Detailed Syllabus
Lecture-wise Breakup

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

Faculty (Names)	Coordinator(s)	Ambalika Sarkar
	Teacher(s) (Alphabetically)	Mukta Goel Sanjeev Patel

COURSE OUTCOMES		COGNITIVE LEVELS
C314.1	Understand the regular expression, regular languages, context free languages and its acceptance using automata.	Understand level (C2)
C314.2	Identify the phases of compilers for a programming language and construct the parsing table for a given syntax	Apply Level (C3)
C314.3	Build syntax directed translation schemes for a given context free grammar by analyzing S-attributed and L-attributed grammars.	Analyze Level (C4)
C314.4	Construct grammars and machines for a context free and context sensitive languages.	Apply Level (C3)
C314.5	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.	Unit-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.	Unit-2	PDA and Parser: Push down automata, Context Free grammars, top down and bottom up parsing, YACC programming specification [12 L]	12
3.	Unit-3	Chomsky hierarchy and Turing Machine: Chomsky hierarchy of languages and recognizers, Context Sensitive features like type checking, Turing Machine as language acceptors and its design.[6L]	6
4.	Unit-4	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
Lab-wise Breakup

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Course Code	15B11CI671	Semester Even	Semester 6 Session 2018 -2019
		(specify Odd/Even)	Month from Jan to May

Course Name	Theory of Computation and Compiler Design Lab		
Credits	2	Contact Hours	2

Faculty (Names)	Coordinator(s)	Dr. Chetna Dabas
	Teacher(s) (Alphabetically)	Ankit Vidyarthi, Chetna Dabas, Dharmveer Rajpoot, Kavita Pandey, Kirti Aggarwal, Monali Mavani

COURSE OUTCOMES		COGNITIVE LEVELS
C376.1	Design different types of automata.	Apply (level 3)
C376.2	Design programs using Lex and Yaac tools.	Apply(level 3)
C376.3	Applying lex and yacc programs to create lexical analyzer and language scanners and parsers.	Apply (level 3)
C376.4	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, Interpret and analyze given examples in Lex, Design Lex and yacc calculator using yylex(), yywrap(),yyin(), Design of standalone scanner using Lex.	3
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 2	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 editon
2.	Lab Material for lex and yacc supplied by the department

Course Code	15B11CI612	Semester EVEN 2019 (specify Even)	Semester VI 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
C315.1	Define the characteristics of programming languages and the functionality of various phases of a compiler.	Remember Level (Level 1)
C315.2	Demonstrate the formal grammars, functional programming paradigms, Logic programming paradigms, and multi-language programming concepts.	Understand Level (Level 2)
C315.3	Construct deterministic top-down and bottom-up parsers.	Apply Level (Level 3)
C315.4	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)
C315.5	Explain concurrency using C++, Java and Python.	Analyze Level (Level 4)
C315.6	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 Principles, Compiler, Interpreter, Assembler, Linker and Loader, Language evaluation criteria, PL translators, compilers and interpreters.	2
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	2

		types, type checking, type conversion	
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/

Course Code	15B17CI672	Semester EVEN 2019 (specify Even)	Semester 6th 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
C377.1	Understand the principle to program in an imperative (or procedural), an object-oriented, a functional, and a logical programming language.	Understand Level (Level 2)
C377.2	Improve the ability of applying appropriate programming languages for various classes of programming problems.	Apply Level (Level 3)
C377.3	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)
C377.4	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)
C377.5	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 (Lex and Yacc).	Lab Assignments 03, 04 and 05	2
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.

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	3	**Contact Hours**	4(3+1)

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

COURSE OUTCOMES		COGNITIVE LEVELS
C313.1	Understand the basics of data mining and pre-processing of data.	Understand Level (Level 2)
C313.2	Analyze the transactional data for finding frequent and interesting patterns using association rule mining techniques like Apriori and FP-Growth**.**	Analyse Level (Level 4)
C313.3	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)
C313.4	Cluster the similar/dissimilar objects using different methods like partitioning, hierarchical and density based clustering.	Create Level (Level 6)
C313.5	Analyze the link structure of web using page rank and HITS algorithms.	Analyse Level (Level 4)
C313.6	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	08

		Partitioning Algorithm. Applications of clustering.	
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)

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

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
C375.1	Apply the data pre-processing techniques on the dataset to handle missing information, duplicate information etc.	C3
C375.2	Implement association rule mining techniques like Apriori and FP-Growth to analyze frequent and interesting patterns in the transactional data.	C3
C375.3	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
C375.4	Implement and validate the Clustering methods and outcomes of different methods like partitioning, hierarchical and density based clustering using SSE.	C5
C375.5	Analyze the link structure of web using page rank and HITS algorithms.	C4
C375.6	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. Implement ECLAT algorithm for rule mining.	C3
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	20
		Lab Test 2	20
		Day-to-Day (Evaluations , Project, 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.	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

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
C311.1	Explain the fundamental Data Structures including linked-lists, trees, binary search trees, AVL trees, heap trees, graphs, and hash-tables.	Understand level (C2)
C311.2	Analyze and compare different sorting algorithms - Merge Sort, Quick sort, Shell sort and Bucket Sort.	Evaluating Level (C5)
C311.3	Develop basic programs using data structures in various real-time practical problems	Apply Level (C3)
C311.4	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

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Detailed Syllabus

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Subject Code	15B11CI578	Semester: EVEN (specify Odd/Even)	Semester 6 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
C371.1	Demonstrate the use of basic data structure and algorithm design such as Linked lists, Stacks, Queues, and others, for various applications.	Understanding Level (C2)
C371.2	Interpret the complexity of algorithms for given problems.	Understanding Level (C2)
C371.3	Apply Searching, Sorting, and Trees and use their properties for abstractions and defining modules for implementing functionalities.	Apply Level (C3)
C371.4	Examine case-study specific application of Heaps, Graphs, and Hashing methods.	Apply Level (C3)
C371.5	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 **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	CO1 Understanding Level (C2) 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

Course Code	16B1NCI643	Semester EVEN, 2019	Semester VI Session 2018 -2019 Month from January to June
Course Name	Computational Intelligence		
Credits	**4**	**Contact Hours**	3+1

Faculty (Names)	Coordinator(s)	Parul Agarwal
	Teacher(s) (Alphabetically)	Parul Agarwal

COURSE OUTCOMES	COGNITIVE LEVELS
C330-1.1	Infer vagueness, ambiguity and uncertainty in natural language using fuzzy logic concepts.	Understanding Level- (Level-2)
C330-1.2	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)
C330-1.3	Analyze the principles of fuzzification, defuzzification and their applications in different set of problems.	Analyze-(Level-4)
C330-1.4	Integrate and develop hybrid Intelligent techniques for real time engineering application.	Create Level (Level-6)
C330-1.5	Compare and conclude the results of different techniques through writing technical reports	Evaluate(Level-5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction	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.	Methods of Knowledge representation	Rough Set Theory, Fuzzy sets and Fuzzy relations, methods of knowledge representation	04
3.	Fuzzy Inference System with applications	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)	09
4.	Neural Network with Applications	Pattern recognition and neural networks: Supervised and unsupervised learning, machine perception, object identification and speech recognition Unsupervised learning neural networks: self-organizing feature maps , Radial basis function networks , ART network, case studies	9
5.	Evolutionary Computations	Introduction to evolutionary computing: GA, DE, PSO, ACO.	8
6.	Intelligent Systems	Hybrid Intelligent systems: Evolutionary algorithms in designing neural networks, Evolutionary algorithms vs. fuzzy system Neuro Fuzzy Systems concepts and applications	9
		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.	Ross, Timothy J. *Fuzzy logic with engineering applications*. John Wiley & Sons, 2005.
2.	Poole, David Lynton, Alan K. Mackworth, and Randy Goebel.*Computational intelligence: a logical approach*. Vol. 1. New York: Oxford University Press, 1998.
3.	Jang, Jyh-Shing Roger, Chuen-Tsai Sun, and Eiji Mizutani. "Neuro-fuzzy and soft computing; a computational approach to learning and machine intelligence." (1997).
4.	Konar, Amit. *Computational intelligence: principles, techniques and applications*. Springer Science & Business Media, 2006.
5.	Rutkowski, Leszek. *Computational intelligence: methods and techniques*. Springer Science & Business Media, 2008.
6.	Eberhart, Russell C., and Yuhui Shi. *Computational intelligence: concepts to implementations*. Elsevier, 2011.
7.	Fulcher, John. "Computational intelligence: an introduction." In*Computational intelligence: a compendium*, pp. 3-78. Springer, Berlin, Heidelberg, 2008.
8.	Cox, Earl, Michael O'Hagan, Rodman Taber, and Michael O'Hagen. *The fuzzy systems handkbook with cdrom*. Academic Press, Inc., 1998.
9.	Haykin, Simon. *Neural networks: a comprehensive foundation*. Prentice Hall PTR, 1994.
10.	De Jong, Kenneth A. *Evolutionary computation: a unified approach*. MIT press, 2006.

Detailed Syllabus
Lecture-wise Breakup

Course Code	16B1NCI631	Semester Even (specify Odd/Even)		Semester VI Session 2019-2020 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: At the completion of the course, students will be able to		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 datawith 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

Subject Code	16B1NCI635	Semester Even	Semester VI Session 2018 Month from January to June
Subject Name	Data and Web Mining		
Credits	4	**Contact Hours**	4

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

S. No.	Description	Cognitive Level (Bloom's Taxonomy)
C330-3.1	Apply the pre-processing techniques to nominal, binary, categorical and ordinal data.	Apply Level (Level III)
C330-3.2	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)
C330-3.3	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)
C330-3.4	Cluster the similar/dissimilar objects using different methods like partitioning, hierarchical and density based clustering.	Create Level (Level VI)
C330-3.5	Analyze the transactional data for finding frequent and interesting patterns using association rule mining techniques like Apriori and FP-Growth**.**	Analyse Level (Level IV)
C330-3.6	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 Mining Task Primitives, Integration of a Data	3

		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

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 Lectures +1 Tutorial

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

COURSE OUTCOMES		COGNITIVE LEVELS
C330-4.1	Define basic terminologies related to IoT and IoT security.	Remember Level (Level 1)
C330-4.2	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)
C330-4.3	Identify infeasibility of hardware and software design constraints due to specific security implementations in real scenarios.	Apply Level (Level 3)
C330-4.4	Analyze the security related challenges at various layers and security mechanisms adapted to address them.	Analyze Level (Level 4)
C330-4.5	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	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.	02

	EACH LAYER AND CORRESPONDING SECURITY PROBLEMS		
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

Course Code	19B12CS312	Semester Even (specify Odd/Even)	Semester VI 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
C330-5.1	Define all the basic terminologies related to blockchain, bitcoin, decentralized applications and smart contracts.	Remember Level (Level 1)
C330-5.2	Understand the pillar security featured in decentralized networks like cryptography, digital signatures, proof of work and consensus algorithms.	Understand Level (Level 2)
C330-5.3	Identify the feasibility of applying blockchain security features in real world scenarios using different consensus algorithms.	Apply Level (Level 3)
C330-5.4	Analyze various consensus algorithms like PoW, PoS, PoB, Raft consensus, Paxos consensus, BFT etc.	Analyze Level (Level 4)
C330-5.5	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 blocks in blockchain.	6
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

Subject Code	16B1NCI642	Semester (Even)	Semester VI 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
C330-6.1	Define basic concepts & terms related to IEEE 802.11 wireless networks	Remember Level (Level 1)
C330-6.2	Explain cellular concepts of mobile radio propagation in wireless networks, IEEE 802.11 adhoc routing protocols and transport layer protocols	Understand Level (Level 2)
C330-6.3	Identify different categories and design issues of IEEE 802.11 MAC protocol	Apply Level (Level 3)
C330-6.4	Analyze metrics of MAC & Mobile IP based routing protocols using simulators	Analyze Level (Level 4)
C330-6.5	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 and Atomic Operations, Backoff Procedure with the DCF, Hidden and Exposed Stations,	10
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	8

		Mobile Ad Hoc Networks	
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/

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
C330-7.1	Interpret the trade-offs between traditional software development methods and agile software development methods for a software project effectively.	Understand level (Level 2)
C330-7.2	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)
C330-7.3	Apply Refactoring techniques on source code for improved design	Apply Level (Level3)
C330-7.4	Choose tools and construct the methods for testing Agile projects using various testing strategies	Apply level (Level3)
C330-7.5	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 prototyping.	3
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

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
C330-8.1	Analyze functional aspects of Android mobile operating system for developing Android applications	Analyze Level (Level 4)
C330-8.2	Explain how Android applications work, their life cycle, manifest, Intents, event handling and using external resources	Understand Level (Level 2)
C330-8.3	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)
C330-8.4	Make use of Google Map API to develop location aware services through Internet for mobile environments	Apply Level (Level 3)
C330-8.5	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, performing simple operations with button	6
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	7

		receiving SMS programmatically, sending Email and implementing location based services using map APIs	
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

Subject Code	16B1NCI644	Semester Even (specify Odd/Even)	Semester 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
C330-9.1	Differentiate between Public, Private, and Hybrid Clouds	Understand Level (Level 2)
C330-9.2	Develop Enterprise applications based on XML, JavaScript, Java Servlets, Java Server Pages, etc.	Apply Level (Level 3)
C330-9.3	Develop web service based solutions by using REST, JSON, SOAP, etc.	Apply Level (Level 3)
C330-9.4	Examine emerging technologies in cloud environment.	Analyse Level (Level 4)
C330-9.5	Evaluate the performance of different Public Cloud Platforms e.g., GAE, AWS and Azure.	Evaluate Level (Level 5)
C330-9.6	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

		42
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)

Course Code	19B13CS311	Semester Even	Semester 6th Session 2018 -2019 Month from Jan to Jul		
Course Name	Blockchain& Cyber Security				
Credits			Contact Hours	4hrs	

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

COURSE OUTCOMES		COGNITIVE LEVELS
C305-7.1	Define all the basic terminologies related to blockchain, Cryptocurrencies and Smart contract mechanism	Remember Level (Level 1)
C305-7.2	Understand blockchain mechanisms, Proof-of-Work, Proof-of-Stake concepts, and Block Certs.	Understand Level (Level 2)
C305-7.3	Implement smart contracts based decentralized network processes; Identify and implement Cryptographic concepts of Blockchain	Apply Level (Level 3)
C305-7.4	Analyze blockchain technology for integrity and availability of the information, Test for the issues in the existing implementations of blockchain and consensus algorithms	Analyze Level (Level 4)
C305-7.5	Evaluate Blockchain based network protection	Evaluate Level (Level 5)

Module No.	Title of the Module	List of Experiments	CO
1.	Introduction to Blockchain& Cyber Security	1. Read and understand papers: Satoshi Nakamoto, Bitcoin, " A Peer-to-Peer Electronic Cash System" Michael Crosby, Nachiappan, Pradhan Pattanayak, Sanjeev Verma, VigneshKalyanaraman, "BlockChain Technology Beyond Bitcoin" Install node js Study and implement Constructor function in java script Study and implement Prototype object in java script	CO1
2.	Basics of Blockchain and Cryptocurrencies	Create the blockchain using the constructor functions and prototype objects install Postman Create an API using express framework of node js to interact with blockchain data structure, create three API methods for getting the current blockchain, posting transactions and mining a block Install body parser. Requests that we send using postman will go through this body parser, and wecan use that data in the requests. Test post request using postman. Apply POST, SEND to check working of postman. Write code for allowing transactions through postman method. Write a new method to create new transactions. This method will take threeparameters i:e amount, sender and receiver. All these transactions are pending transactionsand are not recorded in any block. These transactions get mined and get added to the next blockin that chain.	CO2
3	Science of Blockchain-I (POW, POS etc.)	Write a proof of work and proof of stake methods. PoW method validates that whatever transactionswe are adding to the blockchain are valid. This method will take in the current block data, previous block hash and will think of a nonce, that should create a specific hash as outputtest the proof of work method, check that the block is valid, by using it in hashblock method. Create a genesis block in blockchain data structure. Genesis block is the	CO2, CO3

		firstblock. It has no previous block hash. It doesn't include any transactions in genesis block , so ithas no hash and we don't need to do any proof of work for this, so nonce is also not required	
4	Science of Blockchain-II (Decentralizati on)	Create a decentralized network to host blockchain to have a look that how blockchain works in real world. Create a decentralized network by creating multiple instances of API. Eachinstance will represent a node in the blockchain network. These all nodes will work together to host our blockchain. Register the nodes to a network. For this we need to createthree new end point in networkNodes.js. Synchronize the network , so that the copy of blockchain is same at all the nodes Update the mine end point, so that it broadcasts the newly created block to all the other nodes in the network and we need to broadcast the mining reward transaction to all nodes.	CO3, CO4
5	Smart Contracts (Solidity)	Build smart contract on Ethereum command line. Construct smart contract in javascript to connect front-end.	CO3
6	HyperLedger	Build your application with hyperledger technologies	CO4
7	Blockchain Security	Create a hash block method, that will take the block data as parameter and will hashthe complete data into a 256 bit string. import it in blockchain Use library packages to generate private keys, Public Keys Generate Private Key WIF "wallet import format" Bitcoin wallet that to make transactions. Check address in blockchain.info to see balance. Use it to infer public key hash from node address Apply homomorphic encryption in python Apply homomorphic encryption in blockchain Read paper Decentralizing Privacy: Using Blockchain to Protect Personal Data (ZNP15) in the same folder	CO2, CO4, CO5

Evaluation Criteria

Components	Maximum Marks
Lab Test 1	20
Lab Test 2	20
Evaluation 1	15
Evaluation 2	30
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.	Bitcoin and Cryptocurrency Technologies, Arvind Narayanan, Joseph Bonneau, Edward Felten, **Andrew Miller, Steven Goldfeder, Princeton**
2.	Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, Imran Bashir, Packt Publishing
3.	Bitcoin: A Peer-to-Peer Electronic Cash System, Satoshi Nakamoto
4.	Michael Crosby, Nachiappan, Pradhan Pattanayak, Sanjeev Verma, Vignesh Kalyanaraman, "BlockChain Technology Beyond Bitcoin
5.	Using Blockchain to Protect Personal Data, Guy Zyskind, et. al.
6.	IEEE Blockchain Initiative at https://blockchain.ieee.org/

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 (Bloom Taxonomy)
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 tensor flow and keras libraries for CNN, neural style transfer Case studies of	6

		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.

