COURSE STRUCTURE
&
DETAILED SYLLABUS
(R20 Regulation)
For
Bachelor of Technology
I, II, III & IV B. Tech. (CSE) with
Honors and Minors
(Applicable for Batches Admitted from 2020-2021)

Department of
COMPUTER SCIENCE & ENGINEERING
(Applicable for Batches Admitted from 2020-2021)

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
Lendi Institute of Engineering and Technology
(Approved by A.I.C.T.E & Permanent Affiliated to JNTUK, Kakinada)
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COMPUTER SCIENCE AND ENGINEERING (CSE)

R20 Course Structure

I B. Tech I Semester

I Year - I Semester							
S. No.	**Course code**	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
1	R20BSH-EN1101	Communicative English-1	HMSC	2	0	2	3
2	R20BSH-MA1101	Numerical Method and Ordinary Differential Equations	BSC	3	0	0	3
3	R20CSS-ES1101	Problem Solving and Programming using C	ESC	3	0	0	3
4	R20BSH-PH1101	Engineering Physics	BSC	3	0	0	3
5	R20EEE-ES1101	Essentials of Electrical & Electronics Engineering	ESC	3	0	0	3
6	R20CSE-ES1102	Problem Solving and programming using C Lab	ESC	0	0	3	1.5
7	R20BSH-PH1101	Engineering Physics Lab	BSC	0	0	3	1.5
8	R20EEE-ES1101	Essentials of Electrical & Electronics Engineering Lab	ESC	0	0	3	1.5
			Total	**13**	**1**	**11**	**19.5**

Category	**Credits**
Basic Science Course	7.5
Engineering Science Courses	9
Humanities & Social Science	3
Total Credits	19.5

I B.Tech II Semester

I Year - II Semester							
S. No.	**Course code**	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
1	R20BSH-MA1201	Linear Algebra and Multivariable Calculus	BSC	3	0	0	3
2	R20BSH-MA1202	Mathematical Methods	BSC	3	0	0	3
3	R20BSH-CH1201	Engineering Chemistry	BSC	3	0	0	3
4	R20MEC-ES1201	Engineering Drawing	ESC	1	0	4	3
5	R20CSE-ES1201	Data structures	ESC	3	0	0	3
6	R20BSH-EN1201	Communicative English -2	HMSC	0	0	3	1.5
7	R20BSH-BS1202	Engineering Chemistry Lab	BSC	0	0	3	1.5
8	R20CSE-ES1202	Data structures Lab	ESC	0	0	3	1.5
9	R20BSH-MC1201	Environmental Science	MC	3	0	0	0
			Total	**15**	**0**	**15**	**19.5**

Category	**Credits**
Basic Science Course	10.5
Engineering Science Courses	7.5
Humanities & Social Science	1.5
	19.5

Semester III (Second year)

II Year - I Semester							
S. No	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
1.	R20BS-HM2101	Managerial Economics and Financial Accountancy	HSMC	3	0	0	3
2.	R20CS-PC2102	Python Programming	PCC	3	0	0	3
3.	R20BS-PC2103	Mathematical Foundations of Computer Science	ESC	3	0	0	3
4.	R20CS-PC2104	Database Management Systems	PCC	3	0	0	3
5.	R20EC-PC2105	Digital Logic Design	ESC	3	0	0	3
6.	R20CS-PC2106	Python Programming LAB	PCC	0	0	3	1.5
7.	R20CS-PC2107	Database Management Systems LAB	PCC	0	0	3	1.5
8.	R20EC-PC2108	Digital Logic Design LAB	ESC	0	0	3	1.5
9.	R20BS-HM2109	Employability Skills - I (Skill Course)	SDC	0	1	1	2
10	R20BS-HM2110	Constitution of India	MC	2	0	0	0
Total				**18**	1	**10**	**21.5**

Category	**CREDITS**
Humanities, Social Science & Management	3
Engineering Science Courses	4.5
Professional core Courses	12
Skill Development course*	2
TOTAL CREDITS	**21.5**

Semester IV (Second year)

		II Year - II Semester					
S. No	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
1.	R20CS-PC2201	Computer Organization& Architecture	PCC	**3**	**0**	0	3
2.	R20CS-PC2202	Software Engineering	PCC	**3**	**0**	0	3
3.	R20CS-PC2203	Java Programming	PCC	**3**	**0**	0	3
4.	R20CS-PC2204	Operating Systems	PCC	**3**	**0**	0	3
5.	R20CS-PC2205	Probability and Statistics	ESC	**3**	**0**	0	3
6.	R20CS-PC2206	Java Programming LAB	PCC	**0**	**0**	3	1.5
7.	R20CS-PC2207	Operating Systems LAB	PCC	**0**	**0**	3	1.5
8.	R20CS-PC2208	Software Engineering LAB	PCC	**0**	**0**	3	1.5
9.	R20CS-PC2209	R- Programming (**(Skill advanced course/ soft skill course*)**)	SDC	0	0	4	**2**
10.		English	MC	0	0	2	**0**
		Total		**16**	1	**10**	**21.5**
Internship 2 Months (Mandatory) during summer vacation							

Category	**CREDITS**
Professional core Courses	16.5
Engineering Science Courses	3
Skill advanced course/ soft skill course*	2
Summer Internship	1.5
TOTAL CREDITS	**21.5**

	Honors courses II Year - II Semester						
S. No.	**Course code**	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
1.	R20CS-HDC2201	Data Communications(Track-1)	**HC**	**3**	**1**	0	4
2.	R20CS-HCIS2202	Information Security(Track -2)	**HC**	**3**	**1**	0	4
3.	R20CS-HCWF2203	Web UI Framework(Track-3)	**HC**	**3**	**1**	0	4
4.	R20CS-HCAP2204	Advanced Python Programming(Track-4)	**HC**	**3**	**1**	0	4
5.		**MOOCS:** 1. Intrusion detection System(MOOCS),Track-1 2. Cloud Security(MOOCS),TRACK-2 3. Django Framework (MOOCS),TRACK-3 Mongo DB MOOCS),TRACK-4			**1**	2	2

Category	**CREDITS**
Honors Courses	4
MOOCS Course	2
TOTAL CREDITS	**6**

Semester V (Third year)

III Year - I Semester							
S. No	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
1.	R20CS-PC3101	Formal Languages and Automata Theory	PCC	3	0	0	3
2.	R20CS-PC3102	Data Mining and Data Warehousing	PCC	3	0	0	3
3.	R20CS-PC3103	Object Oriented Analysis & Design (OOAD)	PCC	3	0	0	3
4.	R20CS-OE3104	**Open Elective Course/Job oriented elective:** 1.Micro Processors & Interfacing 2.Advanced Java Programming 3.DevOps	OEC	3	0	0	3
5.	R20CS-PE3105	**Professional Elective courses:** 1.Artificial Intelligence 2.Principles of Programming Languages 3.Advanced Data Structures 4. Advanced Operating Systems	PEC	3	0	0	3
6.	R20CS-PC3106	DMDW Lab	PCC	0	0	3	1.5
7.	R20CS-PC3107	OOAD Lab	PCC	0	0	3	1.5
8.	R20CS-SDC3108	Employbility Skills-2 (**(Skill advanced course/ soft skill course*)**)	SDC	0	1	2	**2**
Internship 2 Months (Mandatory) during summer vacation Evaluation				0	0	0	1.5
			Total	**17**	**0**	**8**	**21.5**

Category	**CREDITS**
Professional core Courses	12
Professional Elective courses	3
Open Elective Course/Job oriented elective	3
Skill advanced course/ soft skill course*	2
Summer Internship	1.5

