

### Unit 4: Java Servlet Programming

Servlet basics, types of servlet, servlet life cycle, HTTP request, HTTP response, servlet init parameters, ServletRequest, ServletConfig, ServletContext, session tracking, database handling.

**Learning Outcomes:** Student will be able to

- Understand the lifecycle of servlets. (L2)
- Implement HTTP request and response handling using HTTP Servlet APIs. (L4)
- Implement sessions and cookies using servlet APIs. (L4)

### Unit 5: Java Server Pages (JSP)

Basics of JSP, life cycle of JSP, scripting elements, implicit objects, directive elements, JSP actions: include and forward, session tracking, page redirection, database handling.

**Learning Outcomes:** Student will be able to

- Understand the lifecycle of JSP over Servlets. (L2)

- Implement scripting elements of JSP in web pages. (L4)
- Apply implicit objects and actions on server-side APIs. (L4)

**Text Books:**

1. *Web Technologies: HTML, JavaScript, PHP, Java, JSP, ASP.NET, XML and Ajax*, Black Book Paperback – 1 January 2009 by Kogent Learning Solutions Inc., Dreamtech Press; 1st edition.
2. *Java for Web Development* by Vivek Gupta & Sarika Agarwal, BPB Publications.

**Reference Books:**

1. *Java: How to Program*, 9th Edition by Paul Deitel & Harvey M. Deitel.
2. *Java 8 in Action: Lambdas, Streams, and Functional-style Programming* by Raoul-Gabriel Urma et al.

SubjectCode	SubjectName	L	T	P	C
R20CSE-OE3106	DevOps (Open Elective /Job oriented Elective Course -1)	3	0	0	3

#### Course Objectives:

1. Understand the fundamentals of DevOps.
2. Understand how DevOps improves collaboration and productivity by automating infrastructure.
3. Understand workflows and continuously measuring applications' performance.
4. Implement DevOps applications using CI/CD.
5. Understand the concept of session tracking mechanisms of DevOps in real-time applications.

#### Course Outcomes:

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

1. Understand principles and values of agile methodology.
2. Understand the architecture and ecosystem of DevOps.
3. Implement tool stack and adopt DevOps in real-time applications.
4. Analyze Continuous Integration and Continuous Deployment (CI/CD) pipelining for project implementation.
5. Analyze the performance of DevOps maturity models with respect to project assessment.

#### UNIT I:

Phases of Software Development Lifecycle, values and principles of agile software development.

#### UNIT II:

Fundamentals of DevOps: Architecture, deployments, orchestration, need, instances of applications, DevOps delivery pipeline, DevOps ecosystem.

#### UNIT III:

DevOps adoption in projects: Technology aspects, Agile capabilities, tool stack implementation, people aspect, processes.

#### UNIT IV:

CI/CD: Introduction to Continuous Integration, Continuous Delivery and Deployment, benefits of CI/CD, metrics to track CI/CD practices.

#### UNIT V:

DevOps Maturity Model: Key factors of DevOps maturity model, stages of DevOps maturity model, DevOps maturity assessment.

#### Text Books:

1. *The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations* by Gene Kim, John Willis, Patrick Debois, Jez Humble, 1st Edition, O'Reilly Publications, 2016.
2. *What is DevOps? Infrastructure as Code*, 1st Edition by Mike Loukides, O'Reilly Publications, 2012.

#### Reference Books:

1. *Building a DevOps Culture*, 1st Edition by Mandi Walls, O'Reilly Publications, 2013.
2. *The DevOps 2.0 Toolkit: Automating the Continuous Deployment Pipeline With Containerized Microservices*, 1st Edition by Viktor Farcic, CreateSpace Independent Publishing Platform Publications, 2016.
3. *Continuous Delivery: Reliable Software Releases Through Build, Test, and Deployment Automation*, 1st Edition by Jez Humble and David Farley, 2010.
4. *Achieving DevOps: A Novel About Delivering the Best of Agile and DevOps*.



SubjectCode	SubjectName	L	T	P	C
R20CSE-PE3101.1	ArtificialIntelligence (ProfessionalElective-1)	3	0	0	3

### Course Objectives:

1. Expose various AI application areas.
2. Introduce problem-solving techniques like state space search and other control strategic techniques.
3. Disseminate various logic techniques like predicate logic and propositional logic.
4. Demonstrate the applications of AI-based expert systems.
5. Elucidate probability theory and fuzzy logic.

### Course Outcomes:

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

1. Understand AI applications using different AI programming languages and tools.
2. Apply various search techniques and solve constraint satisfaction problems in AI.
3. Apply predicate and propositional logic techniques to solve problems in AI.
4. Summarize different reasoning techniques used to handle uncertain information in AI.
5. Analyze real-world problems for AI implementation and trace the dynamic behavior of systems.

### UNIT I: Introduction to Artificial Intelligence

Introduction, history, intelligent systems, foundations of AI, applications, tic-tac-toe game playing, development of AI languages, current trends in AI.

#### Learning Outcomes:

At the end of this module, students will be able to:

- Classify various AI applications. (L2)
- Apply the logic for tic-tac-toe game playing. (L3)
- List the AI languages. (L1)
- Outline the current trends in AI. (L2)

### UNIT II: Problem Solving

State-space search and control strategies: Introduction, general problem solving, characteristics of problems, exhaustive searches, heuristic search techniques, iterative-deepening A\*, constraint satisfaction.

Problem reduction and game playing: Introduction, problem reduction, game playing, alpha-beta pruning, two-player perfect information games.

#### Learning Outcomes:

At the end of this module, students will be able to:

- Demonstrate the state space search and control strategies techniques. (L2)
- Apply informed search and uninformed search techniques to problems. (L3)
- Identify problem reduction techniques. (L1)
- Develop game playing strategies using AI techniques. (L3)

### UNIT III: Logic Concepts

Introduction, propositional calculus, propositional logic, natural deduction system, axiomatic system, semantic tableau system in propositional logic, resolution refutation in propositional logic, predicate logic.

#### Learning Outcomes:

At the end of this module, students will be able to:

- Classify predicate and propositional logic techniques. (L2)
- Explain natural deduction system and axiomatic system. (L2)
- Explain semantic tableau system in propositional logic. (L2)

### UNIT IV: Knowledge Representation

Introduction, approaches to knowledge representation, knowledge representation using semantic networks, extended semantic networks for KR, knowledge representation using frames.

Expert systems and applications: Introduction phases in building expert systems, expert systems versus traditional systems, rule-based expert systems, application of expert systems, list of shells and tools.

### **Learning Outcomes:**

At the end of this module, students will be able to:

- Illustrate knowledge representation using semantic networks, extended semantic networks, and frames. (L2)
- List phases in building expert systems. (L1)
- Distinguish between expert systems and traditional systems. (L2)
- Develop rule-based expert systems. (L3)

### **UNIT V: Uncertainty Measure**

Probability theory: Introduction, probability theory, Bayesian belief networks, certainty factor theory.

Fuzzy sets and fuzzy logic: Introduction, fuzzy sets, fuzzy set operations, types of membership functions, multi-valued logic, fuzzy logic, linguistic variables and hedges, fuzzy propositions, inference rules for fuzzy propositions, fuzzy systems.

### **Learning Outcomes:**

At the end of this module, students will be able to:

- Apply probability approaches like Bayesian belief networks and certainty factor theory to address AI problems. (L3)
- Apply fuzzy sets and fuzzy logic operations to address uncertainty in AI. (L3)

### **Text Books:**

1. *Artificial Intelligence* by Saroj Kaushik, CENGAGE Learning.
2. *Artificial Intelligence: A Modern Approach*, 2nd ed., by Stuart Russell & Peter Norvig, PEARSON.

### **Reference Books:**

1. *Artificial Intelligence: Structures and Strategies for Complex Problem Solving* by George F. Luger, 5th ed., PEA.
2. *Introduction to Artificial Intelligence* by Wolfgang Ertel, Springer.
3. *Artificial Intelligence: A New Synthesis* by Nils J. Nilsson.
4. *Artificial Intelligence* by Rich Kevin Knight & Shiv Shankar B Nair, 3rd ed., TMH.
5. *Introduction to Artificial Intelligence* by Patterson, PHI.

SubjectCode	SubjectName	L	T	P	C
R20CSE-PE3101.2	Principles of Programming Languages (Professional Elective-1)	3	0	0	3

:

### Course Objectives:

1. To understand and describe the syntax and semantics of programming languages.
2. Understand the significance and implementation of programming languages in a compiler or interpreter.
3. To implement programs in imperative, functional, logical, and object-oriented programming languages.
4. Learn principles to design new programming languages.
5. Increase capacity to express programming concepts in alternative ways.

### Course Outcomes:

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

1. Understand data types, arrays, pointers, and control structures in various programming languages (L6).
2. Understand basic concepts of subprograms in various programming languages (L6).
3. Understand basic concepts of OOP, multithreading, and exception handling in various programming languages (L6).
4. Understand the basic knowledge of lambda calculus, functional programming languages, Programming with Scheme, Programming with ML (L2).
5. Understand the basic knowledge of logic programming, Prolog, and multi-paradigm languages (L2).

### Unit I:

Evolution of programming languages; names, variables, binding; type checking; scope rules; primitive data types; strings; array types; associative arrays; record types; union types; pointers and references; arithmetic expressions; overloaded operators; relational & Boolean expressions; statements & mixed mode assignments; control structures.

### Learning Outcomes:

Students should be able to:

- Apply the data types, declarations, and expressions in the languages (L3).
- Understand various control statements (L2).

### Unit II:

Subprograms & design issues; local reference; parameter passing; overloaded & generic methods; design issues for functions; semantics of call & return; implementing programs stack & dynamic local variables; nested subprograms; blocks; dynamic scoping.

### Learning Outcomes:

Students should be able to:

- Understand various parameter passing methods (L2).
- Apply scoping in various languages (L3).

### Unit III:

Object-orientation; design issues for OOP languages; implementation of object-oriented constructs; concurrency: semaphores, monitors, message passing, threads, statement-level concurrency, exception handling, event handling.

### Learning Outcomes:

Students should be able to:

- Understand various concurrency techniques (L2).
- Apply object-oriented concepts in real-time applications (L3).

### Unit IV:

Introduction to lambda calculus; fundamentals of functional programming languages; programming with Scheme; programming with ML.

**Learning Outcomes:**

Students should be able to:

- Understand the fundamental concepts of functional programming languages (L2).

**Unit V:**

Introduction to logic programming overview; basics of Prolog; applications of logic programming; programming with Prolog; multi-paradigm languages.

**Learning Outcomes:**

Students should be able to:

- Learn how to implement expert systems with Prolog (L2).
- Understand the usage of predicate calculus in logic programming languages (L2).

**Text Books:**

1. Robert W. Sebesta, *Concepts of Programming Languages*, Tenth Edition, Addison-Wesley 2012.
2. Allen B. Tucker & Robert E. Noonan, *Programming Languages: Principles & Paradigms*, 2nd Edition, TMH.

**References:**

1. R. Kent Dybvig, *The Scheme Programming Language*, Fourth Edition, MIT Press, 2009.
2. Jeffrey D. Ullman, *Elements of ML Programming*, Second Edition, Prentice Hall, 1998.
3. W. F. Clocksin & C. S. Mellish, *Programming in Prolog: Using the ISO Standard*, Fifth Edition, Springer, 2003.

This structured overview provides clarity on the objectives and outcomes while maintaining a professional format suitable for academic purposes.

SubjectCode	SubjectName	L	T	P	C
R20CSE-PE3101.3	AdvancedDataStructures (ProfessionalElective-1)	3	0	0	3

#### Course Objectives:

- To demonstrate the importance of internal and external sorting techniques.
- Describe the various implementations of hashing techniques, variants of trees, heaps, queues, and analysis.
- To deal with optimal, efficient binary search trees and multi-way trees.
- To create awareness on digital search trees, binary tries, and Patricia tries.

#### Course Outcomes:

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

1. Analyze external sorting techniques on large data.
2. Apply static hashing and dynamic hashing on dictionaries.
3. Apply priority queues in real-time applications.
4. Implement balanced search trees for efficient searching.
5. Implement multi-way search trees for database indexing.

#### UNIT I: Sorting

Basic concepts of sorting including:

- Sorting by insertion (Insertion sort)
- Selection (Heapsort)
- Exchange (Bubblesort, Quicksort)
- Distribution (Radix sort)
- Merging (Mergesort)

**External Sorting:** Introduction to external sorting, K-way merging, buffer handling for parallel operation, run generation, optimal merging of runs.

#### Learning Outcomes:

Students should be able to:

- Understand various internal sorting techniques. (L2)
- Understand external sorting techniques with some examples. (L2)
- Understand differences between internal and external sorting techniques. (L2)
- Implement K-way merging techniques. (L6)

#### UNIT II: Hashing

Introduction to hashing:

- Static hashing

- Hash table
- Hash functions
- Secure hash function
- Overflow handling
- Theoretical evaluation of overflow techniques
- Dynamic hashing: motivation for dynamic hashing, dynamic hashing using directories, directory-less dynamic hashing.

#### **Learning Outcomes:**

Students should be able to:

- Understand the hashing techniques for dictionaries. (L2)
- Implement various techniques of hashing. (L6)
- Identify the differences between directory-less and directory-oriented concepts. (L2)

### **UNIT III: Priority Queues (Heaps)**

Model and simple implementation of priority queues:

- Binary heap: structure property, heap-order property
- Basic heap operations and other heap operations
- Applications of priority queues: selection problem, event simulation problem
- Binomial queues: structure and operations

#### **Learning Outcomes:**

Students should be able to:

- Understand the concepts of binary heaps and binomial queues. (L2)
- Apply heap techniques in priority queues. (L4)

### **UNIT IV: Efficient Binary Search Trees**

Optimal binary search trees, AVL trees, red-black trees:

- Definition and representation of a red-black tree
- Searching a red-black tree
- Inserting into a red-black tree
- Deletion from a red-black tree
- Joining and splitting red-black trees
- Introduction to splay trees

#### **Learning Outcomes:**

Students should be able to:

- Understand different balanced binary search trees like AVL, OBST, and red-black trees. (L2)

- Apply data structures such as AVL, red-black, and optimal binary search trees for faster searching in directories. (L4)

## **UNIT V: Multiway Search Trees**

M-way search trees:

- Definition and properties
- Searching an M-way search tree
- B-trees: definition and properties, number of elements in a B-tree
- Insertion into B-tree
- Deletion from a B-tree
- B+-trees: definition, searching a B+-tree, insertion into a B+-tree, deletion from a B+-tree

### **Learning Outcomes:**

Students should be able to:

- Understand the concepts of B-trees and B+-trees. (L2)
- Apply data structures such as M-way search trees, B-trees, and B+-trees in database indexing. (L4)

### **Text Books:**

1. *Data Structures: A Pseudocode Approach* by Richard F. Gilberg & Behrouz A. Forouzan, Cengage.
2. *Fundamentals of Data Structures in C*, 2nd ed., by Horowitz, Sahani & Anderson-Freed, Universities Press.
3. *Data Structures and Algorithm Analysis in C*, 2nd Edition by Mark Allen Weiss, Pearson.

