Detailed Syllabus

Course Code	15B11CI111	**Semester Odd (specify Odd/Even)**	**Semester I**. **Session** 2018 -2019 **Month from July** to **December**
Course Name	Software Development Fundamentals-I		
Credits	4	**Contact Hours**	**3 (L) + 1(T)**

Faculty (Names)	**Coordinator(s)**	Archana Purwar (J62) + Sudhanshu Kulshrestha (J128)
	Teacher(s) (Alphabetically)	Adwitiya Sinha, Amanpreet Kaur, Chetna Dabas, Dharamveer Rajput, Gaganmeet Kaur, Parul Agarwal, Sakshi Agarwal , Sonal, Shradha Porwal

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Solve puzzles , formulate flowcharts, algorithms and develop HTML code for building web pages using lists, tables, hyperlinks, and frames	Apply Level (Level 3)
CO2	Show execution of SQL queries using MySQL for database tables and retrieve the data from a single table.	Understanding Level (Level 2)
CO 3	Develop python code using the constructs such as lists, tuples, dictionaries, conditions, loops etc. and manipulate the data stored in MySQL database using python script.	Apply Level (Level 3)
CO4	Develop C Code for simple computational problems using the control structures, arrays, and structure.	Apply Level (Level 3)
CO5	Analyze a simple computational problem into functions and develop a complete program.	Analyze Level (Level 4)
CO6	Interpret different data representation , understand precision, accuracy and error	Understanding Level (Level 2)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Scripting Language & Algorithmic Thinking	Introduction to HTML, Tagging v/s Programming, Algorithmic Thinking and Problem Solving, Introductory algorithms and flowcharts	5
2.	Developing simple software applications with scripting and	Developing simple applications using python; data types (number, string, list), operators, simple input output, operations, control flow (if -else, while)	4

	visual languages		
3.	Elementary Database	Introduction to data base system, Single Table applications, basic operations : ADD,DELETE,UPDATE,SELECT, ALTER ,Introduction to primary key	4
4.	C Programming	Syntax and semantics, data types and variables, expressions and assignments, array and struct, simple I/O, conditional and iterative control structures Programs on unit conversion, approximating the square root of a number, finding the greatest common divisor, average, sum, min, max of a list of numbers, common operations on vector, matrix, polynomial, strings, programs for pattern generation	15
5.	Functions in C Programming	Functions and parameter passing (numbers, ,characters, array, structure) , recursion , e.g. factorial, Fibonacci, Scope of variable	8
6.	Data base connectivity using MySQL	Creating Web pages with Database connectivity using MySQL	2
7.	Aspects of numerical computing	Data representation , Understanding precision, accuracy, error, Introduction to Scientific Computation	4
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	H. Cooper and H. Mullish, Jaico Publishing House. "Spirit of C", 4th Edition, Jaico Publishing House, 2006
2.	Herbert Schildt. "The Complete Reference C ", 4th Edition, TMH, 2000

3.	Brian W. Kernighan and Dennis M. Ritchie ,"The C Programming Language", 2nd Edition, Prentice-Hall India, New Delhi, 2002
4.	Peter Norton, "Introduction to Computers", 5th edition, Tata McGraw-Hill, Delhi., 2005.
5	Balaguruswamy, Programming in ANCI C", 2nd Edition, TMH, 2001.
***6*.**	Ashok N. Kamthane , "Programming with ANSI and Turbo C", Pearson Education, Delhi, 2003
7.	Rajaraman V., "Fundamentals of Computer", 3rd Edition, Prentice-Hall India, New Delhi, 2005.
8.	B. A. Forouzan, R. F. Gilberg "Computer Science: A Structured Programming Approach Using C", 2nd Edition, Thomson Press, New Delhi, 2006
9	Avi Silberschatz, Henry F. Korth, and S. Sudarshan, "Database System Concepts", 6th edition, McGraw-Hill, 2010.
10.	User manuals supplied by department for SQL and Python

Detailed Syllabus

Course Code	15B17CI171	**Semester Odd** **(specify Odd/Even)**	**Semester** 1st **Session** 2018 -2019 **Month from** July to December
Course Name	Software Development Fundamentals 1 Lab		
Credits	2	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Dr. Chetna Dabas and Sarishty Gupta (Sec-62) & Akanksha (Sec-128)
	Teacher(s) (Alphabetically)	Amanpreet Kaur, Amarjeet Prajapati, Ankit Vidyarthi, Ankita Verma, Ankita Wadhwa, Aparajita Nanda, Archana Purwar, Arpita Jadhav, Bharat Gupta, Chetna Dabas, Deepti Singh, Dharamveer Rajpoot, Kavita Pandey, K. Rajalakshmi, Mradula Sharma, Nisha Chaurasia, Niyati Aggarwal, Parul Aggarwal, Prashant Kaushik, Purtee Kohli, Rohit Pal Singh, Sakshi Aggarwal, Sarishty Gupta, Shardha Porwal, Sherry Garg, Shikha Jain, Somya Jain, Sonal, Vikas Hassija

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Design HTML code for building web pages using lists, tables, hyperlinks, and frames.	Apply Level (C3)
CO2	Develop python programs for constructs such as lists, tuples, dictionaries, conditions, and loops using Python 3.6.	Apply Level (C3)
CO3	Design simple SQL queries using MySQL to create database tables and retrieve the data from a single table.	Apply Level (C3)
CO4	Develop C programs for datatypes, expressions, conditional structure, and iterative control structure and pattern generation using Code Blocks and Virtual Lab.	Apply Level (C3)
CO5	Design C programs for array, structure, and functions using Code Blocks and Virtual Lab.	Apply Level (C3)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	Introduction to HTML	Experiments to create web pages using tags, lists, tables, frames, forms.	1
2.	Python	Experiments to develop python programs using data types (number, string, list), operators, simple input output operations, control flow (if -else, while)	2

3.	MySQL	Experiments to create MySQL queries using operations like ADD, DELETE,UPDATE, SELECT	3
4.	C Programming (Part-1)	Experiments to develop C programs using datatypes, expressions, conditional structure (if-else), and iterative control structure (do-while, while, for).	4
5.	C Programming (Part-2)	Experiments to develop C programs using for array, structure, and functions.	5

Evaluation Criteria

Components	**Maximum Marks**
Evaluation 1	15
Lab Test 1	20
Evaluation 2	20
Evaluation 3	15
Lab Test 2	20
TA	10
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	H. Cooper and H. Mullish, Jaico Publishing House. “Spirit of C”, 4th Edition, Jaico Publishing House, 2006
2.	Herbert Schildt. “The Complete Reference C ”, 4th Edition, TMH, 2000
3.	Brian W. Kernighan and Dennis M. Ritchie ,“The C Programming Language”, 2nd Edition, Prentice-Hall India, New Delhi, 2002
4.	Peter Norton, “Introduction to Computers”, 5th edition, Tata McGraw-Hill, Delhi., 2005.
5.	Balaguruswamy, Programming in ANCI C”, 2nd Edition, TMH, 2001.
6.	Ashok N. Kamthane , “Programming with ANSI and Turbo C”, Pearson Education, Delhi, 2003
7.	B. A. Forouzan, R. F. Gilberg “Computer Science: A Structured Programming Approach Using C”, 2nd Edition, Thomson Press, New Delhi, 2006.
8.	https://www.w3schools.com/html/
9.	https://www.w3schools.com/sql/
10.	https://www.w3schools.com/python/
11.	User manuals supplied by department for HTML, SQL and Python

Detailed Syllabus

Course Code	15B11CI211	**Semester** Even **(specify Odd/Even)**	**Semester** 2nd **Session** 2018 -2019 **Month from** January to May
Course Name	Software Development Fundamental - 2		
Credits	4	**Contact Hours**	3 (L)+ 1 (T)

Faculty (Names)	**Coordinator(s)**	Dr. Aparajita Nanda, Sarishty Gupta
	Teacher(s) (Alphabetically)	Aditi Sharma, Aparajita Nanda, Arpita Jadhav Bhatt, Manju, Monali Mavani, Sakshi Aggarwal, Sangeeta , Sarishty Gupta, Sonal

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Develop C programs using structures, pointers, functions, and files.	Apply Level (C3)
CO2	Solve problems related to data storage, retrieval, searching, and sorting by utilizing stack/queue.	Apply Level (C3)
CO3	Make use of linked list to solve various problems.	Apply Level (C3)
CO4	Apply binary tree data structure to perform operations like searching, insertion, deletion, and traversing.	Apply Level (C3)
CO5	Explain basic features of object-oriented design such as objects, classes, encapsulation, polymorphism, inheritance, and abstraction	Understand Level (C2)
CO6	Develop C++ programs using OOPs concepts like encapsulation, Inheritance, Polymorphism, and Standard Template Library.	Apply Level (C3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Advanced C programming	Revision of Functions, Pointers, Pointer arithmetic, Handling 1 D and 2 D array using its pointer notation, sending these in function, Handling structures using pointer. FILE handling (binary and text), Linear and binary search, insertion, selection, and bubble sort.	14
2.	Implementations and applications of elementary data structures	Stacks, Stack and Stack applications (array based implementation. Queue and queue applications, Circular Queue and Deque using array, Linked list, Link list application, link list based storage, sparse matrix, Binary trees, Binary tree Implementation: array and pointer based	15

3.	Object Oriented Programming	Introduction to of Object-Oriented Programming using C++, objects, classes, methods, implementing functions in the class, use of scope resolution operator, Access Modifiers, static functions and static data members, constructor and destructors, Inheritance: single, multiple, multi-level and hybrid, Polymorphism: function and operator overloading, virtual member functions, abstract base classes and pure virtual functions, Introduction to SDLC.	16
		Total number of Lectures	**45**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignments (10) +Attendance & Class Performance (10)+ Tutorial (5))
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	H. Cooper and H. Mullish, Jaico Publishing House. "Spirit of C", 4th Edition, Jaico Publishing House, 2006
2.	Herbert Schildt. "The Complete Reference C ", 4th Edition, TMH, 2000
3.	Brian W. Kernighan and Dennis M. Ritchie ,"The C Programming Language", 2nd Edition, Prentice-Hall India, New Delhi, 2002
4.	Ellis Horowitz, Sartaj Sahni Fundamentals of Data Structures in C, 2008, Silicon press
5	E Balaguruswamy , Object Oriented Programming With C++ , 4th Edition , TMH, 2008
6.	Manuals provided by the department

Detailed Syllabus

Course Code	15B17CI271	Semester : Even	Semester 2nd Session 2018 -2019 Month from Jan-May 2019
Course Name	Software Development Fundamental – 2 LAB		
Credits	1	Contact Hours	2

Faculty (Names)	Coordinator(s)	Sakshi Agarwal, Somya Jain
	Teacher(s) (Alphabetically)	Aditi Sharma, Aparajita Nanda, Arpita Jadhav, Dhanalekshmi G., K. Rajalakshmi, Parul Agarwal, Pawan Upadhyay, Prantik Biswas, Purtee Kohli, Sakshi Agarwal, Sarishty Gupta, Shardha Porwal, Somya Jain

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Make use of structures, pointers, functions, and files to build basic C programs.	Apply (level 3)
CO2	Construct stack/queue based solutions for data storage, retrieval, searching, and sorting problems.	Apply (level 3)
CO3	Apply linked list data structure to solve problems like polynomial operations and sparse matrix representation.	Apply (level 3)
CO4	Build operations like searching, insertion, deletion, traversing on binary tree data structure.	Apply (level 3)
CO5	Demonstrate fundamental concepts of object-oriented programming i.e. objects, classes, encapsulation, polymorphism, inheritance, and abstraction.	Understand (level 2)
CO6	Apply object-oriented programming features like encapsulation, Inheritance, Polymorphism, and Standard Template Library to construct C++ programs.	Apply (level 3)

Module No.	Title of the Module	List of Experiments	CO
1.	Structures	Write C programs to store heterogeneous data and perform basic queries over it.	CO1
2.	Pointers & Functions	Write C programs using pointers and recursive functions like palindrome, factorial, fibonacci series, number system etc.	CO1

3.	File Handling & Dynamic Memory Allocation	Write menu driven C programs to perform basic file operations (create, read, write, update).	CO1
4.	Searching & Sorting	Write C programs to perform searching (Linear and binary) and sorting (Insertion, bubble, selection) on set of n numbers, strings using runtime input or stored input from a file.	CO2
5.	Stacks	Write C programs using LIFO concept such as push an element, pop an element, display status of the stack and arithmetic expressions evaluation and representations.	CO2
6.	Queue	Write programs in C to perform operations on queues using array implementation.	CO2
7.	Linked List	Write programs in C to perform basic operations (add, delete, search etc.) via linked list representation.	CO3
8.	Binary Tree	Write programs in C to implement binary tree properties (traversal, leaf node identification, height etc.) using array and linked list representation.	CO4
9.	Introduction to C++ : Classes and Objects	Understand fundamental concepts of OOPs i.e. objects, classes, constructor, destructor, friend function through output based C++ programs.	CO5
10.	Object oriented programming Concepts	Write programs in C++ using OOPs concept like encapsulation, Inheritance, Polymorphism and Abstraction.	CO6

Evaluation Criteria

Components	**Maximum Marks**
Lab Test -1	**20**
Lab Test -2	**20**
TA	**60**
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	H. Cooper and H. Mullish, Jaico Publishing House. “Spirit of C”, 4th Edition, Jaico Publishing House, 2006
2.	Herbert Schildt. “The Complete Reference C ”, 4th Edition, TMH, 2000
3.	Brian W. Kernighan and Dennis M. Ritchie ,“The C Programming Language”, 2nd Edition, Prentice-Hall India, New Delhi, 2002

4.	Ellis Horowitz, Sartaj Sahni Fundamentals of Data Structures in C, 2008, Silicon press
5.	E Balaguruswamy , Object Oriented Programming With C++ , 4th Edition , TMH, 2008
6.	Manuals provided by the department on \\fileserver2

Detailed Syllabus

Lecture-wise Breakup

Course Code	18B11CI121	**Semester** Even **(specify Odd/Even)**	**Semester** Second **Session** 2018 -2019 **Month from Jan to June**
Course Name	Fundamental of Computer Programming II		
Credits	4	**Contact Hours**	**3L+1T**

Faculty (Names)	**Coordinator(s)**	Mradula Sharma
	Teacher(s) (Alphabetically)	Mradula Sharma

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Define basics of C programming language like its data types, operators, control flow and loop control.	Remember (C3)
CO2	Develop C programs using Controls flows like while, do while, for loops, if else , switch case, etc.	Apply (C3)
CO3	Experiment with single and multi dimensional arrays, structure and functions in C programming Language.	Apply (C3)
CO4	Explain basic features of object-oriented design such as encapsulation, polymorphism, inheritance, and abstraction and compare it with function oriented programming.	Understand(C2)
CO5	Develop a simple web application with client and server side scripting using JavaScript and PHP and connect with a given relational database	Apply (C3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	C Programming	Syntax and semantics, data types and variables, expressions and assignments, array and struct, simple I/O, conditional and iterative control structures Programs on unit conversion, approximating the square root of a number, finding the greatest common divisor, average, sum, min, max of a list of numbers, common operations on vector, matrix, polynomial, strings,	16

		programs for pattern generation	
2.	Functions in C Programming	Functions and parameter passing (numbers, ,characters, array, structure) , recursion , e.g. factorial, Fibonacci, Scope of variable	10
3.	functions oriented programming Vs object oriented programming	comparison between FOP and OOP , OOPs Concepts	7
4.	HTML forms, Introduction to client and servers side scripting, introduction to PHP	HTML forms, creating dynamic web pages with database connectivity using Mysql	9
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25(Attendance :10, Assignment :10, quiz:5)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	H. Cooper and H. Mullish, Jaico Publishing House. “Spirit of C”, 4th Edition, Jaico Publishing House,2006
2.	Herbert Schildt. “The Complete Reference C ”, 4th Edition, TMH, 2000
3.	Brian W. Kernighan and Dennis M. Ritchie ,“The C Programming Language”, 2nd Edition, Prentice-Hall India, New Delhi, 2002
4.	User manuals supplied by department for C , PHP, html and sql

Detailed Syllabus

Lab-wise Breakup

Course Code	**18B15CI121**	**Semester** Even **(specify Odd/Even)**	**Semester** Second **Session** 2018 -2019 **Month from** Jan to June
Course Name	Computer Programming lab II		
Credits	1	**Contact Hours**	2

Faculty (Names)	**Coordinator(s)**	Mradula Sharma
	Teacher(s) (Alphabetically)	Mradula Sharma

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Demonstrate basic programs of different data types and operators in C.	Understand (C2)
CO2	Develop C programs using Controls flows like while, do while, for loops, if else , switch case, etc.	Apply (C3)
CO3	Make use of single and multi dimensional arrays, structure and functions in C programming language.	Apply (C3)
CO4	Demonstrate basic features of object-oriented programming such as objects and classes in C++.	Understand (C2)
CO5	Develop a simple web application with client and server side scripting using Javascript and PHP and connect with a given relational database	Apply (C3)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	Basic Programming In C	Data types, Declaring Variables, Initializing Variables, Type Conversion	CO1
2.	Operators and Expressions And Input Output In C	Conditional operators, Arithmetic, Relational, Assignment, Logical and Bitwise operators, Formatted Functions, Flags, Widths and Precision with Format String, Unformatted Functions	CO1
3.	Decision Statements	If statement, IF- else, If-else-if, break, continue, go to, switch case	CO2
4.	Loop Control	The for loops , nested for loop, the while loop, do while loop	CO2
5.	Data Structure: Array and structure	Array, 2 D array, Matrix operations, structure and functions	CO3
...	C++ programming	Programs based on class and objects	CO4

***n*.**	PHP, Java Script and HTML Forms	Develop a simple web application with client and server side scripting using Javascript and PHP and connect with a given relational database	CO5

Evaluation Criteria

Components	**Maximum Marks**
Evaluation 1	15
Evaluation 2	15
Evaluation 3	15
Lab Test 1	20
Lab Test 2	20
TA	15
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	H. Cooper and H. Mullish, Jaico Publishing House. “Spirit of C”, 4th Edition, Jaico Publishing House,2006
2.	Herbert Schildt. “The Complete Reference C ”, 4th Edition, TMH, 2000
3.	Brian W. Kernighan and Dennis M. Ritchie ,“The C Programming Language”, 2nd Edition, Prentice-Hall India, New Delhi, 2002
4.	User manuals supplied by department for C , PHP, html and sql

Detailed Syllabus

Lecture-wise Breakup

Course Code	15B11CI311	**Semester** Odd **(specify Odd/Even)**	**Semester** III **Session** 2018 -2019 **Month from July** to December
Course Name	Data Structures		
Credits	4	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	TRIBHUWAN KUMAR TEWARI
	Teacher(s) (Alphabetically)	ANKITA WADHWA , K VIMAL KUMAR, MANISH KUMAR THAKUR, SHERRY GARG, TRIBHUWAN KUMAR TEWARI, VIKAS SAXENA

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO210.1	Develop programs using object oriented programming (C++) including STL, conversion of a recursive algorithm to non-recursive algorithm using stack, the stack and queue based solutions for various computing problems	Apply Level (Level 3)
CO210.2	Construct test cases for their programs and debug the code.	Apply Level (Level 3)
CO210.3	Explain abstract data types and design implementations, using abstraction functions to document them.	Understanding Level (Level 2)
CO210.4	Implement and compare various searching(Linear, Binary, Interpolation, Median) and sorting (Bubble, Selection, Insertion, Merge, Radix, and Quick)algorithms and interpret their time complexities;	Understanding Level (Level 2)
CO210.5	Demonstrate and implement the various operations (Storage, Search, Traverse, Insertion, Deletion, Updating, etc.) on different tree data structures (binary trees, k-ary trees, binary search trees, AVL tree, heap, B tree and B+ tree)	Understanding Level (Level 2)
CO210.6	Demonstrate and implement the various operations (Storage, Search, Traverse, Insertion, Deletion, Updating, Path finding, Minimum spanning tree etc.) on different Graph data structures.	Understanding Level (Level 2)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**

1.	Basics of OOP	Class diagram, Polymorphism, Template, STL, Introduction to SDLC, Testing fundamentals and test-case generation,	8
2.	Searching and Sorting	Searching, Sorting (Merge, Quick, Radix, Bucket), Simple fractal graphics;	6
3.	Liners data Structures	ADT, Time and space complexity, analysis of algorithms, Stack & Queue based applications, Recursion removal,	6
4.	Non-linear Data Structures	Binary tree, k-ary tree, BST, Threaded Tree, AVL Tree, B Tree, B+ Tree, Heap and Priority Queue, Hashing, Set, Multiset, Dictionary, Maps, Graphs and basic algorithms, e.g., traversal, spanning tree, isomorphism. Data structure evaluation.	16
5.	Advanced Programming issues	Memory management (garbage collection), Assertion, Defensive programming (e.g. secure coding, exception handling), Code reviews, Program correctness (The role and the use of contracts, including pre- and post-conditions), Unit testing, Event-Driven and Reactive Programming, Debugging techniques.	6
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Atendance, Discipline(10), Assignment(10),Quiz(5))
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1	Object Oriented Programming With C++, E Balagurusamy, TMH,2000
2	Object Oriented Programming in C++, Robert Lafore, SAMS, 2002
3	Fundamanetal of Data Structures in C++, Horobitz and Sahni and Mehta, 2009, Galgotia
4	Theory and Problems of Data Structures with C++, Shaum's outline, McGraw-hill, 2000
5	Course Material supplied at SM

Detailed Syllabus

Lab-wise Breakup

Course Code	15B17CI371	**Semester: ODD (specify Odd/Even)**	**Semester** III **Session** 2018 -2019 **Month from Jul '18 to Dec '18**
Course Name	Data Structures Laboratory		
Credits	**0-0-2**	**Contact Hours**	2

Faculty (Names)	**Coordinator(s)**	K Vimal Kumar
	Teacher(s) (Alphabetically)	Ankita Wadhwa, Dr. Manish Kumar Thakur, Dr. Neetu Sardana, Prantik Biswas, Rohit Pal Singh, Sherry Garg, Dr. Tribhuwan Tewari

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Develop programs using object oriented programming (C++) including STL	Apply Level (C3)
CO2	Develop various searching (Linear, Binary, Interpolation, Median) and sorting (Merge, Radix, and Quick) algorithms	Apply Level (C3)
CO3	Experiment with lists, multi linked list for sparse matrix representation, rat in a maze problem, n queens problem, etc.	Apply Level (C3)
CO4	Develop the programs for different tree data structure operations like, storage, search, traverse, insertion, deletion, updating, etc. on binary trees, k-ary trees, binary search trees, AVL trees, heap trees, B trees and B+ trees.	Apply Level (C3)
CO5	Develop the various operations (Storage, Search, Traverse, Insertion, Deletion, Updating, Path finding, Minimum spanning tree etc.) on different Graph data structures.	Apply Level (C3)
CO6	Develop the programs for priority queue and hashing techniques.	Apply Level (C3)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	**Introduction to DS & OOP**	Introduction to data structures, Case study on data Structure, Introduction to OOP, Classes & its relationships, Class diagram representation, Polymorphism, Templates, STL	CO1
2.	**Introduction to SDLC**	Introduction to SDLC, Memory management (garbage	CO1

		collection), Assertion, Defensive programming (e.g. secure coding, exception handling), Code reviews, Program correctness (The role and the use of contracts, including pre- and post-conditions), Unit testing, Event-Driven and Reactive Programming, Debugging techniques.	
3.	**Sorting & Searching**	Merge Sort, Quick sort, Radix sort, Median search, Interpolation search	CO2
4.	**List**	List, List of list, Multi list, Sparse matrix, Applications – Rat in a maze problem, n-queens problem	CO3
5.	**Trees**	Binary Tree, K-ary tree, Binary Search tree, Threaded Tree, AVL Tree, B Tree, B+ Tree	CO4
6.	**Heaps & Priority queue**	Introduction, Binary heap, Priority queue	CO4
7.	**Set & Map Data structure**	Set, Multiset, Dictionary, Maps	CO1
8.	**Graph**	Introduction to graphs, Representation – adjacency list, adjacency matrix, Traversal – BFS, DFS, Isomorphism, Minimum spanning tree – Prims and Kruskal's algorithm, Shortest path – Dijkstra algorithm and Floyd–Warshall algorithm	CO5
9.	**Hashing**	Introduction to hashing, Collision resolution – open and closed hashing methods	CO6

Evaluation Criteria

Components	**Maximum Marks**
Lab Test-1	**20**
Lab Test-2	**20**
Day-to-Day (Project, Lab Assessment, Attendance)	**60**
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Yedidyah Langsam, Moshe J., Augenstein and Aaron M. Tenenbaum: Data Structures Using C and C++, 2nd Edition, PHI, 2001
2.	Kurt Mehlhorn: Data Structures and Algorithms 3, Springer, 1984
3.	Dinesh P Mehta, Sartaj Sahani: Handbook of Data Structure and Applications, Chapman & Hall, 2004
4.	Mark Allen Weiss: Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson
5.	Sahni: Data Structures, Algorithms and applications in C++, Universities press, Hyderabad, 2005

6.	Kruse, Tonso, Leung: Data Structures and Program Design in C, 2rd Edition, Pearson Education Asia, 2002
7.	Weiss, Mark Allen: Data Structures and Algorithm Analysis in C/C++, 2nd Edition, Pearson Education Asia, 2003
8.	Cormen et al: Introduction to Computer Algorithms, 2nd edition , PHI New Delhi 2003
9.	Aho, Hopcraft, Ullman: Data Structures and Algorithms, Pearson Education Asia (Adisson Wesley), New Delhi, 2001
10.	Standish: Data Structures in Java, Pearson Education Asia (Adisson Wesley), New Delhi, 2000
11.	Knuth: The Art of Computer programming Vol I, Vol III, 2nd edition , Pearson Education Asia (Adisson Wesley), New Delhi, 2002
12.	Heileman: Data Structures, Algorithms and Object Oriented Programming, Tata Mc-Graw Hill, New Delhi, 2002
13.	Sorenson and Tremblay: An Introduction to Data Structures with Algorithms, 2nd Edition, Tata Mc-Graw Hill, New Delhi, 2003

Detailed Syllabus

Course Code	15B11CI312	**Semester : Odd**	**Semester :** Odd **Session :** 2018-2019 **Month from** July'18 to Dec'18
Course Name	Database Systems & Web		
Credits	4	**Contact Hours**	**4(3+1)**

Faculty (Names)	**Coordinator(s)**	Mahendra Kumar Gurve
	Teacher(s) (Alphabetically)	Ankit Vidyarthi, Dhanalekshmi G, Indu Chawla, Kashav Ajmera, Megha Rathi, Sangeeta

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Explain the basic concepts of Database systems and Web components.	Understand Level (Level II)
CO2	Model the real world systems using Entity Relationship Diagrams and convert the ER model into a relational logical schema using various mapping algorithms	Apply Level (Level III)
CO3	Develop a simple web application with client and server side scripting using Javascript and PHP and connect with a given relational database	Create Level (Level VI)
CO4	Make use of SQL commands and relational algebraic expressions for query processing.	Apply Level (Level III)
CO5	Simplify databases using normalization process based on identified keys and functional dependencies	Analyse Level (Level IV)
CO6	Solve the atomicity, consistency, isolation, durability, transaction, and concurrency related issues of databases	Apply Level (Level IV)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Databases	Introduction to Databases, Physical Level of Data Storage, Structure of relational databases, Review of SQL Create, Insert, Update, Delete and Select Statements, Overview of NoSQL databases	4
2.	Web Architecture & Introduction	Motivation, characteristics and complexities of web applications, Basics, of Web Server and Application server, differences between web application and conventional software, architecture layers.	2

3.	Client Side Web Technology	SGML, HTML 5, DHTML, CSS, Java script	3
4.	Server Side Web Technology	PHP, Database Connectivity with PHP	4
5.	Database Design and ER Model	Entity type, Attributes, Relation types, Notations, Constraints, Extended ER Features	4
6.	Relational Model and Structured Query Language	SQL: Data Definition and Data Manipulation, Relational Algebra	9
7.	Procedural Language	PL/SQL: Stored Procedures, Functions, Cursors, Triggers	4
8.	Normalisation	Data Dependencies, 2NF, 3NF, BCNF, building normalised databases	5
9.	Transaction Management	Transactions, Concurrency, Recovery, Security	7
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Henry F Korth, Abraham Silberschatz, S. Sudurshan, Database system concepts, 5th Edition, McGraw-Hill,2006
2.	Ramez Elmasri , Shamkant B. Navathe , Fundamentals of Database Systems, 4th Edition, Pearson Education, 2006.
3.	Ramakrishnan, Gehrke, Database Management Systems, Mcgraw-Hill, 3rd Edition, Addison-Wesley,2006.
4.	Thomas Connolly, Carolyn Begg, Database Systems-A Practical Approach to design, Implementation and Management, 3rd Edition, Addison-Wesley,2002.
5.	"PHP and MYSQL Manual" by Simon Stobart and Mike Vassileiou
6.	"PHP and MYSQL Web Development" by Luke Welling and Laura Thomson(Pearson Education)

Detailed Syllabus

Course Code	15B17CI372	**Semester** Odd	**Semester** III **Session** 2018 -2019 **Month from** July'18 **to** Dec'18
Course Name	Database System & Web Lab		
Credits	0-0-1	**Contact Hours**	2

Faculty (Names)	**Coordinator(s)**	Kashav Ajmera
	Teacher(s) (Alphabetically)	Anuja Arora, Mahendra Kumar gurve, Megha rathi, parmeet kaur and Sandeep Kumar Singh

COURSE OUTCOMES		**COGNITIVE LEVELS**
C01	Explain the basic concepts of Database systems and Web components.	Understand (Level II)
C02	Develop web page using HTML, CSS with client side scripting using javascript.	Apply (Level III)
C03	Develop a simple web application with client and server side scripting using Javascript and PHP and connect to a given relational database.	Apply (Level III)
C04	Programming PL/SQL including stored procedures, stored functions, cursors, Triggers.	Apply (Level III)
C05	Design and implement a database schema for a given problem-domain and normalize a database.	Creating (Level VI)
C06	Design a Project based on database management	Create (Level VI)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	Introduction to Database System and Web components	1. Introduction to Databases,Physical Level of Data Storage, Structure of relational databases. 2. Review of SQL Create, Insert, Update, Delete and Select Statements. 3. Characteristics and complexities of web applications, Basics, of Web Server and Application server.	C01, C05, C06
2.	Client Side Web Technology	1. Design web page using SGML, HTML 5, DHTML, CSS, Java script.	C02, C06
3.	Server Side Web Technology	1. Develop a web application with client and server side scripting using Javascript.	C03,

		2. Develop a web application with client and server side scripting using PHP. 3. Design web application with databased connectivity. 4. Design web application with entering user data into database. 5. Desig web application for user - databse interaction through PHP.	C06
4.	Procedural Language	1. Write C program for storing data using procedures. 2. Write C program for storing data using stored functions. **3.** Write C program for storing data using cursors and Triggers.	C04, C06
5.	Design, Database uses normalization based on identifying keys	1. Implement normalization techniqus on database(Data Dependencies, 2NF, 3NF, BCNF)	C05, C06
6.	Project	1. Students are expected to designed web application based on Php or JavaScript and connect with databased to execute insert, update, retrieve and delete data queries.	C06

Evaluation Criteria

Components	**Maximum Marks**
Lab Test-1	**20**
Lab Test-2	**20**
Day-to-Day (Project, Lab Assessment, Attendance)	**60**
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Henry F Korth, Abraham Silberschatz, S. Sudurshan, Database system concepts, 5th Edition, McGraw-Hill,2006
2.	Ramez Elmasri , Shamkant B. Navathe , Fundamentals of Database Systems, 4th Edition, Pearson Education, 2006.
3.	Ramakrishnan, Gehrke, Database Management Systems, Mcgraw-Hill, 3rd Edition, Addison-Wesley,2006.
4.	Thomas Connolly, Carolyn Begg, Database Systems-A Practical Approach to design, Implementation and Management, 3rd Edition, Addison-Wesley,2002.
5.	"PHP and MYSQL Manual" by Simon Stobart and Mike Vassileiou
6.	"PHP and MYSQL Web Development" by Luke Welling and Laura Thomson(Pearson Education)

Detailed Syllabus

Course Code	15B11CI313	**Semester** Odd **(specify Odd/Even)**	**Semester** Third **Session** 2018 -2019 **Month from** July-December
Course Name	Computer Organization and Architecture		
Credits	4 (L=3, T=1)	**Contact Hours**	3+1

Faculty (Names)	**Coordinator(s)**	Dr. Taj Alam
	Teacher(s) (Alphabetically)	Amarjeet Kaur, Hema N., Padam Kumar, Pawan Upadhyay, Taj Alam

COURSE OUTCOMES		**COGNITIVE LEVELS**
C213.1	Summarize and compare the different computer systems based on RISC and CISC Architecture.	(Analyze Level)Level 4
C213.2	Categorize different types of computers based on Instruction set Architecture.	(Analyze Level)Level 4
C213.3	Apply the knowledge of performance metrics to find the performance of systems.	(Apply Level) Level 3
C213.4	Design RISC and CISC based Computer using Hardwired / Microprogrammed Controller.	(Evaluate Level) Level 5
C213.5	Create and analyze an assembly language program of RISC and CISC based systems.	(Evaluate Level) Level 5
C213.6	Apply the knowledge of pipeline, IO and cache to understand these systems. Further, analyze the performance of such systems.	(Analyze Level)Level 4

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Levels in architecture, Virtual machine, Evolution of multi-level machines.	02
2.	Performance of Computer	Performance Measures For Computer System	02
3.	CPU Organization	Data-path and control, Instruction execution, Microinstruction.	03

4.	Data Path and Control	Hardwired designing for JC62. Micro-programmed control designing for JC62.	02
5.	Generalized Study of Instruction Set Architecture	Stack/accumulator/register-register/register-memory type of architecture. Memory addressing techniques.	02
6.	Types of Instruction	Data movement, Arithmetic/logic, Control flow, Addressing modes. Instruction format.	02
7.	Instruction Set Architecture (ISA) of 8085	8085 Architecture, 8085 Instruction Set, 8085 Instruction Format, 8085 Addressing Modes, 8085 instruction execution and datapath. 8085 Assembly programming for simple applications.	05
8.	ISA of MIPS	MIPS Architecture, MIPS Instruction Set, MIPS Instruction Format, MIPS Addressing Modes, MIPS instruction execution and datapath. MIPS Assembly programming for simple applications.	05
9.	ISA of 8086	8086 Architecture, 8086 Instruction Set, 8086 Instruction Format, 8086 Addressing Modes, 8086 instruction execution and datapath. 8086 Assembly programming for simple applications.	05
10.	Memory Organization	Hierarchal memory structure, Cache memory and organization. Memory interfacing for 8085 and 8086.	05
11.	I/O Organization	Programmed/Interrupt driven I/O, Direct memory access	04
12.	Pipelining	Introduction To Pipelining System and Pipelining in RISC based Systems (MPIS)	03
13.	Multicore Architecture	Generalized study of Multicore Machines.	02
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Attendance 10, Quiz 10, Tutorial 5 Marks)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	M. Morris Mano, Computer System Architecture, Prentice Hall of India Pvt Ltd, Fourth Edition, 2002.
2.	William Stallings, Computer Organization and Architecture–Designing for Performance, Ninth Edition,

	Pearson Education, 2013.
3.	John L. Hennessy and David A Patterson, Computer Architecture A quantitative Approach, Morgan Kaufmann / Elsevier, Fourth Edition, 2007
4.	Ramesh Gaonkar, Microprocessor Architecture Programming and Applications with the 8085, Prentice Hall, Fifth Edition, 1996.
5.	Barry B. Brey, The Intel Microprocessors: 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4, and Core2 with 64-bit Extensions : Architecture, Programming, and Interfacing. Pearson Education India, Eigth Edition, 2009.
6.	Nicholas Carter, Schaum's outline of Computer Architecture, Tata McGraw Hill, Second Edition, 2002.

