Faculty of Engineering and Technology

SRM UNIVERSITY
(Under section 3 of UGC Act 1956)

CURRICULUM, PRE-REQUISITES/ CO-REQUISITES CHART, AND SYLLABUS FOR B.TECH.

UNDER CHOICE BASED FLEXIBLE CREDIT SYSTEM

REGULATIONS 2015

(For students admitted from 2015-16 onwards)

Specialization	:	**COMPUTER SCIENCE AND ENGINEERING**
Offering Department	:	**COMPUTER SCIENCE AND ENGINEERING**

Placed in the 32nd Academic Council Meeting held on 23rd July 2016

15CS101L	Programming Laboratory	L	T	P	C
		1	0	2	2
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Core				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July, 2016				

PURPOSE	This Lab Course will enable the students to understand the fundamentals of programming and gain knowledge on using the preliminary constructs in solving simple applications

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**
At the end of the course, student will be able		
1.	Learn the fundamentals of programming and its environment	k
2.	Ability to write programs using commands and functions	a
3.	To be able to apply programming skills in their area of specialization	d
4.	Learn to work with team members in developing mini projects	c

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Students shall be given experiments covering the following topics: 1. Practicing the environment for programming to familiarize Workspace, Directory, Windows, Edit options, Help, Shortcuts etc. Simple exercises to familiarize Basic Commands. 2. Data types, Constants and Variables, operators, Input-output functions, reading and storing data, Assignment statements, Control Structures, Iterative statements 3. Vectors and Matrices, commands to operate on vectors and matrices, Matrix Manipulations, Arithmetic, Relational and Logical operations on Matrices. 4. Polynomial Evaluation, Roots of Polynomial, Arithmetic Operations on Polynomials. 5. Basic Graphics: 2D / 3D plots, Printing labels, Grid & Axes box, Text in plot, Bar and Pie chart, Histograms, Animation 6. Experiments in solving simple Engineering problems – To be decided by the Lab Course Coordinator. 7. Students shall be encouraged to form groups (Maximum 3) to do a mini Project covering the above mentioned topics.	Theory 15 Practical 30	D, I,O	1,2,3,4	
	Total contact hours	**45**			

LEARNING RESOURCES	
Sl. No.	**REFERENCE BOOKS**
1.	www.scilab.org
2.	Rudra Pratap., "Getting started with MATLAB", Oxford University Press, 2010.
3.	Bansal R.K, Goel A.K.,Sharma M.K., "MATLAB and its Applications in Engineering", Pearson Education, 2012.

Course nature				**Practical**	
Assessment Method (Weightage 100%)					
In-semester	**Assessment tool**	Observation	Model Exam	Mini Project & Report	**Total**
	Weightage	**20%**	**15%**	**25%**	**60%**
				End semester examination Weightage :	**40%**

15CS201J	Data Structures	L	T	P	C
		3	0	2	4
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Core				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	Data structure is a particular way of storing and organizing information in a computer so that it can be better processed. This course introduces different kind of data structures like stack, queue, linked list, tree and graph suitable for different kinds of applications. Specific data structures are most important for many efficient algorithms.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Understand analysis of algorithm and its time complexity	a	b					
2.	Be familiar with and implement the Linked list data structure	a	b	c				
3.	Be familiar with and implement the Stack and Queue data structure	a	b	c				
4.	Have a comprehensive knowledge of Trees and their implementations	a	b	c				
5.	Learn advanced data structures like Graphs and their implementation, hash tables and Hashing methods	a	b	c				

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
UNIT I: INTRODUCTION TO DATA STRUCTURES		**6**			
1.	Introduction : Basic terminology - Data structures – Data structure operations	1	C	1	1
2.	ADT – Algorithms: Complexity, Time – Space trade off	1	C	1	1
3.	Mathematical notations and functions	1	C	1	1
4.	Asymptotic notations – Linear and Binary search	1	C,I	1	1
5.	Asymptotic notations – Bubble sort	1	C,I	1	1
6.	Asymptotic notations -Insertion sort	1	C,I	1	1
UNIT II: ARRAYS AND LIST		**9**			
7.	Array : Operations on Arrays, Applications of Arrays	1	C,I	2	1,2,3
8.	Multidimensional Arrays : Sparse Matrix	2	C	2	1,2,3
9.	Linked List : Insertion, Deletion and Search, Cursor based implementation	2	C,I	2	1,2
10.	Polynomial Arithmetic	1	C,I	2	1,2
11.	Circular Linked List – Applications – Josephus Problem	1	C, I	2	1,2
12.	Doubly linked list: Insertion, Deletion and Search	2	C,I	2	1,2
UNIT III: STACK AND QUEUE		**9**			
13.	Stack: Array implementation, Linked list implementation	1	C	3	1,2
14.	Applications of Stack – Infix to Postfix – Evaluation of Postfix	2	C,I	3	1,2
15.	Application of Stack – Balancing symbols – Nested function calls	1	C,I	3	1,2
16.	Recursion – Towers of Hanoi	1	C,I	3	1,2
17.	Queue – Array implementation , Linked List implementation	1	C,I	3	1,2
18.	Circular Queue	1	C	3	1,2
19.	Applications of Queue – Priority queue – Double ended queue	2	C	3	1
UNIT IV: TREES		**11**			
20.	General trees – Terminology – Representation of trees – Tree traversal	1	C,D,I	4	1,2
21.	Binary tree – Representation – Expression tree – Binary tree traversal, Threaded Binary Tree	1	C,D,I	4	1,2

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
22.	Binary Search Tree – Construction - Searching , Deletion	2	C,D,I	4	1,2
23.	AVL trees – Rotation, Insertion	2	C,D,I	4	1,2
24.	B-Trees, construction, searching, deletion	2	C,D,I	4	1,2
25.	Splay trees	1	C	4	1,2
26.	Red-Black Trees	2	C	4	1,2
UNIT V: GRAPHS AND HASH TABLES		**10**			
27.	Graph Terminology, Graph Traversal, Topological sorting	1	C,D,I	5	1,2,4
28.	Minimum spanning tree – Prims - Kruskals	2	C,D,I	5	1,2,3
29.	Network flow problem	1	C	5	1,2,4
30.	Shortest Path Algorithm: Dijkstra	2	C,D,I	5	1,2,3
31.	Graph Search: Depth First Search, Breadth First Search	1	C,D,I	5	1,2
32.	Hashing: Hash functions, Collision avoidance, Separate chaining	1	C,D,I	5	1,2
33.	Open addressing: Linear probing, Quadratic Probing, Double hashing, Rehashing, Extensible Hashing	2	C	5	1,2
	Total contact hours	**45***			

Session	Description of the Experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Implementation of Sorting, searching	4	D,I	1	1,2,3,4,5
2.	Implementation of Linked List (Singly , Doubly, Circular)	4	D,I	2	1,2,3,4,5
3.	Implementation of stack using array, linked list	4	D,I	2	1,2,3,4,5
4.	Implementation of queue using array, linked list	4	D,I	2	1,2,3,4,5
5.	Applications of stack, queue	4	D,I	3	1,2,3,4,5
6.	Binary Tree Traversal , Binary Search Tree Implementation	4	D,I	4	1,2,3,4,5
7.	Minimum Spanning Tree	4	D,I	5	1,2,3,4,5
8.	Shortest path algorithm using Dijkstra	3	D,I	5	1,2,3,4,5
	Total Contact Hours	30*			

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Seymour Lipschutz, “Data Structures with C”, McGraw Hill Education, Special Indian Edition, 2014.
2.	R.F.Gilberg, B.A.Forouzan, “Data Structures”, Second Edition, Thomson India Edition, 2005.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	A.V.Aho, J.E Hopcroft and J.D.Ullman, “Data structures and Algorithms”, Pearson Education, First Edition Reprint 2003.
4.	Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education,
5.	ReemaThareja, “Data Structures Using C”, Oxford Higher Education , First Edition, 2011

Course nature		**Theory + Practical**					
Assessment Method – Theory Component (Weightage 50%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**
Assessment Method – Practical Component (Weightage 50%)							
In-semester	**Assessment tool**	Experiments	Record	MCQ/Quiz/Viva Voce	Model examination		**Total**
	Weightage	**40%**	**5%**	**5%**	**10%**		**60%**
End semester examination Weightage :							**40%**

* Excluding Assessment Hours

15CS202	Digital System Design	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Core				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	To understand the basics of Boolean algebra and the operation of logic components, combinational, sequential circuits and VHDL.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Apply the principles of Boolean algebra to manipulate and minimize logic expressions.	a						
2.	Apply two-level logic functions with AND, OR, NAND, NOR and XOR gates	a						
3.	Use K-maps and table method to minimize and optimize two-level logic functions up to 5 variables.	a	b					
4.	Design combinational circuits using decoders, ROM and transmission gates.	a	b					
5.	Design finite state machines using various types of flip-flops and combinational circuits with prescribed functionality	a	b					
6.	Use the VHDL language for representation of digital signals	a						

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
UNIT I: Introduction to Number Systems and Boolean Algebra		**9**			
1.	Digital and Analog Basic Concepts, Some history of Digital Systems	1	C	1	1
2.	Introduction to number systems , Binary numbers , Number Base Conversion	1	C	1	1,2,3,4
3.	Complement Codes, Binary Arithmetic , Binary codes: BCD, Weighted codes -2421,8421,gray code	3	C	1	1,2,3,4
4.	Binary Logic functions, Boolean Algebra, Theorems and Properties of Boolean Algebra	4	C	1,2	1,2,3,4
UNIT II: Minimization techniques in digital Logic		**9**			
5.	Canonical forms, Generation of Switching Equations from Truth Table	2	C	1,2	1,2,3,4
6.	K-map(Karnaugh map) 2 ,3,4 and 5 variables, K map with Don't care terms	3	C	3	1,2
7.	Quine Mc-Cluskey minimization technique, Quine Mc-Cluskey using Don't Care Terms	3	C	3	1,2
8.	Mixed logic Combinational circuits	1	C,D	4	1,2
UNIT III: Design of Combinational Logic Circuits		**9**			
9.	Introduction to Combinational Circuits, Analysis and Design Procedure	1	C	4	1,2
10.	Binary Adder, Subtractor, Carry Look Ahead Generator, Decimal Adder, Binary Multiplier	4	C,D	4	1,2,3,4
11.	Decoder, Encoder, Priority Encoder, Digital Multiplexer, Magnitude Comparator	4	C,D	4	1,2,3,4
UNIT IV: Synchronous Sequential Circuits		**10**			
12.	Flip-flops- SR,D,JK,T	2	C	5	1,2
13.	Analysis of Synchronous Sequential Circuit	1	C	5	1,2
14.	State Reduction and Assignment	1	D,I	5	1,2

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
15.	Design of Synchronous Sequential Circuit: Sequence Detector for D,JK,T flip-flops	2	D,I	5	1,2,3,4
16.	BCD Counter, Registers: Shift Registers, Analysis of Asynchronous Sequential Circuit: Transition Table, Flow Table	4	D,I	5	1,2,3,4
UNIT V: Hardware Description Language		**8**			
17.	Introduction to HDL: Module Declaration, Gate delays, Boolean Expressions, User Defined Primitives	2	C	6	2,5,6
18.	HDL models for Combinational Circuits: Gate Level Modeling, Data Flow , Behavioral Modeling	3	D,I	6	2,5,6
19.	HDL flow Behavioral Sequential Circuits: HDL Models for Flip-Flops and Latches	3	D,I	6	2,5,6
	Total contact hours	45*			

LEARNING RESOURCES	
Sl.No.	**TEXT BOOKS**
1.	John . M. Yarbrough," Digital Logic: Applications and Design", Cengage Learning, Reprint, 2009
2.	M.Morris Mano, Michael D. Ciletti ,"Digital Design with an Introduction to the verilog HDL", Pearson Publications, Fifth edition, 2014.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Roth , Kinney,"Fundamentals of Logic Design", Cengage Learning, 7th edition, 2015
4.	Donald D. Givone, " Digital Principles and Design", McGraw Hill Education (India) Pvt. Ltd,2013
5.	Richard S. Sandige, Michael L Sandige, " Fundamentals of Digital and Computer Design with VHDL", McGraw Hill, 2014
6.	Stephen Brown, Zvonko Vranesic, "Fundamentals of Digital Logic with Verilog Design",Second Edition, McGraw Hill, 2015.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS203	Computer System Architecture	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Core				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	To study the basic structure of a digital computer and the organization of the Arithmetic and Logical unit, the Memory unit, Control unit and I/O unit.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	To study basic structures and functions of Control Unit, Memory unit, Storage devices and Input/output organization in a computer system.	a						
2.	To understand the representations of signed and unsigned numbers and arithmetic algorithms such as addition, subtraction, multiplication and division.	a	b					
3.	To learn the concepts of various instruction set architectures (ISA), addressing modes to understand the concepts of pipelining and superscalar execution.	d						
4.	To understand the various classes of instruction types such as data movement, arithmetic, logical and flow control and to study the various control unit design.	a	b	c				
5.	To identify the various memory technologies and memory hierarchies found in a computer and to describe the various ways of organizing cache memory and appreciate the cost-performance tradeoffs.	a	b					
6.	To understand how interrupts are used to implement I/O control and data transfers and to identify various types of buses in a computer system and understand how devices compete for a bus and are granted access to the system bus.	a	b	c				

Session	Description of Topic	Contact hours	C- D-I- O	IOs	Reference
UNIT I: BASIC STRUCTURE OF COMPUTERS		**8**			
1.	Computer Types, Functional units, Basic operational concepts , Bus structures	1	C	1, 6	1,2,4
2.	Memory locations and addresses, Memory operations	1	C	1,5	1
3.	Instruction and instruction sequencing, Assembly language, Addressing modes, Basic I/O operations	3	C,D,I	3,4,6	1,2,4
4.	Evolution of Parallel computers, System Attributes to Performance	2	C	1	7
5.	Multiprocessors and Multicomputers	1	C	1	4,5,7
UNIT II: ARITHMETIC UNIT		**9**			
6.	Addition and subtraction of signed numbers, Design of fast adders	2	C,D,I	1,2	1,6
7.	Multiplication of positive numbers, Signed operand multiplication	2	C,D,I	2	1,6
8.	Fast multiplication-Bit pair recoding of Multipliers, Carry Save Addition of summands	2	C,D,I	2	1,6
9.	Integer division- Restoring Division, Non Restoring Division	2	D,I	2	1,6
10.	Floating point numbers and its operations	1	D,I	2	1,4
UNIT III: BASIC PROCESSING UNIT		**11**			
11.	Fundamental concepts, Execution of a complete instruction, Multiple bus organization	2	C	1,3	1,2,8
12.	Hardwired control	1	D,I	1,4	1,2,4,6
13.	Micro programmed control	2	D,I	1,4	1,2,4,6
14.	Pipelining- Basic concepts, Data hazards, Instruction hazards,	3	C,D,I	3,4	1,5,8
15.	Pipelining- Influence on Instruction sets, Datapath and control considerations	2	C	3,6	1,9

Session	Description of Topic	Contact hours	C- D-I- O	IOs	Reference
16.	Superscalar Operation	1	C	3	1,7
UNIT IV: MEMORY UNIT		**8**			
17.	Basic concepts of memory system, Semiconductor RAMs, ROMs Speed, size and cost	3	C,D	1,5	1,2,9
18.	Cache memories, Performance consideration	2	C,D	5	1,3,4,5
19.	Virtual memory	1	C,D	1,5	1,3,5
20.	Memory Management requirements	1	C	5	1
21.	Secondary storage	1	C	5	1,2,4
UNIT V: INPUT – OUTPUT ORGANIZATION		**9**			
22.	Introduction to Data transfer techniques, Bus Interface – UART, Interfacing UART to Microprocessor Unit	3	C,I	1,6	2
23.	Programmed IO, Interrupt driven IO, Direct Memory Access	2	C	1,6	1,2,4
24.	I/O Interrupt, I/O channel/Processor	2	C,I	1,6	1,2
25.	Interconnection Standards – PCI Bus, SCSI, USB, Firewire, SATA, SAS, PCI Express	2	C	6	1,8
	Total contact hours	**45***			

LEARNING RESOURCES	
Sl.No.	**TEXT BOOKS**
1.	Carl Hamacher, Zvonko Vranesic, Safwat Zaky, "Computer Organization", McGraw-Hill, Fifth Edition, Reprint, 2015.
2.	Pal Chaudhuri,"Computer Organization and Design",PHI Pvt, Third Edition,2008.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Ghosh T. K., "Computer Organization and Architecture", Tata McGraw-Hill, Third Edition, 2011.
4.	William Stallings, "Computer Organization and Architecture – Designing for Performance", Pearson Education, Tenth Edition, 2015.
5.	Behrooz Parahami, "Computer Architecture", Oxford University Press, Eighth Impression, 2015.
6.	John P. Hayes, "Computer Architecture and Organization", McGraw Hill, Third Edition, 2015.
7.	Kai Hwang & Naresh Jotwani,"Advanced Computer Architecture", McGraw Hill, Third Edition, 2016.
8.	Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian,"Computer Organization and Embedded Systems", McGraw-Hill, Sixth Edition, 2012.
9.	P.V.S. Rao,"Computer System Architecture", PHI Learning Pvt Ltd, 2011

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS204J	Algorithm Design and Analysis	L	T	P	C
		3	0	2	4
Co-requisite:	Nil				
Prerequisite:	15CS201J				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Core				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	To acquire the ability of applying various algorithmic concepts for all domains and efficient interpretation of real life problems.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Apply Mathematical concepts and notations to define a problem	a						
2.	Apply divide and conquer method to solve a problem	b						
3.	Ability to solve a real life problems with these algorithmic techniques	j						
4.	Familiarize the concept of multidisciplinary functions	d						
5.	Interpret data using NP problems and applications of various algorithms to solve real life problems	b	j					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	References
UNIT I: INTRODUCTION TO ALGORITM DESIGN		**10**			
1.	Introduction, Fundamentals of algorithm(Line count, operation count)	1	C	1	2,3,6
2.	Algorithm Design Techniques (Approaches, Design Paradigms)	1	C	1	1,2,3,6
3.	Designing an algorithm and its Analysis(Best ,Worst & Average case)	2	C,D	1,3	1,2,3,6
4.	Asymptotic Notations (O, Ω, Θ) based on Orders of Growth	1	C,I	1	1,2,3,6
5.	Mathematical Analysis - Induction	1	C	1	3,4
6.	Recurrence Relation - Substitution method	1	C	1	3,2
7.	Recurrence Relation - Recursion method	2	C	1	2,3
8.	Recurrence Relation - Master's Theorem	1	C	1	2
UNIT II: DIVIDE AND CONQUER		**8**			
9.	Introduction, Binary Search	1	D,I	2	1,3
10.	Merge sort and its algorithm analysis	1	C,D	2	1,3
11.	Quick sort and its algorithm analysis	2	D,I	2	1,3
12.	Strassen's Matrix multiplication	1	C	2	1,3
13.	Finding Maximum and minimum	1	D,I	2,3	1,3
14.	Algorithm for finding closest pair	1	C,I	2	3,5
15.	Convex Hull Problem	1	C	2	1,3
UNIT III: GREEDY AND DYNAMIC PROGRAMMING		**9**			
16.	Introduction - Greedy- Huffman Coding	1	C	3	1
17.	Greedy - Knapsack Problem	1	C,D,I	3	1,3
18.	Greedy - Minimum Spanning Tree(Kruskals Algorithm)	2	C,D,I	3	1,3
19.	Introduction - Dynamic Programming - 0/1 Knapsack Problem	1	C,D	3	1,3
20.	Dynamic Programming - 0/1 Knapsack Problem	1	C	3	1,3
21.	Dynamic Programming- Travelling Salesman Problem	1	C,D	3	1,3
22.	Dynamic Programming- Multistage Graph- Forward path and backward path	2	C,D,I	3	1
UNIT IV: BACK TRACKING		**9**			
23.	Introduction - NXN Queen's Problem	1	C	4	1,2
24.	NXN Queen's Problem	1	D,I	4	1,2
25.	Sum Of Subsets	1	D,I	4	1,3
26.	Graph Coloring	2	D,I	3,4	1