### **Reference Books:**

1. [LCM - Data Structures](#)
2. [Utubersity Data Structures](#)
3. [Free Video Lectures - C Programming and Data Structures](#)
4. [Free Video Lectures - Data Structures And Algorithms](#)
5. *File Structures: An Object-Oriented Approach with C++*, 3rd ed., by Michel J. Folk et al.
6. *C and Data Structures: A Snapshot-Oriented Treatise with Live Examples from Science and Engineering* by N.B. Venkateswarlu & E.V. Prasad, S.Chand, 2010.

SubjectCode	SubjectName	L	T	P	C
R20CSE-PE3101.4	AdvancedOperatingSystems (ProfessionalElective-1)	3	0	0	3

### Course Objectives:

- Learn various issues in distributed operating systems.
- Discuss how deadlocks are handled in distributed operating systems.
- Provide various difficulties in shared memory and failure recovery mechanisms.
- Learn the basics of Linux systems and perform administrative tasks on Linux servers.
- Discuss multiprocessor and distributed database systems.

### Course Outcomes:

1. Understand the basics of distributed operating systems. (L2)
2. Analyze various deadlock handling mechanisms in a distributed environment. (L4)
3. Analyze different load balancing and fault recovery algorithms. (L4)
4. Understand Linux and Android operating systems. (L2)
5. Evaluate multiprocessor and distributed database systems. (L5)

### UNIT I: Introduction to Operating Systems

Introduction to OS, types of OS, OS services and functions, architectures of distributed systems – system architecture types, issues in distributed operating systems, theoretical foundations – inherent limitations of a distributed system, Lamport's logical clocks, vector clocks, causal ordering of messages, global state, termination detection. Distributed mutual exclusion – introduction, classification of mutual exclusion and associated algorithms, comparative performance analysis.

#### Learning Outcomes:

- Understand various architectures of distributed systems. (L2)
- Analyze how clocks play an important role in a distributed environment. (L4)
- Understand how messages are ordered. (L2)
- Analyze various associated algorithms for mutual exclusion. (L4)

### UNIT II: Distributed Deadlock Detection

Distributed deadlock detection – introduction, deadlock handling strategies in distributed systems, issues in deadlock detection and resolution, control organizations for distributed deadlock detection – centralized and distributed deadlock detection algorithms, hierarchical deadlock detection algorithms. Agreement protocols – introduction, system model, classification of agreement problems, solutions to the Byzantine agreement problem, applications of agreement algorithms. Distributed resource management – introduction, architecture, mechanism for building distributed file systems, design issues, log-structured file systems.

#### Learning Outcomes:

- Understand various deadlock handling strategies in distributed systems. (L2)
- Analyze various deadlock detection algorithms. (L4)
- Analyze various mechanisms to build distributed file systems. (L4)

### UNIT III: Distributed Shared Memory

Distributed shared memory – architecture and algorithms for implementing DSM, memory coherence and protocols, design issues. Distributed scheduling – introduction, issues in load distributing, components of a load distributing algorithm, stability, load distributing algorithm performance comparison, selecting a suitable load sharing algorithm, requirements for load distributing, task migration and associated issues. Failure recovery and fault tolerance – introduction, basic concepts, classification of failures, backward and forward error recovery, recovery in concurrent systems.

#### Learning Outcomes:

- Understand about distributed shared memory and protocols. (L2)



- Analyze various components of a load distributing algorithm. (L4)
- Compare the performance of various load distributing algorithms. (L2)
- Understand synchronous and asynchronous checkpointing and recovery in concurrent systems. (L2)

#### **UNIT IV: Linux System**

Linux system – components of Linux; interprocess communication; synchronization; interrupts; exceptions; system calls.

**Android Software Platform:** Android architecture; operating system services; Android runtime application development; application structure; application process management.

#### **Learning Outcomes:**

- Understand about the Linux operating system. (L2)
- Understand about Android operating systems. (L2)

#### **UNIT V: Multiprocessor Operating Systems**

Basic multiprocessor system architectures; interconnection networks for multiprocessor systems; caching; hypercube architecture.

**Multiprocessor Operating System:** Structures of multiprocessor operating systems; operating system design issues; threads; process synchronization and scheduling.

**Distributed Database Systems:** Concurrency control algorithms – introduction, basic synchronization primitives, lock-based algorithms, timestamp-based algorithms, optimistic algorithms.

#### **Learning Outcomes:**

- Understand about multiprocessor operating systems. (L2)
- Analyze various concurrency control mechanisms in distributed database systems. (L4)

#### **Text Books:**

1. Mukesh Singhal & Niranjana G. Shivaratri, *Advanced Concepts in Operating Systems: Distributed, Database and Multiprocessor Operating Systems*, TMH, 2001.

#### **Reference Books:**

1. Andrew S. Tanenbaum, *Modern Operating Systems*, PHI, 2003.
2. Pradeep K. Sinha, *Distributed Operating System - Concepts and Design*, PHI, 2003.

SubjectCode	SubjectName	L	T	P	C
R20CSE-PC3104	DataMiningandDataWareHouse(DMDW) Lab	0	0	3	1.5

**Course Objectives:**

- Practical exposure on implementation of well-known data mining tasks.
- Exposure to real-life data sets for analysis and prediction.
- Learning performance evaluation of data mining algorithms in a supervised and unsupervised setting.
- Handling a small data mining project for a given practical domain.

**Course Outcomes:**

1. Understand the environment of the Weka tool and prepare datasets.
2. Apply various pre-processing techniques on datasets.
3. Analyze various classification algorithms.
4. Apply association rule mining to various datasets to extract patterns.
5. Analyze various clustering algorithms.

**System/Software Requirements:**

- Intel-based desktop PC
- Weka Tool

**Demonstrations:**

1. Demonstration of preprocessing on dataset `student.arff`.
2. Demonstration of preprocessing on dataset `labor.arff`.
3. Demonstration of classification rule process on dataset `student.arff` using J48 algorithm.
4. Demonstration of classification rule process on dataset `employee.arff` using J48 algorithm.
5. Demonstration of classification rule process on dataset `employee.arff` using ID3 algorithm.
6. Demonstration of classification rule process on dataset `employee.arff` using Naïve Bayes algorithm.
7. Demonstration of association rule process on dataset `contactlenses.arff` using Apriori algorithm.
8. Demonstration of association rule process on dataset `test.arff` using Apriori algorithm.
9. Demonstration of clustering rule process on dataset `iris.arff` using Simple K-Means.
10. Demonstration of clustering rule process on dataset `student.arff` using Simple K-Means.

**Applications:**

1. Financial Analysis
2. Biological Analysis
3. Scientific Analysis
4. Intrusion Detection
5. Fraud Detection
6. Research Analysis

SubjectCode	SubjectName	L	T	P	C
R20CSE-PC3105	ObjectOrientedAnalysis&Design(OOAD)Lab	0	0	3	1.5

#### **COURSE OBJECTIVES:**

1. Focus on design rather than implementation.
2. Design static and dynamic parts of the system using UML diagrams.
3. Obtain case study experience with architecture, analysis, and design.
4. Gain programmatic interactions using UML diagrams and OOP.

#### **COURSE OUTCOMES:**

1. Develop a detailed case study with architecture, analysis, and design.
2. Develop Use Case and Class diagrams for the given application.
3. Develop sequence and collaboration diagrams for the given application.
4. Build Activity diagrams and State Chart diagrams for the given application.
5. Design Component and Deployment diagrams for the given application.

#### **Case Studies:**

- Point-Of-Sale Terminal
- Library Management System
- Traffic Management

#### **Week 1:**

- Understanding usage of Rational Rose or Umbrello.

#### **For Each Case Study:**

#### **Weeks 2, 3 & 4:**

- a) Identify and analyze events.
- b) Identify Use Cases.
- c) Develop event table.
- d) Identify & analyze domain classes.
- e) Represent use cases and a domain class diagram using Rational Rose.
- f) Develop CRUD matrix to represent relationships between use cases and problem domain classes.

#### **Weeks 5 & 6:**

- a) Develop Use Case diagrams.
- b) Develop elaborate Use Case descriptions & scenarios.
- c) Develop system sequence diagrams.

#### **Weeks 7, 8, 9 & 10:**

- a) Develop high-level sequence diagrams for each use case.

- b) Identify MVC classes/objects for each use case.
- c) Develop detailed Sequence Diagrams / Communication diagrams for each use case showing interactions among all three-layer objects.
- d) Develop three-layer package diagrams for each case study.

**Weeks 11 & 12:**

- a) Develop Use Case Packages.
- b) Develop component diagrams.
- c) Identify relationships between use cases and represent them.
- d) Refine domain class model by showing all the associations among classes.

**Weeks 13 Onwards:**

1. Develop sample diagrams for other UML diagrams - State Chart diagrams, Activity diagrams, and Deployment diagrams.

**Reference Books:**

1. *Applying UML and Patterns* by Craig Larman, Pearson.
2. *Object-Oriented Analysis and Design with Applications* by Grady Booch, Jacobson, Rumbaugh.
3. *Object-Oriented Analysis & Design with the Unified Process* by Satzinger, Jackson & Burd, Cengage Learning.

SubjectCode	SubjectName	L	T	P	C
R20BSH-SC3102	Employability Skills-2 (Soft Skillcourse)	0	1	2	2

### Course Objectives

- Encourage use of a wide range of grammatical structures and vocabulary in speech and writing
- Demonstrate good writing skills for effective paraphrasing, argumentative essays, and formal correspondence
- Provide training and opportunities to develop fluency in English through participation informal group discussions and presentations using audio-visual aids
- Knowing the best practices at the workplace to perform well in the interview.
- Encouraging smart self-learning, communication skills that focus on employability.

### Course Outcomes

1. understand the grammatical forms of English and the use of these forms in specific communicative and career context
2. use a wide range of reading comprehension strategies appropriate to texts, to retrieve information
3. strengthen their ability to write paragraphs, essays, emails and summaries
4. improve their speaking ability in English both in terms of fluency and comprehensibility by participating in Group discussion and oral assignments
5. prepare their own resume and answer interview related questions unhesitatingly with acceptable soft skills

#### Unit 1 Preparing for Written Assessment [6 Hours]

**Grammar: Articles:** Know how to use different types of Articles, use articles appropriately in context Identify errors in the use of articles, **Prepositions:** Learn to use prepositions in context, Identifying errors in the use of prepositions, Look at the different functions of Prepositions, **Tenses:** understand the different form of tense used in sentences, know the various purposes of using different Tense forms, Use appropriate tense forms of verbs in context, Identify the errors in the use of tense forms.

**Soft Skills: Leadership:** Introduction to Leadership, Leadership Power, Leadership Styles, Leadership in Administration. **Interpersonal Relations:** Introduction to Interpersonal Relations, Analysis of different ego states, Analysis of Transactions, Analysis of Strokes, Analysis of Life position

#### Unit 2 Reading Comprehension [6 Hours]

**Purposes & Strategies of Reading:** know the general purpose of Reading, assess your skills of reading, develop reading Strategies **Skimming for details:** Skim through a variety of passages, understand how skimming will orient you to the text, **Identifying main Ideas:** Identify the main ideas in the give text, Look for supporting statements in a passage, understand how the writer supports main ideas with details **Scanning for information:** Scan passages for factual information, understand how scanning can help find certain answers quickly, know how to look for factual answers, **drawing inferences:** Understand how to draw inferences, infer meanings while reading passages, **vocabulary:** Learn strategies to understand difficult words used in the passage, Apply strategies of reading to understand a variety of passages, **practise tests**

**Soft Skills: Communication:** Introduction to Communication, Flow of Communication, Listening, Barriers of Communication, How to overcome barriers of communication. **Stress Management:** Introduction to Stress, Causes of Stress, Impact Stress, Managing Stress

### Unit 3 Writing paragraphs & Essays [6 Hours]

**Features of Good Writing:** understand what makes a piece of writing good, Analyze & discuss some samples of good & bad writing, **Gathering Ideas:** Discuss various techniques for gathering ideas before you start writing, practice some of the techniques that can be used in the Prewriting stage, **Purposes of Writing:** understand the importance of purpose of writing, explore various purpose of writing, choose content & language based on the purpose **Writing for Specific audience:** Study ways of tailoring content to suit a target audience, analyze text to deduce the target audience, discuss how language is used to suit the target audience **organizing ideas:** understand the importance of organizing ideas in a text, Learn the different ways of organizing ideas, practice organizing ideas while writing **Soft Skills: Group Dynamics and Team Building:** Importance of groups in organization, Interactions in group, Group Decision Taking, Team Building, Interaction with the Team, How to build a good team?

### Unit 4 Preparing for oral Assignment [6 Hours]

**Group Discussion:** Group Discussions as a tool for selection, skills for GD, Leadership & Problem-Solving Skills, Types of GD, Group Dynamics, Roles & Functions: Beginning, Presenting, Elaborating, Roles & Functions: Clarifying, Synthesizing & Challenging, Roles & Functions: Agreeing, Disagreeing & Summarizing., Etiquette: Body Language & Time Management, GD Activities

**Soft Skills: Conflict Management:** Introduction to Conflict, Causes of Conflict, Managing Conflict **Time Management:** Time as a Resource, Identify Important Time Wasters, Individual Time Management Styles, Techniques for Better Time Management.