Detailed Syllabus

Course Code	**15B17CI373**	**Semester** Odd **(specify Odd/Even)**	**Semester** III **Session** 2018 -2019 **Month from** July-Dec 2018
Course Name	**Computer Organization and Architecture Lab**		
Credits	1	**Contact Hours**	0-0-2

Faculty (Names)	**Coordinator(s)**	Dr. Hema N
	Teacher(s) (Alphabetically)	Amarjeet Kaur, Hema N, Pawan Upadhyay, Taj Alam

COURSE OUTCOMES		**COGNITIVE LEVELS**
C273.1	Implementation basic ALU of 2-bit and 4-bit computer using hardwired simulation tool	Apply Level (C3)
C273.2	Initialization and fetching of data from specific memory using various addressing mode of 8085 and 8086	Understand Level (C2)
C273.3	Develop 8086 assembly language programs using software interrupts and various assembler directives.	Apply Level (C3)
C273.4	Develop Microprocessor Interfacing program using PPI for various external devices	Apply Level (C3)
C273.5	Develop MIPS assembly language programs using software interrupts and various assembler directives.	Apply Level (C3)
C273.6	Create of application and its software using 8085/8086 microprocessor or microcontrollers	Create Level (C6)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	COA Hardwired simulation tool	1. Realize the truth table of various gates like as AND, OR, NOT, XOR, NAND and NOR. 2. Conversion of universal gates 3. Design the half adder and full adder circuits. 4. Realization of ripple adder logic circuit. 5. Design the 4 x1 multiplexor circuit and realize the various input output logic based on control. 6. Design the 4X1 multiplexor with NAND gates logic circuits.	**C273**.1
2.	Combinational	1. Design the subtractor circuits with defined bit logic.	**C273.**1

	circuits	2. Design the adder subtractor logic circuits. 3. Design the odd frequency divider circuits Ex: input is F and output is F/3. 4. Design the carry lookup adder, carry select and carry save adder circuits by modifying the ripple carry adder logic given in **module-1.** 5. See the timing diagram of all four adder circuits and compare which of the adder circuits is best in performance. 6. Design the decoder circuits with defined logic. 7. Design the 4 bit ALU circuits with defined operation logic.	
3.	8085 Simulator Introduction	1. Understanding Hardware Specification of the Manosim in detail 2. Load add two 8-bit numbers from **load sample program** from file menu, assemble and execute it step by step and view the contents of registers and memory. 3. Study of basic data transfer instructions of 8085 using sample programs. 4. Study the basic Arithmetic instruction instructions of 8085 and perform the following on sample program and note the changes in the flag register. 5. Study the basic Logical instruction instructions of 8085 and perform the following on sample program and note the changes in the flag register.	**C273.**2
4.	8085 Programming (Simple)	1. Write assembly code for multiplying 2 numbers by the repeated addition method.i.e. 2 * 3 = 2 + 2 + 2. Note: you can NOT use the shift method or any other algorithm in this program. 2. Write an assembly program for adding elements present in 2 arrays and storing the corresponding sum in another array. 3. Write a assembly program for a link list having five node which can store the student name and id. 4. Write an assembly program for reverse the half of the string/Number . 5. Write an assembly program for extracting the vowels from the string “JIIT IS A UNIVERSITY:” . Assume the string is located at some memory location.	**C273.**2
5.	8085 Programming (Complex)	1. Write an assembly program for addition and subtraction of two 8-bit & 16 bit numbers using 8085 microprocessor. 2. Write an assembly program for Multiplication & Division of two 8-bit numbers. 3. Write an assembly program for Largest & Smallest among N numbers	**C273.**2, **C273.**4

		4. Write an assembly program for Factorial of N number. 5. Sort the numbers stored from location 2000H in ascending order. 6. Sort the numbers stored from location 2000H in descending order. 7. You have 10 numbers stored from location 2000H. Store the odd numbers at location 3000H and even at 4000H. 8. Simulation of 8085 interfacing with 8255	
6.	8086(MASM/emu86)	1. Write an assembly program for addition and subtraction of two 8-bit & 16 bit numbers using 8086 microprocessor. 2. Write an assembly program for Multiplication & Division of two 8-bit numbers. 3. Write an assembly program for Largest & Smallest among N numbers 4. Write an assembly program forFactorial of N number. 5. Sort the numbers stored from location 2000H in ascending order. 6. Sort the numbers stored from location 2000H in descending order. 7. You have 10 numbers stored from location 2000H. Store the odd numbers at location 3000H and even at 4000H. 8. Program based on BIOS interrupt to read and write IO devices.	**C273.**3
7.	MIPS(MARS) simulator	1. Write a MIPS program to Take two values from the user, add these values and print the output. 2. Write a MIPS program to Take two values of your choice, add these values and print the output. 3. Write a MIPS program to add array of elements of size 10 and display it 4. Write a MIPS to compute first twelve Fibonacci numbers and put in array, then print.	**C273.**5
8.	Projects	Students are expected to create an hardware and software co-designed application based on 8085/8086/MIPS programming either in assembly or high level language.	**C273.**6

Evaluation Criteria

Components	**Maximum Marks**
Lab Test-1	20
Lab Test-2	20
Evaluation-1	10
Evaluation-2	10
Project	25
Attendance	15
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	M. Morris Mano, Computer System Architecture, Prentice Hall of India Pvt Ltd, Fourth edition, 2002. ISBN: 81-203-0855-7.
2.	William Stallings, Computer Organization and Architecture–Designing for Performance, 9th Edition, Pearson Education, 2013.
3.	John L. Hennessy and David A Patterson, Computer Architecture A quantitative Approach, Morgan Kaufmann / Elsevier, Fourth Edition, 2007
4.	Microprocessor Architecture Programming and Applications with the 8085 [HB]-6/e. 25 September 2014. by Ramesh Gaonkar .
5.	The Intel Microprocessors: 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4, and Core2 with 64-bit Extensions : Architecture, Programming, and Interfacing. Barry B. Brey, Pearson Education India, 2009.
6.	Nicholas Carter, Schaum's outline of Computer Architecture, Tata McGraw Hill, 2006,
7.	http://nptel.ac.in/courses/Webcourse-contents/IIT-%20Guwahati/comp_org_arc/web/
8.	http://cs.nyu.edu/~gottlieb/courses/2010s/2011-12-fall/arch/class-notes.html
9.	http://www.cse.iitm.ac.in/~vplab/courses/comp_org/LEC_INTRO.pdf
10.	http://www.cs.iastate.edu/~prabhu/Tutorial/title.html
11.	http://www.cag.csail.mit.edu/
12.	http://www.research.ibm.com/compsci/arch

Detailed Syllabus

Subject Code	15B11CI411	**Semester Odd** **(specify Odd/Even)**	**Semester** IV **Session** 2018 -2019 **Month from:** Jan **to** June 2019
Subject Name	Algorithms and Problem Solving		
Credits	**4**	**Contact Hours**	**4**

Faculty (Names)	**Coordinator(s)**	Dr. Manish Kumar Thakur (J62), Varsha Garg (J128)
	Teacher(s) (Alphabetically)	J62 - Dr. Anita Sahoo, Deepti Singh, Kashav Ajmera, Dr. Manish K Thakur, Sherry Garg J128 – Dr. Mukesh Saraswat, Dr. Neeraj Jain, Pulkit Mehendiratta, Varsha Garg

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Analyze the complexity of different algorithms using asymptotic analysis.	Analyze Level (Level 4)
CO2	Select an appropriate data structure and apply related operations for a given problem.	Apply Level (Level 3)
CO3	Apply algorithmic principles for solving a given problem.	Apply Level (Level 3)
CO4	Identify, formulate and design an efficient solution to a given problem using appropriate data structure and algorithm design technique.	Create Level (Level 6)

Module No.	**Subtitle of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Introduction to problem solving approach; Asymptotic Analysis: Growth of Functions and Solving Recurrences; Notations- Big O, big omega, big theta, little o; Empirical analysis of sorting and searching algorithms – Merge sort, Quick sort, Heap sort, Radix sort, Count sort, Binary search, and Median search	6
2.	Search Trees and Priority Queue	Search Trees: Segment tree, Interval Tree, and RB Tree; Priority queue using Binomial and Fibonacci Heap	6
3.	Design Technique: Divide and Conquer	Fundamentals of Divide and Conquer (D&C) approach using Binary search, Quick sort, and Merge sort; Strassen's matrix multiplication; and Closest pair, etc.	2
4.	Design Technique:	Introduction to greedy based solution approach; Minimum Spanning Trees (Prim's and Kruskal algorithms); Shortest	6

	Greedy Algorithms	Path using Dijkstra's algorithm; Fractional and 0/1 Knapsack; Coinage problem; Bin packing; Job scheduling – Shortest job first, Shortest remaining job first, etc.; Graph coloring; and Text compression using Huffman coding and Shannon-Fano coding, etc.	
5.	Design Technique: Backtracking Algorithms	Review of backtracking based solution approach using N queen, and Rat in a maze; M-coloring problem; Hamiltonian Cycle detection; Travelling salesman problem; Network flow	4
6.	Dynamic Programming	Fundamentals of Dynamic programming based solution approach; 0/1 Knapsack ; Shortest path using Floyd Warshall; Coinage problem; Matrix Chain Multiplication; Longest common subsequence; Longest increasing sequence, String editing	6
7.	String Algorithms	Naïve String Matching, Finite Automata Matcher, Rabin Karp matching algorithm, Knuth Morris Pratt, Tries; Suffix Tree; and Suffix Array	6
8.	Problem Spaces and Problem solving by search	Problem Spaces: States, goals and operators, Factored representation (factoring state into variables) Uninformed search (BFS, DFS, DFS with iterative deepening), Heuristics and informed search (hill-climbing, generic best-first, A*)	4
9.	Tractable and Non-Tractable Problems	Efficiency and Tractability, P, NP, NP-Complete, NP- Hard problems	2
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Punctuality (5), Online Test on CP Portal (10), Mini-project (10))
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein , Introduction to Algorithms, MIT Press, 3rd Edition, 2009
2.	Steven Skiena ,The Algorithm Design Manual, Springer; 2nd edition , 2008
3.	Knuth, The art of Computer Programming Volume 1, Fundamental Algorithms, Addison-Wesley Professional; 3 edition,1997
4.	Horowitz and Sahni, Fundamentals of Computer Algorithms, Computer Science Press, 1978
5.	Sedgewick, Algorithms in C, 3rd edition. Addison Wesley, 2002

6.	Weiss, Data Structures and Algorithm Analysis in C, Benjamin and Cummings Pub., 1994
7.	Alfred V. Aho, J.E. Hopcroft, Jeffrey D. Ullman, Data Structures and Algorithms, Addison-Wesley Series in Computer Science and Information Processing, 1983
8.	ACM Transactions on Algorithms (TALG)
9.	Algorithmica Journal, Springer
10.	Graphs and Combinatorics, Journal, Springer
11.	The ACM Journal of Experimental Algorithmics

Detailed Syllabus

Subject Code	15B17CI471	**Semester Odd** **(specify Odd/Even)**	**Semester** IV **Session** 2018 -2019 **Month from:** Jan **to** June 2019
Subject Name	Algorithms and Problem Solving Lab		
Credits	**2**	**Contact Hours**	**4**

Faculty (Names)	**Coordinator(s)**	Dr. Ankita Verma and Mr. Pulkit Mehendiratta
	Teacher(s) (Alphabetically)	Dr. Amarjeet Prajapati, Ms. Ankita Wadhwa, Dr. Ankita Verma, Dr. Anita Sahoo, Dr. Aparajita Nanda, Dr. Bharat Gupta, Ms. Deepti Singh, Mr. Kashav Ajmera, Dr. Manish Thakur, Dr. Manju, Ms. Indu Chawla, Mr. Rohitpal Singh, Dr. Sangeeta Mittal, Dr. Satish Chandra, Ms Sherry Garg, Dr. Shikha Jain, Ms Sonal

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Choose and define appropriate data structure to a given problem	Remember Level (Level 1)
CO2	Understand various data structures and algorithm design techniques with the help of examples.	Understand Level (Level 2)
CO3	Apply and build various algorithms and design techniques to solve the given problem.	Apply Level (Level 3)
CO4	Analyze the algorithm by their complexity using asymptotic analysis.	Analyze Level (Level 4)
CO5	Evaluate the correctness and complexity of the algorithm for a given problem.	Evaluate Level (Level 5)
CO6	Formulate, elaborate and design an efficient solution to a given problem using appropriate data structure and algorithm design technique	Create Level (Level 6)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	Analysis of algorithms, Searching and sorting based problems	Introduction to problem solving approach; Asymptotic Analysis; Solving Recurrences; Empirical analysis of sorting and searching algorithms – Merge sort, Quick sort, Heap sort, Radix sort, Count sort, Binary search, and Median search	CO1, CO4

2.	Search Trees and Priority Queue	Search Trees: Segment tree, Interval Tree, and RB Tree; Priority queue using Binomial and Fibonacci Heap	CO1, CO2
3.	Design Technique: Divide and Conquer	Problems based on Divide and Conquer (D&C) approach such as Binary search, Quick sort, and Merge sort; and Closest pair, etc.	CO3, CO5
4.	Design Technique: Greedy Algorithms	Introduction to greedy based solution approach; Minimum Spanning Trees (Prim's and Kruskal algorithms); Shortest Path using Dijkstra's algorithm; Fractional and 0/1 Knapsack; Coinage problem; Bin packing; Job scheduling – Shortest job first, Shortest remaining job first, etc.; Graph coloring; and Text compression using Hamming coding and Shannon-Fano coding, etc.	CO3, CO5
5.	Design Technique: Backtracking Algorithms	Review of backtracking based solution approach using N queen, and Rat in a maze; M-coloring problem; Hamiltonian Cycle detection; Travelling salesman problem; Network flow	CO3, CO5
6.	Dynamic Programming	Fundamentals of Dynamic programming based solution approach; 0/1 Knapsack ; Shortest path using Floyd Warshall; Coinage problem; Matrix Chain Multiplication; Longest common subsequence; Longest increasing sequence, String editing	CO3, CO5
7.	String Algorithms	Naïve String Matching, Finite Automata Matcher, Rabin Karp matching algorithm, Knuth Morris Pratt, Tries; Suffix Tree; and Suffix Array	CO3, CO5
8.	Problem Spaces and Problem solving by search	Problem Spaces: States, goals and operators, Factored representation (factoring state into variables) Uninformed search (BFS, DFS, DFS with iterative deepening), Heuristics and informed search (hill-climbing, generic best-first, A*)	CO3, CO5
9.	Project Evaluation	Designing an efficient solution to a given problem using appropriate data structure and algorithm design technique	CO6

Evaluation Criteria

Components	**Maximum Marks**
Labtest 1	**20**
Labtest 2	**20**
Quiz(6)	**5*6 (each of 5 marks)**
Project	**15**
Attendance	**15**
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein , Introduction to Algorithms, MIT Press, 3rd Edition, 2009
2.	Steven Skiena ,The Algorithm Design Manual, Springer; 2nd edition , 2008
3.	Knuth, The art of Computer Programming Volume 1, Fundamental Algorithms, Addison-Wesley Professional; 3 edition,1997
4.	Horowitz and Sahni, Fundamentals of Computer Algorithms, Computer Science Press, 1978
5.	Sedgewick, Algorithms in C, 3rd edition. Addison Wesley, 2002
6.	Weiss, Data Structures and Algorithm Analysis in C, Benjamin and Cummings Pub., 1994
7.	Alfred V. Aho, J.E. Hopcroft, Jeffrey D. Ullman, Data Structures and Algorithms, Addison-Wesley Series in Computer Science and Information Processing, 1983

Detailed Syllabus

Course Code	15B11CI412	**Semester** Even **(specify Odd/Even)**	**Semester** IV **Session** 2018 -2019 **Month from** Jan to May 2019
Course Name	Operating Systems and System Programming		
Credits	3	**Contact Hours**	3-1-0

Faculty (Names)	**Coordinator(s)**	1. Hema N
	Teacher(s) (Alphabetically)	1. Amanpreet kaur 2. Amarjeet Kaur 3. Hema N 4. Taj Alam 5. Shilpa Budhkar

COURSE OUTCOMES		**COGNITIVE LEVELS**
C215.1	Understanding fundamental of operating systems and system programming.	Understand Level (C2)
C215.2	Apply the process management concept and threads in OS	Apply Level (C3)
C215.3	Analyze the performance of various device and resource management techniques for different systems.	Analyze Level (C4)
C215.4	Examine process synchronization and deadlock problem related to inconsistency and race conditions with shared variables.	Analyze Level (C4)
C215.5	Analyze the working of IO management and disk scheduling	Analyze Level (C4)
C215.6	Analyze and report appropriate OS design choices when building real-world systems.	Analyze Level (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction and Historical context of Operating Systems	What are Operating Systems? All components Description, The Evolution of OS: Batch Systems, multi programming systems, Time sharing systems, Parallel systems, Real Time systems, Distributed systems.	2
2.	Operating Structure and Architecture	Operating system structure: Micro kernel, Monolithic systems, Layered systems, Virtualization, Client-server model, Mobile Operating System. X86 architecture overview, Booting sequences, Boot loaders and their stages, BIOS and its routines, Interrupts.	2

3.	Process Concepts, Threads & Concurrency, Scheduling Concurrency & Synchronization issues,	Process concepts, Threads: Overview, Benefits, User and Kernel threads, Multithreading models. Scheduling, Operations on processes, Cooperative processes, IPC, Scheduling criteria, Scheduling algorithms, Multiple processor scheduling, Process synchronization: Critical section problems, Semaphores, Synchronization hardware and monitors.	10
4.	Deadlock	System model, Characterization, Methods for handling deadlocks. Deadlock prevention, Avoidance and detection, Recovery from deadlock	3
5.	Memory Management.	Background, Swapping, Contiguous memory allocation, Paging, Segmentation, Segmentation with Paging, Virtual Memory	6
6.	File System management and Input output management	File concept, Access models, Directory structure, Protection, File-system Structure, Allocation methods, Free space management. Overview, I/O hardware, Application I/O interface.	2
7.	Secondary Storage Management	Disk structure, Disk scheduling, Disk management., Swap-space management	2
8.	Fault and Security Issues	Overview of system security, Security methods and devices, Protection, access, and authentication, Models of protection, Memory protection.	2
9.	Distributed O.S	Int. to distributed operating systems, synchronization and deadlock in distributed systems	1
10.	Case studies of OS	Windows, Linux ,IBM	2
11.	System Programming	Introduction, Components of a Programming System: Assemblers, Loaders, Macros, Compliers, Formal System.	2
12.	Memory Addressing	Memory Multiplexing, Binding of Instruction and Data to Memory. Address Translation, Multi-Segment, Special Registers, Wait/Exit, Address Translation.	2
13.	Interrupts and Exceptions	Synchronous and asynchronous interrupts, Calling a System Call from User Space, INT, Trap Handling, System call dispatch, arguments and return value, Device Interrupts.	2
14.	Kernel Synchronization, System Calls and System Signals	Disabling Interrupts, Lock Implementation, Linux Synchronization Primitives	2
15.	Device Drivers	Block Device Drivers, Character Device Drivers, Network	2

		Drivers	
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz+ Assignment)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Charles Crowley "Operating System A Design Approach" TMH.
2.	Andrew S. Tanenbaum "Operating Systems Design and Implementation", Third Edition, Prentice Hall Publications 2006
3.	A.S. Tanenbaum, "Modern Operating Systems", 2nd edition, Prentice Hall India.
4.	A.Silberschatz, P.Galvin, G. Gagne, "Operating systems concepts" Willey international company (sixth edition)
5.	Gary Nutt, "Operating Systems – A modern perspective", Pearson Education
6.	David Solomon and Mark Russinovich ," Inside Microsoft Windows 2000", Third Edition, Micorosoft Press
7.	D. M. Dhamdhere, " Systems Programming and Operating systems" TMH, 2nd revised edition.2006
8.	ACM/IEEE transactions on operating systems concepts.
9.	www.vmware.com
10.	www.luitinfotech.com/kc/what-is-cloud-computing.pdf
11.	https://cs162.eecs.berkeley.edu/static/sections/section8.pdf
12.	Charles Crowley "Operating System A Design Approach" TMH.

Detailed Syllabus

Course Code	**15B17CI472**	**Semester Even (specify Odd/Even)**	**Semester** 4 **Session** 2018 -2019 **Month from Jan to May**
Course Name	**Operating System and System Programming LAB**		
Credits	0-0-1	**Contact Hours**	**2**

Faculty (Names)	**Coordinator(s)**	Sangeeta
	Teacher(s) (Alphabetically)	2. Amanpreet kaur 2. Amarjeet Kaur 3. Hema N 4. Sangeeta 5. Taj Alam 6. Shilpa Budhkar 7. Parmeet Kaur 8. Purtee Kohli 9. Vivek Singh

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Understand Various Unix Commands	Understanding (Level-2)
CO2	Develop programs to create different types of processes using pthread library under Linux environment.	Apply (Level-3)
CO3	Develop programs to implement resource management task like CPU scheduling algorithms, deadlock handling.	Apply (Level-3)
CO4	Develop programs to implement and test various synchronization techniques like semaphores, binary semaphore and monitors via different classical test suites.	Apply (Level-3)
CO5	Design and analyse various disk-scheduling algorithms, memory management schemes, file management systems.	Analyzing (Level-4)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	Introduction to UNIX	Learning Unix Commands(file commands, directory commands, symolic links,terminal commands,help commands,information commands,useful cshell symbols,permissions and file storage (unix),permissions and file storage (andrew),processes,printingEnvironment,customizing networking,x-applicationsunix filters)	1
2.	Process Management and Thread Management	Develop programs to create different types of processes under Linux environment. Develop programs to create multitasking threads using pthread library under Linux environment.	2

		Develop programs to implement interprocess communication	
3.	CPU Scheduling, Deadlock Handling	Develop programs to implement resource management task like CPU scheduling algorithms(First Come First Served,Shortest Job First, Round Robin, Priority Scheduling, Multi level Queue, Multilevel Feedback), deadlock handling(Prevention, Avoidance and Detection)	3
4.	Process Sychronization	Develop programs to implement and test various synchronization techniques like semaphores, binary semaphore and monitors via different classical test suites.	4
5.	Disk Scheduling and File Management	Design and analyse various disk-scheduling algorithms. Develop programs to implement memory management schemes. Design, implement and assess file management systems (file organization and file directories) for different OS.	5

Evaluation Criteria

Components	**Maximum Marks**
Lab Test 1	20
Lab Test 2	20
Day-to-Day(Evaluations, Viva, Attendance, Project)	60
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	CharlesCrowley “Operating System A Design Approach”TMH.
2.	Andrew S. Tanenbaum “Operating Systems Design and Implementation”, Third Edition,Prentice Hall Publications2006
3.	A.S. Tanenbaum, “Modern Operating Systems”, 2nd edition, Prentice Hall India.
4.	A.Silberschatz, P.Galvin, G. Gagne, “Operating systems concepts” Willey international company (sixth edition)
5.	Gary Nutt, “Operating Systems – A modern perspective”, Pearson Education
6.	David Solomon and Mark Russinovich ,” Inside Microsoft Windows 2000”, Third Edition, Micorosoft Press
7.	D. M. Dhamdhere, “ Systems Programming and Operating systems” TMH, 2nd revised edition.2006
8.	ACM/IEEE transactions on operating systems concepts.
9.	www.vmware.com

10.	www.luitinfotech.com/kc/what-is-cloud-computing.pdf
11.	https://cs162.eecs.berkeley.edu/static/sections/section8.pdf

Detailed Syllabus

Subject Code		**Semester** **EVEN**	**Semester** EVEN (IV Sem CSE & IT) **Session** 2018 - 19 **Month: January to June**
Subject Name	Automata Theory and Computations		
Credits	**3**	**Contact Hours**	**3-0-0**

CO	**Course objective**	**Cognitive Level**
CO1	Relate the basic difference between deterministic and non-deterministic computing machines.	Understand (Level 2)
CO2	Summarize and translate the output based finite machines	Understand (Level 2)
CO3	Solve the problems related to language recognition for non-regular grammar	Apply (Level 3)
CO4	Interpret the language accepted by tuning machine	Apply (Level 3)
CO5	Analyze problems related to undecidability and take part in approximation theory.	Analyze (Level 4)

Faculty (Names)	**Coordinator(s)**	1. Dr. Ankit Vidyarthi
	Teacher(s) (Alphabetically)	

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Introduction	Alphabets, Strings and Languages, Automata, Grammars, Deterministic finite Automata (DFA), State transition graph, Transition table, Language of DFA, Nondeterministic finite Automata (NFA), NFA with epsilon transition, Language of NFA, Equivalence of NFA and DFA, Minimization of Finite Automata	7
2.	Regular expression	Operators of regular expression and their precedence, Algebraic laws for Regular expressions, Kleen's Theorem, Regular expression to FA, DFA to Regular expression, Non Regular Languages, Pumping Lemma for regular Languages, FA with output: Moore and Mealy machine	7
3.	Context free grammar	Derivation, Derivation trees, Ambiguity in Grammer, Inherent ambiguity, Ambiguous	7

		to Unambiguous CFG, Useless symbols, Simplification of CFGs, Normal forms for CFGs: CNF and GNF, Closure properties of CFLs, Decision Properties of CFLs: Emptiness, Finiteness and Membership	
4.	Push Down Automata	Language of PDA, Acceptance by Final state, Acceptance by empty stack, Deterministic PDA, Equivalence of PDA and CFG, CFG to PDA and PDA to CFG, Two stack PDA	8
5.	Turing machines	Language acceptance by TM, Variants of Turing Machine, TM as Computer of Integer functions, Universal TM, Church's Thesis, Recursive and recursively enumerable languages, Halting problem	8
6.	Undecidability	Introduction to Undecidability, Undecidable problems about TMs, Post correspondence problem (PCP), Modified PCP, Introduction to recursive function theory	5
		Total number of Lectures	42

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	J. Hopcroft, R. Motwani, and J. Ullman. "Introduction to Automata Theory, Languages, and Computation", 3rd edition, 2007, Pearson/Addison-Wesley
2	P. Linz., "Introduction to Formal Languages and Automata", 6th edition, 2017, Jones and Barlett
3.	Michael Sipser, "Introduction to the Theory of Computation", 3rd edition 2013, Cengage Learning.
4.	K.L.P. Mishra and N.Chandrasekaran, "Theory of Computer Science : Automata, Languages and Computation", PHI Learning Private Limited, Delhi India.
5.	Harry R. Lewis and Christos H. Papadimitriou, Elements of the theory of Computation, Second Edition, Prentice-Hall of India Pvt. Ltd.