Session	Description of Topic	Contact hours	C-D-I-O	IOs	References
27.	Hamiltonian's Circuit	1	C	3,4	1
28.	Travelling Salesman Problem	2	C	3,4	1,3
29.	Generating Permutation	1	C	1	2,4
UNIT V: BRANCH BOUND AND RANDOMIZED ALGORITHM		**9**			
30.	Branch and bound - 0/1 Knapsack	1	D,I	4	1,3
31.	Branch and Bound - Travelling Sales man Problem	1	C,I	3,4	1,3
32.	Randomized algorithm- Hiring Problem	1	C,I	3,4	2
33.	Randomized algorithm- Matrix Chain Multiplication	1	C,I	3,4	1,2
34.	Randomized Quick Sort	1	C	4	2
35.	Introduction to PN problems	1	C	5	5
36.	Introduction to NP problems	1	C	5	5
37.	NP Complete	2	C	5	4,5
Total Contact Hours		**45***			

Session	Description of the Experiments	Contact hours	C-D-I-O	IOs	References
Divide and conquer Technique		**10**			
1.	Binary Search	2	I	2	1,3,6
2.	Quick Sort	2	C,I	2	1,3,6
3.	Merge sort	2	I	2	1,3,6
4.	Min Max Problem	4	I	2	1,3,6
Greedy and Dynamic Programming Technique		**14**			
5.	Knapsack Problem	2	C	3	1,3,5,6
6.	Huffman Coding	4	C,I	3	1,3,5,6
7.	Minimum Spanning Tree(Kruskal Algorithm)	4	C,I	3	1,3,6
8.	Multistage Graph (Forward path & Backward path)	4	C,I	3	1,6
Backtracking Technique		**4**			
9.	NXN Queens problem	2	C,I	4	1
10.	Graph Coloring	2	C,I	3,4	1
Randomized Algorithm		**2**			
11.	Hiring Problem	2	I	5	2
Total Contact Hours		**30***			

LEARNING RESOURCES	
Sl.No.	**TEXT BOOKS**
1.	Ellis Horowitz, Sartajsahni, Sanguthevar, Rajesekaran, *"Fundamentals of Computer Algorithms"*, Galgotia Publication Pvt. Ltd., Reprint, 2010.
2.	Thomas H Cormen, Charles E Leiserson, Ronald L Revest, Clifford Stein, "*Introduction to Algorithms" 3rd Edition,* The MIT Press Cambridge, Massachusetts London, England, 2014
3.	S.Sridhar, "Design and Analysis of Algorithms", Oxford University Press, 2015
	REFERENCE BOOKS/OTHER READING MATERIAL
4.	Richard Johnson Baugh, Marcus Schaefer,*"Algorithms",* Pearson education, 2004
5.	Mark Allen Weiss, *"Data Structures and Algorithm Analysis in C"*, 2nd Edition, Pearson Education, Inc., 2006
6.	Rajesh K Shukla, *"Analysis and Design of Algorithms-A Beginner's Approach",* Wiley publisher ,2015

Course nature				**Theory + Practical**			
Assessment Method – Theory Component (Weightage 50%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**
Assessment Method – Practical Component (Weightage 50%)							
In-semester	**Assessment tool**	Experiments	Record	MCQ/Quiz/Viva Voce	Model examination		**Total**
	Weightage	**40%**	**5%**	**5%**	**10%**		**60%**
End semester examination Weightage :							**40%**

* Excluding Assessment Hours

15CS205J	Microprocessors And Microcontrollers	L	T	P	C
		3	0	2	4
Co-requisite:	Nil				
Prerequisite:	15CS202 (or) 15IT212J				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Core				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	The purpose of this course is to develop Assembly Language Programs and build a Microprocessor based system for various applications.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	To learn the basics of 8086 Microprocessor to Pentium-core Microprocessor and their functions	a	b					
2.	To understand and implement the 8086 family Assembly Language Programming	a	c					
3.	To explore the I/O interfacing and advanced Microprocessors	a	c					
4.	Expose to the functional architecture of 8051 and its basic programming using C	a	c					

Session	Description of Topic (Theory)	Contact hours	C-D-I-O	IOs	Reference
UNIT I: INTRODUCTION TO MICROPROCESSOR AND FAMILY		**8**			
1.	Introduction –Microprocessors and Microcontrollers-its computational functionality and importance - overview of syllabus	1	C	1,4	1-5
2.	8086 architecture and Historical background	2	C,D	1,2	1,2
3.	The Microprocessor–Based Personal Computer Systems	1	C	1	1
4.	Internal Microprocessor Architecture	2	C,D	1,2	1
5.	Real mode memory Addressing–Protected mode Memory Addressing	2	C	1,2	1
UNIT II: 8086 Family Assembly Language Programming		**10**			
6.	Machine language instruction format-Addressing modes-Data addressing	1	C	2	1,2
7.	Program memory and stack addressing modes	2	C	2	1
8.	Instruction Set: Data Movement Instructions	2	C	2	1
9.	Arithmetic and Logic Instructions	2	C	2	1
10.	Program control Instructions	2	C	2	1
11.	Assembler Directives of 8086	1	C	2	1
UNIT III: PROGRAMMING CONCEPTS		**10**			
12.	Using Assembly Language with C/C++ for 16-Bit DOS Applications and 32-Bit Applications	4	C	2	1
13.	Modular Programming	2	C	2	1
14.	Using the Keyboard and Video Display	2	C,D	2,3	1
15.	Data Conversions–Example Programs: Binary to ASCII- ASCII to Binary	2	C	2	1
UNIT IV: I/O INTERFACE & ADVANCED MICROPROCESSORS		**9**			
16.	Introduction to I/O Interface	1	C	2,3	1
17.	Programmable Peripheral Interface architecture- modes	2	C	2,3	1
18.	Basic DMA Operations- 8237 DMA Controller architecture--software commands	2	C,D	2,3	1,2
19.	Disk Memory Systems	1	C	2,3	1
20.	Introduction to Pentium - Pentium Pro Microprocessor-Pentium II- Pentium III- Pentium-IV & Core2	3	C	1,2	1

Session	Description of Topic (Theory)	Contact hours	C-D-I-O	IOs	Reference
UNIT V: ARCHITECTURE AND PROGRAMMING 8051		**8**			
21.	Architecture of 8051-Signal Descriptions-Registered- Program Status Word	2	C,D	4	2,3,5
22.	Memory and I/O Addressing-Addressing modes- Instruction set	2	C	4	2,3,5
23.	Timer/Counter-Serial-Interrupt	2	C	4	2,3,5
24.	Basic Programming	2	C	4	2,6
Total contact hours		**45***			

Sl. No.	Description of experiments	Contac t hours	C-D-I-O	IOs	Reference
Assembly Language Programs Using TASM/MASM					
1	Program involving Arithmetic Instructions on 16 bit data i. Addition & Subtraction ii. Multiplication & Division iii. Factorial of a given number	6	C,I	2	1-4
2	Program involving Data Transfer Instructions on 16 bit data i. Byte and Word data transfer in different addressing modes ii. Block Data Transfer	2	I	2	1-4
3	Program involving Bit Manipulation Instructions on 16 bit data - Given data is positive or negative	2	I	2	1-4
4	Implementation of Bubble Sort Algorithm	2	I	2	1-4
5	Program involving String Instructions on 16 bit data i. Reverse a given string and check whether it is a palindrome ii. String Display using Display Interrupt (Read your name from the keyboard and displays it at a specified location on the screen after the message "What is your name?" You must clear the entire screen before display)	4	I	2	1-4
6.	Time display using Interrupt (Read the current time from the system and display it in the standard format on the screen)	4	C,I	2,3	1-4
Basic 8051 programming using C					
7	Port Programming	4	C,I	4	2,6
8	Timer-Counter Programming	2	I	4	2,6
9	Serial Programming	2	I	4	2,6
10	Interrupt Programming	2	I	4	2,6
Total contact hours		**30***			

LEARNING RESOURCES	
Sl.No.	**TEXT BOOKS**
1.	Barry B. Brey**, "**THE *INTEL Microprocessors-Architecture, Programming and Interfacing***"**, 8th Edition, Pearson, 2012.(Units I-IV)
2.	A.K.Ray and K.M. Bhurchandi, "*Advanced Microprocessor and Peripherals*" Tata McGraw Hill, 3rd Edition, 2013(Unit-5).
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	N.Senthilkumar, M.Saravanan, S,Jeevanathan, "Microprocessors and Microcontrollers", Oxford University Press, 2011
4.	Kenneth J Ayala, "The 8086 Microprocessor: Programming and Interfacing the PC", Cengage Learning, Reprint 2014
5.	Kenneth J Ayala, "The 8051 Microcontroller", 3rd edition, Cengage Learning, Reprint 2014..
6.	Muhammed Ali Mazidi, Janice GillispleMaidi, Rolin.D. McKinlay, "The 8051 Microcontroller and Embedded Systems, Using Assembly and C", Second edition, Pearson Prentice Hall, 2015.

Course nature				**Theory + Practical**			
Assessment Method – Theory Component (Weightage 50%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**
Assessment Method – Practical Component (Weightage 50%)							
In-semester	**Assessment tool**	Experiments	Record	MCQ/Quiz/Viva Voce	Model examination		**Total**
	Weightage	**40%**	**5%**	**5%**	**10%**		**60%**
End semester examination Weightage :							**40%**

* Excluding Assessment Hours

15CS301	Theory of Computation	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Core				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	The purpose of the course is to understand all basic concepts in theoretical Computer science.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	To understand and design various Computing models like Finite State Machine, Pushdown Automata, and Turing Machine.	a						
2.	To understand the various types of grammar and the corresponding languages	a						
3.	To understand Decidability and Undecidability of various problems	a						
4.	To understand the computational complexity of various problems	a						

Session	Description of Topic	Contact hours	C-D-I-O	I O s	Reference
UNIT I: FINITE AUTOMATA		**10**			
1.	Introduction: Basic Mathematical Notation and techniques	1	C	1	1,2,5
2.	Finite State systems, Basic Definitions, Finite Automaton : DFA	1	C,D	1	1,2
3.	Finite Automaton : NDFA, Finite Automaton with €- moves	1	C,D	1	1,5
4.	Regular Languages- Regular Expression	1	D	1,2	1,5
5.	Equivalence of NFA and DFA	1	C,D	1	1,2
6.	Equivalence of NDFA's with and without €-moves	1	C,D	1	1,4
7.	Equivalence of finite Automaton and regular expressions	2	C,D	1,2	1,2,3
8.	Minimization of DFA	1	C,D	1	1,3
9.	Pumping Lemma for Regular sets, Problems based on Pumping Lemma	1	C	2	1
UNIT II: GRAMMARS		**8**			
10.	Grammar Introduction: Types of Grammar, Context Free Grammars and Languages	1	C	2	1
11.	Derivations, Ambiguity, Relationship between derivation and derivation trees	1	C	2	1,5
12.	Simplification of CFG: Elimination of Useless Symbols	1	C,D	2	1,5
13.	Simplification of CFG: Unit productions , Null productions	1	C,D	2	1,4
14.	Chomsky normal form	1	C	2	1,2,3
15.	Problems related to CNF	1	C,D	2	1,2,3
16.	Greiback Normal form	1	C	2	1,4,5
17.	Problems related to GNF	1	C,D	2	1,4,5
UNIT III: PUSHDOWN AUTOMATA		**9**			
18.	Pushdown Automata: Definitions Moves, Instantaneous descriptions	1	C	1	1,4
19.	Deterministic pushdown automata	1	C,D	1	1,5
20.	Problems related to DPDA	2	C,D	1	1,5
21.	Non - Deterministic pushdown automata	1	C,D	1	1,5
22.	Equivalence : Pushdown automata to CFL	1	C,D	1,2	1,3
23.	Equivalence : CFL to Pushdown automata	1	C,D	1,2	1,3
24.	Problems related to PDA to CFG and CFG to PDA	1	C,D	1,2	1,3,4
25.	Pumping lemma for CFL, Problems based on pumping Lemma	1	C	2	1
UNIT IV: TURING MACHINE		**9**			
26.	Turing Machines: Introduction, Formal definition of Turing machines, Instantaneous descriptions	1	C	1	1,2
27.	Turing Machine as Acceptors	1	C,D	1	1,2

Session	Description of Topic	Contact hours	C-D-I-O	I O s	Reference
28.	Problems related to Turing Machine as Acceptors	2	C,D	1	1,3
29.	Turing Machine for computing functions(Transducer)	3	C,D	1	1,4
30.	Turing Machine constructions	1	C	1	1,3
31.	Modifications of Turing Machines	1	C	1	1,3
UNIT V: COMPUTATIONAL COMPLEXITY		**9**			
32.	Undecidability :Basic definitions, Decidable problems	1	C	3	1,2,4
33.	Examples of undecidable problems	1	C	3	1,2,4
34.	Rice's Theorem	1	C	3	2,3,5
35.	Undecidable problems about Turing Machine – Post's Correspondence Problem	2	C,D	3	1,2
36.	Properties of Recursive and Recursively enumerable languages	1	C	3	2
37.	Introduction to Computational Complexity: Definitions, Time and Space complexity of TMs	1	C	4	2
38.	Complexity classes: Class P, Class NP	1	C	4	2,3
39.	Complexity classes: Introduction to NP-Hardness and NP-Completeness	1	C	4	2,3
Total contact hours		**45***			

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Hopcroft J.E., Motwani R. and Ullman J.D, *"Introduction to Automata Theory, Languages and Computations"*, Second Edition, Pearson Education, 2008.
2.	Michael Sipser, "*Introduction to the Theory of Computation"* Cengage Learning, 2012.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	John.C.Martin, *"Introduction to Languages and the Theory of Computation*" McGraw-Hill Education, 01- May-2010.
4.	Kamala Krithivasan, Rama.R*," Introduction to Formal Languages, Automata Theory and Computation*", Pearson Education India, 01-Sep-2009.
5.	Peter Linz , "*An introduction to formal languages and automata*", Jones & Bartlett Learning, 2001.

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS302J	Operating Systems	L	T	P	C
		3	0	2	4
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Core				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	To acquire analytical ability in solving mathematical problems as applied to the respective branches of Engineering.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Understand the structure and functions of OS	a						
2.	Learn about Processes and Threads	a	b					
3.	Understand and Implement the principles of concurrency Scheduling algorithms and Deadlocks and Implement them	a	b					
4.	Learn and Implement the different memory management schemes	a	b					
5.	Understand and Implement the different Input , Output and File management schemes	a	b					

Session	Description of Topic (Theory)	Contact hours	C-D-I-O	IOs	Reference
UNIT I: INTRODUCTION		**9**			
1.	Computer System Overview-Basic Elements, Basic Linux commands.	2	C,I	1	2,6
2.	Instruction Execution, Memory Hierarchy	2	C	1	2
3.	Interrupts, Cache Memory, Direct Memory Access	2	C,D	1	2
4.	Operating system overview-objectives and functions	1	C,D	1	1,2
5.	Evolution of Operating System.	2	C	1	1,2
UNIT II: PROCESSES AND THREADS		**9**			
6.	Definition of process and Process Control Block	1	C,D	2	1,2,3,5
7.	Process States-Two state, Five state, Suspended Processes	2	C,D	2	1,2,3,5
8.	Process Description and Process Control	2	C	2	1,2,3,5
9.	Processes and Threads	2	C,D	2	1,3,5
10.	Types of Threads	1	C,D	2	1,2
11.	Windows 7 - Thread and SMP Management.	1	C,D,I	2	1
UNIT III: CONCURRENCY AND SCHEDULING		**9**			
12.	Principles of Concurrency	1	C	3	1,3,5
13.	Mutual Exclusion, Semaphores	2	C,D,I	3	1,3,5
14.	Monitors, Readers/Writers problem	1	C,D,I	3	1,3,5
15.	Principles of Deadlock	1	C	3	1,3,5
16.	Deadlocks – prevention- avoidance – detection	1	C,I	3	1,3,5
17.	Scheduling- Types of Scheduling	2	C,I	3	1,3,5
18.	Scheduling algorithms.	1	C,I	3	1,3,5
UNIT IV: MEMORY		**9**			
19.	Memory management requirements, Partitioning	1	C,D,I	4	1,3,5
20.	Paging and Segmentation	2	C,D,I	4	1,3,5
21.	Virtual memory - Hardware and control structures	1	C,D	4	1
22	Operating system software	3	C	4	1
23	Linux memory management,	1	D,I	4	1
24	Windows memory management.	1	D,I	4	1
UNIT V: INPUT/OUTPUT AND FILE SYSTEMS		**9**			
25	I/O management and disk scheduling – I/O devices, organization of I/O functions	2	C,D	5	1,3,5
26	OS design issues, I/O buffering	1	C,D	5	1,3,5

Session	Description of Topic (Theory)	Contact hours	C-D-I-O	IOs	Reference
27	Disk scheduling,	1	D,I	5	1,3,5
28	Disk cache	1	C	5	1,3,5
29	File management-Overview, Organization and Access	2	C,D,I	5	1,3,5
30	Directories, File sharing	1	C	5	1,3,5
31	Record Blocking, secondary storage management.	1	C,D	5	1,3,5
Total contact hours		**45***			

Sl. No.	Description of experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Write programs using the following system calls of Linux operating system: Fork, exec, getpid, exit, wait, close, stat, opendir, readdir	2	D,I	1	6
2.	Write programs using the I/O system calls of Linux operating system (open, read, write,etc), ls, grep Commands	2	D,I	1	6
3.	Simulate the following CPU scheduling algorithms a. Round Robin b) SJF c) FCFS d) Priority	4	D,I	2	1,3,5
4.	Simulate file allocation strategies a). Sequential b) Indexed c) Linked	4	D,I	4	1
5.	Simulate Memory partitioning using MVT and MFT	2	D,I	4	1,3,5
6.	Implementation of Bankers Algorithm for Dead Lock Avoidance	2	D,I	3	1,3,5
7.	Simulate an Algorithm for Dead Lock Detection	2	D,I	3	1,3,5
8.	Simulate page replacement algorithms a. FIFO b) LRU c) LFU	4	D,I	4	1,3,5
9.	Simulate File Organization Techniques a. Single level directory b) Two level c) Hierarchical	2	D,I	5	1
10.	Simulate Paging Technique of memory management.	2	D,I	4	1,3,5
11.	Simulate Shared memory and IPC	2	D,I	4	1
12.	Implement Threading & Synchronization Applications	2	D,I	2	1
Total contact hours		**30***			

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	William Stallings, "Operating Systems – internals and design principles", Prentice Hall, 7thEdition, 2011.(Ch 1-9,11,12).
2.	William Stallings "Operating Systems – Internals and design principles", Pearson Education, 5th Edition.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Andrew S. Tannenbaum & Albert S. Woodhull, "Operating System Design and Implementation", Prentice Hall , 3rd Edition, 2006.
4.	Andrew S. Tannenbaum, "Modern Operating Systems", Prentice Hall,3rd Edition,2007.
5.	Silberschatz, Peter Galvin, Greg gagne "Operating System Principles", Wiley India,7th Edition, 2006.
6.	Unix Command Reference Guide

Course nature		**Theory + Practical**					
Assessment Method – Theory Component (Weightage 50%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**
Assessment Method – Practical Component (Weightage 50%)							
In-semester	**Assessment tool**	Experiments	Record	MCQ/Quiz/Viva Voce	Model examination		**Total**
	Weightage	**40%**	**5%**	**5%**	**10%**		**60%**
End semester examination Weightage :							**40%**