### Unit 5 Interview Skills [6 Hours]

**Purpose of interviews:** Know what recruiters looking for during Interviews, Become familiar with the process of career search, understand your skills, interests, achievements and attitude better **Preparing a Resume:** Understand what a job application is, know the details to be included in a CV, Know how to lay out details of a CV & prepare CV on your own **Writing a Cover Letter:** Study the information which is included in a cover letter. Learn how to organize information in a cover letter, **Before and at the interview:** Learn how to prepare for an interview, learn how to behave during the interview, discuss what the interviewer might assess you on **Answering FAQs about yourself & your families:** Learn how to answer questions about yourself & family, Learn how to identify & talk about your strengths and Weaknesses **Answering FAQs about Soft Skills: Motivation:** Introduction to Motivation, Relevance and types of Motivation, Motivating subordinates, Analysis of Motivation

### ASSESSMENT

The learners will demonstrate their knowledge and abilities through completion of the following required assessments while or at the end of this course — 4 Quizzes, 5 GD, 4 Activities on Interview Readiness and Soft Skills, 1 Personal Interview

#### **Grammar & Vocabulary Quizzes: (20M)**

4 Quizzes are conducted on Grammar and Vocabulary. The Quiz consists of 50 questions and will be scaled down to 10 Marks. Maximum duration of the quiz is 50 Minutes only and it is Computer Based Test (CBT)

#### **Writing: (20M)**

The writing consists of Personal Inquisitive Questions (PIQ), Paragraph Writing, Picture Perception Discussion Test (PPDT), Essay Writing and Statement of Purpose (SOP)

#### **Job Skills: (60M)**

Since the course outcome demands students' job readiness, this part of the assessment emphasizes **their skill of preparing a Resume and Visume, participating in a GD, Self Analysis through Case Study etc.,** to ace the job interview.

**Resume:(10M)**

Each student is required to submit 2 independently written Resumes along with a Cover Letter and a Statement of Purpose during the course. (SOP by assuming the candidate is applying for Higher Education Abroad).

**GD:(25M)**

Each student has to perform **4** Group Discussions during the course on a peer evaluation basis which fetches them **10 Marks each**.

The Final Assessment through one formal GD in the External Examination is for 10 marks.

The obtained score will be scaled down to **25 Marks**.

**The GD will be assessed on the following criteria :**

- Content (3M)
- Body Language(2M)
- Group dynamics & Leadership Skills (3M)
- Communication Skills (2M)

**PI & Soft Skills:25M** Student will be assessed on

- Presentation of his/her Readiness of Interview (Grooming) with Prepared Visume(**10M**)
- Aptitude based/Case Study based /Behaviour based Questions (**10M**)
- Soft Skills Activity (**10M**)

**Personal Interview (PI) /Activities on Interview Readiness:(20M)**

The External Examiners assess on Interview readiness

**Tell something about Yourself (10M)**

Assessment Parameters:

- Initiation
- Confidence level
- Body Language
- Attention Grabbing

**JAM/Face to Face Interview (10M):**

Student will be given a topic on-Spot for JAM and will be assessed by the External examiner on

- Flow of Speech
- Accuracy and Language
- Confidence

**Grading:**

Writing	G&V	Job Skills	Total
/20	/20	/60	/100

**Pass Criterion:**

1. Student has to Secure **40%** to pass this examination
2. Student who has an achievement certificate of any National or International Level Quiz/Psychometric Analysis, he/she has to secure a Minimum **30 Marks** in this examination (**Certificate+30 Marks**) to pass the summative exam.
3. Clearing all categories is mandatory. Need to get **60%** in each category.
4. **30M** +Certificate=Successful or **40M**+No certificate=Successful



SubjectCode	SubjectName	L	T	P	C
R20CSE-HN3101	TCP/IP Protocol Suite (Honors Courses 2: Track-1)	3	1	0	4

### Course Objectives:

1. To understand the architecture and principles of today's Internet.
2. To understand the various protocols and their functionalities.
3. To understand congestion and Quality of Service (QoS).
4. To understand queue management.
5. To understand the requirements for the future Internet and its impact on computer network architecture.

### Course Outcomes:

1. Understand different reference models and networking devices. (L2)
2. Analyze the various protocols and IP addressing. (L4)
3. Illustrate different methods to handle congestion control. (L3)
4. Analyze queue and buffer management. (L4)
5. Analyze Stream Control Transmission Protocol (SCTP). (L4)

### UNIT I: Overview of Network Models

- Layered tasks, the OSI model, layers in the OSI model, TCP/IP protocol suite, addressing.
- Connecting devices: passive hubs, repeaters, active hubs, bridges, two-layer switches, routers, three-layer switches, gateways, and backbone networks.

### Learning Outcomes:

Students should be able to:

- Acquire knowledge on the basic arrangement of nodes (computers) in the network. (L2)
- Analyze the structure of layers in the network OSI and TCP/IP reference models. (L4)

### UNIT II: Internet Protocols

- Properties of the Internet, Internet architecture, interconnection through IP routers.
- TCP, UDP & IP: TCP services, TCP features, segment, a TCP connection, flow control, error control, congestion control, process-to-process communication.
- User Datagram Protocol (UDP), checksum, UDP operation, IP datagram, fragmentation, options.
- IP addressing: classful addressing, IPv6.

### Learning Outcomes:

Students should be able to:

- Acquire knowledge on different protocols. (L2)
- Analyze the IP addressing scheme. (L4)
- Analyze the header formats. (L4)

### UNIT III: Congestion and Quality of Service

- Data traffic, congestion, congestion control in TCP, congestion control in Frame Relay.
- Source-based congestion avoidance, DEC bit scheme.
- Quality of Service (QoS), techniques to improve QoS: scheduling, traffic shaping, admission control, resource reservation, integrated services and differentiated services.

### Learning Outcomes:

Students should be able to:

1. Acquire knowledge on congestion control. (L2)
2. Analyze how to improve Quality of Service. (L4)



#### **UNIT IV: Queue Management**

- Concepts of buffer management: Drop Tail, Drop Front, Random Drop.
- Passive buffer management schemes; drawbacks of Passive Queue Management (PQM).
- Active Queue Management: Early Random Drop, Random Early Detection (RED) algorithm.

#### **Learning Outcomes:**

Students should be able to:

1. Acquire knowledge on queue management. (L2)
2. Analyze PQM. (L4)

#### **UNIT V: Stream Control Transmission Protocol**

- SCTP services, SCTP features, packet format.
- Flow control, error control, congestion control.

**Mobile Network Layer:** Entities and terminology; IP packet delivery; agents; addressing; agent discovery; registration; tunneling and encapsulating; inefficiency in Mobile IP.

#### **Learning Outcomes:**

Students should be able to:

1. Acquire knowledge on Stream Control Transmission Protocol. (L2)
2. Analyze how the IP packet delivery process works. (L4)

#### **Text Books:**

1. Behrouz A Forouzan, *TCP/IP Protocol Suite*, TMH, 3rd Edition.
2. B.A. Forouzan, *Data Communication & Networking*, TMH, 4th Edition.

#### **References:**

1. Mahbub Hasan & Raj Jain, *High Performance TCP/IP Networking*, PHI - 2005.
2. Douglas E. Comer, *Internetworking with TCP/IP*, Volume I PHI.
3. Larry L. Peterson & Bruce S. Davie, *Computer Networks: A Systems Approach*, 2011, Morgan Kaufmann.

SubjectCode	SubjectName	L	T	P	C
R20CSE-HN3102	SecureCoding (Honors Courses 2: Track-2)	3	1	0	4

### Course Objectives:

1. To understand the security development process.
2. Knowledge of the outline of the techniques for developing a secure application.
3. To handle dynamic memory management effectively.
4. Knowledge on stored procedures and XSS attacks.
5. Acquire knowledge on software architecture and design.

### Course Outcomes:

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

1. Analyze secure systems and various security principles. (L2)
2. Understand the development process of software that leads to secure coding practices. (L2)
3. Apply secure programs and various risks in dynamic memory management. (L3)
4. Understand XSS-related attacks and remedies. (L2)
5. Understand various software architecture models. (L2)

### UNIT I: Introduction

- Need for secure systems, proactive security development process, security principles to live by, and threat modeling.

### Learning Outcomes:

Students should be able to:

- Understand the need for secure systems. (L2)
- Analyze the security development process. (L4)
- Analyze various threats in secure systems. (L4)

### UNIT II: Secure Coding in C

- Character strings, string manipulation errors, string vulnerabilities and exploits, mitigation strategies for strings, pointers, mitigation strategies in pointer-based vulnerabilities, buffer overflow vulnerabilities.

### Learning Outcomes:

Students should be able to:

- Describe the string manipulation errors. (L2)
- Analyze string buffer overflow vulnerabilities. (L4)
- Analyze mitigation strategies for strings. (L4)

### UNIT III: Secure Coding in C++ and Java

- Dynamic memory management, common errors in dynamic memory management, memory managers, double-free vulnerabilities, integer security, mitigation strategies.

### Learning Outcomes:

Students should be able to:

- Analyze errors in dynamic memory management. (L4)
- Analyze double-free vulnerabilities. (L4)
- Apply integer security to various applications. (L3)

### UNIT IV: Database and Web Specific Input Issues

- Quoting the input, use of stored procedures, building SQL statements securely, XSS-related attacks and remedies.

### Learning Outcomes:

Students should be able to:

- Understand stored procedures. (L2)

- Implement SQL statements related to security. (L5)
- Analyze XSS attacks and remedies. (L4)

#### **UNIT V: Software Security Engineering**

- Requirements engineering for secure software: misuse and abuse cases, SQUARE process model, software security practices and knowledge for architecture and design.

#### **Learning Outcomes:**

Students should be able to:

- Describe misuse and abuse cases in requirements engineering. (L2)
- Understand software security practices. (L2)
- Understand software architecture and design. (L2)

#### **Text Book:**

1. Michael Howard & David LeBlanc, *Writing Secure Code*, Microsoft Press, 2nd Edition, 2003.

#### **Reference Books:**

1. Robert C. Seacord, *Secure Coding in C and C++*, Pearson Education, 2nd Edition, 2013.
2. Julia H. Allen et al., *Software Security Engineering: A Guide for Project Managers*, Addison-Wesley Professional, 2008.

SubjectCode	SubjectName	L	T	P	C
R20CSE-HN3103	AngularJSFramework (Honors Courses 2: Track-3)	3	1	0	4

### Course Objectives:

- To understand the model-view framework for building applications.
- Create modules for binding the application.
- Understand dependency injection for implementing services.
- Create and establish routes, redirects, and navigation.
- Validate forms for the submission of data.

### Course Outcomes:

1. Create Angular components using Angular dependencies.
2. Apply data binding objects for implementing modules.
3. Create services and retrieve REST call data.
4. Understand routes and their configuration in Angular.
5. Implement form handling with event-driven apps.

### Unit I: Angular JS

- Introduction to Angular JS, JavaScript vs Angular, MVC Framework, Component-Based Model.
- Setting up Angular: Installation of Node and NPM, Angular CLI, creating and running projects, dependencies, AppComponent, anatomy of a component, creating components.

### Learning Outcomes:

Students will be able to:

- Understand the MVC framework for building applications. (L2)
- Understand the installations of Node, NPM, and Angular. (L2)
- Create components using Angular dependencies. (L4)

### Unit II: Data Binding

- Introduction to data binding, types of binding, binding data from components.
- Async, template interpolation, looping with ngFor, condition with ngIf.
- Passing inputs and variables to components, ngModel for 2-way binding, ngOnInit, styling with components, creating multiple modules.

### Learning Outcomes:

Students will be able to:

- Understand data binding for components. (L2)
- Implement looping and decision-making for components. (L4)
- Create components and modules for binding data from the applications. (L4)

### Unit III: Dependency Injection

- Understanding Dependency Injection (DI), services.
- Creating a service, service injection context, REST calls with HttpClient, building Angular projects.

### Learning Outcomes:

Students will be able to:

- Understand dependency injection and its types. (L2)
- Create REST-based calls from the client using HttpClient. (L4)
- Create an Angular project by building Angular services. (L4)

### Unit IV: Routing & Wrap Up

- Introduction to routing in Angular projects.
- Creating routes, route redirects and wildcards, configuring child routes, navigation for routes.

**Learning Outcomes:**

Students will be able to:

- Understand routing with Angular. (L2)
- Create and redirect routes for navigation. (L4)
- Implement wildcards and wrap up for building an Angular project. (L4)

**Unit V: Form Handling**

- Introduction to form handling, form validation using ng-minlength, ng-maxlength, ng-pattern, ng-required.
- Submitting forms and event handling with forms.

**Learning Outcomes:**

Students will be able to:

- Understand the working of forms and their validations. (L2)
- Implement event handling methods for form submissions. (L4)

**Applications:**

1. Online web applications
2. Financial and banking applications
3. Online and social media applications

**Text Books:**

1. *Angular 6 by Example: Get Up and Running with Angular by Building Modern Real-world Web Apps*, 3rd Edition by Chandermani Arora.
2. *Pro Angular 6*, Apress by Adam Freeman.

**Reference Books:**

1. *Angular JS* by Green, O'Reilly.
2. *Professional AngularJS* by Valeri Karpov.

Subject Code	Subject Name	L	T	P	C
R20CSE-HN3104	Mathematical Essential for Data Science (Honors Courses 2: Track-4)	3	1	0	4

#### Course Objectives:

- To introduce the various mathematical concepts and models, and provide skills required to implement the models.
- To undertake a critical evaluation of a wide range of numerical and data.
- To develop designing skills for modeling non-deterministic problems.

#### Course Outcome:

1. Apply linear algebra in data science problems
2. Apply decompose the matrices to solve data science problems.
3. Demonstrate the data analysis using regression models.
4. Apply the optimization techniques to data science models.
5. Demonstrate with illustrative examples using sampling theory in data science models.

#### Unit-1

**Linear Algebra (All theorems without Proofs):** Introduction to Data Science. Importance of Mathematics in Data Science. Vector spaces and subspaces, basis and dimensions, rank, null space, linear transformations, basic properties-invertible linear transformation, matrices of linear transformations. Inner products space, orthogonality, orthonormal basis, Gram-Schmidt orthogonalisation.