Detailed Syllabus

Subject Code	16B1NCI432	**Semester: (specify Odd/Even)**	**Semester** Even **Session** 2018-2019 **Month from** Jan19 **to** June19
Subject Name	Fuzzy logic and Neural Network		
Credits	3-1-0	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Ms. Archana Purwar
	Teacher(s) (Alphabetically)	Ms. Ankita Verma , Ms. Parul Agarwal

SL.NO.	**COURSE OUTCOME(CO)**	**COGNITIVE LEVEL (BLOOMS TAXONOMY)**
CO1	Explain the concepts of fuzziness involved in various systems and fuzzy set theory.	Understanding Level (Level 2)
CO 2	Apply the different methods of defuzzification, Fuzzy Logic and approximate reasoning	Apply Level (Level 3)
CO3	Analyze different fuzzy inference systems for various real world problems.	Analyze Level (Level 4)
CO4	Explain the fundamental concepts of Artificial Neural Networks and various learning algorithms of supervised, unsupervised and associative memory networks.	Understanding Level (Level 2)
CO5	Apply artificial neural networks in various applications of classification e.g. pattern recognition, character recognition, etc.	Apply Level (Level 3)
CO6	Analyze different artificial neural networks to solve practical problems.	Analyze Level (Level 4)

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	Introduction to Fuzzy Logic	Classical Sets, Fuzzy Sets: operations and properties. Operations on fuzzy relations	4
2.	Membership functions	Features, fuzzification, methods of membership value assignments	2
3.	Defuzzification	Introduction; Lambda-Cuts for fuzzy sets and fuzzy relations; Defuzzification methods	3
4.	Fuzzy Rules	Introduction; formation of rules, decomposition and aggregation of rules; Approximate Reasoning	4
5.	Fuzzy inference systems (FIS) and applications	FIS methods: Mamdani and Sugeno; Applications: such as fuzzy logic control etc.	5
6.	Artificial Neural Network: An Introduction	Fundamental concepts; Evolution of NN; Basic Models of ANN; connections and learning; Terminologies such as weights, Bias, Threshold, Learning Rate etc.; McCulloch-Pitts Neuron; Heb Network	5
7.	Supervised Learning Network	Perceptron Network, Adaptive Linear Neuron; Multiple Adaptive Linear Neurons, Back Propagation Network, Radial Basis Function Network	5
8.	Associate Memory Networks	Introduction and training algorithm for pattern association; Autoassociative Memory Netwok; Hetroassociative Memory Network, Bidirectional associative memory; Hopfield Network	6
9.	Unsupervised Learning Network	Introduction; Fixed Weight Competitive Nets; Kohonen Self-Organizing Feature Maps; Adaptive Resonance Theory	6
10.	Applications of ANN	Applications: Recognition of characters, Fabric defect identification etc.	2
		Total number of Lectures	**42**

Evaluation Criteria	
Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Timothy J. Ross, "Fuzzy Logic with Engineering Applications," McGraw Hill, 1995
2.	Simon Haykin, "Neural Networks" Pearson Education
3.	B.Yegnanarayana, "Artificial Neural Networks," PHI, India, 2006
4.	S. N. Sivanandan and S.N. Deepa, "Principles of Soft Computing", Wiley India, 2012.
5.	Limin Fu, "Neural Networks in Computer Intelligence," McGraw Hill, 2003
6.	Fakhreddine O. Karray and Clarence De Silva., "Soft Computing and Intelligent Systems Design, Theory, Tools and Applications," Pearson Education, India, 2009
7.	Simbrain and Matlab tools for simulation of ANN and FIS

Detailed Syllabus

Subject Code	Computer Graphics and Image Processing	**Semester:** EVEN **(specify Odd/Even)**	**Semester 4 Session** 2018-19 **Month from JAN to MAY**
Subject Name	16B1NCI440		
Credits	**3**	**Contact Hours**	L-T-P (3-1-0)

Faculty (Names)	**Coordinator(s)**	Pawan Kumar Upadhyay
	Teacher(s) (Alphabetically)	1. Pawan Kumar Upadhyay

On successful completion of the course, the students will be able to:

Sl. NO	**DESCRIPTION**	**Cognitive level(Bloom's Taxonomy)**
CO1	Exemplify the basic concept of computer graphics and image processing	**Understanding (Level 2)**
CO2	Apply the common 2D & 3D graphics concepts, including viewing transformations, clipping, projections.	**Apply (Level 3)**
CO3	Apply Image processing concept related to intensity and neighbourhood transformations, image enhancement, frequency transformations: DFT,DCT, DWT	**Apply (Level 3)**
CO4	Categorize the various types of graphical methods and techniques of image processing used to describe the different system	**Analyze (Level 4)**
CO5	Estimate the performance of color models, illumination and lighting techniques, spatial and frequency filters and qualify for the graphics and image processing.	**Evaluating (Level 5)**
CO6	Use applications related to computer graphics and image processing using computing resources based on best practices and design principles	**Apply (Level 3)**

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	Computer Graphics	Introduction, Basic graphics system, Color models, primitive like point, line, circle drawing, 2D translation, Windowing and clipping	15
2.	Image Processing	Image storage, Image processing in spatial domain, Image processing in frequency domain, Line , edge detection, basic filters, Laplacian, Gaussian	15
3.	Case Studies and Applications	Soma basic vision applications like OCR, Signature recognition, gesture recognition etc.	12
		Total number of Lectures	**42**

Evaluation Scheme

Assessment Scheme	Marks
*Test 1 Examination	20
*Test 2 Examination	20
#Final Examination	35
˜Internal Assessment (Continuous Evaluation) [Assignments, Surprise Quizzes and Project]	25
Total	100

Recommended Reading material:	
1.	Computer Graphics with OpenGL by Donald Hearn, M. Pauline Baker (Published by: Prentice Hall)
2.	Machine Vision by Ramesh Jain, Rangachar Kasturi and Brian Schunk (McGraw Hill 1995)
3.	Computer Graphics: Principles and Practice by James D. Foley, Andries van Dam, Steven K. Feiner, John Hughes (Published by: Addison-Wesley Professional)
4.	Fundamentals of Computer Graphics by Peter Shirley (Published by: AK Peters)
5.	Digital Image Processing (Hardcover) by Rafael C. Gonzalez (Published by: Prentice Hall)
6.	Image Processing by Henri Maitre (Published by: Wiley-Iste)
7.	Principles of Digital Image Processing: Fundamental Techniques (Undergraduate Topics in Computer Science) by Wilhelm Burger, Mark J. Burge (Published by: Springer)

Detailed Syllabus

Lecture-wise Breakup

Course Code	**18B12CS311**	**Semester** ODD **(specify Odd/Even)**	**Semester** IV **Session** 2018 -2019 **Month from** January 2019 – June 2019
Course Name	**OOAD (Object Oriented Analysis and Design)**		
Credits	3-1-0	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Dr. Sandeep Kumar Singh
	Teacher(s) (Alphabetically)	…

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Illustrate algorithmic (procedural) decomposition and Object-Oriented decomposition.	Understand Level (Level 2)
CO2	Dissect the requirements to identify the potential use cases, classes and objects in the system.	Analyzing Level (Level 4)
CO3	Build UML diagrams such as class diagram, object diagram for structural modelling and state chart diagram, sequence diagrams for behavioural modelling.	Apply Level (Level 3)
CO4	Apply object oriented design principles to solve real world problems.	Apply Level (Level 3)
CO5	Analyse and implement complex software systems using the Gang of Four (GoF) design patterns, e.g., creational patterns, structural patterns, behavioural patterns, etc.	Analyse Level (Level 4)
CO6	Estimate the complexity of object oriented designs using several metrics.	Evaluate Level (Level 5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Object Oriented Analysis and Design	What is OOAD, Why OOAD, Benefits and Costs, Understanding the challenges OOAD can address.	3
2.	Object Oriented Analysis	Identifying Classes and Objects, Responsibilities, Relationships in problem domain, Object Model	6
3.	Object Oriented Design	Use Case Diagrams, Class Diagram, Object Diagram Sequence Diagram, State Diagrams	6
4.	Object Oriented Design	Object Constraint Language(OCL), Use Case Modeling, Modelling and Implementing Static Behaviour and Dynamic Behaviour.	6
5.	Design Principles	SOLID principles and its applications	3

6.	Design Patterns	Overview of Design Patterns, Design Patterns Types- Creational, Structural and Behavioral Patterns. Understand and Apply various design patterns in different scenarios, Reusable Design Patterns.	7
7.	OO Design Metrics	Understanding and Analyzing Software Design Metrics for Object Oriented Software.	6
8.	OOAD Case Studies	Applying OOAD in different contexts	7
		Total number of Lectures	**44**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (To be mapped from Class Test 1,2,3)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Object-Oriented Modeling and Design with UML (2nd Edition) Michael R. Blaha; James R Rumbaugh
2.	Head First Object-Oriented Analysis and Design A Brain Friendly Guide to OOA&D By Brett McLaughlin, Gary Pollice, David West
3.	OBJECT-ORIENTED ANALYSIS AND DESIGN With applications Third EDITION Grady Booch Rational Santa Clara, California
4.	Object Oriented Analysis and Design Andrew Haigh
5.	UML and C++ A practical approach to OO Development
6.	Testing Object-oriented Systems: Models, Patterns, and Tools Book by Robert V. Binder
7.	A Practical Guide to Testing Object-oriented Software Book by David A. Sykes and John D. McGregor
8.	Object Management Group (OMG): http://www.omg.org/. This is the official Site for UML.
9.	Design Patterns: Elements of Reusable Object-Oriented Software with Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and the Unified Process by Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides, 2003

Detailed Syllabus

Lecture-wise Breakup

Subject Code	15B11CI513	**Semester (specify Odd/Even)**	**Semester Odd Session 2018-2019 Month from July 18 to December 18**
Subject Name	Software Engineering		
Credits	**4**	**Contact Hours**	**4(L+T)**

Faculty (Names)	**Coordinator(s)**	Dr. Amarjeet Prajapati
	Teacher(s) (Alphabetically)	Dr. Sangeeta

S.N.	DESCRIPTION	COGNITIVE LEVEL (BLOOM TAXONOMY)
CO1	Explain software engineering principles and software process models for project development	Remember Level (Level 1)
CO2	Identify functional and non-functional requirements of a software project and design document software requirements specification	Understand Level (Level 2)
CO3	Design, represent and document software requirements specification. Plan and execute activities for a software project	Create Level (Level 6)
CO4	Apply UML modeling for software design from software requirements specification.	Apply Level (Level 3)
CO5	Analyze code checklist. Perform code Reviews, Code Refactoring, and Code optimization	Analyze Level (Level 4)
CO6	Apply testing principles, develop and implement various manual and automated testing procedures	Apply Level (Level 3)
CO7	Evaluate software in terms of general software quality attributes and possible trade-offs presented within the given problem	Evaluate Level (Level 5)

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Introduction to Software Engineering	Introduction to software engineering Principles, Software process models(build and fix model, waterfall model, Incremental process model, Evolutionary- Prototype and Spiral models, Agile Models, PSP, TSP, Software Reengineering. Project planning, Project Scheduling: network diagram, Gant Chart, CPM and PERT.	7

2.	Requirement Engineering	Types of requirement, Requirement Elicitation, Analysis, Specification, SRS, Requirement Verification and Validation.	4
3.	Software Design	Use case diagram, State diagram, Activity Diagram, Class Diagram, Sequence diagram, Collaboration diagram, Deployment Diagram, Component Diagram and Package diagram. Design Modularity: Coupling Cohesion.	7
4.	Software Construction	Coding standards and guidelines, Code checklist, Code Reviews, Code Refactoring, Code optimization. Modern programming environments (Code search, Programming using library components and their APIs), Program comprehension; Program correctness, Defensive programming	8
5.	Software Metrics	Size-Oriented Metric, Functional Point metric, Function-oriented Metric, Halstead's Software Metric, Information Flow Metric, Object-oriented Metric, Class-Oriented Metric, COCOMO Model.	7
6.	Software Testing	White-Box Testing, Basis Path Testing, Control Structure Testing: Condition Testing, Data Flow Testing, Loop Testing, Black-Box Testing: Equivalence class partitioning, Boundary Value Analysis, Decision table testing, Cause effect graphing, Mutation Testing and regression Testing.	9
Total number of Lectures			**42**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Roger S. Pressman, "Software Engineering: A practitioner approach", Fifth Edition-TMH International .
2.	Sommerville , "Software Engineering" , Seventh Edition - Addison Wesley
3.	GRADY BOOCH**,** JAMES RUMBAUGH**,** IVAR JACOBSON, The Unified Modeling Language User Guide, Addison Wesley, Reading, Massachusetts, May 2005

4.	Richard Thayer , “Software Engineering Project Management”, Second Edition - Wiley-IEEE Computer Society Press.
5.	B. Bezier, “Software Testing Techniques”, Second Edition- International Thomson Computer Press.
6.	e, “An Integrated Approach to Software Engineering” Third addition , Springer Press
7.	nphrey, Introduction to Personal Software Process, Pearson Education.
8.	nphrey, Introduction to Team Software Process, Pearson Education.
9.	al Journal on Software Tools for Technology Transfer, Springer
10.	ctions on Software Engineering
11.	ctions on Software Engineering Methodology
12.	urnal of Empirical Software Engineering
13.	urnal of Software and Systems Modeling

Detailed Syllabus

Course Code	**15B17CI573**	**Semester Even (specify Odd/Even)**	**Semester** V **Session** 2018 -2019 **Month from July to December**
Course Name	**Software Engineering LAB**		
Credits	0-0-1	**Contact Hours**	**2**

Faculty (Names)	**Coordinator(s)**	Dr. Sangeeta
	Teacher(s) (Alphabetically)	3. Amarjeet Prajapati

COURSE OUTCOMES		**COGNITIVE LEVELS**
C371.1	Explain software engineering principles and software process models for project development, software requirements specification for a software project	Understand Level (Level II)
C371.2	Apply Software Design and modeling.	Apply Level (Level III)
C371.3	Apply Software Optimizing and Refactoring	Apply Level (Level III)
C371.4	Apply testing principles and implement various testing procedures	Apply Level (Level III)
C371.5	Creation of software using software engineering principals	Create (level VI)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	Introduction to Software Engineering Principals	Introduction to software engineering Principles (evolution, failures, changing nature of software, software myths, product, process, software crisis and need of testing), Software process models (build and fix model, waterfall model, Incremental process model, Evolutionary- Prototype and Spiral models, Agile models – extreme programming and scrum, selection of a life cycle model), PSP, TSP. Types of requirement, Feasibility studies, Requirement Elicitation, Analysis, Specification, SRS, Requirement Verification and Validation.	1
2.	Software Design and modeling.	Use case diagram, State diagram, Activity Diagram, Class Diagram, Sequence diagram, Collaboration diagram, Deployment Diagram, Event trace diagram. Size oriented metrics, LOC, token count, Function Count, cost estimation, data structure metrics, Halstead's Software Metric, Information	2

		Flow Metric, Overview of Quality Standards like ISO 9001, SEI-CMM, COCOMO, COCOMO-II, Software risk management	
3.	Software Optimizing and Refactoring	Coding standards and guidelines, Code checklist, Code Refactoring and Code optimization	3
4.	Software Testing	Black box testing techniques: Equivalence class testing, Boundary value analysis, Decision table testing, Cause effect graphing, White box testing: Path testing, Data flow and mutation testing, Levels of testing- unit testing, integration and system testing, Debugging- techniques, approaches, tools & standards.	4

Evaluation Criteria

Components	**Maximum Marks**	
Lab Test 1	20	
Lab Test 2	20	
Day-to-Day(Evaluations, Viva, Attendance, Project)	60	…
Total	**100**	

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Pressman, Roger S. Software engineering: a practitioner's approach. Palgrave Macmillan, 2005.
2.	Jalote, Pankaj. An integrated approach to software engineering. Springer Science & Business Media, 2012.
3.	KK Aggarwal, Software Engineering, 2001.
4.	David Solomon and Mark Russinovich ," Inside Microsoft Windows 2000", Third Edition, Micorosoft Press
5.	https://www.tutorialspoint.com/software_engineering/
6.	ACM/IEEE transactions on Software Engineering
7.	ACM Transactions on Software Engineering Methodology
8.	Springer Journal of Empirical Software Engineering
9.	Springer Journal of Software and Systems Modeling

Detailed Syllabus

Subject Code	15B11CI514	**Semester:** **(specify Odd/Even)**	**Semester** ODD **Session** 2018-2019 **Month from** June 18 **to** Dec 18
Subject Name	ARTIFICIAL INTELLIGENCE		
Credits	3-1-0	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Dr. Shikha Jain
	Teacher(s) (Alphabetically)	Ms. Dhanlakshmi, Dr. Gaganmeet Kaur, Dr. Satish Chandra, Dr. Shikha Jain

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Design, implement and analyze the problem solving agents using various informed, uninformed search strategies.	Analyzing [Level 4]
CO2	Analyze and apply algorithms to solve problems requiring evolutionary search strategies, constraint satisfaction and game theory.	Analyzing [Level 4]
CO3	Represent knowledge and Apply inference mechanisms using propositional logic (PL) and first order predicate logic (FOPL).	Apply [Level 3]
CO4	Apply model of probabilistic reasoning in incomplete and uncertain environment.	Apply [Level 3]
CO5	Develop the agents with natural language processing and learning capabilities.	Apply [Level 3]

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Introduction	History and foundations of AI	01
2.	Problem solving and intelligent agents	PEAS, Structure of agents, nature of environments, concept of rationality	03
3.	Problem solving-I	Problem solving agents, Uninformed search strategies (BFS, UCS, DFS, DLS, IDS)	04

4.	Problem solving-II	Informed Search and Exploration (GBFS, Heuristic function, A*, RBFS Genetic Algorithms)	06
5.	Problem solving-III	Constraint satisfaction problems (backtracking search), Adversarial Search (optimal decision in games, alpha beta pruning)	05
6.	Propositional Logic	Knowledge based agents, Propositional Logic, First order Logic, Syntax and Semantics), Inference in FOPL (Unification, forward and backward chaining, resolution)	05
7.	Knowledge representation	Ontology, actions, situations and events, time and event calculus, mental events,	03
8.	Uncertainty	Inference using full joint distribution, Probabilistic reasoning, Bayesian rule, Bayesian network, Maximum likelihood estimation	04
9.	Learning	decision tree, ensemble learning, K-Nearest Neighbor, K-Means algo, Reinforcement Learning	07
10.	Natural Language Processing	Preprocessing, POS tagging using MLE, Parsing using CYK	04
		Total number of Lectures	**42**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Artificial Intelligence – A modern approach by Stuart Russel and Peter Norvig, PHI, 2008.
2.	Artificial Intelligence: foundations of computational agents, Cambridge University Press, 2017
3.	Artificial Intelligence Review: An International Science and Engineering Journal, Springer
4.	Minds and Machines: Journal for Artificial Intelligence, Philosophy and Cognitive Science, Springer
5.	IEEE Intelligent Systems

Detailed Syllabus

Course Code	15B17CI574	**Semester** Odd **(specify Odd/Even)**	**Semester 5th Session** 2018 -2019 **Month from June 18 to Dec 18**
Course Name	Artificial Intelligence Lab		
Credits	1	**Contact Hours**	2

Faculty (Names)	**Coordinator(s)**	Dhanalekshmi G
	Teacher(s) (Alphabetically)	Ankita Verma, Dhanalekshmi ,Satish Chandra, Shikha Jain

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Construct problem solving agent using various Informed and uninformed search strategies	Apply Level (C3)
CO2	Utilize evolutionary search algorithms to solve the real world complex problems	Apply Level (C3)
CO3	Analyze and apply algorithms to solve problems requiring constraint satisfaction and game theory	Analyze Level (C4)
CO4	Demonstrate and understand the inference mechanisms using prepositional and first order logic	Understand(C2)

Module No.	**Title of the Module**	**List of Experiments**	**No. of Lab hours for the module**	**CO**
1	Introduction to Programming in Python	➢ Familiarize the following concepts of Python programming language like Arrays, Lists, functions, Tuples, Dictionary, Sets, Objects and classes	2	C2
2	Problem solving	➢ Problem solving agents, Uninformed search strategies (BFS, UCS, DFS, DLS, IDS) ➢ Informed Search and Exploration (BFS, A*, IDA*, SMA*,IDA*)	4	C3
3	Evolutionary Algorithms	➢ Genetic Algorithms	2	C3

4	Constraint satisfaction problems	➢ Formulating Problems as constraint satisfaction problems	2	C4
5	Adversial Search problems	➢ Adversarial Search (optimal decision in games, alpha beta pruning)	3	C3
6	Knowledge representation	➢ Inference using Prolog	2	C2

Evaluation Criteria

Components	**Maximum Marks**
Evaluation 1	20
Lab Test 1	20
Quiz 1	20
Day to Day evalution	10
Evaluation 2	10
Lab Test 2	20
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Artificial Intelligence – A modern approach by Stuart Russel and Peter Norvig, PHI, 2008.
2.	Artificial Intelligence: foundations of computational agents, Cambridge University Press, 2017
3.	Artificial Intelligence Review: An International Science and Engineering Journal, Springer
4.	Minds and Machines: Journal for Artificial Intelligence, Philosophy and Cognitive Science, Springer
5.	IEEE Intelligent Systems

Detailed Syllabus

Course Code	15B17CI575	**Semester** ODD **(specify Odd/Even)**	**Semester** IV **Session** 2018 -2019 **Month from** …
Course Name	Open Source Software Lab		
Credits	1	**Contact Hours**	2 hours

Faculty (Names)	**Coordinator(s)**	Prakash Kumar
	Teacher(s) (Alphabetically)	Archana Purwar, Indu Chawla, Parul Agarwal, Prakash Kumar, Sakshi Agarwal, Satish Chandra, Suma Dawn

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Demonstrate the working of Git repository hosting service through git commands to manage files, support version control and contribute to open source community by providing enhanced versions.	Understand level (C2)
CO2	Apply a mix of Client, Server and Database technologies to solve Open Source Software issues/ to enhance projects.	Apply Level (C3)
CO3	Develop Server side programs using python with Database Servers-SQL, MongoDb	Apply Level (C3)
CO4	Construct Server side programs using PHP with Database Server-SQL and Apache/Tomcat as web Servers.	Analyze Level (C4)
CO5	Build J2EE Programs using JDBC Connectivity with SQL Database and Apache/ Glassfish as web servers.	Evaluate Level (C5)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	Introduction to GitHub & Sustainable Development Goals (SDG's)	1. Read and explore the Github and SDG's from the following links: • https://guides.github.com/activities/hello-world/ • https://sustainabledevelopment.un.org/?menu=1300 2. Create a simple program and upload it on Github. 3. Extract one open source project from github. Perform the reverse engineering of the same.	CO1
2.	Introduction To Python	Making use of lists, tuples, and dictionaries, indexing and slicing to access data	CO2
3.	Python	Create user defined functions using built-in functions such as	CO3

		filter (f, a) from python libraries.	
4.	Numpy (Python)	Write python programs using various functions of numpy library.	CO4
5.	Beautiful Soup (Python)	Write a program using Beautiful Soup for scrapping data from web , store in csv files and process them.	CO5

Detailed Syllabus & Course Description

Semester & Session	V Semester 2018-19	Credits	1	Contact Hours L T P	2 0-0-2

Faculty Coordinator(s)	Suma Dawn
Teaching Methodology	The course will emphasize on hands on experience in the laboratory sessions. A mini project work using the Graphics design Packages (as mentioned above) has to be carried out to ensure integrated learning.
Course Outcomes	At the completion of the course, students will be able to

SLNO	DESCRIPTION	COGNITIVE LEVEL (BLOOMS TAXONOMY)
C205.1	Illustrate aesthetics of visual composition.	Understanding Level (Level 2)
C205.2	Demonstrate various operations in Adobe Photoshop CS5 such as, applying filters and effects, colour and tonal adjustments, automating tasks, image editing, image enhancement, image restoration, etc.	Understanding Level (Level 2)
C205.3	Design graphics & user interfaces using Adobe Photoshop CS5	Creating Level (Level 6)
C205.4	Demonstrate various operations in Adobe Illustrator CS5 such as, adding typography, creating, editing & using brushes, applying filters & effects, etc.	Understanding Level (Level 2)
C205.5	Create graphics layouts, illustrations and vector drawing using Adobe Illustrator CS5.	Creating Level (Level 6)
C205.6	Design 2D animations using key framing, interactive animation using action scripting, and fun games.	Creating Level (Level 6)

Module No.	Subtitle of the Module	Topics in the module	No. of Lab hours for the module
1	Introduction to Digital Graphics	➢ Computer Graphics: Vector graphics and Raster images ➢ Handling Digitally Designed Graphics	2
2	Adobe Photoshop CS5	➢ Working with Layers, Channels and Paths. ➢ Understanding Resolution, File formats & sizes ➢ Applying Filters and Effects. ➢ Making Color and Tonal Adjustments ➢ Automating Tasks ➢ Optimization and linking to web ➢ Image Editing, Enhancement & Restoration ➢ Visualization and Graphics Design	4
3	Adobe Illustrator CS5	➢ Working with Layers, Transformations ➢ Adding Typography ➢ Creating, Editing & Using Brushes ➢ Applying Filters and Effects ➢ Creating Illustrations & Vector Drawings	4
4	Animation Concepts & Design	➢ Creating a Story line, Storyboarding & Creating an Animation Script ➢ 2D Animation – Keyframing, Actionscripting	5
		Total number of Lectures	**15**

Evaluation Scheme	
A. Laboratory Assessment; Project & Assignments; Quizzes	45
B. Attendance	15
C. Lab Test(s) – Lab Test 1 & Lab Test 2	40
Total Marks	100

Recommended Reading material:	
<u>Multimedia, Photoshop and Illustrator</u>	1. "Multimedia – An Introduction" by John Villamil and Louis Molina. 2. "Multimedia Magic" by Gokul, S. 3. "Real World Illustrator 9" by Deke McClelland and Sandee Cohen. 4. "Photoshop 6 Primer" by Jason I. Miletsky. 5. "Mastering Photoshop 6" by Steve Romaniello.

Flash & ActionScript	6. **Adobe Flash CS3 Professional Bible** by Robert Reinhardt and Snow Dowd 7. **ActionScript 3.0 in Flash CS3 Professional Beyond the Basics** by Todd Perkins Web links Links: http://www.flashandmath.com/flashcs5/index.html http://helpx.adobe.com/flash/topics.html http://www.republicofcode.com/tutorials/flash/ Flash CS4/CS5 Platform Game Tutorials - 8. http://www.entheosweb.com/flash/default.asp
Additional reading material may be given to the students as and when required.	

Detailed Syllabus

Course Code	15B22CI521	**Semester Odd (specify Odd/Even)**	**Semester** VII **Session** 2018 -2019 **Month: from July 2018**
Course Name	Cloud based enterprise systems		
Credits	3	**Contact Hours**	42

Faculty (Names)	**Coordinator(s)**	Vikas Hassija
	Teacher(s) (Alphabetically)	Vikas Hassija

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Define all the basic terminologies related to cloud computing and basic nodejs concepts.	Remember Level (Level 1)
CO2	Write basic nodejs programs for creating server, rendering html, routing, get and post methods.	Understand Level (Level 2)
CO3	Develop all nodejs programs using nested loops and api methods to restrict post and get requests.	Apply Level (Level 3)
CO4	Test for the issues in the existing code using debugging tools or other exception handling methods.	Analyze Level (Level 4)
CO5	Basic understanding of the importance of various advanced concepts of big data like hadoop, mapreduce, mongodb, combiners, practitioners, pig and hive.	Evaluate Level (Level 5)
CO6	Create or design an end to end API using nodejs and store the posted data in a mongodb collection.	Create Level (Level 6)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Module 1: Cloud computing defined	We will introduce and define cloud computing and cloud based enterprise systems, explain the structure and operational aspects of cloud systems, and compare different types of cloud based applications.	8

2.	Module 2: Basics of Node js	We will discuss the basics of node js programming language. We will be creating web pages, connect them using routing functions and create basic APIs to interact with the data structure.	6
3.	Module 3: Big data	We will discuss the concept of Big data and the need of Big data storage and analysis. We will be defining various V's in big data and the end to end process of data generation, cleaning, analysis and decision making.	5
4.	Module 4: Hadoop and Mapreduce	The purpose of this module is to introduce the concept of hadoop and maps reduce in big data. We will be studying the detailed architecture of hadoop, the way files are stored and retrieved from hadoop and the concept of name nodes. We will be studying the algorithms used in map reduce to analyze the data.	7
5.	Module 5: Nosql basics	The purpose of this module is to introduce the basics of Nosql. We will be discussing a lot about the differences of sql and nosql data bases. We will be studying the CAP theorem to form the foundation of nosql data bases. We will be also studying the format of data stored in nosql data bases.	7
6.	Module 6: Mongo db	We will explore the most commonly used nosql database i:e mongo db. We will be running various basic and complex commands to query the collections in mongodb data base.	3
7.	Module 7: AWS, Azure and Dockers	We will explore practically the implementation of web applications on different cloud service providers like AWS and Azure. We will be studying the concept of dockers and will be comparing it to virtual machines.	5
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Attendance , Assignment and Quiz)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	"Cloud Computing: From Beginning to End" written by Mr. Ray J Rafaels

2.	Big Data: A Revolution That Will Transform How We Live, Work, and Think
3.	Hadoop: The Definitive Guide, 4th Edition by Tom White
4.	IEEE Transactions on cloud computing
5	ACM Transactions on cloud computing

Detailed Syllabus

Subject Code	15B28CI581	**Semester odd**	**Semester: Fifth Session 2018- 2019** **Month from Jan to June**
Subject Name	CLOUD BASED ENTERPRISE SYSTEMS LAB(15B28CI581)		
Credits	**1**	**Contact Hours**	**2**

Faculty (Names)	**Coordinator(s)**	Prashant kaushik
	Teacher(s) (Alphabetically)	Prashant kaushik

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Create Server app and its modules	Create Level (Level 6)
CO2	Develop multi core server apps	Apply Level (Level 4)
CO3	Use nodejs for multi core apps	Apply Level (Level 4)
CO4	Design Auto Scale apps for server	Apply Level (Level 4)
CO5	Analyse the VMs for the cloud deployment	Evaluate Level (Level 6)
CO6	Understand the cloud concept for App dev.	Understand Level (Level 2)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	Hypervisior Virtual machine (PAAS, IAAS, VAAS)	Use hypervisor scripts to create VMs	4

2.	Types of virtual machine (compute, storage, etc) AWS EC2	Create Storage and compute virtual machines	2
3.	Private Clouds and Public clouds software virtualization. Lambda	Install openstack on personal PC	1
4.	S3cloud orchestration Python scripts for load balancing. DynamoDB	Use S3to host files	2
5.	VPC - cloud networking Backup and recovery	Create a VPC of two node cluster in AWS	3
6.	Billing and Alerts OpenStack using dev stack and more python scripts	Install billing policy in Open stack	5

Evaluation Criteria

Components	**Maximum Marks**
LabTest 1	20
LabTest 1	20
Day 2 Day	60
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Cloud Computing for Complete Beginners: Building and Scaling High-Performance Web Servers on the Amazon Cloud by Ikram Hawaramani
2.	AWS System Administration: Best Practices for Sysadmins in the Amazon Cloud by Mike Rayan , 2018
3.	AWS Scripted: How to Automate the Deployment of Secure and Resilient Websites with Amazon Web Services VPC, ELB, EC2, RDS, IAM, SES and SNS by Christian cerri, 2014

Detailed Syllabus

Subject Code	15B11CI511	**Semester:** **(specify Odd/Even)**	**Semester** Even **Session** 2018-2019 **Month from** JUL'18 **to** DEC'18
Subject Name	Computer Networks		
Credits	3-1-0	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Dr K. Rajalakshmi
	Teacher(s) (Alphabetically)	Dr. Gagandeep Kaur Dr. Kavita pandey Dr K. Rajalakshmi Kriti Agarwal Dr. Prakash Kumar

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Defining the basics of networking, delay components and underlying technologies	Remembering (Level 1)
CO2	Illustrate the various key protocols in OSI model and TCP/IP protocol suite and explain various application protocols.	Understanding (Level 2)
CO3	Examine various transport protocols and its performance enhancing mechanisms.	Analyzing (Level 4)
CO4	Assess the performance of the network under various routing mechanisms and IP addressing schemes.	Evaluating (Level 5)
CO5	Identify various multiple access protocol and perform error detection and correction in data communication	Applying (Level 3)

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Introduction	Network terminologies, Clients and Servers, Network Models, Protocol layers and their services, Connection Oriented and Connectionless services, Switching Techniques, Physical Media. Network Vulnerability and security	8

2.	The Application Layer	Principles of Application-Layer Protocols, The World Wide Web: HTTP, File Transfer: FTP, The Internet's Directory Service: DNS, Electronic Mail in the Internet, Introduction to Sockets, Security Aspects in Application layer, HTTPS, SFTP etc., Multimedia Aspects of the Application Layer	6
3.	The Transport Layer	Transport-Layer Services and Principles, Multiplexing and Demultiplexing Applications, UDP and TCP, Connection Establishment, Transport Layer Protocols (go back N, stop and wait, selective repeat), Flow Control and Error Control, Principles of Congestion Control, TCP Congestion Control, Attack and vulnerability issues in Transport layer: Denial of Service (DoS), Distributed Denial of Service (DDoS) etc., Transport layer Security aspects, SSL, TLS etc., Multimedia aspects of the Transport layer	8
4.	The Network Layer	Introduction and Network Service Model, Routing Principles, Hierarchical Routing, IP: the Internet Protocol, Routing in the Internet, Broadcast and multicast routing, IPSec Architecture: Authentication Header (AH) and Encapsulating Security Payload (ESP),Multimedia networking aspects and applications	10
5.	The Link Layer and Local Area Networks	The Data Link Layer: Introduction, Services, Error Detection and Correction, Multiple Access Protocols and LANs, LAN Addresses and ARP, Ethernet, PPP: the Point-to-Point Protocol, Introduction to ATM,MPLS and Sonet, IEEE MAC Security Standard, MACSec (802.1AE), Multimedia aspects of the DL layer	8

6.	Wireless Networks	Introduction, Wireless links and characteristics, Architecture, AODV and DSR wireless routing protocols	2
Total number of Lectures			**42**
Evaluation Criteria **Components** **Maximum Marks** T1 20 T2 20 End Semester Examination 35 TA 25 (Assignments, Quiz, Attendance) **Total** **100**			

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1	James Kurose, Keith Ross," Computer Networking: A Top-Down Approach Featuring the Internet ", Addison Wesley
2	Andrew S. Tanenbaum ,"Computer Networks ", Prentice-Hall Publishers
3	Larry Peterson , Bruce Davie ,"Computer Networks a Systems Approach ", Morgan Kaufmann
4	William Stallings ,"Data and Computer Communications", Prentice Hall
5	K. Thramboulidis, A. Mikroyannidis, "Using UML for the Design of Communication Protocols: The TCP Case Study" 11th International Conference on Software, Telecommunications and Computer Networks, October 7-10, 2003.
6	Juha Parssinen, Niklas von Knorring,Jukka Heinonen, Markku Turunen, "UML for Protocol Engineering-Extensions and Experiences", Proceedings of the Technology of Object-Oriented Languages and Systems (TOOLS),. IEEE Computer Society, page 82, 2000

Detailed Syllabus

Course Code	15B17CI571	**Semester :** Odd **(specify Odd/Even)**	**Semester** V **Session** 2018 -2019 **Month from** July- Dec
Course Name	Computer Networks Lab		
Credits	1	**Contact Hours**	2

Faculty (Names)	**Coordinator(s)**	Kirti Aggarwal
	Teacher(s) (Alphabetically)	Kavita Pandey, Kirti Aggarwal, K. Rajalakshmi, Nisha Chaurasia

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Classify all the wired/wireless technologies and the basic network building blocks	Level 2 (Understanding)
CO2	Visualize and analyze the data packets of different TCP/IP layers. Store the data packets as *.pcap files.	Level 3 (Applying)
CO3	Create client and server applications using the "Sockets" and the implementation of various protocols at Data link and TCP layer	Level 4 (Analyzing)
CO4	Model a communication network and Estimate the delay caused in the network due to congestions and link breakages.	Level 5 (Evaluating)
CO5	Simulate and compare different routing algorithms, error detection and correction and buffer management techniques	Level 3 (Applying)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	Basics of Networking	**To** Classify all the wired/wireless technologies and the basic network building blocks	CO1
2.	Wireshark	**To** make some simple packet captures and observations.	CO2
3.	Wireshark	To explore several other aspects of the HTTP protocol	CO2
4.	Socket Programming	To create a socket and bind it to a specific address and port	CO3
5.	Socket Programming	To send and receive a HTTP packet and learn some basics of HTTP header format.	CO3

6.	NS2	Write program to create network Topologies in NS2	CO4
7.	NS2	To send some traffic/data in the network topologies created and reading the trace file.	CO4
8.	NS2	Using Trace File and Plotting using AWK scripts and Xgraph-Trace Analysis	CO4
9.	NS2	To Route the packets in the network and study about Network Dynamics	CO4
10.	Routing	Implementation of Routing Algorithms	CO5
11.	Error Correction & Detection	To Implement various Error Correction and Detection Algorithms	CO5

Evaluation Criteria

Components	**Maximum Marks**
Lab Test 1	20
Lab Test 2	20
Day to Day Evaluation 1	60
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Kurose, J. F., Computer networking: A top-down approach featuring the internet, 3/E. Pearson Education India, (2005).
2.	Forouzan, A. B., Data Communication and Networking, (2007).
3.	Issariyakul, T., & Hossain, E. Introduction to Network Simulator 2 (NS2). In Introduction to network simulator NS2(pp. 1-18). Springer, (2009).
4.	Orebaugh, A., Ramirez, G., & Beale, J., Wireshark & Ethereal network protocol analyzer toolkit. Elsevier, (2006).
5.	Goerzen, J., Foundations of Python network programming. Apress, (2004).