TOTAL CREDITS	21.5

Honors courses III Year - I Semester

S. No.	Course code	Course Title	Category	L	T	P	Credits
1.	R20CS-HCTP3101	TCP/IP Protocol Suite (Track-1)	HC	3	1	0	4
2.	R20CS-HCSC3102	Secure Coding(Track -2)	HC	3	1	0	4
3.	R20CS-HCAJ3103	Angular JS Framework (Track-3)	HC	3	1	0	4
4.	R20CS-HCMD3104	Mathematical Essential For Data Science(Track-4)	HC	3	1	0	4
5.		**MOOCS:** 1. Introduction to Packet Tracer Tool (MOOCS),Track-1 2. Web Security (MOOCS),TRACK-2 3. Mobile UI Framework (MOOCS),TRACK-3 4. Data Visualization (MOOCS),TRACK-4		0	1	2	2

Category	CREDITS
Honors Courses	4
MOOCS Course	2
TOTAL CREDITS	**6**

Semester VI (Third year)

III Year - II Semester

S. No	Course Code	Course Title	Category	L	T	P	Credits
1.	R20CS-PC3201	Computer Networks	PCC	3	0	0	3
2.	R20CS-PC3202	Compiler Design	PCC	3	0	0	3
3.	R20CS-PC3203	Design and Analysis Algorithms	PCC	3	0	0	3
4.	R20CS-PE3204	**Professional Elective courses:** 1.Distributed Systems 2.Web Services 3.Human Computer Interaction 4.Speech Processing	PEC	3	0	0	3
5.	R20CS-OE3205	Open Elective Course/**Job oriented elective:** 1.VLSI 2.Sales Force 3.Industrial IoT	OEC	3	0	0	3
6.	R20CS-PC3206	Computer Networks Lab	PCC	0	0	3	1.5
7.	R20CS-PC3207	Compiler Design Lab	PCC	0	0	3	1.5
8.	R20CS-PC3208	Design and Analysis Algorithms Lab	PCC	0	0	3	1.5
9.	R20BS-HM3209	Advanced Communication skills **(Skill advanced course/ soft skill course*)**	SDC	0	1	1	**2**
10.	R20BS-HM3210	Mandatory course (AICTE) IPR	MC	2	0	0	0
Internship 2 Months (Mandatory) during summer vacation				0	0	0	1.5
		Total		**17**	**1**	**13**	**23**

Category	CREDITS
Professional core Courses	13.5
Professional Elective courses	3
Open Elective Course/Job oriented elective	3
Skill advanced course/ soft skill course*	2
Summer Internship	1.5
TOTAL CREDITS	**23**

	Honors courses III Year - II Semester						
S. No.	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
1.	R20CS-HCWN3201	Wireless Sensor Networks (Track-1)	**HC**	**3**	**1**	0	4
2.	R20CS-HCBTNF3202	Block Chain Technologies (Track -2)	**HC**	**3**	**1**	0	4
3.	R20CS-HC3203	.NET Framework (Track-3)	**HC**	**3**	**1**	0	4
4.	R20CS-HCNP3204	Natural Langauge Processing (Track-4)	**HC**	**3**	**1**	0	4

Category	CREDITS
Honors Courses	4
TOTAL CREDITS	**4**

Semester VII (Fourth year)

IV Year - I Semester							
S. No	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
1.	R20CS-PE4101	**Professional Elective courses** 1.Software Architecture& Design Patterns 2.Advanced Computer Networks 3. Soft Computing	PEC	3	0	0	3
2.	R20CS-PE4102	**Professional Elective courses** 1.Big Data Analytics 2.Advanced Computer Architecture 3.Mobile Computing	PEC	3	0	0	3
3.	R20CS-PE4103	**Professional Elective courses** 1.Cloud Computing 2.Cryptogrphy & Network Security 3. Software Project Management	PEC	3	0	0	3
4.	R20CS-PE4104	**Open Elective Courses/ Job oriented elective** 1.Digital Signal Processing 2.Embedded Systems 3.Web Services	OEC	3	0	0	3
5.	R20CS-PE4105	**Open Elective Courses/ Job oriented elective** 1.Scripting Languages 2.Robotics 3.Digital Image Processing	OEC	3	0	0	3
6.	R20BS-HM4106	**Management Science/(MOB)** **1. Universal Human Values** **2: Understanding Harmony**	HMSC	3	0	0	3
7.	R20BS-HM3108	**Skill advanced course/ soft skill course***	SDC	0	1	1	2
Industrial/Research Internship 2 Months(Mandatory) after third				0	0	0	1.5

Year(to be evaluated during VII Semester)					
Total		**19**	1	1	**21.5**

Category	**CREDITS**
Professional Elective courses	9
Open Elective Course/Job oriented elective	6
Humanities and Social Science Elective	3
Skill advanced course/ soft skill course*	2
Industrial/Research Internship	1.5
TOTAL CREDITS	**21.5**

	Honors courses IV Year - I Semester						
S. No.	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
1.	R20CS-HCIT3201	Internet of Things (IoT) (Track-1)	HC	**3**	**0**	0	4
2.	R20CS-HCVT3202	Vulnerability Assessment & Penetration Testing(Track -2)	HC	**3**	**0**	0	4
3.	R20CS-HCJF3203	Java Enterprise Framework (Track-3)	HC	**3**	**0**	0	4
4.	R20CS-HCDL3204	Deep Learning (Track-4)	HC	**3**	**0**	0	4

Category	**CREDITS**
Honors Courses	4
TOTAL CREDITS	**4**

Semester VIII (Fourth year)

IV Year - II Semester							
S. No	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
1.	R20CS-PROJ4201	Project Project work, seminar and internship in industry	**PCC**	**0**	**0**	**0**	**12**
	INTERNSHIP(6 MONTHS)						
Total				**12**			

Subject Code	Subject Name	L	T	P	C
R20CS-PC3101	Formal Languages & Automata Theory	3	0	0	3

Course Objectives:

This course is designed to:

1. Introduce languages, grammars, and computational models
2. Discussing regular expressions and regular languages
3. Illustrating pushdown-automata and context free grammar.
4. Explain Turing machines
5. Demonstrate decidability and un decidability for NP Hard problems

Course Outcomes:

Students will be able to:

1. Design finite state machines for acceptance of languages.
2. Understand regular expressions and finite automata.
3. Develop context free grammars for formal languages.
4. Design pushdown automata for context free grammars.
5. Design Turing machine and Formulate decidability and un-decidability problems.

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 Limitation of Finite Automata.

Learning Outcomes:

Students will be able to:

1. Distinguish DFA and NFA (L4)
2. Construct DFA for an input string (L6)
3. Perform minimization of Automata (L3)
4. 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, Inter Conversion, Equivalence between Finite Automata and Regular Expressions, Pumping Lemma, Closers Properties, Applications of Regular Expressions, Finite Automata and Regular Grammars, Regular Expressions and Regular Grammars.

Learning Outcomes:

Students will be able to:

1. Build regular expression for the given Finite Automata (L3)
2. Construct finite automata for the given regular expression (L6)
3. 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:

1. Define Context Free Grammar (L1)
2. Differentiate between Chomsky Normal Form and Greibach Normal form (L4)
3. 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:

1. List the applications of Pushdown Automata (L1)
2. 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 Un-decidable Problems Post's Correspondence Problem, Classes of P and NP, NP hard and NP-Complete Problems.

, Students will be able to:

1. List the applications of Turing machine (L1)
2. Design Turing machine for context free grammar (L6)
3. List types of Turing Machines (L1)
4. Design Turing Machine (L6)
5. Formulate decidability and un decidability problems. (L2)

Text Books:

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

Reference Books:

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

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH:3;MEDIUM:2;LOW:1**):**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2								2	1	1	2
CO2	3	3	3	3						1		2	2	2	3
CO3	3	3	3	3						1		2		1	3
CO4	3	3	3	3								1	2	2	3
CO5	3	3	3	3								1	2	2	3
CO6	2	2	2	2						2		1			2
CO. *	3	3	2	3						1		2	2	2	3

Subject Code	Subject Name	L	T	P	C
R20CS-PC3102	Data Mining and Data Warehousing	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 to analyze their behavior.