#### Unit-2

**Matrix Decompositions:** The LU decomposition, The Cholesky decomposition, QR decomposition, Singular value decomposition (SVD), Eigen values and Eigen vectors using the power method.

#### Unit-3

**Regression:** Linear Models: Simple Linear Regression, Multiple Regression Generalized Linear Models: Logistic Regression, Poisson Regression, other Generalized Linear Models: Survival Analysis, Nonlinear Models: Splines, Decision- Random Forests.

#### Unit-4

**Optimization** Jacobian, hessian, convex sets, convex functions and its properties, Unconstrained and Constrained optimization, Lagrange's Method, Kuhn-tucker conditions, Numerical optimization techniques for constrained and unconstrained optimization: Newton's method, Steepest descent method, Penalty function method. Linear Programming Problems, Simplex Method.

#### Unit-5

**Statistics and Hypothesis Testing:** Basic Fundamentals of Sampling, Simple Random Sampling, Stratified Random Sampling, Bootstrap Methodology, Sampling distributions and Functions of random variables, Statistical inference, Methods of point estimation of parameters, Point and confidence interval estimation, and test of hypothesis, Test of hypothesis for attributes and, t-distributions, p-values, Z-scores, z-tests, and t-tests.

#### Text Books

1. Jin Ho Kwak and Sungpyo Hong, Linear Algebra, Second edition Springer(2004)(For Unit-1).
2. Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press, 2020.
3. Matthias Dehmer, Salissou Moutari, Frank Emmert-Streib, Mathematical Foundations of Data Science Using R, De Gruyter Oldenbourg, 2020(for Unit-5).
4. Norman Matloff, Probability and Statistics for Data Science: Math + R + Data, CRC Data Science Series, 2019.
5. S.D.Sharma, Operations Research, Kedar Nath Ram Nath & Co. Meerut(for Unit-4)

6. Jared P. Lander, R for Everyone Advanced Analytics and Graphics, , Pearson(Unit-3)
7. D. S. Watkins, Fundamentals of Matrix Computation, 2nd Edition, Wiley, 2002(Unit-2)
8. William G. Cochran, Sampling Techniques, John Willey, 1977(for Unit-5).

#### **References**

1. Bradley Efron, R.J. Tibshirani, An introduction to the bootstrap, Chapman and Hall/CRC 1994.
2. D. G. Luenberger and Y. Ye, Linear and Nonlinear Programming, 3rd Edn., Springer, 2010.
3. Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining, Introduction to Linear Regression Analysis by (Wiley).
4. E. K. P. Chong and S. H. Zak, An Introduction to Optimization, 2nd Edn., Wiley India Pvt. Ltd., 2010.
5. G. James, D. Witten, T. Hastie and R. Tibshirani, An Introduction to Statistical Learning: with Applications in R (Springer Texts in Statistics), Springer, 2013.
6. Gene H. Golub, Charles F. Van Loan, Matrix Computations, The Johns Hopkins University Press, 2013.
7. Heumann, Christian, Schomaker, Michael, Shalabh, Introduction to Statistics and Data Analysis With Exercises, Solutions and Applications in R, Springer 2016
8. Irwin Miller, Marylees Miller, Probability and Statistics for Engineers.
9. J. Nocedal and S. J. Wright, Numerical Optimization. New York: Springer Science+Business Media, 2006.
10. J. S. Rosenthal, A First Look at Rigorous Probability Theory (Second Edition). Singapore: World Scientific Publishing, 2006.
11. C.R. Rao, H. Toutenburg, Shalabh, and C. Heumann, Linear Models and Generalizations - Least Squares and Alternatives (Springer, 2008)
12. Nathan Carter, Data Science for Mathematicians, CRC Press, Taylor & Francis Group, 2021.
13. Norman R. Draper, Harry Smith ,Applied Regression Analysis ,Wiley
14. P.S.R.S. Rao, Sampling Methodologies and Applications, Chapman and Hall/ CRC
15. Pierre Lafaye de Micheaux, RémyDrouilhet, Benoît Lique, The R Software-Fundamentals of Programming and Statistical Analysis -, Springer 2013
16. Robert V. Hogg. Allen T. Craig, Introduction to. Mathematical. Statistics, Pearson Education
17. S. Axler, Linear Algebra Done Right (Third Edition). Springer International Publishing, 2015.
18. W.G. Cochran, Sampling Techniques : Wiley
19. Trevor Hastie, Robert Tibshirani, Jerome Friedman, Data Mining, Inference, and Prediction, Springer.
20. W John Braun, Duncan J Murdoch, A First Course in Statistical Programming with R, Cambridge University Press 2008.
21. W. Cheney, Analysis for Applied Mathematics. New York: Springer Science+Business Medias, 2001.

### III Year -II Semester

SubjectCode	SubjectName	L	T	P	C
R20CSE-PC3201	ComputerNetworks	3	0	0	3

#### CourseObjectives:

1. understand the contemporary technologies in network protocols and network architecture
2. To acquire the knowledge on design principles of network infrastructure. the basics Physical layer and their functionality
3. Understand the functionalities of the Data Link Layer and their protocols..
4. Understand the functionalities of the Network Link Layer and routing Algorithms
5. Analyze different protocols in Application Layer.

#### CourseOutcomes:

1. Understand the different types of network topologies, various Reference models
2. Analyze network performance metrics and data transmission Techniques..
3. Analyze different data link layer framing techniques and Link Layer Protocols..
4. Analyze the medium access techniques and different routing algorithms
5. Understand various Application layer protocols

#### Unit 1: Introduction

- **Overview of Data Communications System:**
  - Components of a data communication system
  - Data flow
  - Network topologies: LAN, MAN, WAN
- **Reference Models:**
  - The OSI Reference Model
  - The TCP/IP Reference Model

#### Learning Outcomes:

Students will be able to:

- Understand the components involved to form a computer network. (L2)
- Understand the data flow in a computer network and the use of protocols. (L2)
- Analyze the importance of each layer in the reference models. (L4)

#### Applications:

- Conceptual framework of a network
- ATM systems
- Online reservation systems

#### Unit 2: Physical Layer and Overview of PL Switching

- **Transmission Media:**
  - Guided and unguided media
  - Bandwidth, throughput, latency
- **Multiplexing Techniques:**
  - Frequency division multiplexing
  - Wavelength division multiplexing
  - Synchronous time division multiplexing
  - Statistical time division multiplexing



**Learning Outcomes:**

Students will be able to:

- Understand the connecting devices. (L2)
- Analyze different types of multiplexing. (L4)
- Understand the performance metrics of a network. (L3)

**Applications:**

- Identify the use of different devices in real-time computer networks and data processing tasks.

**Unit 3: Data Link Layer Design Issues**

- **Data Link Layer:**
  - Design issues
  - Framing: fixed size framing, variable size framing
  - Flow control, error control, error detection and correction, CRC
- **Elementary Data Link Layer Protocols:**
  - Simplex protocol, Simplex stop and wait protocol for noisy channels
  - Sliding window protocol: one bit, Go Back N, Selective Repeat
  - Data link layer in HDLC: configuration and transfer modes

**Learning Outcomes:**

Students will be able to:

- Understand data link layer services to the network layer. (L2)
- Understand error correction and detection techniques. (L2)
- Apply detecting codes for sample data. (L3)

**Applications:**

- Error correction and detecting procedures on binary data.

**Unit 4: Random Access and Network Layer**

- **Random Access Techniques:**
  - ALOHA, MAC addresses
  - Carrier Sense Multiple Access (CSMA), CSMA with Collision Detection, CSMA with Collision Avoidance
- **Network Layer:**
  - Routing algorithms: shortest path routing, flooding, hierarchical routing, broadcast, multicast, distance vector routing
- **Transport Layer:**
  - Addressing, establishing a connection, releasing connection, flow control and buffering, crash recovery
  - End-to-end protocols: UDP

**Unit 5: Application Layer (WWW and HTTP)**

- **Architecture:**
  - Client (Browser), Server, Uniform Resource Locator (URL)
- **HTTP:**
  - HTTP transaction, HTTP operational model and client/server communication
  - HTTP generic message format, HTTP request message format, HTTP response message format

**Learning Outcomes:**

Students will be able to:

- Understand the data link layer protocols. (L2)
- Understand which protocols are used for noisy and noiseless channels. (L2)

**Applications:**

- Used to implement data transfer and collision detection mechanisms.

**Text Books:**

1. Behrouz A Forouzan, *Data Communications and Networking*, Fourth Edition.
2. Andrew S. Tanenbaum & David J. Wetherall, *Computer Networks*, 5th Edition, Pearson Education, 2010.

**Reference Books:**

1. Behrouz A Forouzan & Firouz Mosharraf, *Computer Networks: A Top Down Approach*, McGraw Hill Education.
2. Larry L. Peterson & Bruce S. Davie, *Computer Networks: A Systems Approach*, 5th Edition, Morgan Kaufmann/Elsevier, 2011.
3. Jochen Schiller, *Mobile Communications*, Pearson, 2nd Edition.

Subject Code	Subject Name	L	T	P	C
R20CSE-PC3202	Compiler Design	3	0	0	3

### Course Objectives:

- To teach concepts of language translation and phases of compiler design
- To describe the common forms of parsers
- To inculcate knowledge of parser by parsing LL parser and LR parser
- To demonstrate intermediate code using technique of syntax directed translation
- To Illustrate the various optimization techniques for designing various optimizing compiler

### Course Outcomes:

1. Understand phases of compiler and regular expressions.
2. Analyze recursive and non-recursive predictive parsing techniques.
3. Analyze Bottom-up parsers and handling ambiguities in grammar
4. Understand semantic analysis and storage organization.
5. Analyze intermediate code generation techniques and code optimization.

### UNIT-I:

Overview of language processing – preprocessors – compiler – assembler – interpreters – linkers & loaders - structure of a compiler – phases of a compiler. Lexical Analysis – Role of Lexical Analysis – Lexical Analysis Vs. Parsing – Token, patterns and Lexemes – Lexical Errors – Regular Expressions – Regular definitions for the language constructs – Strings, Sequences, Comments – Transition diagram for recognition of tokens, Reserved words and identifiers, Examples.

**Learning outcomes:** Student should be able to

- Analyze the differences between different translators. [L4]
- Differentiate the various phases of a compiler. [L4]
- Understands the role of parser. [L2]
- Designing lexical analyzer for the programming phrase. [L6]

### UNIT-II:

Syntax Analysis – Role of a parser – classification of parsing techniques – Top down parsing – First and Follow- LL (1) Grammars, Non-Recursive predictive parsing – Error recovery in predictive parsing.

**Learning outcomes:** Student should be able to

- Understand the differences between Top-Down and Bottom-Up parsing techniques. [L2]
- Apply parsing techniques to design Top-Down parser. [L3]
- Understand the error recovery in Top-Down parsing. [L2]

### UNIT -III:

Introduction to simple LR – Why LR Parsers – Model of an LR Parsers – Operator Precedence- Shift Reduce Parsing – Difference between LR and LL Parsers, Construction of SLR Tables.

More powerful LR parses, construction of CLR (1), LALR Parsing tables, Dangling ELSE Ambiguity, Error recovery in LR Parsing.

**Learning outcomes:** Student should be able to

- Understand the model of LR parser. [L2]
- Apply parsing techniques to design Bottom-Up parser. [L3]
- Understand the error recovery in Bottom-Up parsing. [L2]

### UNIT-IV

Semantic analysis, SDT, evaluation of semantic rules, symbol tables, use of symbol tables.

Runtime Environment: storage organization, stack allocation, access to non-local data, heap management, parameter passing mechanisms.

**Learning outcomes:** Student should be able to

- Apply syntax directed translation techniques. (SDT) [L3]
- Understand the structure of symbol table. [L2]
- Understand the storage organization. [L2]

#### **UNIT-V:**

Intermediate code, three address code, quadruples, triples, abstract syntax trees, basic blocks, CFG. Machine independent code optimization - Common sub expression elimination, constant folding, copy propagation, dead code elimination, strength reduction, loop optimization, procedure inlining.

Machine dependent code optimization: Peephole optimization, register allocation, instruction scheduling, inter procedural optimization, garbage collection via reference counting.

**Learning outcomes:** Student should be able to

- Design intermediate code for various statements and expressions. [L6]
- Design data flow graph and to optimize the data flow graph. [L6]
- Design code generator and apply code optimization techniques. [L6]

#### **Text Books:**

1. Compilers, Principles Techniques and Tools- Alfred V Aho, Monical S Lam, Ravi Sethi, Jeffrey D. Ullman, 2<sup>nd</sup>ed, Pearson, 2007.
2. Principles of compiler design, V. Raghavan, 2<sup>nd</sup>ed, TMH, 2011.
3. Principles of compiler design, 2<sup>nd</sup>ed, Nandini Prasad, Elsevier

#### **Reference Books:**

1. <http://www.nptel.iitm.ac.in/downloads/106108052/>
2. Compiler construction, Principles and Practice, Kenneth C Loudon, CENGAGE
3. Implementations of Compiler, A new approach to Compilers including the algebraic methods, Yunlinsu, SPRINGER

Subject Code	Subject Name	L	T	P	C
R20CSE-PC3203	Design and Analysis Algorithms	3	0	0	3

### Course Objectives:

The course is designed to

- Discuss performance analysis of algorithms.
- Familiarize with different algorithm design techniques
- Explain the selection of appropriate data structure and algorithm for a specified problem and its impact on performance
- Explain algorithm design techniques like greedy method, divide & conquer, dynamic programming, backtracking and branch & bound.
- Introduce complexity classes P, NP, NP-Complete and NP Hard problems.