Detailed Syllabus

Course Code	15B17CI579	**Semester** Odd **(specify Odd/Even)**	**Semester** 5th (ECE) **Session** 2018 -2019 **Month from** Jul-Dec
Course Name	UNIX Programming Lab		
Credits	1	**Contact Hours**	2 per week (Total 14 weeks)

Faculty (Names)	**Coordinator(s)**	Dr. Adwitiya Sinha
	Teacher(s) (Alphabetically)	Dr. Adwitiya Sinha, Purtee Kohli

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO 1	Demonstrate use of common Unix/Linux commands	Understanding Level (Level 2)
CO 2	Apply Unix/Linux file redirection and pipelining to combine utilities to perform complex tasks	Apply Level (Level 3)
CO 3	Develop shell scripting using Selection, Case & Conditional Statements	Apply Level (Level 3)
CO 4	Build shell scripts to solve various problems using commands like grep, line number, test, expressions, compare, command line input, etc.	Apply Level (Level 6)
CO 5	Create and manage files and directories, file permissions, and navigate the Unix/Linux file system	Create Level (Level 6)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	The UNIX File System & Basic Commands	History of UNIX, Introduction, UNIX file system, Executing commands & options	CO1
2.	UNIX Editor & Operations	UNIX Processes, Process Utilities, Pipes and Signals	CO2
3.	UNIX File Handling & Regular Expressions	File Handling, File commands, Basic Filters (cat, head, tail, sort, uniq), Use of Regular Expressions, Field Matching, grep, fgrep, egrep	CO2

4.	UNIX Advanced Filters	Advanced Pattern Matching, Stream-oriented & Non-Interactive Text Editor (Sed), Programmable Filters, Awk, Gnu Awk (Gawk), Text Processing, Practical Extraction and Report Language (Perl)	CO3
5.	UNIX Shell Scripting	UNIX Scripting, Variables, Naming Conventions, Conditional Constructs, Looping Statements, Arrays, Functions, Document Handling, Quoting, Arithmetic Operations & Executions, Parsing	CO4
6.	UNIX Administration	UNIX Administration, Overview of Linux, Login Process, Users & Permission (chmod, su, mount, cron, NFS), Process Management	CO5
7.	UNIX Case Studies	Projects, Application-based Extensions, Security	CO5

Evaluation Criteria

Components	**Maximum Marks**
Lab Test-1	20
Lab Test-1	20
Day-to-Day	60 (Quiz + Evaluative Assignment + Class Test + Attendance)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Sumitabha Das, UNIX Concepts & Applications, 4th Edition, Tata McGraw-Hill Education, 2008
2.	Maurice J. Bach, Design of UNIX Operating System, Prentice-Hall, 1986
3.	Richards Stevens, Advanced Programming in the UNIX Environment, Pearson Education India, 2005
4.	Marc J. Rochkind, Advanced UNIX Programming, 2nd Edition, Pearson Education, 2004
5.	Evi Nemeth, Garth Snyder, Trent R. Hein, Unix and Linux System Administration Handbook, 4th Edition Pearson Education India, 2011
6.	Richards Stevens, Unix Network Programming, Addison-Wesley Professional, 2004

Detailed Syllabus

Course Code	15B11CI611	**Semester** Even **(specify Odd/Even)**	**Semester 6th Session** 2018 -2019 **Month:** January to June
Course Name	**Theory of Computation and Compiler Design**		
Credits	**4** (3-1-0)	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Dhanalekshmi G
	Teacher(s) (Alphabetically)	Ankit Vidhyarthi,Chetna Dabas,Dharamveer Rajpoot,Dhanalekshmi,Kirti Aggarwal

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Understand the regular expression, regular languages, context free languages and its acceptance using automata.	Understand level (C2)
CO2	Identify the phases of compilers for a programming language and construct the parsing table for a given syntax	Apply Level (C3)
CO3	Build syntax directed translation schemes for a given context free grammar by analyzing S-attributed and L-attributed grammars.	Analyze Level (C4)
CO4	Construct grammars and machines for a context free and context sensitive languages.	Apply Level (C3)
CO5	Generate the intermediate code and utilize various optimization techniques to generate low level code for high level language program.	Apply Level (C3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	***Finite automata***	Review of Automata, its types and regular expressions, Equivalence of NFA, DFA and €-NFA, Conversion of automata and regular expression, Applications of Finite Automata to lexical analysis. [14 L]	**14**
2.	***PDA and Parser***	Push down automata, Context Free grammars, top down and bottom up parsing, YACC programming specification **[12 L]**	**12**
3.	***Chomsky hierarchy and Turing***	***Chomsky hierarchy and Turing Machine:*** Chomsky hierarchy of languages and recognizers, Context Sensitive	**6**

	Machine	features like type checking, Turing Machine as language acceptors and its design.**[6L]**	
4.	***Code generation and optimization***	***Code generation and optimization:*** Syntax directed translation, S-attributed and L-attributed grammars, Intermediate code generation, type conversions, and equivalence of type expression, Code generation and optimization. **[10L]**	**10**
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignments : 10 Quizzes/Tutorial : 10 Attendance : 5)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

Text Book(s):

1.	Peter Linz, "An Introduction to Formal Languages and Automata," 3rd Edition, Narosa Publisher 2005.
2.	Alfred Aho, Monica S. Lam, Ravi Sethi, and Jeffrey D. Ullman, "Compilers: principles, techniques, and tools," 2nd Edition, Pearson Education

Reference Book(s):

3.	John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, "Introduction to Automata Theory, Languages, and Computation", 2nd Edition, Pearson Education Asia 2002
4.	K. L. P. Mishra, N. Chandrasekaran, "Theory of Computer Science Automata, Languages and Computation", 3rd Edition, PHI 2007
5.	John C. Martin, "Introduction to Language and the Theory of Computation", TMH 2004
6.	S.P.Eugene, "Theory of automata, formal language and computation", New Age International Publishers , New Delhi 2003
7.	Sipser, M., Introduction to the Theory of Computation, Second Edition, Thomson Course Technology, 2007
8.	ACM Transactions on Computation Theory
9.	ACM Journal on Theory of Computation.

Detailed Syllabus

Course Code	15B17CI671	**Semester** Even **(specify Odd/Even)**	**Semester** 1st **Session** 2018 -2019 **Month from** Jan to May
Course Name	Compiler Design Lab		
Credits	2	**Contact Hours**	2

Faculty (Names)	**Coordinator(s)**	Dr. Chetna Dabas (Sec-62) & Himanshu Mittal (Sec-128)
	Teacher(s) (Alphabetically)	Ankit Vidyarthi, Chetna Dabas, Dharmveer Rajpoot, Kavita Pandey, Kirti Aggarwal, Monali Mavani

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Design different types of automata.	Apply (level 3)
CO2	Design programs using Lex and Yaac tools.	Apply(level 3)
CO3	Applying lex and yacc programs to create lexical analyzer and language scanners and parsers.	Apply (level 3)
CO4	Evaluate different lexical analyzers and parsers	Evaluate (level 5)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	Automata Design	Experiments to design different types of automata (NFA, DFA), Language recognized by specific strings like Implementation of scenario based automata, Simulating the automata recognition a Language, Implementation of extended transition function using C Language. Extraction of email ids from text files.	1
2.	Lex and Yacc Tools	Experiments to design programs for lexical analysis and parsing using Lex and Yaac tools, Study of Lex and Yacc Tools, like Lex programs for recognizing and stripping of comments in a file, count number of characters, words, lines, Design Lex programs for recognizing all HTML tags in a file, extraction of valid IP addresses, Lex programs for Recognition and extraction of vowels in English Language.	2
3.	Designing Lexical Analyzers and Parsers	Experiments for applying lex and yacc programs to create lexical analyzer and language scanners and parsers, like design a Scanner which stores all the identifiers and literals encountered in an input stream in the form of a STACK and prints the STACK,	3

		Interpret and analyze given examples in Lex, Design Lex and yacc calculator using yylex(), yywrap(),yyin(), Design of standalone scanner using Lex.	
4.	Combined Lexical Analyzer and Parsers	Experiments to evaluate different lexical analyzers and parsers while combining lexical analyzer and syntax analytics parts, like Design and evaluate lex and yacc program to recognize nested if control statement and display the levels of nesting, Lex and Yacc Program to recognize and evaluate the string corresponding to a specified grammar.	4

Evaluation Criteria

Components	**Maximum Marks**
Lab Test 1	20
Project	30
Evaluation 1	20
Lab Test 2	20
TA	10
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Compilers: Principles, Tools and Techniques fourth edition
2.	Lab Material for lex and yacc supplied by the department

Detailed Syllabus

Course Code	15B11CI612	**Semester** EVEN 2019 **(specify Even)**	**Semester** II **Session** 2018 -2019 **Month from** January to July
Course Name	Theory of Programming Languages		
Credits	04	**Contact Hours**	(L+T) (3+1)

Faculty (Names)	**Coordinator(s)**	Dr. P. Raghu Vamsi
	Teacher(s) (Alphabetically)	Dr. P. Raghu Vamsi

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Define the characteristics of programming languages and the functionality of various phases of a compiler.	Remember Level (Level 1)
CO2	Demonstrate the formal grammars, functional programming paradigms, Logic programming paradigms, and multi-language programming concepts.	Understand Level (Level 2)
CO3	Construct deterministic top-down and bottom-up parsers.	Apply Level (Level 3)
CO4	Examine fundamental issues underlying the design decisions of different programming languages such as data types, sub programs, sequence control, storage management, event handling, parameter passing, etc.	Analyze Level (Level 4)
CO5	Explain concurrency using C++, Java and Python.	Analyze Level (Level 4)
CO6	Perform comparative evaluation of programming languages with respect to readability, writability, reliability, and cost of execution by selecting an appropriate programming language for evaluation of a computational problem.	Evaluate Level (Level 5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Introduction**	Need to study concepts of Programming Languages (PLs), History of PLs, Characteristics of good PL, Language Design	2

		Principles, Compiler, Interpreter, Assembler, Linker and Loader, Language evaluation criteria, PL translators, compilers and interpreters.	
2.	**Lexical Analysis**	Formal grammars – Chomsky hierarchy of grammars – Type 1, 2, 3 grammars; DFA and NFA construction, Minimizing DFA, Attribute Grammars; Weakness in Grammars; Derivation of Languages – Left and Right most derivation; Derivation trees; Ambiguity in grammars – Cause of ambiguity, removing ambiguity, eliminating epsilon productions, eliminating unit productions, eliminating useless productions; Chomsky Normal Form; Bakus Norm Form.	8
3.	**Parsing**	Deterministic Top-Down parsing – LL(1) grammars without epsilon rules, LL(1) with epsilon rules, recursive descent parsing; Deterministic Bottom-up parsing – LR parser.	5-6
4.	**Data Types**	Elementary data types, user defined data types, pointer types, type checking, type conversion	2
5.	**Expressions and Assignment Statements**	Arithmetic expressions, overloaded operators, type conversion, relational and Boolean expression, short circuit evaluation, assignment statements, mixed mode assignment.	2
6.	**Sub Programs**	Design issues of subprograms, Local referencing environments, parameter passing methods, parameters that are subprograms, calling subprograms directly, generic subprograms, design issues, user defined overloaded operators, subprograms with static and dynamic variables, nested subprograms, blocks, dynamic scoping, recursion.	3
7.	**Sequence control**	Implicit and explicit sequence control, statement level control structures, selection statements, iterative statements, unconditional branching, guarded commands;	2
8.	**Storage Management**	Run time elements requiring storage, storage management phases, stack storage, heap storage, fixed and variable size elements	2
9.	**Event and Exception Handling**	Bug, Error, exception, event, Exception handling in C++ and Java, Event handling in Java	2
10.	**Support for Object-Oriented Programming (OOP)**	Object Orientation, Design issues for Object Oriented Languages, OOP in Ada, C++, C#, Java, Objective-C, Ruby, and Smalltalk.	2

11.	**Concurrent Programming**	Subprogram level concurrency, semaphores, Monitors, message passing, statement level concurrency, Java Threads, concurrency in C++ and Python.	5-6
12.	**Functional Programming**	Functions and Lambda calculus, Scheme, Haskell	3
13.	**Logic Programming**	Logic and Horn Clauses, Logic programming in Prolog, Prolog examples.	3
14.	**Program correctness**	Axiomatic semantics, correctness of object oriented programs, correctness of functional programs, Formal methods and Tools.	2
		Total number of Lectures	**43-45**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Robert W. Sebesta, “Concepts of Programming Languages”, Tenth Edition, Pearson Publisher, 2014.
2.	A.B. Tucker, R.E. Noonan, “Programming Languages: Principles and Paradigms”, 2nd Edition, TMH, 2015.
3.	Daniel I. A. Cohen, "Introduction to Computer Theory", 2nd edition, Wiely.
4.	Kenneth C. Louden, Programming Languages: Principle and practice, Cengage Learning, 2012.
5.	Robert Harper, Practical Foundations for Programming Languages (Second Edition). Cambridge University Press, 2016.
6.	Friedman, Wand and Haynes, Essentials of Programming Languages, 2nd or 3rd ed., MIT Press.
7.	D. A. Watt, Programming Language Design Concepts, Wiley dreamtech – 2007
8.	NPTEL Video Lecture: http://nptel.ac.in/courses/106102067/

Detailed Syllabus

Course Code	15B17CI672	**Semester** EVEN 2019 **(specify Even)**	**Semester** II **Session** 2018 -2019 **Month from** January-June
Course Name	Programming Languages Lab		
Credits	01	**Contact Hours**	02

Faculty (Names)	**Coordinator(s)**	Dr. P. Raghu Vamsi
	Teacher(s) (Alphabetically)	Dr. P. Raghu Vamsi and Dr. Satish Chandra

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Understand the principle to program in an imperative (or procedural), an object-oriented, a functional, and a logical programming language.	Understand Level (Level 2)
CO2	Improve the ability of applying appropriate programming languages for various classes of programming problems.	Apply Level (Level 3)
CO3	Construct and apply programming languages parsers, programming abstractions, Graphical User Interfaces, Common Gate Way applications, database programming using Java and Python programming languages.	Apply Level (Level 3)
CO4	Analyze and examine the behaviour of simple programs in imperative languages using concepts such as binding, scope, control structures, subprograms and parameter passing mechanisms.	Analyze Level (Level 4)
CO5	Evaluate multi-language programming concepts using applicable concurrent programming features of C++, Java, and Python.	Evaluate Level (Level 5)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	Introduction to Java/Python programming – Control statements, String handling, Functions, and File I/O	Lab Assignments 01 and 02	1
2.	Regular expressions	Lab Assignments 03, 04 and 05	2

	(Lex and Yacc).		
3.	Java/Python data structures – Lists, Tuples, Sets, and Dictionaries	Lab Assignments 01 and 02	2
4.	Object oriented programming with C++/Java/Python.	Lab Assignments 08 and 09	3
5.	GUI Programming	Lab Assignments 08 and 09	3
6.	Database Access	Lab Assignment 10	3
7.	CGI programming	Lab Assignment 10	3
8.	Exception Handling	Lab Assignment 11	4
9.	Concurrent programming	Lab Assignment 12 and 13	5
10.	Functional programming using Haskell and Logic programming using Prolog	Lab Assignment 14	1

Evaluation Criteria

Components	**Maximum Marks**
Lab evaluation -1 + Lab Test – 1 (After T1 Examination)	10 + 20 = 30
Lab evaluation -2 + Lab Test – 2 (After T2 Examination)	10 + 20 = 30
Lab Project and Viva	25
Attendance *	15
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Y. Daniel Liang, “Introduction to Programming using Python”, Person, 2013.
2.	Fabrizio Romano, “Learning Python”, Open source, Packet Publishing, 2015.
3.	Magnus Lie, “Beginning Python from Novice to Professional”, 2nd Edition, Apress, 2008.
4.	Zed A. Shaw, “Learn Python the Hard Way”, 3rd Edition, Addison-Wesley, 2014.

5.	Mark Lutz, “Learning Python”, O’reilly, 2013.
6.	Mark Lutz, “Python Pocket Reference”, O’relly, 2014.
7.	Schildt, H. (2002). “The Complete Reference Java 2. Williams”, 2009. 1034 p.
8.	Schildt, Herbert. C++: The Complete Reference. McGraw-Hill, 2003.
9.	Kanetkar, Yashavant P. Let us C. BPB publications, 2016.

Detailed Syllabus

Course Code	**15B22CI621**	**Semester** : **Even**	**Semester** 6th **Session** 2018 -2019 **Month from Jan 19 to June 19**
Course Name	**Data Mining And Web Algorithms**		
Credits	4	**Contact Hours**	4(3+1)

Faculty (Names)	**Coordinator(s)**	Mahendra Kumar Gurve
	Teacher(s) (Alphabetically)	

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Understand the basics of data mining and pre-processing of data.	Understand Level (Level 2)
CO2	Analyze the transactional data for finding frequent and interesting patterns using association rule mining techniques like Apriori and FP-Growth**.**	Analyse Level (Level 4)
CO3	Apply a wide range of classification techniques like Naïve-bayes, decision tree, and KNN for the numerous application including fraud detection, target marketing, medical diagnosis, etc.	Apply Level (Level 3)
CO4	Cluster the similar/dissimilar objects using different methods like partitioning, hierarchical and density based clustering.	Create Level (Level 6)
CO5	Analyze the link structure of web using page rank and HITS algorithms.	Analyse Level (Level 4)
CO6	Develop recommendation system using collaborative filtering techniques	Create Level (Level 6)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Course overview**	What Motivated Data Mining? Why Is It Important? What Is Data Mining? Data Mining—On What Kind of Data? Data Mining Functionalities—What Kinds of Patterns Can Be Mined? Are All of the Patterns Interesting? Data mining process, Types of datasets and attributes, Major Issues in Data Mining.	**03**
2.	Data Preprocessing	Getting To know your data, Data extraction, Data cleaning, Data Integration and transformation, Data reduction	**06**

3.	Association Rule mining	Usability and Complexity Analysis of Apriori Algorithm, Sampling Algorithm, Partitioning, Using multiple minimum supports	**05**
4.	Classification Algorithms	Issues Regarding Classification and Prediction, Bayesian Classification, Usability and Complexity Analysis of Bayesian algorithm, Nearest Neighbor algorithm, Decision Tree based algorithm.	**07**
5.	Clustering Algorithms	Clustering Algorithms: Types of Data in Cluster Analysis, Similarity Measures, A Categorization of Major Clustering Methods, Partitioning Methods, Hierarchical Methods, Usability and Complexity Analysis of Agglomerative Hierarchical Algorithm, k-means and K-Mediod Partitioning Algorithm. Applications of clustering.	**08**
6.	Web algorithms:	Web algorithms: Link Based Search Algorithm, Web Crawling, Indexing, Searching, Zone Indexing, Term-Frequency, Link Analysis Algorithm.	**04**
7.	Ranking Algorithms:	Ranking Algorithms: Page rank, Hits ranking algorithms	**03**
8	Web caching Algorithm :	Web caching Algorithm : LRV, FIFO, LRU, Random, OPT	**03**
9	Recommendation Algorithms:	Recommendation Algorithms: Collaborative Filtering, Item-to-Item recommendation, Memory Based Recommendation,	**03**
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1	Jiawei Han, Micheline Kamber, Data Mining, Morgan Kaufmann Publishers,Elsevier,2005
2	Kimball R. and Ross M ,The Data Warehouse Toolkit", Wiley
3	Pujari, Arun K,Data mining and statistical analysis using SQL, Universities press
4	Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining

5	Soumen Chakrabarti, Mining the Web: Discovering knowledge from hypertext data", Morgan Kaufmann, Elsevier
6	Alex, Berson,Stephen J.Smith, Data Warehousing, data mining and OLAP , McGraw-Hill,2004
7	Inmon W.H.,Building the Data Warehouse ,4th Edition, Wiley
8	Anahory S. and Murray D, Data Warehousing in the Real World, Addison-Wesley
9	Margaret H. Dunham, Data Mining: Introductory and Advanced Topics, Prentice Hall,2003
1	Mattison R. ,Web Warehousing and Knowledge Management", Tata McGraw-Hill.
1	David Hand, Heikki Mannila and Padhraic Smyth ,Principles of Data Mining,PHI
1	Transactions on Database Systems (ACM)
1	IEEE Transactions on Knowledge & Data Engineering
1	The VLDB Journal The International Journal on Very Large Data Bases

Detailed Syllabus

Course Code	15B28CI681	**Semester Even**	**Semester VI Session** 2018 -2019 **Month from Jan – June 2019**
Course Name	Data Mining And Web Algorithms Lab		
Credits	0-0-1	**Contact Hours**	2

Faculty (Names)	**Coordinator(s)**	Dr Dharmveer Singh Rajpoot
	Teacher(s) (Alphabetically)	Dr. Dharmveer Singh Rajpoot, Mr. Mahendra Gurve

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Apply the data pre-processing techniques on the dataset to handle missing information, duplicate information etc.	C3
CO2	Implement association rule mining techniques like Apriori and FP-Growth to analyze frequent and interesting patterns in the transactional data.	C3
CO3	Apply a wide range of classification techniques like Naïve-Bayes, decision tree, and KNN for the numerous application including fraud detection, target marketing, medical diagnosis, etc.	C3
CO4	Implement and validate the Clustering methods and outcomes of different methods like partitioning, hierarchical and density based clustering using SSE.	C5
CO5	Analyze the link structure of web using page rank and HITS algorithms.	C4
CO6	Develop a project using data mining technique to solve the real world problems like fraud detection, hand writing recognition, stock prediction etc.	C5

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	Data Preprocessing	Explore the various data mining tools. Apply Data pre-processing i.e. Cleaning, Integration, and Missing Value etc. Perform Data Similarity Measure (Euclidean, Manhattan Distance). Implement Jaccard coefficient for documents similarity.	C3
2.	Association Rule Mining	Develop Apriori algorithm to mine frequent item-sets. Implement FP-growth algorithm to identify the frequent item sets.	C3

		Implement ECLAT algorithm for rule mining.	
3.	Clustering	Develop K-Means Algorithm to generate clusters. Develop K-Medoids Algorithm to generate clusters. Develop Hierarchical Approach to generate clusters.	C5
4.	Classification	Do Practice of Decision Tree Algorithm for classification. Implement ID3, C4.5 and Naïve Bayes.	C3
5.	Validity Measures	Implement Validity Measures to evaluate the quality of Data Mining Algorithms.	C5
6.	Web Application	Analyze the link structure of web using page rank algorithms. Analyze the link structure of web using HITS algorithms.	C4

Evaluation Scheme	Lab Test 1 Lab Test 2 Day-to-Day (Evaluations , Project, Attendance)	**20** **20** **60**
	Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Jiawei Han, Micheline Kamber, Data Mining, Morgan Kaufmann Publishers,Elsevier,2005
2.	Kimball R. and Ross M ,The Data Warehouse Toolkit", Wiley
3.	Soumen Chakrabarti, Mining the Web:Discovering knowledge from hypertext data", Morgan Kaufmann, Elsevier
4	Alex, Berson,Stephen J.Smith, Data Warehousing, data mining and OLAP , McGraw-Hill,2004
5.	Inmon W.H.,Building the Data Warehouse ,4th Edition, Wiley
6.	Anahory S. and Murray D, Data Warehousing in the Real World, Addison-Wesley
7.	Margaret H. Dunham, Data Mining: Introductory and Advanced Topics, Prentice Hall,2003
8.	Mattison R. ,Web Warehousing and Knowledge Management", Tata McGraw-Hill.

9.	David Hand, Heikki Mannila and Padhraic Smyth ,Principles of Data Mining,PHI
10.	Pujari, Arun K,Data mining and statistical analysis using SQL, Universities press
11.	Transactions on Database Systems (ACM)
12.	IEEE Transactions on Knowledge & Data Engineering
13.	The VLDB Journal The International Journal on Very Large Data Bases

Detailed Syllabus

Course Code	15B11CI518	**Semester : Even (specify Odd/Even)**	**Semester** VI **Session** 2018 -2019 **Month from Jan '19 to May '19**
Course Name	Data Structures & algorithms		
Credits	3-1-0	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	K Vimal Kumar
	Teacher(s) (Alphabetically)	Prantik Biswas, Shardha Porwal, Dr. Tribhuwan Tewari, K Vimal Kumar

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Explain the fundamental Data Structures including linked-lists, trees, binary search trees, AVL trees, heap trees, graphs, and hash-tables.	Understand level (C2)
CO2	Analyze and compare different sorting algorithms - Merge Sort, Quick sort, Shell sort and Bucket Sort.	Evaluating Level (C5)
CO3	Develop basic programs using data structures in various real-time practical problems	Apply Level (C3)
CO4	Formulate novel solutions for programming problems or improve existing code using learned algorithms such as, Backtracking, Branch and Bound, Greedy algorithm and Dynamic programming	Apply Level (C3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Introduction**	Introduction to data structures, lists, Doubly linked list, circular linked list, multi linked list, Applications - sparse matrix representation, Stack and queue (array and linked list representation)	6
2.	**Algorithm Complexity**	Abstract data type, Growth of function, Space-Time tradeoffs, Complexity analysis of algorithms - Asymptotic analysis	2
3.	**Sorting & Searching**	Merge Sort, Quick sort, Shell sort, Bucket Sort, Median search, Interpolation search	6

4.	**Trees**	Binary Tree, Binary Search tree, AVL Tree, RB Tree, B Tree, B+ Tree	7
5.	**Heaps**	Introduction, Binary heap, Binomial heap, Skew heaps	5
6.	**Graph**	Introduction to graphs, Representation – adjacency list, adjacency matrix, Traversal – BFS, DFS, Minimum spanning tree – Prims and Kruskal's algorithm, Shortest path – Dijkstra algorithm and Floyd–Warshall algorithm	8
7.	**Hashing**	Introduction to hashing, Collision resolution – open and closed hashing methods	4
8.	**Algorithm**	Backtracking Algorithm (n-queens puzzle, rat in a maze), Branch and Bound, Greedy algorithm, Dynamic programming	6
		Total number of Lectures	**44**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment, Quiz, Attendance)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Yedidyah Langsam, Moshe J., Augenstein and Aaron M. Tenenbaum: Data Structures Using C and C++, 2nd Edition, PHI, 2001
2.	Kurt Mehlhorn: Data Structures and Algorithms 3, Springer, 1984
3.	Dinesh P Mehta, Sartaj Sahani: Handbook of Data Structure and Applications, Chapman & Hall, 2004
4.	Mark Allen Weiss: Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson
5.	Sahni: Data Structures, Algorithms and applications in C++, Universities press, Hyderabad, 2005
6.	Kruse, Tonso, Leung: Data Structures and Program Design in C, 2rd Edition, Pearson Education Asia, 2002
7.	Weiss, Mark Allen: Data Structures and Algorithm Analysis in C/C++, 2nd Edition, Pearson Education Asia, 2003
8.	Cormen et al: Introduction to Computer Algorithms, 2nd edition , PHI New Delhi 2003
9.	Aho, Hopcraft, Ullman: Data Structures and Algorithms, Pearson Education Asia (Adisson Wesley), New Delhi, 2001
10.	Standish: Data Structures in Java, Pearson Education Asia (Adisson Wesley), New Delhi, 2000
11.	Knuth: The Art of Computer programming Vol I, Vol III, 2nd edition , Pearson Education Asia (Adisson

	Wesley), New Delhi, 2002
12.	Heileman: Data Structures, Algorithms and Object Oriented Programming, Tata Mc-Graw Hill, New Delhi, 2002
13.	Sorenson and Tremblay: An Introduction to Data Structures with Algorithms, 2nd Edition, Tata Mc-Graw Hill, New Delhi, 2003

Detailed Syllabus

Subject Code	15B11CI578	**Semester:** **(specify Odd/Even)**	**Semester** EVEN **Session** 2018-2019 **Month from** Jan'19 **to** Jun'19
Subject Name	Data Structures & Algorithms Lab		
Credits	0-0-1	**Contact Hours**	2

Faculty (Names)	**Coordinator(s)**	Suma Dawn
	Teacher(s) (Alphabetically)	K Vimal Kumar, Neetu Sardana, Prashant Kaushik, Suma Dawn, Taj Alam, Tribhuwan Tewari

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Demonstrate the use of basic data structure and algorithm design such as Linked lists, Stacks, Queues, and others, for various applications.	Understanding Level (C2)
CO2	Interpret the complexity of algorithms for given problems.	Understanding Level (C2)
CO3	Apply Searching, Sorting, and Trees and use their properties for abstractions and defining modules for implementing functionalities.	Apply Level (C3)
CO4	Examine case-study specific application of Heaps, Graphs, and Hashing methods.	Apply Level (C3)
CO5	Model algorithmic solutions for small real-life problems using Backtracking, Greedy algorithm and Dynamic programming, Branch and Bound, and others	Apply Level (C3)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	Introduction & Algorithm Complexity	Lab Assignments 1, 2: Conversion from one number system to another; Manipulation with arrays and strings, structures; Manipulation with a single Linked lists of integers; Stacks and Queues Finding Complexity: Big O, Big Omega Lab Assignment 6: Cost Analysis	CO1, CO2, Understanding Level (C2)
2.	Sorting, Searching & Trees	Lab Assignments 2, 3: Doubly Linked List, Circular Linked List, Multi-Linked Lists	CO1 Understanding Level (C2)

		Lab Assignments 4, 5: Sorting, Searching, Application based. Lab Assignments 6: Binary Tree, Binary Search Trees, AVL Tree , Case-study: Priority Queue with Binary Trees	CO3 Apply Level (C3)
3.	Heaps, Graph	Lab Assignments 7: B Trees, Heaps, Lab Assignments 8: Directed and undirected graphs, weighted graphs, etc.	CO4 Apply Level (C3)
4.	Hashing & other Algorithms	Lab Assignments 9: Hashing, Backtracking, Branch and Bound, Greedy Algorithms, Dynamic Programming.	CO5 Apply Level (C3)