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
C305-9.1	Define all tools and techniques used for Data Mining and Analysis. Explain the basic & core concept of R	Understand Level (Level 2)
C305-9.2	Develop code for data extraction & loading. Apply data pre-processing techniques and build predictive model	Apply Level (Level 3)
C305-9.3	Choose Data Visualization techniques for graphical representation of results	Apply Level (Level 3)
C305-9.4	Analyze the results. Compare and contrast the results obtained to discover new pattern insight in data.	Analyze Level (Level 4)
C305-9.5	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. Introduction to String handling, String functions, String Manipulation, Regular Expressions & Pattern Matching, and Introduction to "stringr" package.	2+3
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	2+4

		Analysis, R packages for Data Pre-processing.	
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

Subject Code	18B16CS311	Semester: Even (specify Odd/Even)	Semester VI 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
C305-10.1	Define exiting IoT frameworks and techniques used for developing applications	Remember (level 1)
C305-10.2	Explain the uses of IoT edge devices & basic concept of Node-RED platform.	Understand (level 2)
C305-10.3	Develop Java Script based IoT applications using functional nodes , flows and dashboard on Node-RED platform	Apply (level 3)
C305-10.4	Evaluate the data gathered using Node-RED functionalities and choose appropriate graphical user interface to output the results.	Evaluate (level 5)
C305-10.5	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 web pages	C2,C3
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/

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
C305-11.1	Demonstrate basic & advance facets of application-based data analytical tools & IDEs	Understand Level (Level 2)
C305-11.2	Apply large scale data spanning over complex structures	Apply Level (Level 3)
C305-11.3	Analyze benchmark methods for pre-processing, indexing, clustering and classification algorithms	Analyze Level (Level 4)
C305-11.4	Evaluate performance of innovated algorithms for application-specific target domains	Evaluation Level (Level 5)
C305-11.5	Design methods to yield required information from real-world data sources	Create Level (Level 6)
C305-11.6	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

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
C305-12.1	Illustrate spatial data mining concepts, techniques and real world applications.	Understand Level (Level 2)
C305-12.2	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)
C305-12.3	Apply spatial clustering and classification algorithms to discover interesting and useful patterns in spatial data.	Apply Level (Level 3)
C305-12.4	Identify and evaluate the best spatial data mining technique for predictive Modeling and suitability analysis.	Analyse Level (Level 4)
C305-12.5	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 data	03
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	08

		(DBSCAN), Ordering points to identify the clustering structure (OPTICS), SATCAN , Applications of clustering in spatial data mining.	
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
Lab-wise Breakup

Course Code	15B19CI691	Semester : Even (specify Odd/Even)		Semester: VI Session 2018 -2019 Month: Jan-May
Course Name	Minor Project-CSE			
Credits	5		Contact Hours	

Faculty (Names)	Coordinator(s)	Dr. Adwitiya Sinha, Megha Rathi, Sonal
	Teacher(s) (Alphabetically)	Dr. Anuja Arora, Dr. Adwitiya Sinha, Dr. Dhanalakshmi G, Dr. Gagandeep Kaur, Dr. K.Rajalakshmi, Mahendra Kumar Gurve, Megha Rathi, Dr. Potukuchi Raghu Vamsi, Dr. Sangeeta Mittal

COURSE OUTCOMES		COGNITIVE LEVELS
C351.1	Compare and Contrast all tools and techniques to generate solution that meet specific need to solve complex problems.	Understand Level (Level 2)
C351.2	Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach	Apply Level (Level 3)
C351.3	Develop software systems that meet specified design and performance requirements that contributes to global, economic, environmental and social-context	Apply Level (Level 3)
C351.4	Evaluate & justify the proposed solution using appropriate learning strategies	Evaluate Level (Level 5)
C351.5	Design & develop integrated software models and techniques towards research initiatives	Create Level (Level 6)

Evaluation Criteria

Components	Maximum Marks
Synopsis	10
Mid-Term evaluation	40
Final evaluation	50
Total	**100**

Course Code	16B1NCI637	Semester Even	Semester VIth Session 2018 -2019
			Month from Jan - May

Course Name	Meta-heuristic Algorithms		
Credits	4	Contact Hours	3 – 1 -- 0

Faculty (Names)	Coordinator(s)	Mr. Raju Pal
	Teacher(s) (Alphabetically)	…

COURSE OUTCOMES		COGNITIVE LEVELS
C330-11.1	Explain the concepts of optimization including single-objective, multi-objective, exploration, exploitation, unimodal, multimodal, evolutionary, and swarm based methods.	II. Understanding
C330-11.2	Apply the knowledge of meta-heuristic fundamentals to solve various complex combinatorial optimization problems	III. Applying
C330-11.3	List and analyze various real world problems as an optimization problem and examine various hybrid meta-heuristic algorithms to solve it.	IV. Analyzing
C330-11.4	Solve the designed algorithms in a python programming language.	III. Applying
C330-11.5	Examine empirical studies of the applied methods and draw sound conclusions on qualitative and quantitative aspects of these methods.	IV. Analyzing

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Classification of optimization problems	Basics of optimization problems: mathematical formulation, constrained and unconstrained problems optimization, various case studies.	3
2.	A brief review of conventional search algorithms	Introduction to randomized search heuristics including randomized local search; Local search Vs global search, Iterated local search and guided local search; single solutions Vs population based algorithms, Tabu Search and Simulated annealing.	4
3.	Standard Benchmark Problems	Overview of standard benchmark functions with their parameters, multi-modal and unimodal functions, IEEE congress on Evolutionary Computation (CEC) benchmark problems, CEC2005, CEC2013, CEC2017, CEC2018 benchmark problems.	3
4.	Evolutionary Algorithms (EA)	Basic concepts, evolutionary algorithms in discrete Evolutionary and continuous domains, Genetic Alogrithm (GA): selection, crossover and mutation schemes, Binary GA, Real-coded GA, Constraint-handling in GA.	6
5.	Other Evolutionary	Evolution Stategies (ES): non-recombinative,	7

	Algorithms	recombinative, self-adaptive; Evolutionary Programming (EP), Genetic Programming (GP), Differential Evolution (DE), Biogeography-based Optimization (BBO): Main algorithm, basic components, issues and variations.	
6.	Multi-objective EAs	Multi-objective genetic algorithm (MOGA): Non-dominated sorting, crowding distance, elitist model, NSGA-II.	8
7.	Swarm based approach	Swarm intelligence, Ant colony optimization (ACO): Main algorithm, basic components, issues and variations, Gravitational search optimization (GSA): Main algorithm, basic components, issues and variations, , Particle swarm optimization (PSO): Main algorithm, basic components, issues and variations.	8
8.	Applications and implementation	Various case studies and literature available of selected methods covered in the module. Implementation of those methods to solve real world problems in python.	4
		Total number of Lectures	**45**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (D2D experiments in LABs)
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.	Nunes de Castro, Leandro, " Nature-Inspired Computing Design, Development, and Applications" IGI Global, 31-May-2012 - 435 pages
2.	Nelishia Pillay, Andries P. Engelbrecht, Ajith Abraham, Mathys C. du Plessis, Václav Snášel, Azah Kamilah Muda, "Advances in Nature and Biologically Inspired Computing", Springer, 01-Dec-2015, 452 pages
3.	Mandal, Jyotsna Kumar, "Handbook of Research on Natural Computing for Optimization Problems", IGI Global, 25-May-2016-1015 pages
4.	Xin-She Yang, "Nature-Inspired Computation in Engineering", Springer, 19-Mar-2016 - Computers - 276 pages
5.	Xin-She Yang, "Nature-Inspired Optimization Algorithms", Elsevier, 17-Feb-2014 - Computers - 300 pages

Course Code	16B1NCI645	Semester Even	Semester VIth Session 2018 -2019 Month from Jan - May
Course Name	Introduction to Cloud Computing		
Credits	4	Contact Hours	3 – 1 -- 0

Faculty (Names)	Coordinator(s)	Sudhanshu Kulshrestha
	Teacher(s) (Alphabetically)	Sudhanshu Kulshrestha

COURSE OUTCOMES		COGNITIVE LEVELS
C330-10.1	Defining the basic concepts of cloud computing, enabling technologies, characteristics, deployment models, and service paradigms.	I. Remembering
C330-10.2	Illustration of Service Oriented Architecture (SOA), elements of data center, energy management, disaster recovery, and virtualization.	II. Understanding
C330-10.3	Build Virtual Machines (VM) using IaaS provided by AWS.	III. Applying
C330-10.4	Categorization of virtualization, tools, hypervisors, resource allocation techniques and evaluating the performance of servers on various metrics.	IV. Analyzing

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, Next big thing: cloud computing. System models for Distributed and Cloud Computing, Enabling Technologies. **Demo** – AWS Instance provisioning	4
2.	Introduction to Cloud Computing , Issues and Challenges	What's cloud computing, History of cloud computing, Properties & Characteristics, Benefits of cloud computing, Service models, Deployment models. Current issues and challenges of cloud computing, Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS). **Demo** – AWS Instance provisioning, auto-scaling the compute and storage capacity.	6
3.	Cloud Architecture	Traditional computing architecture, cloud computing architecture, network components, processing elements, Storage, - RAID, FC-SAN, and others. Energy Management of data centers.	6
4.	Virtualization Techniques	Computer Clusters and Technologies used in Clustering. Virtualization in Cloud Computing, Virtualization Technologies, Types, Virtual Machines Monitors (VMM) - Hypervisors, Virtualization of resources and related issues.	11
5.	Cloud Resource Management	Resource Allocation taxonomy, Load balancing at data center level (network), resource allocation at the host level – VM consolidation and VM Migration, Scheduling of tasks in VMs. Performance evaluation metrics for data center	6

		hosts.	
6.	Cloud computing : case studies	Case Studies of different Cloud Computing platforms and related tools - Amazon Web Services Elastic Cloud Compute, Google Application Engine, windows Azure., KVM, Kubernetes, Docker containers, VMWare, OpenStack etc.	10
		Total number of Lectures	**42 - 45**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (10 Attd, 10 Assignment, 5 Class Performance)
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.	Behrouz Forouzan, "Data Communication and Networking, 4th Edition", McGraw-Hill Publication
3.	Abrahan Silberschatz, Peter B Galvin, Greg Gagne, "Operating System Concepts", 9th Edition, Wiley Publication.
4.	Journal articles from • IEEE Transactions on Cloud Computing, • IEEE Transactions on Network and Service Management • IEEE Transactions on Parallel and Distributed Systems Other Journals and Conference papers on "Distributed and Cloud Computing."
5.	"Virtualization Overview", White paper, VM Ware.
6.	AWS Educate Platform for Educators - https://www.awseducate.com/
7.	AWS Cloud Services – Cloud Service Provider - Demonstration - https://aws.amazon.com/
8.	Google Cloud Platform - Cloud Service Provider - Demonstration - https://cloud.google.com/

Subject Code	16B1NCI648	Semester Even (specify Odd/Even)	Semester VI Session 2018_2019 Month from Jan to Jun
Subject Name	Information Retrieval and Semantic Web		
Credits	4	Contact Hours	3-1-0
Faculty (Names)	Coordinator(s)	Dr Devpriya Soni	
	Teacher(s) (Alphabetically)	Dr Devpriya Soni	

COURSE OUTCOMES		COGNITIVE LEVELS
C648.1	Analyze the capabilities and limitations of information retrieval systems.	Analyze Level (Level 4)
C648.2	Apply techniques for design and implementation of retrieval systems for text and other media.	Apply Level (Level 3)
C648.3	Analyze the results of retrieval from large quantities of data by using various algorithms of information retrieval and Optimization of the results.	Create Level (Level 6)
C648.4	Analyze the different retrieval metrics for retrieval evaluation.	Analyze Level (Level 4)
C648.5	Understand the concepts of web crawling and web retrieval and its optimization.	Understanding Level (Level 2)
C648.6	Apply the taxonomy and ontology concepts, Resource Description Framework (RDF) and web ontology language (OWL) on semantic web applications	Apply Level (Level 3)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the Module
1.	Introduction to Information Retrieval	Theory of information retrieval, Information retrieval on data and information retrieval on the web Information retrieval tools and their architecture.	4
2.	Boolean Retrieval & Index Construction	An example information retrieval problem, Processing Boolean queries, The extended Boolean model versus ranked retrieval, Blocked sort based, single pass in Memory, Distributed and dynamic Indexing.	6
3.	Dictionary and tolerant retrieval	Wild card queries, Spelling correction , Phonetic correction	4
4.	Scoring Term weighting and the vector space model	Term frequency and weighting, Vector space model, Variant tf-idf scoring	4
5.	Link analysis	Web as graph, PageRank	4
6.	Information retrieval tools	Web directory, Search engine, Meta search engines, Web searching and search engine architecture, Searching algorithms (Fish, Shark	6

		etc...), and Page ranking algorithms.	
7.	Web Crawling	WebCrawler architecture and Web crawling (parallel, distributed and focused web crawling).	6
8	Taxonomy and Ontology	Creating domain specific ontology, Ontology life cycle Semantic Web: Resource description Framework (RDF), Turtle format, Storing RDF in Databases/files, Language Tags and labels in RDF files, RDF schema and web ontology language (OWL).	8
		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.	Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, "An introduction to Information Retrieval", 2009 Cambridge University Press UP.
2.	Rijsbergen C. J. ,"Information Retrieval", 2nd edition**.**
3.	Salton, G. and McGill, M.J., "*Introduction to Modern Information Retrieval*", Computer Series. McGraw-Hill, New York, NY**.**
4.	ACM Transaction on Internet Technology.

Course Code	16B19CI602	Semester Even	Semester VIth Session 2018 -2019
			Month from Jan - May

Course Name	Algorithmic Skill Enhancement (Value Added Course)			
Credits	2	**Contact Hours**	1-0-2	

Faculty (Names)	Coordinator(s)	Shariq Murtuza
	Teacher(s) (Alphabetically)	Anurag Goel, Himanshu Agrawal, Vartika Puri

COURSE OUTCOMES		COGNITIVE LEVELS
C305-13.1	Recognize, recall and select general principles with good algorithm design techniques for developing efficient algorithms by explaining when an algorithmic design situation calls for it.	Understanding Level 2
C305-13.2	Apply mathematical preliminaries to the analysis and design stages of different types of algorithms to write efficient algorithms.	Applying Level 3
C305-13.3	Compare and analyze the time and space complexities of different types of algorithms and distinguish them on the basis of efficiency.	Analyzing Level 4
C305-13.4	Identify the class of solutions that can be applied to given problem and solve an efficient algorithm for the problem.	Applying Level 3

Module No.	Title 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	2
2.	Basics of Data structures	Array, Pointer, Structure, Linked List, Stack, Queue, Searching, Sorting	4
3.	Trees and Graph Handling	Binary Trees, Heaps and Priority Queues	4
4.	Divide-and-Conquer Algorithms, Greedy Algorithms, Dynamic Programming	Closest Pair of Points, Strassen's Algorithm, Maximum Subarray Sum, Job Sequencing Problem, Huffman Coding, Dijkastra's Shortest Path Algorithm, Travelling Salesman Problem, Graph Coloring, K-centers problem, Fractional Knapsack Problem, Minimum number of coins required, Sub-sequence, Largest Subsequence, Longest common Sub Sequence, Maximum Sum in 3 D array, Longest repeating	6

		and non-overlapping substring	
5.	String Matching, Prime Sieving, Hashing	Naive Pattern Searching, KMP Algorithm, Rabin-Karp Algorithm, Segmented Sieve, Sieve of Eratosthenes, Maximum Matching in Bipartite Graphs,	4
6.	NoSQL Databases	Introduction to NoSQL and MongoDB	4
7.	Web APIs	Interacting with web services using API	4
		Total number of Lectures	**28**

Evaluation Criteria

Components	Maximum Marks
Mid Semester Examination	
(To be held along with T-2 Exam)	30
End Semester Examination	40
Teachers Assessment (TA)	30
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.	Cormen, Thomas H., et al. Introduction to algorithms. MIT press, 2009.
2.	Goodrich, Michael T., and Roberto Tamassia. Algorithm design: foundation, analysis and internet examples. John Wiley & Sons, 2006.
3.	Horowitz, Ellis, and Sartaj Sahni. Fundamentals of Computer Algorithm. WH Freeman & Co., 1978.
4.	Chodorow, Kristina. MongoDB: the definitive guide: powerful and scalable data storage. " O'Reilly Media, Inc.", 2013.
5.	Allamaraju, Subbu. Restful web services cookbook: solutions for improving scalability and simplicity. " O'Reilly Media, Inc.", 2010.