### Course Outcomes:

1. Analyze the performance of algorithms in terms of space, time, and Amortized Complexity
2. Apply the Divide and Conquer techniques.
3. Apply the greedy paradigm and dynamic programming methods for analysis of algorithms.
4. Apply back tracking and dynamic-programming paradigms for the analysis of algorithms
5. Apply branch and bound paradigms for the analysis of algorithms

### UNIT-1

**Introduction:** Algorithm, Algorithm specification, Performance analysis, Space Complexity, Time Complexity, Asymptotic Notations, Practical Complexities

**At the end of the module, students will be able to:**

- Identify the criteria of an algorithms(L1)
- Analyze space requirements of a problem(L4)
- Analyze running times of algorithms using asymptotic notations(L4)

### UNIT II

Divide and Conquer: General method, Binary Search, Finding the maximum and minimum, Merge sort, Quick Sort, Selection, Strassen's matrix multiplication

**At the end of the module, students will be able to:**

- generating algorithms for intractable problems(L6)
- Apply linear and binary searches(L3)
- Compare complexities of Merge sort , quick sort and selection sort techniques(L1)

### UNIT III

**Greedy Method:** General method, Knapsack problem, Job Scheduling with Deadlines, Minimum cost Spanning Trees, Optimal storage on tapes, Optimal merge patterns, Single-source shortest paths.

**Dynamic programming:** General Method, Multistage graphs, All-pairs shortest paths, Optimal binary search trees, 0/1 knapsack, The traveling salesperson problem, Reliability Design. Basic Traversal and Search Techniques: Techniques for binary trees, Techniques for Graphs, Connected components and Spanning trees, Bi-connected components and DFS

**At the end of the module, students will be able to:**

Implementing Greedy method and multistage graphs(L3)  
Create minimum spanning trees(L6)

### UNIT IV

**Back tracking:** General Method, 8 – queens problem, Sum of subsets problem, Graph coloring and Hamiltonian cycles, Knapsack Problem

**At the end of the module, students will be able to:**

- Apply 8-queen problem using back tracking(L3)
- Apply algorithms for graph coloring and knapsack problem(L3)

#### **UNIT V**

**Branch and Bound:** The method, Travelling salesperson, 0/1 Knapsack problem, Efficiency considerations.

**Lower Bound Theory:** Comparison trees, Lower bounds through reductions – Multiplying triangular matrices, Inverting a lower triangular matrix, Computing the transitive closure.

At the end of the module, students will be able to:

- Explain Branch and Bound concept(L2)
- Explain Model Travelling salesperson, 0/1 Knapsack problem using Branch and Bound Method(L2) Explain the lower bound theory concept(L2)

#### **Text Books**

1. Ellis Horowitz, Sartaj Sahni and Rajasekaran, Fundamentals of Computer Algorithms, 2nd Edition, 2012, University Press.
2. Parag Himanshu Dave and Himanshu Bhalchandra Dave, Design and Analysis of Algorithms, Second Edition, Pearson Education.

#### **References**

1. Anany Levitin, “Introduction to the Design and Analysis of Algorithms”, Third Edition, Pearson Education, 2012.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, “Introduction to Algorithms”, Third Edition, PHI Learning Private Limited, 2012.
3. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson Education, Reprint 2006.
4. Donald E. Knuth, “The Art of Computer Programming”, Volumes 1 & 3 Pearson Education, 2009. Steven S. Skiena, “The Algorithm Design Manual”, Second Edition, Springer, 2008.
5. <http://nptel.ac.in/>

Subject Code	Subject Name	L	T	P	C
R20CSE-PE3201.1	Distributed Systems (Professional Elective-2)	3	0	0	3

#### Course Objectives:

1. Understand how systems will communicate through network and to understand the Architectural design of Distributed Systems.
2. Understand and apply the various communication techniques and analyze the network IP address allocation.
3. Understand the Local and Remote procedure calls between processes
4. Understand the role of operating Systems in Distributed Communication and the different technologies used for file sharing in Distributed Systems.
5. Apply Distributed algorithms for communication and to understand the Distributed Deadlocks and Replication requirement..

#### Course Outcomes:

1. Understand the characteristics of Distributed architecture.
2. Apply inter process communication in a distributed environment..
3. Apply standard protocols (RMI& RPC) in distributed systems.
4. Understand the fundamentals of Distributed File systems
5. Analyze the mutual exclusions, transactions and replications in distributed systems.

**Characterization of Distributed Systems:** Introduction, Examples of Distributed Systems, Resource Sharing and the Web, Challenges.

**System Models:** Introduction, Architectural Models- Software Layers, System Architecture, Variations, Interface and Objects, Design Requirements for Distributed Architectures, Fundamental Models- Interaction Model, Failure Model, Security Model.

**Learning Outcomes:** student will be able to

- Outline the characteristics of file systems.(L2)
- Understand the challenges of system models.(L2)
- Understand the Design Requirements of Distributed Architecture.(L2)

#### Unit 2:

**Interprocess Communication:** Introduction, The API for the Internet Protocols- The Characteristics of Interprocess communication, Sockets, UDP Datagram Communication, TCP Stream Communication; External Data Representation and Marshalling; Client Server Communication; Group Communication- IP Multicast- an implementation of group communication, Reliability and Ordering of Multicast.

**Learning Outcomes:** Student will be able to

- Understand the Inter process communication. (L2)
- Apply the TCP stream communication.(L3)
- Outline IP Multicast and its ordering.(L2)

#### Unit 3:

**Distributed Objects and Remote Invocation:** Introduction, Communication between Distributed Objects- Object Model, Distributed Object Model, Design Issues for RMI, Implementation of RMI, Distributed Garbage Collection; Remote Procedure Call, Events and Notifications, Case Study: JAVA RMI

**Learning Outcomes:** Student will be able to

- Understand the communication between objects.(L2)
- Apply Java RMI to different applications.(L3)
- Experiment with Remote Procedure call.(L3)

#### **Unit 4:**

**Operating System Support:** Introduction, The Operating System Layer, Protection, Processes and Threads –Address Space, Creation of a New Process, Threads.

**Distributed File Systems:** Introduction, File Service Architecture; Peer-to-Peer Systems: Introduction, Napster and its Legacy, Peer-to-Peer Middleware, Routing Overlays.

**Learning Outcomes:** Student will be able to

- Understand Operating system Layers.(L2)
- Illustrate the file server Architecture.(L2)
- Understand Peer to Peer Middleware Routing.(L2)

#### **Unit 5:**

**Coordination and Agreement:** Introduction, Distributed Mutual Exclusion, Elections, Multicast Communication.

**Transactions & Replications:** Introduction, System Model and Group Communication, Concurrency Control in Distributed Transactions, Distributed Dead Locks, Transaction Recovery; Replication-Introduction, Passive (Primary) Replication, Active Replication.

**Learning Outcomes:** Student will be able to

1. Compare coordination and Agreement.(L2)
2. Understand system Model and Group communication.(L2)
3. Summarize the challenges of Replication.(L2)

#### **Text Books:**

1. Ajay D Kshemkalyani, MukeshSigal, “Distributed Computing, Principles, Algorithms and Systems”,Cambridge
2. George Coulouris, Jean Dollimore, Tim Kindberg, “Distributed Systems- Concepts and Design”, Fourth Edition, PearsonPublication

#### **Reference Books**

1. Distributed-Systems-Principles-Paradigms-Tanenbaum PHI



Subject Code	Subject Name	L	T	P	C
R20CSE-PE3201.2	Web Services (Professional Elective-2)	3	0	0	3

### Course Objectives:

- Understand web services and Service oriented architecture (SOA).
- Implement java generic classes and annotations.
- Implement java persistence using JSON and XML Parsers.
- Implement XML Web services using WSDL and JAX-WS.
- Implement RESTFul Web Services using JAX-RS.

### Course Outcomes:

1. Understand the importance of Web Services and Service Oriented Architecture.
2. Implement Java Generic data Structures and Annotations.
3. Implement object persistence using different APIs.
4. Apply XML Web Services using JAX-WS APIs.
5. Apply RESTFul Web Services using JAX-RS APIs..

### Unit 1:

**Introduction to Web Services** - Introduction to Web Services, Web Service Architecture, Applications of Web Services, Distributed Computing VS Web Services, Service Registries, Service Discovery, UDDI Architecture, UDDI Data Model, Service Oriented Architecture (SOA).

**Learning Outcomes:** student will be able to

- Understand Web Service Architecture (L2).
- Understand Service discovery and registry through UDDI (L2).
- Understand Web Services architecture and its role in services. (L2).

### Unit 2:

**Generics &Annotations:**Generics in Java, Advantages of generics, Generic Classes, Type Parameters, Wild Cards, Nested Collections, Annotations, Annotation Elements, Built-in Annotations, Custom Annotations.

**Learning Outcomes:**student will be able to

- Understand java generics and annotations (L2).
- Implement Wild cards for generic types and classes (L4).
- Implement Custom annotations and for complex java classes. (L4).

### Unit 3:

**Object Persistence:** XML, Rules of XML Document, XML Schema and Namespace, Marshalling and UnMarshalling XML document using JAXB, DOM Parser, JSON Object, JSON Array, Serializing and De-serializing JSON, JSON Parsing using Jackson APIs.

**Learning Outcomes:** Student will be able to

- Understand structure of XML document(L2).
- Implement XML parsers using JAXB APIs and DOM (L4).
- Implement JSON binding using JACKSON APIs (L4).

### Unit 4:

**SOAP Web Services:** Introduction to SOAP, SOAP Architecture, WSDL, Structure of WSDL, WSDL Document Elements: Definitions, Types, Message, Operation, portType, binding, port & services, Schema Types and Binding styles, Publishing SOAP Web Services, Consuming Web Services, Exploring javax.xml.ws.\*.

**Learning Outcomes:** Student will be able to

- Understand the structure of SOAP and WSDL (L2)
- Implement WSDL using JAX-WS APIs.(L4)

### **Unit 5:**

**RESTful Web Services:** Introduction to RESTful Web Services, HTTP Request & Response Header, HTTP Methods, Publishing and Consuming Rest based XML Web Services, Publishing and Consuming REST based JSON web services, Exploring JAX-RS through Jersey APIs: javax.ws.rs.\*.

**Learning Outcomes:** Student will be able to

- Understand RESTful Web Services and its structure. (L2)
- Analyze end point Web Services using JAX-RS. (L4)

#### **Text Books:**

1. Java, How to Program, 9<sup>th</sup> Edition, Dieitel&Deitel, 2012.
2. Java Web Services: Up and Running, 2<sup>nd</sup> Edition by Martin Kalin, 2013, Orielly Media.
3. Java XML and JSON, 2nd Edition, Jeff Friesen, Apress.

#### **Reference Books:**

1. XML, Web Services, and the Data Revolution, F.P.Coyle, Pearson Education.
2. Building web Services with Java, 2nd Edition, S. Graham and others, Pearson Education.
3. Java Web Services, D.A. Chappell & T. Jewell, O'Reilly, SPD.

Subject Code	Subject Name	L	T	P	C
R20CSE-PE3201.3	Human Computer Interaction (Professional Elective-2)	3	0	0	3

#### Course Objectives:

- To get student to think constructively and analytically about how to design and evaluate interactive technologies.
- Describe the various styles and interactive devices in designing.
- Analyze the quality and different strategies in language processing.
- Study the design principles and guidelines of HCI.
- Apply different search patterns on data.

#### Course Outcomes:

1. Understand the capabilities of interactive systems.
2. Understand the human-computer interaction (HCI) models
3. Apply an interactive design process and universal design principles to designing HCI systems.
4. Understand HCI design principles, standards and guidelines.
5. Analyzed tasks and dialogs of relevant HCI systems based on task analysis and dialog design.

#### Unit 1:

##### Introduction:

Usability of Interactive Systems- introduction, usability goals and measures, usability motivations, universal usability, goals for our profession

**Managing Design Processes:** Introduction, Organizational design to support usability, Four pillars of design, development methodologies, Ethnographic observation, Participatory design, Scenario Development, Social impact statement for early design review, legal issues, Usability Testing and Laboratories

**Learning Outcomes:** student will be able to

- Describe basic concepts of interactive systems.
- Analyze basic design and development methods.

**Applications:** useful for managing design process.

#### Unit 2:

##### Menu Selection, Form Fill-In and Dialog Boxes:

Introduction, Task- Related Menu Organization, Single menus, Combinations of Multiple Menus, Content Organization, Fast Movement Through Menus, Data entry with Menus: Form Fill-in, dialog Boxes, and alternatives, Audio Menus and menus for Small Displays.

**Interaction Devices:** Introduction, Keyboards and Keypads, Pointing Devices, Speech and Auditory Interfaces, Displays- Small and large.

**Learning Outcomes:** student will be able to

- Describe utilisation of menus & dialog boxes.
- Analyze the interactive devices.

**Applications:** useful for designing of menus & dialog boxes in newly developed user applications.

#### Unit 3:

**Command and Natural Languages:** Introduction, Command organization Functionality, Strategies and Structure, Naming and Abbreviations, Natural Language in Computing

**Quality of Service:** Introduction, Models of Response-Time impacts, Expectations and attitudes, User Productivity, Variability in Response Time, Frustrating Experiences

**Learning Outcomes:** student will be able to

- Describe structure & strategies of natural language computing.

- Analyzeworking quality of designed applications.

**Applications:** useful for verifying quality of service by taking certain parameters.

#### **Unit 4:**

Balancing Function and Fashion: Introduction, Error Messages, Non anthropomorphic Design, Display Design, Web Page Design, Window Design, Color

#### **User Documentation and Online Help:**

Introduction, Online Vs Paper Documentation, Reading from paper Vs from Displays, Shaping the content of the Documentation, Accessing the Documentation, Online tutorials and animated documentation, Online communities for User Assistance, The Development Process.

**Learning Outcomes:** student will be able to

- Analyzeand design different web pages.
- Analyzedocumentation generation.

**Applications:** useful for designing of different pages ,documentation for each application

#### **Unit 5:**

**Information Search:** Introduction, Searching in Textual Documents and Database Querying, Multimedia Document Searches, Advanced Filtering and Searching Interfaces Information Visualization: Introduction, Data Type by Task Taxonomy, Challenges for Information Visualization

**Learning Outcomes:**student will be able to

- Analysis of information search in textual documentation.

**Applications:**Easy to apply information search in all categories.

#### **Text Books:**

1. Designing the User Interface, Strategies for Effective Human Computer Interaction, 5ed, Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven M Jacobs, Pearson
2. The Essential guide to user interface design,2/e, Wilbert O Galitz, Wiley DreamaTech.