Evaluation Criteria

Components	**Maximum Marks**
Lab Test 1	20
Lab Test 2	20
Day-to-Day Evaluations	45
Day-to-Day - Attendance	15
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1	Yedidyah Langsam, Moshe J., Augenstein and Aaron M. Tenenbaum: Data Structures Using C and C++, 2nd Edition, PHI, 2001
2	Kurt Mehlhorn: Data Structures and Algorithms 3, Springer, 1984
3	Dinesh P Mehta, Sartaj Sahani: Handbook of Data Structure and Applications, Chapman & Hall, 2004
4	Mark Allen Weiss: Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson
5	Sahni: Data Structures, Algorithms and applications in C++, Universities press, Hyderabad, 2005
6	Kruse, Tonso, Leung: Data Structures and Program Design in C, 2rd Edition, Pearson Education Asia, 2002
7	Weiss, Mark Allen: Data Structures and Algorithm Analysis in C/C++, 2nd Edition, Pearson Education Asia, 2003
8	Cormen et al: Introduction to Computer Algorithms, 2nd edition , PHI New Delhi 2003
9	Aho, Hopcraft, Ullman: Data Structures and Algorithms, Pearson Education Asia (Adisson Wesley), New Delhi, 2001
10	Standish: Data Structures in Java, Pearson Education Asia (Adisson Wesley), New Delhi, 2000
11	Knuth: The Art of Computer programming Vol I, Vol III, 2nd edition , Pearson Education Asia (Adisson

	Wesley), New Delhi, 2002
12	Heileman: Data Structures, Algorithms and Object Oriented Programming, Tata Mc-Graw Hill, New Delhi, 2002
13	Sorenson and Tremblay: An Introduction to Data Structures with Algorithms, 2nd Edition, Tata Mc-Graw Hill, New Delhi, 2003

Detailed Syllabus

Subject Code	**16B1NCI643**	Semester: Sixth	Session: Even 2019 Month from January to June
Subject Name	**Computational Intelligence**		
Credits	4	Contact Hours	3L + 1T

Faculty (Names)	Coordinator	Parul Agarwal

COURSE OUTCOMES		Cognitive Level
CO1	Infer vagueness, ambiguity and uncertainty in natural language using fuzzy logic concepts.	Understanding Level- (Level-2)
CO2	Apply the intelligent techniques using rough set theory, fuzzy Logic, genetic and hybrid techniques to solve different type of real world problems.	Apply- (Level-3)
CO3	Analyze the principles of fuzzification, defuzzification and their applications in different set of problems.	Analyze-(Level-4)
CO4	Integrate and develop hybrid Intelligent techniques for real time engineering application.	Create Level (Level-6)
CO5	Compare and conclude the results of different techniques through writing technical reports	Evaluate(Level-5)

Lecture Plan:

Sr. No.	Topic	No. of Lectures
1.	Introduction to CI: Pitfalls of AI, formal definition of CI, synergism in soft computing, Types of Adaptation and learning, Computational intelligence as Adaptation and Self organization	03
2.	Fuzzy sets and Fuzzy relations, methods of knowledge representation	04
3.	Rule-Based Expert Systems and Fuzzy Expert Systems : Rule-based expert systems, Fuzzy sets and operations of fuzzy sets, Fuzzy rules and fuzzy inference, Fuzzy expert systems . Case Studies (data clustering, pattern recognition)	08
4.	Pattern recognition and neural networks: Supervised and unsupervised learning, machine perception, object identification and speech recognition	9

	Unsupervised learning neural networks: self-organizing feature maps , Radial basis function networks , ART network, case studies	
5.	Introduction to evolutionary computing: GA, DE, PSO, ABC, GWO, BBO	8
6.	Hybrid Intelligent systems: Evolutionary algorithms in designing neural networks, Evolutionary algorithms vs. fuzzy system Neuro Fuzzy Systems concepts and applications	8
	Evaluation Criteria **Components** **Maximum Marks** T1 20 T2 20 End Semester Examination 35 TA 25 **Total** **100**	

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1	Poole, David Lynton, Alan K. Mackworth, and Randy Goebel.*Computational intelligence: a logical approach*. Vol. 1. New York: Oxford University Press, 1998
2	Jang, Jyh-Shing Roger, Chuen-Tsai Sun, and Eiji Mizutani. "Neuro-fuzzy and soft computing; a computational approach to learning and machine intelligence." (1997)
3	Konar, Amit. *Computational intelligence: principles, techniques and applications*. Springer Science & Business Media, 2006
4	Rutkowski, Leszek. *Computational intelligence: methods and techniques*. Springer Science & Business Media, 2008
5	Eberhart, Russell C., and Yuhui Shi. *Computational intelligence: concepts to implementations*. Elsevier, 2011
6	Fulcher, John. "Computational intelligence: an introduction." In*Computational intelligence: a compendium*, pp. 3-78. Springer, Berlin, Heidelberg, 2008
7	Cox, Earl, Michael O'Hagan, Rodman Taber, and Michael O'Hagen. *The fuzzy systems handkbook with cdrom*. Academic Press, Inc., 1998
8	Haykin, Simon. *Neural networks: a comprehensive foundation*. Prentice Hall PTR, 1994
9	De Jong, Kenneth A. *Evolutionary computation: a unified approach*. MIT press, 2006

Detailed Syllabus

Course Code	16B1NCI631	**Semester** Even **(specify Odd/Even)**	**Semester** VI **Session** 2018 -2019 **Month from** Jan 2019
Course Name	Advanced Data Structures and Applications		
Credits	4	**Contact Hours**	3-1-0

Faculty (Names)	**Coordinator(s)**	Mr. Prantik Biswas, Prof. Krishna Asawa
	Teacher(s) (Alphabetically)	Prof. Krishna Asawa, Mr. Prantik Biswas, Mr. Vimal Kumar K

COURSE OUTCOMES		**COGNITIVE LEVELS**
CI631.1	Comprehend insights of various variants of string processing and space partitioning data structures.	Understand level (Level 2)
CI631.2	Build efficient storage and sorting mechanisms for large data with the help of k-way merge-sort algorithm.	Apply Level (Level 3)
CI631.3	Analyse various advanced data structures- BST Variants, Heap variants, Indexed Trees, Disjoint Set etc.	Analyse Level (Level 4)
CI631.4	Compare performance of various Hashing algorithms.	Evaluating Level (Level 5)
CI631.5	Propose solutions for the real life problems with the aid of suitable data structures.	Creating Level (Level 6)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Amortized Analysis	Aggregate, Accounting and Potential Method, Dynamic tables	3
2.	External Sorting	Introduction to external sorting. Selection trees & k-way merging. Run generation. Optimal merging of runs.	3
3.	Binary Trees Variants	Optimal Binary Search Tree, Splay tree, AA-Tree, Treap.	5

4.	Indexed Tree	T-tree, Dancing tree, Queaps	3
5.	String Processing Data Structures	Rope, Tries, Suffix Tree,Ternary search tree,Gap buffer	4
6.	Disjoint SetData Structures	Disjoint-set operations, representation of disjoint sets, Disjoint-set forests	6
7.	Heaps	Pairing heap, Beap, Leftist tree.	3
8.	Space partitioning tree	Binary space partitioning, KD tree, Quad tree, Interval Tree, Segment Tree, Priority Search Tree.	6
9.	Hashes	Introduction, Perfect hash function - Cuckoo hashing, Coalesced hashing, Universal Hashing.	5
10.	Applications	Searching, Memory Indexing, Computer Graphics, Image Data Structures, Computational Biology.	4
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1	HananSamet: Foundations of Multidimensional and Metric Data Structure, Morgan Kaufman, 2006
2	Kurt Mehlhorn: Data Structures and Algorithms 3, Springer, 1984
3	Dinesh P Mehta, SartajSahani: Handbook of Data Structure and Applications, Chapman & Hall, 2004
4	Langsam, Augestein, Tenenbaum: Data Structures using C and C++, 2nd Edition, PHI, 2001
5	Sahni: Data Structures, Algorithms and applications in C++, Universities press, Hyderabad, 2005
6	Kruse, Tonso, Leung: Data Structures and Program Design in C, 2rd Edition, Pearson Education Asia, 2002
7	Weiss, Mark Allen: Data Structures and Algorithm Analysis in C/C++, 2nd Edition, Pearson Education Asia, 2003
8	Cormen et al: Introduction to Computer Algorithms, 2nd edition , PHI New Delhi 2003
9	Aho, Hopcraft, Ullman: Data Structures and Algorithms, Pearson Education Asia (Adisson Wesley), New Delhi, 2001
10	Standish: Data Structures in Java, Pearson Education Asia (Adisson Wesley), New Delhi, 2000
11	Knuth: The Art of Computer programming Vol I, Vol III, 2nd edition , Pearson Education Asia (Adisson

	Wesley), New Delhi, 2002
12	Heileman: Data Structures, Algorithms and Object Oriented Programming, Tata Mc-Graw Hill, New Delhi, 2002
13	Sorenson and Tremblay: An Introduction to Data Structures with Algorithms, 2nd Edition, Tata Mc-Graw Hill, New Delhi, 2003

Detailed Syllabus

Subject Code	16B1NCI635	**Semester Even**	**Semester** Even **Session 2019** **Month from January to June**
Subject Name	Data and Web Mining		
Credits	4	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Neetu Sardana
	Teacher(s) (Alphabetically)	1. Megha Rathi 2. Neetu Sardana 3. Somya Jain

S. No.	**Course Objective**	**Cognitive Level (Bloom's Taxonomy)**
CO1	Apply the pre-processing techniques to nominal, binary, categorical and ordinal data.	Apply Level (Level III)
CO2	Design a Data warehouse using star, snowflake and galaxy schema and perform OLAP operations like roll-up, drill-down, slicing and dicing, etc	Apply Level (Level III)
CO3	Apply a wide range of classification techniques like Naïve-bayes, decision tree, and KNN for the numerous application including fraud detection, target marketing, medical diagnosis, etc.	Apply Level (Level III)
CO4	Cluster the similar/dissimilar objects using different methods like partitioning, hierarchical and density based clustering.	Create Level (Level VI)
CO5	Analyze the transactional data for finding frequent and interesting patterns using association rule mining techniques like Apriori and FP-Growth.	Analyse Level (Level IV)
CO6	Analyze the link structure of web using page rank and HITS algorithms.	Analyse Level (Level IV)

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Introduction	What Motivated Data Mining? Why Is It Important? What Is Data Mining? Data Mining—On What Kind of Data? Data Mining Functionalities—What Kinds of Patterns Can Be Mined? Are All of the Patterns Interesting? Classification of Data Mining Systems, Data	3

		Mining Task Primitives, Integration of a Data Mining System with a Database or Data Warehouse System, Major Issues in Data Mining.	
	Data Warehouse		
2.	Data Warehouse Concepts	Data Warehouse, Multidimensional Data Model, Data Warehouse Architecture, Data Warehouse Implementation, From Data Warehousing to Data Mining	1
3.	Data Pre-processing	Data extraction, Data Cleaning, Data Integration and Transformation, Data Reduction, Loading into Staging area, Post Load Processing	1
4.	Dimensional modeling and OLAP Technology	Defining Dimensional model, Granularity of Facts, Additivity of facts, Helper tables, Implementing Many–to-Many Relationship between fact and dimension tables, Implementing changing dimensions, Efficient Methods for Data Cube Computation, Further Development of Data Cube and OLAP Technology, Attribute-Oriented Induction	2
	Data Mining		
5.	Classification Algorithms	Issues Regarding Classification and Prediction, Bayesian Classification, Usability and Complexity Analysis of Bayesian algorithm, Nearest Neighbour algorithm, Decision Tree based algorithm , Rule based Algorithm , Performance evaluation of classifiers: Precision recall, F Measure, Sensitivity, Sensibility,; Ensemble based techniques	9
6.	Clustering Algorithms	Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Methods, Hierarchical Methods, Usability and Complexity Analysis of Agglomerative Hierarchical Algorithm, k-means Partitioning Algorithm, Density based clustering,: DBSCAN, BIRCH	6
7.	Association Algorithms	Usability and Complexity Analysis of Apriori Algorithm, Sampling Algorithm, Partitioning, Using multiple minimum supports , Rough set approach	6
	Web Mining		
8	Searching , crawling and indexing Algorithms	Link Based Search Algorithm, Web Crawling, Indexing, Searching, Zone Indexing, Term-Frequency, Link Analysis Algorithm.	4

9	Ranking Algorithms	Page rank, Hits ranking algorithms	3
10	Web caching Algorithm	LRV, FIFO, LRU, Random, OPT	3
11	Recommendation Algorithms	Collaborative Filtering, Item-to-Item recommendation, Memory Based Recommendation,	3
		Total number of Lectures	41

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

15.	Jiawei Han, Micheline Kamber, Data Mining, Morgan Kaufmann Publishers,Elsevier,2005
16.	Kimball R. and Ross M ,The Data Warehouse Toolkit", Wiley
17.	Pujari, Arun K,Data mining and statistical analysis using SQL, Universities press
18.	Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining
19.	Soumen Chakrabarti, Mining the Web: Discovering knowledge from hypertext data", Morgan Kaufmann, Elsevier
20.	Alex, Berson,Stephen J.Smith, Data Warehousing, data mining and OLAP , McGraw-Hill,2004
21.	Inmon W.H.,Building the Data Warehouse ,4th Edition, Wiley
22.	Anahory S. and Murray D, Data Warehousing in the Real World, Addison-Wesley
23.	Margaret H. Dunham, Data Mining: Introductory and Advanced Topics, Prentice Hall,2003
24.	Mattison R. ,Web Warehousing and Knowledge Management", Tata McGraw-Hill.
25.	David Hand, Heikki Mannila and Padhraic Smyth ,Principles of Data Mining,PHI
26.	Transactions on Database Systems (ACM)
27.	IEEE Transactions on Knowledge & Data Engineering
28.	The VLDB Journal The International Journal on Very Large Data Bases

Detailed Syllabus

Course Code	19B12CS311	**Semester** Even **(specify Odd/Even)**	**Semester** VI **Session** 2018 -2019 **Month from** January-June
Course Name	IoT and IoT Security		
Credits	**04**	**Contact Hours**	**3-1-0**

Faculty (Names)	**Coordinator(s)**	Vikas Hassiza
	Teacher(s) (Alphabetically)	Vivek Kumar Singh

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Define basic terminologies related to IoT and IoT security.	Remember Level (Level 1)
CO2	Explain IoT reference model, different architectural views and security aspects moving from machine to machine (M2M) technology to Internet of Things.	Understand Level (Level 2)
CO3	Identify infeasibility of hardware and software design constraints due to specific security implementations in real scenarios.	Apply Level (Level 3)
CO4	Analyze the security related challenges at various layers and security mechanisms adapted to address them.	Analyze Level (Level 4)
CO5	Evaluate the performance of various IoT security protocols implemented at different layers.	Evaluate Level (Level 5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**INTRODUCTION & BASIC CONCEPTS**	IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management	06

2.	**REFERENCE ARCHITECTURE**	IoT Architecture-State of the Art – Introduction, State of the art, Reference Model and architecture, IoT reference Model - IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control.	12
3.	**ANALYSIS OF VARIOUS SECURITY THREATS AT EACH LAYER AND CORRESPONDING SECURITY PROBLEMS**	PHY/MAC layer-Physical capture, Cloning, Impersonation, Denial of service (DoS), Network Layer-Routing, Encryption, Node subversion, Traffic analysis etc, Middleware- Session attack, and data attacks.	04
4.	**IOT DATA LINK LAYER & NETWORK LAYER PROTOCOLS AND THEIR SECURITY MECHANISMS**	PHY/MAC Layer (IEEE 802.15), WirelessHART, Z-Wave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH,ND, DHCP, ICMP, RPL, CORPL, CARP	10
5.	**TRANSPORT & SESSION LAYER PROTOCOLS AND THEIR SECURITY MECHANISMS**	Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS) – Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT	06
6.	**SERVICE LAYER PROTOCOLS AND THEIR SECURITY MECHANISMS**	Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols – MAC 802.15.4 , 6LoWPAN, RPL,	04
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (…)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Bernd Scholz-Reiter, Florian Michahelles, “Architecting the Internet of Things”, ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer
2.	Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014
3.	Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications”, ISBN: 978-1-118-47347-4, Willy Publications
4.	Peter Waher, “Learning Internet of Things”, PACKT publishing, BIRMINGHAM – MUMBAI
5.	tp://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html
1.	Bernd Scholz-Reiter, Florian Michahelles, “Architecting the Internet of Things”, ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer

Detailed Syllabus

Course Code	19B12CS312	**Semester Even (specify Odd/Even)**	**Semester** VII **Session** 2018 -2019 **Month: from January 2019**
Course Name	Blockchain Technology		
Credits	3	**Contact Hours**	42

Faculty (Names)	**Coordinator(s)**	Vikas Hassija
	Teacher(s) Alphabetically)	Vikas Hassija

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Define all the basic terminologies related to blockchain, bitcoin, decentralized applications and smart contracts.	Remember Level (Level 1)
CO2	Understand the pillar security featured in decentralized networks like cryptography, digital signatures, proof of work and consensus algorithms.	Understand Level (Level 2)
CO3	Identify the feasibility of applying blockchain security features in real world scenarios using different consensus algorithms.	Apply Level (Level 3)
CO4	Analyze various consensus algorithms like PoW, PoS, PoB, Raft consensus, Paxos consensus, BFT etc.	Analyze Level (Level 4)
CO5	Evaluation of blockchain based consensus algorithms namely Byzantine fault tolerance, proof of work etc.	Evaluate Level (Level 5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Blockchain defined	We will introduce and define blockchain, explain the structure and operational aspects of Bitcoin blockchain, and compare different types of blockchains.	8
2.	Ethereum Blockchain	We will discuss the innovation of the Ethereum blockchain, review its protocol, and explore the payment model for code execution.	6
3.	Algorithms & Techniques	We will discuss the concept of asymmetric key encryption, define the concept of hashing, and explain techniques that use algorithms to manage the integrity of transactions and	6

		blocks in blockchain.	
4.	Trust Essentials	The purpose of this module is to introduce the reasons for a smart contract and its critical role in transforming blockchain technology from enabling decentralized systems. We will explore the structure and basic concepts of a smart contract through examples, and illustrate Remix (remix.ethereum.org) web IDE for deploying and interacting with a smart contract.	7
5.	Smart Contract Basics	The purpose of this module is to introduce the reasons for a smart contract and its critical role in transforming blockchain technology from enabling decentralized systems. We will explore the structure and basic concepts of a smart contract through examples, and illustrate Remix (remix.ethereum.org) web IDE for deploying and interacting with a smart contract.	7
6.	Decentralized Applications (Dapps)	We will explore the notion of the blockchain server as the foundation for a Decentralized Application. We will demonstrate how to install the blockchain server and establish a peer-to-peer network of nodes. It is a common practice to develop and test a Dapp on a local test network before deploying it on a public network.	4
7.	Current challenges and solutions	We will explore just a few of the important challenges and solutions that are continuously innovating Blockchain.	4
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Attendance , Assignment and Quiz)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Blockchain Revolution: How the Technology Behind Bitcoin Is Changing Money, Business, and the World
2.	Blockchain: Blueprint for a New Economy
3.	The Truth Machine: The Blockchain and the Future of Everything
4.	IEEE Transactions on vehicular technology
5	ACM Transactions on Blockchain

Detailed Syllabus

Subject Code	16B1NCI642	**Semester (Even)**	**Semester** Even **Session** 2018 - 19 **Month from** January **to** May
Subject Name	Wireless Networks		
Credits	**3+1**	**Contact Hours**	**3 Lectures +1 Tutorial**

Faculty (Names)	**Coordinator(s)**	Dr. Gagandeep Kaur
	Teacher(s) (Alphabetically)	1. Dr. Gagandeep Kaur

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Define basic concepts & terms related to IEEE 802.11 wireless networks	Remember Level (Level 1)
CO2	Explain cellular concepts of mobile radio propagation in wireless networks, IEEE 802.11 adhoc routing protocols and transport layer protocols	Understand Level (Level 2)
CO3	Identify different categories and design issues of IEEE 802.11 MAC protocol	Apply Level (Level 3)
CO4	Analyze metrics of MAC & Mobile IP based routing protocols using simulators	Analyze Level (Level 4)
CO5	Evaluate various security parameters in wireless networks	Evaluate Level (Level 5)

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Overview of Wireless Communications & Networks	Introduction to wireless communication & wireless networks, principles and challenges of various wireless communication generations; GSM, GPRS, 3G, 4G, and 5G	4
2.	Data Link Layer	Path Loss and Shadowing, The 802.11 MAC, MAC Access Modes and Timing Section, Contention-Based Access Using the DCF Section, Fragmentation and Reassembly Frame Format. Data Frames, Control Frames, Management Frames, Contention-Based Data Service, Multi-acces communication, Aloha and CSMA Protocols, Other MAC Protocols, Multiple access Interference, IEEE 802.11 wireless LAN, Medium Access control, Interframe spaces, Virtual Carrier Sensing and Network Allocation Vector, ARQ	10

		and Atomic Operations, Backoff Procedure with the DCF, Hidden and Exposed Stations,	
3.	Network Layer	Mobile IP, Network layer routing protocols, key component mechanisms, link metric estimation and neighborhood table management for proactive and reactive routing protocols, opportunistic routing, End-to-End Path Capacity, Mobility, Capacity of Mobile Ad Hoc Networks	8
4.	Transport Layer	Transport layer protocols, with an emphasis on congestion control, including TCP over wireless, Feedback TCP, Adhoc TCP, Split TCP, congestion sharing mechanisms, Explicit and precise rate control,	8
5.	Security in Wireless Networks	Wireless security techniques, WEP, The Extensible Authentication Protocol, Application based attacks, Network Security Attacks, Transport Layer Attacks, DLL Attacks, Cryptographic solutions	8
6.	Introduction to Simulation Tools & Performance Measurement	Network simulation software tools, MAC Protocol Performance Measures, Wireless networks security performance measurement	4
			42

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignments+Attendance)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Matthew Gast, 802.11Wireless Networks: The Definitive Guide , O'Reilly .
2	C. Siva Ram Murthy, B. S. Manoj, "Ad Hoc Wireless Networks Architectures and Protocols, Prentice Hall Communications Engineering and Emerging Technologies Series
3.	James F. Kurose, Keith W. Ross, 'Computer Networking : A Top-Down Approach, 6th Edition, Pearson
4.	Ivan Marsic , Wireless Networks: Local and Ad Hoc Networks, 1st Ed., Prentice-Hall, Englewood Cliffs, NJ, 1995.

5.	Nupur Prasad Giri, Wireless Technology, Dreamtech Engineering Textbooks
6.	Sunilkumar S. Manvi, Mahabaleshwar S. Kakkasageri, 'Wireless and Mobile Networks: Concepts and Protocols, 1st Edition, Wiley
7.	IEEE, ACM Transactions, Journals and Conference papers on "Wireless Communications & Networking."
8.	NS2 Simulator, https://www.isi.edu/nsnam/ns/

Detailed Syllabus

Course Code	16B1NCI634	**Semester Even (specify Odd/Even)**	**Semester: VIth Session** 2018 -2019 **Month from January to May**
Course Name	Agile Software Development		
Credits	**4**	**Contact Hours**	**4**

Faculty (Names)	**Coordinator(s)**	Indu Chawla
	Teacher(s) (Alphabetically)	Indu Chawla

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Interpret the trade-offs between traditional software development methods and agile software development methods for a software project effectively.	Understand level (Level 2)
CO2	Identify and make use of an appropriate agile software engineering approach viz. extreme programming, Scrum, Crystal techniques as a part of software development.	Apply Level (Level3)
CO3	Apply Refactoring techniques on source code for improved design	Apply Level (Level3)
CO4	Choose tools and construct the methods for testing Agile projects using various testing strategies	Apply level (Level3)
CO5	List the Planning, tracking, estimation and monitoring of agile projects with techniques like burn down charts, velocity calculation and task boards etc.	Analyze level (level4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Traditional software development methods, Agile software development methods and lean software development methods	3
2.	Agile Fundamentals	Agile manifesto, Agile principles, Characteristics of Agile processes, an iterative development process, Pros and cons of incremental development and software	3

		prototyping.	
3.	Requirements and Planning	User stories, agile estimation, planning techniques- Prioritizing Themes, Financial prioritization, prioritizing desirability	4
4.	Scrum	Introduction, Scrum - Prioritizing, Estimating, and Planning, The Scrum Experience (hands-on exercise)	5
5.	Extreme Programming (XP)	Extreme Programming Values, Principles and Practices, Pair programming, Embracing change, incremental change	5
6.	Crystal	Crystal methodologies: project categories, complexity, family members, Crystal's seven properties, Crystal clear development process cycle, Crystal yellow, crystal orange and crystal orange web.	4
7.	Kanban	The principles of kanban, Improving process with kanban, Measure and manage flow, Emergent behavior	4
8.	Feature-Driven Development	Processes of feature driven development, practices and progress in FDD	2
9.	Testing	Agile testing strategy, automated unit test, test plan, test driven development, alpha, beta and acceptance testing	5
10.	Refactoring	Bad smells in code, properties of refactoring, refactoring examples, benefits, cost and risk of reafctoring	7
		Total number of Lectures	42

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Cohn, Mike. Agile estimating and planning. Pearson Education
2.	Beck, Kent. Extreme programming explained: embrace change. Addison-wesley professional
3.	Martin, Robert C. Agile software development: principles, patterns, and practices. Prentice Hall.
4.	Shore, James. The Art of Agile Development: Pragmatic guide to agile software development. " O'Reilly

	Media, Inc.".
5.	Schwaber, Ken. Agile project management with Scrum. Microsoft press
6.	Stellman, Andrew, and Jennifer Greene. Learning agile: Understanding scrum, XP, lean, and kanban. " O'Reilly Media, Inc."
7.	Cohn, Mike. User stories applied: For agile software development. Addison-Wesley Professional

Detailed Syllabus

Subject Code	16B1NCI644	**Semester Even** **(specify Odd/Even)**	**Session** 2018 - 19 **Month from** January to May
Subject Name	Cloud based Enterprise Applications		
Credits	4	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Bharat Gupta
	Teacher(s)	Bharat Gupta

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO 1.	Differentiate between Public, Private, and Hybrid Clouds	Understand Level (Level 2)
CO 2.	Develop Enterprise applications based on XML, JavaScript, Java Servlets, Java Server Pages, etc.	Apply Level (Level 3)
CO 3.	Develop web service based solutions by using REST, JSON, SOAP, etc.	Apply Level (Level 3)
CO 4.	Examine emerging technologies in cloud environment.	Analyse Level (Level 4)
CO 5.	Evaluate the performance of different Public Cloud Platforms e.g., GAE, AWS and Azure.	Evaluate Level (Level 5)
CO 6.	Design and deploy Enterprise applications on one of the Cloud Service Providers, i.e., Amazon AWS or Microsoft Azure.	Create Level (Level 6)

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1	XML Programming	XML, DTD, XML schema, XPath, XQuery	6
2	Web services	REST, JSON,SOAP	6
3	JavaScript	Basic constructs, Conditional statements, Loop, External linking with .js, Browser related events	6
4.	Server Side programming	Java servlet, Java server pages	8
5.	Introduction to Cloud Computing	Public, private, and Hybrid clouds; Features of cloud platforms,	4
6.	Public Cloud Platforms	Introduction to GAE, AWS and Azure; Programming support of Google App Engines, Amazon AWS, and Microsoft Azure; Emerging cloud software environments	7

7.	Apache Hadoop	Introduction to distributed computing, Map Reduce	3
8.	Virtualization	Virtualization structures/tools and mechanism, Virtualization of CPU, Memory and I/O devices	2
Total number of Lectures			42

Evaluation Criteria

Components	**Maximum Marks**
T1	**20**
T2	**20**
End Semester Examination	**35**
TA	**25 (Attendance (5); Tutorial performance and Quiz (10); Mini-project (10))**
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc.)

1.	https://www.w3.org/XML/
2.	https://aws.amazon.com/
3.	https://azure.microsoft.com/en-in/
4.	https://cloud.google.com/appengine/docs/
5.	John Pollock, JavaScript, 3rd Edition, Mc Graw Hill, 2011
6.	https://docs.oracle.com/javase/tutorial/jaxp/
7.	Elliotte Harold, W. Means, XML in a Nutshell, 3rd Edition, O'Reilly Media, 2009
8.	http://www.oracle.com/technetwork/java/javaee/jsp/index.html (JSP)
9.	https://docs.oracle.com/javaee/6/tutorial/doc/bnafd.html (Java Servlet Technology)

Detailed Syllabus

Course Code	16B1NCI633	**Semester** Even **(specify Odd/Even)**	**Semester** VI **Session** 2018 -2019 **Month from** January-June
Course Name	Introduction to Mobile Application Development		
Credits	3	**Contact Hours**	3(Lectures) + 1 (Tut)

Faculty (Names)	**Coordinator(s)**	Arpita Jadhav Bhatt
	Teacher(s) (Alphabetically)	Arpita Jadhav Bhatt, Mradula Sharma

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Analyze functional aspects of Android mobile operating system for developing Android applications	Analyze Level (Level 4)
CO2	Explain how Android applications work, their life cycle, manifest, Intents, event handling and using external resources	Understand Level (Level 2)
CO3	Design and develop useful Android applications with compelling user interfaces by using, extending, and creating own layouts using different adapters and picker views, fragments, sending and receiving SMS and email	Create Level (Level 6)
CO4	Make use of Google Map API to develop location aware services through Internet for mobile environments	Apply Level (Level 3)
CO5	Apply functional aspects of database handling to develop Android applications using SQLite database	Apply Level (Level 3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to App development	Introduction to app development process and its platforms and development tools, Android Architecture, Setting up the environment, SDK, Architectural components, Creating simple Android applications, Activities, Intents and manifest files, Life cycles of an activity, working with intents, using intent object to link activities and types of intent, passing data using intents,	8
2.	Event Handling	Handling buttons and action listener methods and events,	6

		performing simple operations with button	
3.	Designing and handling Graphical User Interface –I	Views and View Groups, Types of Layouts, Textview, EditText, XML layouts, Image View, List View, Grid View, Spinners Navigation bar, tab bar, user inputs like swipes, pinch, zoom etc. Adapter classes, model classes	10
4.	Designing and handling Graphical User Interface –II	**Part 1:** Handling different types of buttons: Radio button, Check box button, toggle, progress bar view, displaying pictures and menus with views, using menus with views Designing interfaces with Views: Basic views, Picker views : Date/Time,	8
5.	Designing and handling Graphical User Interface –II	**Part 2:** Customizing List view, Enabling Filtering and Multi-Item Support in the List View , Creating and Using a List Fragment, customizing Grid and Spinner views by defining row layouts, using GridView view, Sending and receiving SMS programmatically, sending Email and implementing location based services using map APIs	7
6.	Mobile Databases	Sqlite introduction, database Create, Retrive, Update, delete operations, backup of DB's	7
		Total number of Lectures	**46**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Project:15, Class Test:5, Attendance:5)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Griffiths D, Griffiths D. Head First Android Development: a brain-friendly guide. " O' Reilly Media, Inc."; 2017 Aug 9.
2.	Burd BA. Android application development all-in-one for dummies. John Wiley & Sons; 2015 Jul 9.
3.	Annuzzi Jr J, Darcey L, Conder S. Introduction to Android application development: Android essentials. Pearson Education; 2014.
4.	Meier R. Professional Android 4 application development. John Wiley & Sons; 2012.
5.	Lee WM. Beginning android 4 application Development. John Wiley & Sons; 2012 Feb 3.
6.	Darcey L, Conder S. Sams Teach Yourself Android Application Development in 24 Hours: Sams Teac Your Andr Appl D_2. Pearson Education; 2011 Jul 25.