COURSE OUTCOMES:

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

Syllabus:

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: Student should be able to

1. Summarize the process of Data mining.(L2)
2. Classify various kinds of Data Mining techniques.(L2)
3. Memorize different visualization techniques.(L1)
4. 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: Student should be able to

1. Recognize various steps in Data Preprocessing.(L1)
2. 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: Alterative Techniques, Bayesian Classifier: Bayes theorem, using bayes theorem for classification, Native Bayes Classifier: Bayes error rate, Bayesian Belief Networks: Model representation, model building (Tan)

Learning Outcomes: Student should be able to

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

UNIT –IV:

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

Learning Outcomes: Student should be able to

1. Apply the Apriori algorithm on any sample data.(L3)
2. 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: Student should be able to

1. Identify the data objects and partition them into different clusters.(L2)
2. Apply the different clustering techniques on sample data.(L3)
3. Acquire the knowledge of The strenthg and weakness of clustering algorithms.(L2)

TEXT BOOKS:

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 : VikramPudi 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.

Subject Code	Subject Name	L	T	P	C
R20CS-PC3103	Object Oriented Analysis & Design	3	0	0	3

COURSE OBJECTIVES:

1. The focus of this course is on design rather than implementation.
2. Introducing the Unified Process and showing how UML can be used within the process.
3. Case study experience with architecture, analysis and design.
4. Programmatic interactions using UML diagrams and OOP.

COURSE OUTCOMES:

1. Understand concepts of object-oriented modeling.
2. Apply qualitative knowledge and techniques to develop use case diagrams.
3. Create class diagrams that model both the domain model and design model of a software system.
4. Create interaction diagrams that model the dynamic aspects of a software system.
5. Design a logical architecture in terms of layers and partitions with the Layers pattern with case study.

UNIT I

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

Learning outcomes:

1. Define object-oriented analysis and design (OOA/D).
2. Illustrate a brief example (Next Gen POS System).
3. 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:

1. Define the FURPS+ model.
2. Relate types of requirements to UP artifacts.
3. 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:

1. Create system sequence diagrams for use cases.
2. Identify conceptual classes related to the current iteration requirements.
3. 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:

1. Create state chart diagrams for classes and use cases.
2. Create object diagram and state diagrams.
3. 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:

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

Text books

- 'Applying UML and patterns' by Craig Larman, Pearson.
- "Object oriented analysis and design with applications" by gradey booch,jocobson,rambaugh.
- Object-Oriented Analysis & Design with the Unified Process by Satzinger, Jackson & Burd Cengage Learning
- 'UML distilled' by Martin Fowler, Addison Wesley, 2003

Reference

- O'reilly ' s 'Head-First Design Patterns' by Eric Freeman et al, Oreillly
- UML 2 Toolkit, by Hans-Erik Eriksson, Magnus Penker, Brian Lyons, David Fado: WILE\'-Dreamtech lndia Pvt. Lid.

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1**):**

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	3	1				2						1	
CO2	3	2	3	3	2			2		2				3	2
CO3	3	3	3	2	3				2					3	2
CO4	3	2	3	2	3				2	2				3	2
CO5	3	2	3	2	2				2					3	2
CO.*	3	3	3	2	2			2	2	2				3	2

** For Entire Course, PO & PSO Mapping*

Open Elective

Subject Code	Subject Name	L	T	P	C
R20CS-OE3104.2	Advanced Java Programming	3	0	0	3

Course Objectives:

1. Create GUI screens for stand alone 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.

Course Outcomes:

1. Create GUI based applications using Panels and Components.
2. Analyze the collections using Lambdas and Streams.
3. Implement JDBC connections using java SQL packages.
4. Create Server Side programs for request-response handling using Servlets.
5. Apply JSP for server side tag implementation.

Unit 1:

GUI Programming: Basics of Swing, Swing Features, Components and Containers, Event Handling, Various Swing components, Writing Swing Application

Learning Outcomes: student will be able to

- Understand the fundamentals of GUI programming. (L2)
- Understand components and panels for user interface. (L2)
- Create Stand-alone 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 of Servlet, 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 life cycle of servlet. (L2)
- Implement HTTPRequest and response handling using HTTPServlet 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 Life cycle of JSP over Servlet. (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 (English, Paperback, Vivek, Gupta Sarika, Agarwal), BPB Publications

Reference Books:

1. Java: How to Program, 9th Edition (Deitel) 9th Edition by Paul Deitel (Author), Harvey M. Deitel (Author).
2. Java 8 in Action: Lambdas, Streams, and functional-style programming Paperback, 2014 by Raoul-Gabriel Urma (Author), Mario Fusco (Author), Alan Mycroft (Author)

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1**)**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO\	PSO2	PSO3
CO1	3	2	2	1	3						1	1	2	3	3
CO2	3	2	2	1	3						1	1	2	3	3
CO3	3	3	3	2	3						1	2	3	3	3
CO4	3	3	3	2	3						1	2	3	3	3
CO5	2	2	2	2	2						1	1	2	2	2
CO.*	3	2	2	2	3						1	1	2	3	3

Subject Code	Subject Name	L	T	P	C
R20CS-OE3104.3	DevOps	3	0	0	3

Course Objectives:

DevOps improves collaboration and productivity by automating infrastructure and workflows and continuously measuring applications performance.

Course Outcomes:

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

1. Understand the principles of SDLC.
2. Understand DevOps & DevSecOps methodologies and their key concepts
3. Analyze diffrient types of version control systems and tools using GIT
4. Analyze the principles of continuous integration and deployment (CICD) pipelining.
5. Understand the DevOps maturity model

UNIT –I:

Phases of Software Development life cycle. Values and principles of agile software development.

UNIT -II:

Fundamentals of DevOps: Architecture, Deployments, Orchestration, Need, Instance of applications, DevOps delivery pipeline, DevOps eco system.

UNIT –III:

DevOps adoption in projects: Technology aspects, Agiling 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 CICD 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, Gene Kim , John Willis , Patrick Debois , Jez Humb,1st Edition, O'Reilly publications, 2016.
2. What is Devops? Infrastructure as code, 1st Edition, Mike Loukides ,O'Reilly publications, 2012.

Reference Books:

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

Professional Elective

Subject Code	Subject Name	L	T	P	C
R20CS-PE3105.1	Artificial Intelligence	3	0	0	3

Course Objectives:

1. Expose various AI Applications 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:

1. Understand various AI applications and languages
2. Analyze the various searching techniques, constraint satisfaction problem
3. Apply predicate and propositional logic techniques.
4. Understand the knowledge representation techniques
5. Understand the Fuzzy sets and expert systems.

UNIT-I:

Introduction to artificial intelligence: Introduction, history, intelligent systems, foundations ofAI, applications, tic-tac-toe game playing, development of AI languages, current trends in AI

Learning Outcomes:

1. At the end of the module, students will be able to:
2. Classify various AI Applications (L2)
3. Apply the logic for tic-tac-toe game playing (L3)
4. List the AI Languages (L1)
5. Outline the current trends in AI (L2)

UNIT-II:

Problem solving: state-space search and control Strategies: Introduction, general problemsolving, characteristics of problem, 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 the module, students will be able to:

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

UNIT-III:

Logic concepts: Introduction, propositional calculus, propositional logic, natural deductionsystem, axiomatic system, semantic tableau system in propositional logic, resolution refutation in propositional logic, predicate logic.

Learning Outcomes:

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

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

UNIT-IV:

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

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

Learning Outcomes:

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

1. Illustrate knowledge representation using semantic networks, extended semantic networks and frames. (L2)
2. List phases in building expert systems (L1)
3. Distinguish between expert systems and traditional systems (L2)
4. Develop rule based expert system (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,linguistics variables and hedges, fuzzy propositions, inference rules for fuzzy propositions, fuzzy systems.