#### **Reference Books:**

- 1 Human Computer, Interaction Dan R.Olsan, Cengage ,2010.
2. Designing the user interface. 4/e, Ben Shneidermann, PEA.
3. User Interface Design, Soren Lauesen, PEA.
4. Interaction Design PRECE, ROGERS, SHARPS, Wiley

Subject Code	Subject Name	L	T	P	C
R20CSE-PE3201.4	Speech Processing (Professional Elective-2)	3	0	0	3

#### Course Objectives:

- To understand the speech production mechanism and the various speech analysis techniques.
- To understand the speech compression algorithms.
- To understand the speech recognition models.
- To understand the speaker recognition techniques.
- To know the speaker recognition and text to speech synthesis techniques.

#### Course Outcomes:

1. Understand speech analysis techniques and speech models.
2. Analyze speech compression techniques.
3. Analyze speech recognition techniques.
4. Design speaker recognition systems.
5. Design text to speech conversion systems.

#### UNIT-I:

**Speech Signal Characteristics & Analysis:** Speech production process - speech sounds and features - Phonetic Representation of Speech – representing speech in time and frequency domains - Short-Time Analysis of Speech - Short-Time Energy and Zero-Crossing Rate - Short-Time Autocorrelation Function - Short-Time Fourier Transform (STFT) - Speech Spectrum - Cepstrum - Mel-Frequency Cepstrum Coefficients - Hearing and Auditory Perception - Perception of Loudness - Critical Bands - Pitch Perception

**Learning outcomes:** Student should be able to

- Understand speech production process and speech features. (L2)
- Understand speech representation. (L2)
- Understand various speech models. (L2)

#### UNIT-II:

**Speech Compression:** Sampling and Quantization of Speech (PCM) - Adaptive differential PCM - Delta Modulation - Vector Quantization - Linear predictive coding (LPC) - Code excited linear predictive Coding (CELP)

**Learning outcomes:** Student should be able to

1. Analyze various speech compression techniques. (L4)

#### UNIT-III:

**Speech Recognition:** LPC for speech recognition - Hidden Markov Model (HMM)- training procedure for HMM- sub word unit model based on HMM- language models for large vocabulary speech recognition - Overall recognition system based on sub word units - Context dependent sub word units - Semantic post processor for speech recognition

**Learning outcomes:** Student should be able to

- Understand machine training procedure for speech recognition. (L2)
- Analyze various speech recognition models. (L4)

#### UNIT-IV:

**Speaker Recognition:** Acoustic parameters for speaker verification - Feature space for speaker recognition - similarity measures - Text dependent speaker verification - Text independent speaker verification techniques

**Learning outcomes:** Student should be able to

- Analyze feature space for speaker recognition. (L4)
- Design speaker recognition systems. (L5)

#### UNIT-V:

**Text To Speech Synthesis:** Text to speech synthesis (TTS) - Concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness-role of prosody

**Learning outcomes: Student should be able to**

- Analyze text to speech conversion algorithms. (L4)
- Design text to speech conversion systems. (L5)

**Text Books:**

1. L. R. Rabiner and R. W. Schafer, Introduction to Digital Signal Processing, Foundations and Trends in Signal Processing 2007.
2. Ben Gold and Nelson Morgan - Speech and Audio signal processing- processing and perception of speech and music, John Wiley and sons 2006.

**References**

1. Lawrence Rabiner, Biiing and– Hwang Juang and B.Yegnanarayana -Fundamentals of Speech Recognition, Pearson Education, 2009.
2. Claudio Becchetti and LucioPrinaRicotti -Speech Recognition, John Wiley and sons 1999.

SubjectCode	SubjectName	L	T	P	C
R20ECE-OE3203	VLSI (Open Elective/Job Oriented Course-2)	3	0	0	3

#### Course Objectives:

1. To understand the security development process.
2. Knowledge of the outline of the techniques for developing a secure application.
3. To handle dynamic memory management effectively.
4. Knowledge on stored procedures and XSS attacks.
5. Acquire knowledge on software architecture and design.

#### Course Outcomes:

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

1. Analyze secure systems and various security principles. (L2)
2. Understand the development process of software that leads to secure coding practices. (L2)
3. Apply secure programs and various risks in dynamic memory management. (L3)
4. Understand XSS-related attacks and remedies. (L2)
5. Understand various software architecture models. (L2)

#### UNIT I: Introduction to MOSFETs

- Introduction to IC technology, fabrication process: nMOS, pMOS, and CMOS.
- Ids versus Vds relationships, aspects of MOS transistor threshold voltage.
- MOS transistor transconductance, output conductance, and figure of merit.
- nMOS inverter, pull-up to pull-down ratio for nMOS inverter driven by another nMOS inverter, and through one or more pass transistors.
- Alternative forms of pull-up, the CMOS inverter, latch-up in CMOS circuits, Bi-CMOS inverter, comparison between CMOS and BiCMOS technology.

#### Applications:

- Used for switching and amplifying electronic signals in electronic devices.
- Can be used in electronic DC relays.

#### Learning Outcomes:

Students will be able to:

- Outline CMOS fabrication process flow and  $\lambda$ -based design rules. (L2)
- Explain the electrical parameters of MOS transistors. (L2)
- Demonstrate the driving parameters of inverters. (L2)

#### UNIT II: MOS and Bi-CMOS Circuit Design Processes

- MOS layers, stick diagrams, design rules and layout.
- General observations on design rules: 2 $\mu$ m double metal, double poly; CMOS/BiCMOS rules; 1.2 $\mu$ m double metal, double poly CMOS rules.
- Layout diagrams of NAND and NOR gates and CMOS inverter; symbolic diagrams translated to mask form.

#### Applications:

- Stick diagrams are useful for planning the layout and routing of integrated circuits.
- CMOS used in microcontrollers, static RAM, registers, microchips, and other digital circuits.

#### Learning Outcomes:

Students will be able to:

- Outline MOS design rules. (L2)
- Draw stick diagrams and layouts for MOS gates. (L3)

### **UNIT III: Scaling of MOS Circuits**

- Scaling models and scaling factors for device parameters.
- Limitations of scaling: substrate doping, depletion width, limits of miniaturization, limits of interconnects and contact resistances.
- Limits due to sub-threshold currents; limits on logic levels and supply voltage due to noise and current density.

#### **Applications:**

- Scaling scenarios for wire capacitance.
- Scaling results in the decrease of dimensions of a MOS device.
- Increases device density and functional capacity of the chip.

#### **Learning Outcomes:**

Students will be able to:

- Analyze scaling parameters on devices. (L4)
- Understand the factors affecting scaling on devices. (L2)
- Examine the various limitations that occur while scaling MOS devices. (L4)

### **UNIT IV: Digital Circuits Using CMOS**

- Pseudo NMOS, pass transistor, transmission gates, dynamic logic, domino logic, differential cascode voltage switch logic.
- Design of combinational circuits; design of sequential circuits; timing requirements.

**Programmable Logic Devices:** Introduction to PLA, PAL, standard cells, FPGAs, CPLDs.

#### **Applications:**

- Flash memory chip designing.
- Used to design application-specific integrated circuits (ASICs).

#### **Learning Outcomes:**

Students will be able to:

- Compare CMOS and pseudo-NMOS inverters with respect to area and speed. (L2)
- Compare TG logic and pass transistor logic gates. (L2)
- Compare static and dynamic logic styles. (L2)
- Understand performance of simple arithmetic circuits designed using CMOS. (L2)

### **UNIT V: Basics of Testing**

- Fault models; combinational logic and fault simulation; test generation for combinational circuits.
- Current sensing based testing; classification of sequential ATPG methods; fault collapsing and simulation.

**Design for Testability:** Scan design, partial scan, use of scan chains, boundary scan, built-in self-test (BIST), path sensitizing technique.

#### **Applications:**

- Ensure high yield and proper detection of faulty chips after manufacturing.
- Predictive study to ensure the produced version of the synthesized design will work to carry out the specified I/O operation.

#### **Learning Outcomes:**



Students will be able to:

- Explain the significance of testable design. (L2)
- Understand fabrication defects, errors, and faults. (L2)
- Compare combinational and sequential circuit test generation algorithms. (L2)

**Text Books:**

1. Kamran Eshraghian et al., *Essentials of VLSI Circuits and Systems*, Prentice-Hall of India Private Limited, 2005 Edition.
2. P.K. Lala, *Digital Circuit Testing and Testability*, Academic Press, 1997.

**Reference Books:**

1. Neil H.E. Weste & David Harris, *CMOS VLSI Design: A Circuits and Systems Perspective*, 4th Edition, Pearson Education, 2015.
2. Jan M.Rabaey et al., *Digital Integrated Circuits*, 2nd Edition, Pearson Education, 2003.

Subject Code	Subject Name	L	T	P	C
R20CSE-OE3206	Sales Force (Open Elective/Job Oriented Course-2)	3	0	0	3

#### Course Objectives:

1. Basic knowledge of Salesforce platform
2. Analyse the App Functionality
3. Improving the business work flow
4. Data access and security measures
5. Application deployment process and Different types of cloud integrations

#### Course Outcomes

1. Understand the functionality of CRM.
2. Analyze the Custom App Functionality and design the real world Apps.
3. Apply SOSL & SOQL Queries to improvise the business work flow.
4. Apply knowledge to prevent vulnerabilities in APEX & Visualforce..
5. Apply APEX integration services to synchronize salesforce data with external system.

#### Unit I

Introduction to Cloud, CRM, Cloud Models: SAAS, PAAS, IAAS, Trailhead and Trailblazer Community, Salesforce Platform Basics, Platform Development Basics, Customize a Salesforce Object, Data Modeling, Picklist Administration, Duplicate Management , Formulas and Validations

#### Unit II

Build a Data Model for Travel Approval App, Improve Data Quality for Recruiting App, Customize User Interface For Recruiting App, Lightning App Builder, Data Management, Leads and Opportunities for Lightning Experience, Quick Start Process Builder, Quick Start Lightning App Builder, Automate Business Process For Recruiting App, Build a Discount Approval Process

#### Unit III

Salesforce Flow, Flow Builder, Data Security, Keep Data Secure In Recruiting App, Apex Triggers, Apex Testing, Asynchronous Apex.

#### Unit IV

VS Code Setup, CLI Setup, API Basics, Event Monitoring, Shield Platform Encryption, Apex Integration Services

#### Unit V

**Super Badges-** Apex Specialist, Process Automation Specialist

#### Textbooks:

1. Learning Salesforce Development with APEX, Paul Battison
2. Practical Guide To Salesforce Communities, Philip Weinmeister, Apress

#### References:

1. <https://trailhead.salesforce.com>
2. <https://trailblazercommunitygroups.com>

SubjectCode	SubjectName	L	T	P	C
R20ECE-OE3204	<b>IndustrialInternetofThings(IOT)</b> <b>(Open Elective/Job Oriented Course-2)</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### Course Objectives:

1. To introduce the various steps involved in the MOS transistor fabrication of integrated circuits.
2. To explain the electrical properties of MOS devices.
3. To introduce design rules and scaling effects in CMOS technology.
4. To study the behavior of inverters designed with various loads.
5. To provide an overview of testing fundamentals and its testability design.

### Course Outcomes:

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

1. Explain the fabrication process and characteristics of a MOSFET. (L2)
2. Design stick and layout diagrams for various logic gates. (L3)
3. Analyze the effects of scaling on device parameters. (L4)
4. Design CMOS digital combinational logic circuits. (L3)
5. Explain the importance of testable design. (L2)

### UNIT I: Introduction to MOSFETs

- Introduction to IC technology, fabrication process: nMOS, pMOS, and CMOS.
- $I_{ds}$  versus  $V_{ds}$  relationships, aspects of MOS transistor threshold voltage.
- MOS transistor transconductance, output conductance, and figure of merit.
- nMOS inverter, pull-up to pull-down ratio for nMOS inverter driven by another nMOS inverter, and through one or more pass transistors.
- Alternative forms of pull-up, the CMOS inverter, latch-up in CMOS circuits, Bi-CMOS inverter, comparison between CMOS and BiCMOS technology.

### Applications:

- Used for switching and amplifying electronic signals in electronic devices.
- Can be used in electronic DC relays.

### Learning Outcomes:

Students will be able to:

- Outline CMOS fabrication process flow and  $\lambda$ -based design rules. (L2)
- Explain the electrical parameters of MOS transistors. (L2)
- Demonstrate the driving parameters of inverters. (L2)

### UNIT II: MOS and Bi-CMOS Circuit Design Processes

- MOS layers, stick diagrams, design rules and layout.
- General observations on design rules:  $2\mu\text{m}$  double metal, double poly; CMOS/BiCMOS rules;  $1.2\mu\text{m}$  double metal, double poly CMOS rules.
- Layout diagrams of NAND and NOR gates and CMOS inverter; symbolic diagrams translated to mask form.

### Applications:

- Stick diagrams are useful for planning the layout and routing of integrated circuits.

- CMOS used in microcontrollers, static RAM, registers, microchips, and other digital circuits.

### **Learning Outcomes:**

Students will be able to:

- Outline MOS design rules. (L2)
- Draw stick diagrams and layouts for MOS gates. (L3)

### **UNIT III: Scaling of MOS Circuits**

- Scaling models and scaling factors for device parameters.
- Limitations of scaling: substrate doping, depletion width, limits of miniaturization, limits of interconnects and contact resistances.
- Limits due to sub-threshold currents; limits on logic levels and supply voltage due to noise and current density.

### **Applications:**

- Scaling scenarios for wire capacitance.
- Scaling results in the decrease of dimensions of a MOS device.
- Increases device density and functional capacity of the chip.

### **Learning Outcomes:**

Students will be able to:

- Analyze scaling parameters on devices. (L4)
- Understand the factors affecting scaling on devices. (L2)
- Examine the various limitations that occur while scaling MOS devices. (L4)

### **UNIT IV: Digital Circuits Using CMOS**

- Pseudo NMOS, pass transistor, transmission gates, dynamic logic, domino logic, differential cascode voltage switch logic.
- Design of combinational circuits; design of sequential circuits; timing requirements.

**Programmable Logic Devices:** Introduction to PLA, PAL, standard cells, FPGAs, CPLDs.

### **Applications:**

- Flash memory chip designing.
- Used to design application-specific integrated circuits (ASICs).