* Excluding Assessment Hours

15CS375L	Minor Project I	L	T	P	C
		0	0	3	2
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July, 2016				

PURPOSE	To obtain an hands-on experience in converting a small novel idea / technique into a working model / prototype involving multi-disciplinary skills and / or knowledge and working in at team.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able								
1.	To conceptualise a novel idea / technique into a product	c						
2.	To think in terms of multi-disciplinary environment		d					
3.	To understand the management techniques of implementing a project				k			
4.	To take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.			g				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	An Multidisciplinary project to be taken up by a team of maximum of ten students. Development of prototype product, a 3D model, simulation, blueprint for a larger project and any other development work are permitted. The contribution of the individuals in the project should be clearly brought out. A combined report is to be submitted. A presentation is to be made for the reviewers on the work done by the candidate.		C,D,I	1,2,3,4	
	Total contact hours				

Course nature		**Project – 100% internal continuous assessment**	
Assessment Method (Weightage 100%)			
In-semester	**Assessment tool**	Refer the table	**Total**
	Weightage	Refer the table below	**100%**
End semester examination Weightage :			**0%**

Assessment components

Assessment component	Expected outcome	Evaluators	Criteria or basis	Marks
Project proposal (Review – I)	A short presentation to be delivered on: • A brief, descriptive project title (2-4 words). This is critical! • The 3 nearest competitors (existing solutions) and price. • Team members name, phone number, email, department/degree program, and year. • A description of the product opportunity that has been identified. To include: Documentation of the market need, shortcomings of existing competitive products, and definition of the target market and its size. • Proposed supervisor / guide	Panel of reviewers	Viability / feasibility of the project Extent of preliminary work done.	**0**

Assessment component	Expected outcome	Evaluators	Criteria or basis	Marks
Review II	• Mission Statement / Techniques • Concept Sketches, Design Specifications / Modules & Techniques along with System architecture • Coding	Panel of reviewers	Originality, Multi-disciplinary component, clarity of idea and presentation, team work, handling Q&A.	**20**
Review III	• Final Concept and Model / Algorithm/ Technique • Drawings, Plans / programme output • Financial Model / costing • Prototype / Coding • Final Presentation and Demonstration	Panel of reviewers	Originality, Multi-disciplinary component, clarity of idea and presentation, team work, handling Q&A.	**50**
Final technical Report	A good technical report	Supervisor / Guide	Regularity, systematic progress, extent of work and quality of work	**30**
			Total	**100**

15CS380L	Seminar I	L	T	P	C
		0	0	3	2
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July, 2016				

PURPOSE	To inculcate the research culture among the students through literature reading, modelling a problem, analyzing and presenting.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able								
1.	To understand the research methodology adopted by various researchers	h	i	j				
2.	To mathematically model a problem, critically analyse it and adopt strategies to solve	b	c	e				
3.	To understand and present a well documented research	e	g					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Guidelines for conducting 15CS380L Seminar for B.Tech 1. Upon registering for the course the student must identify a sub-domain of the degree specialization that is of interest to the student and start collecting research papers as many as possible. 2. After collecting sufficient number of research papers the student must peruse all the papers, meet the course faculty and discuss on the salient aspects of each and every paper. 3. The course faculty, after discussion with the student will approve TWO research papers that is appropriate for presentation. 4. The student must collect additional relevant reference materials to supplement and compliment the two research papers and start preparing the presentation. 5. Each student must present a 15-minute presentation on each of the approved research paper to the panel of evaluators. 6. The presenter must present one research paper within the first half of the semester (6 weeks) and another research paper in the next half of the semester (6 weeks) as per the schedule. 7. All other students registered for the course will form the audience. 8. The audience as well as the evaluators will probe the student with appropriate questions and solicit response from the presenter. 9. The presentation will be evaluated against 7 to 8 assessment criteria by 4 to 5 evaluators. 10. The score obtained through the presentations of TWO research papers will be converted to appropriate percentage of marks. This course is 100% internal continuous assessment.		C,D	1,2,3,4	
Total contact hours		**30**			

Course nature		**100% internal continuous assessment.**		
Assessment Method (Weightage 100%)				
In-semester	**Assessment tool**	Presentation 1	Presentation 2	**Total**
	Weightage	**50%**	**50%**	**100%**
End semester examination Weightage :				**0%**

15CS385L	MOOCs I	L	T	P	C
		0	0	3	2
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July, 2016				

PURPOSE	To offer students the opportunity to study with the world's best universities by integrating select MOOCs in a regular degree programme and providing students full credit transfer, as per university regulations, if they earn a "Verified / Completion Certificate" and take a proctored examination through a secure, physical testing center.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able								
1.	To apply the concepts, theories, laws, technologies learnt herein to provide engineering solutions.	f	h	i	j			

Course nature		**Online - 100% internal continuous assessment.**				
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Quiz	Assignment	Non-proctored / Unsupervised Tests	Proctored / Supervised Test	**Total**
	Weightage	**25%**	**25%**	**10%**	**40%**	**100%**
End semester examination Weightage :						**0%**

Registration process, Assessment and Credit Transfer:

1. Students can register for courses offered by approved global MOOCs platforms like edX, Coursera or Universities with which SRM partners specifically for MOOCs.
2. Annually, each department must officially announce, to the students as well as to the Controller of Examinations, the list of courses that will be recognized and accepted for credit transfer.
3. The department must also officially announce / appoint one or more faculty coordinator(s) for advising the students attached to them, monitoring their progress and assist the department in proctoring the tests, uploading the marks / grades, and collecting and submitting the graded certificate(s) to the CoE, within the stipulated timeframe.
4. Student who desires to pursue a course, from the above department-approved list, through MOOCs must register for that course during the course registration process of the Faculty of Engineering and Technology, SRM University.
5. The maximum credit limits for course registration at SRM will include the MOOCs course registered.
6. The student must periodically submit the marks / grades obtained in various quizzes, assignments, tests etc immediately to the Faculty Advisor or the Course Coordinator for uploading in the university's academic module.
7. The student must take the final test as a Proctored / Supervised test in the university campus.
8. The student must submit the "Certificate of Completion" as well as the final overall Marks and / or Grade within the stipulated time for effecting the grade conversion and credit transfer, as per the regulations. It is solely the responsibility of the individual student to fulfil the above conditions to earn the credits.
9. The attendance for this course, for the purpose of awarding attendance grade, will be considered 100% , if the credits are transferred, after satisfying the above (1) to (7) norms; else if the credits are not transferred or transferable, the attendance will be considered as ZERO.

15CS490L	Industrial Module I	L	T	P	C
		0	0	3	2
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July, 2016				

PURPOSE	To offer students the opportunity to interact with industries and learn the best practices adopted by them.							
INSTRUCTIONAL OBJECTIVES		**STUDENT**						
At the end of the course, student will be able								
1.	To obtain an insight into the current industrial trends and practices	h						
2.	To obtain an insight into the technologies adopted by industries	k						
3.	To obtain an insight into the technical problems encountered by the industries and the scope for providing solutions.	e						
4.	To network with industry	h						

Description of Topic	Contact hours	C-D-I-O	IOs	Reference
1. The department will identify and shortlist few emerging topics that are trending in industry. 2. The department will identify experts from industry who are willing to deliver modules on the shortlisted topics. 3. The identified expert will assist the department in formulating the course content to be delivered as a 30-hour module, prepare lectures notes, ppt, handouts and other learning materials. 4. The department will arrange to get the necessary approvals for offering the course, from the university's statutory academic bodies well before the actual offering. 5. The department must officially announce, to the students as well as to the Controller of Examinations, the list of courses that will be offered as industry module. 6. The department must also officially announce / appoint one or more faculty coordinator(s) for advising the students attached to them, monitoring their progress and assist the department in proctoring/supervising/assessment the quizzes, assignments, tests etc, uploading the marks, attendance etc, within the stipulated timeframe. 7. The Student who desires to pursue a course, from the above department- approved list, must register for that course during the course registration process of the Faculty of Engineering and Technology, SRM University. 8. The maximum credit limits for course registration at SRM will include the Industry Module also. 9. All academic requirements of a professional course like minimum attendance, assessment methods, discipline etc will be applicable for this Industry Module. 10. The course will be conducted on week ends or beyond the college regular working hours.		C,D,I,O	1,2,3,4	
Total contact hours		**30**		

Course nature		**100% internal continuous assessment.**					
Assessment Method – Theory Component (Weightage 50%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage							**50%**

15CS390L	Industrial Training	L	T	P	C
		0	0	3	2
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Core				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July, 2016				

PURPOSE	To provide short-term work experience in an Industry/ Company/ Organization							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able								
1.	To get an inside view of an industry and organization/company				j			
2.	To gain valuable skills and knowledge				j			
3.	To make professional connections and enhance networking	f	g					
4.	To get experience in a field to allow the student to make a career transition			i				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	1. It is mandatory for every student to undergo this course. 2. Every student is expected to spend a minimum of 15-days in an Industry/ Company/ Organization, during the summer vacation. 3. The type of industry must be NOT below the Medium Scale category in his / her domain of the degree programme. 4. The student must submit the "Training Completion Certificate" issued by the industry / company / Organization as well as a technical report not exceeding 15 pages, within the stipulated time to be eligible for making a presentation before the committee constituted by the department. 5. The committee will then assess the student based on the report submitted and the presentation made. 6. Marks will be awarded out of maximum 100. 7. Appropriate grades will be assigned as per the regulations. 8. Only if a student gets a minimum of pass grade, appropriate credit will be transferred towards the degree requirements, as per the regulations. 9. It is solely the responsibility of the individual student to fulfill the above conditions to earn the credits. 10. The attendance for this course, for the purpose of awarding attendance grade, will be considered 100%, if the credits are transferred, after satisfying the above (1) to (8) norms; else if the credits are not transferred or transferable, the attendance will be considered as ZERO. 11. The committee must recommend redoing the course, if it collectively concludes, based on the assessment made from the report and presentations submitted by the student, that either the level of training received or the skill and / or knowledge gained is NOT satisfactory.		D, I,O	1,2,3,4	
	Total contact hours				

Course nature		**Training – 100% internal continuous assessment**		
Assessment Method (Weightage 100%)				
In-semester	**Assessment tool**	**Presentation**	**Report**	**Total**
	Weightage	**80%**	**20%**	**100%**
End semester examination Weightage :				**0%**

15CS314J	Compiler Design	L	T	P	C
		3	0	2	4
Co-requisite:	Nil				
Prerequisite:	15CS301				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Core				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	To acquire analytical ability in solving mathematical problems as applied to the respective branches of Engineering.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, the students would be able to								
1.	Learn the fundamentals of the Design of Compilers by applying mathematics and engineering principles	a						
2.	Design a system for parsing the sentences in a compiler grammar	c						
3.	Design a system to translate into various intermediate codes	c						
4.	Analyze the methods of implementing a Code Generator for compilers	a	c					
5.	Analyze and Design the methods of developing a Code Optimizer	a	c					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
UNIT I: INTRODUCTION TO COMPILER & AUTOMATA		**9**			
1.	Compilers – Analysis of the source program	1	C	1	1,2
2.	Phases of a compiler – Cousins of the Compiler	1	C	1	1
3.	Grouping of Phases – Compiler construction tools	1	C	1	1
4.	Lexical Analysis – Role of Lexical Analyzer	1	C	1	1,2
5.	Input Buffering – Specification of Tokens- design of lexical analysis (LEX)	1	C,D	1	1
6.	Finite automation (deterministic & non deterministic) - Conversion of regular expression of NDFA – Thompson's	2	C,D	1	1,2,3,4,5
7.	Conversion of NDFA to DFA- minimization of NDFA	1	C,D	1	1,2,3,4,5
8.	Derivation - parse tree - ambiguity	1	C	1	1,2,3,4,5
UNIT II: SYNTAX ANALYSIS – PARSING		**10**			
9.	Definition - role of parsers - top down parsing - bottom-up parsing	1	C	2	1,2
10.	Left recursion - left factoring - Handle pruning , Shift reduce parsing	1	C	2	1,2
11.	LEADING- TRAILING- Operator precedence parsing	1	C,D	2	2
12.	FIRST- FOLLOW	1	C	2	1,2,3,4,5
13.	Predictive parsing	1	C,D	2	1,2,3,4,5
14.	Recursive descent parsing	1	C,D	2	1
15.	LR parsing – LR (0) items - SLR parsing	2	C,D	2	1,2,3,4,5
16.	Canonical LR parsing	1	C,D	2	1,2
17.	LALR parsing	1	C,D	2	1,2
UNIT III: INTERMEDIATE CODE GENERATION		**9**			
18.	Intermediate Languages - prefix - postfix - Quadruple - triple - indirect triples	1	C	3	1,2,3,4,5
19.	Syntax tree- Evaluation of expression - three-address code	1	C	3	1,2
20.	Synthesized attributes – Inherited attributes	1	C	3	1,2
21.	Intermediate languages – Declarations	1	C,D	3	1,2
22.	Assignment Statements	1	C,D	3	1,2,3,4,5
23.	Boolean Expressions	2	C,D	3	1,2,3,4,5
24.	Case Statements	1	C,D	3	1
25.	Back patching – Procedure calls.	1	C,D	3	1
UNIT IV: CODE GENERATION		**9**			
26.	Issues in the design of code generator.	1	C,D	4	1

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
27.	The target machine – Runtime Storage management	2	C,D	4	1
28.	Basic Blocks and Flow Graphs	1	C	4	1,2,3,4,5
29.	Next-use Information – A simple Code generator	1	C,D	4	1
30.	DAG representation of Basic Blocks	1	C,D	4	1,2,3
31.	Peephole Optimization	1	C	4	1
32.	Cross Compiler – T diagrams	1	C,D	4	1
UNIT V: CODE OPTIMIZATION		**9**			
33.	Introduction– Principal Sources of Optimization	1	C	5	1
34.	Optimization of basic Blocks	1	C,D	5	1,2,3
35.	Loop Optimization	2	C,D	5	1,2,3
36.	Introduction to Global Data Flow Analysis –	1	C	5	1
37.	Runtime Environments – Source Language issues	1	C,D	5	1
38.	Storage Organization	1	C,D	5	1
39.	Storage Allocation strategies – Access to non-local names	1	C	5	1
40.	Parameter Passing.	1	C	5	1
Total contact hours		**45***			

Session	Description of the Experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Converting a regular expression to NFA	2	D,I	1	1,2,3
2.	Conversion of Regular Expression to NFA	4	D,I	1	1,2,3
3.	Conversion of an NFA to DFA	4	D,I	1	1,2,3
4.	Computation of FIRST and FOLLOW sets	2	D,I	2	1,2,3
5.	Computation of Leading and Trailing Sets	2	D,I	2	1,2,3
6.	Construction of Predictive Parsing Table	2	D,I	2	1,2,3
7.	Construction of Recursive Descent Parsing	2	D,I	2	1,2,3
8.	Implementation of Shift Reduce Parsing	2	D,I	2	1,2,3
9.	Computation of LR(0) items	4	D,I	2	1,2,3
10.	Construction of DAG	2	D,I	4	1,2,3
11.	Intermediate code generation – Three Address Codes	2	D,I	3	1,2,3
12.	Intermediate code generation – Postfix, Prefix	2	D,I	3	1,2,3
	Total Contact Hours	**30***			

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Alfred V Aho , Jeffery D Ullman , Ravi Sethi, " Compilers , Principles techniques and tools ", Pearson Education 2011
2.	S.Godfrey Winster,S.Aruna Devi,R.Sujatha,"Compiler Design",Yesdee Publishing Pvt.Ltd, 2016
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	K.Muneeswaran , ,"Compiler Design", Oxford Higher Education,Fourth edition 2015
4.	David Galles, "Modern Compiler Design", Pearson Education, Reprint 2012.
5.	Raghavan V., "Principles of Compiler Design", Tata McGraw Hill Education Pvt. Ltd., 2010.

Course nature			**Theory + Practical**				
Assessment Method – Theory Component (Weightage 50%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**
Assessment Method – Practical Component (Weightage 50%)							
In-semester	**Assessment tool**	Experiments	Record	MCQ/Quiz/Viva Voce	Model examination		**Total**
	Weightage	**40%**	**5%**	**5%**	**10%**		**60%**
End semester examination Weightage :							**40%**

* Excluding Assessment Hours

15CS303M	Multi Disciplinary Design	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Core				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	Students of any specialization at an undergraduate level learn courses related to various sub-domains (Multi-disciplinary) of their specialization individually. They are not exposed to understanding how the various multi-disciplinary fields interact and integrate in real life situations. It is very common that an expert in a particular domain models and designs systems or products oblivious of the impact of other subsystems. This lack of multi-disciplinary thinking is very blatantly visible when the students take up their major project during their final year. This course aims to develop appropriate skills on systemic thinking on how to identify and formulate a problem, decompose the problem into smaller elements, conceptualize the design, evaluate the conceptual design by using scientific, engineering and managerial tools, select, analyze and interpret the data, consideration of safety, socio-politico- cultural, risks and hazards, disposal, regional and national laws, costing and financial model and undertake documentation and finally presentation.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able								
1.	To subdivide a complex system into smaller disciplinary models, manage their interfaces and reintegrate them into an overall system model	a	c	e	f	i	l	
2.	To rationalize a system architecture or product design problem by selecting appropriate design variables, parameters and constraints	a	c	e	f	i	l	
3.	To design for value and quantitatively assess the expected lifecycle cost of a new system or product	a	c	e	f	i	l	
4.	To take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.	a	c	e	f	i	l	

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
1	Introduction: Facilitating Multidisciplinary Projects		C,D,I,O	1,2,3,4	1,2
2	Identifying and formulating a problem				
3	System Modelling				
4	Thinking perspectives: Decomposition–Composition Thinking Hierarchical Thinking, Organizational Thinking, Life-Cycle Thinking, Safety Thinking, Risk Thinking, Socio-politico-cultural thinking, Environment thinking				
5	Decomposing a system – Identifying the major sub-systems				
6	Mathematical Modeling and Governing equations for each sub systems				
7	Objectives, Constraints and Design Variables				
8	Conceptual Design				
9	Collaborative Design – Disciplinary teams satisfy the local constraints while trying to match the global constraints set by the project coordinator.				
10	Tools for modeling, designing, analysis, data interpretation, decision making etc				
11	Design Analysis, evaluation and selection				
12	Costing and Financial model				
13	Documentation, reviewing and presentation				
Total contact hours		**45**			

LEARNING RESOURCES	
Sl. No.	**REFERENCES**
1.	**Systems Design and Engineering: Facilitating Multidisciplinary Development Projects** G. Maarten Bonnema, Karel T. Veenvliet, Jan F. Broenink December 15, 2015, CRC Press ISBN 9781498751261
2.	**Exploring Digital Design-Multi-Disciplinary Design Practices,** Ina Wagner , Tone Bratteteig , Dagny Stuedahl, Springer-Verlag London, 2010, ISSN:1431-1496 ***Additional references can be included by the respective departments based on the domain and / or theme.***

Course nature				**Predominantly Practice complimented by theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Review 1	Review 2	Review 3	Review 4	**Total**
	Weightage	**10%**	**25%**	**25%**	**40%**	**100%**
End semester examination Weightage :						**0%**

Pedagogy:

Theme or major/broad domains will be announced by the department every semester. Multi-disciplinary designs will be made by the students in groups (group size may be decided by the course coordinator), with the topic of interest falling within the theme or major/broad domains as announced by the department, applying any combinations of the disciplines in engineering. 3D modelling and / or simulation must be used to validate the design.

In a combination of lecture and hands-on experiences, students must be exposed to understand and analyze engineering designs (or products) and systems, their realization process and project management. Analysis of the design criteria for safety, ergonomics, environment, life cycle cost and sociological impact is to be covered. Periodic oral and written status reports are required. The course culminates in a comprehensive written report and oral presentation. If required guest lecturers from industry experts from the sub-domains may be arranged to provide an outside perspective and show how the system design is being handled by the industry. The Conceive Design Implement Operate (CDIO) principles must be taught to the students.