7.	Felker D. Android application development for dummies. John Wiley & Sons; 2010 Nov 17.
8.	Murphy, M. L. "The Busy Coder's Guide to Advanced Android Development: CommonsWare." (2009).
9.	Hashimi SY, Komatineni S. Pro Android. Apress; 2009 Jun 22.
10.	Rogers R, Lombardo J, Mednieks Z, Meike B. Android application development: Programming with the Google SDK. O'Reilly Media, Inc.; 2009 May 26.
11.	https://developer.android.com

Detailed Syllabus

Subject Code	19B16CS311	**Semester odd**	**Semester Sixth Session 2018- 2019** **Month from Jan to June**
Subject Name	Neural network Workshop		
Credits	**0-0-4**	**Contact Hours**	**4 lab hours**

Faculty (Names)	**Coordinator(s)**	Anuja Arora
	Teacher(s) (Alphabetically)	Anuja Arora Archana Purwar Pawan Upadhay Ankit Vidhyarthi

SNO	**Description**	**Cognitive Level**
CS311.1	Understand the fundamentals and concepts of neural network, neural network architectures, and its paradigm.	Understand Level (Level 2)
CS311.2	Apply the neural network to solve practical problems	Apply Level (Level 3)
CS311.3	Examine the engineering applications that can learn using neural networks	Evaluate Level (Level 5)
CS311.4	Implement Neural network in context of problem solving and modelling in python	Analyze Level (Level 4)
CS311.5	To develop neural network applications on real-world tasks	Create Level (Level 6)

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Labs for the module**
1.	Overview of classification and Regression	Linear Regression, Multiple Linear Regression, KNN classifier, SVM Classifier	4
2.	Neural Fundamental Concept	Neuron models, basic Learning rules, Single Neuron NN, Single layer neural network, Activation Function, Two Layer Neural Network, error function	4
3	Basic neural network models	Multilayer Perceptron Learning Algorithm, Stochastic gradient descent, Forward Propagation, Backpropagation, Real life case studies	8
4	Other Neural network models	Associative memory, Self-organizing feature map, Neural network decision tree, Data visualization with self-organizing feature map	6
5	Convolution Neural Network	Fundamentals of convolution Neural network and Object detection, introducing	6

		tensor flow and keras libraries for CNN, neural style transfer Case studies of Convolution neural network.	
		Total number of Lectures	**28**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	S. Haykin, Neural Networks: A Comprehensive Foundation 2nd edition, (Prentice Hall, 1999)
2.	Rajasekaran, S., & Pai, G. V. (2003). Neural networks, fuzzy logic and genetic algorithm: synthesis and applications (with cd). PHI Learning Pvt. Ltd..
3.	C. Looney, Pattern Recognition Using Neural Networks, Oxford University Press, 1997
4.	Hagan, M. T., Demuth, H. B., Beale, M. H., & De Jesús, O. (1996). Neural network design (Vol. 20). Boston: Pws Pub..
5.	Sivanandam, S. N., & Deepa, S. N. (2007). Principles of Soft Computing (With CD). John Wiley & Sons.

Detailed Syllabus

Subject Code	18B16CS311	**Semester: (specify Odd/Even)**	**Semester** Even **Session** 2018-2019 **Month from** January'19 **to** June'19
Subject Name	Internet Of Things (Workshop)		
Credits	0-0-4	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Dr K. Rajalakshmi
	Teacher(s) (Alphabetically)	Dr K. Rajalakshmi, Dr. Prakash Kumar, Ms. Purtee Kholi, Mr. Vivek Kumar Singh

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Define exiting IoT frameworks and techniques used for developing applications	Remember (level 1)
CO2	Explain the uses of IoT edge devices & basic concept of Node-RED platform.	Understand (level 2)
CO3	Develop Java Script based IoT applications using functional nodes , flows and dashboard on Node-RED platform	Apply (level 3)
CO4	Evaluate the data gathered using Node-RED functionalities and choose appropriate graphical user interface to output the results.	Evaluate (level 5)
CO5	Analyze various communication protocols, network connectivity, and cloud services using Node-RED platform.	Analyze (level 4)

Module No.	**Subtitle of the Module**	**Topics in the module**	**CO**
1.	Java scripts for inbuilt functional nodes and deploy it in Node-Red flows, types of Message	Setup and Install Node.js and Node-RED as IDE platform for IoT application development.	C1
2.		I/O nodes, flows, third party palettes, import/export of flows in Node-RED	C1,C2
3.	User defined functional nodes into Node-RED flows and FRED cloud and using various dashboard UI interfaces	Java scripts for user defined functional nodes and deploy it in Node-Red flows.	C2,C3
4.		User defined functional nodes into Node-RED flows and FRED cloud.	C2,C3
5.		UI modules for peripheral sensors and devices that can be controlled through smart phones and	C2,C3

		web pages	
6.	MQTT brokers for publishing and subscribing between IoT sensors and devices.	MQTT brokers for publishing and subscribing between IoT sensors and devices.	C4,C5
7.	Using websocket for HTTP, TCP and UDP traffic flow in IoT applications.	HTTP, TCP and UDP traffic flow for IoT applications.	C4,C5
8.		Using WebSocket through internet and cloud platforms.	C4,C5
Total number of Lab hours			**56**

Evaluation Criteria	
Components	**Maximum Marks**
Mid Term Evaluation	30
D2D Evaluation	30 (Lab Evaluation (20) + Attendance (10))
Final Evaluation	40
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	"Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti (Universities Press)
2.	"Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud" Cuno Pfister
3.	The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
4.	https://www.raspberrypi.org/documentation/
2.	https://www.arduino.cc/en/Tutorial/HomePage
3.	https://nodered.org/docs/hardware/raspberrypi
4.	https://nodered.org/docs/getting-started/installation
5.	https://docs.oasis-open.org/mqtt/mqtt/v5.0/mqtt-v5.0.html
6.	https://mosquitto.org/

Detailed Syllabus

Course Code	18B16CS312	**Semester Even (specify Odd/Even)**	**Semester** VI **Session** 2018 -2019 **Month from** Jan-Jun
Course Name	R Programming Workshop		
Credits	0	**Contact Hours**	1-0-2 (3 hrs per week)

Faculty (Names)	**Coordinator(s)**	Megha Rathi
	Teacher(s) (Alphabetically)	Dr. Adwitiya Sinha, Kirti Aggarwal, Megha Rathi

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Define all tools and techniques used for Data Mining and Analysis. Explain the basic & core concept of R	Understand Level (Level 2)
CO2	Develop code for data extraction & loading. Apply data pre-processing techniques and build predictive model	Apply Level (Level 3)
CO3	Choose Data Visualization techniques for graphical representation of results	Apply Level (Level 3)
CO4	Analyze the results. Compare and contrast the results obtained to discover new pattern insight in data.	Analyze Level (Level 4)
CO5	Design predictive models and techniques towards research initiatives	Create Level (Level 6)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to R	Introduction to R, Installation, Getting Started ,Some Information on R Commands, Objects,Functions, Number & Vector, Matrices & Array,Factors, Conditional Statements, Loop, Scripts, R package.	1+3
2.	List , Data Frames & String Handling	Introduction, Creating a List, List Operation, Recursive List, Introduction to Data Frame, Creating Data Frame, Data Frame Operations, lapply() and sapply() functions.	2+3

		Introduction to String handling, String functions, String Manipulation, Regular Expressions & Pattern Matching, and Introduction to "stringr" package.	
3.	Object Oriented Programming	Introduction, Object Oriented Programming Concepts, S3 classes, S4 classes, Reference Classes.	1+3
4.	Import & Export	Introduction, Saving & Loading R data, Import and Export to different file formats: Excel File, Binary File, XML File, JSON File. Analyzing data & Reshaping the data.	1+3
5.	R-working with database (Mysql + Hadoop)	Introduction to Databases, Introduction to SQL Commands, RMySQL Package, Connecting R to MySQL ,Import Table, Querying Data, Export data to MySQL , Disconnect Function. Introduction to Hadoop, Import and Export data (Hadoop)	2+4
6.	Data Preprocessing using R	Data Pre-processing, forms of Data Pre-processing, Data Cleaning Techniques, Data Redundancy- chi square test, correlation analysis, covariance coefficient, Data Transformation, Data Reduction- Principal Component Analysis, R packages for Data Pre-processing.	2+4
7.	Data Visualization	Visual Representation of statistical analysis, High level plotting commands- create plots with axes, titles, labels and others on the graphics device and Low level plotting commands- add new features like extra labels, point or line. Plots, Histogram, Scatter Plots, Pie chart, Box Plot, QQ Plot, customized Plotting. Introduction to data visualization packages: Ggobi & ggplot.	2+3
8	Classification and Clustering Algorithm	Classification Techniques: Introduction to Classification, Regression, Naïve Bayes, Decision Tree, KNN, Ensemble Methods. Clustering Techniques: Introduction to Clustering, K-means, Hierarchical Clustering, DB Scan.	3+4
9	Data Analytics	Tools for Data Analytics by integrating R with Android or web Interface, Introduction to shiny Package.	1+3
		Total number of Lectures	**45**

Evaluation Criteria

Components	**Maximum Marks**
Lab Test1	30
End Semester Examination	40
TA	30 (Quiz + Evaluative Assignment + Class Test + Attendance)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Paul Teetor.R Cookbook - Proven Recipes for Data Analysis, Statistics, and Graphics. O'Reilly, 2011.
2.	Alain F. Zuur, Elena N. Ieno, and Erik Meesters. A Beginner's Guide to R. Use R. Springer, 2009. ISBN: 978-0- 387-93836-3.
3.	John Maindonald and John Braun. Data Analysis and Graphics Using R. Cambridge University Press, Cambridge, 2nd edition, 2007. ISBN 978-0-521-86116-8.
4.	Advanced R, by Hadley Wickham, ISBN 9781466586963.
5.	Using R for Introductory Statistics, by John Verzani, Chapman & Hall/CRC, 2004, ISBN 1584884509
6.	R Programming for Data Science, by Roger D. Peng,
7.	Phil Spector. Data Manipulation with R. Springer, New York, 2008. ISBN 978-0-387-74730-9.

Detailed Syllabus

Course Code	19B16CS312	**Semester Even (specify Odd/Even)**	**Semester** VI **Session** 2018 -2019 **Month from** Jan-Jun
Course Name	Data Analytics Workshop		
Credits	0	**Contact Hours**	1-0-2 (3 hrs per week)

Faculty (Names)	**Coordinator(s)**	Dr. Adwitiya Sinha
	Teacher(s) (Alphabetically)	Dr. Adwitiya Sinha, Megha Rathi

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Demonstrate basic & advance facets of application-based data analytical tools & IDEs	Understand Level (Level 2)
CO2	Apply large scale data spanning over complex structures	Apply Level (Level 3)
CO3	Analyze benchmark methods for pre-processing, indexing, clustering and classification algorithms	Analyze Level (Level 4)
CO4	Evaluate performance of innovated algorithms for application-specific target domains	Evaluation Level (Level 5)
CO5	Design methods to yield required information from real-world data sources	Create Level (Level 6)
CO6	Construct low-complexity computation framework for massive datasets	Create Level (Level 6)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Data	Overview to Data & Analysis, Needs for Analytics, Data Visualization	1+0
2.	Analytical Tools	Matlab, Gephi, Netlogo, Python, R, Python, Libraries & Packages like – plotly, Matplotlib, Numpy, Pandas, Seaborn, Scikit-Learn, Scipy, BeautifulSoup, Bokeh, Urllib, PandaSQL, Basemap	1+6
3.	Data Collection & Extraction	Data Crawling, Data Scrapping, Real-time Data Extraction, Streaming Data, Authenticated Data Repositories	1+4
4.	Data Management	Data Mining & Management, Data Cleaning, Data Pre-processing, Spatial Data Representation, Demographic Analysis	1+4

5.	Descriptive & Inferential Statistics	Descriptive Statistics - Central Tendency & Data, Distribution & Dispersion, Random Variables, Probability Distribution, Inferential Statistics – Error Analysis, Confidence Intervals, Regression, Logistic	3+4
6.	Graph Analytics	Random Graphs, Bollobás Configuration Model, Isolation Probability, Giant Component, Strategic Networks, Game Theory, Big Data Analytics, Social Networks, Web Analytics, Google Analytics	3+4
7.	Supervised Learning	Linear Discriminant Analysis, Quadratic Discriminant Analysis, Classification Trees, Support Vector Machines, Random Forest	2+2
8.	Unsupervised Learning	Clustering, Divisive & Agglomerative Clustering, Density-based Clustering, Associative Rule Mining	1+2
9.	Deep Learning	Neural Networks, Feed Forward Neural Networks, Fuzzy Logic, Recurrent Neural Nets, Convolutional Neural Nets, Deep Neural Networks	1+2
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
Lab Test1	30
End Semester Examination	40
TA	30 (Quiz + Evaluative Assignment + Class Test + Attendance)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Data Analytics by Anil Maheshwar, McGraw Hill Education, 2017
2.	Data Smart: Using Data Science to Transform Information into Insight, by J. W. Foreman, Wiley 2013
3.	The Elements of Statistical Learning by Hastie, Trevor, Tibshirani, Robert, Friedman, Jerome, Springer, 2009
4.	Introduction to Statistical Learning by Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani, Springer, 2017
5.	Data Mining: Practical Machine Learning Tools and Techniques by Ian H. Witten, Eibe Frank, Mark A. Hall, The Morgan Kaufmann Series, Elsevier, 2011
6.	Designing Data-Intensive Applications by Martin Kleppmann, O'Reilly, 2017
7.	Big Data at Work: Dispelling the Myths, Uncovering the Opportunities by Thomas H. Davenport, Harvard Business School Publishing Corporation, 2014

8.	Machine Learning by Tom Mitchell, McGraw Hill Education, 2017
9.	Advanced Analytics with Spark: Patterns for Learning from Data at Scale by Sandy Ryza, Uri Laserson, Sean Owen, Josh Wills, O'Reilly, 2017
10.	Analytics in a Big Data World: The Essential Guide to Data Science and its Applications, by B. Baesens, Wiley, 2014
11.	Business UnIntelligence: Insight and Innovation Beyond Analytics and Big Data, by B. Devlin, Technics Publications, 2013

Detailed Syllabus

Course Code	**19B16CS313**	**Semester : Even**	**Semester** 6th **Session** 2018 -2019 **Month from Jan 19 to May 19**
Course Name	**Spatial Data Mining**		
Credits	**0**	**Contact Hours**	1-0-2 (3 hrs per week)

Faculty (Names)	**Coordinator(s)**	Mahendra Kumar Gurve
	Teacher(s) (Alphabetically)	Ankita Wadawa

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Illustrate spatial data mining concepts, techniques and real world applications.	Understand Level (Level 2)
CO2	Create maps using the basics of data capture, storage, analysis, and output procedure in open source spatial data mining (QGIS) tool.	Apply Level (Level 3)
CO3	Apply spatial clustering and classification algorithms to discover interesting and useful patterns in spatial data.	Apply Level (Level 3)
CO4	Identify and evaluate the best spatial data mining technique for predictive Modeling and suitability analysis.	Analyse Level (Level 4)
CO5	Develop a project using spatial data mining technique to solve the real world problems like finding accident prone area, recommend best place/site for ATM/schools/industries etc.	Create Level (Level 6)

Module No.	**Title of the Module**	**List of Experiments**	**No. of Lectures for the module**
1.	Course overview:	Course overview: What Spatial Motivated Data Mining? Why Is It Important? Spatial Data Mining vs Classical Data Mining ? Data Mining Functionalities—What Kinds of Spatial Patterns Can Be Mined? Are All of the Patterns Interesting? Data mining process, Types of datasets and attributes, Major Issues in Spatial Data Mining.	**06**
2.	Data Preprocessing :	Data Preprocessing : Getting To know your data, Types of spatial data , Raster data, Vector data, , Spatial Data collection methods , Data extraction, online sources of spatial	**03**

		data	
3.	QGIS,	Installation and Launching QGIS, introduction to QGIS GUI, visualization and export spatial data into QGIS, Load raster and vector layers, Create, edit, manage and export data, Working with Projections, Working with Vector Data, Working with Raster Data, Extension of QGIS functionality through plugins, Python Console for QGIS.	**10**
4.	Classification Algorithms :	Classification Algorithms : Issues Regarding classical Classification methods , Spatial Classification Algorithms like spatial Decision Tree based algorithm, spatial entropy etc.	**07**
5.	Clustering Algorithms:	Clustering Algorithms: Types of Data in Cluster Analysis, Similarity Measures, Usability and Complexity Analysis of major Clustering Methods in spatial data mining. k-means, Density-based spatial clustering of applications with noise (DBSCAN), Ordering points to identify the clustering structure (OPTICS), SATCAN , Applications of clustering in spatial data mining.	**08**
6	Spatial Rule mining:	Spatial Rule mining: Usability and Complexity Analysis of Apriori Algorithm using multiple minimum supports for spatial rule mining.	**04**
7	**Suitability analysis**	Case studies and application of spatial data mining technique to solve the real world problems like prediction of accident prone area, crime hotspot analysis , recommend best place/site for ATM/schools/industries etc	**06**
			42

Evaluation Criteria

Components	**Maximum Marks**
Lab Test1	30
End Semester Examination	40
TA	30 (Quiz + Evaluative Assignment + Class Test + Attendance)
Total	**100**

Detailed Syllabus

Subject Code	15B1NCI738	**Semester :odd**	**Semester Seventh Session 2018- 2019 Month from July to December**
Subject Name	Social Network Analysis		
Credits	**3**	**Contact Hours**	**3+1**
Faculty (Names)	**Coordinator(s)**	Dr. Neetu Sardana	
	Teacher(s) (Alphabetically)	Dr. Anuja Arora, Dr. Neetu Sardana, Somya Jain	

S.NO	Course objectives:	COGNITIVE LEVEL (BLOOMS TAXONOMY)
CO 1	Define social network growth models and their characteristics.	Remember level (Level 1)
CO 2	Compare and interpret social network structure, size and its connectivity pattern using degree distribution, clustering coefficient, centrality, motifs, density, etc.	Understand Level (Level 2)
CO 3	Apply link prediction techniques like Jaccard Coefficient, Adamic Adar, Preferential attachment, Katz score, etc. to discover new links in the social network.	Apply Level (Level 3)
CO 4	Discover community structure in complex network using statistical techniques like Newman Girvan, Clique Percolation Method, Ford Fulkerman etc.	Analyse Level (Level 4)
CO 5	Model the cascading/flow of information in social network for maximizing the cascade, locating the seed nodes and influential nodes.	Apply Level (Level 3)
CO 6	Develop secured social networks by applying mechanisms like K-anonymity, L-diversity, T-closeness, etc. to ensure privacy and security.	Apply Level (Level 3)

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	Introduction	Concepts: how services such as Facebook, LinkedIn, Twitter, etc. are using SNA to understand their users and improve their functionality.	2

2.	Network Concept	Introduction: Graphs, Paths and components, Adjacency Matrices, Ways and Modes, Matrix Product, node degree, types of nodes and types of ties, actor atributes	4
3.	Random network models	Erdos-Renyi , Barabasi-Albert , Watts-Strogatz small-world model, shortest path, six degree of separation	5
4.	Social Network Visualization	Tools: Gephi, NetLogo, Pajek, EgoNet	2
5.	Characterizing whole network	Cohesion, reciprocity, Transitivity and clustering Coefficient, Triad census	2
6.	Network centrality	Undirected Non-valued networks: Degree, Eigenvector, betweeness.Directed Non-valued Networks: Degree, Eigenvector, closeness. Valued Networks,Negative tie Networks, subgroup: Cliques and groups	5
7.	Community Detection	clustering, community structure, modularity, overlapping communities	5
8.	Link Prediction	The Katz Score, Hitting & Commute Time, Rooted PageRank, SimRank, Predictors Summary, Meta-measures	5
9.	Information Diffusion	Cascading Behavior: Herd Behaviour, Information Cascade Model, Threshold Model, Cascade Maximization, Epidemic Modeling	5
10.	Security and Privacy in Social Network	Introduction, K-Anonymity, L-Diversity, Q-Anon, T- Closeness	6
		Total number of Lectures	**41**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Liu, Bing. Web data mining. Springer-Verlag Berlin Heidelberg, 2007.
2.	Chakrabarti, Soumen. Mining the Web: Discovering knowledge from hypertext data. Morgan Kaufmann, 2003.
3.	Scime, Anthony, ed. Web mining: applications and techniques. IGI Global, 2005.
4.	Hitzler, Pascal, Markus Krotzsch, and Sebastian Rudolph. Foundations of semantic web technologies. CRC Press, 2011.
5.	King, Andrew B. Website optimization. " O'Reilly Media, Inc.", 2008.
6.	Segaran, Toby. Programming collective intelligence: building smart web 2.0 applications. " O'Reilly Media, Inc.", 2007.
7.	Charu.C. Aggarwal, Social Network Data Analytics, Springer Science+Business Media, LLC 2011

8.	Easley, David, Jon Kleinberg. *Networks, Crowds, and Markets: Reasoning about a Highly Connected* World. New York, NY: Cambridge University Press, 2010.
9.	Jackson, Matthew O. *Social and Economic Networks*. Princeton, NJ: Princeton University Press, 2008

Course Description

Subject Code	16B1NCI833	**ODD**	**Semester** VII **Session** 2018 -2019 Month from: June 2018 to December 2018
Subject Name	Nature Inspired Computing		
Credits	**4**	**Contact Hours**	**4**

Coordinator	Dr. Ankita Verma

S.No.	Description	Cognitive Level (Blooms Taxonomy)
1	Explain the concepts of problem solving via search, optimization and pattern recognition with various practical examples.	Understanding (Level 2)
2	Apply the NIC methods to model, learn and optimize computing problems.	Applying (Level 3)
3	Analyze the key ideas, algorithmic steps of various nature inspired computing methods and their general applicability in various domains.	Analyzing (Level 4)
4	Compare and contrast the similarities and differences among various nature inspired computing methods.	Evaluating (Level 5)
5	Formulate and design an efficient solution to a given problem by using the most appropriate nature inspired computing method.	Creating (Level 6)

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	Introduction	Introduction to Nature Inspired Computing: Need and Motivation behind Nature Inspired Algorithms; Problem solving by Search and Optimization; Optimization: Continuous vs Combinatorial optimization, Single objective vs Multi-objective optimization, Implicit vs Explicit Constraints; Pattern Recognition.	5
2.	Heuristic Search Algorithms	Heuristics and Meta-heuristics; Problem Spaces: States, goals and operators; Heuristics search: Hill Climbing and Simulated Annealing.	3
3.	Evolutionary Algorithms (EA)	Genetic Algorithms: Introduction, Motivation, Basic Terminology, General framework; Encoding Techniques: Binary Encoding, Value Encoding, Permutation Encoding and Tree Encoding); Selection Operators: Fitness Proportionate Selection, Rank-	4

		based Selection, Tournament Selection; Crossover Techniques: Single-point Crossover, Two-point Crossover, Uniform Crossover, Partially Mapped Crossover, and Order Crossover; Mutation Operators; Replacement Strategies: Generational GA, Steady GA, Elitist GA.	
4.	Hybrid Evolutionary Algorithms, Multi-objective Optimization Evolutionary Algorithms	Hybrid EA: Need of Hybridization, Memetic Algorithm, Intelligent Initialization, Local Search, Lamarkian vs. Baldwinian adaptation. Multi-objective Optimization EA: Dominance, Non-dominated Solution, Pareto Optimal Solution, Elitist Non-dominated Sorting Algorithm.	3
5.	Neuro-Computing	Introduction to Artificial Neural Network (ANN): Artificial vs Biological neuron, Basic terminology; Classification and Inductive Learning; Linear seperability; Basic models of ANN; McCulloch-Pitts Neuron; Perceptron: Architecture, Perceptron learning rule, and Delta learning rule.	3
6.	Artificial Neural Network Models	Supervised Learning Network: Multi-layer Feed Forward Network, Back-propagation algorithm; Associate Memory Networks: Introduction and training algorithm for pattern association, Hopfield Network, Unsupervised Learning Network: Competitive Learning, Kohonen Self-Organizing Feature Maps.	6
7.	Swarm Intelligence	Introduction to Swarm Intelligence, Particle Swarm Optimization (PSO): Algorithm, PSO vs EAs; Ant Colony Optimization (ACO): ACO Procedure, Travelling Salesman Problem using ACo, Ant Systems and its direct Variants (Elitist Ant Systems, Rank-based Ant Systems, Max-Min AS, Ant Colony Systems);	7
8	Nature Inspired Algorithms	Artificial Bee Colony; Grey Wolf Optimization; Cuckoo Search	6
9.	Artificial Immune System	Immune System and Immunity; Artificial Immune System(AIS); Biological Immune System(BIS) vs Artificial Immune System(AIS); Typical Applications of AIS; General framework for AIS: Problem Representation, Affinity measure, Selection, Mutation; Basic Arificial Immune Models and Algorithms: Negative Selection Algorithms, Clonal Selection Algorithm, Immune Network Models; Movie Recommender System using AIS.	5

Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (15 marks Project, 5 marks Attendance, 5 Marks Tutorial Assignment)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Xin-She Yang. *Nature-inspired optimization algorithms*. Elsevier, 2014.
2.	Raymond Chiong ed. *Nature-inspired algorithms for optimisation*. Vol. 193. Springer, 2009.
3.	Dario Floreano and Mattiussi Claudio. *Bio-inspired artificial intelligence: theories, methods, and technologies*. MIT press, 2008.
4.	De Castro, Leandro Nunes. *Fundamentals of natural computing: basic concepts, algorithms, and applications*. Chapman and Hall/CRC, 2006.
5	Swarm and Evolutionary Computation: Elsevier
6	Natural Computing : Springer

Detailed Syllabus

Subject Code	17B1NCI731	**Semester Odd** **(specify Odd/Even)**	**Session** 2018 - 19 **Month from** July to December
Subject Name	Machine Learning and Natural Language Processing		
Credits	4	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Bharat Gupta
	Teacher(s)	Bharat Gupta
		Chetna Dabas

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Explain different syntax and semantics approaches in NLP	Understand Level (Level 2)
CO2	Understand the fundamental mathematics applied in the field of NLP	Understand Level (Level 2)
CO3	Apply different models like Hidden Markov Model, SVM, CRF, RNN, LSTM in parts of speech tagging.	Apply Level (Level 3)
CO4	Apply different probabilistic parsing techniques in NLP	Apply Level (Level 3)
CO5	Apply different supervised and unsupervised techniques for document classification.	Apply Level (Level 3)
CO6	Analyse and apply appropriate Machine Learning techniques to solve the real world problem in NLP	Apply Level (Level 3)

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1	Introduction to Machine Learning & NLP	Introduction to Machine Learning & NLP, Challenges & Requirements	3
2	Mathematical Foundation	Probability Theory, Vector Spaces, Matrix algebra, Probability, Data representation, Tokenization, Lemmatization	5
3	Parts of Speech Tagging	Various Models: Hidden Markov Model, SVM, CRF, RNN, LSTM	11
4.	Parsing	Linguistic Essentials, Markov Models, Applications of tagging, Probabilistic parsing - CFG, CNF, CYK	8

5.	Document classification	Supervised: Naive Bayes, Ngram's model, Sentiment analysis, Text classification, Unsupervised: K-means, MaxEnt classifier	8
6.	Topic Modelling	Latent Dirichlet Allocation (LDA) and its variants	5
7.	Applications	Machine Translation, Question Answering	2
Total number of Lectures			42

Evaluation Criteria	
Components	**Maximum Marks**
T1	**20**
T2	**20**
End Semester Examination	**35**
TA	**25 (Attendance and Tut Performance (10), Quiz/ MiniProject/Assignment (15))**
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc.)

1.	Handbook of Natural Language Processing & Machine Translation by Olive, Joseph, Christianson, Caitlin, McCary, John (Eds.), Springer
2.	Statistical Machine Translation by Philipp Koehn, Cambridge University Press
3.	Readings in Machine Translation edited by Sergei Nirenburg, H. L. Somers, Yorick Wilks, MIT Press
4.	Natural Language Understanding by James Allen, Benjamin Cummins Publisher
5.	Foundations of Statistical NLP by Hinrich Schtze, Christopher D. Manning
6.	Natural Language Processing with Python by Steven Bird, Ewan Klein, and Edward Loper
7.	Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition (third edition) D. Jurafsky and J. Martin

Detailed Syllabus

Course Code	17B1NCI748	**Semester ODD (specify Odd/Even)**	**Semester** VII **Session** 2018 -2019 Month from July to December 2018
Course Name	Graph Algorithms and Applications		
Credits	4	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Dr Manish Kumar Thakur (J62), Dr. Mukta Goyal (J128)
	Teacher(s) (Alphabetically)	Dr Manish Kumar Thakur

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Find the shortest path, minimum spanning tree, maximum flow, articulation points, bridges, *etc.* in the given graph	Remember Level (L1)
CO2	Model the real world computational problems using graph	Understand Level (L2)
CO3	Apply conventional, approximation and evolutionary algorithmic approaches for graph based computational problems like, covering problems, set matching, planarity testing, graph reliability, *etc.*	Apply Level (L3)
CO4	Develop computing solutions for the real world computational problems modeled using graph	Create Level (L6)
CO5	Analyze the time and space complexities of the designed algorithms and developed solutions for the computational problems	Evaluate Level (L5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Graph representation using Adjacency Matrix and List, Incidence Matrix, Cycle Matrix, Cut-set Matrix, Path Matrix, *etc.*	1
2.	Applications of Traversability	DFS, BFS, Shortest paths, Optimal tours, Cycle detection, Euler's Cycle, Hamiltonian Cycle, TSP, etc.	4
3.	Applications of Trees	Minimum Spanning Tree, Steiner Tree, Depth First Search Spanning Tree, Breadth First Search Spanning Tree, *etc.*	4
4.	Applications of	Reliable communication network design, Articulation	5

	Reliability	points, Bridges, Multiway cut, Minimum K-cut, *etc.*	
5.	Applications of Matching	Personnel assignment, Optimal assignment, Hungarian Algorithm, Territory demarcation, Stable Marriage, Project Allocation, etc.	5
6.	Applications of Covering	Vertex Cover, Set Cover, Shortest superstring, Geometric problems, etc.	4
7.	Applications of Coloring	Algorithms for Graph Coloring, Applications in Storage management, Timetable schedules, etc.	3
8.	Applications of Planarity	Planarity detection, PCB design, Facilities layout and floor plan design, Software testing, Defense strategies, etc.	4
9.	Applications of Digraphs	Transport networks, Job sequencing, Disk scheduling, Participant rankings in tournaments, Choice consistency, Project management, etc.	5
10.	Applications of Flow Network	Max-flow min-cut, Feasible flows, Transportation problems, Assignment problems, etc.	4
11.	Graph Database	Embrace Relationships with Graph Databases, Querying Graphs: Cypher Query Language, Graph Database Application	3
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (10 Marks – Attendance &Punctuality, 15 Marks - Mini-project & Viva)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science, Prentice-Hall, 1974
2.	Kenneth H. Rosen, Discrete Mathematics and its Applications, 6e, McGraw-Hill, 2007
3.	V. A. Vazirani, Approximation Algorithms, Springer International Edition
4.	Reinhard Diestel, Graph Theory, 3e, Springer-Verlag, 2005

5.	Thomas H Cormen, Charles E Leiserson, Ronald L. Rivest, and Cliff Stein, Introduction to Algorithms, 2ed, MIT Press, 2001
6.	A Gibbons, Algorithmic Graph Theory, Cambridge University Press, 1985
7.	Graph Databases by Ian Robinson, Jim Webber, and Emil Eifrem, O'Reilly, 2nd Edition, 2015

Detailed Syllabus

Course Code	17B1NCI749	**Semester** Odd **(specify Odd/Even)**	**Semester** VII **Session** 2018 -2019 Month from July-December
Course Name	Mobile Computing		
Credits	3	**Contact Hours**	3 (Lectures) + 1(Tutorial)

Faculty (Names)	**Coordinator(s)**	Arpita Jadhav Bhatt
	Teacher(s) (Alphabetically)	Arpita Jadhav Bhatt (62), Dr. Sanjeev Patel (128)

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Assess the suitability of different techniques in multiplexing, modulation, spread spectrum, frequency reuse factor for specific wireless network requirements.	Evaluate Level (Level 5)
CO2	Identify important issues and concerns on security and privacy of a mobile computing environment and assess technical solution for security and privacy of user data.	Apply Level (Level 3)
CO3	Analyze performance aspects of medium accessing, transport layer methodologies and routing techniques in wireless networks (WLAN, WPAN) and mobile networks (GSM, UMTS, UTRAN).	Analyze Level (Level 4)
CO4	Apply functional aspects of Android mobile operating system in developing mobile applications.	Apply Level (Level 3)
CO5	Build contemporary mobile applications based on different widgets, different views and view groups, SMS, mail, and location aware services through Internet for mobile environments.	Create Level (Level 6)
CO6	Explain the working of different protocols for mobile network layer and mobile transport layer.	Understand Level (Level 2)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**