Course Code	16B19CI699	Semester Even **(specify Odd/Even)**	Semester VI Session 2018 -2019 **Month from** January 2019
Course Name	Mobile Application Development Workshop (Value added course)		
Credits	2	**Contact Hours**	1-0-2

Faculty (Names)	Coordinator(s)	Anurag Goel
	Teacher(s) (Alphabetically)	Anurag Goel, Bansidhar Joshi, Rupesh Kumar Koshariya, Shailesh

COURSE OUTCOMES		COGNITIVE LEVELS
C305-15.1	Apply java programming concepts to build mobile applications using Android.	Apply Level (Level 3)
C305-15.2	Explain the various components and the various activity life cycle events of an android application.	Understand Level (Level 2)
C305-15.3	Demonstrate the use of implicit and explicit intent in android application.	Understand Level (Level 2)
C305-15.4	Build mobile application which retrieves data from network and saves the data in the mobile device storage.	Create Level (Level 6)
C305-15.5	Test mobile application on various parameters.	Analyze Level (Level 4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures + No. of Labs for the module
1.	Basics of Java Programming	History and Features of Java, Internals of Java – JDK, JRE, and JVM, Java fundamentals - Data types, Variables, Operators, Arrays, Loops, Strings, Input/Output. Object, Class, Instance, Function overloading and overriding, Constructor, Runtime polymorphism, static and dynamic binding, Relationships between classes and objects – inheritance, aggregation, and composition, Abstract class and Interface, Packages. Exception Handling - Use of try and catch block	2+2
2.	Introduction to Android Programming	Introduction to Android Programming, Installation of Android Studio, Preparing the working environment, Creating a project in Android Studio, Building "Hello World" android application	2+2
3.	User Interface and Input Controls	Organization of Resources in Android Studio, User Interface – View Group, Layouts: Linear Layout, Relative Layout, List View, Grid View. Input Controls – Buttons, Checkboxes etc. Input Events, Event Listener, Toast.	2+2
4.	Android App	Android App Components – Activities, Services, Content	2+2

	Fundamentals	Providers, Background Receivers. Intent and Activating Components. Activity LifeCycle.	
5.	Intent, App Icon, Rotation Handling, Debugging, Fragments	Intent – Passing data across activities, App Icon - Drawables, Rotation Handling – Saving data while rotation, Android specific debugging, Fragments.	2+2
6.	Saving Data	Saving Data – Key-value pair, SQLite Database, File storage	2+2
7.	System Permissions, Networking, Sensors	System Permissions, Networking: Connecting app to network, Location and Sensors	2+2
		Total number of Lectures	**14+14**

Evaluation Criteria

Components	Maximum Marks
Mid Semester Examination	30
End Semester Examination	40
TA	30
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.	Android Programming (Big Nerd Ranch Guide), by Phillips, Stewart, Hardy and Marsicano
2.	Android Programming – Pushing the limits by Hellman

Course Code	18B19CS391	Semester Even	Semester VIth Session 2018 -2019 Month from Jan - May		

Course Name	Core Java (Value Added Course)				

Credits	2		Contact Hours	1--0--2	

Faculty (Names)	Coordinator(s)	Sudhanshu Kulshrestha
	Teacher(s) (Alphabetically)	Gaurav Kumar Nigam, Raju Pal

COURSE OUTCOMES		COGNITIVE LEVELS
C305-14.1	Define the structure and model of the Java programming language.	C1. Remembering
C305-14.2	Demonstrate the basic OOP principles and String methods with programming examples.	C2. Understanding
C305-14.3	Classify the various types of exception, and implications of handling the exception in two different ways – throw-throws and try-catch.	C4. Analyzing
C305-14.4	Evaluate the given requirements and decide the suitable system design – interfaces, classes, and relationships – IS A (generalization) and HAS A (aggregation).	C5. Evaluating
C305-14.5	Build modular application connected to relational database using concepts like – JDBC, Design Patterns, Collection Framework, Exception Handling and File Handling.	C3. Applying

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Basics of Java	History and Features of Java, Need of Java, Internals of Java – JDK, JRE, and JVM, JVM in detail, Variables and data types, Unicode character set.	2
2.	Object oriented programming concepts	Object, Class, Instance, Function overloading and overriding, Constructor, Runtime polymorphism, static and dynamic binding, Relationships between classes and objects – inheritance, aggregation, and composition, Abstract class and Interface, Packages Static, this, final, strictfp, and super keywords	6
3.	String Handling	Creating strings, immutable strings, methods of string class, Use of StringBuffer, StringTokenizer, and StringBuilder class, Use of toString method	4
4.	Exception Handling	Use of try and catch block, Multiple catch blocks, nested try statements and finally block, Use of throw and throws keyword, creating custom exceptions	4
5.		FileInputStream and FileOutputStream, FileReader and FileWriter class, PrintWriter and PrintStream classes,	4

		File Handling	Compressing and uncompressing the Files, Taking input form keybaord by Console, Scanner, and InputStreamReader	
6.		Collection Framework	List (ArrayList, LinkedList), Queue (PriorityQuee, DeQueue), Sets (HashSet, HashTable), Maps (HasMap), - Classes and Interfaces	2-4
7.		Design Patterns and JDBC (Java Database Connectivity)	Class diagrams, Creational, Structural, Behavioral, Connecting Java with Database tutorial	2-4
			Total number of Lectures	**24-28**

Evaluation Criteria

Components   **Maximum Marks**
Mid Semester Examination
(To be held along with T-2 Exam)   30
End Semester Examination   40
Teachers Assessment (TA)   30
                    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.	Horstmann CS, Cornell G. Core Java 2: Volume I, Fundamentals. Pearson Education; 2002 Aug 1.
2.	Schildt, Herbert. *Java 2: the complete reference*. McGraw-Hill Professional, 2000.
3.	Nanyang Technical University - Java Programming Tutorial - http://www.ntu.edu.sg/home/ehchua/programming/java/j2a_basicsexercises.html
4.	Oracle - The Java™ Tutorials - https://docs.oracle.com/javase/tutorial/scholar

Course Code	19B16CS315	Semester : EVEN (specify Odd/Even)	Semester VIth Session 2018 -2019 Month from Jan-May
Course Name	**Advanced UNIX and System Administration**		
Credits	**Audit**	**Contact Hours**	**01-0-02**

Faculty (Names)	Coordinator(s)	Dr. Charu
	Teacher(s) (Alphabetically)	…

COURSE OUTCOMES		COGNITIVE LEVELS
C305-16.1	Explain and Demonstrate UNIX Utilities for system resource management.	Understanding(02)
C305-16.2	Experiment with different constructs of Perl language and develop programs Using Perl	Apply(03)
C305-16.3	Using advanced UNIX utilities and shell programming to solve real time computing problems	Evaluate (05)
C305-16.4	Analyze potential security threats using system calls and administration tools for real time attacks problems.	Analyzing(04)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module(L+P)
1.	**AN OVERVIEW OF PERL**	File handles, Operators, Control Structures, Regular Expressions, List Processing	(01+04)
2.	**SYNTAX AND SYMANTICS OF PERL**	Built-in Data Types, Terms, Pattern Matching, Operators, Statements and Declarations, Subroutines, Formats Special Variables	(01+04)
3.	**PERL FUNCTIONS**	Perl Functions by Category Perl Functions in Alphabetical Order	(02+04)
4.	**REFERENCES AND NESTED DATA STRUCTURES**	What Is a Reference, Creating Hard References, Using Hard References Symbolic References, Braces, Brackets, and Quoting	(02+04)
5.	**UNIX FILE I/O**	Opening Files, . The open( ) System Call, Owners of New Files, Permissions of New Files, The creat( ) F unction, Return Values and Error Codes	(03+06)

		Reading via read, Return Values, Reading All the Bytes	
		Nonblocking Reads, Other Error Values Size Limits on read( )	
		Writing with write( ), Partial Writes, Append Mode	
		Nonblocking Writes, Other Error Codes . Size Limits on write( ) Behavior of write( ) Synchronized I/O . fsync( ) and fdatasync( ) Direct I/O, Closing Files	
6.	**MAPPING FILES INTO MEMORY**	Protection Flags, Architectures, and Security, Synchronized, Synchronous, and Asynchronous Operations	02+02
7.	**FILE AND DIRECTORY MANAGEMENT**	Files and Their Metadata, Directories. Links, Device Nodes,	02
	INTER PROCESS COMMUNICATION	Interprocess communication, Networked processes, sockets, Asynchronous I/O	02+04
		Total number of Lectures	43

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz 02, Lab Day-to-Day evaluations)
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.	Advanced Programming in the UNIX Environment, by Richard Stevens. Addison Wesley Press.
2.	UNIX SYSTEMS Programming: Communication, Concurrency and Threads by Kay A. Robbins and Steven Robbins, Prentice Hall
3.	Jorba Esteve, J. & Suppi Boldrito, R. (2009). GNU/Linux advanced administration (2nd ed.). Barcelona, Spain: Eureca Media
4.	Randal L. Schwartz, Tom Phoenix, brian d foyLearning Perl, 5th Edition, O'Reilly Media

Course Code	18B11CS212	Semester : EVEN (specify Odd/Even)	Semester VIth Session 2018 -2019 Month from Jan-May	
Course Name	Computers and Security			
Credits	04		Contact Hours	3L+1T=04

Faculty (Names)	Coordinator(s)	Dr. Charu	
	Teacher(s) (Alphabetically)	…	

COURSE OUTCOMES		COGNITIVE LEVELS
C330-17.1	List common system vulnerabilities, attacks and define security goals and principles	Remember (01)
C330-17.2	Understand security goals & principles; system vulnerabilities & network attacks; and classify OS security mechanisms and network protocols	Understand (02)
C330-17.3	Apply security and privacy principles to solve security problems in IT environments.	Apply(03)
C330-17.4	Analyze the overarching importance of IT security in areas such as networking, databases, operating systems, and web systems.	Analyze(04)
C330-17.5	Evaluate performance of various security mechanisms work, and assess these security mechanisms with respect to security principles	Evaluate(05)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	INTRODUCTION	What Does a Secure Mean?, Attacks, The Meaning of Computer Security, Computer Criminals, Methods of Defense	03
2.	PROGRAM SECURITY	Secure Programs Non malicious Program Errors, Viruses and Other Malicious Code, Targeted Malicious Code, Controls Against Program Threats	05
3.	WEB SECURITY	The Web—User Side, Browser Attacks Browser Attack Types How Browser Attacks Succeed: Failed Identification and Authentication Web Attacks Targeting Users False or Misleading Content Malicious Web Content Protecting Against Malicious Web Pages, Obtaining User or Website Data Code Within Data Website Data: A User's Problem, Too Foiling Data Attacks Email Attacks Fake Email Fake Email Messages as Spam Fake (Inaccurate) Email Header Data Phishing Protecting Against Email Attacks	06
4.	SECURITY IN NETWORKS	Threats in Networks, Network Security Controls, Firewalls, Intrusion Detection Systems, Secure E-Mail, Wireless Networks Security, Denial of Service, Distributed Denial of	10

		Service, Scripted Denial-of-Service Attacks Bots, Botnets, Malicious Autonomous Mobile Agents, Autonomous Mobile Protective Agents	
5.	**AUTHENTICATI ON**	Authentication Basics , Passwords, Attacking a Password System, Countering Password Guessing Random Selection of Passwords,Pronounceable and Other Computer-Generated Passwords , User Selection of Passwords ,Reusable Passwords and Dictionary Attacks ,Guessing Through Authentication Functions Password Aging ,Challenge-Response Pass Algorithms ,One-Time Passwords Hardware-Supported and Dictionary ,Biometrics	06
6.	**PRIVACY**	Privacy Concepts, Aspects of Information Privacy Computer-Related Privacy Problems, Privacy on the Web Understanding the Online Environment, Payments on the Web, Site and Portal Registrations, Whose Page Is This? Precautions for Web Surfing, Spyware, Shopping on the Internet, Email Security, Where Does Email Go, and Who Can Access It?, Interception of Email, Monitoring Email Anonymous, Pseudonymous, and Disappearing, Email Spoofing and Spamming, Privacy Impacts of Emerging Technologies, Radio Frequency Identification, Electronic Voting, VoIP and Skype, Privacy in the Cloud	06
7.	**EMERGING TOPICS**	The Internet of Things, Medical Devices, Mobile Phones Security in the Internet of Things, Electronic Voting What Is Electronic Voting?, What Is a Fair Election? What Are the Critical Issues?, Cyber Warfare, What Is Cyber Warfare?, Possible Examples of Cyber Warfare Critical Issues	05
		Total number of Lectures	**41**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignments, 02 nos 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.	Security in Computing (5th edition), Pfleeger, Pfleeger and Margulies, Pearson.
2.	Introduction to Modern Cryptography (2nd edition), Katz and Lindell, Chapman & Hall/CRC
3.	Cryptography Theory and Practice (3rd edition), Stinson, Chapman & Hall/CRC
4.	Computer Security: Art and Science by Matt Bishop, Addison-Wesley Educational Publishers Inc

Course Code	16B1NCI638	Semester Even (specify Odd/Even)	Semester VI. Session 2018 -2019 Month from January to June
Course Name	Big data and Data Analytics		
Credits	3-1-0	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Dr Shikha Mehta
	Teacher(s) (Alphabetically)	Dr Shikha Mehta

COURSE OUTCOMES		COGNITIVE LEVELS
C330-12.1	Understand and Compare SQL, NOSQL and NewSQL database	Understand level (C2)
C330-12.2	Identify NoSQL /New SQL Systems to Store and process large volumes of structured and unstructured data	Apply Level (C3)
C330-12.3	Develop a simple application and connect with a NoSQL database or Hadoop distributed file system.	Apply Level (C3)
C330-12.4	Apply machine learning algorithms for data analysis.	Apply Level (C3)
C330-12.5	Analyze parallel models of evolutionary algorithms for solving computation intensive problems.	Analyze Level (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction to Database Systems and Cloud Computing	Overview of Database Management Systems , Introduction to Big Data, Introduction – distributed file system – Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics.	2
2	Trade-offs in Cloud Databases	Differences between conventional (relational) databases and cloud databases ACID database properties, CAP Conjecture, and BASE properties of cloud databases	2
3.	NoSQL Databases	Cloud Data Models: Key-Value data model, Document data model, Column Family data model. Graph Data Model	2
4.	Cassandra Architecture and Cassandra Data Model	Internode Communication ,Data Distribution and Replication ,Partitioning , Snitches ,Basic features of Cassandra CDBMS, Formal definition of Cassandra column family data model, Cassandra CQL query language and CQL data model: Key space, Table definition, Column, and Data Types	4
5.	Cassandra Consistency Levels	Configuring Data Consistency -Write Requests, Read Requests	2
6.	Cassandra Repair Mechanisms , Transaction	Hinted Handoff Writes, Anti-entropy Node Repair, Transactions and Concurrency Control, Light Weight Transactions	3

		Processing		
7.	Cassandra CQL Queries	The Syntax of the SELECT Statement Simple SELECT expressions ,Filtering Data using WHERE Clause ,Using Indexes ,Filtering Collections , Querying Tables with Columns of the counter Type Keyspace Design Heuristics	3
8.	SQL based Cloud Databases	SQL compliancy, Transaction Control, Elasticity & Scalability. Case Study: nuoDB/ DB as a service	8
9.	Hadoop Framework	Apache Hadoop & Hadoop EcoSystem – Moving Data in and out of Hadoop, Understanding inputs and outputs of MapReduce, Data Serialization. Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands , Anatomy of File Write and Read., NameNode, Secondary NameNode, and DataNode, Hadoop MapReduce paradigm, Map and Reduce tasks, Job, Task trackers - Cluster Setup – SSH & Hadoop Configuration – HDFS Administering –Monitoring & Maintenance.	10
10.	Applications to Data Mining	Cluster analysis, K-means algorithm, Naïve Bayes, Parallel k-means using Hadoop , parallel particle swarm algorithm using MapReduce, case studies on big data mining	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.	Dan Sulliva ,NoSQL for Mere Mortals 1st Edition., Pearson Publishers
2.	Pramod J. Sadalage, Martin Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence 1st Edition, Pearson Publishers, ISBN-13: 978-0321826626
3.	John D. Kelleher, Brian Mac Namee, Aoife D'Arcy, Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies (The MIT Press)
4.	John D. Kelleher, Brendan Tierney, Data Science (MIT Press Essential Knowledge series)
5	Xin-She Yang , Nature-Inspired Algorithms and Applied Optimization (Studies in Computational Intelligence Book 744) 1st Edition,Springer

Subject Code		Semester: (specify Odd/Even): Even	Semester: Sixth Session: 2018-19 Month: from January to June
	16B1NCI647		
Subject Name	Image Processing and Applications		
Credits	4	**Contact Hours**	3 (L)

Faculty	Coordinator(s)	Dr. Gyan Singh Yadav
Course Outcome:		**COGNITIVE LEVELS**
C330-14.1	Explain general terminology of image processing systems.	
C330-14.2	Apply intensity transformations, enhancement, restoration, and filtering techniques on binary, grayscale, and colour images in spatial domain	
C330-14.3	Illustrate various image transformation methods like, DFT, DCT, and DWT.	
C330-14.4	Apply image segmentation methods on binary, grayscale, and colour images e.g., gradient, Laplacian, Watershed transformation, LOG etc.	
C330-14.5	Explain Morphological Processing operations such as dilation, erosion, opening, closing, pruning, thinning, etc.	
C330-14.6	Demonstrate various image processing applications viz., Face Detection, Finger print recognition, Optical Character Recognition etc.	