Learning Outcomes:

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

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

Text Books:

1. Artificial Intelligence- SarojKaushik, CENGAGE Learning,
2. Artificial intelligence, A modern Approach , 2nded, Stuart Russell, Peter Norvig, PEARSON

Reference Books:

1. Artificial intelligence, structures and Strategies for Complex problem solving, -George F Luger, 5th ed, PEA
2. Introduction to Artificial Intelligence, Ertel, Wolf Gang, Springer
3. Artificial Intelligence, A new Synthesis, Nils J Nilsson
4. Artificial Intelligence- Rich, Kevin Knight, Shiv Shankar B Nair, 3rded, TMH
5. Introduction to Artificial Intelligence, Patterson, PHI

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1**):**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1			2			3	2	1	2
CO2	3	3	2									2	2	1	2
CO3	3	3	2	2					2			3	2	2	2
CO4	3	3	3	3	3				3			3	3	2	2
CO5	3	3	3	3					2			3	3	2	3
CO*	3	3	2	3	3	1			2			3	3	2	2

Subject Code	Subject Name	L	T	P	C
R20CS-PE3105.2	Principles of Programming Languages	3	0	0	3

Course Objectives:

1. To understand and describe 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 an Imperative, functional, logical and object-oriented programming languages
4. Learning principles to design new programming languages
5. Increase capacity to express programming concepts alternative ways

Course Outcomes:

1. Understand the 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 OOPs, 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: Student should be able to

1. Apply the data types, declarations and expressions in the languages (L3)
2. 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: Student should be able to

1. Understand various parameter passing methods (L2)
2. apply scoping in various languages (L3)

Unit III : Object-Orientation, Design issues for oops languages, Implementation of object oriented constructs, Concurrency: Semaphores, monitors, Message passing, Threads, Statement level concurrency, Exception handling, Event handling.

Learning outcomes: Student should be able to

1. Understand various concurrency techniques (L2)
2. apply object oriented concepts in the real time applications (L3)

Unit IV: Introduction to lambda calculus, fundamentals of functional programming languages, Programming with Scheme, Programming with ML.

Learning outcomes: Student should be able to

1. Understand the fundamentals concepts of functional programming languages (L2)

Unit V: Introduction, Logic programming overview, Basics of prolog, Applications of Logic programming, Programming with prolog, Multi-paradigm languages.

Learning outcomes: Student should be able to

1. Learn how to implement expert systems with prolog (L2)
2. Understanding the usage of predicate calculus in the logic programming languages (L2)

Text Books:

1) Robert W. Sebesta, "Concepts of Programming Languages", Tenth Edition, Addison Wesley2012
2) Programming Languages, Principles & Paradigms, 2ed, Allen B Tucker, Robert E Noonan, 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

Course Outcomes VS POs Mapping (High:3; Medium:2;Low:1**):**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2							2	2		2
CO2	3	2	2	1	1							2	2		2
CO3	2	3	2	2	1							2	2		2
CO4	2	3	3	2	1							2	2		3
CO5	2	2	1									2	2		2
CO.*	2	2	2	2	2							2	2		2

Subject Code	Subject Name	L	T	P	C
R20CS-PE3105.3	Advanced Data Structures	3	0	0	3

Course Objectives:

1. To Demonstrate the importance of Internal and External Sorting Techniques
2. Describe the various implements of Hashing Techniques, variants of trees, heaps, queues and analysis
3. To Deal with the Optimal, Efficient binary search trees and Multi-way Trees
4. To Create awareness on Digital Search trees, Binary ties, Patricia

Course Outcomes:

1. Understand various internal and external sorting techniques
2. Apply various hashing techniques.
3. Apply binomial heap in real time applications.
4. Understand the various advanced search trees.
5. Understand B trees and B+ trees for data base indexing.

UNIT-I:

Sorting: Basic concepts, Sorting by insertion (Insertion sort), selection heap sort), exchange (bubble sort, quick sort), distribution (radix sort) and merging (merge sort) Algorithms.

External Sorting: External Sorting, Introduction, K-way Merging - Buffer Handling for parallel Operation- Run Generation- Optimal Merging of Runs.

Learning outcomes: Student should be able to

1. Understand the Various Internal Sorting Techniques(L2)
2. Understand the External sorting techniques with some examples(L2)
3. Understand Differences between internal and external sorting techniques(L2)
4. Implement the K-way Merging Techniques(L6)

UNIT-II:

Hashing: Introduction-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: Student should be able to

1. Understand the Hashing Techniques for Dictionaries(L2)
2. Implement the various techniques of Hashing Techniques(L6)
3. To identify the differences between Directory less and Directory oriented concepts(L2)

UNIT -III:

Priority Queues (Heaps): Model, Simple Implementation, Binary Heap-Structure Property-Heap-Order Property-Basic Heap Operations- Other Heap Operation, Applications of Priority Queues- The Selection Problem Event Simulation Problem, Binomial Queues- Binomial Queue Structure – Binomial Queue Operation- Implementation of Binomial Queues

Learning outcomes: Student should be able to

1. Understand the concepts of Binary Heap and Binomial Queues(L2)
2. Apply the Heap techniques in Priority Queues(L4)

UNIT-IV

Efficient Binary Search Trees: Optimal Binary Search Trees, AVL Trees, Red-Black Trees, Definition- Representation of a Red- Black Tree- Searching a Red-Black Tree- Inserting into a Red Black Tree- Deletion from a Red-Black Tree- Joining Red-Black Trees, Splitting a Red-Black tree. Splay tree Introduction

Learning outcomes: Student should be able to

1. Understand different Balanced Binary Search trees like AVL,OBST, Red-Black Trees(L2)
2. Apply the 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+-Tree Definition- Searching a B+-Tree- Insertion into B+-tree- Deletion from a B+-Tree.

Learning outcomes: Student should be able to

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

Text Books:

1. Data Structures, a Pseudo code Approach, Richard F Gilberg, Behrouz A Forouzan,Cengage
2. Fundamentals of DATA STRUCTURES in C: 2nd ed, , Horowitz , Sahani, Andersonfreed, Universities Press
3. Data structures and Algorithm Analysis in C, 2nd edition, Mark Allen Weiss, Pearson

Reference Books:

1. Web : http://lcm.csa.iisc.ernet.in/dsa/dsa.html
2. http://utubersity.com/?page_id=878
3. http://freevideolectures.com/Course/2519/C-Programming-and-Data-Structures
4. http://freevideolectures.com/Course/2279/Data-Structures-And-Algorithms
5. File Structures :An Object oriented approach with C++, 3rd ed, Michel J Folk, Greg Riccardi, Bill Zoellick
6. C and Data Structures: A Snap Shot oriented Treatise with Live examples from Science and Engineering, NB Venkateswarlu & EV Prasad, S Chand, 2010.

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2										2		2
CO2	2	3	2										2		
CO3	3	2	2	2									2		
CO4	3	3	2	1										1	3
CO5	3	2	3	2									2		2
CO.*	2	2	2	2									2	2	2

Subject Code	Subject Name	L	T	P	C
R20CS-PE3105.4	Advanced Opearting Systems	3	0	0	3

Course Objectives:

1. Learn various issues in distributed operating systems.
2. Discuss how dead locks are handled in distributed operating systems.
3. Provide various difficulties in shared memory and failure recovery mechanisms.
4. Learn the basics of Linux system and perform administrative tasks on Linux Servers.
5. Discuss about multiprocessor and distributed database systems.

Course Outcomes

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

UNIT - I:

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 - lamp ports logical clocks - vector clocks - casual ordering of messages - global state ,Termination detection. Distributed Mutual Exclusion - introduction the classification of mutual exclusion and associated algorithms - a comparative performance analysis.