A full-scale fabrication is not within the purview /scope of this course. Of course this design, if scalable and approved by the department, can be extended as the major project work
This course is 100% internal continuous assessment.

15CS376L	Minor Project II	L	T	P	C
		0	0	3	2
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July, 2016				

PURPOSE	To obtain an hands-on experience in converting a small novel idea / technique into a working model / prototype involving multi-disciplinary skills and / or knowledge and working in at team.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able								
1.	To conceptualize a novel idea / technique into a product	c						
2.	To think in terms of multi-disciplinary environment		d					
3.	To understand the management techniques of implementing a project				k			
4.	To take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.			g				

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	An Multidisciplinary project to be taken up by a team of maximum of ten students. Development of prototype product, a 3D model, simulation, blueprint for a larger project and any other development work are permitted. The contribution of the individuals in the project should be clearly brought out. A combined report is to be submitted. A presentation is to be made for the reviewers on the work done by the candidate.		C,D,I	1,2,3,4	
	Total contact hours				

Course nature		**Project – 100% internal continuous assessment**	
Assessment Method (Weightage 100%)			
In-semester	**Assessment tool**	Refer the table	**Total**
	Weightage	Refer the table below	**100%**
End semester examination Weightage :			**0%**

Assessment components

Assessment component	**Expected outcome**	**Evaluators**	**Criteria or basis**	**Marks**
Project proposal (Review – I)	A short presentation to be delivered on: • A brief, descriptive project title (2-4 words). This is critical! • The 3 nearest competitors (existing solutions) and price. • Team members name, phone number, email, department/degree program, and year. • A description of the product opportunity that has been identified. To include: Documentation of the market need, shortcomings of existing competitive products, and definition of the target market and its size. • Proposed supervisor / guide	Panel of reviewers	Viability / feasibility of the project Extent of preliminary work done.	**0**

Assessment component	Expected outcome	Evaluators	Criteria or basis	Marks
Review II	• Mission Statement / Techniques • Concept Sketches, Design Specifications / Modules & Techniques along with System architecture • Coding	Panel of reviewers	Originality, Multi-disciplinary component, clarity of idea and presentation, team work, handling Q&A.	**20**
Review III	• Final Concept and Model / Algorithm/ Technique • Drawings, Plans / programme output • Financial Model / costing • Prototype / Coding • Final Presentation and Demonstration	Panel of reviewers	Originality, Multi-disciplinary component, clarity of idea and presentation, team work, handling Q&A.	**50**
Final technical Report	A good technical report	Supervisor / Guide	Regularity, systematic progress, extent of work and quality of work	**30**
			Total	**100**

15CS381L	Seminar II	L	T	P	C
		0	0	3	2
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July, 2016				

PURPOSE	To inculcate the research culture among the students through literature reading, modelling a problem, analyzing and presenting.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able								
1.	To understand the research methodology adopted by various researchers	h	i	j				
2.	To mathematically model a problem, critically analyze it and adopt strategies to solve	b	c	e				
3.	To understand and present a well documented research	e	g					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Guidelines for conducting 15CS381L Seminar for B.Tech 1. Upon registering for the course the student must identify a sub-domain of the degree specialization that is of interest to the student and start collecting research papers as many as possible. 2. After collecting sufficient number of research papers the student must peruse all the papers, meet the course faculty and discuss on the salient aspects of each and every paper. 3. The course faculty, after discussion with the student will approve TWO research papers that is appropriate for presentation. 4. The student must collect additional relevant reference materials to supplement and compliment the two research papers and start preparing the presentation. 5. Each student must present a 15-minute presentation on each of the approved research paper to the panel of evaluators. 6. The presenter must present one research paper within the first half of the semester (6 weeks) and another research paper in the next half of the semester (6 weeks) as per the schedule. 7. All other students registered for the course will form the audience. 8. The audience as well as the evaluators will probe the student with appropriate questions and solicit response from the presenter. 9. The presentation will be evaluated against 7 to 8 assessment criteria by 4 to 5 evaluators. 10. The score obtained through the presentations of TWO research papers will be converted to appropriate percentage of marks. This course is 100% internal continuous assessment.		C,D	1,2,3,4	
Total contact hours		**30**			

Course nature		**100% internal continuous assessment.**		
Assessment Method (Weightage 100%)				
In-semester	**Assessment tool**	Presentation 1	Presentation 2	**Total**
	Weightage	**50%**	**50%**	**100%**
End semester examination Weightage :				**0%**

15CS386L	MOOCs II	L	T	P	C
		0	0	3	2
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July, 2016				

PURPOSE	To offer students the opportunity to study with the world's best universities by integrating select MOOCs in a regular degree programme and providing students full credit transfer, as per university regulations, if they earn a "Verified / Completion Certificate" and take a proctored examination through a secure, physical testing center.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able								
1.	To apply the concepts, theories, laws, technologies learnt herein to provide engineering solutions.	f	h	i	j			

Course nature		**Online - 100% internal continuous assessment.**				
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Quiz	Assignment	Non-proctored / Unsupervised Tests	Proctored / Supervised Test	**Total**
	Weightage	**25%**	**25%**	**10%**	**40%**	**100%**
End semester examination Weightage :						**0%**

Registration process, Assessment and Credit Transfer:

1. Students can register for courses offered by approved global MOOCs platforms like edX, Coursera or Universities with which SRM partners specifically for MOOCs.
2. Annually, each department must officially announce, to the students as well as to the Controller of Examinations, the list of courses that will be recognized and accepted for credit transfer.
3. The department must also officially announce / appoint one or more faculty coordinator(s) for advising the students attached to them, monitoring their progress and assist the department in proctoring the tests, uploading the marks / grades, and collecting and submitting the graded certificate(s) to the CoE, within the stipulated timeframe.
4. Student who desires to pursue a course, from the above department-approved list, through MOOCs must register for that course during the course registration process of the Faculty of Engineering and Technology, SRM University.
5. The maximum credit limits for course registration at SRM will include the MOOCs course registered.
6. The student must periodically submit the marks / grades obtained in various quizzes, assignments, tests etc immediately to the Faculty Advisor or the Course Coordinator for uploading in the university's academic module.
7. The student must take the final test as a Proctored / Supervised test in the university campus.
8. The student must submit the "Certificate of Completion" as well as the final overall Marks and / or Grade within the stipulated time for effecting the grade conversion and credit transfer, as per the regulations. It is solely the responsibility of the individual student to fulfil the above conditions to earn the credits.
9. The attendance for this course, for the purpose of awarding attendance grade, will be considered 100% , if the credits are transferred, after satisfying the above (1) to (7) norms; else if the credits are not transferred or transferable, the attendance will be considered as ZERO.

15CS491L	Industrial Module II	L	T	P	C
		0	0	3	2
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July, 2016				

PURPOSE	To offer students the opportunity to interact with industries and learn the best practices adopted by them.							
INSTRUCTIONAL OBJECTIVES		**STUDENT**						
At the end of the course, student will be able								
1.	To obtain an insight into the current industrial trends and practices	h						
2.	To obtain an insight into the technologies adopted by industries	k						
3.	To obtain an insight into the technical problems encountered by the industries and the scope for providing solutions.	e						
4.	To network with industry	h						

Description of Topic	Contact hours	C-D-I-O	IOs	Reference
1. The department will identify and shortlist few emerging topics that are trending in industry. 2. The department will identify experts from industry who are willing to deliver modules on the shortlisted topics. 3. The identified expert will assist the department in formulating the course content to be delivered as a 30-hour module, prepare lectures notes, ppt, handouts and other learning materials. 4. The department will arrange to get the necessary approvals for offering the course, from the university's statutory academic bodies well before the actual offering. 5. The department must officially announce, to the students as well as to the Controller of Examinations, the list of courses that will be offered as industry module. 6. The department must also officially announce / appoint one or more faculty coordinator(s) for advising the students attached to them, monitoring their progress and assist the department in proctoring/supervising/assessment the quizzes, assignments, tests etc, uploading the marks, attendance etc, within the stipulated timeframe. 7. The Student who desires to pursue a course, from the above department- approved list, must register for that course during the course registration process of the Faculty of Engineering and Technology, SRM University. 8. The maximum credit limits for course registration at SRM will include the Industry Module also. 9. All academic requirements of a professional course like minimum attendance, assessment methods, discipline etc will be applicable for this Industry Module. 10. The course will be conducted on week ends or beyond the college regular working hours.		C,D,I,O	1,2,3,4	
Total contact hours		**30**		

Course nature		**100% internal continuous assessment.**					
Assessment Method – Theory Component (Weightage 50%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage							**50%**

15CS401	Artificial Intelligence	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Core				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	Introduce the concepts of Artificial Intelligence; Learn the methods of solving problems using Artificial Intelligence in Graph Playing, Natural Language Processing, Expert Systems and Machine Learning.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Identify problems that are amenable to solution by AI methods.	a	b					
2.	Identify appropriate AI methods to solve a given problem.	a	b					
3.	Formalize a given problem in the language/framework of different AI methods	a	b					
4.	Design and carry out an empirical evaluation of different algorithms on a problem formalization, and state the conclusions that the evaluation supports	a	b	c				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
UNIT I: Introduction		**9**			
1.	Introduction to Artificial Intelligence-History of AI- AI Techniques	1	C	1	1,2,3,4
2.	Problem Solving with AI- AI models-Data Acquisition and Learning Aspects in AI	3	C	1	1,2,3,4
3.	Problem-Solving Process – Formulating Problems-Problem Types and Characteristics- Problem Analysis and Representation	3	C,D	1	1,2,3,4
4.	Performance Measuring-Problem Space and Search-Toy Problems- Real-world problems-Problem Reduction Methods	2	C,D	1	1,2,3,4
UNIT II: Heuristic Search Techniques		**9**			
5.	General Search algorithm – Uniformed Search Methods – BFS, Uniform Cost Search	2	C	2-4	1,2,3,4
6.	Depth First search , Depth Limited search (DLS), Iterative Deepening	2	C,D	2-4	1,2,3,4
7.	Informed Search-Introduction- Generate and Test, BFS, A* Search, Memory Bounded Heuristic Search.	3	C,D	2-4	1,2,3,4
8.	Local Search Algorithms and Optimization Problems – Hill climbing and Simulated Annealing	2	D,I	2-4	1,2,3,4
UNIT III: Knowledge and Reasoning		**9**			
9.	Knowledge Representation-Knowledge based Agents-The Wumpus World	2	C	3	1,2,3,4
10.	Logic-Propositional Logic-Predicate Logic-Unification and Lifting	3	C,D,I	3	1,2,3,4
11.	Representing Knowledge using Rules-Semantic Networks-Frame Systems	2	C,D	3	1,2,3,4
12.	Inference – Types of Reasoning	2	C	3	1,2,3,4
UNIT IV: Planning		**9**			
13.	Planning Problem – Simple Planning agent –Blocks world	2	C	4	1,2,3,4
14.	Goal Stack Planning-Means Ends Analysis- Planning as a State-space Search	2	D,I	4	1,2,3,4
15.	Partial Order Planning-Planning Graphs-Hierarchical Planning-Non- linear Planning -Conditional Planning-Reactive Planning	1	C,D,I	4	1,2,3,4
16.	Knowledge based Planning-Using Temporal Logic – Execution Monitoring and Re-planning-Continuous Planning-Multi-agent Planning-Job shop Scheduling Problem	2	C,D	4	1,2,3,4

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
17.	NLP-Introduction-Levels of NLP-Syntactic and Semantic analysis-Discourse and Pragmatic Processing-Information Retrieval-Information Extraction-Machine Translation-NLP and its Application	2	C,D,I	1-4	1,2,3,4,5
UNIT V: Game Playing		**9**			
18.	Introduction-Important Concepts of Game Theory	1	C	3-4	1,2,3
19.	Game Playing and Knowledge Structure-Game as a Search Problem	2	C, D	3-4	1,2,3
20.	Alpha-beta Pruning-Game Theory Problems Game Theory	3	C, D, I	3-4	1,2,3
21.	Expert System-Architecture- Knowledge acquisition-Rule based Expert System-Frame based and Fuzzy based expert system- Case study in AI Applications	3	C,D,I	1-4	1
Total contact hours		**45***			

LEARNING RESOURCES	
Sl. No.	
1.	Parag Kulkarni, Prachi Joshi, "Artificial Intelligence –Building Intelligent Systems "PHI learning private Ltd, 2015
2.	Kevin Night and Elaine Rich, Nair B., "Artificial Intelligence (SIE)", Mc Graw Hill- 2008.
3.	Stuart Russel and Peter Norvig "AI – A Modern Approach", 2nd Edition, Pearson Education 2007.
4.	Deepak Khemani "Artificial Intelligence", Tata Mc Graw Hill Education 2013.
5.	Akshar Bharati, Vineet Chaitanya, Rajeev Sangal, "Natural Language Processing: A Paninian Perspective", Prentice Hall India Ltd.,New Delhi, 1996

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS496L	Major Project	L	T	P	C
		0	0	24	12
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Core				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting, 23rd July, 2016				

PURPOSE	The Major Project experience is the culminating academic endeavor of students who earn a degree in their Undergraduate Programs. The project provides students with the opportunity to explore a problem or issue of particular personal or professional interest and to address that problem or issue through focused study and applied research under the direction of a faculty member. The project demonstrates the student's ability to synthesize and apply the knowledge and skills acquired in his/her academic program to real-world issues and problems. This final project affirms students' ability to think critically and creatively, to solve practical problems, to make reasoned and ethical decisions, and to communicate effectively.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able								
1.	To provide students with the opportunity to apply the knowledge and skills acquired in their courses to a specific problem or issue.	a	c		e	f		i
2.	To allow students to extend their academic experience into areas of personal interest, working with new ideas, issues, organizations, and individuals.	a	c		e	f		i
3.	To encourage students to think critically and creatively about academic, professional, or social issues and to further develop their analytical and ethical leadership skills necessary to address and help solve these issues.	a	c		e	f	h	i
4.	To provide students with the opportunity to refine research skills and demonstrate their proficiency in written and/or oral communication skills.	a	c		e	f	g	i
5.	To take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.			d			g	

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	1. The Major project is a major component of our engineering curriculum: it is the culmination of the program of study enabling the students to showcase the knowledge and the skills they have acquired during the previous four years, design a product/service of significance, and solve an open-ended problem in engineering. 2. Each student must register to the project course related to his or her program 3. Major Project course consists of one semester and would be allowed to register only during the final year of study. 4. The Major Project may be initiated during the pre-final semester but will be assessed and credits transferred only during the last semester of study, upon completion of all other degree requirements. Generally the undergraduate major project is a team based one. 5. Each team in the major project course will consist of maximum of 5 students. 6. Each project will be assigned a faculty, who will act as the supervisor. 7. The project shall be driven by realistic constraints like that related to economic, environmental, social, political, ethical, health & safety, manufacturability and sustainability. 8. Each group must document and implement a management		C,D,I,O	1,2,3,4, 5	

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	structure. Group leadership roles must be clearly identified including who has responsibility for monitoring project deliverables and group coordination. 9. A group project may be interdisciplinary, with students enrolled in different engineering degrees, or in Engineering plus other faculties such as Management, Medical and Health Sciences, Science and Humanities. 10. Each student team is expected to maintain a log book that would normally be used to serve as a record of the way in which the project progressed during the course of the session. 11. Salient points discussed at meetings with the supervisor (i.e., suggestions for further meetings, changes to experimental procedures) should be recorded by the student in order to provide a basis for subsequent work. 12. The logbook may be formally assessed; 13. The contribution of each individual team member will be clearly identified and the weightage of this component will be explicitly considered while assessing the work done. 14. A project report is to be submitted on the topic which will be evaluated during the final review. 15. Assessment components will be as spelt out in the regulations. 16. The department will announce a marking scheme for awarding marks for the different sections of the report. 17. The project report must possess substantial technical depth and require the students to exercise analytical, evaluation and design skills at the appropriate level.				
	Total contact hours				

Course nature		**Project – 100 % Internal continuous Assessment**			
Assessment Method (Weightage 100%)					
In-semester	**Assessment tool**	**Review 1**	**Review 2**	**Review 3**	**Total**
	Weightage	**10%**	**15%**	**20%**	**45%**
End semester examination	**Assessment Tool**	**Project Report**	**Viva Voce**		
	Weightage :	**25%**	**30%**		**55%**

15CS320E	Computational Logic	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	To study important concepts in Logic							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Provide main notions of Mathematical Logic	a						
2.	Learn Formal framework to construct logic arguments	e						
3.	Use deductive systems along with completeness	a						
4.	Learn about comprehensive introduction of the methods and techniques in Computational Logic	a	e					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
UNIT I: PROPOSITIONAL LOGIC		**9**			
1.	Introduction, declarative sentences	1	C	1	1,2
2.	Syntax, Well formed formula, Induction and recursion, Satisfiability and Tautology	2	C	1	1
3.	Propositional connectives and boolean function, Semantics	2	C	1	1
4.	Computability and Decidability, CNF, Examples for conversion of CNF	3	C	1	1,2
5.	Boolean Satisfiability	1	C	1	1
UNIT II: PROPOSITIONAL LOGIC RULES		**8**			
6.	Natural Deduction , Examples, Problems	3	C	2,3	2,4
7.	Derived rules, Examples, Exercise Problems	3	C	2, 3	2,4
8.	Soundness theorem, Completeness theorem	2	C	3	2,4
UNIT III: FIRST ORDER LOGIC		**9**			
9.	Relations and predicates, Formulas, Interpretations	3	C	2,3	1,3
10.	Logical Equivalence, Semantic tableaux, Algorithm for semantic tableaux	4	C	2,3	1,3
11.	Soundness Theorem, Completeness Theorem	2	C	2,3	1,3
UNIT IV: FIRST ORDER LOGIC RESOLUTION		**9**			
12.	Ground resolution, Substitution, Unification Algorithm	3	C	4	1
13.	Correctness of unification Algorithm, Robinson's unification Algorithm	2	C	4	1
14.	General Resolution, Soundness of General Resolution, Completeness of General resolution	4	C	4	1
UNIT V: TEMPORAL LOGIC		**10**			
15.	Syntax and Semantics, Modal of time	2	C	3,4	1,3
16.	LTL, Semantic Tableaux	2	C	3,4	1, 2,3,5
17.	Binary Temporal Operators	1	C	3,4	1,3
18.	Branching Time Temporal Logic	2	C	3,4	1, 2,3
19.	BDD, OBDD	2	C,D	3,4	2,3
Total Contact Hours		**45***			

LEARNING RESOURCES	
Sl.No.	**TEXT BOOKS**
1.	Mordechai Ben-Ari,"Mathematical Logic for Computer Science" ,III Edition,Springer ,2012
2.	Huth M and Ryan M ," Logic in Computer Science : Modeling and Reasoning about systems", Cambridge University Press, 2005

	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Jean H. Gallier"Logic for Computer Science: Foundations of Automatic Theorem Proving", Second Edition, Dover Publications,2014
4.	I.M.Copi, D.Cohen, P.Jetli, M.Prabakar, “Introduction to Logic”, Pearson Education,2006
5.	Matt Kaufmann, Panagiotis Manolios, and J Strother Moore. Kluwer,"Computer-Aided Reasoning: An Approach.", Academic Publishers, June, 2000