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	Introduction to Image Processing	Taxonomy of digital images and applications	4
2.	Spatial domain processing	Geometric transformations, enhancement of gray images	8
3.	Frequency domain processing	Fourier transformation-based processing	4
4.	Image Segmentation	Point, Line, and edge detection, thresholding, Region based segmentation	6
5.	Color image processing	Color Models: RGB, CMYK, HIS etc, Color image enhancement, segmentation, filtering in color images	6
6.	Morphological Processing	Dilation, erosion, opening, closing, pruning, thinning, etc.	6
7.	Computer Vision Algorithms and other	Face Detection, Finger print recognition, Optical Character Recognition	8

	image applications		
		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.	Bhabatosh Chanda, Dwijesh Dutta Majumder, "Digital Image Processing and Analysis", Eighth edition, PHI Learning Pvt. Ltd, New Delhi, India, 2006
2.	Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", 3rd edition, Pearson Education, New Delhi, India, 2009
3.	Rafael C. Gonzalez, Richard Eugene Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", 2nd edition, Pearson Education India, 2004
4.	W. K. Pratt, "Digital Image Processing" , 3rd Edition, John Wiley & sons, 2006
5.	Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision", 2nd Edition, Thomson Learning, 2008

Detailed Syllabus
Lecture-wise Breakup

Course Code	16B1NCI646	Semester Even	Semester VI Session 2018 -2019
		(specify Odd/Even)	Month from January to June

Course Name	Wireless Networks and Security

Credits	4		Contact Hours	3-1-0 (L-T-P)

Faculty (Names)	Coordinator(s)	Himanshu Agrawal
	Teacher(s) (Alphabetically)	Himanshu Agrawal

COURSE OUTCOMES		COGNITIVE LEVELS
C305-24.1	Define vulnerabilities, privacy issues and security requirements for different types of wireless networks.	Remembering Level (C1)
C305-24.2	Demonstrate various concepts related to secured wireless networks and security challenges in upcoming wireless networks.	Understanding Level (C2)
C305-24.3	Apply various cryptographic algorithms to achieve security such as confidentiality, integrity and availability.	Applying Level (C3)
C305-24.4	Able to analyze the security model for various applications of wireless networks such as Internet of things, wireless sensor networks, cognitive radio networks.	Analyzing Level (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction & Basic Concepts	Wireless and Mobile Networks, Elements of a wireless network, single hop, multiple hops, infrastructure based, No infrastructure (adhoc), IEEE 802.11 standard, terminology, elements, services, The Wi-Fi alliance, IEEE 802 Protocol Architecture,	8
2.	Wireless Security Overview	Wireless Security risk factors, Network Threats, Securing Wireless Transmissions, signal-hiding techniques, Encryption, Mobile Device Security, Wireless LAN Security, IEEE 802.11i phases of operation, WEP, WAP, 802.11x/EAP, Discovery phase Authentication phase, Key management phase, Protected data transfer phase	6
3.	Cryptography Overview - I	Classical Encryption Techniques, Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Block Ciphers and the Data Encryption Standard,	5
4.	Cryptography Overview - II	Advanced Encryption Standard, Stream Ciphers, Public-Key Encryption , Message Authentication and Hash Functions, Digital Signatures and Authentication Protocols	7
5.	Network Security	IP Security, IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations, Transport-level security, MAC-level security	7
6.	Key Management and Distribution	Key Distribution Issues, Symmetric Key Distribution Using Public Keys, Hybrid Key Distribution, Distribution of Public Keys, Public-Key Authority, Public-Key Certificates, Public Key Infrastructure	6

7.	Security and privacy issues in modern wireless networks and systems	cellular networks, wireless LANs, wireless PANs, mobile ad hoc networks, vehicular networks, satellite networks, wireless mesh networks, sensor networks	3
		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.	Cryptography and Network Security: Principles and Practice, by William Stallings
2.	Wireless Communications: Principles and Practice by Rappaport
3.	Wireless communications and networks, by Williant Stallings
4.	Security for Wireless Sensor Networks, by Liu and Ning
5.	Security and Cooperation in Wireless Networks, by Buttyan and Hubaux
6.	Real 802.11 Security_ Wi-Fi Protected Access and 802.11i , Addison-Wesley 2004, by Edney, Arbaugh:
7.	Wireless Network Security, by Vacca.
8.	Network Security: Current Status and Future Directions, by Douligeris and Serpanos

Course Code	16B1NHS631	Semester Even	Semester 6th Session 2018 -2019
			Month from January 2019 to May 2019

Course Name	PROJECT MANAGEMENT		
Credits	3	**Contact Hours**	2-1-0

Faculty (Names)	Coordinator(s)	Dr. Santoshi Sengupta (Sec-62), Dr. Deepak Verma (Sec-128)
	Teacher(s) (Alphabetically)	Dr. Deepak Verma, Dr. Santosh Dev, Dr. Santoshi Sengupta

COURSE OUTCOMES		COGNITIVE LEVELS
304-5.1	Apply the basic concepts of project management such as features, objectives, life cycle, model and management, in a given context	Apply Level (C3)
304-5.2	Analyze projects and their associated risks by understanding the various theoretical frameworks, non-numerical and numerical models in order to make correct selection decisions	Analyze Level (C4)
304-5.3	Evaluate the various stages of project management and identify and determine correct techniques for planning, scheduling, controlling and terminating the projects	Evaluate Level (C5)
304-5.4	Evaluate project management processes, tools and techniques in order to achieve overall project success	Evaluate Level (C5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Project Management: Introduction	Characteristics of project; Life Cycle of Project; Project Model; Project Management as discipline; Contemporary aspects of Project Management	4
2.	Project Selection	Theoretical Models; Non-numeric models; Numeric Models; Financial Models; Project Portfolio process, Significance and applicability of Monte Carlo simulation	6
3.	Project Organization, Manager and Planning	Pure Project organization; Functional Organizations; Mixed organizations; Matrix organizations; Role, Attitudes and Skills of Project Manager, Project Coordination, Systems Integration, Work Breakdown Structure, Linear Responsibility Charts.	4
4.	Risk Management	Theoretical Aspects of risk, Risk Management process, Numeric Techniques, Hillier model, Sensitivity Analysis, Certainty Equivalent approach and Risk adjusted discount rates, Game theory.	4
5.	Project Scheduling and Resource Allocation	Theoretical aspects-Importance, Focus Area-PERT/CPM, AOA and AON charts, Probability Analysis, Gantt Charts, Crashing of Projects- Time and Cost tradeoff, Basics-Resource Leveling and Loading.	6
6.	Budgeting, Control and Project Termination	Estimating Project Budgets, Improving the process of cost estimation, Basics, Importance, Purpose of control, Types of Control, Desirable features of Control, Control Systems,	4

		Critical Ratio Method, Control of creative activities, Control of change and scope creep, Why Termination, Types of termination, typical termination activities.	

Total number of Lectures	**28**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment, Project, Oral Questions)
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.	Meredith, Mantel, Project Management-A Managerial Approach, 10th Edition, Wiley Publications, First Published 1985
2.	Timmothy Kloppenborg, Contemporary Project Management, 1st Edition, Cengage Learning, 2014
3.	Vohra, N. D., Quantitative Techniques in Management, 3rd Edition, Tata McGraw Hill Publishing Company, 2007

Course Code	16B1NHS635	Semester: Even	Semester: VI Session: 2018 -2019 Month: Jan 2019 to June 2019
Course Name	Organizational Behavior		
Credits	3	Contact Hours	3(2-1-0)

Faculty (Names)	Coordinator(s)	Ms Puneet Pannu (Sec 62) & Dr Anshu Banwari (Sec 128)
	Teacher(s) (Alphabetically)	Dr Anshu Banwari Ms Puneet Pannu

COURSE OUTCOMES		COGNITIVE LEVELS
C304-6.1	Identify dynamic human behavior through an insight into relationships between individuals, groups and organizations	Apply (C3)
C304-6.2	Analyze individual management style as it relates to influencing and managing behavior in the organization.	Analyze (C4)
C304-6.3	Decide and justify set of strategies for meeting the special challenges in the 21st century competitive workplace	Evaluate (C5)
C304-6.4	Assess the potential effects of important developments in the external environment on behavior in organizations	Evaluate (C5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1	Introduction to OB: Challenges and Opportunities	Interdisciplinary Field, Concepts, Approaches, Responding to Globalization; Improving Quality & Productivity; Improving Customer Service; Improving People Skill; Empowering People; Stimulating Innovation & Change; Coping with Temporariness; Positive Organizational Behavior, Working in Networked Organizations; Balancing Work-Life Conflict	3
2	Managing Workforce Diversity	Major forms of Workplace Diversity, Valuing Diversity, Role of Disabilities, Discrimination, Diversity Initiatives, Diversity Awareness and Affirmative Action, Diversity Management and strategies to implement it Competitive Advantage of Diversity Management Generational Workforce	4
3.	Job Design and Flexible Job Environment	Job Design & its uses; Flexible Job Environment; Job Enrichment Model	2
4.	Leadership: Authentic Leadership	Inspirational Approach to Leadership: Authentic, Ethical & Servant Leadership Defining Authentic Leadership through Intrapersonal, Interpersonal and Developmental Aspects; Basic Model Of Authentic Leadership; Practical Approach to Authentic Leadership through the research of Terry and Bill George; Authentic Leadership: Trust and	6

		Ethics, Dimensions of Trust, Counseling & Mentoring	
5.	Power & Politics	Concept of Power; Sources of Power Contingencies of Power; Power Tactics; Measuring Power Bases: Power Authority Obedience Organizational Politics: Types Factors contributing to Political Behavior; Consequences & Ethics of Politics	5
6.	Employee Engagement	Creating a Culture of Engagement, Models of engagement, Benefits of Employee Engagement, Gallup Study, Methods of engaging employees – from entry to exit, Managers Role in Driving Engagement	2
7.	Organizational Culture & Workplace Spirituality	Creating Organizational Culture Approaches to Organizational Culture; How employees learn culture; Measuring Organizational Culture; Spirituality & Organizational Culture	3
8.	Organizational Change & Development	Organizational Change: Meaning & Types; Technology & Change; Resistance to Change v/s Inviting Change; Approaches to Organizational Change; Planning & Implementing Change; Organizational Development; OD Interventions & Change	3
		Total number of Lectures	**28**

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Evaluation Criteria

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Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Oral Questions, Assignment, 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.	**S. Robbins, T. Judge, S. Sanghi**, *Organizational Behavior*, 13th Ed, Prentice-Hall India, 2001
2.	**P.Subba Rao***, Organizational Behavior: Text Cases & Games*, 2nd Edition, Himalaya Publishing House , 2015
3.	**John R. Schermerhorn, Richard N. Osborne, Mary Uhl-Bien; James G. Hunt**, *Organizational Behavior*, 12th Edition, Wiley India Pvt. Ltd, 2012
4.	**Debra L.Nelson and James C. Quick**, *Organizational Behavior*, Cengage Learning, India Edition, 2009
5.	**Steven L. McShane and Mary Ann Von Glinow**, *Organizational Behavior Essentials*, Tata McGraw Hill Publishing Company Ltd, 2007
6.	**Jerald Greenberg**, *Behavior in Organizations*, 10th Ed, PHI Learning Pvt Ltd

Detailed syllabus
Lecture-wise Breakup

Subject Code	16B1NHS632	Semester: EVEN	Semester VI Session 2018-19
			Month from Jan 2019 to June 2019
Subject Name	COGNITIVE PSYCHOLOGY		
Credits	3	Contact Hours	2-1-0
Faculty (Names)	Coordinator(s)	Dr. Ruchi Gautam Dr. Badri Bajaj	
	Teacher(s) (Alphabetically)	Dr. Badri Bajaj Dr. Ruchi Gautam	

COURSE OUTCOMES	COGNITIVE LEVELS
After pursuing the above mentioned course, the students will be able to:	
304-4.1	Understand and apply the concepts of cognitive psychology in everyday life	Applying Level (C3)
304-4.2	Analyze the different models of various cognitive processes	Analyzing Level (C4)
304-4.3	Evaluate cognitive psychology issues and recommend possible solutions	Evaluating Level (C5)
304-4.4	Evaluate interventions/solutions for self-development through cognitive processes	Evaluating Level (C5)

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	Introduction to Cognitive Psychology	Historical Background: Emergence of modern cognitive Psychology; Approaches: Information Processing and PDP Model; Research Methods	3
3.	Perceptual Processes	Perceptual learning and development; perception of shape, space and movement.	4
3.	Attention	Selective Attention and Divided Attention: Meaning, Definition and Theories.	4
4.	Memory	Short Term Memory	3
5.	Imagery	Properties of mental images; Representation of images and cognitive maps.	3
6.	Language	Structure of language and its acquisition, speech perception, factors affecting comprehension.	4
7.	Thinking and Problem Solving	Types of thinking; Classification of problems; Problems solving approaches, Problems space theory by Newell and	4

		Simon, Creativity	
8.	Decision Making	Logical reasoning types and errors in reasoning processes.	3
		Concept formation and categorization; Judgment and decision making	
Total number of Hours			**28**

Evaluation Criteria	
Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment, Quiz , Oral Questions)
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.	Ronald T. Kellogg, Fundamentals of Cognitive Psychology, 2nd Ed., Sage Publishing, 2012
2.	Robert Solso, Otto Maclin, M. Kimberly Maclin, Cognitive Psychology, 8th Ed., Pearson Education, 2013
3.	Kathleen M. Galotti, Cognitive Psychology, 5th Ed., Sage Publishing, 2014

Course Code	16B1NHS636	Semester : Even	Semester VI Session 2018 -2019
			Month from Jan 2019 to June 2019
Course Name	Literature & Adaption		
Credits	3	Contact Hours	2-1-0

Faculty (Names)	Coordinator(s)	Dr. Monali Bhattacharya (Sector 62)
		Dr. Ekta Srivastava Sector (128)
	Teacher(s) (Alphabetically)	Dr. Ekta Srivastava, Dr. Monali Bhattacharya.

COURSE OUTCOMES		COGNITIVE LEVELS
C304-3.1	Understand and outline the elements and theories of adaptation and its various forms, and relate with the texts reflecting the cultural, moral and linguistic changes in the contemporary society.	Understand Level (C2)
C304-3.2	Utilize visual literacy to analyze the language and style adopted in filmed texts and examine them as reflections of Readers' and Audience' values and perceptions in the context of myriad cultures and multidisciplinary settings individually and in groups.	Apply Level (C3)
C304-3.3	Analyze texts and their adaptations beyond the surface level of narrative or character as reflections of value systems of various cultures and times individually and in a team.	Analyse Level (C4)
C304-3.4	Evaluate, interpret and document source texts and adaptations thematically and stylistically to learn the nuances of language, culture and values of the society.	Evaluate Level (C5)
C304-3.5	Compose and make an effective presentation of a literary/non literary piece in any genre and design an ethical adaptation of any literary/non literary piece in another form individually and in groups.	Create Level (C6)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction Literary Devices	Figures of speech, Character, Plotline, Conflict, Point of View	2
2.	Literature & Adaptation	Understanding Cultural Contexts Forms of Adaption Cinematography & Narratology	4
3.	Framework	Adaptation Theories; Reader Response & Audience Response Theories	4
4.	Play & adaptations	The Pygmalion: George Bernard Shaw Hamlet : William Shakespeare	6
5.	Novel & Adaptations	Pride & Prejudice: Jane Austen The Kite Runner: Khalid Hossenni The Namesake: Jhumpa Lahiri The Godfather: Mario Puzo	12

	Total number of Lectures	28

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment, Poster Presentation , Oral Questions)
Total	**100**

Recommended Reading material:	
1.	**Linda Hutcheon**, *A Theory of Adaptation*, Routledge, 2006
2.	**Mark William Roche**, *Why Literature matters in the 21st Century*, 1st edition, Yale University Press 2004
3.	**George Bernard Shaw**,*Pygmalion,* Electronic Version, Bartleyby.com, New York, 1999
4.	**Stanley Wills & Gary Taylor**, *The Complete Works. The Oxford Shakespeare* (Compact ed.). Oxford: Clarendon Press. , 1988.
5.	**Jhumpa Lahiri** , *The Namesake*, 1st Edition, Houghton Mifflin US, 2003
6.	**Jane Austen**, *Pride & Prejudice*, Reprint, Thomas Egerton, 2013
7.	**Mario Puzo***, The Godfather*, 1st Edition, G. P. Putnam's Sons, USA, 1969
8.	**Khalid Hossenni**, *The Kite Runne*r, 1st edition, Riverhead Books US,.2003

Course Code	19B12HS612	Semester : Even	**Semester** VI **Session** 2018 -2019
			Month from Jan 2019 to June 2019

Course Name	Social Media and Society		
Credits	3	**Contact Hours**	2-1-0

Faculty (Names)	**Coordinator(s)**	Dr. Shirin Alavi
	Teacher(s) (Alphabetically)	Dr. Shirin Alavi

COURSE OUTCOMES		**COGNITIVE LEVELS**
C304-1.1	Infer the implications of digital change, and the concept of social media and e-marketing in the context of the changing marketing landscape	Apply Level(C3)
C304-1.2	Elaborate the implications of cyber branding and digitization on online marketing mix decisions	Create Level (C6)
C304-1.3	Develop specific models related to social media and social media analytics	Create Level (C6)
C304-1.4	Evaluate concepts related to Search Engine Marketing, Customer Centric Web Business models and Web Chain Analysis	Evaluate Level(C5)
C304-1.5	Illustrate the new age marketing practices	Understand Level (C2)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction , Individuals Online and Rules for engagement for social media	What is social media marketing, the importance of social media for influencing target audience, Patterns of internet usage, Internet user demographics, The Behavioural Internet, E-Marketing, The Virtual world, the changing Marketing Landscape, E -Marketing-Strengths and Applications, Online Marketing Domains, Digital Marketing Optimization, The Need for Digital Engagement	4
2.	The Online Marketing Mix	The Online Marketing Mix, Consumer Segmentation, Consumer Traits, Consumers and Online Shopping Issues, E-Product, E-Place, E-Price, E-Promotion, Website Characteristics affecting online purchase decision.	3
3.	The Online Consumer and Social Media	The Digital Ecosystem, Online Consumer Behavior, Cultural Implications of key web characteristics, Models of website visits, Web 2.0 and Marketing, The collaborative web, Network evolution, Network science, Marketing with networks, Metcalfe's law, Netnography, Social Media Model by McKinsey, Social Media Tools-Blogs, Wikis, Online Communities, Facebook, Twitter, You Tube , Flickr, Microblogging.	4