Learning outcomes: Student should be able to

1.Understand various architectures of distributed systems.(L2)
2.Analyze how clocks play important role in distributed environment.(L4)
3.Understand how messages are ordered.(L2)
4.Analyze various associated algorithms for mutual exclusion.(L4)

UNIT - II:

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-the system model, a 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: Student should be able to

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

UNIT-III:

Distributed shared memory-Architecture- 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, backward error recovery- recovery in concurrent systems - consistent set of check points - synchronous and asynchronous check pointing and recovery - check pointing for distributed database systems-recovery in replicated distributed databases.

Learning outcomes: Student should be able to

1.Understand about distributed shared memory and protocols.(L2)
2.Analyze various components of a load distributing.(L4)
3.Compare the performance of various load distributing algorithms.(L2)
4.Understand synchronous and asynchronous check pointing and recovery in concurrent systems.(L2)

UNIT-IV:

Linux System: Components of LINUX, Interprocess Communication, Synchronization, Interrupt, Exception and System Call.

Android Software Platform: Android Architecture, Operating System Services, Android Runtime Application Development, Application Structure, Application Process management.

Learning outcomes: Student should be able to

1.Understand about Linux operating system.(L2)

2.Understand about Android operating systems.(L2)

UNIT-V:

Multiprocessor operating systems - basic multiprocessor system architectures - inter connection Networks for multiprocessor systems - caching - hypercube architecture. Multiprocessor Operating System – structures of multiprocessor operating system, 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 - concurrency control algorithms.

Learning outcomes: Student should be able to

1.Understand about multiprocessor operating systems.(L2)

2.Analyze various concurrency control mechanisms in distributed database systems.(L4)

Text Books:

Mukesh Singhal, Niranjan G.Shivaratri, "Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems", TMH, 2001

Reference Books:

Andrew S.Tanenbaum, "Modern operating system", PHI, 2003

Pradeep K.Sinha, "Distributed operating system-Concepts and design", PHI, 2003.

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1**):**

SNO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1											1		1
CO2	3	3	2	1								1	2		2
CO3	3	3	2	1								1	2		2
CO4	3	2										1	1		1
CO5	3	3	1	1								1	2		2
CO.*	3	3	2	1								1	2		2

*** For Entire Course, PO & PSO Mapping**

Subject Code	Subject Name	L	T	P	C
R20CS-PC3106	Data Mining and Data Ware House Lab	0	0	3	1.5

Course Objective:

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

Course Outcomes:

1. Understand the Environment of weka tool and prepare Data sets.
2. Understand various pre-processing Techniques.
3. Analyze Various classification Algorithms.
4. Apply the Association rule mining to various data sets to Extract Patterns.
5. Analyze various clustering Algorithms.

System/Software Requirements:

- **Intel based desktop PC**

WEKA TOOL

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 apriorialgorithm
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

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1**):**

SNO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2		2									3	2
CO2	3	3	2	3	2								2	3	
CO3	3	3	2	3	2								3	3	2
CO4	3	3	2	3	2								3	3	2
CO5	3	3	2	3	2								3	3	2
CO.*	3	3	2	3	2								3	3	2

** For Entire Course, PO & PSO Mapping*

Subject Code	Subject Name	L	T	P	C
R20CS-PC3107	Object Oriented Analysis & Design Lab	0	0	3	1.5

COURSE OBJECTIVES:

1.The focus of this course is on design rather than implementation.

2.To design static and dynamic parts of the system using UML diagrams.

3.Case study experience with architecture, analysis and design.

4.Programmatic interactions using UML diagrams and OOP.

COURSE OUTCOMES:

1. Detailed case study experience with architecture, analysis and design.
2. Design class diagrams that model both the domain model and design model of a software system.
3. Design interaction diagrams that model the dynamic aspects of a software system.
4. Design class diagrams that model both the domain model and design model of a software system.
5. Design activity, state, component and deployment diagrams.

Take three case studies:

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

Week 1:

Understanding usage of Rational Rose or Umbrella .

For each case study:

Week 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.

Week 5 & 6:

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

Week 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 the three-layer objects
d)) Develop three-layer package diagrams for each case study.

Week 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

Week 13 onwards:

a) Develop sample diagrams for other UML diagrams - state chart diagrams, activity diagrams and deployment diagrams.

Reference books:

- 'Applying UML and patterns' by Craig Larman, Pearson.
- "Object oriented analysis and design with applications" by gradey booch,jocobson,rambaugh.
- Object-Oriented Analysis & Design with the Unified Process by Satzinger, Jackson & Burd Cengage Learning

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1**):**

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	**2**	**2**	**3**	**2**				**2**	**2**		**2**			**3**	**2**
CO2	**2**	**3**	**3**	**2**	**3**				**2**		**2**			**3**	**2**
CO3	**2**	**3**	**3**		**3**				**2**		**2**			**3**	**2**
CO4	**2**	**2**	**3**		**3**				**2**		**2**			**3**	**2**
CO5	**2**	**2**	**3**		**3**				**2**		**2**			**3**	**2**
CO.*	**2**	**3**	**3**	**2**	**3**			**2**	**2**		**2**			**3**	**2**

** For Entire Course, PO & PSO Mapping*

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Honors Courses

Subject Code	Subject Name	L	T	P	C
R20CS-HCTP3101	TCP /IP Protocol Suite	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 the Congestion and Quality of Service
4. To understand the Queue Management
5. To understand the requirements for the future Internet and its impact on the computer network architecture.

Course Outcomes:

1. Understand different reference models and networking Devices .
2. Analyze the various protocols and IP addressing.
3. Understand different methods to handle Congestion Control .
4. Analyze the Queue and Buffer Management.
5. Analyze Stream Control Transmission Protocol.

Syllabus:

UNIT – I :

Overview Network Models: Layered Tasks, The OSI Model, Layers in OSI Model, TCP/IP Protocol suite, Addressing. Connecting devices: Passive Hubs, Repeaters, Active Hubs, Bridges, Two Layer Switches, Routers, Three Layer Switches, Gateway, and Backbone Networks.

Learning outcomes: Student should be able to

1. Acquire the knowledge on basic arrangement of nodes (computers) in the network(L2)
2. Analyze the structure of layers in the network OSI and TCP/IP Reference Models(L4)

UNIT – II :

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, Checksum, UDP Operation, IP Datagram, Fragmentation, Options, IP Addressing: Classful Addressing, IPV6.

Learning Outcomes: Student should be able to

1. Acquire the knowledge on different Protocols (L2).
2. Analyze the IP addressing scheme(L4)
3. Analyze the header formats (L4)

UNIT – III :

Congestion and Quality of Service: Data Traffic, Congestion, Congestion Control, Congestion Control in TCP, Congestion Control in Frame Relay, Source Based Congestion Avoidance, DEC Bit Scheme, Quality of Service, Techniques to Improve QOS: Scheduling, Traffic Shaping, Admission Control, Resource Reservation, Integrated Services and Differentiated Services.

Learning Outcomes: Student should be able to

1. Acquire the knowledge on Congestion control (L2)
2. Analyze the 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 PQM, Active Queue Management: Early Random Drop, RED Algorithm.

Learning Outcomes: Student should be able to

1. Acquire the knowledge on Queue Management (L2)
2. Analyze the PQM (L4)

UNIT – V:

Stream Control Transmission Protocol: SCTP Services, SCTP Features, Packet Format,FlowControl, 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: Student should be able to

1. Acquire the knowledge on Stream Control Transmission Protocol (L2)
2. Analyze the how IP Packet Delivery process (L4)

Text Books:

- Behrouz A Forouzan, "TCP/IP Protocol Suite", TMH, 3rd Edition
- B.A. Forouzan, "Data communication & Networking", TMH, 4th Edition.

References:

- Mahbub Hasan & Raj Jain, " High performance TCP/IP Networking", PHI -2005
- Douglas. E.Comer, "Internetworking with TCP/IP ", Volume I PHI
- Larry L. Perterson and Bruce S. Davie , "Computer Networks- A Systems Approach", 2011, Morgan Kaufmann
- Jochen Schiiler, "Mobile Communications", Pearson, 2nd Edition.