Course nature				**Theory**			
Assessment Method – (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS322E	Neuro Fuzzy And Genetic Programming	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	This course provides a way to understand the concepts of Neural Networks , Fuzzy Systems and Genetic Algorithms and its applications							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, students will be able to								
1.	Understand the fundamentals of Neural Networks	a						
2.	Learn the various topologies and learning algorithms of ANN	a	i					
3.	Understand the principles and fundamentals of Fuzzy Logic	a						
4.	Understand the Fuzzy Rule based systems	a	i					
5.	Understand the concepts and techniques of Genetic Algorithms	a	i					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
UNIT I FUNDAMENTALS OF ARTIFICIAL NEURAL NETWORKS AND SIMPLE MODELS		**8**			
1.	Biological and Artificial Neuron, History of ANN	1	C	1	1,2,4
2.	ANN architectures and Learning Algorithms	1	C	1	1,2,4
3.	Activation Functions, Bias Threshold and other parameters	1	C	1	1,2,4
4.	McCullosh Pitts model, Simulation of Logic Functions	1	C	1	1,2,4
5.	Perceptron Network, Hebbian network	1	C	1	1,2,4
6.	Linear Separability problem and solutions	1	C	1	1,2,4
7.	ADALINE and MADALINE networks	1	C	1	1,2,4
8.	Practice of Neural Network tool : Simple Logic functions, XOR problem,	1	C,I	1	1,2,4
UNIT II FEEDFORWARD NETWORK, PATTERN ASSOCIATION, UNSUPERVISED LEARNING		**10**			
9.	Delta Rule, Derivation of GDR	1	C	2	1,2,4
10.	Backpropagation Algorithm, Local Minima Problem	1	C	2	1,2,4
11.	Radial Basis Function	1	C	2	1,2,4
12.	Pattern Association, Auto Associative nets	1	C	2	1,2,4
13.	Hetero Associative nets	1	C	2	1,2,4
14.	Bidirectional Associative Memory	1	C	2	1,2,4
15.	Hopfield network	1	C	2	1,2,4
16.	Competitive networks: Maxnet, SOM	1	C	2	1,2,4
17.	Learning Vector Quantization, Adaptive Resonance Theory	1	C	2	1,2,4
18.	Practice of Neural Network tool : Delta rule, Associative memory, LVQ	1	C,I	2	1,2,4
UNIT III FUNDAMENTALS OF FUZZY LOGIC		**10**			
19.	Crisp sets, Fuzzy sets, Fuzzy membership functions	1	C	3	1,2,5
20.	Operations of Fuzzy sets, Fuzzy Relations, Operations	1	C	3	1,2,5
21.	Fuzzy Extension Principle	1	C	3	1,2,5
22.	Crisp Relations, Fuzzy relations, Properties, operations,	2	C	3	1,2,5
23.	Crisp Logic, Propositional Logic, Predicate Logic Rules of Inference	2	C,D	3	1,2,5
24.	Fuzzy Truth, Fuzzy Rules,	1	C	3	1,2,5
25.	Fuzzy Reasoning	1	C	3	1,2,5
26.	Practice of Fuzzy Logic tool: Fuzzy functions, operations	1	C,I	3	1,2,5
UNIT IV FUZZY RULE BASED AND INFERENCESYSTEMS		**8**			
27.	Fuzzification of Input Variables, Application of Fuzzy operations	1	C	4	1,5

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
28.	Evaluation of Fuzzy rules, Aggregation of output Fuzzy sets	1	C	4	1,2,5
29.	Rule based systems, Conventional programs vs Rule based systems	1	C	4	1,2,5
30.	Fuzzy Propositions	1	C	4	2,5
31.	Fuzzification and Defuzzification	1	C	4	1,2,5
32.	Fuzzy Controller : Air conditioner control, Cruise Controller	1	C	4	1
33.	Fuzzy Decision making	1	C	4	1,2
34.	Practice of Fuzzy Logic tool : Fuzzy controller design and applications	1	C,I	4	1,2
UNIT V CONCEPTS AND TECHNIQUES OF GENETIC ALGORITHMS		**9**			
35.	History of Evolutionary Computing, Genetic Algorithms, basic concepts	1	C	5	1,2,3,6
36.	GA Cycle , Fitness Function, Introduction to GA Operators	1	C	5	1,2,3,6
37.	Selection Operators, Crossover, Mutation Operations	2	C	5	1,2,3,6
38.	Schema Theorem, Example	1	C,D	5	1,2,3,6
39.	Classification of Genetic Algorithm	1	C	5	1,2,3
40.	Holland Classifier Systems	1	C	5	1,2,3
41.	Genetic Programming, Data Representation	1	C	5	1,2,3
42.	Application of Genetic Algorithm, Genetic Operators	1	C,D,I	5	1,2,3,6
Total contact hours		**45***			

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Samir Roy, Udit Chakraborty, "Introduction to Soft Computing: Neuro-Fuzzy and Genetic Algorithms", Pearson Education, 2013
2.	B.K.Tripathy, J.Anuradha," Soft Computing", Cengage Learning, 2015
3.	S.N.Sivanadam, S.N.Deepa,"Principles of Soft Computing, Wiley India Edition, 2007
4.	Laurene Fausett, "Fundamentals of Neural Networks, Architectures, Algorithms and Applications", Pearson Education, 2008
	REFERENCE BOOKS/OTHER READING MATERIAL
5.	Timothy J. Ross , "Fuzzy Logic with Engineering Applications", McGraw-Hill International Editions,1995
6.	David E. Goldberg, "Genetic Algorithms-In Search, optimization and Machine Learning", Pearson Education

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS323E	Distributed Computing	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	To provide knowledge on principles and practice underlying in the design of distributed systems.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Layout foundations of Distributed Systems.	a						
2.	Get familiar with the idea of middleware and related issues	a						
3.	Understand in detail the system level and support required for distributed system	a						
4.	Understand the issues involved in studying data and cryptographic algorithms	a	e					
5.	Expose to the concept of design and implementation of distributed file systems	a	c					

Session	Description of Topic	Contact hours	C- D- I- O	IOs	Reference
UNIT I: INTRODUCTION		**7**			
1.	Introduction - overview of syllabus- Applications	1	C	1-5	1-3
2.	Examples of Distributed Systems	2	C	1	1
3.	Trends in Distributed Systems	2	C	1	1
4.	Focus on resource sharing	1	C	1	1
5.	Challenges	1	C	1	1
UNIT II: COMMUNICATION IN DISTRIBUTED SYSTEM		**9**			
6.	System Model– Physical model	1	C,D	2	1
7.	Architectural Model	1		2	1,3
8.	Fundamental Model	2	C,D	2	1
9.	Inter process Communication	1	C,D	2	1
10.	External data representation and Multicast communication	1	C,D	2	1
11.	API for internet protocols	1	C,D	2	1
12.	Network Virtualization: Overlay Networks	1	C,D	2	1
13.	Case Study: MPI	1	C,D	2	1
UNIT III: REMOTE METHOD INVOCATION AND OBJECTS		**10**			
14.	Remote Invocation – Introduction	1	C	3	1
15.	Request-reply protocols	1	C	3	1
16.	Remote procedure call	1	C	3	1
17.	Remote method invocation	1	C	3	1,2
18.	Design Issues	2	C,D	3	1
19.	Group communication - Publish-subscribe systems	2	C,D	3	1,3
20.	Shared memory approaches -Distributed objects	1	C	3	1,3
21.	Case study: CORBA	1	C	3	1
UNIT IV: SECURITY		**10**			
22.	Introduction- Overview of security techniques	1	C	4	1
23.	Cryptographic algorithms	3	C,I	4	1
24.	Digital Signatures	2	C,I	4	1
25.	Cryptography pragmatics	2	C	4	1
26.	case study: Kerberos	2	I	4	1
UNIT V: Distributed File System and Name Services		**9**			
27.	Distributed File Systems –Introduction	1	C	5	1
28.	File service architecture	2	C,D	5	1
29.	case study: Andrew File system	2	C	5	1
30.	Name Services- Introduction	1	C	5	1

Session	Description of Topic	Contact hours	C- D-I- O	IOs	Reference
31.	Name Services and Domain Name System	1	C	5	1
32.	Directory Services	1	C	5	1
33.	Case study:The X.500 Directory Service	1	C	5	1
Total Contact Hours		**45***			

LEARNING RESOURCES	
Sl.No.	**TEXT BOOKS**
1.	George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems Concepts and Design" Fifth edition – 2011- Addison Wesley.
	REFERENCE BOOKS/OTHER READING MATERIAL
2.	Tanenbaum A.S., Van Steen M., " Distributed Systems: Principles and Paradigms" , Pearson Education,2007.
3.	Liu M.L., "Distributed Computing, Principles and Applications", Pearson and education,2004.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS324E	Machine Learning	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	This Course will enable the students to study various aspects of Machine Learning and its applications useful in modern data processing							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, students will be able to								
1.	Understand the concepts of machine learning	a						
2.	Understand the clustering techniques and their utilization in machine learning	a	b					
3.	Study the neural network systems for machine learning	a	b					
4.	Learn and understand the linear learning models in machine learning	a						
5.	Study the tree based machine learning techniques and to appreciate their capability	a						

Session	Description of Topic	Contact hours	C- D- I- O	IOs	Reference
UNIT I: Introduction		**9**			
1.	Machine learning: What and why?	1	C	1	1,6
2.	Types of Machine Learning - Supervised Learning - Unsupervised Learning - reinforcement	1	C	1	1,2,6
3.	The Curse of dimensionality	1	C	1	1,6
4.	Over fitting and linear regression	1	C	1	1,6
5.	Bias and Variance	1	C	1	1,6
6.	Learning Curve	1	C	1	1,6
7.	Classification	1	C	1	1,6
8.	Error and noise	1	C	1	2,6
9.	Parametric vs. non-parametric models-Linear models	1	C	1	1,6
UNIT II: Clustering Approaches		**9**			
10.	Measuring (dis)similarity - Evaluating the output of clustering method	1	C	2	2,7
11.	Spectral clustering - Graph Laplacian - Normalized graph Laplacian	1	C	2	2,7
12.	Hierarchical clustering -Agglomerative clustering - Divisive clustering - Choosing the number of clusters	1	C	2	2,7
13.	Bayesian hierarchical clustering	1	C	2	2,7
14.	Clustering datapoints and features	1	C	2	2,7
15.	Bi-clustering	1	C	2	2,7
16.	Multi-view clustering	1	C	2	2,7
17.	K-Means clustering	1	C	2	2,7
18.	K-meloids clustering	1	C	2	2,7
UNIT III: NEURAL NETWORKS		**9**			
19.	Biological motivation for Neural Network ; Neural network Representation	1	C	3	4
20.	Perceptrons	1	C	3	4
21.	Feed forward networks	1	C	3	4
22.	Multilayer Networks and Back Propagation Algorithms	2	C	3	4
23.	Convergence and local minima and Hidden layer representation in back propagation	1	C,D	3	4
24.	Recurrent networks	1	C	3	4
25.	Application of neural network- Face recognition using neural network	2	C,D	3	4

Session	Description of Topic	Contact hours	C- D-I- O	IOs	Reference
UNIT IV: LINEAR MODELS		**9**			
26.	Linear Regression	1	C	4	2,5
27.	Logistic Regression	1	C	4	2,5
28.	Maximum Likelihood estimation (least squares)	1	C	4	1,5
29.	Robust linear regression	1	C	4	1,5
30.	Robust Linear Regression	1	C	4	1,5
31.	Ridge Regression	1	C	4	1,5
32.	Principal Component Analysis	1	C	4	1,5
33.	Bayesian Classifier	1	C	4	1 & 3
34.	Support Vector Machines	1	C	4	1
UNIT V: TREE LEARNING		**9**			
35.	Directed and Undirected trees	1	C	5	1
36.	Decision tree representation	1	C	5	**3**
37.	Basic decision tree learning algorithm	1	C	5	3
38.	Inductive bias in decision tree	1	C	5	3
39.	Issues in decision tree	1	C	5	3
40.	Classification and regression trees(CART)	1	C	5	1
41.	Random forest	1	C	5	1
42.	Multivariate adaptive regression trees(MART)	1	C	5	1
43.	Junction tree algorithm	1	C	5	1
Total contact hours		**45***			

LEARNING RESOURCES	
Sl.No.	**TEXT BOOKS**
1.	Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012
2.	Ethem Alpaydin, "Introduction to Machine Learning", Prentice Hall of India, 2005
3.	Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.
4.	Laurene Fausett, "Fundamentals of Neural Networks, Architectures, Algorithms and Applications", Pearson Education, 2008
	REFERENCE BOOKS/OTHER READING MATERIAL
5.	Hastie, Tibshirani, Friedman, "The Elements of Statistical Learning" (2nd ed)., Springer, 2008
6.	Stephen Marsland, "Machine Learning –An Algorithmic Perspective", CRC Press, 2009
7.	Christopher Bishop, "Pattern Recognition and Machine Learning" Springer, 2006

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS325E	Digital Image Processing	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	To acquire knowledge about the procedure of digital image data acquisition, processing, analysis, and their application							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, students will be able to								
1.	Understand the digital image fundamentals.	a						
2.	Improve their ability in image enhancement and restoration	a	e					
3.	Equip themselves familiar with image segmentation and compression	a	e					
4.	Familiarize with the image representation and recognition	a	e					
5.	Develop codes for various image processing techniques/applications using MATLAB Image Processing Toolbox	a	b	e				

Session	Description of Topic	Contact hours	C-D-I-O	IOS	Reference
UNIT I: DIGITAL IMAGE FUNDAMENTALS		**8**			
1.	Introduction – Digital Image Processing and overview of syllabus	1	C	1	1-7
2.	Origin – Fundamental Steps in Digital Image Processing – Components – Elements of Visual Perception	2	C,D	1	1,3,4
3.	Image Sensing and Acquisition – Image Sampling and Quantization	2	C,D	1	1,3,4
4.	Relationships between pixels	1	C	1	1,3,4
5.	Introduction to Image processing toolbox in MATLAB	2	C,I	1,5	2
UNIT II: IMAGE ENHANCEMENT		**10**			
6.	**Spatial Domain:** Gray level transformations – Histogram processing	3	C	2	1,3,4
7.	Basics of Spatial Filtering–Smoothing and Sharpening Spatial Filtering	3	C	2	1,3,4
8.	**Frequency Domain:** Basics of filtering **–** Smoothing and Sharpening frequency domain filters.	2	C	2	1,3,4
9.	MATLAB code for histogram equalization, spatial and frequency domain filter.	2	C,I	2,5	2,3,4
UNIT III: IMAGE RESTORATION AND SEGMENTATION		**10**			
10.	Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Inverse Filtering – Wiener	3	C	2,3	1,3,4
11.	**Segmentation:** Point, Line, and Edge Detection- Marr-Hildreth & Canny edge detector	2	C	2,3	1,3,4
12.	–Edge Linking and Boundary detection Local & Regional processing – Region based segmentation	2	C	2,3	1,3,4
13.	Morphological processing – Watershed segmentation algorithm.	1	C	2,3	1,3,4
14.	MATLAB code for restoring an image after degradation using adaptive and wiener filter – Edge detection operators	2	C,I	2,3,5	2,3,4
UNIT IV: WAVELETS AND IMAGE COMPRESSION		**9**			
15.	Wavelets – Sub band coding – Multi resolution expansions	2	C	3	1,3,4
16.	**Compression:** Fundamentals – Image Compression methods – Huffman, Arithmetic coding	2	C,D	3	1,3,4
17.	LZW coding, Run Length Encoding, Block Transform coding, Wavelet coding, JPEG standard.	3	C,D	3	1,3,4
18.	MATLAB code for image compression: Huffman coding ,	2	C,I	3,5	2,3,4

Session	Description of Topic	Contact hours	C-D-I-O	IOS	Reference
	Arithmetic coding, wavelet coding				
UNIT V: IMAGE REPRESENTATION AND RECOGNITION		**8**			
19.	Boundary representation – Chain Code – Polygonal approximation, signature, boundary segments	2	C	4	1,3,4
20.	Boundary description – Shape number – Fourier Descriptor	2	C	4	1,3,4
21.	Patterns and Pattern classes – Recognition based on matching	2	C,D	4	1,3,4
22.	MATLAB code for image boundary segments, Fourier Descriptor, Recognition based on matching	2	C,I	4,5	2,3,4
Total contact hours		**45***			

LEARNING RESOURCES	
Sl.No.	**TEXT BOOKS**
1.	Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education, 2014.
	REFERENCE BOOKS/OTHER READING MATERIAL
2.	Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011.
3.	Jayaraman S, Esaki Rajan S, T.Veera Kumar, "Digital Image Processing", Tata McGraw Hill Pvt. Ltd., Seventh Reprint, 2012.
4.	S.Sridhar, "Digital Image Processing", Oxford University Press, 2015.
5.	Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2015.
6.	Willliam K Pratt, "Digital Image Processing", John Willey, 2014.
7.	http://eeweb.poly.edu/~onur/lectures/lectures.html.

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS326E	Visualization Techniques	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	This course aims at understanding Information and Scientific visualization techniques and gives a clear picture of various abstraction mechanisms							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Ability to learn about different Visualization Techniques	a	g	k				
2.	Ability to study the Interaction techniques in information visualization fields	a	b					
3.	Ability to understand Various abstraction mechanisms	a	b					
4.	Ability to create interactive visual interfaces	a	b					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
UNIT I : FOUNDATIONS FOR DATA VISUALIZATION		**9**			
1.	Introduction to Visualization	1	C	1	1,4,7
2.	Visualization stages	2	C,D	1	1,4,7
3.	Experimental Semiotics based on Perception	1	C	1	1
4.	Gibson's Affordance theory	1	C	1	1
5.	A Model of Perceptual Processing	2	C,D	1	1
6.	Costs and Benefits of Visualization	1	C	1	1
7.	Types of Data	1	C	1	1
UNIT II : COMPUTER VISUALIZATION		**9**			
8.	Non-Computer Visualization	1	C	1	2,5
9.	Computer Visualization: Exploring Complex Information Spaces	1	C	1,2	2,5
10.	Fisheye Views – Applications	**2**	C	2	2
11.	Comprehensible Fisheye views – Fisheye views for 3D data	1	C	2	2
12.	Non Linear Magnification	1	C	1	2
13.	Comparing Visualization of Information Spaces	1	C	1,2	2
14.	Abstraction in computer Graphics	1	C	1,3	2,8
15.	Abstraction in user interfaces	1	C	1,3	2,8
UNIT III : MULTIDIMENSIONAL VISUALIZATION		**9**			
16.	1D, 2D, 3D Visualization techniques	2	C,D	1,3	3
17.	Trees	1	C,D	3	3
18.	Web Works	2	C	3	3
19.	Data Mapping: Document Visualization	2	C,D,I	3	3,5
20.	Workspaces	2	C,D	3	3
UNIT IV : TEXTUAL METHODS OF ABSTRACTION		**9**			
21.	From Graphics to Pure Text	1	C	1,3	2
22.	Figure Captions in Visual Interfaces	1	C,D	1.3	2
23.	Interactive 3D illustrations with images and text – Related work	1	C,D,I	3	2,6
24.	Consistency of rendered – images and their textual labels	1	C	3	2
25.	Architecture	2	C	3	2
26.	Zoom techniques for illustration purpose	2	C	3	2
27.	Interactive handling of images and text	1	C	3	2
UNIT V : ABSTRACTION IN TIME AND INTERACTIVE SYSTEMS		**9**			
28.	Animating non Photo realistic Computer Graphics	1	C,I	4	2
29.	Interaction Facilities and High Level Support for Animation Design	1	C,I	4	2,6

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
30.	Zoom Navigation in User Interfaces	1	C	4	2
31.	Interactive Medical Illustrations	1	C	4	2
32.	Rendering Gestural Expressions	1	C	4	2
33.	Animating design for Simulation	1	C,D	4	2
34.	Tactile Maps for Blind People	1	C,D	4	2
35.	Synthetic holography	1	C	1,4	2
36.	Abstraction Versus Realism, Integrating spatial and non-spatial data	1	C	1,4	2
Total contact hours		45*			