4.	Online Branding and Traffic Building	Cyberbranding, Online brand presence and enhancement, The Digital Brand Ecosystem, Brand Experience, Brand Customer Centricity, Brands and Emotions, The Diamond Water paradox, Internet Traffic Plan, Search Marketing Methods, Internet Cookies and Traffic Building, Traffic Volume and quality, Traffic Building Goals, Search Engine Marketing, Keyword Advertising, Keyword value, Internet Marketing Metrics, Websites and Internet Marketing.	4
5.	Web Business Models ,Social Media Strategy ,Social Media Marketing Plan	The value of a Customer Contact, Customer Centric Business Management, Web Chain of Events, Customer Value Analysis and the Internet, Business Models, Revenue Benefits, Value Uncertainty, Purchase Importance, Define a social media plan, explain the social Media marketing planning cycle, list the 8C's of strategy development.	4
6.	Market Influence analytics in a Digital Ecosystem	Engagement Marketing through Content Management, Online Campaign Management, Consumer Segmentation, Targeting, and Positioning using Online Tools, Market Influence Analytics in a Digital Ecosystem, The Digital Ecosystem, Knowledge as a value proposition, CGM and Consumer behavior, The value of the power of influence, Amplifying Social Media Campaigns.	4
7.	The Contemporary Digital Revolution and its impact on society	Online Communities and Co-creation, The fundamentals of online community management strategies, The World of Facebook, The Future of Social media Marketing—Gamification and Apps, Game based marketing The world of Apps, Apps and the Indian Diaspora	3
8.	Integrating Mobile into Social Media Marketing	Types of Mobile Marketing, Progression of the mobile as a Marketing channel, some Indian mobile marketing campaigns, Impact of Social Media on government, the economy, development, and education	2
Total number of Lectures			**28**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment and Class Test)
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.	Social Media Marketing A Strategic Approach, Melissa Barker,Donald Barker,Second Edition Cengage Learning ,2017.
2.	Digital Marketing ,Seema Gupta,First Edition ,Mc Graw Hill Education (India) Private Limited ,2018
3.	Digital Marketing, Vandana Ahuja, First Edition, Oxford University Press, 2015
4.	Social Media Marketing, Liana "Li" Evans,First Edition , Pearson, 2011.

Detailed Syllabus

Course Code	19B12HS613	Semester: Even	Semester VI Session 2018 -2019
			Month from: Jan 2019-June 2019

Course Name	International Trade and Finance

Credits	03	Contact Hours	2-1-0

Faculty (Names)	Coordinator(s)	Dr. Amba Agarwal
	Teacher(s) (Alphabetically)	Dr. Amba Agarwal

COURSE OUTCOMES		COGNITIVE LEVELS
After pursuing the above mentioned course, the students will be able to:		
C304-8.1	Explain the foundations of international trade and finance in the era of globalisation.	Understanding Level (C2)
C304-8.2	Analyze the major models and theories of international trade.	Analyzing Level (C4)
C304-8.3	Identify the effects of tariffs, quotas and technical progress on economic growth.	Applying Level (C3)
C304-8.4	Examine the equilibrium in the Balance of Payments (BOP) and measures to correct disequilibrium.	Analyzing Level (C4)
C304-8.5	Compare the fixed and flexible exchange rate, monetary policy, foreign trade multiplier & trade policy.	Analyzing Level (C4)
C304-8.6	Analyze the working of regional blocks & international organization.	Analyzing Level (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction	International trade and globalisation.	2
2.	Theory of International Trade	The pure theory of international trade -Theories of absolute advantage, comparative advantage and opportunity costs, modern theory of international trade; Theorem of factor price equalization; Theory of absolute cost and comparative cost.	4
3.	Economic Growth and International Trade Policy	Terms of trade, Technical progress: Neutral, Labour Saving and Capital Saving, Trade Restrictions: Tariffs, General equilibrium analysis of a tariff in a small and large country, Optimum tariff. Non-Tariff Barriers: Import Quota, Dumping, Voluntary Export Restraints, Export Subsidy.	5
4.	Balance of Payments	Meaning and components of balance of payments; balance of trade, equilibrium and disequilibrium in the balance of payments; Measuring Deficit or Surplus in BOP, Measures to correct it.	4
5.	Fixed and Flexible Exchange Rate	Fixed exchange rates and flexible exchange rates; Internal and External Balance, IS-LM-BP Model, Expenditure-reducing and expenditure-switching policies.	4
6.	Trade and Monetary Policy	Foreign Trade Multiplier, Devaluation, Review of the monetary approach to the theory of balance of payments adjustment. Trade problems and trade policies in India.	3
7.	The Theory of Regional Blocs &	Rationale and economic progress of SAARC/SAPTA and ASEAN regions. Regionalism (EU, NAFTA); Functions of	6

International organisation	GATT/WTO (TRIPS, TRIMS), Custom Unions, IMF and World Bank.	
	Total number of Lectures	**28**

Evaluation Criteria

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

	Recommended Reading material:
1.	**Bhagwati, J.**, International Trade, Selected Readings, Cambridge, University Press, Massachusetts, 1981
2.	**Kindleberger, C.P.,** International Economics, R.D. Irwin, Homewood, 1973
3.	**Salvatore, D.**, International Economics, Prentice Hall, Upper Saddle River, N.J., New York, 1997
4.	**Soderston, Bo**, International Economics, The Macmillan Press Ltd., London, 1991
5.	**Dana, M.S.**, International Economics: Study, Guide and Work Book, (5th Edition), Routledge Publishers, London, 2000

Course Code	19B12HS611	Semester : EVEN (specify Odd/Even)	Semester : VI Session 2018 -2019 Month from: January- June
Course Name	Econometric Analysis		
Credits	03	**Contact Hours**	2-1-0

Faculty (Names)	Coordinator(s)	Manas Ranjan Behera
	Teacher(s) (Alphabetically)	Manas Ranjan Behera

COURSE OUTCOMES	COGNITIVE LEVELS
After pursuing the above mentioned course, the students will be able to:	
C304-2.1	*Demonstrate* the key concepts from basic statistics to understand the properties of a set of data.	Understanding Level –(C2)
C304-2.2	*Apply* Ordinary Least Square method to undertake econometric studies.	Apply Level – (C3)
C304-2.3	*Examine* whether the residuals from an OLS regression are well-behaved.	Analyze Level – (C4)
C304-2.4	*Evaluate* different model selection criteria for forecasting.	Evaluation Level – (C5)
C304-2.5	*Create* models for prediction from a given set of data.	Creation Level – (C6)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Statistical Inference	Point and interval estimation; ;The Z distribution ;The Null and Alternate hypotheses ;The chi-square distribution; The F distribution; The t distribution	3
2.	Regression Analysis	Two variable regression model; The concept of the PRF; Classical assumptions of regression; Derivation of the OLS estimators and their variance; Properties of OLS estimators under classical assumptions; Gauss-Markov Theorem; Tests of Hypothesis, confidence intervals for OLS estimators; Measures of goodness of fit: R square and its limitations; Adjusted R square and its limitations	7
3.	Econometric Model Specification	Identification: Structural and reduced form; Omitted Variables and Bias; Misspecification and Ramsay RESET; Specification test; Endogeneity and Bias	5
4.	Failure of Classical Assumptions	Multi-collinearity and its implications; Auto-correlation: Consequences and Durbin-Watson test ;Heteroskedasticity: Consequences and the Goldfeld -Quandt test	2
5.	Forecasting	Forecasting with a)moving averages b) linear trend c) exponential trend CAGR; Forecasting with linear regression; Classical time series decomposition; Measures of forecast performance: Mean square error and root mean square error; Limitations of econometric forecasts	5

6.	Time Series Analysis	Univariate Time Series Models: Lag Operator, ARMA , ARIMA models, Autoregressive Distributed Lag Relartionship	3
7.	Linear Programming	Linear programming; Dual of a linear programming problem; Simplex method Transportation	3
		Total number of Lectures	**28**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz+ Assignment+Viva -Voce)
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.	Gujarati, D.N. (2002), Basic Econometric (4th ed.), New York: McGraw Hill.
2.	Greene, W.H. (2003), Econometric Analysis, New Jersey: Prentice Hall.
3.	Madala, G.S. (1992), Introduction to Econometrics (2nd ed.), New York: Macmillan.

Course Code	18B12HS611	Semester :EVEN	Semester VI Session 2018 -2019
			Month from Jan 2019 to June 2019

Course Name	Marketing Management

Credits	3	Contact Hours	2-1-0

Faculty (Names)	Coordinator(s)	Dr Swati Sharma
	Teacher(s) (Alphabetically)	Dr. Swati Sharma

COURSE OUTCOMES		COGNITIVE LEVELS
After pursuing the above mentioned course, the students will be able to:		
C304-7.1	To illustrate the fundamentals of marketing, marketing environment and market research	Understanding Level (C2)
C304-7.2	To model the dynamics of marketing mix	Applying Level (C3)
C304-7.3	To demonstrate the implications of current trends in social media marketing and emerging marketing trends.	Understanding Level (C2)
C305-7.4	To appraise the importance of marketing ethics and social responsibility	Evaluating(C5)
C-305-7.5	To conduct environmental analysis, design business portfolios and develop marketing strategies for businesses to gain competitive advantage.	Creating (C6)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Understanding New Age Marketing	Defining Marketing For 21st Century The importance of marketing and marketing's role in business and society. Introduction to Digital Marketing. Online Communication Tools. The Social Media-Conversations, Community and Content. Affiliate Marketing and Mobile Engagement. The Digital Campaigns	5
2	Marketing Environment and Market Research and insights	Internal and external forces impacting marketers. Marketing and Customer Value. Gathering Information and Scanning the environment. Company's Micro and Macro Environment Responding to the Marketing Environment	3
3	Strategic Planning and the marketing Process	Explore the impact of social forces on marketing actions. Describe how technological change affects marketing. Designing the business Portfolio Discuss the Strategic Planning Process and Strategic	5

		Marketing Process.	
4	**Consumer and Business Buyer Behavior**	Consumer Markets and consumer buyer behaviour. The buying decision process. Business Markets and business buyer behaviour. Discuss the modern ethical standards.	5
5	**Branding**	Brand Image, Identity and Association. Product brands and Branding decisions. Product line and mix decisions. Consumer Brand Knowledge. New Product Development and Product life cycle strategies.	4
6	**Pricing products: Pricing considerations and strategies**	Factors to consider when setting prices. New product pricing strategies. Product mix pricing strategies. Price adjustments and changes.	4
7	**The New Age Social Marketing**	Ethics and social responsibility in marketing. Ethical behavior in business. Ethical decision making. Social forces affecting marketing. Impact of culture on marketing. Discuss modern ethical standards. Importance of marketing in CSR and business sustainability.	2
		Total number of Lectures	**28**

Evaluation Criteria

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

	Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Reference Books, Journals, Reports, Websites etc. in the IEEE format)
1.	Kotler, Philip and Gary Armstrong, Principles of Marketing, 17th Edition, New Delhi, Pearson Education, 2017.
2.	Kotler, Philip., and Kevin Lane Keller, Marketing Management, 15th Edition, New Delhi, Pearson Education, 2014.
3.	Grewal D., &Levy Michael, Marketing, 5th Edition, Mc graw Hill Education (India) Private Limited 2017.
4.	Winer, Russell S ., Marketing Management, 4th Edition, Prentice Hall,2014.

Detailed Syllabus
Lecture-wise Breakup

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Course Code	16B1NHS634	Semester: Even	Semester VI Session 2018 -2019
			Month from Jan 2019 to June2019

Course Name	**Theatre and Performance**		
Credits	**2**	**Contact Hours**	**1-0-2**

Faculty (Names)	**Coordinator(s)**	Dr Nilu Choudhary
	Teacher(s) (Alphabetically)	Dr Nilu Choudhary

CO Code	COURSE OUTCOMES	COGNITIVE LEVELS
C305-20.1	Demonstrate problem solving ability and effective life skills through theatre performances.	Understanding level(C2)
C305-20.2	Develop awareness of the role of these arts in human life	Understanding level(C2)
C305-20.3	Apply skills of listening, articulation, awareness and collaboration through the creation of performance.	Applying level(C3)
C305-20.4	Design and present an original performance alone or in collaboration with other artists.	Creating level(C6)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction of Theatre	History of theatre: role of theatre in human culture with special reference to India	2
2.	Characterization	Tips for developing character, thinking about thoughts, Flash –back, Performance	2
3.	Script Writing	Turning a story into a play , How to write a one Act , setting the scene ,character , stage direction , Dialogues	3
4.	School of Drama	Natya-Shastra, Stanislavsky and Brecht	3
5.	Text and its interpretation	Mother Courage ,Galileo , Aadhe Adhure (any one)	3
6.	Back-stage work	Management, planning, execution	1
		Total number of Lectures	**14**

Module No.	Title of the Module	List of Experiments/Activities	CO
1.	Moving in Space.	Students will be moving around the room, filling up the space, changing pace, changing direction, being aware of other people but not touching them. Find new ways of moving, with a different emphasis each time – smooth, jagged, slow, fast, heavy, light, high up, low down and so on. Every now and again Teacher will shout "Freeze! And Students need to freeze every muscle in your body. Absolutely NO LAUGH, LOOKING	C305-20.1

		AROUND, OR MOVING. You will be out.	
2.	Mirror Activity	A great way to get students aware of body movement and working together.	C305-20.1
3.	Characterization	Developing and analyzing characters to reveal the special qualities and personalities of the characters in a story, making character believable.	C305-20.2
4.	Script Writing	The more passionate you feel about your idea, the more attractive your play will be. Divide the idea into a beginning, middle and end.	C305-20.3
5.	Role Assignment	No acting or movement at this point – just sit together to speak and hear the script carefully. Discuss and clarify any confusing aspects of the script and any apparent challenges in bringing the script to the stage. Division of script into small "units" and rehearsed separately	C305-20.3
6.	Turning story into a play	Read thru each episode or unit separately "on its feet". Actors moving around the stage space. Set blocking for each episode. Use ideas generated from Mini-Episodes, and Staging with Images. Make sure the gestures, movements, and stage pictures tell the story clearly.	C305-20.3
7.	Stage blocking	Practice the blocking and the lines so that everyone knows what happens when and what their performance responsibilities are. Memorize lines. Work on making characters, relationships, and dialogue clear. This is a good place in which to use the Creating the Character lessons. Pay attention to vocal projection and articulation. Generate ideas about any technical elements you want to incorporate using the Transformation of Objects.	C305-20.3
8.	Script to performance	Finalize and run the entire play from beginning to end without stopping to check any additional rehearsal required to get everything running smoothly or not. Finally Perform!!	C305-20.4

Evaluation Criteria

Components	Maximum Marks
Mid Term	30
End Term	40
TA	30 (Presentation 1, Presentation 2 and 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.	Eric Bentley, ed., The Theory of the Modern Stage: An Introduction to Modern Theatre and Drama, Penguin Books, 1968
2.	Mark Fontier, Theory/ Theatre: An Introduction, New York: Routledge, 2002
3.	Michael Holt, Stage Design and Property, Oxford: Phaidon, 1986
4.	Michael Holt, Costume and Make-up, Oxford: Phaidon, 1988
5.	Natyashastra, tr. by Adya Rangacharya, New Delhi: Munshiram Manoharlal, 1996,

Detailed Syllabus

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Course Code	19B13HS611	**Semester**: Even	**Semester: VI Session**: 2018 -2019 **Month From** Jan 2019 to June 2019
Course Name	Morality of Everyday Living and Moral Decision Making		
Credits	2	**Contact Hours**	1-0-2

Faculty (Names)	Coordinator(s)	Ms Puneet Pannu, Dr Deepak Verma
	Teacher(s) (Alphabetically)	Ms Puneet Pannu, Dr Ekta Srivastava, Dr Praveen Sharma, Dr Deepak Verma

COURSE OUTCOMES		COGNITIVE LEVELS
C305-3.1	Apply and Analyze morality in all facets of personal and professional life	Analyze (C4)
C305-3.2	Discover ways to address moral dilemmas by deliberating on the pros and cons to find the best possible outcome	Analyze (C4)
C305-3.3	Justify and Formulate morally correct decisions and stand by them	Evaluate (C5)
C305-3.4	Adapt and develop a character respected by peers and superior alike	Create (C6)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	The Big Questions: Origins of Morality	What is **morality? Universal aspects** of morality, **Evolution** of Morality, **Development** of Morality**, Morality Theories, Everyday Dilemmas and Decision Making**	4
2.	Compassion/ Empathy	Reason/Emotion; Where does concern for others come from? Empathy—and is more empathy necessarily a good thing? And what can we learn from the study of those who seemingly lack normal moral feelings, such as violent psychopaths?	3
3.	Moral Differences	How does culture influence our moral thought and moral action? What role does religion play? Why are some of us conservative and others liberal, and how do political differences influence our sense of right and wrong?	2
4.	Moral Circles: Family, Friends, and Strangers	Moral feelings: Family, Friends, and allies. Reciprocal Altruism, The Morality of Group Preference, Morality of racial and ethnic bias. **:** Stereotypes, How Do We Treat Strangers	2
5.	Moral Decision Making	Contemporary Everyday Ethical Issues	3
		Total number of Lectures	**14**