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1**):**

SNO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO.1	3	3	2	2									2	2	1
CO.2	3	3	2	2									2	3	1
CO.3	3	3	2	2									3	2	1
CO.4	3	3	3	2									3	2	1
CO.5	3	3	3	3									3	3	1
CO*	3	3	2	2									3	2	1

** For Entire Course, PO & PSO Mapping*

Subject Code	Subject Name	L	T	P	C
R20CS-HCTP3102	Secure Coding	3	1	0	4

Course Objectives:

1. To understand the security development process.
2. Knowledge of outline of the techniques for developing a secure application.
3. To handling 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, student will be able to

1. Analyze secure systems and various security principles.
2. Understand the development of process of software leads to secure coding practices
3. Apply Secure programs and various risk in the dynamic memory management.
4. Understand XSS related attacks and remedies
5. Understand various software architecture models.

UNIT–I:

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

Learning Outcomes:student will be able to

- Understand the need of secure system (L2).
- Analyzesecurity 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 based vulnerabilities.

Learning Outcomes:student will be able to

- Describe the string manipulation errors (L2).
- Analyze the string buffer overflow Vulnerabilities (L4).
- Analyzemitigation 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:student will be able to

- Analyze errors in dynamic memory management (L4).
- Analyze double free vulnerabilities (L4).
- Apply integer security to various applications (3).

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:student will be able to

- Understand the 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:student will 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, Sean J. Barnum, Robert J. Ellison, Gary McGraw, Nancy R. Mead, "Software Security Engineering: A guide for Project Managers", Addison-Wesley Professional, 2008.

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1**):**

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2										2	2	2	2
CO2	3	2	2		1							2	2	2	2
CO3	3	2	2		1							2	2	2	2
CO4	3	2	2		1							2	2	2	2
CO5	3	2			1							2	1	2	2
C0.*	3	2	2		1							2	2	2	2

** For Entire Course, PO & PSO Mapping*

Subject Code	Subject Name	L	T	P	C
R20CS-HCAJ3103	Angular JS Framework	3	1	0	4

Course Objectives:

1. Understand model view framework for building applications.
2. Create modules for binding the application.
3. Understand dependency injection for implementing services.
4. Create and establish routes redirects and navigation.
5. Validate forms for the submission of data.

Course Outcomes:

6. Create Angular component using angular dependencies.
7. Apply data binding objects for implementing modules.
8. Create service and retrieve rest call data.
9. Understand routes and their configuration in angular.
10. Implement form handling with event driven apps.

Unit I:

Angular JS – Introduction to Angular JS, Java Script vs Angular, MVC Framework, Component Based Model, Setting Up Angular, Installation of Node and NPM, Angular CLI, Creating and Running Project, Dependencies, App Component, Anatomy of Component, Creating Components.

Learning Outcomes: student will be able to

- Understand 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 Component, 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: Student 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 Project.

Learning Outcomes: Student will be able to

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

Unit IV:

Routing & Wrap Up: Introduction to Routing, Angular Project with routing, Creating routes, Route redirects and wild cards, Configuring child routes, Navigation for routes, Wrap Up

Learning Outcomes: Student will be able to

- Understand routing with angular (L2)
- Create and redirect routes for navigation. (L4)
- Implement wild cards and wrap up for building angular project. (L4)

Unit V:

Form Handling : Introduction to Form Handling, Form Validation, ng-minlength, ng-maxlength, ng-pattern, ng-required, Submitting Forms, Event Handling with Forms.

Learning Outcomes: Student will be able to

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

Applications:

- Online web applications
- Financial, banking applications and gateways etc
- 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:

- Angular JS by Green, Orielly
- Professional AngularJS (WROX), by Valeri Karpov

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	2	2	1	3						1	1	2	3	3
CO2	3	2	2	1	3						1	1	2	3	3
CO3	3	3	3	2	3						1	2	3	3	3
CO4	3	3	3	2	3						1	2	3	3	3
CO5	2	2	2	2	2						1	1	2	2	2
CO.*	3	2	2	2	3						1	1	2	3	3

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1**)**

Subject Code	Subject Name	L	T	P	C
R20CS-HCMD3104	Mathematical Essential for Data Science	3	1	0	4

Course Outcomes:

1. Recall the basics of sets, natural numbers, integers, rational numbers, and real numbers.
2. Learn to use the coordinate system, and plot straight lines.
3. Identify the properties and differences between linear, quadratic, polynomial, exponential, and logarithmic functions.
4. Find roots, maxima and minima of polynomials using algorithmic methods.
5. Learn to represent sets and relations between set elements as discrete graphs using nodes and edges.

UNIT – 1:

Set Theory - Number system, Sets and their operations

Relations and functions - Relations and their types, Functions and their types, Rectangular coordinate system

UNIT – 2:

Straight Lines- Slope of a line, Parallel and perpendicular lines, Representations of a Line, General equations of a line, Straight-line fit

Quadratic Functions - Quadratic functions, Minima, maxima, vertex, and slope, Quadratic Equations

UNIT – 3:

Algebra of Polynomials - Addition, subtraction, multiplication, and division, Algorithms

UNIT – 4:

Graphs of Polynomials - X-intercepts, multiplicities, end behavior, and turning points, Graphing & polynomial creation

Functions - Horizontal and vertical line tests, Exponential functions, Composite functions, Inverse functions

Logarithmic Functions - Properties, Graphs, Exponential equations, Logarithmic equations

UNIT – 5:

Graph Theory - Representation of graphs, Breadth-first search, Depth-first search, Applications of BFS and DFS

Directed Acyclic Graphs - Complexity of BFS and DFS, Topological sorting and longest path, Transitive closure, Matrix multiplication

Graph theory Algorithms - Single source shortest paths, Dijkstra's algorithm, Bellman-Ford algorithm, All-pairs shortest paths, Floyd–Warshall algorithm, Minimum cost spanning trees, Prim's algorithm, Kruskal's algorithm

Text Books:

1. Introductory Algebra: a real-world approach (4th Edition) - by Ignacio Bello

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1**)**

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CS.1	3	2	1	1								2	2		
CS.2	3	2	1	1								2	2		
CS.3	3	2	1	1								2	2		
CS.4	3	2	1	1								2	2		
CS.5	3	2	1	1								2	2		
CO*	3	2	1	1								2	2		

III-II Semester

Subject Code	Subject Name	L	T	P	C
R20CS-PC3201	Computer Networks	3	0	0	3

Course Objectives:

1. Understand the network architecture and applications.
2. Understand about the basic Networking Components and their functionality.
3. Understand the functionalities of the Data Link Layer.
4. Understand the protocols for data transfer.
5. Analyse different protocols and architecture of IEEE 802.11

Course Outcomes:

1. Understand diffrent Reference Models.
2. Understand the functions of physical layer
3. Understand the functions of Data Link Layer.
4. Understand the functions of Network and Transport layers.
5. Analyze the Application layer protocols

Unit 1:

Introduction: Components of a Data Communication system, Dataflow **,** Network Topologies LAN,MAN,WAN. Reference models- The OSI Reference Model- the TCP/IP Reference Model

Learning Outcomes:student 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)
- Analyzethe importance of each layer in the reference models.(L4).

Applications:

Conceptual Framework of a Network, ATM, Online reservation systems, reservation systems.

Unit 2:

Physical Layer and overview of PL Switching:

TransmissionMedia:Guided,Unguided.Bandwidth,throughput,Latency.

Multiplexing: frequency division multiplexing, wave length division multiplexing, synchronous time division multiplexing, statistical time division multiplexing,

Learning Outcomes: Studentwill be able to

- Understand the Connecting Devices.(L2).
- Analyzedifferent 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, errordetection and correction, CRC,

Elementary Data Link Layer protocols: simplex protocol, Simplex stop and wait, Simplex protocol forNoisyChannel. **Sliding window protocol**: One bit, Go back N, Selective repeat-Stop and wait protocol,

Data link layer in HDLC:configuration and transfer modes, frames, control field, point to point protocol (PPP): framing transition phase, multiplexing.