LEARNING RESOURCES	
Sl.No.	**TEXT BOOKS**
1.	Colin Ware "Information Visualization Perception for Design", 3 rd edition, Morgan Kaufman 2012.
2.	Stuart.K.Card, Jock.D.Mackinlay and Ben Shneiderman, "Readings in Information Visualization Using Vision to think", Morgan Kaufmann Publishers, 1999.
3.	Thomas Strothotte, "Computer Visualization–Graphics Abstraction and Interactivity", Springer Verlag Berlin Heiderberg 1998.
	REFERENCE BOOKS/OTHER READING MATERIAL
4.	Chaomei Chan, "Information Visualization", Beyond the horizon, 2nd edition, Springer Verlag, 2004.
5.	Pauline Wills, "Visualisation: A Beginner's Guide", Hodder and Stoughlon, 1999.
6.	Benedikt. M, "Cyberspace: Firot Steps", MIT Press, 1991.
7.	http://www.silvalifesystem.com/articles/visualization-techniques/
8.	http://www.barnesandnoble.com/w/computational-visualization-thomasstrothotte/1111486638

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS327E	Cellular Automata	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	To understand how Cellular Automata ideas can be used in Computer Processors, Cryptography, Artificial Intelligence, Biology, Finance, Physics etc.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Understand how simple rules can lead to phenomenally complex and Beautiful behaviors.	a						
2.	Understand universal computation from a mathematical point of view, and how very simple cellular automata rules can reproduce computers as powerful as any desktop or super computer.	a	c					
3.	Understand the close theoretical relationship between computer science and other disciplines particularly Mathematics and Physics.	a	b					
4.	Understand applications of Theoretical Computer Science to physical and social sciences, particularly Sociology, Biology (including medical applications), and Physics (including fluid flow)..	a	b					
5.	Expose to the concept of three dimensional analytical geometry.	a	d					

Session	Description of Topic	Contact hours	C-D-I-O	Los	Reference
UNIT I : INTRODUCTION		**9**			
1	Introduction-Short History	1	C	1	1
2	CA &Computation -Why Study CA? -CA as Powerful Computation Engines	1	C-D	1	1
3	CA as Discrete Dynamical System Simulators	1	C-D	1	1
4	Mathematical Preliminaries -Set Theory	1	C-D	1	1
5	Information Theory - Graph Theory	1	C-D	1	1
6	Groups, Rings and Fields	1	C-D	1	1
7	Rings and Fields	1	C-D	1	1
8	Abstract Cellular Automata	1	C-D	1	1
9	One Dimensional and two Dimensional CA	1	C-D	1	1
UNIT II : PHENOMENOLOGICAL STUDIES OF CELLULAR AUTOMATA		**9**			
10	Phenomenological Studies of Generic CA	1	C	1,2	1,4
11	One-dimensional Systems -Space-Time Patterns	1	C	1,2	1
12	Behavioural Classes -Difference Patterns Blocking Transformations	1	C-D	1,2	1,4
13	General Properties of Elementary CA -Local Properties - Global Properties	1	C	1,2	1
14	A Small Sampling of Rules - The k=2, r = 1 rule R22	1	C-D	1	1,3
15	The k=2, r-1 rule R30	1	C	1,2	1
16	Just-Critical-Like Behavior-Particle-Like Behavior for Space Time Pattern	1	C	1,2	1
17	Reversible Rules	1	C	1	1
18	Parameterizing the Space of CA Rules	1	C	1	1
UNIT III : CELLULAR AUTOMATA AND LANGUAGE THEORY		**9**			
19	Cellular Automata and Language Theory	1	C	1,2,3	1
20	Regular Languages/ Finite Automata	1	C-D-I	1,2,3	1

Session	Description of Topic	Contact hours	C-D-I-O	Los	Reference
21	Context-Free Languages/ Push-Down Automata	1	C-D-I	1,2,3	1
22	PDA Examples	1	C-D-I	1,2,3	1
23	CA Rule + Finite S t a t e Transition Graph	1	C	1,2	1
24	Regular Language Complexity -Entropy-Power Spectra of Regular Languages	1	C	1,2,3	1
25	Numerical Estimates	1	C-D-I	1,2,3	1
26	Li's Algorithm for Generating Power Spectra - Reversible Computation	1	C	1	1,2
27	Universal Logic Gates, T h e Billiard Ball Model	1	C	1	1,2
UNIT IV : PROBABILISTIC CELLULAR AUTOMATA		**9**			
28	Probabilistic CA Critical Phenomena	1	C	1,3	2
29	A Heuristic Discussion	1	C-D	1,2,3	2
30	-Contd-	1		1,2,3	1,2
31	Boltzmann Distribution	1	C	1	1,2
32	Free Energy -Stochastic Dynamics	1	C	1,3	2
33	Monte Carlo Dynamics	1	C-D	3	2
34	Critical Exponents	1	C	3	2
35	Monte Carlo Dynamics some examples	1	C-D	1,2,3	2,3
36	Ising Model ,General-One Dimensional Ising Model	1	C	1,3	2,3
UNIT V : QUANTUM CELLULAR AUTOMATA		**9**			
37	Quantum Cellular Automata-Introduction	1	C	1,2,3	2,3,4
38	General Properties	1	C	1,2	2
39	A Conservation Law –k=2 systems k=3 systems	1	C	1,2,3	2
40	Reaction-Diffusion Systems	1	C	1,2,3	2,3,4
41	The Belousov-Zhabotinskii Reaction	1	C	1,3	2,3
42	Greenberg-Hastings Model -Hodgepodge Rule	1	C	1,2,3	2
43	Applications to Immunology	1	C	1,2,3	2
44	Random Boolean Networks	1	C	1,2,3	2
45	Overview of the Dynamics of (N , K) Nets	1	C	1,2,3	2,4
Total contact hours		**45***			

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Andrew Ilachinski **"***Cellular Automata A Discrete Universe*" - World scientific publishing company private limited, 2001. (Unit 1,2,3).
2.	Andrew Adamatzky *"Game of Life Cellular Automata"*- Springer; 1st Edition, 2010. (Unit 4,5)
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	*Michael Batty,* "Cities and Complexity: Understanding Cities with Cellular Automata, Agent-Based Models, and Fractals**",** The MIT Press,2007
4.	*Bastien Chopard, Michel Droz, "*Cellular Automata Modeling of Physical Systems**",** Cambridge University Press, 2005

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS328E	Virtual Reality	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	To acquire a knowledge about the basic concepts of Virtual Reality and its applications, system functions and design considerations.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will have an understanding about								
1.	The basic functioning of Virtual Reality Systems	a						
2.	The concepts of Geometric modeling and Geometrical Transformations.	a						
3.	Learning to animate the Virtual Environment.	a	c					
4.	Applications of the Virtual Environment	a	h					
5.	The various types of Hardware's and software's in virtual Reality systems	a	h					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
UNIT I: INTRODUCTION		**9**			1
1.	Introduction– Computer graphics	1	C,D	1-5	1
2.	Real Time Computer graphics	1	C	1	1
3.	Flight Simulation – Virtual Environments	1	C	1	1
4.	Requirements – benefits of virtual reality	1	C	1	1
5.	Introduction–The Virtual world space	1	C	1	1
6.	Positioning the virtual observer	1	C	1.2	1
7.	The perspective projection–human vision	1	C	1	1
8.	Stereo perspective projection–3Dclipping	1	C	1	1
9.	Colourtheory–Simple3D modeling	1	C	1	1
	UNIT II: Geometric Modeling Geometrical Transformations	**9**			
10.	Introduction–From 2Dto3D–3D space curves	1	C,D	2	1
11.	3D boundary representation	1	C	2	1
12.	Introduction–Frames of reference– Modeling transformations	1	C	2	1
13.	Instances–Picking–Flying	1	C	2	1
14.	Scaling the VE– Collision detection	1	C	2	1
15.	Introduction–The virtual environment	1	C	2	1
16.	The Computer environment	1	C	2	1
17.	VR Technology–Model of interaction	1	C	2	1
18.	VR System.	1	C,D	2	1
UNIT III: VIRTUAL ENVIRONMENT		**9**			
19.	Introduction–The dynamics of numbers	1	C	3	1,2
20.	Linear and Non-linear interpolation	1	C	3	1,2
21.	The animation of objects–linear and non-linear translation- shape & object in between	1	C	3	1,2
22.	Freeform – deformation–particle system	1	C	3	1,2
23.	Introduction–Objects falling in a graphical field	1	C	3	1,2
24.	Rotating wheels–Elastic collisions	1	C	3	1,2
25.	Projectiles–simple pendulum	1	C	3	1
26.	Springs	1	C	3	1
27.	Flight dynamics of an aircraft	1	C	3	1
UNIT IV: VR HARDWARES & SOFTWARES		**9**			
28.	Introduction–the age- the ear	1	C	5	1,3
29.	Thesomaticsenses	1	C	5	1

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
30.	Introduction–sensor hardware	1	I	5	1,3
31.	Head-coupled displays–Aquatic hardware	1	I	5	1,3
32.	Integrated VR systems	1	C	5	1,3
33.	Introduction– Modeling virtual world	1	C	5	1
34.	Physical simulation	1	C	5	1
35.	VR toolkits	1	D,I	5	1
36.	Introduction to VRML	1	C	5	1
UNIT V: VR APPLICATION		**9**			
37.	Introduction– Engineering	1	D	4	1,4
38.	Entertainment	1	D	4	1,4
39.	Science	1	C	4	1,4
40.	Training	1	C	4	1,4
41.	**The Future**: Introduction	1	C	4	1
42.	**The Future**: Introduction	1	C	4	1
43.	Virtual environments	2	C	4	1,4
44.	Modes of interaction	1	C	4	1
Total Contact hours		**45***			

LEARNING RESOURCES	
Sl.No.	**TEXT BOOK**
1.	John Vince, "*Virtual Reality Systems*", Pearson Education, 2002
	REFERENCE BOOKS/OTHER READING MATERIAL
2.	Adams, "*Visualizations of Virtual Reality*",TataMcGrawHill,2000.
3.	Grigore C. Burdea,PhilippeCoiffet ,"*Virtual Reality Technology*" ,WileyInterscience,1 Edition,1994.
4.	WilliamR.Sherman, AlanB.Craig, "*Understanding Virtual Reality:Interface, Application,and Design*",Morgan Kaufmann,1stEdition,2002.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Attendance	Surprise Test	Model Exam	**Total**
	Weightage	**10%**	**10%**	**5%**	**5%**	**20%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS329E	Geographical Information Systems	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	The purpose of this course is to ensure that students become sufficiently grounded in theoretical knowledge of GIS and gain skills including data capture, analysis, modeling and cartographic representation techniques.							
At the end of the course, student will be able to		**STUDENT OUTCOMES**						
1.	Understand basic concepts of GIS data structures and analysis	a	b					
2.	Gain fundamental cartographic knowledge of map projections, scale, coordinates and mapping accuracy	a	b	c				
3.	Use spatial analysis techniques to solve geographic problems	a	b	c				
4.	Find sources of geographic data	a	c					
5.	Gain the skills necessary to create GIS data through a variety of methods	a	b					
6.	Providing an introductory understanding of the ethical questions surrounding data creation, analysis, and representation	c						

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
UNIT I: FUNDAMENTALS OF GIS		**9**			
1.	Introduction to GIS, Defining GIS	2	C	1	1,2
2.	Components of GIS	1	C	1	1,3
3.	Introduction to Spatial data, Maps and their influence on the character of spatial data	2	C,D,I	2	1,2,3
4.	Basic spatial entities, Thematic characteristics of spatial data	2	C,D,I	1	1
5.	Sources of Spatial data, Field data sources – Surveying and GPS	2	C,D,I,O	4	1
UNIT II: SPATIAL DATA MODELING		**9**			
6.	Spatial data modeling introduction, Spatial data models & data structures	2	C,D,I,O	6	1,2,3
7.	Modeling Surfaces and Networks, Modeling third dimension, Modeling fourth dimension	3	C,D,I,O	5,6	1,3
8.	Introduction to attribute data management, Database data models and creating database	2	C,D,I	5	1,3
9.	GIS Database applications, Database developments	2	O	6	1,3
UNIT III: DATA INPUT AND EDITING		**11**			
10.	Introduction to data input and editing, Methods of Data input	2	C,D,I	5	1,2,4
11.	Data editing, Towards an integrated database	2	I,O	6	1,2
12.	Introduction to data analysis, Measurements in GIS, Queries and reclassification	2	C,D,I	2	1,2,3
13.	Buffering and neighborhood function, Map overlay and spatial interpolation, Analysis of surfaces and networks	2	C,DI, O	3	1,2,4
14.	Remote Sensing and GIS Integration- Principles, Classifications and Characteristics	1	C,D	5	3
15.	Extraction of Metric and Thematic Information's, Integration of Remote Sensing and GIS	2	C,D,I	5	3
UNIT IV: ANALYTICAL MODELING IN GIS		**7**			
16.	Introduction to analytical modeling, Process models	2	C,D	3,5	1
17.	Modeling physical, environmental and human processes, Modeling the decision making process and its issues	2	C,D	5	1,3
18.	Maps as output, Non-cartographic output	2	I,O	6	1,2

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
19.	Spatial multimedia and Mechanisms of delivery	1	C	5	1
UNIT V: ISSUES IN GIS		**9**			
20.	Development of computer methods for handling spatial data, Handling spatial data manually, Development of GIS	3	C,D	5	1
21.	Data quality issues, Describing data quality, Describing data errors sources of errors in GIS	3	C,O	6	1
22.	Real time GIS Applications	1	O	3	1,2
23.	Future of GIS, GIS Project Design and management	2	C	3,5	1,4
Total contact hours		**45***			

LEARNING RESOURCES	
Sl.No.	**TEXT BOOK**
1.	Ian Heywood, Sarah Cornelius and Steve carver, "Introduction to geographical information systems", Pearson Education, 4th Edition, 2012
	REFERENCE BOOKS/OTHER READING MATERIAL
2.	DeMers, M.N., "Fundamentals of Geographic Information Systems", 4thEdition, Wiley Press, 2012.
3.	Lo C.P. and Yeung, A.K.W.,"Concepts and Techniques of Geographic Information Systems", Prentice Hall, 2002.
4.	Burrough, P.A. and R.A. McDonald, "Principles of Geographical Information Systems", Oxford University Press, 1998.

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS330E	Human Computer Interface	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	The purpose of this course is to make the students knowledgeable in the area of designing, implementing and using interactive computer systems and how effective design of human computer interfaces influence individuals and organizations.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**
At the end of the course, student will be able to		
1.	Understand the basic HCI concepts and various design process, standards and guidelines	a
2.	Perform implementation support and evaluation of their design	k
3.	learn various models like Brain computing	a
4.	learn various dialogue notations and importance of groupware	a

Session	Description of Topic	Contact hours	C-D-I- O	IOs	Reference
UNIT I : FOUNDATIONS		**9**			
1.	The Human – Input-output channels – Human Memory	2	C	1	1
2.	Thinking – emotions – Psychology & design of interactive systems	1	C	1	1
3.	Computer – Text entry devices	1	C	1	1
4.	Positioning, Pointing & drawing	1	C	1	1
5.	Display devices for Virtual reality,3D	1	D	1	1
6.	Interaction – models – Frameworks & HCI	1	C	1	1
7.	Ergonomics – Interaction style	1	C	1	1
8.	WIMP Interfaces – context	1	C	1	1
9.	Paradigms for Interaction	1	C	1	1
UNIT II : SOFTWARE PROCESS & DESIGN RULES		**9**			
10.	Interaction design basics – user focus – scenarios	1	C	2	1,3
11.	Navigation – screen design & layout	1	C	2	1
12.	HCI in software process – life cycle	1	C	1	1
13.	Usability engineering	1	C	1	1,3
14.	Interactive design & prototyping	1	C	2	1,2
15.	Design rules – Principles for usability – standards	1	C	1	1
16.	Guidelines	1	C	1	1
17.	Golden rules	1	C	1	1
18.	HCI patterns	1	C	1	1
UNIT III: IMPLEMENTATION & USER SUPPORT		**9**			
19.	Implementation support – Windowing system elements	1	C	2	1,2
20.	Using tool kits – user interface management	1	C	2	1,2
21.	Evaluation techniques – goals	1	C	2	1
22.	Expert analysis – choosing a method	1	C	2	1
23.	Universal design principles	1	C	2	1
24.	Multimodal interaction, user support	1	C	2	1
25.	User support – requirements	1	C	2	1
26.	Approaches – adaptive help systems	1	C	2	1
27.	Designing user support system	1	C	2	1
UNIT IV: COGNITIVE, COMMUNICATION & COLLABORATIVE MODELS		**9**			
28.	Cognitive models – Goal & task hierarchies	1	D	3	1,4

Session	Description of Topic	Contact hours	C-D-I- O	IOs	Reference
29.	Linguistic models – Physical & device models – architectures	1	C	3	1,4
30.	Communication & collaboration models	1	C	3	1
31.	Face-to-face communication	1	C	3	1
32.	Conversation – text based	1	C	3	1
33.	Group working	1	C	3	1,4
34.	Brain computing Interface concepts	1	C	3	1,4
35.	Brain Signals - EEG	1	C	3	1,4
36.	BCI Application – case Study	1	D	3	4
UNIT V : UBIQUITOUS COMPUTING, HYPERTEXT, WWW		**9**			
37.	Ubiquitous computing application research	1	C	4	1
38.	Virtual & augmented reality –	1	C	4	1
39.	Information & data visualization	1	C	4	1
40.	Understanding hypertext	1	C	4	1
41.	Finding things, Web Technology & issues	1	C	4	1
42.	Static Web content and Dynamic Web content	1	C	4	1
43.	Groupware systems	1	C	4	1
44.	Computer mediated communication	1	C	4	1
45.	Frameworks for groupware	1	C	4	1
Total contact hours		**45***			

LEARNING RESOURCES	
Sl.No.	**TEXT BOOKS**
1.	Alan Dix- Janet Finlay- Gregory D. Abowd and Russel Beale- *Human – Computer Interaction*, (3rd Edition), Pearson Education, 2004.
2.	Ben Shneiderman and Catherine Plaisant, *Designing the User Interface: Strategies for Effective Human-Computer Interaction,* (5th Edition), Pearson Addison-Wesley, 2009.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	John M.Carrol, "*Human Computer Interaction in the New Millenium*", Pearson Education, 2002
4.	Jonathan Worlpaw andElizabeth Winter Wolpaw,"Brain – Computer Interfaces"Oxford University Press 2012.