Module No.	Title of the Module	List of Experiments/Activities	CO
1.	The Big Questions: Origins of Morality	Experiential Sharing: Morality & its significance to them Case Study: No such thing as free drink.	C305-3.1
2.	The Big Questions: Universal Aspects of Morality	Universal Aspects of Morality: Big Questions: Why be good? Universal Aspects of Morality: Big Questions: Is it permissible to lie? Universal Aspects of Morality: Big Questions: Is it good to gossip??	C305-3.1
3.	The Big Questions: Everyday Dilemmas and Decision Making	UPSC Case Study Ethical Dilemma of a Marketing Manager	C305-3.2 C305-3.3
4.	Evolution & Development of Morality	Ethical Analysis: A young Professor's Career	C305-3.1 C305-3.2 C305-3.3
5.	Compassion/ Empathy: Reason v/s Emotion	Discussion: Can we do better than the Golden Rule Discussion: Obligation to Others/ Is jealousy & Resentment always bad?	C305-3.1 C305-3.4
6	Compassion/ Empathy	EI Assessment Discussion on Reading: What's the matter with Empathy?	C305-3.1 C305-3.4
7	Moral Differences	Case Study: Difference in Morality Experiential Exercise: Country/ Org/ Home Moral Culture	C305-3.4
8	Moral Circles: Family, Friends, and Strangers	Experiential Sharing: Moral Circles and their influence on us Stereotyping in Morality	C305-3.4
9	Moral Decision Making	Contemporary Real World Scenario: Analyzing it through CATWOE	C305-3.1 C305-3.2 C305-3.3 C305-3.4

Evaluation Criteria

Components	Maximum Marks
Mid Term	30 (Project Presentation)
End Semester Examination	40 (End Term Written Paper)
TA	30 (Case Study Assessment, Assignment, Oral Questions)
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.	**Martin, Clancy** "Moral Decision Making: How to approach everyday Ethics", The Great Courses, USA, 2014
2.	**Shukla T., Yadav A.& Chauhan G.S**." Human Values & Professional Ethics", Cengage Learning India Pvt Ltd, 2018
3.	**Khanka S.S**. "Business Ethics & Corporate Governance (Principles & Practices)", S. Chand, 2014
4.	**Mruthyunjaya H.C**.," Business Ethics & Value systems", PHI Learning Pvt Ltd, 2013

Course Code	18B13HS612	Semester : Even	Semester VI Session 2018 -2019 Month from Jan 2019 to June 2019
Course Name	Effective tools for Career Management and Development		
Credits	2	Contact Hours	1-0-2

Faculty (Names)	Coordinator(s)	Dr Kanupriya Misra Bakhru
	Teacher(s) (Alphabetically)	Dr Kanupriya Misra Bakhru

COURSE OUTCOMES		COGNITIVE LEVELS
C305-2.1	Assess ones personal priorities, skills, interests, strengths, and values using a variety of contemporary assessment tools and reflection activities.	Evaluate Level (C 5)
C305-2.2	Apply knowledge of all the Career Stages in making informed career decisions.	Apply Level (C 3)
C305-2.3	Develop and maximize ones potential for achieving the desired career option.	Create Level (C6)
C305-2.4	Analyze the processes involved in securing and managing career by employees of different organizations.	Analyze Level (C 4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures and Tutorial for the module
1.	Introduction to Career Life cycle	Introduction to Career Life Cycle of an individual-Role and importance of human resource in an organization, Evolution of Strategic Human Resource Management.	3
2.	Self Branding and strategies to do well in Recruitment and Selection	Introduction to complete cycle of Recruitment and Selection, Introduction to various tools used for assessment and testing candidates-aptitude test, personality test, graphology test etc. Introduction to Workforce planning, Importance and practical application of Job Analysis, Job Description and Job Specification.	3
3.	Personnel Development and your career	Introduction to various learning and development, Introduction to various techniques used for learning and development, measure of training effectiveness, Training techniques / delivery, Kirkpatrick Model, Introduction to Succession Planning, Transactional Analysis.	3
4.	Human Resource Evaluation and Compensation	Performance Management: Measurement Approach, Developing Job Descriptions, Key Result Areas, Key Performance Indicators, Assessment Centre, 360 Degree feedback, Balanced Scorecard, Effective Performance Metrics. Compensation Strategy and trends- Compensation package, ESOPs, Performance based pay, Recognition, Retrial benefits, Reward management, Team rewards.	3
5.	Human Resource Control	Human Resources Audit, The Human Resource Information System (HRIS), Human Resources Accounting,	2

	and special topics	Competency Management, Human Resource Management Practices in India, Internationalization of Human Resource Management Commonly Used Jargons.	
		Total number of Lectures	**14**

Module No.	Title of the Module	List of Experiments/Activities	CO
1.	Introduction to Career Life cycle	**Practical Sessions on Resume and Cover Letter Writing**	C305-2.1, C30 2.2
2.	Self Branding and strategies to do well in Recruitment and Selection	Practical Sessions on Job Description, Job Specification and Self-Branding	C305-2.3, CO
3.	Personnel Development and your career	Practical Sessions on Johari Window-Knowing Thyself, Transaction Analysis-Parent, Child, Adult Ego State for effective interpersonal communication.	C305-2.1, C30 2.3
4.	Human Resource Evaluation and Compensation	Practical Sessions on HR Interview and Mock HR Interview	C305-2.2, C30 2.4
5.	Human Resource Control and special topics	Practical Sessions on Group Discussions and Mock Group Discussions	C305-2.2, C30 2.4

Evaluation Criteria
Components	Maximum Marks
Mid Term	30 (Project)
End Term	40 (Written)
TA	30 (Class Mock Activities, Assignment, 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.	Pande and Basak, Human Resource Management- Text and Cases, Pearson, 2012
2.	Dessler and Varkkey, Human Resource Management, Pearson, 2011
3.	VSP Rao, Human Resource Management, Excel Books, 2007
4.	Aswathappa, Human Resource Management, McGraw-Hill, 2010
5.	Gary Dessler, Human Resource Management, Pearson/Prentice Hall, 2005

Course Code	16B19HS692	Semester: EVEN	Semester VI Session 2018-19
			Month from Jan 2019 to June 2019

Course Name	Psychological Testing		
Credits	2	Contact Hours	1-0-2

Faculty (Names)	Coordinator(s)	Dr. Ruchi Gautam
	Teacher(s) (Alphabetically)	Dr. Ruchi Gautam

CO Code	COURSE OUTCOMES	COGNITIVE LEVELS
C305-19.1	Explain the various concepts of psychological testing.	Understanding Level (C2)
C305-19.2	Apply concepts from psychological testing to researches and real life scenarios.	Apply Level (C3)
C305-19.3	Analyze the different psychological tests.	Analyze Level (C4)
C305-19.4	Evaluate the psychological testing procedures.	Evaluate Level (C5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction to Psychological Testing	Psychological Testing: History and Overview	1
2.	Nature of Psychological Tests	Timeline; Types of Tests: Intelligence Tests, Aptitude Tests, Achievement Tests, Creativity Tests, Personality Tests, Interest inventories, and Behavioral procedures; Uses of tests.	2
3.	Types of Scales	Concept and Different types of scales: Nominal, Ordinal, Interval, and Ratio.	2
4.	Item Writing	Test Construction; Principles of Item Writing; Factor Analysis	2
5.	Item Analysis	Concept, Procedure, Factor Analysis, Discrimination Index, Difficulty Value, Criteria for Selection & Rejection Items.	2
6.	Interpretation of Scores	Standardized procedure; Scores or categories; Norms or standards; and Prediction of non-test behavior	1
7.	Reliability	Meaning, Types: Test-Retest Reliability, Parallel-Forms Reliability, and Internal Consistency Reliability.	2
8.	Validity	Concept, Types: Face validity, Content validity, Construct validity, and Criterion validity.	2
Total number of Lectures			14

Module No.	Title of the Module	List of Experiments/Activities	CO
1.	Item Writing Item Analysis Interpretation of Scores Reliability Validity	Personality Big Five Inventory / Personality Assessment Inventory	C305-19.2 C305-19.3 C305-19.4
2.	Item Writing Item Analysis Interpretation of Scores Reliability Validity	Cognitive Emotion Regulation Questionnaire/ Indian Adaptation of the Multidimensional Aptitude Battery - MAB - II	C305-19.2 C305-19.3 C305-19.4
3.	Item Writing Item Analysis Interpretation of Scores Reliability Validity	Cognitive Failures Scale/ Test of Memory and Learning - Second Ed. (TOMAL-2)	C305-19.2 C305-19.3 C305-19.4
4.	Item Writing Item Analysis Interpretation of Scores Reliability Validity	Five Facet Mindfulness Questionnaire (FFMQ)	C305-19.2 C305-19.3 C305-19.4
5.	Item Writing Item Analysis Interpretation of Scores Reliability Validity	Resilience Scale/ Social Skills Inventory	C305-19.2 C305-19.3 C305-19.4
6.	Item Writing Item Analysis Interpretation of Scores Reliability Validity	Hamilton Depression Rating Scale (HDRS)/ Children's Academic Intrinsic Motivation Inventory	C305-19.2 C305-19.3 C305-19.4
7.	Item Writing Item Analysis Interpretation of Scores Reliability Validity	The Warwick–Edinburgh Mental Well-being Scale (WEMWBS)/ Emotions & Expressions/ Problem Solving Picture Cards	C305-19.2 C305-19.3 C305-19.4

Evaluation Criteria

Components	Maximum Marks
Mid Sem	30
End Semester Examination	40
TA	30 (Lab Assignment and Research 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.	Ronald Jay Cohen & Mark E. Swerdlik, Psychological Testing and Assessment 9th Edition, McGraw-Hill Education, 2017.
2.	Anne Anastasi & Susana Urbina, Psychological Testing, 7th Ed., Pearson Education, 2012.
3.	Frank S. Freeman, Theory and Practice of Psychological Testing, 3rd Ed., Oxford & IBH Publishing, 2010.
4.	Robert J. Gregory, Psychological Testing: History, Principles and Applications, 1st Ed., Pearson Publishing, 2006.

Detailed Syllabus

Subject Code	18B12MA612		Semester Even		Semester VI Session 2018-2019
					Month from Jan2019 to June 2019
Subject Name	Applied Mathematical Methods				
Credits	4			**Contact Hours**	3-1-0
Faculty (Names)	**Coordinator(s)**		Dr. Puneet Rana		
	Teacher(s) (Alphabetically)		Dr. Puneet Rana, Dr. Neha Ahlawat		

COURSE OUTCOMES		
After pursuing the above mentioned course, the students will be able to:		**COGNITIVE LEVELS**
C302-4.1	explain the functional and its variations required to optimize the physical problem.	Understanding Level (C2)
C302-4.2	apply different forms of Euler–Lagrange equation on the various variational problems with fixed boundaries.	Applying Level (C3)
C302-4.3	explain different types of integral equations including their conversions from IVP and BVP.	Understanding Level (C2)
C302-4.4	solve Volterra and Fredholm integral equations using various analytical methods.	Applying Level (C3)
C302-4.5	explain various numerical methods along with their stability analysis.	Understanding Level (C2)
C302-4.6	apply different numerical methods for solving differential equations.	Applying Level (C3)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Functional and its Variation	Introduction, problem of brachistochrone, problem of geodesics, isoperimetric problem, variation and its properties, comparison between the notion of extrema of a function and a functional.	8
2.	Variational Problems with Fixed Boundaries	Euler's equation, the fundamental lemma of the calculus of variations, examples, functionals in the form of integrals, special cases contaning only some of the variables, examples, functionals involving more than one dependent variables and their first derivatives, the system of Euler's equations,	5
3.	Variational Problems (continued)	Functionals depending on the higher derivatives of the dependent variables, Euler- Poisson equation, functionals containing several independent variables, Ostrogradsky equation, Variational problems in parametric form, applications to differential equations.	5
4.	Fredholm and Volterra Integral Equations	Introduction and basic examples, Classification, Conversion of Volterra Equation to ODE, Conversion of IVP and BVP to integral equation, decomposition, direct computation, successive approximation, successive substitution methods for Fredholm and Volterra integral equations.	8
5.	Numerical Methods	Finite difference method, derivation from Taylor's polynomial, Accuracy and order, explicit method, implicit method, Crank–Nicolson method and applications,	8
6.	FEM and its comparison	Galerkin finite element method for one dimensional problems, various type of elements and their shape	8

		functions, stiffness matrix, assembly of equations, handling of the boundary conditions, triangular and rectangular elements, stiffness matrices and assembly. Comparison of FEM and FDM.	
Total number of Lectures			**42**

Evaluation Criteria	
Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz , Assignments, Tutorials)
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.	**Hilderbrand, F.B.,** Methods of Applied Mathematics, 2ndEdition, Prentice Hall, 1969.
2.	**Gupta, A.S.,** Calculus of Variations with Applications, Prentice Hall of India, 1997.
3.	**Gelfand, I.M.,** Fomin, S.V. Calculus of Variations, Prentice Hall, 1963.
4.	**Elsgolts, L.,** Differential Equations and the Calculus of Variations, Mir Publishers, Moscow, 1973.
5.	**Petrovsky, I.G.,** Lectures on the Theory of Integral Equations, Mir Publishers, Moscow, 1971.
6.	**Zienkiewicz, O.C., Morgan, K.,** Finite Elements and Approximation, John Wiley, 1983.
7.	**Smith, G. D.**., Numerical solution of partial differential equations: finite difference methods. Oxford University Press, 1985

Lecture-wise Breakup

Course Code	16B1NMA631		Semester Even (specify Odd/Even)		Semester VI Session 2018 -2019 Month from Jan 2019-June2019
Course Name	Computational Continuum Mechanics				
Credits	4		**Contact Hours**	3-1-0	
Faculty (Names)	**Coordinator(s)**	Prof. Sanjeev Sharma			
	Teacher(s) (Alphabetically)	Prof. Sanjeev Sharma			

COURSE OUTCOMES		COGNITIVE LEVELS
After pursuing the above mentioned course, the students will be able to:		
C302-2.1	explain the concept of existence and uniqueness theorem of initial value problems and their solutions.	Understanding Level (C2)
C302-2.2	apply matrix algebra to find the solution of system of differential equations.	Applying Level (C3)
C302-2.3	explain Sturm-Liouville boundary value problems, orthogonality of functions and Fourier series.	Understanding Level (C2)
C302-2.4	identify the phase plane, critical points and paths of nonlinear systems.	Applying Level (C3)
C302-2.5	explain the basic mechanics of materials in two and three dimensional system.	Understanding Level (C2)
C302-2.6	solve and examine the physical problems using differential equations.	Analyzing Level (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Existence and Uniqueness Theorem	The fundamental existence and uniqueness theorem, dependence of solutions on initial conditions and on the functions.	8
2.	Sturm-Liouville Boundary Value Problem	Sturm-Liouville problems, orthogonality of characteristic functions, the expansion of a function in a series of orthogonal functions, trigonometric Fourier series.	12
3.	Matrix Methods to solve ODE's	Matrix Method for Homogeneous Linear systems with Constant Coefficients.	4
4.	Theory of Nonlinear Differential Equations	Phase Plane, Paths and Critical Points and Paths of Nonlinear Systems.	4
5.	Basic Theory of Continuum Mechanics	Stress, Strain, Differential Equation of Equilibrium in a general three-dimensional stress system, Principal Stresses and Strains, Generalized Hook's Law, Mechanical Properties of Different Materials. Applications.	6
6.	Plane Thermoelastic Problems	Plane Strain, Plane Stress, Stress Function, Complex Variable Method, Potential Method, Finite Difference Method.	8
Total number of Lectures			**42**

Evaluation Criteria

Components	Maximum Marks	
T1	**20**	
T2	**20**	
End Semester Examination	**35**	
TA	**25**	(Quiz , Assignments, Tutorials)
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.	**Noda, N., Hetnarski, R.B., Tanigawa, Y.,** Thermal Stresses, 2nd Ed., Taylor & Francis, New York, 2003.
2.	**Ross, S.L.,** Differential Equations, 3rd Ed., John Wiley & Sons, 2004.
3.	**Chandramouli, P.N.,** Continuum Mechanics, Yes Dee Publishing India, 2014.
4.	**Hearn, E.J.,** Mechanics of Materials, Vol. 1 & 2, 3rd Ed., Elsevier, 2008.
5.	**Gupta, R.S.,** Elements of Numerical Analysis, by 1st Ed., Macmillan, 2009.