1.	Introduction	Mobile computing applications: vehicles, emergencies, business, replacement of wired networks, infotainment, location dependent services, mobile and wireless devices, history of wireless communication, open research topics, simplified reference model	**03**
2.	Wireless Transmission	Frequency for radio transmission, regulation, signals, antennas, signal propagation, multiplexing, modulation, spread spectrum, cellular systems	**05**
3.	Medium Access Control	Specialized MAC, Hidden and exposed terminals, near and far terminals, SDMA, FDMA, TDMA, CDMA., comparison of S/T/F/CDMA	**04**
4.	Telecommunicatio n Systems	GSM: Mobile Services, System Architecture, Radio Interface, Protocols, Localization and calling, Handover, Security, Data Services, UMTS and IMT-2000: UMTS releases and standardization, UMTS system architecture, UMTS radio interface, UTRAN, Core Network, Handover	**04**
5.	Wireless LAN	Infra-red vs. radio transmission, Infrastructure and ad-hoc network, IEEE802.11: System architecture, protocol architecture, Physical Layer, Medium access control layer, MAC management, 802.11b, 802.11a,HIPERLAN, Bluetooth	**05**
6.	Mobile network Layer	Mobile IP, Dynamic host configuration protocol, mobile ad-hoc networks	**04**
7.	Mobile transport layer	Traditional TCP: congestion control, slow start, fast retransmit/fast recovery, implications of mobility, TCP improvements, TCP over 2.5, 3.5 wireless	**05**
8.	File Systems	File systems, world wide web, wireless application protocol,WAP 2.0	**02**
9.	Mobile Operating Systems	Android OS- Installing, Setup, Getting started, Making and testing Android projects, Basic program structure, Java-based layout, XML-based layout, Android Studio, ADT visual layout editor, Hybrid layout, Project structure summary, Application fundamentals: DPI, Themes, Metrics and Grids, Typography, Color ,Iconography, Writing Style, Patterns, Use of Dalvik Virtual machine in Android OS, Application components- Activities, Services, Broad cast	**10**

		receivers, content providers, SDK, setting Android Virtual Device, role of Manifest file, Event handling – buttons, image buttons, creating activity files, creating multiple activity files, creating layouts for activity files ,Intent class, passing data using intents, List view using array adapters, creating customized list view, creating grid view using array adapter, creating customized list view, web view, spinners, parsing data using JSON parser iOS : Introduction to iOS Architecture, SDK for creating iOS applications, Building blocks for iOS apps, Interface file, Implementation file, Delegate file	
10.	Research Issues in Wireless and Mobile Computing	Mobile networking, Quality of Service in Mobile Networks, Mobile access to World-Wide-Web, Mobile Data Management, Mobile Transactions, Mobile Computing Models	**02**
		Total number of Lectures	**…**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Project:15, Assignment:5, Attendance:5)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Jochen Schiller, “Mobile Communications”, second edition, Addison-Wesley, 2004.
2.	Stojmenovic, and Cacute, “Handbook of Wireless Networks and Mobile Computing”, Wiley, 2002.
3.	Reza Behravanfar, “Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML”, Cambridge University Press, 2004.
4.	Adelstein, Frank, Gupta, Sandeep KS, Richard III, Golden , Schwiebert, Loren, “Fundamentals of Mobile and Pervasive Computing”, McGraw-Hill Professional, 2005
5.	Griffiths D, Griffiths D. Head First Android Development: a brain-friendly guide. " O' Reilly Media, Inc.";

	2017 Aug 9.
6.	Burd BA. Android application development all-in-one for dummies. John Wiley & Sons; 2015 Jul 9.
7.	Hansmann, Merk, Nicklous, Stober, “Principles of Mobile Computing”, Springer, second edition, 2003.
8.	Martyn Mallick, “Mobile and Wireless Design Essentials”, Wiley DreamTech, 2003.
9.	Raj Kamal, “Mobile Computing”, first edition, Oxford University Press, 2007.
10.	Asoke K Talukder, and Roopa R. Yavagal, “Mobile Computing: Technology, Application and Service Creation”, Tata McGraw-Hill Professional, 2005
11.	Abdelsalam Helal, “Any Time, Anywhere Computing: Mobile Computing Concepts and Technology”, Kluwer Academic Publishers, 1999.
12.	IEEE Transaction on Broadcasting

Course Description

Subject Code	17B2NCI731	**Semester** Odd	**Semester VII Session** 2018 - 19 **Month from** July '19 **to** Dec '19
Subject Name	Computer Graphics		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Suma Dawn
	Teacher(s) (Alphabetically)	Suma Dawn

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Explain the basics and core concepts of computer graphics including different graphics systems, usage of GPUs, applications of computer graphics, and others.	Understanding Level (Level 2)
CO2	Compose scenes by applying common 2D & 3D graphics algorithms such as, viewing transformations, clipping, projections, rendering, etc. using OpenGL.	Creating Level (Level 6)
CO3	Analyze models for lighting – distant and multiple light sources; reflection and models for shading – flat, smooth, Phong, etc.	Analyzing Level (Level 4)
CO4	Demonstrate the use of planer and surface curves, and use of visible surface detection methods for scene presentation.	Understanding Level (Level 2)
CO5	Explain animation and key framing.	Understanding Level (Level 2)
CO6	Interpret and critique procedural modelling, fractals, and particle systems and critique existing systems.	Evaluating Level (Level 5)

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Introduction	Context, Requirements, and Application: History of computer graphics, graphics architectures and software, imaging: pinhole camera, human vision,	3

		synthetic camera, modeling vs rendering.	
2.	Graphics Pipeline and Hardware	Display Unit, Frame buffer, DPU, GPU	2
3.	Data structures and algorithms for Raster Graphics	Line, circle, ellipse, polygon, Area filling; Rasterization: line drawing via Bresenham's algorithm, clipping, polygonal fill; Introduction to hidden surface removal (z buffer);	9
4.	Colours	Color perception, color models (RGB, CMY, HLS), color transformations. Color in OpenGL. RGB and Indexed color;	3
5.	2D and 3D Planer and Curved objects	Data structures for modeling; Algorithms for Mesh generation, Clipping, 2D and 3D; Geometric Transformations, and so on; Geometric transformations: affine transformations (translation, rotation, scaling, shear), homogeneous coordinates, concatenation, current transformation and matrix stacks; Three dimensional graphics: classical three dimensional viewing, specifying views, affine transformation in 3D, projective transformations;	10
6.	Rendering and animation	Data Structures, Algorithms and hardware support; Ray Tracing; Shading: illumination and surface modeling, Phong shading model, polygon shading; Discrete Techniques: buffers, reading and writing bitmaps and pixelmaps, texture mapping, compositing; Introduction to animation and keyframing;	10
7.	Procedural modeling	Fractals and particle systems	5
		Total number of Lectures	**42**

Evaluation Scheme	**A. THEORY Examination**	**Marks**
	I. Test1	20
	II. Test2	20
	III. End Term	35
	B. Internal - including Assignments, Quizzes etc	25
	Total	100

Recommended Reading material: (APA format)	
1.	Parent, R. (2012). *Computer animation: algorithms and techniques*. Newnes.
2.	Perkins, T. (2007). *Adobe Flash CS3 Professional Hands-On Training*. Peachpit Press.
3.	Mullen, T. (2010). *Introducing character animation with Blender*. John Wiley & Sons.
4.	Fisher, G. (2012). *Blender 3D Basics*. Packt Publishing Ltd.
5.	Interactive Multimedia Electronic Journal of Computer-Enhanced Learning.
6.	IEEE Transactions on Multimedia
7.	ACM Transactions on Multimedia Computing, Communications and Applications
8.	Springer's Multimedia Tools and Applications

Detailed Syllabus

Course Code	**18B12CS434**	**Semester (Odd)**	**Semester** I **Session** 2018 -2019 Month from July - December
Course Name	Ethical Hacking		
Credits	04	**Contact Hours**	(L+T) (3+1)

Faculty (Names)	**Coordinator(s)**	Dr. P. Raghu Vamsi
	Teacher(s) (Alphabetically)	Dr. P. Raghu Vamsi

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Define what is ethical hacking and penetration testing, and when and why penetration testing is required along with testing phases.	Remember Level (Level 1)
CO2	Classify and outline the penetration testing phases and relate the phases to the specified context.	Understand Level (Level 2)
CO3	Identify and analyse the stages a penetration tester requires to take in order to compromise a target system.	Apply Level (Level 3)
CO4	Examine and implement tools and techniques to carry out a penetration testing.	Analyze Level (Level 4)
CO5	Critically evaluate security techniques used to protect system and user data to suggest countermeasures.	Evaluate Level (Level 5)
CO6	Demonstrate systematic understanding of the concepts of security at the level of policy and strategy in a computer system.	Create Level (Level 6)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**

1.	Unit -1 Ethics and Legality	Networking and security and areas of security like Applicatication secureity, Web security, Network security, Privileges, Foot Printing, scanning virus and worms. Understand 18 U.S.C. § 1030 US Federal Law, Understand the legal implications of hacking.	6
2.	Unit 2: Scanning	Define the terms port scanning, network scanning, and vulnerability scanning, Understand the CEH scanning methodology, Understand Ping Sweep techniques Understand nmap command switche,s Understand SYN, Stealth, XMAS, NULL, IDLE, and FIN scans List TCP communication flag types ,Understand war dialing techniques ,Understand banner grabbing and OF fingerprinting techniques , Understand how proxy servers are used in launching an attack ,How do anonymizers work? , Understand HTTP tunneling techniques , Understand IP spoofing techniques.	6
3.	Unit 3: Trojans and Backdoors	Understanding Netcat, Trojan, Wrapping, Trojan Evading techniques.	6
4.	Unit 4: Sniffers	ARP poisoning, Wireless Sniffers, mac flooding, DNS spoofing, IP spoofing.	6
5.	Unit 5: Web servers	Web application vulnerabilities, hacking web servers, SQL-Injections.	6
6.	Unit 6: Virus and worms	Linux hacking, virus and worms,Evading IDS, Firewalls, Reverse shell.	6
7.	Unit 7: Mobile Security	Detecting infected APKs, securing Bluetooth	6
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz/project and Attendance)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books,

Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Kimberly Graves, CEH certifited ethical hacking, 2015, Wiley publication.
2.	Alper, Al. "Revealed! The Secrets to Protecting Yourself from Cyber-Criminals", Lulu. com, 2016
3.	Wright, Joshua, and Johnny Cache. "Hacking exposed wireless: wireless security secrets & solutions". McGraw-Hill Education Group, 2015.
4.	Engebretson, Patrick, "The basics of hacking and penetration testing: ethical hacking and penetration testing made easy", Elsevier, 2013
5.	Cannings, Rich, Himanshu Dwivedi, and Zane Lackey. Hacking exposed web 2.0: Web 2.0 security secrets and solutions. McGraw Hill, 2008

Detailed Syllabus

Subject Code	**18B12CS435**	**Semester (Odd)**	**Semester Odd Session** 2018 - 19 **Month from July to Dec**
Subject Name	Open Data Centric Services		
Credits	**3+1**	**Contact Hours**	**3 Lectures +1 Tutorial**

Faculty (Names)	**Coordinator(s)**	Dr. Gagandeep Kaur
	Teacher(s) (Alphabetically)	1. Dr. Gagandeep Kaur 2. Sarishty Gupta

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Understand facts and concepts of open data, open govt. data by comparing & interpreting linked data.	Understand Level (Level 2)
CO2	Apply RDF and Silk frameworks to create, interlink and publish linked data repositories.	Apply Level (Level 3)
CO3	Create & implement RESTful API enabled data resource objects using Python Libraries.	Evaluate Level (Level 5)
CO4	Plan various phases of data cleaning, preprocessing, transforming, analysis and prediction.	Apply Level (Level 3)
CO5	Choose open data statistical and predictive analysis techniques to perform static and dynamic data plotting and visualization	Evaluate Level (Level 5)

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Introduction to Open Data	Open data concepts, open government data initiatives, challenges, open data infrastructures,	4
2.	Role of Open Data	Linking Open Government Data , linked open data, multidimensional linked open data, providing open data;	10
3.	Open Data Frameworks	RDF and SILK frameworks, Using the Silk API , Silk Server , Silk Workbench , SILK integration with SPARQL Endpoint, open data protocol, RESTful Interface and Open Data APIs, Queries with the REST API	8

4.	Open Data Analysis	Open data aggregation; Resource Association, Resource Aggregation, Composition & Aggregation , Manipulating aggregate resources in a REST API, Aggregation Functions, Representing non-resourceful aggregated data and integration, open data statistical analytics, Aggregate Statistics, SILK Transformation and Aggregation, Linked Statistical Data Analysis, fetching analysis data, applying statistical functions for analysis, Update and return analysis, predictive analysis,	8
5.	Open Data Visualization	open data visualizations, Linked Data Visualization, Challenges for Linked Data visualization, Challenges for Open Linked Data visualization, Classification of visualization techniques	8
6.	Protégé based Open Data Design	Designing ontologies using Protégé, Steps in ontology development process, Use of semantic web technology Sparql, OWL Querying, Entities/Classes Ontology driven application development , Introduction to Ontology, Introduction to OWL, Developing an Ontology in Protégé OWL - Classes and Properties , Developing an Ontology in Protégé OWL - Axioms and Restrictions, SPARQL Query Language for RDF , Protégé Ontology case studies	4
			42

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Linked Open Data: The Essentials A Quick Start Guide for Decision Makers, Florian Bauer, Martin Kaltenböck
2	Silk Link Discovery Framework for the web of data, Julius Volz. Et. al.
3.	Open Government Data, https://data.gov.in/
4.	Ontologies and the Semantic Web. Grimm S., Abecker A., Völker J., Studer R. (2011) In: Domingue J., Fensel D., Hendler J.A. (eds) Handbook of Semantic Web Technologies. Springer, Berlin, Heidelberg
5.	Ubaldi, B. (2013), “Open Government Data: Towards Empirical Analysis of Open Government

	Data Initiatives", *OECD Working Papers on Public Governance*, No. 22, OECD Publishing.
6.	Algemili, U. A. (2016). Outstanding Challenges in Recent Open Government Data Initiatives. *International Journal of e-Education, e-Business, e-Management and e-Learning*, *6*(2), 91.
7.	Bob DuCharme, "Learning SPARQL", O'Reilly
8.	Protégé Tool, https://protege.stanford.edu/
9.	IEEE, ACM Transactions, Journals and Conference papers on Semantic web

Detailed Syllabus

Course Code	18B12CS436	**Semester** ODD **(specify Odd/Even)**	**Semester** VIII **Session** 2019-2020 Month from July 2019- December 2019
Course Name	Software Construction		
Credits	3-0-0	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Dr. Sandeep Kumar Singh
	Teacher(s) (Alphabetically)	Dr. Sandeep Kumar Singh

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Choose appropriate fundamental element of software construction for an actual software development.	Remembering Level (Level 1)
CO2	Apply various Assertion, Error-Handling, Exceptions techniques for defensive programming.	Apply Level (Level 3)
CO3	Make use of appropriate coding standards and conventions of code construction at class routines, variables, and statements level.	Apply Level (Level 3)
CO4	Experiment with code improvement strategies like Code Refactoring, Code Optimisation and Tuning.	Apply Level (Level 3)
CO5	Demonstrate use of software construction techniques like parameterisation, debugging and tools for GUI builders, unit testing , profiling, performance analysis and slicing .	Understanding Level (Level 2)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Fundamentals of software construction	What and Why Software Construction, Construction Decisions, Design in Construction, Software Metaphors use and importance, Code Quality, Managing Construction, Practical Considerations, Metaphors for Software development.	3

2.	Code Construction	Design in Construction, Class Design and Working Classes, High-Quality Routines. Variables, Statements, Pseudo code Programming Process, limiting dependencies, Meta Programming	6
3.	Defensive Programming	Protecting Your Program from Invalid Inputs, Assertion, Error-Handling, Exceptions, Protecting Code from damage caused by errors, Debugging Aids, Determining How Much Defensive Programming to Leave in Production Code	8
4.	Code Improvements	Debugging, Code Refactoring, Code Optimisation and Tunning strategies and techniques	7
5.	Code Analysis	Tracing, Static and Dynamic analysis	3
6.	Source Code Control	Version Control, CVS, working and organising source tree, branching ,Jump start with Git	6
7.	Scaling Code	Parameterization and Generics, Internationalization of code, Securing Code	6
8.	Build , Test and Release code	Development Environments, GUI Builders, Unit Testing Tools, Profiling, Performance Analysis, and Slicing	3
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignments and Attendance)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Maguire, Steve, Writing Solid Code – Microsoft's Techniques for Developing Bug-Free C Software. Microsoft Press, 1993.
2.	McConnell, Steve, Code Complete: A Practical Handbook of Software Construction. Microsoft Press, 1993.
3.	Meyer, Bertrand, Object-Oriented Software Construction (Second Edition). Prentice-Hall, 1997.

4.	Warren, Nigel, and Bishop, Philip, Java in Practice – Design Styles and Idioms for Effective Java. Addison-Wesley, 1999.
5.	Fowler, Martin, Refactoring – Improving the Design of Existing Code. Addison-Wesley, 1999.
6.	Writing solid code : Maguire, Steve. LeBlanc, David. Publisher: Bangalore WP Publishers & Distributors Pvt. 2001

Detailed Syllabus

Course Code	18B12CS438	**Semester Odd (specify Odd/Even)**	**Semester** VII **Session** 2018 -2019 Month: from July 2018
Course Name	Java Programming and Software Engineering		
Credits	3	**Contact Hours**	42

Faculty (Names)	**Coordinator(s)**	Vikas Hassija
	Teacher(s) (Alphabetically)	Vikas Hassija

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Define all the basic terminologies related to software engineering and basic OOPS concepts.	Remember Level (Level 1)
CO2	Write basic java programs using basic loops, getter setter methods, switch cases and arrays.	Understand Level (Level 2)
CO3	Develop all core java programs using nested loops, methods, classes, interfaces and getting user input.	Apply Level (Level 3)
CO4	Test for the issues in the existing code using debugging tools or other exception handling methods.	Analyze Level (Level 4)
CO5	Basic understanding of the importance of various advanced concepts of java like servlets, JSPs, collection framework and serialization	Evaluate Level (Level 5)
CO6	Create or design an end to end application or project based on java.	Create Level (Level 6)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**

1.	Introduction	Software Development Life Cycle Models, Waterfall Model, V-Shaped Model, Iterative Model, Spiral Model, Agile Model.	3
2.	Requirement Specification	Types of Requirements, SRS: Introduction, Characteristics of SRS, Structure of SRS (IEEE-830).	5
3.	UML	Introduction, Categories of diagram Structural diagram: Class diagram, Object Diagram Behavioral diagram: Use Case Diagram, Sequence Diagram, Data Flow Diagram, Activity Diagram, State Chart Diagram	9
4.	Implementation	Applications of Exception Handling, File Handling, GUI, Event Handling using Java Multi- Threading, J2EE: JDBC, Java Servlets, JSP.	5
5.	Testing	Testing methods, testing levels, testing types, writing test cases in Java	10
6.	Maintenance	Importance of Maintenance, Types of software Maintenance.	10
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Attendance , Assignment and Quiz)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Java™ 2: The Complete Reference, Fifth Edition
2.	Head First Java, 2nd Edition by Bert Bates, Kathy Sierra

Detailed Syllabus

Course Code	18B12CS439	**Semester (Even)**	**Semester II** **Session** 2018 -2019 Month from July to Dec, 2018
Course Name	Cloud Computing and Internet of Things		
Credits	**4**	**Contact Hours**	**3 Lectures+ 1 Tutorial**

Faculty (Names)	**Coordinator(s)**	Dr. Prakash Kumar
	Teacher(s) (Alphabetically)	Dr. Prakash Kumar

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Understand various Cloud Service Models and Virtualization Technology to Create Virtual Machines for cloud based applications using Virtual Machine Monitors (VMMs).	Understanding (Level 2)
CO2	Analyze various VM migration techniques and their performances in cloud environments.	Analyze Level (Level 4)
CO3	Optimize the performances of VMs for application specific cloud environments.	Create Level (Level 6)
CO4	Understanding and Modeling of Process, Domain, Information and Service specifications for IoT devices.	Apply Level (Level 3)
CO5	Create functional blocks and use the layer-wise communication protocols based on technological requirements for IoT devices	Create Level (Level 6)
CO6	Design and implement various applications on cloud and IoT models for sustainable development.	Create Level (Level 6)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Overview of Distributed Computing	Trends of computing, Introduction to distributed computing, System models for Distributed and Cloud Computing, Enabling Technologies.	2
2.	Introduction to Cloud Computing , Issues and Challenges, Cloud Architecture	What's cloud computing, Characteristics and benefits of cloud computing, Service Models, Deployment models. challenges of cloud computing, Cloud Architecture	3
3.	Virtualization Techniques	Role of Virtualization in Cloud Computing, Virtualization Technologies, Virtual Machines Monitors (VMM), Virtualization Techniques, Virtualization of resources and related issues.	8
4.	Web Services for Cloud Environments	Web Services and their approach to Distributed Computing, Web Services Technologies, Simple Object Access Protocol (SOAP), Web Services Description Language (WSDL), Universal Description Discovery and Integration (UDDI).	5
5.	Cloud Security and Data Management	Network level security, Data level security, Access management and control, Authentication, Managing data-storage & processing in Cloud.	5
	Introduction to IoT	Characteristics, Physical and Logical Design of IoT, Enabling Technologies	4
6.	IoT Platform Design Methodology	Generic Design methodologies for IoT, Design of Process, Domain and Information Models for IoT, Design as per Functional and Operational views. Component Integration and Development of Applications for Sustainable computing.	4
7.	Protocols and Technologies for	IoT Protocols and Technologies, 802.15.4, 6LoWPan. ZigBee.	6

	IoT		
8.	Roles for Cloud and IoT for Green and Sustainable Computing,	Energy aware computing in Cloud Environments and IoTs, Roles and Opportunities for Cloud and IoT for meeting Sustainability Challenges.	5
			42

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignments, Presentations of assigned topics)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	K. Hwang, Geoffrey C. Fox, Jack J. Dongarra, "Distributed and Cloud Computing- From Parallel Processing to the Internet of Things", Morgan Kauffman Publishers, Elsevier.
2.	Tanenbaum, A.S, Marten, V. Steen, Distributed Systems : Principles and Paradigms, 2nd Edition, Prentice Hall .
3.	M. Singhal, N. G. Shivaratri, Advanced Concepts in Operating Systems, 1st Ed., Tata McGraw-Hill, 1994.
4.	"Introduction to Cloud Computing Architecture" Sun's White Paper, 1st Edition, June, 2009.
5.	Tanenbaum, A. S Distributed Operating Systems, 1st Ed., Prentice-Hall, Englewood Cliffs, NJ, 1995.
6.	Sanderson, Dan, Programming Google's Application Engine, O'Reilly, Google Press.
7.	IEEE, ACM Transactions, Journals and Conference papers on "Distributed and Cloud Computing."
8.	George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud" O'REILLY publication.
9.	"Virtualization Overview", White paper, VM Ware.
10.	"Implementing Virtualization" White paper, Intel virtualization Technology, 2008
11.	Tulloch, Mitch, Understanding Microsoft virtualization solutions: From the Desktop to Data Center,

	Microsoft Press.
***m*.**	…

Detailed Syllabus

Course Code	17B1NCI742	**Semester: Odd**	**Semester: VIII Session:** 2018 -2019 Month: **July-December**
Course Name	**ALGORITHMS AND ARTIFICIAL INTELLIGENCE**		
Credits	**3**	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Satish Chandra
	Teacher(s) (Alphabetically)	

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Evaluate on the basis of Big O notation the algorithms of type DAC, DP, Greedy etc.	Level-V (Evaluate)
CO2	Implement and analyze the problem solving agents using various informed, uninformed and evolutionary search strategies.	Level-III (Apply)
CO3	Represent and illustrate constraint satisfaction problems and adversarial search algorithms for solving problems of game theory.	Level-II (Understanding)
CO4	Apply fundamental Machine Learning and Data Mining tools on given dataset	Level-III (Apply)
CO5	Use probabilistic learning to classify / cluster given dataset.	Level-III (Apply)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Sorting and searching algorithms ($O(N^2)$ sorting, Heap, Quick and Merge sorting	04
2.	Graph Algorithms	DFS, BFS, Shortest path algorithms;	05
3.	Algorithm Design Techniques: Greedy	Greedy, Divide and Conquer and Dynamic Programming techniques.	05
4.	Artificial Intelligence approaches: Problem Solving- I	State Spaces, Uninformed search strategies (BFS, DFS, DLS, IDS, Bidirectinal search),	05

5.	Problem solving-II	Informed Search and Explorartion (A*, Heuristic function, Local search algorithms, online search agents)	05
6.	Problem solving-III	Constraint satisfaction problems (backtracking, variable and value ordering, local search), Adversarial Search (games, alpha beta pruning, elements of chance, state of art games)	05
7.	Propositional Logic	Knowledge based agents, PL, FOPL, Syntax and semantics, use, knowledge engineering) , Inference in FOPL((Propositional vrs First order inference, Unification and lifting, f/w and b/w chaining)	5
8	Uncertainty	Probabilistic reasoning, Bayesian rule, Bayesian network, Inference, Reasoning over time	4
9	Natural Language Processing	Parsers, Derivations and Syntax trees, Grammar Free Analyzers, Sentence generation and Translation	4
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Peter Norvig, Stuart Russel, Artificial Intelligence – A modern approach, PHI, 2009
2.	Sartaz Sahni and Horowitz, "Fundamentals of Computer Algorithms(second edition)– 2008

Detailed Syllabus

Course Code	17B1NCI736	**Semester** ODD **(specify Odd/Even)**	**Semester** VII **Session** 2018 -2019 Month from July 2018
Course Name	Bioinformatics Algorithms		
Credits	4	**Contact Hours**	3-1-0

Faculty (Names)	**Coordinator(s)**	Mr. Prantik Biswas
	Teacher(s) (Alphabetically)	Dr. Aparajita Nanda, Mr. Prantik Biswas

COURSE OUTCOMES		**COGNITIVE LEVELS**
C432-1.1	Relate to different computational challenges in Computational Molecular Biology.	Level-2
C432-1.2	Examine proper algorithmic concepts to solve a computational problem.	Level-4
C432-1.3	Determine the importance of traditional to contemporary approaches for solving the biological problems.	Level-5
C432-1.4	Design strategy to resolve real-world biological challenges.	Level-6
C432-1.5	Identify appropriate algorithmic technique to solve a given bioinformatics related task.	Level-3
C432-1.6	Develop an optimized solution model for computational biology problems.	Level-6
C432-1.7	Formulate prediction tools and estimate the solutions for biological problems.	Level-6

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1	Algorithms and Complexity	Introduction, Biological Algorithms versus Computer Algorithms, The Change Problem, Comparative Analysis of	2

		Various Classes of Algorithms.	
2	Molecular Biology	Introduction, Structure of Genetic Materials, Structural Formation of Proteins, Information Passage Between DNA and Proteins, Evaluation of Bioinformatics.	3
3	Exhaustive Search	Restriction Mapping, Practical Restriction Mapping Algorithm, Regulatory Motifs in DNA Sequences, Profiles, Search Trees, Finding Motifs, Finding a Median String.	4
4	Greedy Algorithms	Genome Rearrangements, Sorting by Reversals, Approximation Algorithms, Breakpoints: A Different Face of Greed, A Greedy Approach to Motif Finding.	3
5	Dynamic Programming Algorithms	Classical Problems: DNA Sequence Comparison, The Manhattan Tourist Problem, etc, Edit Distance and Alignments, Global Sequence Alignment, Scoring Alignments, Local Sequence Alignment, Alignment with Gap Penalties, Multiple Alignment, Gene Prediction, Statistical Approaches to Gene Prediction, Similarity-Based Approaches to Gene Prediction, Spliced Alignment.	7
6	Divide-and-Conquer Algorithms	Divide-and-Conquer Approach to Sorting, Space-Efficient Sequence Alignment, Block Alignment and the Four-Russians Speedup, Constructing Alignments in Sub-quadratic Time.	4
7	Graph Algorithms	Graphs and Genetics, DNA Sequencing, Shortest Superstring Problem, DNA Arrays as an Alternative Sequencing Technique, Sequencing by Hybridization, SBH as a Hamiltonian Path Problem, SBH as an Eulerian Path Problem, Fragment Assembly in DNA Sequencing, Protein Sequencing and Identification, The Peptide Sequencing Problem, Spectrum Graphs, Protein Identification via Database Search, Spectral Convolution, Spectral Alignment.	8
8	Combinatorial Pattern Matching	Repeat Finding, Hash Tables, Exact Pattern Matching, Keyword Trees, Suffix Trees, Heuristic Similarity Search Algorithms, Approximate Pattern Matching	4
9	Clustering and Trees	Hierarchical Clustering, k-Means Clustering, Evolutionary Trees, Distance-Based Tree Reconstruction, Reconstructing Trees from Additive Matrices, Evolutionary Trees and Hierarchical Clustering, Character-Based Tree Reconstruction	3

10	Applications	BLAST: Comparing a Sequence against a Database; The Motif Finding Problem, Gene Expression Analysis, Clustering and Corrupted Cliques, Small and Large Parsimony Problem, Hidden Markov Models, Randomized Algorithms	4
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (…)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1	Jones, N. C., & Pevzner, P. (2004). *An introduction to bioinformatics algorithms*. MIT press.
2	Schölkopf, B., Tsuda, K., & Vert, J. P. (2004). *Kernel methods in computational biology*. MIT press.
3	Jiang, T., Xu, Y., & Zhang, M. Q. (2002). *Current topics in computational molecular biology*. MIT Press.
4	Pevzner, P. (2000). *Computational molecular biology: an algorithmic approach*. MIT press.
5	Gusfield, D. (1997). *Algorithms on strings, trees and sequences: computer science and computational biology*. Cambridge university press.
6	Lesk, A. (2013). *Introduction to bioinformatics*. Oxford University Press.
7	Gollery, M. (2005). Bioinformatics: Sequence and Genome Analysis, David W. Mount. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press, 2004, 692 pp., ISBN 0-87969-712-1. *Clinical Chemistry*, *51*(11), 2219-2219.
8	Cormen, T. H. (2009). *Introduction to algorithms*. MIT press.
9	*IEEE/ACM Transactions on Computational Biology and Bioinformatics*
10	*Bioinformatics* , https://academic.oup.com/bioinformatics
11	Nature Communications, http://www.nature.com/ncomms/

Detailed Syllabus

Course Code	17B1NCI732	**Semester** Odd **(specify Odd/Even)**	**Semester** 7th **Session** 2018 -2019 Month from July 2018- Dec 2018
Course Name	Computer and Web Security		
Credits	3	**Contact Hours**	3-1-0

Faculty (Names)	**Coordinator(s)**	Dr. Sangeeta Mittal
	Teacher(s) (Alphabetically)	Dr. Sangeeta Mittal

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Describe Vulnerability-Threat-Control Paradigm for assessing computing system's security challenges	Understand (Level-2)
CO2	Explain Unintentional Software Security Issues and their solutions	Understand (Level-2)
CO3	Evaluate various malware detection systems	Analyze (Level-4)
CO4	Identify client-side web access threats like cross site scripting and SQL injection	Apply (Level-3)
CO5	Apply mechanisms of correct Identification and Authentication for access control of computing resources	Apply (Level-3)
CO6	Examine non-cryptographic network protocol vulnerabilities and their solutions	Analyze(Level-4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Vulnerability-Threat-Control Paradigm	Threats: Confidentiality, Integrity, Availability, Types of Threats, Types of Attackers, Software Security: Buffer Overflow, Coding threats	3
2.	Software Security Issues	Unintentional insecure Coding Practices, Buffer Overflow, Format String vulnerabilities, Stack Smashing	6

3.	Malware	Virus, Worms – Definition , Modelling and Solutions	5
4.	Malware Detection systems	Worm Detection, Worm Signature Extraction, Virus Detection, Intrusion Detection Systems – Anomaly Vs Signature Based and Host vs Network Based	4
5.	Web Access Threats	Web Browser Attacks: Browser Attack Types, Web Attacks Targeting Users, Obtaining User or Website Data, Code within Data, Foiling Data Attacks, Email Attacks: Phishing	7
6.	Access Control -1	Access Control and Authorization in OS	4
7.	Access Control -2	Authentication Protocols	4
8.	Non-Cryptographic network protocol vulnerabilities	Threats to Network Communications, Denial of Service: Flooding Attacks, Network Flooding Caused by Malicious Code, Network Flooding by Resource Exhaustion, Denial of Service by Addressing Failures, Traffic Redirection, DNS Attacks, Exploiting Known Vulnerabilities Distributed Denial-of-Service: Scripted Denial-of-Service Attacks, Bots, Botnets	9
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Tut(5) + Attendance(5) +Quiz(5)+Mini Project(5))
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Security in Computing 5th Edition , Charles P Fleeger et. al. , Prentice Hall
2.	Information Security, Principles and Practice, Mark Stamp, Wiley
3.	Kali Linux, Abhinav Singh, Packt Publishing
4.	Computer Viruses and Malware, John Aycock, Springer
5.	Computer Security: Art and Science, Matt Bishop, Addison Wesley