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS331E	Data Mining And Analytics	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	To acquire knowledge of Data mining techniques							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, students will be able to								
1.	Understand the concepts of Data Mining	a						
2.	Familiarize with association rule mining	a						
3.	Familiarize various classification algorithms	a						
4.	Understand the concepts of Cluster analysis	a						
5.	Implement the Data mining concepts with various domains	a	k					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
UNIT I: Introduction		**9**			
1.	Introduction to Data Mining – Kinds of Data	2	C	1-4	1-3
2.	Data mining Functionalities – Interesting Patterns	2	C	1	1-3
3.	Task Primitives	1	C	1	1
4.	Issues in Data Mining	1	C	1	1
5.	Data Preprocessing	3	C	1	1,2,4
UNIT II: Association Rules		**8**			
6.	Basic Concepts	1	C	2	1,2
7.	Frequent Item Set Mining Methods	3	C	2	1,3
8.	Association Rules	2	C,I	2	1,3,4
9.	Correlation analysis	2	C	2	1,3
UNIT III: Classification and Prediction		**9**			
10.	Issues Regarding Classification and Prediction	1	C	3	1,2,3
11.	Decision Tree Induction Classification	2	C,I	3	1,2,4
12.	Bayesian and Rule Based Classification	3	C,I	3	1,4
13.	Support Vector Machine	2	C,I	3	1,2,4
14.	Prediction	1	C	3	1,2
UNIT IV: Cluster Analysis		**9**			
15.	What is Cluster Analysis	1	C	4	1
16.	Types of Data in Cluster Analysis	2	C	4	1
17.	Categorization of Clustering Methods	3	C,I	4	1,2,4
18.	Hierarchical Methods	3	C,I	4	1,2
UNIT V: PLASTIC ANALYSIS		**10**			
19.	Applications and Trends in Data Mining	3	C	5	1,2
20.	Machine learning	3	C,I	5	4
21.	Big data	2	C,I	5	5
22.	Cloud computing	2	C,I	5	6
Total contact hours		**45***			

LEARNING RESOURCES	
Sl.No.	**TEXT BOOKS**
1.	Jiawei Han and Micheline Kamber,"Data Mining – Concepts and Techniques", Second Edition, Morgan Kaufmann Publishers, 2006.
	REFERENCE BOOKS/OTHER READING MATERIAL
2.	M. H. Dunham, "Data Mining: Introductory and Advanced Topics", Pearson Education. 2001.
3.	D. Hand, H. Mannila and P. Smyth, "Principles of Data Mining", Prentice Hall. 2001.
4.	I H. Witten and E. Frank, "Data Mining: Practical Machine Learning Tools and Techniques", Morgan Kaufmann. 2000.
5.	Nathan Marz, James Warren, "Big Data-Principles and best practices of scalable real-time data systems", DreamTech Press, 2015
6.	Arshdeep Bahga, Vijay Madisetti, "Cloud Computing: A Hands-On Approach", University Press, 2016

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Mini Project	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS332E	Wireless Sensor Networks	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	This course provides a broad coverage of challenges and research results related to the design and management of wireless sensor networks							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Understand basic sensor network concepts	a						
2.	Know physical layer issues, Medium Access Control Protocols	a	b					
3.	Comprehend network and transport layer characteristics and protocols	a	b					
4.	Understand the network management and Middleware services	a	b					

Session	Description of Topic	Contact hours	C-D- I-O	IOs	Reference
UNIT I: FUNDAMENTALS OF SENSOR NETWORKS		**9**			
1.	Introduction to computer and wireless sensor networks and Overview of the syllabus	1	C	1-4	1-4
2.	Motivation for a network of Wireless Sensor nodes- Sensing and sensors-challenges and constraints	2	C	1	1-4
3.	node architecture-sensing sub system, processor subsystem-communication interfaces- prototypes	2	C,D	1	1
4.	Application of Wireless sensors	4	C,D	1	1
UNIT II: COMMUNICATION CHARACTERISTICS AND DEPLOYMENT MECHANISMS		**11**			
5.	Wireless Transmission Technology and systems-Radio Technology Primer-Available Wireless Technologies	2	C	1,3	2
6.	Hardware- Telosb, Micaz motes	4	C,I	1-3	2
7.	Time Synchronization- Clock and the Synchronization Problem	1	C	1	1
8.	Basics of time synchronization-Time synchronization protocols	2	C	1	1
9.	Localization- Ranging Techniques- Range based Localization-Range Free Localization- Event driven Localization	2	C	1,3	1
UNIT III: MAC LAYER		**7**			
10.	Overview-Wireless Mac Protocols-Characteristics of MAC protocols in Sensor networks	3	C	2	1-4
11.	Contention free MAC Protocols- characteristics- Traffic Adaptive Medium Access-Y-MAC, Low energy Adaptive Clustering	2	C,I	2	1
12.	Contention based MAC Protocols- Power Aware Multi-Access with signaling, Sensor MAC-Timeout MAC-Data gathering MAC	2	C,I	2	1
UNIT IV: Routing in Wireless Sensor Networks		**9**			
13.	Design Issues in WSN routing- Data Dissemination and Gathering-Routing Challenges in WSN	1	C	3	1-4
14.	Flooding-Flat Based Routing – SAR, Directed Diffusion-MCFA-Coherent and non-Coherent Processing	3	C, I	3	1,3
15	Hierarchical Routing- LEACH, PEGASIS, TEEN, APTEEN	3	C, I	3	1,3
16	Query Based Routing- Negotiation Based Routing- Geographical Based Routing	2	C,I	3	1,3
UNIT V :MIDDLEWARE AND SECURITY ISSUES		**9**			
17.	WSN middleware principles-Middleware architecture-Existing	3	C	4	2

Session	Description of Topic	Contact hours	C-D- I-O	IOs	Reference
	middleware				
18.	operating systems for wireless sensor networks-performance and traffic management	4	C	4	2
19.	Fundamentals of network security-challenges and attacks Protocols and mechanisms for security	2	C	2-4	1-4
Total contact hours		**45***			

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Waltenegus Dargie, Christian Poellabauer , "Fundamentals of Wireless Sensor Networks, Theory and Practice", Wiley Series on wireless Communication and Mobile Computing, 2011
2.	Kazem Sohraby, Daniel manoli , "Wireless Sensor networks- Technology, Protocols and Applications", Wiley InterScience Publications 2010.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Bhaskar Krishnamachari , " Networking Wireless Sensors", Cambridge University Press, 2005
4.	C.S Raghavendra, Krishna M.Sivalingam, Taieb znati , "Wireless Sensor Networks", Springer Science 2004.

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Programming Assignment-1	Programming Assignment-2	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS333E	Biometrics	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	15CS325E				
Data Book / Codes/Standards	Nil				
Course Category	P | Professional Elective				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	To understand the biometric system development and evaluation, with an emphasis on different modalities, biometric application development, cryptography, image enhancement and biometrics standards.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Understand biometrics systems operation from sensor to decision	a						
2.	Describe the principles of the core biometric modalities (face, fingerprint, retina and iris), and to deploy them in authentication scenarios	a	b					
3.	Identify the privacy and security concerns surrounding biometric systems	a						
4.	Deal with poor image qualities and its effect in biometrics.	a	k					
5.	Enumerate the most up-to-date examples of real biometric applications in human authentication	a	b	k				
6.	Organize and conduct biometric data collections, and apply biometric databases in system evaluation	a						

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
UNIT I: Introduction to Biometrics		**9**			
1.	History of Biometrics ,Types of Biometric Traits, General Architecture of Biometric System, Biometric Characteristics	3	C	1	1,3,4
2.	Basic working of Biometric Matching , Biometric System Error and Performance Measures	2	C	1	1,3,4
3.	Design of Biometric Systems , Identification and Verification Concepts	2	C,D	1	1,2,3,4
4.	Applications of Biometrics, Benefits of Biometrics versus Traditional Authentication Methods	2	C	1	1,3,4
UNIT II: Face, Fingerprint, Retina and Iris biometrics		**10**			
5.	Introduction to Face, Finger Print Retina and Iris biometrics	2	C	2	1,2,3,4
6.	Design of Face Recognition System, Neural Network for Face Recognition	2	C,D	2	1,2,3,4
7.	Face Detection in video sequences, Challenges in Face Biometrics, Face Recognition Methods, Advantages and Disadvantages	2	C	2	1,2,3,4
8.	Fingerprint Biometrics, Fingerprint Recognition System, Minutiae Extraction	2	C,D	2	1,2,3,4
9.	Design of Retina and Iris Recognition System, Iris Segmentation Method	1	C,D	2	1,2,3,4
10.	Determination of Iris Region, Experimental Results of Iris Location, Applications of Iris Biometrics, Advantages and Disadvantages	1	C	2	1,2,3,4
UNIT III: Privacy Enhancement and cryptography for biometrics		**10**			
11.	Introduction to privacy enhancement and biometric cryptography	1	C	3	1,2
12.	Privacy concerns associated with deployment, identity and privacy, privacy concerns, biometrics with privacy enhancement	1	C	3	1,2
13.	Comparison of biometrics in terms of privacy, soft biometrics	1	C	3	1,2
14.	General purpose crypto system, Model cryptography and attacks	2	C	3	1,2
15.	Symmetric key ciphers, cryptographic algorithms	2	C	3	1,2
16.	Introduction to Multimodal biometrics, Basic architecture of multimodal biometrics	2	C	3	1,2

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
17.	Multimodal biometrics using face and ear, Characteristic and advantages of multimodal biometrics	1	C	3	1,2
UNIT IV: Image Enhancement Techniques		**8**			
18.	Introduction to Image Enhancement Techniques, Current Research in Image Enhancement Techniques	2	C	4	1,5
19.	Image Enhancement, Frequency Domain Filters, Databases and Implementation	3	C	4	1,5
20.	Experimental results of Image Enhancement Techniques	3	I	4	1,5
UNIT V : Biometrics: Scope and future, Repositories for database and biometric standards		**8**			
21.	Scope and future market of biometrics	1	C	5	1,2
22.	Applications of biometrics, Biometrics and information technology infrastructure, Role of biometrics in enterprise security, Role of biometrics in border security	3	C	5	1,2
23.	Smart card technology and biometrics, Radio frequency identification biometrics, DNA biometrics, Comparative study of various biometric techniques	2	C	5	1,2
24.	Biometric Databases and Biometric Standards	2	C	6	1,2
Total contact hours		**45***			

LEARNING RESOURCES	
Sl.No.	**TEXT BOOKS**
1.	G.R.Sinha,Sandeep B Patil,"Biometrics:Concepts and Applications",Wiley publications,New Delhi,2013
2.	Robert Newman"Security and Access control using Biometric Technologies",Cengage Learning,,2010
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Jain, A.K., Flynn, P. and Ross, A. Handbook of Biometrics. 2008.
4.	Ruud M.Bolle,Sharath Pankanti, Nalini K. Ratha,Andrew W. Senior, Jonathan H. Connell, "Guide to Biometrics ",Springer ,2009
5.	Rafael C. Gonzalez, Richard Eugene Woods," Digital Image Processing using MATLAB", 2nd Edition, Tata McGraw-Hill Education ,2010

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS334E	Network Programming	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	15IT303J				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	To learn about the protocols used in internet, understand socket programming and inter system communication, build network applications and services using API.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Become familiar with elementary socket functions	a	b					
2.	Design and implement client –server applications using Sockets	a	b					
3.	Learn about functions that convert between names and numeric values and protocols	a	b	e				
4.	Analyze network programs	a	e					
5.	Build network applications	a	b	c				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
UNIT I: Introduction and TCP/IP		**9**			
1.	Introduction – simple daytime client – protocol independence- Error handling – simple daytime server- Roadmap to client/server.	2	C,I	4	1
2.	Overview of TCP/IP protocol- TCP connection establishment and termination – TCP state transition diagram – Time-wait state	3	C	1,4	1,2,4
3.	SCTP association establishment and termination –port numbers – TCP port numbers and concurrent servers- Buffer size and limitations - standard internet services- protocol usage by common Internet applications.	4	C,I	1,4,5	1
UNIT II: Elementary TCP sockets		**10**			
4.	Socket function – connect function – bind function –listen function – accept function.	4		1	1,2
5.	Fork and exec functions – concurrent servers – close function – getsockname and getpeername.	2	C,I	1,2	1
6.	TCP Echo server and Echo client – normal startup and termination	2	C,I	2	1,2
7.	POSIX signal handling –Wait and Waitpid functions – Termination of server process-Crashing and rebooting of server host	2	C,I	2,4	4
UNIT III: Socket options and UDP sockets		**8**			
8.	Get sock opt and set sock opt function	1	C	1	1
9.	IPV4 , ICMP and TCP socket options	2	C,I	1	1,2,3
10.	UDP Echo server and client- recvfrom and send to functions.	2	C,I	1,2,4,5	1,2
11.	Connect function with UDP	1	C,I	1	1
12.	dg_cli function –lack of flow control with UDP .	2	C.I	4	1,2
UNIT IV: DNS, BOOTP and DHCP		**9**			
13.	DNS- resolvers and name servers- gethostbyname function – gethostbyaddr function – getservbyname and getservbyport function.	4	C	3	1,3
14.	tcp_connect function- tcp_listen function - udp_client, udp_connect, udp_server function	3	C,I	3	1,2
15.	BOOTP and DHCP	2	C	3	1,2,3,4

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
UNIT V: Advanced sockets		**9**			
16.	IPV4 and IPV6 interoperability	2	C,I	4	1,2
17.	Daemon processes and the inetd superserver	3	C	4,5	1
18.	Advanced I/O functions	4	C	4	1
Total contact hours		**45***			

LEARNING RESOURCES	
Sl.No.	**TEXT BOOKS**
1.	W.Richard Stevens, Bill Fenner, Andrew M. Rudoff " *Unix Network programming* " 3rd edition Volume – 1, Pearson Education , 2015
2.	Douglas.E.Comer " *Internetworking with TCP/IP " principles, protocols and architecture,* 6th Edition , Volume 1, Pearson Education,2013.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Behrouz A.Forouzan , " *TCP/IP protocol suite",* 4th edition, Mc Graw Hill education private limited,2010
4.	Wendell Odom , " *IP networking ",* 1st edition, Pearson Education 2012.

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS335E	Computer Forensics	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	15IT303J				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	This course provides a way to understand Internet Security and different types of Cyber forensic technologies and enable the student to have a foundation in this emerging area.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	To study various threats associated with security and information warfare	a						
2.	To study about email security and the Importance of Firewalls and their types	a						
3.	To impart an introduction to the need of computer forensics	a						
4.	To study the tools and tactics associated with cyber forensics	a	k					
5.	To analyze and validate computer forensics data	a						

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
UNIT I: Network Layer Security & Transport Layer Security		**9**			
1.	IPSec Protocol	2	C	1	1
2.	IP Authentication Header - IP ESP - Key Management Protocol for IPSec	2	C	1	1
3.	Transport layer Security - SSL protocol	3	C	1	1
4.	Cryptographic Computations - TLS Protocol	2	C	1	1
UNIT II: E-Mail Security & Firewalls		**9**			
5.	PGP - S/MIME	2	C	2	1
6.	Internet Firewalls for Trusted System: Roles of Firewalls	2	C	2	1
7.	Firewall related terminology- Types of Firewalls - Firewall designs	3	C	2	1
8.	SET for E-Commerce Transactions	2	C	2	1
UNIT III: Introduction to Computer Forensics		**9**			
9.	Computer Forensics Fundamentals	1	C	3	2
10.	Types of Computer Forensics	2	C	3	2
11.	Forensics Technology and Systems	2	C	3	2
12.	Understanding Computer Investigation	2	C	3	2
13.	Data Acquisition	2	C	3	2
UNIT IV: Evidence Collection And Forensics Tools		**9**			
14.	Processing Crime and Incident Scenes	3	C	4	2
15.	Working with Windows and DOS Systems	3	C	4	2
16.	Current Computer Forensics Tools: Software/ Hardware Tools.	3	C	4	2
UNIT V: Analysis and Validation		**9**			
17.	Validating Forensics Data- Data Hiding Techniques – Performing Remote Acquisition	3	C	5	2
18.	Network Forensics – Email Investigations	3	C	5	2
19.	Cell Phone and Mobile Devices Forensics	3	C	5	2
Total contact hours		**45***			

LEARNING RESOURCES	
Sl.No.	**TEXT BOOKS**
1.	Man Young Rhee, "Internet Security: Cryptographic Principles, Algorithms and Protocols", Wiley Publications, 2003.
2.	Christopher Steuart, Bill Nelso, Amelia Phillips, "Guide Computer Forensics and Investigations", Cengage Learning, India, Fourth Edition, 2013.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	John R.Vacca, "Computer Forensics: Computer Crime Scene Investigation", Charless RiverMedia, 2002.
4.	Richard E.Smith, "Internet Cryptography", Pearson Education, 3rd Edition, 2008.
5.	Marjie T.Britz, "Computer Forensics and Cyber Crime: An Introduction", Pearson Education, 2nd Edition, 2011.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS336E	Network Routing Algorithms	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	15IT303J				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	To understand the principles behind the data transfer mechanisms over the conventional network.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Understand the principles behind the data transfer mechanisms over the conventional network.	a	b					
2.	Ability to configure routing algorithms over the routers	a	b					
3.	Understand the data traversal through various cross points (routers) in the network	a						
4.	Design routing algorithms for any conventional networks	e						
5.	Understand the various types of key routing protocols used in modern computer networks.	e						

Session	Description of Topic	Contact hours	C-D-I-O	Ios	Reference
UNIT I: NETWORK ROUTING: BASICS AND FOUNDATIONS		**9**			
1.	Network Routing: An Introduction to Routing algorithms	1	C	1,3	1
2.	Functions of Router	1	C	1,3	1
3.	IP Addressing	1	C,D	1,3	1,4
4.	Protocol Stack Architecture	1	C	1,3	1,4
5.	Network Topology and Management architectures	1	C	1,3	1,4
6.	PSTN	1	C	1,3	2
7.	Communication Technologies	1	C	1,3	2,4
8.	Standards committees	1	C	1,3	2,4
9.	Network Protocol Analyzer	1	C	1,3	1
UNIT II: ROUTERS AND ADDRESS LOOKUP ALGORITHMS		**9**			
10.	Types of routers	1	C,I	1	1
11.	Elements of a router	1	C	1	1
12.	Packet flow	1	C,I	1,3	1
13.	Packet processing	1	C	1,3	1
14.	Router architectures	1	C,I	1,3	1
15.	Impact of addressing on lookup	1	C	2,4	1
16.	longest prefix matching	1	C,D	2,4	1
17.	Naïve Algorithms	1	C,D	2,4	1
18.	Binary tries and Multi-bit Tries	1	C,D	2,4	1
UNIT III: ROUTING ALGORITHMS: SHORTEST PATH AND WIDEST PATH		**9**			
19.	Bellman Ford algorithm and distance vector approach	1	C,D,I	2,4	2
20.	Dijikstra's algorithm	2	C,D,I	2,4	2
21.	Comparison of Bellman Ford algorithm and Dijikstra's algorithm	2	C,D,I	2,4	1
22.	shortest and widest path computation	2	C,D,I	2,4	1
23.	k-shortest path algorithms, Routing Protocols: Framework and Principles	2	C,D,I	2,4	1
UNIT IV: ROUTING IN IP NETWORKS		**9**			
24.	IP Routing and Distance Vector Protocol Family	2	C	1,3	1
25.	Routers, Networks, and Routing information Basics	1	C	1,3	1
26.	RIP v1,v2 – IGRP – EIGRP	2	C,D	2,4,5	1
27.	OSPF and integrated IS-IS	1	C,D	2,4,5	1

Session	Description of Topic	Contact hours	C-D-I-O	Ios	Reference
28.	IP Traffic Engineering, BGP, Internet Routing Architectures	3	C,D	2,4,5	1
UNIT V: ROUTING IN WIRELESS NETWORKS		**9**			
29.	Internet based mobile ad-hoc networking	2	C,D	1,3	1,3
30.	Destination sequenced Distance Vector (DSDV),	2	C,D	2,4,5	1,3
31.	Dynamic source Routing (DSR)	2	C,D	2,4,5	1,3
32.	Ad-hoc on demand Distance Vector (AODV)	1	C,D	2,4.5	1,3
33.	Temporarily Ordered Routing algorithm (TORA).	2	C,D	2,4,5	1,3
Total contact hours		**45***			

LEARNING RESOURCES	
Sl.No.	**TEXT BOOKS**
1.	D.Medhi and K.Ramasamy, Network Routing : Algorithms, Protocols and Architectures, Morgan Kaufmann Publishers, First Edition 2007.
2.	Steen Strub M, Routing in Communication networks, Prentice Hall International, 1995
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	C.Siva Ram Murthy and B.S.Manoj, Adhoc Wireless Networks, Pearson Education, 2007.
4.	Internetworking Technologies Handbook, Inc. Cisco Systems, ILSG Cisco