Course Code	19M12MA611	Semester - Even (specify Odd/Even)	Semester VI Session 2018 -2019 Month from January 2019 to June 2019
Course Name	Mathematical Foundations of Geographic Information System		
Credits	4	Contact Hours	3-1-0

Faculty (Names)	Coordinator(s)	Dr. Lakhveer Kaur
	Teacher(s) (Alphabetically)	Dr. Lakhveer Kaur

COURSE OUTCOMES		COGNITIVE LEVELS
After pursuing the above mentioned course, the students will be able to:		
C302-5.1	Understand the concept of Trigonometry, Coordinate systems and Geometric Transformations and then its applications for Geographic information system.	Applying Level (C3)
C302-5.2	Identify basic set operations and database technology based on predicates, quantifiers and predicate Logic.	Understanding Level (C2)
C302-5.3	Describe Geo-statistical methods, used for Geographic information system.	Understanding Level (C2)
C302-5.4	Explain quantitative aspects for image analysis by using analytic and numerical methods.	Analyzing Level (C4)
C302-5.5	Understand the concepts of space and time in spatial information systems and spatiotemporal data models.	Evaluating Level (C5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Trigonometry	Trigonometric functions, allied angles, compound angles.	4
2.	Coordinate Systems	Cartesian rectangular coordinate system, distance formula, section formula, Straight lines, slopes, types of straight lines, Application in solving life science problems.	4
3.	Geometric Transformations	Geometric Transformations and its applications for Geographic information system	2
4.	Set Theory	Review of Set Theory, Overlay operations in Geoinformatics	3
5.	Propositional and Predicate Logic	Relational database technology based on Predicates, Quantifiers and Predicate Logic.	5
6.	Geo-statistical methods	Principle of Least Squares, Fitting of straight line and parabola, Correlation - Karl Pearson's coefficient of correlation and Spearmann's rank correlation	6
7.	Regression and ANOVA	Linear regression, One way and two way classification of ANOVA.	6
8	Image analysis and Map Algebra	Quantitative aspects in decision making for image analysis, Tools available for image analysis –analytical and numerical-Fourier series, Fourier Transforms, Map Algebra.	6
9	Spatial Modeling and Database Design	Spatial Data and Information, Concepts of Space and Time in Spatial Information Systems, Database Design, Spatial Data Models, Spatio-temporal Data Models.	6
Total number of Lectures			**42**
Evaluation Criteria			

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz , Assignments, Tutorials)
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.	**Edward, B.**, Introduction to Mathematics for life scientist – Springer, 1979.
2.	**Burrough, P. A. and McDonnell R. A.,** Principles of Geographical Information Systems. Oxford University Press, 1998.
3.	**Leung, Y.**, Intelligent Spatial Decision Support Systems. Springer-Verlag, Berlin, Heidelberg, 1997.
4.	**Mackenzie, A.**, Mathematics and Statistics for Life Scientists, Taylor & Francis, New York, 2005.
5	**Leung, Y.**, Intelligent Spatial Decision Support Systems. Springer-Verlag, Berlin, Heidelberg, 1997.
6.	**Gupta, S. C. and Kapoor, V. K.**, Fundamentals of Applied statistics, Sultan Chand and sons, 2003.

Course Code	19M12MA612	Semester Even (specify Odd/Even)	Semester VI Session 2018 -2019 Month from Jan – June 2019		
Course Name	Mathematical Modeling with Emphasis on Epidemics and Social Aspects				
Credits	4		Contact Hours		3-1-0

Faculty (Names)	Coordinator(s)	Dr. Pankaj Kumar Srivastava
	Teacher(s) (Alphabetically)	Dr. Pankaj Kumar Srivastava

COURSE OUTCOMES		COGNITIVE LEVELS
After pursuing the above mentioned course, the students will be able to:		
C302-6.1	explain the basic concepts of differential equations, eigen values, eigen vectors and stability theory.	Understanding Level (C2)
C302-6.2	develop mathematical models through differential equations.	Applying Level (C3)
C302-6.3	explain linear and nonlinear population models.	Understanding Level (C2)
C302-6.4	analyze models of epidemic nature.	Analyzing Level (C4)
C302-6.5	analyze modeling on social aspects.	Analyzing Level (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Basic concepts of differential equations and eigen vectors	Basics of differential equations, formation of differential equations, separable, linear and exact differential equations, reducible to these forms, eigen values and eigen vectors, system of differential equations, stability theory and bifurcation	9
2.	Mathematical models through differential equations	Problem definition and formation of mathematical models, principles of mathematical modeling, mechanical applications of differential equations, models through system of differential equations	12
3.	Mathematical linear and nonlinear population models	Types of linear and nonlinear population models, prey-predator model, harvesting models, fishery models	5
4.	Various mathematical models of Epidemics	Susceptible-Infective-Recovered (SIR) type models, Viral infection models, HIV model	8
5.	Various mathematical models in Social Aspects	Traffic flow model, medicine, arms race battles models, international trades models, Pitfalls in modeling	8
		Total number of Lectures	42

Evaluation Criteria

Components	Maximum Marks

T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz , Assignments, Tutorials)
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. D. Raisinghania,** *Ordinary and Partial Differential Equations*, 19th edition, S. Chand Publishing, 2017.	
2.	**J. N. Kapur,** *Mathematical Modeling*, New Age International press, 2000.	
3.	**D. N. Murthy, N. W. Page, E. Y. Rodin**, *Mathematical Modelling: a tool for problem solving in engineering, physical, biological, and social sciences*, Pergamon Press, 1990.	
4.	**C. L. Dym,** *Principles of Mathematical Modelling*, Elsevier Press, Second Edition, 2004.	
5.	**E. A. Bender,** *An Introduction to Mathematical Modeling*, Dover, 2000.	
6.	**W. E. Boyce and R. C. Diprima**, *Elementary Differential Equations and Boundary Value Problems*, 7th Edition, Wiley, 2001.	

Course Code	18B12MA611	Semester Even		Semester VI Session 2018 -2019 Month from Jan 2019 - June 2019		
Course Name	Operations Research					
Credits	4			**Contact Hours**	3-1-0	
Faculty (Names)	**Coordinator(s)**	Dr. Pato Kumari				
	Teacher(s) (Alphabetically)	Prof. A. K. Aggarwal Dr. Amita Bhagat				

COURSE OUTCOMES		**COGNITIVE LEVELS**
After pursuing the above mentioned course, the students will be able to:		
C302-3.1	construct mathematical models for optimization problems and solve linear programming problems (LPP) using graphical and simplex method.	Applying Level (C3)
C302-3.2	apply two-phase, Big-M and dual simplex method for linear programming problems.	Applying Level (C3)
C302-3.3	make use of sensitivity analysis to linear programming problems.	Applying Level (C3)
C302-3.4	solve transportation, assignment and travelling salesman problems.	Applying Level (C3)
C302-3.5	apply cutting plane and branch & bound techniques to integer programming problems.	Applying Level (C3)
C302-3.6	examine optimality conditions and solve multivariable nonlinear problems.	Analyzing Level (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Preliminaries	Introduction, Operations Research Models, Phases and Scope of O.R. Studies.	3
2.	Linear Programming Problems (LPP)	Convex Sets, Formulation of LPP, Graphical Solutions, Simplex Method, Big-M Method, Two Phase Method, Special Cases in Simplex Method.	8
3.	Duality and Sensitivity Analysis	Primal-Dual Relationship, Duality, Dual Simplex Method, Sensitivity Analysis.	8
4.	Transportation Problems	Introduction, Matrix Form, Applications, Basic Feasible Solution- North West Corner Rule, Least Cost Method, Vogel's Approximation Method. Degeneracy, Resolution on Degeneracy, Optimal Solution, Maximization TP Model.	5
5.	Assignment Problems	Definition, Hungarian Method, Traveling Salesmen Problems.	4
6.	Integer Linear Programming Problems	Pure and Mixed Integer Linear Programming Problems, Cutting Plane Method, Branch and Bound Method.	6
7.	Non Linear Programming	Introduction to NLP, convex functions and graphical solution, Unconstrained Problem, Constrained Problems - Lagrange Method for equality constraints, Kuhn-Tucker Conditions for inequality constraints, Quadratic Programming -Wolfe's Method	8
Total number of Lectures			**42**
Evaluation Criteria			

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz , Assignments, Tutorials)
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.	Taha, H. A. - Operations Research - An Introduction, Pearson Education, 2005.
2.	Hadley, G. - Linear Programming, Massachusetts: Addison-Wesley, 1962.
3.	Hiller, F.S. and Lieberman, G. J. - Introduction to Operations Research, San Francisco, 1995.
4.	Wagner, H. M. - Principles of Operations Research with Applications to Managerial Decision, PHI, 1975.
5.	Vohra, N. D., Quantitative Techniques in Management, Second Edition, TMH, 2003.
6.	Taha, H. A. - Operations Research - An Introduction, Pearson Education, 2005.

Course Code	16B1NMA633		Semester : Even	Semester VI Session 2018 -2019 Month from Jan 2019 to June 2019	
Course Name	Statistics				
Credits	4			Contact Hours	3-1-0
Faculty (Names)	Coordinator(s)		Dr. Himanshu Agarwal		
	Teacher(s) (Alphabetically)		Dr. Anuj Bhardwaj, Dr. Himanshu Agarwal, Dr. Pinkey Chauhan		

COURSE OUTCOMES		COGNITIVE LEVELS
After pursuing the above mentioned course, the students will be able to:		
C302-1.1	make use of measures of central tendency, dispersion, skewness and, kurtosis for description and visualization of population data.	Applying Level (C3)
C302-1.2	apply correlation and regression in statistical analysis of data.	Applying Level (C3)
C302-1.3	explain sampling theory and its distributions.	Understanding Level (C2)
C302-1.4	explain the concepts and properties of estimation theory.	Understanding Level (C2)
C302-1.5	apply sampling and estimation theory to find the confidence interval.	Applying Level (C3)
C302-1.6	analyze small and large sample data by using the test of hypothesis.	Analyzing Level (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Descriptive Statistics	Graphical representation such as histogram, frequency polygon, AM, GM, HM, median, mode, measures of dispersion, skewness and kurtosis such as central and non-central moments, population variance, β, γ coefficient, Box and Whisker plot.	8
2.	Correlation and Regression Analysis	Scatter diagram. Karl Pearson's and Spearman's rank correlation coefficient, regression lines, regression coefficient and their properties.	5
3.	Sampling and Sampling Distributions	Populations and Sample, random sample, statistics, sample moments, law of large numbers, central limit theorem, distribution of sample mean and sample variance, MGF, Chi-square distribution, F-distribution, Student's t distribution.	7
4.	Parametric Point Estimation	General concept of point estimation, methods of moments and maximum likelihood for finding estimators, unbiasedness, consistency, efficiency, UMVUE, Cramer-Rao inequality, sufficiency, factorization theorem, completeness, Rao-Blackwell theorem.	10
5.	Parametric Interval Estimation	definition of confidence interval, pivotal quantity, confidence interval for mean, variance, difference of means and difference of variances for small and large samples.	5
6.	Hypothesis Testing	The basic idea of significance test. null and alternative hypothesis, type-I and type II errors, testing of small and large samples for mean,	7

		variance, difference in means, and difference in variances.	
Total number of Lectures			**42**

Evaluation Criteria	
Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz, Assignments, Tutprials)
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.	**Biswas and Srivastava** , A Textbook, Mathematical Statistics Ist Edition, Narosa Publishing House, New Delhi.
2.	**W. Feller**, Introduction to Probability Theory and its Applications Vol. I and II. Wiley Eastern-Ltd, 1971
3.	**V. K.Rohatgi**, An Introduction to Probability Theory and Mathematical Statistics Wiley Eastern, 1984
4.	**R. V. Hogg, A. T. Craig,** Introduction to Mathematical Statistics, McMillan, 1971
5	**AM. Mood**, **F. A. Graybill, and D. C. Boes**, Introduction to the Theory of Statistics McGraw Hill, 1974
6.	**Des Raj & Chandak**, Sampling Theory, Narosa Publishing House, 1998.
7.	**Sheldon Ross**, A First Course in Probability, 6th edition, Pearson Education Asia, 2002.
8.	**Meyer, P.L**, Introductory Probability and Statistical Applications Addison-Wesley Publishing Company, 1965.

Course Code	16B1NPH632	Semester EVEN	Semester VI Session 2018 -2019 Month from January to June

Course Name	SOLID STATE ELECTRONIC DEVICES

Credits	4	Contact Hours	4

Faculty (Names)	Coordinator(s)	Dr. Dinesh Tripathi & Dr. Sandeep Chhoker
	Teacher(s) (Alphabetically)	Dr. Dinesh Tripathi & Dr. Sandeep Chhoker

COURSE OUTCOMES		COGNITIVE LEVELS
C302-7.1	Define terminology and concepts of semiconductors with solid state electronic devices.	Remembering (C1)
C302-7.2	Explain various electronic, optical and thermal properties of semiconductors; various techniques used in device fabrication.	Understanding (C2)
C302-7.3	Solve numerical problems based on solid state electronic devices.	Applying (C3)
C302-7.4	Examine the impact of various parameters on semiconductor devices and their performances.	Analyzing (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Energy band and charges carriers in conductors	Bonding forces and energy bands in solids, charge carriers in semiconductors, carries concentrations, drift of carriers in electric and magnetic fields, Invariance of the Fermi level at equilibrium, optical absorption, Luminescence, Carrier lifetime and photoconductivity, diffusion of carriers	12
2.	Junctions	Fabrication of p-n junctions, equilibrium conditions, steady state conditions, reverse bias breakdown, recombination and generation in the transition region, metal semiconductor junctions, heterojunctions,	10
3.	Transistors	Field effect transistor (FET), Metal-insulator FET, Metal-insulator-semiconductor FET, MOS FET, Bipolar junction transistors	08
4.	Devices	Photodiodes, solar cell, light emitting diodes, semiconductor lasers, Negative conductance Microwave devices: Tunnel diode, IMPATT diode, Gunn diode	10
		Total number of Lectures	40

Evaluation Criteria

Components   Maximum Marks
T1   20
T2   20
End Semester Examination   35
TA   25 [2 Quiz (10), Attend. (10) and Class performance (5)]
Total   **100**

Recommended Reading material:	
1.	Donald A Neamen & Dhrubes Biswas, Semiconductor Physics and Devices, McGraw Hill Education

2.	S. M. Sze, Physics of Semiconductor devices, Wiley-Interscience
3.	Streetman and Banerjee, Solid State Electronic devices, PHI
4.	Umesh Mishra and Jasprit Singh, Semiconductor Device Physics and Design,

Detailed Syllabus
Lecture-wise Breakup

Course Code	16B1NPH633	Semester :Even	Semester VI Session 2018 -2019
			Month: January to June

Course Name	Photovoltaic Techniques

Credits	4	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Dr. B. C. Joshi and Dr. Prashant Chauhan
	Teacher(s)	Dr. B. C. Joshi and Dr. Prashant Chauhan

COURSE OUTCOMES		COGNITIVE LEVELS
C302-8.1	Classify various type of renewable energy sources and explain working of photovoltaic device.	Remembering (C1)
C302-8.2	Demonstrate the use of basic principles to model photovoltaic devices	Understanding (C2)
C302-8.3	Identify challenges and apply strategies to optimize performance of various type of solar cells	Applying (C3)
C302-8.4	Analyze Solar PV module, mismatch parameter and rating of PV module	Analyzing (C4)
C302-8.5	Evaluate the performance of various stand-alone PV systems with battery and AC and DC load	Evaluating (C5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Review	Energy issues, conventional energy sources, Renewable energy sources, Solar Energy	02
2.	Solar cell fundamentals	Fundamental of semiconductor, charge carriers and their motion in semiconductors, carriers generation and recombination, p-n junction diode, introduction to solar cell, p-n junction under illumination, Current-Voltage (I-V), open circuit voltage (V_{OC}), short circuit current (I_{SC}) Maximum power, current and voltage and Efficiency, Quantum Efficiency	10
3.	Design of solar cells	Upper limits of cell parameters, loses in solar cell, solar cell design, design for high I_{sc}, V_{oc}, FF, solar simulators	08
4.	Solar cell technologies	Production of Si, Si wafer based solar cell technology, thin film solar cell technologies (CIGS, microcrystalline and polycrystalline Si solar cells, amorphous Si thin film solar cells), multijunction solar cells, Emerging solar cell technologies: organics solar cells, Dye-sensitized solar cell (DSC), GaAs solar cell	12
5.	Photovoltaic system	PV system : Introduction, Stand alone system, Grid connected system, Hybrid system, Designing of PV system, Balance of system- BOS (Inverters, Controllers, Wiring, Batteries) Photovoltaic Cells, Estimating PV system size and cost, Photovoltaic safety.	08
		Total number of Lectures	**40**

Evaluation Criteria

Components   **Maximum Marks**

T1	20
T2	20
End Semester Examination	35
TA	25 [2 Quiz (10 M), Attendance (10 M) and Cass performance (5 M)]
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.	Tom Markvart and Luis Castaner, "Solar Cells: Materials, Manufacture and Operations," Elsevier, 2006
2.	Stuart R. Wenhem, Martin A. Green, M.E. Watt, "Applied Photovoltaics," Earthscan, 2007
3.	Jenny Nelson, "The Physics of Solar Cells" Imperial college press," 003.Aatec publications, 1995.
4.	C S Solanki, Solar Photovoltaics, PHI

Course Code	16B1NPH634	Semester: Even	Semester VI Session 2018 -2019
			Month: from January to June

Course Name	Applied Statistical Mechanics

Credits	4	Contact Hours	4

Faculty (Names)	Coordinator(s)	Dr. Navendu Goswami
	Teacher(s) (Alphabetically)	Dr. Navendu Goswami

COURSE OUTCOMES		COGNITIVE LEVELS
C302-9.1	Define the fundamental parameters of Thermodynamics and Statistical Mechanics.	Remembering (C1)
C302-9.2	Explain the Thermodynamic potentials, Maxwell's equations and Heat equations.	Understanding (C2)
C302-9.3	Apply the concepts of thermodynamics and statistical ensembles to understand the phase space and distribution functions.	Applying (C3)
C302-9.4	Determine the distribution functions in case of various types of physical and chemical ensembles.	Evaluating (C5)
C302-9.5	Evaluate the ideas of Entropy with respect to Probability and Information Theory; and conclude Liouville's equation.	Evaluating (C5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Basic Thermodynamics	Overview of basic laws of Thermodynamics; Microscopic and macroscopic parameters, Thermodynamic potentials; Introduction to equilibrium and non-equilibrium systems and related problems; Entropy and probability;	3
2.	Statistical Ensembles	Concept of Statistical ensembles, Density of States; Micro canonical, Canonical, Grand-canonical emsembles	5
3.	Distribution functions	Maxwell-Boltzmann, Bose-Einstein, Fermi-Dirac and their applications	6
4.	Non-equilibrium systems	Liouville's equation, von Neumann equation; Random walk, Stochastic methods;	6
5.	Modeling and Simulations	Ising model and its applications, Molecular dynamics, Monte-Carlo simulations and Multi-scale modeling for materials properties and engineering applications.	15
6.	Applications	Applications of ensemble formalism in dynamics of neural networks, ensemble forecasting of weather, propagation of uncertainty over time, regression analysis of gravitational orbits etc.,	5
		Total number of Lectures	40