### **Learning Outcomes:**

Students will be able to:

- Compare CMOS and pseudo-NMOS inverters with respect to area and speed. (L2)
- Compare TG logic and pass transistor logic gates. (L2)
- Compare static and dynamic logic styles. (L2)
- Understand performance of simple arithmetic circuits designed using CMOS. (L2)

### **UNIT V: Basics of Testing**

- Fault models; combinational logic and fault simulation; test generation for combinational circuits.
- Current sensing based testing; classification of sequential ATPG methods; fault collapsing and simulation.

**Design for Testability:** Scan design, partial scan, use of scan chains, boundary scan, built-in self-test (BIST), path sensitizing technique.

### **Applications:**

- Ensure high yield and proper detection of faulty chips after manufacturing.

- Predictive study to ensure the produced version of the synthesized design will work to carry out the specified I/O operation.

### **Learning Outcomes:**

Students will be able to:

- Explain the significance of testable design. (L2)
- Understand fabrication defects, errors, and faults. (L2)
- Compare combinational and sequential circuit test generation algorithms. (L2)

### **Text Books:**

1. Kamran Eshraghian et al., *Essentials of VLSI Circuits and Systems*, Prentice-Hall of India Private Limited, 2005 Edition.
2. P.K. Lala, *Digital Circuit Testing and Testability*, Academic Press, 1997.

### **Reference Books:**

1. Neil H.E. Weste & David Harris, *CMOS VLSI Design: A Circuits and Systems Perspective*, 4th Edition, Pearson Education, 2015.
2. Jan M.Rabaey et al., *Digital Integrated Circuits*, 2nd Edition, Pearson Education, 2003.

Subject Code	Subject Name	L	T	P	C
R20CSE-PC3204	Computer Networks Lab	0	0	3	1.5

**Course Objectives:**

1. To Understand working environment of Packet tracer..
2. To Identify and configure various networking devices and media
3. To Set up and manage LANs, IP addressing, subnetting, and routing.
4. To simulate real-world networking scenarios using Packet Tracer.

**Course Outcomes:** At the end of the Course the student shall be able to:

1. Understand Networking Components and Tools.
2. Apply Networking Topologies and Architectures in real time applications.
3. Analyse and Configure Network Protocols and IP Addressing Schemes.
4. Apply Network Security and Configuration Commands.
5. Design and Simulate Network Topologies Using Packet Tracer Software.

**Week 1:** Study of different types of network cables and practically implements the cross-wired cable and straight through cables using crimping tool.

**Week2:** Configuration of various topologies related to LANs and WANs Using Packet Tracer.

**Week3:** Study on Network Layer and data link layer using Packet Tracer

**Week 4:** Write a program to implement Bit Stuffing and Byte Stuffing.

**Week 5:** Write a program to implement CRC.

**Week 6:** Take an example subnet of hosts. Obtain broadcast tree for it.

**Week 7:** Implement Dijkstra's algorithm to compute the shortest path through a graph and Configure RIP using Packet tracer.

**Week 8:** Take an example subnet graph with weights indication delay between nodes. Now obtain Routing table at each node using distance vector routing algorithm.

**Week 9:** Configure a network using Link state Protocol OSPF using Packet Tracer.

**Week 10:** Configure DHCP on router using Packet Tracer.

**Week 11:** Configure VLAN Using Packet Tracer.

**References:**

1. [http://vlabs.iitb.ac.in/vlabs-dev/labs/ud/computer\\_network/labs/index.php](http://vlabs.iitb.ac.in/vlabs-dev/labs/ud/computer_network/labs/index.php)
2. <https://www.packettracernetwork.com/>  
<http://tutorials.ptnetacad.net/tutorials70.htm>

Subject Code	Subject Name	L	T	P	C
R20CSE-PC3205	Compiler Design Lab	0	0	3	1.5

### Course Objectives:

Course is designed to:

1. To teach concepts of language translation and phases of compiler design
2. To describe the common forms of parsers
3. To inculcate knowledge of parser by parsing LL parser and LR parser
4. To demonstrate intermediate code using technique of syntax directed translation
5. To illustrate the various optimization techniques for designing various optimizing compiler.

### Course outcomes:

1. Implement automatic lexical Analyzer using Lex tool..
2. Implement top-down parsing table using FIRST and FOLLOW functions.
3. Implement bottom-up parsing using FIRST, FOLLOW, LEADING and TRAILING functions.
4. Implement programs for loop unrolling and constant propagation
5. Implement general lexical analyzer..

### Lab Programs

1. Design a lexical analyzer for given language
2. Simulate First and Follow of a Grammar.
3. Develop an operator precedence parser for a given language.
4. Construct a recursive descent parser for an expression.
5. Construct a LL (1) parser for an expression
6. Design predictive parser for the given language
7. Implementation of shift reduce parsing algorithm.
8. Design a LALR bottom up parser for the given language.
9. Implement the lexical analyzer using lex tools.
10. Write a program to perform loop unrolling.
11. Write a program for constant propagation.

### References:

1. Leland L. Beck, System Software – An Introduction to Systems Programming, 3rd Edition, Pearson Education Asia, 2008.
2. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Compilers Principles, Techniques and Tools, Second Edition, Pearson.
3. B. W. Kernighan and D. M. Ritchie, The C Programming Language, Prentice-Hall
4. [https://www.ibm.com/support/knowledgecenter/en/ssw\\_aix\\_72/com.ibm.aix.genprog/ie\\_prog\\_4lex\\_yacc.htm](https://www.ibm.com/support/knowledgecenter/en/ssw_aix_72/com.ibm.aix.genprog/ie_prog_4lex_yacc.htm)

Subject Code	Subject Name	L	T	P	C
R20CSE-PC3206	Design and Analysis Algorithms Lab	0	0	3	1.5

### Course Objectives:

- To learn the importance of designing an algorithm in an effective way by considering space and time complexity
- To learn graph search algorithms.
- To study network flow and linear programming problems
- To learn the dynamic programming design techniques.
- To develop recursive backtracking algorithms.

### Course Outcomes:

After completing this course, the student will be able to:

1. Implement and analyze various sorting techniques
2. Apply iterative and recursive algorithms on graphs using searching and sorting methods
3. Design iterative and recursive algorithms on the concepts of dynamic programming.
4. Implement optimization algorithms for specific and real time applications.
5. Design and implement branch and bound algorithms for specific applications.

### Programs:

1. Sort a given set of elements using the Quick sort method and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted. The elements can be read from a file or can be generated using the random number generator.
2. Implement a Merge Sort algorithm to sort a given set of elements and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted. The elements can be read from a file or can be generated using the random number generator.
3. Compute the transitive closure of a given directed graph using Warshall's algorithm.
4. Implement 0/1 Knapsack problem using Dynamic Programming.
5. From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm
6. Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm.
7. Print all the nodes reachable from a given starting node in a digraph using BFS method.
8. Find a subset of a given set  $S = \{s_1, s_2, \dots, s_N\}$  of n positive integers whose sum is equal to a given positive integer d. For example, if  $S = \{1, 2, 5, 6, 8\}$  and  $d = 9$  there are two solutions  $\{1, 2, 6\}$  and  $\{1, 8\}$ . A suitable message is to be displayed if the given problem instance doesn't have a solution.
9. Implement any scheme to find the optimal solution for the Traveling Salesperson problem and then solve the same problem instance using any approximation algorithm and determine the error in the approximation.
10. Find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm.
11. Implement All-Pairs Shortest Paths Problem using Floyd's algorithm.
12. Implement N Queen's problem using Back Tracking.

### Text Books:

1. Levitin A, "Introduction to the Design And Analysis of Algorithms", Pearson Education, 2008.

### Reference Books

1. Goodrich M.T., R Tomassia, "Algorithm Design foundations Analysis and Internet Examples", John Wiley and Sons, 2006.
2. Base Sara, Allen Van Gelder, "Computer Algorithms Introduction to Design and Analysis", Pearson, 3rd Edition, 1999.



Subject Code	Subject Name	L	T	P	C
R20CSE-SC3201	Django Framework (Soft Skill Course)	0	1	2	2

**Course Objectives:**

1. To understand the fundamentals of Django Framework..
2. To implement Basic Templates for Client-side web pages.
3. To implement Django model objects for generating data processing..
4. To implement Django Forms for input processing and signals for profiles
5. To implement Serializers and Models using Rest APIs.

**Course Outcomes:**

1. Understand the environment of Django Web Server Framework.
2. Apply URL Mappings and Views using Templates.
3. Apply Django models for processing data from templates.
4. Implement Django Forms and Signals for creating customer profile..
5. Implement Restful APIs using Django Rest Framework.

**Django Frame Work-** Introduction to Django, Features of Django, Application areas of Django, Flask vs Django, Django Components, Install and Configure Django Components.

**Learning Outcomes:** student will be able to

- Understand the features and applications of Django .(L2)
- Install Django environment using pip installer. (L5)
- Understand Components and its structure. (L4)

**Unit 2**

**Django Templates:** URLs, Views, Static Files, Images, Forms, Application development using Templates, Template Objects, tags, Filters, Loops and Inheritance.

**Learning Outcomes:** Student will be able to

- Understand DjangoTemplate objects. (L2).
- Implement URLs and Views of Django applications. (L4).
- Implement loops and inheritance in templates. (L4).

**Unit 3**

**Django Models:** Introduction to Django Models, Admin Panel, Database Relationships, One-One, One- Many, Many-Many, Model Queries, Rendering Data to Templates, Dynamic URLs and Routing, CRUD operations.

**Learning Outcomes:** Student will be able to

- Understand the Django Models and Admin Panels (L2)
- Create relationships between multiple model objects.(L4)
- Implement routing for navigating URLs.(L4)

**Unit 4**

**Dynamic Forms & Signals:** Inline Form sets, Search Forms, User Registration and Login Authentication, User Roles & Permissions, User Profiles, Image Upload, Django Signals, Creating customer profiles with Django

**Learning Outcomes:** Student will be able to

- Create dynamic web pages using FormSets (L4)
- Create registration and authentication for user profiles (L4)
- Implement Django signals for creating customer profiles. (L4)

**Unit 5**

**Django Rest Frame Work:** Introduction to Django Rest Framework, Features of Rest APIs, Installation of Django Rest Framework, api\_view, Response, JSONResponse, Models and Serializers, PATH and urlpatterns, HTTP methods GET, POST, PUT and DELETE methods

**Learning Outcomes:** Student will be able to

- Understand Django Rest framework and its packages.(L2)
- Implement Models and Serializers for rest api. (L4)
- Create GET, POST, PUT and DELETE calls using rest framework package. (L4)

**Text Books**

1. DjangoRESTful Web Services: The easiest way to build Python RESTful APIs by Gaston C Hillar , Packt>
2. Building Website with Django, 1 Edition, by AwanishRanjan

**Reference Books**

1. Light Weight Django by O'Reilly Media, by Julia Elman and Mark Lavin
2. Python Web Development with Django, by O'Reilly – Paul Bissex and Jeff Forcier

Subject Code	Subject Name	L	T	P	C
<b>R20BSH-MC3203</b>	<b>Intellectual Property Rights &amp; Patents (Mandatory Course)</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>

#### **Course Objectives:**

1. Provide awareness about Intellectual Property Rights.
2. Analyze the aspects of rights afforded by Copyrights and its infringements.
3. Assess the importance of inventions through Patent law in domestic and International markets
4. Evaluation of protection of Trade Marks by the study of domestic and International aspects of law..
5. Measure the commercial value of Trade Secrets and the state law application and in International aspects. Discuss the consequences of cyber crimes under IT Act ,2000 in India.

#### **Course Outcomes:**

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

1. Outline on basic concepts of Intellectual Property and International Law
2. Adapt principles and rights afforded by Copyright and its infringement
3. Interpret Patent registration requirements, process and new developments
4. Summarize Registration Process of Trademarks and global factors related to trademarks
5. Discuss trade Secrets requirements and cyber laws

#### **UNIT-I**

Introduction to Intellectual Property Rights (IPR): Introduction to IPRs, Basic concepts and need for Intellectual Property – International Instruments and IPR - WIPO - TRIPS – WTO - Laws Relating to IPR

IPR Tool Kit - Agencies for IPR Registration – Emerging trends in IPR - Use and Misuse of Intellectual Property Rights

Application: Applicability and relativity between elements of Intellectual property rights and creating innovative ideas.

#### **Learning Outcomes:**

At the end of this unit student will be able to:

- Understand the knowledge about the elements of IPR (L2)
- Learn International Instruments and emerging areas of IPR (L1)
- List the Agencies responsible for Registration and laws related to IPR (L1)

#### **UNIT-II**

Copyrights and Neighboring Rights: Introduction to Copyrights – Principles of Copyright Protection – Law Relating to Copyrights Subject Matters of Copyright – Copyright Ownership – Transfer and Duration

Right to Prepare Derivative Works – Rights of Distribution – Rights of Performers – Copyright Registration – Limitations – Infringement of Copyright – Relief and Remedy – Semiconductor Chip Protection Act.

Application: Practice of copyrights case and Identification of the infringement to the owner of the copyright.

#### **Learning Outcomes:**

At the end of this unit student will be able to:

- Understand how one can generate economic wealth through copyrights (L2)
- Understand the importance of protection, promotion and enforcement of copy rights (L2)
- List the limitations and Infringement of Copyrights (L2)

## **UNIT III: Patents**

### **Introduction to Patents**

#### **• Overview:**

- Introduction to patents
- Laws relating to patents in India
- Patent requirements
- Patent search
- Patent registration and granting of patent
- Ownership and transfer
- Infringement of patents
- Compulsory licensing
- Patent Cooperation Treaty (PCT)
- New developments in patents
- Software protection and computer-related innovations

#### **Applications:**

- Checking the eligibility for several patents and suggesting remedies for problems through case studies.

#### **Learning Outcomes:**

At the end of this unit, students will be able to:

- Demonstrate the registration process of patents. (L2)
- Understand the infringement of patents and their remedies. (L2)
- Contrast patents, software protection, and computer-related innovations. (L2)

## **UNIT IV: Trademarks**

### **Introduction to Trademarks**

- Overview of trademarks
- Laws relating to trademarks
- Functions of trademarks
- Marks covered under trademark law
- Trademark registration
- Trademark maintenance
- Transfer of rights
- Likelihood of confusion
- Dilution of ownership
- Trademark claims and infringement
- Remedies and case study

#### **Applications:**

- Compare and contrast different trademarks and know how to register a trademark.