Learning Outcomes: Student will be able to

- Understand DataLink 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: ALOHA, MAC addresses, Carrier sense multiple access (CSMA), CSMA with Collision Detection, CSMA with Collision Avoidance

Network Layer: Routing algorithm shortest path routing, Flooding, Hierarchical routing, Broad cast, Multi cast, distance vector routing.

The Transport Layer: addressing, establishing a connection, releasing connection, flow control and Buffering and crash recovery, End to end protocols: UDP,

UNIT –5 :

Application layer (WWW and HTTP): ARCHITECTURE : Client (Browser) ,Server ,Uniform Resource Locator HTTP: HTTP Transaction, HTTP Operational Model and Client/Server Communication, HTTP Generic Message Format, HTTP Request Message Format, HTTP Response Message Format

Learning Outcomes: Student 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. Data Communications and Networking ,Behrouz A Forouzan,Fourth Edition.
2. Tanenbaum and David J Wetherall, Computer Networks, 5th Edition, Pearson Edu, 2010

Reference Books:

1. Computer Networks: A Top Down Approach, Behrouz A. Forouzan, FirouzMosharraf, McGraw Hill Education
2. Larry L. Peterson and Bruce S. Davie, “Computer Networks - A Systems Approach” (5th ed), Morgan Kaufmann/ Elsevier, 2011

Subject Code	Subject Name	L	T	P	C
R20CS-PC3202	Compiler Design	3	0	0	3

Course Objectives:

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. Understand the functionalities of compilation phases and role of lexical analyzer.
2. Analyze the working process of top-down parser.
3. Analyze the working process of Bottom-up parser.
4. Understand the symbol table and storage organization techniques.
5. Design the optimized code by applying optimization techniques.

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

1. Analyze the differences between different translators. [L4]
2. Differentiate the various phases of a compiler. [L4]
3. Understands the role of parser. [L2]
4. 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

1. Understand the differences between Top-Down and Bottom-Up parsing techniques. [L2]
2. Apply parsing techniques to design Top-Down parser. [L3]
3. 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

1. Understand the model of LR parser. [L2]

2. Apply parsing techniques to design Bottom-Up parser. [L3]
3. 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

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

UNIT-V:

Intermediate code, three address code, quadraples, 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

1. Design intermediate code for various statements and expressions. [L6]
2. Design data flow graph and to optimize the data flow graph. [L6]
3. 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,2nd ed, Pearson,2007.
2. Principles of compiler design, V. Raghavan, 2nd ed, TMH, 2011.
3. Principles of compiler design, 2nd ed, Nandini Prasad, Elsevier

Reference Books:

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

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	3	2							2	2	2	3
CO2	3	3	3	3									2	2	3
CO3	3	3	3	3									2	2	3
CO4	3	3	3	2								3	2	3	3
CO5	3	3	3	3								3	3	3	3
CO*	3	3	3	3	2							3	2	2	3

Subject Code	Subject Name	L	T	P	C
R20CS-PC3203	Design and Analysis Algorithms	3	0	0	3

Course Objectives:

The course is designed to

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

Course Outcomes:

1. Understand the functionalities of compilation phases and role of lexical analyzer.
2. Analyze the working process of top-down parser.
3. Analyze the working process of Bottom-up parser.
4. Understand the symbol table and storage organization techniques.
5. Design the optimized code by applying optimization techniques.

UNIT I

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.

http://nptel.ac.in/

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1**)**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1									2			3
CO2	2	2	2									2			2
CO3	2	2	2	2								2			2
CO4	2	2		2								2			2
CO5	3	2		2								2			2
CO6	2	2	2									2			
CO.*	2	2	2	2								2			2

Professional Elective

Subject Code	Subject Name	L	T	P	C
R20CS-PE3204.1	Distributed Systems	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 Transactions and replications in distributed systems.

Unit 1:

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, MukeshSighal, “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

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1**)**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1									1			1
CO2	3	3	2	2								1	2		1
CO3	3	2	2									2	2		
CO4	3	2	1	1	2							1			1
CO5	3	2	2	2	2							1	1	2	
CO*	3	2	2	2	2							1	2	2	1

Subject Code	Subject Name	L	T	P	C
R20CS-PC3204.2	Web Services	3	0	0	3

Course Objectives:

1. Understand web services and Service oriented architecture (SOA).
2. Implement java generic classes and annotations.
3. Implement java persistence using JSON and XML Parsers.
4. Implement XML Web services using WSDL and JAX-WS.
5. 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 JAXBAPIs 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, 9th Edition, Dieitel & Deitel, 2012.
2. Java Web Services: Up and Running, 2nd 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.

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1)

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	3						1	1	2	3	3
CO2	3	2	2	1	3						1	1	2	3	3
CO3	3	3	3	2	3						1	2	3	3	3
CO4	3	3	3	2	3						1	2	3	3	3
CO5	2	2	2	2	2						1	1	2	2	2
CO*	3	2	2	2	3						1	1	2	3	3

Subject Code	Subject Name	L	T	P	C
R20CS-PE3204.3	Speech Processing	3	0	0	3

Course Objectives:

1. To understand the speech production mechanism and the various speech analysis techniques.
2. To understand the speech compression algorithms.
3. To understand the speech recognition models.
4. To understand the speaker recognition techniques.
5. 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

1. Understand speech production process and speech features. (L2)
2. Understand speech representation. (L2)
3. 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

1. Understand machine training procedure for speech recognition. (L2)
2. 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

1. Analyze feature space for speaker recognition. (L4)
2. 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

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

Text Books:

1. L. R. Rabiner and R. W. Schafer, Introduction to Digital Signal Processing, Foundations and Trendsin 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 Lucio Prina Ricotti -Speech Recognition, John Wiley and sons 1999.

COURSE OUTCOMES VS POs MAPPING(DETAILED; HIGH: 3;MEDIUM:2;LOW:1**):**

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2			2					2	2	2	2	2
CO2	3	2	2		2	2					2	2	2	2	2
CO3	3	2	2	2	2	2					2	2	2	2	2
CO4	3	2	2	2	2	2					2	2	2	2	2
CO5	3	2		2	2	2					2	2	2	2	2
CO.*	3	2	2	2	2	2					2	2	2	2	2

** For Entire Course, PO & PSO Mapping*

Subject Code	Subject Name	L	T	P	C
R20CS-PE3204.4	Human Computer Interaction	3	0	0	3

Course Objectives:

1. To get student to think constructively and analytically about how to design and evaluate interactive technologies.
2. Describe the various styles and interactive devices in designing.
3. Analyze the quality and different strategies in language processing.
4. Study the design principles and guidelines of HCI.
5. 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 formanaging 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:

a. Designing the User Interface, Strategies for Effective Human Computer Interaction, 5ed, Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven M Jacobs, Pearson

b. 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

COURSE OUTCOMES VS POs MAPPING(DETAILED;HIGH:3;MEDIUM:2;LOW:1**):**

CO	PO1	PO2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
C01	**3**	**1**	**2**									**2**		**2**	
C02	**3**		**2**		**3**							**2**		**2**	
C03	**3**	**2**										**2**		**2**	
C04	**3**	**2**	**1**		**3**							**2**		**2**	
C05	**3**	**1**										**2**		**2**	
C0*	**3**	**2**	**2**		**3**							**2**		**2**	

** For Entire Course, PO & PSO Mapping*

Subject Code	Subject Name	L	T	P	C
R20CS-OE3205.2	Sales Force	3	0	0	3

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.