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 [2 Quiz (10 M), Attendance (10 M) and Cass performance (5 M)]

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.	Frederick Reif , *Fundamentals of Statistical and Thermal Physics*, Waveland Pr Inc, 2008.
2.	Kerson Huang , *Statistical Mechanics*, Wiley, 2nd Ed., 1987.
3.	R K Pathria, Paul D. Beale, *Statistical Mechanics*, Academic Press, 3rd Ed., 2011.
4.	Daniel V. Schroeder, *An Introduction to Thermal Physics*, Addison-Wesley, 1st Ed., 1999
5.	L D Landau, *Statistical Physics, Part 1: Volume 5 (Course of Theoretical Physics)*, Butterworth-Heinemann, 3rd Ed., 1980

Course Code	16B1NPH635	Semester Even	Semester VI Session 2018 -2019
			Month from January to June

Course Name	Analytical Techniques for Materials		
Credits	4	Contact Hours	4

Faculty (Names)	Coordinator(s)	Dr. Himanshu Pandey
	Teacher(s) (Alphabetically)	Dr. Himanshu Pandey

COURSE OUTCOMES		COGNITIVE LEVELS
C302-10.1	Recall preliminary concepts of various characterization techniques for the structure-property relationship of materials.	Remembering (C1)
C302-10.2	Outline different sophisticated characterization tools and explain basic knowledge about working principle.	Understanding (C2)
C302-10.3	Identify characterization tool as per the necessity of measurement or analysis and solve related problems based on concepts used in various techniques.	Applying (C3)
C302-10.4	Examine material's properties and analyze the results in context of specific techniques.	Analyzing (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Structural analysis by X-rays	X-rays and their properties, Production and detection of X-rays, Safety precautions; X-ray interaction with matter, Crystal structure, Different types of lattices, X-ray Diffraction, Bragg's Law; X-ray spectroscopy, diffraction methods, Scherrer formula, grain size, particle size, crystal perfection; Determination of crystal structure (detailed analysis only for cubic structures), X-ray reflectivity	10
2.	Microstructural analysis	Scanning electron microscopy, practical aspect of the technique, Composition analysis by EDX; Transmission electron microscopy and its analysis, sample preparation	08
3.	Molecular spectroscopy	Regions of spectrum, Spectroscopy (Microwave and Infrared), Fourier transform IR, Raman spectroscopy	08
4.	Electronic spectroscopies of surfaces	Photoelectron spectroscopy (X-ray, Ultra-violet), peak shifts, information about chemical state and elemental compositions	05
5.	Surface Morphology by scanning probe microscopy	Atomic force microscopy (contact & non-contact mode), wide areas of applications, AFM basics, Magnetic force microscopy	05
6.	Thermal analysis	Nomenclature, Thermo gravimetric analysis, Differential thermal analysis, Differential scanning calorimetry	04
		Total number of Lectures	**40**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 [2 Quiz (10 M), Attendance (10 M) and Cass performance (5 M)]
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.	B. D. Cullity,*Elements of X- ray Diffraction*, Addison-Wesley Publishing Company, Inc.
2.	C. Kittel, *Introduction to Solid State Physics,* Wiley-India.
3.	Colin N. Banwell&Elaine M. McCas, *Fundamentals of Molecular Spectroscopy*, Tata McGraw-Hill.
4.	Elton N. Kaufmann, *Characterization of Materials (Vol.1)*, John Wiley & Sons.
5.	Williams, David B., Carter, C. Barry, *Introduction to Transmission electron microscopy*, Springer.

Course Code	16B1NPH636	Semester: Even	Semester: VI Session 2018 -2019
			Month from: January to June

Course Name	**Medical & Industrial Applications of Nuclear Radiation**

Credits	4	Contact Hours	4

Faculty (Names)	**Coordinator(s)**	Dr Papia Chowdhury
	Teacher(s) (Alphabetically)	Dr Papia Chowdhury & Dr Manoj Tripathi

COURSE OUTCOMES		COGNITIVE LEVELS
C302-11.1	Define nuclear structure, properties and reactions; Nuclear magnetic resonance process.	Remembering (C1)
C302-11.2	Explain models of different nuclear imaging techniques; CNO cycle; principle of radioactive decays.	Understanding (C2)
C302-11.3	Apply knowledge of nuclear reaction mechanisms in atomic devices, dosimetry, radiotracers, medical imaging, SPECT, PET, tomography etc.	Applying (C3)
C302-11.4	Analyze different radiocarbon dating mechanisms and processes.	Analyzing (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Nucleus, Radioactivity & Dating	Structure of matter**;** Nucleus: Nuclear Size, Structure and forces; Binding energy and Nuclear stability, mass defect; Nuclear reaction: Fission, Fusion, chain reaction. Nuclear fusion in stars, Formation of basic elements: proton-proton chain, CNO cycle, Hydrostatic equilibrium; Applications: atom bomb, hydrogen bomb, nuclear power plants, Nuclear reactor problems, precautions. **ii)** Radioactive decay, kinetics of radioactive decay, Types of radioactive decay and their measurement, Half life, decay constant, Population of states, Production of radionuclides. Radioactive dating, Radiocarbon dating: Formation, mechanism of dating, carbon cycle, radiocarbon clock and applications, advantages, disadvantages, precautions; Other dating techniques, protein dating, accuracy in dating;	17
2.	Radiation and matter interactions	Dosimetry and applications: Interaction of Radiation of matter: Biological effects of radiations; dosimetry, working principles, Tools and radiotherapy, Doses, Radioisotopes, Radiotracers;	09
3.	NMR and MRI	Nuclear Magnetic Resonance: General Introduction to Magnetic Resonance, Reference Frame; RF Pulses, Larmor precision, Basic principles of NMR & ESR Spectroscopy, Nuclear shielding, Chemical shifts; Couplings, Nuclear Imaging; 1D,2D, 3D Images, Application of NMR in medical industry as MRI, working MRI, Types of differen MRI, Applications of NMR in quantum computation;	09

4.	Nuclear Medicine and Nuclear Imaging	Nuclear Medicine and Nuclear imaging techniques, preclinical imaging, detector designing, photon counting, Medical imaging using β+γ coincidences, SPECT AND PET: Radiation tomography, applications;	05
		Total number of Lectures	**40**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 [2 Quiz (10 M), Attendance (10 M) and Cass performance (5 M)]
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.	Basic Sciences of Nuclear Medicine; Magdy M K halil, Springer
2.	Physics and Radibiology of Nuclear Medicine; Gopal B Saha, Springer
3.	A. Beiser, Concepts of Modern Physics, Mc Graw Hill International.
4.	Radionuclide Techniques in Medicine, JM McAlister (Cambridge University Press, 1979).
5.	Nuclear Physics; S.N.Ghosal

Course Code	16B1NPH631	Semester: Even	Semester: VI Session 2018 -2019 Month from: Jan-June
Course Name	Computational Physics		
Credits	**4**	**Contact Hours**	4

Faculty (Names)	Coordinator(s)	Vikas Malik
	Teacher(s) (Alphabetically)	Vikas Malik

COURSE OUTCOMES		COGNITIVE LEVELS
C302-12.1	Define key concepts used in Monte Carlo Simulation, Random walks, percolation and Numerical methods	Remembering (C1)
C302-12.2	Explain basics of numerical analysis, statistical mechanics, Monte Carlo simulations, percolation, random walks, neural networks	Understanding (C2)
C302-12.3	Model and simulate magnetic systems, polymers and networks; interpret simulation data	Applying (C3)
C302-12.4	Develop advanced Monte Carlo techniques to solve Optimization problems. Simulate percolation of complex networks.	Analyzing (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Numerical Methods	Locating Roots of Equations, Interpolation and Numerical Differentiation, Numerical Integration, Systems of Linear Equations, Ordinary Differential Equations, Fourier Transform Techniques.	10
2.	Simulation Techniques	Random Number Generation and Monte Carlo Methods, Equilibrium Statistical mechanics, Importance sampling, Metropolis algorithm.	10
3.	Applications of Computer Simulations in Physics	Ising Model Simulations of Magnetic Solids and Phase Transitions, Monte Carlo Intergration, Random Walk and its Applications to Polymers, Cluster Identification algorithms, Percolation and Fractal Phenomena, Chaos and Non-Linear Systems.	15
4.	**Advanced Simulation Techniques**	Cluster Algorithms, Variational Methods and Optimization Techniques.	05
		Total number of Lectures	**40**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 [2 Quiz (10 M), Attendance (10 M) and Cass performance (5 M)]
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.	S. S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall India, 2005.
2.	Kerson Huang, Statistical Mechanics, 2nd Edition, John Wiley, 2009.
3.	K. Binder & D. Heermann, Monte Carlo Simulation in Statistical Physics, **2nd Edition,**Springer, 2013.
4.	Newman & Barkema, Monte Carlo Methods in Statistical Physics, Clarendon Press, 1999.
5.	Landau & Binder, A guide to Monte Carlo Simulations in Statistical Physics, Cambridge University Press, 2014.
6.	M. H. Kalos and P. A. Whitlock, *Monte Carlo Methods,* John Wiley and Sons, 2009.

Course Code	16B19PH692	Semester Even	Semester VI Session 2018 -2019
			Month from: January to June

Course Name	Light Emitting Diodes: Basics & Applications

Credits	Value Added	Contact Hours	2

Faculty (Names)	Coordinator(s)	Dr. Bhubesh Chander Joshi
	Teacher(s) (Alphabetically)	Dr. Bhubesh Chander Joshi

COURSE OUTCOMES		COGNITIVE LEVELS
C305-6.1	Recall the basic concepts of semiconducting materials, working of p-n junction diode and light emitting diodes.	Remembering (C1)
C305-6.2	Explain the various physical parameters involved in designing and fabrication of LEDs.	Understanding (C2)
C305-6.3	Solve various problems related to efficiency, emission intensity and spectrum of LEDs..	Applying (C3)
C305-6.4	Analyse the problems in designing & fabricating blue, white and green high brightness LEDs.	Analyzing (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	History of LEDs	History of SiC, GaAs, GaAsP, GaInP, GaN, and InGaN LEDs.	4
2.	Theory of Recombination's	Radiative and non-radiative recombination's, Low-level and high-level excitations, Bio-molecular rate equation for quantum well structure, Van Roosbroeck-Shockley Model, Einstein Model.	6
3.	LED Basics	Electrical properties: I-V characteristics, parasitic resistances, carrier distribution in homo and hetero junctions, carrier losses, carrier overflow in heterojunctions, Optical properties: Internal, external, extraction and power efficiencies, Emission spectra, escape cone and temperature dependency	6
4.	Growth & Fabrications	LED materials, Organic LEDs, Growth, Fabrication and Characterization Techniques	4
5.	Applications	Solid state lighting, White LEDs, HB LEDs, Color Mixing and Rendering, LED Drivers, Display Devices, AMOLED, Communication, High Voltage LEDs	10
		Total number of Lectures	**30**

Evaluation Criteria

Components	Maximum Marks
Mid Term Examination	30
End Semester Examination	40
TA	30 [Presentation/project (15 M) + Attendance (15 M)]
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.	**Text 1:** Light-Emitting Diodes, Schubert E. Fred, Cambridge University Press, 3rd Edition 2018.
2.	**Reference:** Introduction to Light Emitting Diode Technology and Applications, Held Gilbert, Auerbach Publications, 2008.
3.	**Reference:** Light-Emitting Diodes; Materials, Processes, Devices and Applications, Editors: Jinmin Li, G. Q ZHANG, Springer, 2019

Course Code	18B13EC314	Semester Even	Semester VI Session 2018 -2019 January
Course Name	Machine Learning for Signal Processing		
Credits	Audit course	Contact Hours	3

Faculty (Names)	Coordinator(s)	Dr. Abhinav Gupta
	Teacher(s) (Alphabetically)	Dr. Abhinav Gupta

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Illustrate various machine learning approaches	Understanding (C2)
CO2	Experiment with the different techniques for feature extraction and feature selection	Applying (C3)
CO3	Apply and analyze various classifier models for typical machine learning applications	Analyzing (C4)
CO4	Make use of deep learning techniques in real life problems	Applying (C3)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction and Basic Concepts	Linear algebra, Probability distributions, Representing signals, Types of Features and Proximity measures	8
2.	Linear Models for Regression and Feature Selection	Regression: Linear Basis Function Models, The Bias-Variance DecompositionTypes of Feature Selection : Mutual Information (MI) for Feature Selection, Goodman–Kruskal Measure, Laplacian Score, SVD, Ranking for Feature Selection, Feature Selection for Time Series Data	12
3.	Linear Models for Classification	Discriminant Functions, Probabilistic Generative Models, Probabilistic Discriminative Models, The Laplace Approximation	6
4.	Decision Tree Learning	Decision Tree Representation, Hypothesis space search, Inductive bias, Issues in decision tree learning	7
5.	Support Vector Machines	Linear maximum margin classifier for linearly separable data, Linear soft margin classifier, Kernel induced feature spaces, Nonlinear classifiers, Regression by SVM, SVM variants	6
6.	Introduction to Deep Networks	Convolutional neural networks and applications	4
		Total number of Lectures	43

Evaluation Criteria	
Components	**Maximum Marks**
T1	NA
T2	30
End Semester Examination	40
TA	30
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.	Pattern Recognition and Machine Learning, C.M. Bishop, 2nd Edition, Springer, 2011.
2.	Deep Learning, I. Goodfellow, Y, Bengio, A. Courville, MIT Press, 2016.
3.	The Elements of Statistical Learning , T. Hastie, R. Tibshirani, J. Friedman., 2nd Edition, 2008
4.	Machine Learning, T. Mitchell, McGraw Hill, 1997.

Detailed Syllabus
Lecture-wise Breakup

Course Code	19B13BT311	Semester Even (specify Odd/Even)	Semester VI Session 2018 -2019 Month from January-June
Course Name	Nanoscience in Food Technology		
Credits	2	Contact Hours	2

Faculty (Names)	Coordinator(s)	Prof. Sudha Srivastava
	Teacher(s) (Alphabetically)	Prof. Sudha Srivastava

COURSE OUTCOMES		COGNITIVE LEVELS
C305-1.1	Explain properties of nanoparticles and nanoemulsions	Understand Level (C2)
C305-1.2	Outline food processing, packaging and preservation	Understand Level (C2)
C305-1.3	Apply nanotechnology concepts to improve food quality, texture, and shelf life	Apply Level (C3)
C305-1.4	Apply concepts of nanoscience for improving agriculture yields	Apply Level (C3)
C305-1.5	Analyze food quality degradation and pathogens detection, using nanosensors	Analyze Level (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction to Nanomaterials	Introduction to nanomaterials, nanoemulsions, method of synthesis and identification of nanoemulsions	5
2.	Food Packaging and Preservation	Introduction to food processing, packaging and preservation. Modified atmosphere packaging, active packaging and intelligent packaging.	6
3.	Application of nanotechnology in Food and agriculture	Microemulsions for delivery of nutraceuticals, edible films and coating for food, Polymer nanocomposites, effect of nanomaterials on mechanical, thermal and barrier properties of polymers. Application of nanotechnology for pesticide delivery, nutrient uptake etc. Nanomaterials in Food-Health and Safety Issues	7
4.	Biosensors for monitoring food quality	Time temperature indicators, pathogen detection using biosensors, Pesticide detection using biosensor.	6
		Total number of Lectures	24

Evaluation Criteria

Components **Maximum Marks**
Mid Term   30
End Term40
TA   30 (Presentation, Class Test)
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.	VellaichamyChelladurai, Digvir S. Jayas, 2018 Nanoscience and Nanotechnology in Foods and BeveragesCRC Press, ISBN 9781498760638
2.	Recent Research papers

Detailed Syllabus

Course Code	15B22CI521	Semester Even (specify Odd/Even)		Semester VI Session 2018 -2019 Month: from July 2018
Course Name	Cloud based enterprise systems			
Credits	3		Contact Hours	3+1

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

COURSE OUTCOMES		COGNITIVE LEVELS
C311.1	Define all the basic terminologies related to cloud computing and basic nodejs concepts.	Remember Level (Level 1)
C311.2	Write basic nodejs programs for creating server, rendering html, routing, get and post methods.	Understand Level (Level 2)
C311.3	Develop all nodejs programs using nested loops and api methods to restrict post and get requests.	Apply Level (Level 3)
C311.4	Test for the issues in the existing code using debugging tools or other exception handling methods.	Analyze Level (Level 4)
C311.5	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)
C311.6	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	7

		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.	
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 Sixth 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
C371.1	Create Server app and its modules	Create Level (Level 6)
C371.2	Develop multi core server apps	Apply Level (Level 4)
C371.3	Use nodejs for multi core apps	Apply Level (Level 4)
C371.4	Design Auto Scale apps for server	Apply Level (Level 4)
C371.5	Analyse the VMs for the cloud deployment	Evaluate Level (Level 6)
C371.6	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.	Install openstack on personal PC	1

	Lambda		
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