#### **Learning Outcomes:**

At the end of this unit, students will be able to:

- Demonstrate registration and maintenance of trademarks. (L2)
- Illustrate procedures for trademark claims. (L2)
- Understand the transfer of rights in trademarks. (L2)

## **UNIT V: Trade Secrets & Cyber Law**

### **Trade Secrets**

- Introduction to trade secrets
- General principles
- Laws relating to trade secrets
- Maintaining trade secrets
- Physical security
- Employee confidentiality agreements

- Breach of contract
- Trade secret litigation
- **Cyber Law and Cyber Crime**
- Introduction to cyber law
- Information Technology Act 2000
- Protection of online and computer transactions
- Cyber crimes: prevention and punishment
- Case study

**Applications:**

1. Adapt how to protect trade secrets physically and from employees of the organization.
2. Choose and exhibit various securities for access like biometrics, login passwords, facial recognition, UID number, which protect individual properties.

**Learning Outcomes:**

At the end of this unit, students will be able to:

- Understand the level of physical security. (L2)
- Outline employee confidentiality agreements. (L2)
- Explain the prevention and punishment of cyber crimes. (L2)
- Understand the various levels of liability of network providers. (L2)

**Text Books:**

1. *Fundamentals of IPR for Engineers* by Kompal Bansal & Parishit Bansal, B.S. Publications, 2013.
2. *Intellectual Property* by Deborah E. Bouchoux, Cengage Learning, New Delhi, 2012.

**Reference Books:**

1. *Intellectual Property Rights* by Prabuddha Ganuli, Tata McGraw Hill, 2012.
2. *Managing Intellectual Property* by V. Scople Vinod, Prentice Hall of India Pvt Ltd, 2012.

**Web Links:**

1. [Patent Office India](#)
2. [Trademark Office India](#)
3. [Copyright Office India](#)
4. [WIPO](#)
5. [Indian Kanoon](#)

Subject Code	Subject Name	L	T	P	C
R20CSE-HN3201	Wireless Sensor Networks (Honors Courses 3: Track-1)	3	1	0	4

### Course Objectives:

- Emphasize the basic WSN technology and sensor node architecture with its unique constraints and challenges in design of WSN for different Applications.
- Summarize the transceiver design and network technologies used in wireless sensor and networks.
- Explains various key MAC protocols for sensor networks with their merits and demerits.
- Provide knowledge of different routing protocols with their advantages.
- Create awareness on transport layer protocols, security considerations, sensor network platforms and tools with a brief study of different WSN applications.

### Course outcomes:

1. Understand enabling technologies for wireless sensor networks
2. Apply the design principles of WSN architectures.
3. Apply various concepts for assignment of MAC addresses
4. Design network infrastructure for wireless sensor networks.
5. Analyze state-centric programming tools for sensor network.

### Unit 1

**Overview of Wireless Sensor Networks:** Key definitions of sensor networks, Advantages of sensor Networks, Unique constraints and challenges, Driving Applications, Enabling Technologies for Wireless Sensor Networks.

### Architectures:

Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture -Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.

**Learning Outcomes:** Students will be able to:

1. Describe application domain of Wireless Sensor Networks (L2)
2. Understand architecture of Wireless Sensor Networks (L2)

### Unit 2

### Networking Technologies:

Physical Layer and Transceiver Design Considerations, Personal area networks (PANs), hidden node and exposed node problem, Topologies of PANs, MANETs, and WANETs.

**Learning Outcomes:** Students will be able to:

1. Describe design considerations of Physical Layer and Transceiver(L2)
2. Illustrate Topologies of PANs, MANETs, and WANETs (L2)

### Unit 3

### MAC Protocols for Wireless Sensor Networks:

Issues in Designing a MAC protocol for Ad Hoc Wireless Networks, Design goals of a MAC Protocol for Ad Hoc Wireless Networks, Classifications of MAC Protocols, Contention – Based Protocols, Contention - Based Protocols with reservation Mechanisms, Contention – Based MAC Protocols with Scheduling Mechanisms, MAC Protocols that use Directional Antennas, Other MAC Protocols.

**Learning Outcomes:** Students will be able to:

1. Understand MAC protocol (L2).
2. Describe MAC Protocols that use Directional Antennas (L2).

### Unit 4

## **ROUTING PROTOCOLS:**

Introduction, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classification of Routing Protocols, Table –Driven Routing Protocols, On – Demand Routing Protocols, Hybrid Routing Protocols, Routing Protocols with Efficient Flooding Mechanisms, Hierarchical Routing Protocols, Power – Aware Routing Protocols, Proactive Routing.

**Learning Outcomes:** Students will be able to:

1. Understand Routing Protocol for Ad Hoc Wireless Networks (L2)
2. Use Routing Protocols for Ad Hoc Wireless Networks (L2)

### **Unit 5**

#### **Transport layer and security protocols:**

Introduction, Issues in Designing a Transport Layer Protocol for Ad Hoc Wireless Networks, Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks. Security in Ad Hoc Wireless Networks, Network Security Requirements, Issues and Challenges in Security Provisioning. Secure Routing in Ad Hoc Wireless networks.

#### **Sensor network platforms and tools**

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming.

**Learning Outcomes:** Students will be able to:

1. Understand Transport Layer Protocol for Ad Hoc Wireless Networks (L2)
2. Security in Ad Hoc Wireless Networks (L2)

#### **Text Books**

1. Ad Hoc wireless networks: Architectures and protocols - C.Siva Ram Murthy and B.S.Manoj, 2004, PHI.
2. Wireless Ad - Hoc and Sensor Networks: Protocols, Performance and Control - JagannathanSarangapani, CRC Press.
3. Holger Karl & Andreas Willig, Protocol and Architectures for Wireless Sensor Networks, John Wiley, 2005.

#### **References**

1. KazemSohraby, Daniel Minoli, &TaiebZanti, "Wireless Sensor Networks - Technology, Protocols and Applications", John Wiley, 2007.
2. Feng Zhao & Leonidas J.Guibas, "Wireless Sensor Networks - An Information Processing Approach", Elsevier, 2007.
3. Ad Hoc Mobile Wireless Networks: Protocols & Systems, C.K.Toh, 1ed, Pearson Education.
4. Wireless Sensor Networks - C.S.Raghavendra, Krishna M.Sivalingam, 2004, Springer.
5. Wireless Sensor Networks - S Anandamurugan, Lakshmi Publications.

Subject Code	Subject Name	L	T	P	C
R20CSE-HN3202	Block Chain Technologies (Honors Courses 3: Track-2)	3	1	0	4

### Course Objectives:

- Understand how Block chain systems (mainly Bit coin and Ethereum) work,
- To securely interact with Block chain systems,
- Design, build, and deploy smart contracts and distributed applications,
- Integrate ideas from Block chain technology into their own projects.
- To identify the importance of crypto currency.

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

1. Understand basic skills and knowledge of Distributed Database and Cryptography.
2. Analyse Block chain system by sending and reading transactions.
3. Design, build and deploy a distributed application.
4. Understand the Basic knowledge of Crypto currency.
5. Understand the Basic knowledge of Crypto currency Regulation.

### Unit I

**Basics** Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.

### Learning Outcomes: At the end of the unit, student will be able to

1. Acquire basic skills and knowledge of Cryptography.
2. Understanding of current trends of Block chain, and ability to imagine its use cases and future.

### Unit II

**Blockchain:** Introduction, Advantage over conventional distributed database, Block chain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Block chain application, Soft & Hard Fork, Private and Public Block chain.

### Learning Outcomes: At the end of the unit, student will be able to

1. To understand the applications of Block chain.

### Unit III

**Distributed Consensus:** Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.

### Learning Outcomes: At the end of the unit, student will be able to:

1. Identify the challenges in Distributed Consensus.

### Unit IV

**Crypto currency:** History, Distributed Ledger, Bit coin protocols - Mining strategy and rewards, Ethereum -Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Side chain, Name coin.

### Learning Outcomes: At the end of the unit, student will be able to:

1. Understand the Basic knowledge of Crypto currency.
2. Analyze how Bit coin Crypto currency works uses in global market.

### Unit V

**Crypto currency Regulation:** Stakeholders, Roots of Bit coin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy.

### Learning Outcomes: At the end of the unit, student will be able to:

1. Understand the Basic knowledge of Crypto currency Regulation.



### **Text Book**

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).

### **Reference Books**

1. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies.
2. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System.
3. DR. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger," Yellow paper. 2014.
4. Nicola Atzei, Massimo Bartoletti, and Tiziana Cimoli, A survey of attacks on Ethereum smart contracts.

Subject Code	Subject Name	L	T	P	C
R20CSE-HN3203	.NET Framework (Honors Courses 3: Track-3)	3	1	0	4

### Course Objectives:

- To understand the working environment of Microsoft Visual Studio.
- Understand the OOPS concepts, Threads and File handling
- Understand and gain practical knowledge of Collections and Reflection framework
- To make the student to create websites using ASP.NET
- Understand the concept of session tracking mechanism in real time applications.

### Course Outcomes:

1. Understand the environment of JRE
2. Implement real world objects using class Hierarchy
3. Implement generic data structures for iterating distinct objects
4. Implement real-world web applications
5. Design ADO.NET applications and session management

### Unit I

**Introduction to C#**-Overview of Environment-Microsoft Visual Studio 2019 and Visual C#,features,ProgramStructure,DataTypes,Working with Variables and Constants, Type Conversion, Operators, Decision Making statements, Loops, Methods, Boxing and Unboxing,Arrays,Strings.

**Learning Outcomes:** Student will be able to

- Understand Microsoft Visual Studio environment and its program structure. (L2)
- Understand decision making and iterations in C#. (L2)
- Implement typecasting and conversion constructs. (L4)

### Unit II:

**File Handling and Threads**-Structure, Enums, Classes, Inheritance, Abstract class, Polymorphism, Operator Overloading,Interfaces, Namespaces, Pre-processor Directives, Exception Handling, Garbage collection, Threads-Life cycle, creation and managing threads, File Handling.

**Learning Outcomes:** Student will be able to

- Understand object oriented concepts with real time applications. (L2)
- Implement Threads and file handling for synchronous data processing. (L4)
- Understand error and exception handling strategies. (L2)

### Unit III

**Collections and Reflections**-Attributes, Reflections, Properties, Indexers, Delegates, Events, Collections, Generics, Anonymous Methods, Unsafe Codes.

**Learning Outcomes:** Student will be able to

- Understand hierarchy of Collections and Reflections. (L2)
- Implement delegates and events in collections. (L4)

### Unit IV

**ASP.NET – Controls**- An introduction to Web Forms,MVC Architecture, Server-side controls,The ASP.NET execution model. ASP.Net Page Life Cycle, Controls-User, Navigation, Validation and Login Controls, Master Page and Content Page, Themes.

**Learning Outcomes:** Student will be able to

- Implement the Model-View-Controller architecture for creating web applications. (L4)
- Implement ASP life cycle through user controls and navigation. (L4)
- Understand login and validation controls in the web application. (L2)

## **Unit V**

**ADO.NET and Session Management :** Data access and data binding using ADO.NET, ASP.Net State Management-View, Session, Application, cookies and URL encoding, Web Application Security, Authentication and Authorization, Impersonation, ASP.Net provider model, Caching, Networking concepts-Web client, Web request and response, Top Listener, Top client

**Learning Outcomes:** Student will be able to

- Implement ADO.NET for database accessing.(L4)
- Develop web applications with persistency and state management. (L4)
- Develop secure applications for request-response handling. (L4)

### **TEXT BOOKS**

1. A Text book on C#- Pearson Education, S.TamaraiSelvi,R.Murugesan.
2. Programming C# 8.0: Build Cloud, Web, and Desktop Applications,Orielly Publications
3. The Complete Reference ASP.NET, Mathew McDonald,McGraw Hill

### **REFERENCE BOOKS**

1. C# in depth, manning publications, John Skeet
2. ASP.NET Core in Action, Andrew Lock,Manning publication.

Subject Code	Subject Name	L	T	P	C
R20CSE-HN3204	Natural Language Processing (Honors Courses 3: Track-4)	3	1	0	4

**Course Objectives:**

- To learn the fundamentals of natural language processing
- To understand the use of CFG and PCFG in NLP
- To understand the role of semantics of sentences and Pragmatics
- To gain knowledge in automated natural language generation and machine translation
- To understand language modeling

**Course Outcomes:** Upon completion of the course, the student will be able to

1. Understand the fundamentals of basic Language features
2. Analyze the words involved in NLP
3. Analyse the syntactic analysis involved in NLP
4. Apply semantic Analysis for NLP
5. Compare different statistical approaches 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.

**Learning Outcomes:** Student will be able to

1. Outline different grammar based languages (L2)
2. Illustrate the fundamentals of natural language processing (L2)

**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.

**Learning Outcomes:** Student will be able to

- 1 Demonstrate N-Grams in NLP (L2)
- 2 Analyze the Different Stochastic and Transformation-based tagging (L4)

**UNIT III:**

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

**Learning Outcomes:** Student will be able to

1. Interpret CFG and PCFG in NLP (L2)
2. Outline the syntactic importance in NLP (L2)

**UNIT IV:**

**Semantics Analysis:** 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

**Learning Outcomes:** Student will be able to

- 1 Understand different order logics (L2)
- 2 Understand requirements of semantics of NLP (L2)

**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, Word Net, Prop Bank, Frame Net, Brown Corpus, British National Corpus (BNC).

**Learning Outcomes:** Student will be able to

1. Understand Segmentation and Coherence (L2)
2. Determining statistical approaches for NLP applications (L3)

**Text Books:**

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

**References:**

1. Breck Baldwin, —Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.
2. Richard M Reese, —Natural Language Processing with Java, O'Reilly Media, 2015.
3. Nitin Indurkha and Fred J. Damerau, —Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
4. Tanveer Siddiqui, U.S. Tiwary, —Natural Language Processing and Information Retrieval, Oxford University Press, 2008.