Module 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

Module 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

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

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

Module V: Super Badges- Apex Specialist, Process Automation Specialist

Textbooks:

- Learning Salesforce Development with APEX,Paul Battison
- Practical Guide To Salesforce Communities, Philip Weinmeister,Apress

References:

- https://trailhead.salesforce.com
- https://trailblazercommunitygroups.com

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1**):**

COs	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2				2			3	3		2
CO2	3	3	3	3	3	1	1	1	3	2	2	3	3	2	2
CO3	3	3	3	3	3	1	1	1	3	2	2	3	3	2	2
CO4	3	3	3	3	3	1	1	1	3	2	2	3	3	2	2
CO5	3	3	2	3	3	1	1	1	2	2	2	3	3	2	2
CO.*	3	3	3	3	3	1	1	1	3	2	2	3	3	2	2

Subject Code	Subject Name	L	T	P	C
R20CS-PC3206	Computer Networks Lab	0	0	3	1.5

Course Objectives:

- To understand the Configuration of Hardware devices and LAN Topology.
- To understand the working principle of various communication protocols.
- To Understand the importance of IPv4
- To understand the network simulator environment and visualize a network topology and observe its performance.
- To analyze the traffic flow and the contents of protocol frames

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

1. Illustrate a Local Area Network And Physical Hardware Connection
2. Demonstrate Topologies.
3. Model the network protocols using a network simulator.
4. Analyze packet transmission using TCP and UDP .
5. Demonstrate application layer protocols

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 art 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
2. https://www.packettracernetwork.com/

http://tutorials.ptnetacad.net/tutorials70.htm

Subject Code	Subject Name	L	T	P	C
R20CS-PC3207	Compiler Design Lab	0	0	3	1.5

Course Objectives:

Course is designed to:

1. Teach the design and development of lexical analyzer
2. Teach the design and development of parser
3. Describe the concept of lex tool.
4. Explain code optimization techniques.

Course outcomes:

1. Acquire knowledge on designing lexical analyzer.
2. Acquire knowledge on designing parsers.
3. Implement lex program using LEX tool.
4. Understand the techniques of loop unrolling and constant propagation.

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. 4.https://www.ibm.com/support/knowledgecenter/en/ssw_aix_72/com.ibm.aix.genprogc/ie_prog_4lex_yacc.htm

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH:3;MEDIUM:2;LOW:1**):**

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO 3
CO1	3	3	3	1	2							2	3	3	3
CO2	3	3	3	2								3	3	2	3
CO3	2	2	2	2								2	3	2	2
CO4	3	3	2	3								3	3	3	3
CO*	3	3	3	2	2							3	3	3	3

Subject Code	Subject Name	L	T	P	C
R20CS-PC3208	Design and Analysis Algorithms Lab	0	0	3	1.5

Course Objectives:

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

Course Outcomes:

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

1. Design an algorithm in a effective manner
2. Apply iterative and recursive algorithms.
3. Design iterative and recursive algorithms.
4. Implement optimization algorithms for specific applications.
5. Design optimization 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 Dijikstra'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 = {s1, s2,….., sN} 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 Wileyn and Sons, 2006.
2. Base Sara, Allen Van Gelder ," Computer Algorithms Introduction to Design and Analysis", Pearson, 3rd Edition, 1999.

Honors Courses

Subject Code	Subject Name	L	T	P	C
R20CS-HCWN3201	Wireless Sensor Networks	3	1	0	4

Course Objectives:

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

Course outcomes:

1. Illustrate the wireless sensor node architectures.
2. Outline the physical layer design.
3. Inspect MAC protocols of wireless sensor and networks.
4. Inference various network layer routing protocols of wireless sensor.
5. Summarize the network security requirements.

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 II:

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 III:

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 IV:

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 V:

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 - Jagannathan Sarangapani, CRC Press.
3. Holger Karl & Andreas Willig, Protocol and Architectures for Wireless Sensor Networks, John Wiley, 2005.

References:

1. Kazem Sohraby, Daniel Minoli, & Taieb Zanti, "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.

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1)

COs	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PS O3
CO1	3	1	1	-	-	-	-	-	-	-	-	2	1	-	-
CO2	3	1	1	-	-	-	-	-	-	-	-	2	1	-	-
CO3	3	3	2	2	-	-	-	-	-	-	-	2	1	2	-
CO4	3	3	2	2	-	-	-	-	-	-	-	2	1	-	-
CO5	3	3	2	2	-	-	-	-	-	-	-	2	1	2	-
CO.*	3	2	-	-	2	-	-	-	-	-	-	2	2	2	-

** For Entire Course, PO & PSO Mapping*

Subject Code	Subject Name	L	T	P	C
R20CS-HCBTNF3202	Block Chain Technologies	3	1	0	4

Course Objectives:

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

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

1. Acquire basic skills and knowledge of Distributed Database and Cryptography.
2. Interact with a 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 TizianaCimoli, A survey of attacks on Ethereum smart contracts.

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1**):**

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2			2					3	2	2	2	2
CO2	3	2	2			3					3	2	2	2	2
CO3	3	2				3					3	2	2	2	2
CO4	3	2				3					3	2	2	2	2
CO5	3	2				3					3	2	2	2	2
CO.*	3	2	2			3					3	2	2	2	2

** For Entire Course, PO & PSO Mapping*

Subject Code	Subject Name	L	T	P	C
R20CS-HC3203	.NET Framework	3	1	0	4

Course Objectives:

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

Course Outcomes:

1. Understand structure of C# program constructs.
2. Implement object oriented concepts with files and threads.
3. Implement generics and reflections for data collection.
4. Create user interactive web pages using ASP.NET
5. Develop secure web applications with persistence and state.

Unit I:

Introduction to C#-Overview of Environment-Microsoft Visual Studio 2019 and Visual C#, features, Program Structure, Data Types, 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: S**tudent 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, TopListener, Topclient

.**Learning Outcomes: S**tudent 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.Tamarai Selvi,R.Murugesan.

2. Programming C# 8.0: Build Cloud, Web, and Desktop Applications,Orielly Publications

3. The Complete Reference ASP.NET, Mathew Mc Donald,Mc Graw Hill

Reference Books:

1.C# in depth, manning publications, John Skeet

2.ASP.NET Core in Action, Andrew Lock,Manning publication.

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3;

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	3						1	1	2	3	3
CO2	3	2	2	1	3						1	1	2	3	3
CO3	3	3	3	2	3						1	2	3	3	3
CO4	3	3	3	2	3						1	2	3	3	3
CO5	2	2	2	2	2						1	1	2	2	2
CO.*	3	2	2	2	3						1	1	2	3	3

Subject Code	Subject Name	L	T	P	C
R20CS-HCNP3204	**Natural Language Processing**	**3**	**1**	**0**	**4**

Course Objectives:

1. To learn the fundamentals of natural language processing
2. To understand the use of CFG and PCFG in NLP
3. To understand the role of semantics of sentences and Pragmatics
4. To gain knowledge in automated natural language generation and machine translation
5. To understand language modelling

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

1. Illustrate fundamentals of basic Language features
2. Analyze the words involved in NLP
3. Outline the syntactic analysis involved in NLP
4. Utilize semantics of 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 requirenets of semantics of NLP(**L2**)

UNIT V:

Discourse Analysis And Lexical Resources **(9 Periods)**

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. **U**nderstand 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 andSpeech, Pearson Publication, 2014.
2. Steven Bird, Ewan Klein and Edward Loper, ―Natural Language Processing with Python, First Edition, OReilly 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, OReilly Media, 2015.
3. Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural LanguageProcessing, Second Edition, Chapman and Hall/CRC Press, 2010.
4. Tanveer Siddiqui, U.S. Tiwary, ―Natural Language Processing and Information Retrieval, Oxford University Press, 2008.

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1**)**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	2	1	1								2	2		
CO2	3	2	1	1								2	2		
CO3	3	2	1	1								2	2		
CO4	3	2	1	1								2	2		
CO5	3	2	1	1								2	2		
CO.*	3	2	1	1								2	2		