Detailed Syllabus

Subject Code	17B1NCI746	**Semester** **ODD**	**Semester:** ODD (VII Sem CSE) **Session:** 2018 - 19 **Month: July to Dec**
Subject Name	Digital Image Processing		
Credits	**3**	**Contact Hours**	**3-1-0**

Faculty (Names)	**Coordinator(s)**	Dr. Ankit Vidyarthi
	Teacher(s) (Alphabetically)	Dr. Ankit Vidyarthi

Course Objectives: At the completion of this course, students will be able to

CO	**Course objective**	**Cognitive Level**
CO1	Demonstrate the fundamental concepts of a digital image processing system	Understand (Level 2)
CO2	Utilize various transformations to analyze images in the frequency domain	Apply (Level 3)
CO3	Identify the techniques for image enhancement and image restoration.	Apply (Level 3)
CO4	Categorize various Image Segmentation Techniques	Analyze (Level 4)
CO5	Inspect various color models and their conversions	Analyze (Level 4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Digital image processing	Elements of Digital Image Processing System, Visual perception and properties of human eye, Image representation, A simple image model, basic relationship between pixels, Image geometry	4
2.	Image Transformation	Introduction to Fourier transform, DFT	5

	and Frequency domain processing	& FFT, Properties of 2D Fourier Transform, Separable Image Transforms –Walsh, Discrete Cosine Transform, Problems on above Transforms	
3.	Image Enhancement	Image Enhancement – spatial domain techniques, enhancement through point processing technique, Histogram Manipulation, Mask processing. Image arithmetic:	6
4.	Image Filtering analysis	Filtering/smoothening/removing noise, convolution/correlation, image derivatives, Low pass filtering in frequency domain, High pass filtering in frequency domain, use of high pass filtering in spatial domain or image sharpening	5
5.	Image Restoration	Image degradation, types of image blur, classification of image restoration techniques, image restoration model, performance metric , applications of digital image restoration.	4
6.	Image Segmentation	Classification of image segmentation techniques, Region based approach to image segmentation, Image segmentation based on thresholding, Edge based segmentation, Edge detection, edge linking, Hough transform, Watershed transformation, Shape representation- Chain code, polygonal approximation	7
7.	Binary Image Processing	Binarisation, mathematical morphology, structuring element, logical operations, morphological image processing, erosion, dilation, opening, closing, morphological algorithms, boundary extraction, region filling, extraction of connected	7

		components, skeleton.	
8	Color Image Processing	Light and color, color formation, human perception of color, color models, color-image quantization, histogram of color image, color-image filtering, color image segmentation	5
Total number of Lectures			**43**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (…)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	R. Gonzalez and R. Woods , Digital Image Processing, Pearson Education
2.	Jain Anil K. , Fundamentals of digital image processing, PHI
3.	W.K. Pratt, Digital Image Processing, John Wiley
4.	Chanda and Majumdar, Digital Image Processing and Analysis, PHI
5	Rosenfeld A. and A. C. Kak, Digital picture processing, Academic Press, Orlando
***6*.**	Lecture Series of NPTEL

Detailed Syllabus

Course Code	18B12CS437	**Semester Odd (specify Odd/Even)**	**Semester VIIth Session** 2018 -2019 Month from July to Dec
Course Name	Large Scale Database Systems		
Credits	**4**	**Contact Hours**	**4**

Faculty (Names)	**Coordinator(s)**	Indu Chawla
	Teacher(s) (Alphabetically)	Indu Chawla, Parmeet Kaur

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Infer the background processes involved in queries and transactions, and explain how these impact on database operation and design	Understand level (Level 2)
CO2	Explain the concept and challenge of big data and demonstrate the comparison of relational database systems with NoSQL databases	Understand level (Level 2)
CO3	Compare and discover the suitability of appropriate large databases to manage, store, query, and analyze various form of big data	Analyze level (Level4)
CO4	Apply techniques for data fragmentation, replication, and allocation to design a distributed or parallel database system	Apply Level (Level3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to large scale Databases	Review of database systems, modelling and query languages	2
2.	Query processing and Optimization	Query planning, evaluation and optimization	6
3.	Transaction	Transaction processing, Concurrency control techniques, ACID rules	4

	processing		
4.	Overview of Big Data	Introduction to Big Data and the four dimensions of Big Data: volume, velocity, variety, veracity. Big data sources, types and applications, CAP Theorem (consistency, availability, partition tolerance)	5
5.	Storage and Indexing	Data storage and indexing of massive databases in databases and data warehouses. Introduction to technologies for handling big data, NOSQL databases	7
6.	Basics of Hadoop	Introduction to Hadoop, Configu - -ring a Hadoop Development Environment, HDFS Architecture, HDFS Programming Fundamen tals, Analyzing big data with Hadoop,MapReduce Architecture, MapReduce Programming	4
7.	Application-driven databases	Parallel and Distributed databases, Distributed Database Design, Architecture of Distributed DBMS	8
8.	Distributed and parallel Query Processing	Query Processing , Distributed Query Optimization, Parallel Query Processing and Optimization	6
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Henry F Korth, Abraham Silberschatz, S. Sudurshan, Database system concepts, 5th Edition, McGraw-Hill,2006
2.	Ramez Elmasri , Shamkant B. Navathe , Fundamentals of Database Systems, 4th Edition, Pearson Education, 2006.

3.	Sadalage, P.J. & Foowlwer, M. 2013. NoSQL distilled : a brief guide to the emerging world of polygot persistence. Addison-Wesley
4.	White, Tom. Hadoop: The definitive guide. " O'Reilly Media, Inc.", 2012.
5.	Zikopoulos, Paul, and Chris Eaton. Understanding big data: Analytics for enterprise class hadoop and streaming data. McGraw-Hill Osborne Media, 2011.
6.	Shashank Tiwari, Professional NoSQL, Wiley, 2011

Detailed Syllabus

Course Code	17B1NCI735	**Semester (Even)**	**Semester** VIII **Session** 2018 -2019 Month from Jan to July
Course Name	**HIGH PERFORMANCE WEB & MOBILE APPLICATIONS**		
Credits	3	**Contact Hours**	**4**

Faculty (Names)	**Coordinator(s)**	Prashant Kaushik
	Teacher(s) (Alphabetically)	Prashant Kaushik

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Analyze differentiating aspects of high performance and regular web applications.	Analyze Level (Level 4)
CO2	Explain the design goals of high performance web & mobile applications.	Understand Level (Level 2)
CO3	Design and develop Server and mobile applications for Multi threaded environment	Create Level (Level 6)
CO4	Build the performance metrics for evaluating the application load.	Evaluate Level (Level 6)
CO5	Make use application testing suite for performance testing	Apply Level (Level 3)
CO6	Analyze the crash reports for various types of crashes due to multiple platforms of mobile devices in a consolidated manner.	Apply Level (Level 4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Intro to HPC	Introduction to HPC systems and web and its mobile variants	**01**
2.	MQTT	MQTT, other high performance protocols	**04**
3.	MQTT	Programming of MQTT protocols	**04**

	programming		
4.	MQTT Testing	Testing the MQTT with loading	**04**
5.	DB replication	Replication of web servers and databases	**04**
6.	HPC comparision	Comparisons of web servers with new and old	**06**
7.	Replication Testing	Testing the replication system with various metrics and load	**06**
8.	Load generator	Mobile app simulator for load of mobile devices	**06**
9.	MQTT Server	Server with mqtt and high performance outputs	**04**
10.	Hackathon	Live Hackathon for creating High performance protocols	**03**
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Hands-On Mqtt Programming with Python **By Gaston C Hillar**
2.	MQTT A Concise and Practical Tutorial **By Gerard Blokdyk**

Detailed Syllabus

Course Code	17B2NCI743	**Semester** Even **(specify Odd/Even)**	**Semester** 8th **Session** 2018 -2019 Month from Jan 2019 – June 2019
Course Name	Cryptography and Network Security		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr. Sangeeta Mittal
	Teacher(s) (Alphabetically)	Dr. Sangeeta Mittal

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Describe classical encryption methods based on Substitution and Permutation	Understand (Level 2)
CO2	Implement and apply modern block and stream cipher techniques like DES, AES and RC4	Apply (Level 3)
CO3	Analyse the role of prime number theory and quadratic congruence in cryptography	Analyse (Level 4)
CO4	Implement and apply asymmetric encryption algorithms of RSA , ElGamal and Elliptic Curve Cryptography	Apply (Level 3)
CO5	Criticize hashing algorithms like SHA-512 and SHA – 1024	Analyse (Level 4)
CO6	Compare and Choose cryptographic techniques for using Digital Signatures and certificates in existing applications	Evaluate (Level 5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Classical Encryption Techniques	Modular Arithmetic , Substitution Ciphers: Shift , Playfair, Vernam, Vignere, Affine, Hill, Rail fence, Transposition Ciphers	6
2.	Modern Block Ciphers	Fiestel and Non Fiestel Encryptions, Data Encryption Standard, polynomial modular arithmetic, fields, generators, Advanced Encryption Standard	8

3.	Modern Stream Ciphers	Linear Feedback Shift Registers and RC4	4
4.	Mathematics for Public Key Cryptography	Prime number theory, Euler's theorem, Fermat's theorem Chinese Remainder Theorem, quadratic congruence, discrete logarithm, fast exponentation	6
5.	Public Key Cryptography	RSA, Knapsack, Rabin , ElGamal and Elliptic Curve Cryptography	10
6.	Hashing Algorithms	Requirements of Hashes for Cryptography, Message Digests,SHA-1	4
7.	Digital Signatures and Certificates	Elgamal Signatures, Digital Signature Standards, X.509 Certificates, Kerberos	4
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (5 Quiz + 5 Assignment+ 5 Attendance+10 Project)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	William Stallings, Cryptography and Network Security 5th Edition, Prentice Hall 2011
2.	B A Forouzan and Debdeep Mukhopadhyay, Cryptography and Network Security, 3rd Edition, Mc Graw Hill, 2015
3.	W Trappe, L.C. Washington, Introduction to Cryptography with Coding Theory 2nd Edition, Pearson Education,2006
4.	Network security essentials: applications and standards by William Stallings.,5/e, Prentice Hall,2013
5.	ACM Transactions on Information and system security
6.	IEEE Press Computer Security and Privacy

Detailed Syllabus

Subject Code	**18B12CS412**	**Semester:** **(specify Odd/Even)**	**Semester** Even **Session** 2018-2019 **Month from** Jan19 **to** June19
Course Name	**Autonomous Decision Making**		
Credits	4	**Contact Hours**	3-1-0

Faculty (Names)	**Coordinator(s)**	Dr. Shikha Jain
	Teacher(s) (Alphabetically)	Dr. Shikha Jain

COURSE OUTCOMES		**COGNITIVE LEVEL**
CO1	Comprehend and represent the type of agents and environment	Understanding (Level 2)
CO2	Apply various search techniques in partially-observable and dynamic environment and optimizing path.	Applying (Level 3)
CO3	Develop exact and approximate reasoning models for uncertain input and uncertain environment.	Applying (Level 3)
CO4	Construct temporal, utility-based, temporal-utility-based and multi-agents based models for reasoning in uncertain environment.	Applying (Level 3)
CO5	Examine and analyse the application of various techniques in different scenario of uncertain environment.	Analyzing (Level 4)
CO6	Evaluate and compare the performance of different techniques on the basis of complexity.	Evaluating (Level 5)

Module No.	**Title of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Introduction	Formulating problem solving as state-space search, Analysis of uninformed	2

		search (BFS and DFS)	
2.	Exploring Roadmaps and Paths	Exploring Roadmaps: configuration space, combinatorial Planning (visibility graph, voronoi diagram, exact cell, approximate cell, fixed cell), Sampling based planning (probabilistic roadmap, rapidly exploring random tree); Exploring paths: informed search	6
3.	Search in Dynamic Environments	Agent centered search (Learning Real-Time A*, Real-Time Adaptive A*), Anytime search (repeated weighted A*, Anytime Repairing A*), Incremental Search (Lifelong Planning A*), Anytime and incremental search (Anytime D*), Path optimization	7
4.	Reasoning in an Uncertain World	Bayes rule, Bayesian Network, Markov Blanket, Utility Theory	2
5.	Probabilistic Reasoning	Probabilistic Reasoning using uncertain evidence, unreliable evidence; Exact inference in uncertain environment using BN by enumeration and variable elimination; Approximate Inference in uncertain environment using BN by direct sampling, rejection sampling, Likelihood weighting and Markov Chain Monte Carlo algorithm	7
6.	Simple decision making	Simple decision making considering belief and desire in uncertain environment, utility based agent, decision network.	2
7.	Inference in temporal Model	Markov Model; Reasoning over time using Hidden Markov Model (HMM); Exact and approximate inferencing using Dynamic Bayesian network;	5

8.	Complex decision making	Complex decision making for a temporal utility based agent in uncertain environment using MDP and POMDP	5
9.	Multi-agent and Reinforcement Learning	Decision making multi-agent environment in game theory, Nash equilibrium; Reinforcement Learning	4
10.	Handling uncertain input	Handling uncertain input using fuzzy systems.	2
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Russell, Stuart J., and Peter Norvig. Artificial intelligence: a modern approach. Malaysia; Pearson Education Limited,, 2016
2.	Barber, David. Bayesian reasoning and machine learning. Cambridge University Press, 2012.
3.	Durrett, Rick. Probability: theory and examples. Vol. 49. Cambridge university press, 2019.
4.	Shi, Zhongzhi. Advanced artificial intelligence. Vol. 1. World Scientific, 2011.
5.	Maxim Likhachev, Dave Ferguson, Geoff Gordon, Anthony Stentz, and Sebastian Thrun, "Anytime search in dynamic graphs", September 2008.

Detailed Syllabus

Subject Code	18B12CS419	**Semester (Even)**	**Semester** Even **Session** 2018 - 19 **Month from** January **to** May
Subject Name	Distributed Computing		
Credits	**3+1**	**Contact Hours**	**3 Lectures +1 Tutorial**

Faculty (Names)	**Coordinator(s)**	Dr. Parmeet Kaur
	Teacher(s) (Alphabetically)	3. Dr. Parmeet Kaur 4. Dr. Prakash Kumar

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Identify and solve event ordering related problems occurring due to various synchronization related issues in distributed systems (e.g., using Lamport, Vector, Matrix clock implementations).	Identify, Solve Level 3
CO2	Compare and explain the solutions for mutual exclusion and deadlock related issues for various application specific scenarios that may occur in distributed environments (e.g., using token and non-token based techniques). [Level 2]	Compare Level 2
CO3	Examine and distinguish data consistency and replication related issues for various distributed scenarios.	Examine and Distinguish Level 4
CO4	Evaluate and assess fault tolerance related issues for perceiving reliable systems in distributed environments.	Evaluate Level 5
CO5	Show how the concepts of distributed computing have been applied in existing distributed database systems, distributed file systems and cloud based systems.	Show Level 1

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Review of principles, concepts foundation to Distributed Systems.	Review of Operating Systems principles, Introduction to Distributed Systems.	2
2.	Consistency and Replication Issues	Data-centric consistencies, Client-centric consistencies. Epidemic Protocols and Implementation Issues.	6

3.	Fault Tolerance and Reliability	Fault Tolerance, Reliability in Distributed Systems, group communications, and Distributed commit. Two Phase commit and Three Phase commit. Failure Recovery.	7
4.	Synchronization mechanisms	Resource models. Clock synchronization, Inherent limitations of distributed operating systems. Event ordering. Timestamps. Global state collection mechanisms. Termination Detection, Bully Algorithm. Ring Algorithm.	6
5.	Mutual Exclusion and Deadlock handling	Process deadlocks in DS. Distributed mutual exclusion. Token and non-token based algorithms. Comparative performance analysis.	9
6.	Agreement Protocols	System Model, Classification, Byzantine Problems and solutions.	4
7.	Distributed Computing Vs Cloud Computing.	Introduction, Challenges, Cloud Computing architectures, Virtualization in Cloud Computing, Building applications and Infrastructures in the cloud, Security Issues.	2
8.	Self Stabilizing Systems	System model, Self-Stabilization design issues and methodologies, Theoretical Foundations, Stabilizing DMEs, Stabilizing protocols, and Stabilizing Synchronization, Limitations etc.	4
9.	Case Studies	Distributed File Systems and Distributed Databases	2
			42

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Programming assignment:10, Assignments:10, Attendance:5)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Tanenbaum, A.S, Marten, V. Steen, Distributed Systems : Principles and Paradigms, 2nd Edition, Prentice Hall .
2	M. Singhal, N. G. Shivaratri, Advanced Concepts in Operating Systems, 1st Ed., Tata McGraw-Hill, 1994.
3.	"Introduction to Cloud Computing Architecture" Sun's White Paper, 1st Edition, June, 2009.
4.	Tanenbaum, A. S Distributed Operating Systems, 1st Ed., Prentice-Hall, Englewood Cliffs, NJ,

	1995.
5.	Sukumar Ghosh “Distributed Systems An Algorithmic Approach”. Chapman and Hall/ CRC, Taylor and Francis Group.
6.	IEEE, ACM Transactions, Journals and Conference papers on “Distributed and Cloud Computing.”
7.	George Reese, “Cloud Application Architectures: Building Applications and Infrastructure in the Cloud” O’REILLY publication.
8.	“Virtualization Overview”, White paper, VM Ware.
9.	“Implementing Virtualization” White paper, Intel virtualization Technology, 2008
10.	Tulloch, Mitch, Understanding Microsoft virtualization solutions: From the Desktop to Data Center, Microsoft Press.

Detailed Syllabus

Course Code	19B12CS411	**Semester Even (specify Odd/Even)**	**Semester** VIII **Session** 2018 -2019 Month from January to May
Course Name	Geoinformatics		
Credits	3	**Contact Hours**	3L+1T

Faculty (Names)	**Coordinator(s)**	Ankita
	Teacher(s) (Alphabetically)	Ankita

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Illustrate Geoinformatics concepts , branches, techniques and real world applications.	Understanding Level (C2)
CO2	Apply appropriate vector and raster data structures like k-d tree, quad tree, geotree etc to different applications.	Apply Level (C3)
CO3	Sketch maps using the basics of data capture, storage, analysis, and output in QGIS tool.	Apply Level (C3)
CO4	Apply various spatial statistical methods like Local indictors of spatial association for point pattern analysis in numerous Geoinformatics applications.	Apply Level (C3)
CO5	Compare and contrast different spatial data mining techniques to select the appropriate one for discovering useful information from spatial data belonging to different domains.	Analyze Level (C4)
CO6	Implement different algorithms for detection of hotspots of different shapes in spatial and spatio-temporal data.	Apply Level (C3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Geoinformatics	Definition, branches, case studies. GIS components, map scales, georeferencing, projections, and time zones.	03
2.	Spatial data models	Vector and Raster data models. Spatial data Acquisition:	04

		topographical & thematic mapping, Geocoding. Non spatial attributes	
3.	Data Structures for spatial data	k-d tree, Quadtree: region quadtree, point quadtree, point region quadtree, Geo-tree. Insertion, deletion and k nearest neighbor queries.	08
4.	Spatial data mining	Basic concepts, spatial databases. Preprocessing spatial data: data cleaning, conversions of georeferencing systems, spatial interpolation using Voronoi diagrams.	04
5.	Families of SDM patterns	Spatial collocation and association patterns, spatial clustering for large data, decision trees for spatial analysis, outlier detection. Applications and case studies in criminology, epidemiology, earth sciences.	08
6.	Point pattern analysis	Spatial processes, Spatial statistical methods for point pattern analysis: LISA, kernel density functions, heat maps.	05
7.	Spatial and Spatio temporal hotspot detection	Scan statistics based techniques for spatial and spatio temporal detection of various shapes hotspots.	06
8.	QGIS tool	Layering, vector, raster and spatialite files, attribute tables, styling, labeling etc. Basic map making operations. Analysis using Voronoi diagram and buffering.	04
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (mini project, class performance, attendance)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Francis Harvey, A Primer of GIS, Fundamental Geographic and Cartographic Concepts, *Second Edition,* THE GUILFORD PRESS, London, 2008.
2.	Paul, J.C. Geographical Information Systems and computer Cartography, Longman, 2005.
3.	**Karen K. Kemp, Encyclopedia of geographic information,** SAGE Publications, 2008.
4.	A. Stewart Fotheringham and Peter A. Rogerson, The SAGE handbook of spatial analysis, SAGE publications, 2009.

5.	Shellito, Bradley**, Introduction to geospatial technologies, fourth edition, Freeman publications, 2018.**
6.	https://mgimond.github.io/Spatial/introGIS.html
7.	https://www.qgis.org/en/docs/index.html

Detailed Syllabus

Course Code	**19B12CS413**	**Semester (Even)**	**Semester** II **Session** 2018 -2019 Month from January-June
Course Name	Bitcoin and Cryptocurrency Technologies		
Credits	03	**Contact Hours**	(L+T) (3+1)

Faculty (Names)	**Coordinator(s)**	Dr. P. Raghu Vamsi
	Teacher(s) (Alphabetically)	Dr. P. Raghu Vamsi

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Understand cryptographic primitives used for cryptocurrency.	Remember Level (Level 1)
CO2	Understand and describe implementation of crypto currency using Blockchain.	Understand Level (Level 2)
CO3	Identify and analyse the real world problems that the cryptocurrency is trying to solve.	Apply Level (Level 3)
CO4	Examine and implement tools and techniques to build a cryptocurrency and blockchain application.	Analyze Level (Level 4)
CO5	Explore the platforms such as Bitcoin, Ethereum, and Hyperledger to create and evaluate the cryptocurrency implementation.	Evaluate Level (Level 5)
CO6	Build, compose and test the concepts, policies and strategies of specified crypto currency implementation.	Create Level (Level 6)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for**

			the module
1.	Introduction	Introduction to Cryptography and Cryptocurrencies – Introduction to cryptographic hash functions; Hash pointers and data structures; Digital signatures; Public keys as identities; A simple cryptocurrency.	3
2.	Bitcoin	How Bitcoin achieves decentralization; Distributed consensus; Consensus without identity using Blockchain; Incentives and Proof of Work (PoW); Attacks on PoW; Advantages and Limitations of PoW; Bitcoin – NG.	3
3.	Mechanics of Bitcoin	Bitcoin transactions; Bitcoin scripts; Applications of Bitcoin scripts; Bitcoin blocks; Bitcoin network; Limitations and improvements	3
4.	Storing and Using Bitcoins	Simple local storage; Hot and cold storage; Splitting and Sharing Keys; Online wallets and exchanges; Payment services; Transaction Fee; Currency Exchange Markets	3
5.	Bitcoin as platform	Bitcoin as append only log; Bitcoin as smart property; Secure Multi party lotteries in Bitcoin; Bitcoin as public randomness source; Predication markets and real world data feeds	3
6.	Bitcoin Mining	Task of Bitcoin miners; Mining Hardware; Energy consumption and Ecology; Mining pools; Mining Incentives and strategies.	3
7.	Bitcoin and Anonymity	Anonymity basics; De-Anonymizing Bitcoin; Mixing – Decentralized Mixing; Zero coin and Zero hash	3
8.	Community, Politics, and Regulations	Consensus in Bitcoin; Bitcoin software; Stakeholders; Roots of Bitcoin; Governments and Bitcoin; Anti-money laundering; Regulation; New York's Bitcoin License proposal	3
9.	Alternative mining puzzles	Essential puzzle requirements; ASIC- resistant puzzles; Proof of Useful Work; Non-out-sourceable puzzles; Proof of Stake and virtual mining.	3
10.	Decentralized institutions	Future of Bitcoin; Blockchain as vehicle for decentralization; Routes to blockchain integration; Templates for decentralization; Decentralization	3

		implementation requirements.	
11.	Creating a Cryptocurrency	Solidity basics; Meta mask framework; Remix IDE; Ethereum and Truffle IDE; A working example.	8
12.	Altcoins and the Cryptocurrency eco system	Altcoins history and motivation; Few Altcoins in detail; Relation between Bitcoin and Altcoin; Merge mining; Atomic cross chain swaps; Bitcoin backed Altcoins; Ethereum and Smart contracts	4
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder. Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press, 2016.
2.	Antonopoulos, Andreas M. "Mastering Bitcoin: unlocking digital cryptocurrencies", O'Reilly Media, Inc., 2014.
3.	Dannen, Chris. "Introducing Ethereum and Solidity", Berkeley: Apress, 2017.
4.	Prusty, Narayan. "Building Blockchain Projects", Packt Publishing Ltd, 2017.
5.	S Nakamoto, "Bitcoin: A peer-to-peer cash system", 2009. https://bitcoin.org/bitcoin.pdf
6.	Conti, Mauro, Sandeep Kumar, Chhagan Lal, and Sushmita Ruj. "A survey on security and privacy issues of bitcoin." IEEE Communications Surveys & Tutorials (2018).
7.	Khalilov, Merve Can Kus, and Albert Levi. "A Survey on Anonymity and Privacy in Bitcoin-like Digital Cash Systems." IEEE Communications Surveys & Tutorials (2018).
8.	Clark, Joseph Bonneau Andrew Miller Jeremy, Arvind Narayanan Joshua A. Kroll Edward, and W. Felten. "Research Perspectives and Challenges for Bitcoin and Cryptocurrencies." url: https://eprint. iacr. org/2015/261. pdf (2015).

Course Objectives

Course Code	18B12CS428	**Semester : EVEN** …	**Semester : VIII** ... **Session** 2018 -2019 *Month:* from Jan- May, 2019
Course Name	Introduction to Deep Learning		
Credits	**04**	**Contact Hours**	04

Faculty (Names)	**Coordinator(s)**	Satish Chandra
	Teacher(s) (Alphabetically)	Himanshu Mittal Satish Chandra

Sr. No.	**Description**	**Cognitive Level (Bloom's Taxonomy)**
CO1	Identify and express the motivation behind and need of Deep Learning .	Understanding Level (Level-2)
CO2	Comprehend the basic theory of learning, probability in learning, error minimization and regularization techniques.	Understanding Level (Level-2)
CO3	Design and Model Convolution Neural Networks fot Image recognition and Computer Vision.	Apply Level (Level-3)
CO4	Apply Recurrent Neural Networks and LSTM for temporal data	Apply Level (Level-3)
CO5	Assess the Deep Learning techniques on the basis of performance measures such as training speed, classification error, kappa coefficient, precision, recall and F-Measure.	Evaluate Level (Level-5)

Course Description

Sr. No.	**Module**	**Topic**	**No. of Lectures**
1.	Introduction	Course overview: What is deep learning? DL successes; DL versus Shallow Networks	**02**
2.	Mathematics for Machine Learning	Math review : Gradient descent, logistic regression. Probability, continuous and discrete distributions; maximum likelihood. PAC.	**04**
3.	Neural Network Fundamentals	Neural networks : cost functions, hypotheses and tasks; training data; maximum likelihood based cost, cross entropy, MSE cost; feed-forward networks; MLP, sigmoid units. Backpropagation by Gradient Descent Optimization	**04**
4.	Deep Neural Network-1	Deep learning strategies: GPU training,	**04**

		regularization, RELU, dropouts etc.	
5.	Deep Neural Network-2	Convolutional neural networks: HPC in Deep Learning	**06**
6.	Deep Neural Network-3	CNN Architectures LeNet, AlexNet, VGG Net, GooleNet: a comparative analysis	**06**
7.	RNN-1	Recurrent neural networks : architecture, application and performance evaluation	**06**
8.	RNN-2	LSTM and gated networks: architecture, application and performance evaluation	**06**
9.	Unsupervised Deep learning	Unsupervised deep learning (autoencoders)	**04**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Nikhil Buduma, Fundamentals of Deep Learning, Shroff Publishers , 2018
2.	Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Pess , 2017

Detailed Syllabus

Course Code	**18B12CS415**	**Semester** EVEN **(specify Odd/Even)**	**Semester VIII Session** 2018 -2019 Month from January 2019 – June 2019
Course Name	**Search-Based Software Engineering (SBSE)**		
Credits	3-1-0	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Dr. Amarjeet Prajapati
	Teacher(s) (Alphabetically)	Dr. Amarjeet Prajapati

S.N.	DESCRIPTION	COGNITIVE LEVEL (BLOOM TAXONOMY)
CO1	Explain the concepts of various types of optimization problems in the context of software engineering.	Remember Level (Level 1)
CO2	Identify and define and formulate various software engineering activities/tasks as search-based optimization problem.	Understand Level (Level 2)
CO3	Design and develop methods for encoding the software engineering problems for finding optimal solutions from larger search space using search-based techniques	Create Level (Level 6)
CO4	Implement and apply different optimization techniques on various forms of software optimization problems	Apply Level (Level 3)
CO5	Analyze the behavior of different optimization techniques corresponding to different forms of software optimization problems.	Analyze Level (Level 4)
CO6	Evaluate the performance of different single and multi-objective optimization techniques using different quality indicators	Evaluate Level (Level 5)

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Introduction	Search-based Software Engineering (SBSE), why SBSE, architecture of SBSE, commonly used search techniques, Optimization Problems, Metaheuristic Algorithms, software engineering	6

		problem as a search-based optimization problem	
2.	Optimization	Various types of optimization problems (e.g., linear and non-linear, convex and non-convex, single and multi-objective, etc.) in the context of software engineering	6
3	Problem Formulation	Define and formulate various software engineering activities/tasks e.g., requirement analysis, software design and software restructuring as search-based optimization problem	4
4.	Meta-heuristics	Tailoring various optimization methods and algorithms such as Harmony Search (HS), Artificial Bee Colony (ABC), Particle Swarm Optimization (PSO), etc., according to their suitability with respect to various classes of software engineering problems	6
5.	Application to software engineering problem	Apply and Implement different optimization techniques on various forms of software optimization problems e.g., software architecture recovery, software refactoring, and software remodularization	6
6.	Statistical Analysis	Statistical hypothesis testing, parametric and nonparametric statistical tests	6
7.	Evaluation	Evaluate the performance of different single and multi-objective optimization techniques using different quality indicators such as Generational Distance (GD), Inverted Generational Distance (IGD), hyper-volume (HV), Error Ratio, Set Coverage Metric, Spacing and Spread	8
		Total number of Lectures	42

Evaluation Criteria	
Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (To be mapped from Class Test 1,2,3)
	Total **100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Nature-Inspired Optimization Algorithms, **by Xin-She Yang** Publisher: Elsevier *Release Date: February 2014,* ISBN: 9780124167438
2.	Practical Optimization, Book by Philip E. Gill
3.	Practical Methods of Optimization, Book by R. Fletcher
4.	Object-Oriented Modeling and Design with UML (2nd Edition) Michael R. Blaha; James R Rumbaugh
5.	Head First Object-Oriented Analysis and Design A Brain Friendly Guide to OOA&D By Brett McLaughlin, Gary Pollice, David West
6.	OBJECT-ORIENTED ANALYSIS AND DESIGN With applications Third EDITION Grady Booch Rational Santa Clara, California
7.	Prajapati A, Jitender Kumar Chhabra, FP-ABC: Fuzzy-Pareto dominance driven artificial bee colony algorithm for many-objective software module clustering, Computer Languages, Systems & Structures (Elsevier), Volume 51,2018,Pages 1-21,ISSN 1477-8424,https://doi.org/10.1016/j.cl.2017.08.001.
8.	Prajapati A, Jitender Kumar Chhabra, Many-objective artificial bee colony algorithm for large-scale software module clustering problem, Soft Computing Journal (Springer), October 2018, Volume 22, Issue 19, pp 6341–6361 DOI https://doi.org/10.1007/s00500-017-2687-3.
9.	Prajapati A, Jitender Kumar Chhabra, TA-ABC: Two-Archive Artificial Bee Colony for Multi-objective Software Module Clustering Problem, Journal of Intelligent Systems, published online: 2017-05-04 | DOI: https://doi.org/10.1515/jisys-2016-0253.
10.	Prajapati A, Jitender Kumar Chhabra, Optimizing Software Modularity with Minimum Possible Variations, Submitted after minor revision. Journal of Intelligent Systems. published online 2018-11-10.
11.	Prajapati A, Jitender Kumar Chhabra, A Particle Swarm Optimization-Based Heuristic for Software Module Clustering Problem, Arabian Journal for Science and Engineering (Springer), December 2018,

	Volume 43, Issue 12, pp 7083–7094 https://doi.org/10.1007/s13369-017-2989-x.
12.	Prajapati A, Jitender Kumar Chhabra, Harmony search based remodularization for object-oriented software systems, Computer Languages, Systems & Structures (Elsevier), Volume 47, Part 2,2017,Pages 153-169,ISSN 1477-8424,https://doi.org/10.1016/j.cl.2016.09.003.