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS337E	High Performance Computing	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	The Purpose of this course is to make the student familiar with High Performance Computing Principles and its Environment.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	To learn about Modern Processors and concepts	a						
2.	To understand the concepts of optimizations	a	h					
3.	To learn about Parallel Computers and Programming	a	e					
4.	To Study about Memory Parallel Programming using OpenMP and MPI	a	e					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
UNIT I:MODERN PROCESSORS		**9**			
1.	Stored Program Computer Architecture- General purpose cache-based microprocessor	2	C	1	1
2.	Performance based metrics and benchmarks-Moore's Law	2	C	1	1,2
3.	Pipelining- Superscalarity-SIMD Memory Hierarchies Cache-mapping- prefetch-Multicore processors-Mutithreaded processors	3	C	1	1,2
4.	Vector Processors- Design Principles- Maximum performance estimates- Programming for vector architecture.	2	C,D	1	1
UNIT II: BASIC OPTIMIZATION TECHNIQUES FOR SERIAL CODE		**9**			
5.	Scalar profiling- Function and line based runtime profiling- Hardware performance counters- Simple measures large impact	2	C	2	1,4
6.	Elimination of common sub expressions- Avoiding branches- Using SIMD instruction sets- The role of compilers – General optimization	2	C,D	2	1,2
7.	Inlining – Aliasing- Computational Accuracy- Register optimizations- Using compiler logs- C++ optimizations – Temporaries	2	C	2	1,2
8.	Dynamic memory management- Loop kernels and iterators Data Access Optimization: Balance analysis and light speed estimates	2	C	2	1,4
9.	Storage order- Case study: Jacobi algorithm and Dense matrix transpose.	1	C	2	1
UNIT III: PARALLEL COMPUTERS		**9**			
10.	Taxonomy of parallel computing paradigms- Shared memory computers- Cache 1oherence- UMA – ccNUMA	2	C	3	1,5
11.	Distributed-memory computers- Hierarchical systems- Networks-Basic performance characteristics- Buses- Switched	2	C	3	1,3,5
12.	and fattree networks- Mesh networks- Hybrids Basics of parallelization– Data Parallelism – Function Parallelism	1	C,D	3	1,3,5
13.	Parallel Scalability- Factors that limit parallel execution- Scalability metrics- Simple scalability laws	2	C	3	1,5
14.	parallel efficiency – serial performance Vs Strong scalability-Refined performance models	1	C	3	1,5
15.	Choosing the right scaling baseline- Case Study : Can slow processors compute faster- Load balance.	1	C	3	1,5

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
UNIT IV: SHARED MEMORY PARALLEL PROGRAMMING WITH OPENMP		**9**			
16.	Introduction to OpenMP – Parallel execution – Data scoping- OpenMP work sharing for loops- Synchronization – Reductions	3	C	4	1,3
17.	Loop Scheduling – Tasking – Case Study: OpenMP- parallel Jacobi algorithm- Advanced OpenMPwavefront parallelization	3	C,D	4	1,3,5
18.	Efficient OpenMProgramming: Profiling OpenMP programs – Performance pitfalls	2	C,D	4	1,5
19.	Case study: Parale Sparse matrix-vector multiply.	1	C	4	1,5
UNIT V: DISTRIBUTED-MEMORY PARALLEL PROGRAMMING WITH MPI		**9**			
20.	Message passing – Introduction to MPI- Messages and point-to-point communication-	1	C	4	1
21.	- Nonblocking point-to-point communication- Virtual topologies – MPI parallelization of Jacobi solver	2	C	4	1
22.	performance properties Efficient MPI programming: MPI performance tools- communication parameters	2	C	4	1
23.	Synchronization, serialization, contention- Reducing communication overhead optimal domain decomposition- Aggregating messages	2	C	4	1
24.	NonblockingVs Asynchronous communication- Collective communication- Understanding intra node P-to-P communication	2	C	4	1
Total contact hours		**45***			

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Georg Hager, Gerhard Wellein, "Introduction to High Performance Computing for Scientists and Engineers", Chapman & Hall / CRC Computational Science series, 2011.
2.	John Levesque, Gene Wagenbreth, "High Performance Computing: Programming and Application" CRC Press,2010.
3	Kai Hwang, Zhiweixu "Scalable Parallel Computing: Technology, Architecture, Programming", McGraw Hill International, 2000.
4	Charles Severance, Kevin Dowd, "High Performance Computing", O'Reilly Media, 2nd Edition, 1998.
5	Kai Hwang, Faye Alaye Briggs, "Computer Architecture and Parallel Processing", McGraw Hill, 1984.

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS338E	Database Security And Privacy	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	The course provides a foundation in database security and privacy. To design and implement security profiles, password policies, privileges and roles. Also to handle the issues in privacy.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able								
1.	To understand the fundamentals of security, and how it relates to information systems	a	b					
2.	To learn good password policies, and techniques to secure passwords in an organization	a	b	k				
3.	To handle privacy issues	a	b	k				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
UNIT I : SECURITY ARCHITECTURE & OPERATING SYSTEM SECURITY FUNDAMENTALS		**8**			
1.	**Security Architecture**: Introduction-Information Systems-Database Management Systems	2	C	1	1,3
2.	Information Security Architecture- Database Security–Asset Types and value-Security Methods	2	C,D	1	1,3
3.	**Operating System Security Fundamentals**: Introduction-Operating System Overview-Security Environment – Components- Authentication Methods	2	C	1	1,3,5
4.	User Administration-Password Policies-Vulnerabilities-E-mail Security	2	D,I	1	1,3,5
UNIT II : ADMINISTRATION OF USERS & PROFILES,PASSWORD POLICIES, PRIVILEGES AND ROLES		**10**			
5.	**Administration of Users**- Introduction-Authentication- Creating Users	2	C,D	1	1,3
6.	SQL Server User-Removing, Modifying Users-Default	2	D,I	1	1,3
7.	Remote Users-Database Links-Linked Servers-Remote Servers-Practices for Administrators and Managers-Best Practices	2	C	1	1,3
8.	**Profiles, Password Policies, Privileges and Roles**: Introduction-Defining and Using Profiles-Designing and Implementing Password Policies	2	C,D,I	2	1,3
9	Granting and Revoking User Privileges-Creating, Assigning and Revoking User Roles-Best Practices	2	I	2	1,3
UNIT III : DATABASE APPLICATION SECURITY MODELS& VIRTUAL PRIVATE DATABASES		**9**			
10.	**Database Application Security Models**: Introduction-Types of Users-Security Models	2	C	2	1,3,5
11.	Application Types-Application Security Models-Data Encryption	2	C	2	1,3,5
12.	**Virtual Private Databases**: Introduction-Overview of VPD-Implementation of VPD using Views, Application Context in Oracle	2	C,D,I	2	1,3,5
13.	Implementing Oracle VPD-Viewing VPD Policies and Application contexts using Data Dictionary	2	D,I	2	1,3,5
14.	Policy Manager Implementing Row and Column level Security with SQL Server	1	D,I	2	1,3,5

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
UNIT IV : AUDITING DATABASE ACTIVITIES		**9**			
15.	**Auditing Database Activities**: Using Oracle Database Activities-Creating DLL Triggers with Oracle	3	D,I	2	1,3
16.	Auditing Database Activities with Oracle-Auditing Server Activity with SQL Server 2000	3	D,I	2	1,3
17.	Security and Auditing Project Case Study strategy	3	C	2	1,3
UNIT V : PRIVACY PRESERVING DATA MINING TECHNIQUES		**9**			
18.	**Privacy Preserving Data Mining Techniques**: Introduction-Privacy Preserving Data Mining Algorithms	2	C,D	3	2,4
19.	General Survey-Randomization Methods-Group Based Anonymization	3	C	3	2,4
20.	Distributed Privacy Preserving Data Mining-Curse of Dimensionality	3	C,D	3	2,4
21.	Application of Privacy Preserving Data Mining	1	C	3	2,4
Total contact hours		**45***			

LEARNING RESOURCES	
1.	.Hassan A. Afyouni, "Database Security and Auditing", Third Edition, Cengage Learning, 2009. (UNIT 1 to IV)
2.	Charu C. Aggarwal, Philip S Yu, "Privacy Preserving Data Mining": Models and Algorithms, Kluwer Academic Publishers, 2008.(UNIT V).
3	Ron Ben Natan, "Implementing Database Security and Auditing", Elsevier Digital Press, 2005.
4	http://charuaggarwal.net/toc.pdf
5	http://adrem.ua.ac.be/sites/adrem.ua.ac.be/files/securitybook.pdf

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS421E	Natural Language Processing	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data\Book/ Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	This course provides a sound understanding of Natural Language Processing and challenges involved in that area							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Provide the student with knowledge of various levels of analysis involved in NLP	a	b					
2.	Understand the applications of NLP	a	j					
3.	Gain knowledge in automated Natural Language Generation and Machine Translation	a						

Session	Description of Topic	Contact hours	C-D-I- O	IOs	Reference
UNIT I: OVERVIEW AND MORPHOLOGY		**9**			
1	Introduction – Models -and Algorithms - -Regular Expressions Basic Regular Expression Patterns – Finite State Automata	3	C	1	1,2
2	Morphology -Inflectional Morphology - Derivational Morphology -	3	C, D	1	1,2
3	Finite-State Morphological Parsing --Porter Stemmer	3	C,I		1,2
UNIT II : WORD LEVEL AND SYNTACTIC ANALYSIS		**9**			
4	N-grams Models of Syntax - Counting Words - Unsmoothed N-grams	3	C, D	1	1,2
5	Smoothing- Backoff DeletedInterpolation – Entropy - English Word Classes - Tagsets for English	2	C	1,2	1,2
6	Part of Speech Tagging-Rule Based Part of Speech Tagging - Stochastic Part of Speech Tagging - Transformation-Based Tagging -	4	C,D,I	1,2	1,2
UNIT III : CONTEXT FREE GRAMMARS		**9**			
7	Context Free Grammars for English Syntax- Context- Free Rules and Trees -	3	C	1,2	1,2
8	Sentence- Level Constructions–Agreement – Sub Categorization	2	C	1,2	1,2
9	Parsing – Top-down – Earley Parsing -feature Structures – ProbabilisticContext-Free Grammars	4	C	1,2	1,2
UNIT IV : SEMANTIC ANALYSIS		**9**			
10	Representing Meaning - Meaning Structure of Language - First Order Predicate Calculus	2	C	1,2	1,2
11	Representing Linguistically Relevant Concepts -Syntax- Driven Semantic Analysis - Semantic Attachments -Syntax- Driven Analyzer	3	C, D	1,2	1,2
12	- Robust Analysis - Lexemes and Their Senses - Internal Structure - Word SenseDisambiguation -Information Retrieval	4	D,I	1,2	1,2
UNIT V : LANGUAGE GENERATION AND DISCOURSE ANALYSIS		**9**			
13	Discourse -Reference Resolution - Text Coherence - Discourse Structure – Coherence	2	D,I	1,2,3	1,3
14	Dialog and Conversational Agents - Dialog Acts – Interpretation - Conversational Agents -	2	D,I	1,2,3	1,3
15	Language Generation – Architecture -Surface Realizations - Discourse Planning .	2	D,I	1,2,3	1,3
16	Machine Translation -Transfer Metaphor–Interlingua – Statistical Approaches	3	D,I	1,2,3	1,3
Total contact hours		**45***			

LEARNING RESOURCES	
Sl.No.	**TEXT BOOKS**
1.	Daniel Jurafsky and James H Martin, "Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Prentice Hall, 2nd Edition, 2008.
2.	C. Manning and H. Schutze, "Foundations of Statistical Natural Language Processing", MIT Press. Cambridge, MA:,1999
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	James Allen, Bejamin/cummings, "Natural Language Understanding", 2nd edition, 1995.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In- semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS422E	Knowledge Based Decision Support Systems	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	The purpose of this course is to impart knowledge on decision support systems and implementation							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Get an overview of decision support systems	a						
2.	Get Familiarize on group decision support systems	a	d					
3.	Learn about knowledge management	a						
4.	Study about Intelligent DSS	a						
5.	Get familiarize on building decision support systems	a	c					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
UNIT I : INTRODUCTION TO DECISION SUPPORT SYSTEMS		**9**			
1	Management Support Systems: An Overview, Changing Business Environments and Computerized Decision	1	C	1	1
2	Managerial Decision Making and Techniques of Managerial Decision Support	1	C	1	1
3	The Concept of Decision Support Systems (DSS)	1	C	1	1
4	Decision Support Systems: An Overview	1	C	1	1
5	DSS configurations, description, characteristics and capabilities, classifications, components and subsystems.	1	C	1	1
6	Decision Making, Systems, Modeling, and Support	1	C	1	1
7	Decision Making: Introduction, Definitions, Models	1	C	1	1
8	Phases of the Decision Making Process: The Intelligence Phase, the Design Phase, the Choice Phase, the Implementation Phase	1	C	1	1
9	Supporting Decisions	1	C	1	1
UNIT II: GROUP DECISION SUPPORT SYSTEMS		**9**			
10	Making Decisions in Groups: Characteristics, Process, Benefits, and Dysfunctions – Supporting Group work with Computerized systems	3	C	2	1
11	Tools for Indirect Support of Decision Making – Products and Tools for GDSS/GSS and Successful Implementation.	2	C, D	2	1
12	Decision Analysis with Decision Tables and Decision Trees	1	C	2	1
13	Applications of Data Mining	2	C	2	1-2
14	Role of Data Warehouses in decision support	1	C	2	1-2
UNIT III: KNOWLEDGE MANAGEMENT		**9**			
15	Knowledge Management: Introduction – Organizational Learning and Transformation – Knowledge Management Activities – Approaches to Knowledge Management	3	C	3	1
16	Information Technology (IT) in Knowledge Management – Knowledge Management Systems Implementation -	3	C	3	1
17	Roles of People in Knowledge Management – Ensuring the success of knowledge Management Efforts.	3	C	3	1
UNIT IV: INTELLIGENT DECISION SUPPORT SYSTEMS		**9**			
18	Artificial Intelligence: Concepts, Definitions and Applications	3	C	4	1

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
19	Expert Systems: Basic Concepts, Applications, Knowledge engineering, Suitable Problem Areas, Benefits, Limitations, and success Factors.	3	C	4	1
20	Advanced Intelligent Systems: Machine Learning techniques – Genetic Algorithms – Fuzzy inference systems – Support Vector machines – Intelligent agents.	3	C	4	1
UNIT V: BUILDING DECISION SUPPORT SYSTEMS		**9**			
21	Building decision support systems	3	C,D	5	1-2
22	Management support systems: RFID and New BI Application opportunities – Reality Mining – Online Social Networking – Cloud Computing and Business Intelligence	3	C,D	5	1
23	The impact of Management support systems – Impacts on Organizations and Individuals	3	C	5	1
Total contact hours		**45***			

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1	Efraim Turban, Jay Aronson E., Ting-Peng Liang, "Decision Support Systems and Intelligent Systems", 9th Edition, Pearson Education, 2014.
	REFERENCE BOOKS/OTHER READING MATERIAL
2	George M .Marakas, "Decision Support Systems in the 21st century", Pearson, 2016.

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS423E	Software Defined Networks	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	NIL				
Course Category	P Professional Elective				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	This course introduces software defined networking, an emerging paradigm in computer networking that allows a logically centralized software program to control the behavior of an entire network.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Differentiate between traditional networks and software defined networks	a						
2.	Understand advanced and emerging networking technologies	a	b	c				
3.	Obtain skills to do advanced networking research and programming	a	b	c				k
4.	Learn how to use software programs to perform varying and complex networking tasks	a	b	c				k
5.	Expand upon theknowledge learned and apply it to solve real world problems	a	b	g				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
UNIT I: INTRODUCING SDN		**9**			
1.	SDN Origins and Evolution – Introduction – Why SDN?	1	C	1	1,4,5
2.	Centralized and Distributed Control and Data Planes	2	C	1	2,4,5
3.	The Genesis of SDN	2	C	1	1,4,5
4.	Introducing Mininet	4	D,I	3	1,2,3,7
UNIT II: SDN ABSTRACTIONS		**11**			
5.	How SDN Works	2	C,D	1,2	1,5,6
6.	The Openflow Protocol	1	C,D	2	1,2,3
7.	SDN Controllers: Introduction - General Concepts - VMware - Nicira- VMware/Nicira	1	D,I	3	1,2,3,5
8.	OpenFlow-Related - Mininet - NOX/POX - Trema - Ryu - Big Switch Networks/Floodlight	2	D,I	3	1,2,3,5
9.	Layer 3 Centric - Plexxi - Cisco OnePK	1	D,I	3	2
10.	Setting up the Environment and Implementation of Controllers in Mininet	4	D,I	3	1,2.3,8
UNIT III: PROGRAMMING SDN'S		**8**			
11.	Network Programmability	2	I,O	4	2,6
12.	Network Function Virtualization	2	I,O	2	2,5
13.	NetApp Development, Network Slicing	4	I,O	3,4	1,2,3
UNIT IV: SDN APPLICATIONS AND USE CASES		**11**			
14.	SDN in the Data Center	2	I	2	1,2,5
15.	SDN in Other Environments	1	I	2	1
16.	SDN Applications	2	I	5	1,2
17.	SDN Use Cases	2	I	5	1,2,5
18.	The Open Network Operating System	4	D,I,O	3	1,2,3
UNIT V: SDN'S FUTURE AND PERSPECTIVES		**6**			
19.	SDN Open Source	2	C	2	1
20.	SDN Futures	2	C	1,5	1,6
21.	Final Thoughts and Conclusions	2	C	5	1,2
Total contact hours		**45***			

LEARNING RESOURCES	
Sl.No.	**TEXT BOOKS**
1.	Software Defined Networks: A Comprehensive Approach by Paul Goransson and Chuck Black, Morgan Kaufmann Publications, 2014
2.	SDN - Software Defined Networks by Thomas D. Nadeau & Ken Gray, O'Reilly, 2013
3.	Software Defined Networking with OpenFlow By SiamakAzodolmolky, Packt Publishing, 2013
	REFERENCE BOOKS/OTHER READING MATERIAL
4.	Feamster, Nick, Jennifer Rexford, and Ellen Zegura. "The road to SDN: an intellectual history of programmable networks." ACM SIGCOMM Computer Communication Review 44.2 (2014): 87-98.
5.	Kreutz, Diego, et al. "Software-defined networking: A comprehensive survey." Proceedings of the IEEE 103.1 (2015): 14-76.
6.	Nunes, Bruno AA, et al. "A survey of software-defined networking: Past, present, and future of programmable networks." Communications Surveys & Tutorials, IEEE 16.3 (2014): 1617-1634.
7.	Lantz, Bob, Brandon Heller, and Nick McKeown. "A network in a laptop: rapid prototyping for software- defined networks." Proceedings of the 9th ACM SIGCOMM Workshop on Hot Topics in Networks. ACM, 2010.
8.	Monsanto, Christopher, et al. "Composing software defined networks." Presented as part of the 10th USENIX Symposium on Networked Systems Design and Implementation (NSDI 13). 2013.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Assignments	Quiz	**Total**
	Weightage	**5%**	**5%**	**10%**	**25%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS424E	Semantic Web	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	This course provides the students with the concepts to create the Semantic Web include a systematic treatment of the different languages like XML, RDF, OWL, and rules and technologies (explicit metadata, ontologies, and logic and inference) that are central to Semantic Web development.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Understand the XML technologies, RDF and OWL	a	i					
2.	Develop semantic web application using protégé	a	i					
3.	Develop semantic web services	a	i					

Session	Description of Topic	Contact hours	C-D- I-O	IOs	Reference
UNIT I: THE SEMANTIC WEB VISION		**9**			
1.	Levels of semantics, Semantic Web Technologies – Layered Architecture.	3	C	2	1
2.	Thinking and Intelligent Web applications tools.The information age.	3	C,D	2	1
3.	Today's World Wide Web Limitations, syntactic web, data-unstructured, semi structured and structured	3	C ,D	1	2
UNIT II: ONTOLOGY DEVELOPMENT		**9**			
4.	The role of XML – XML and the web – Web services – XML technologies – XML revolution - Structuring with schemas – presentation technologies.	4	C,D	1	5 and 6
5.	Introduction to RDF, Syntax for RDF, Simple Ontologies in RDF Schema, An Example.	2	C,D	1	1,2,3,5,6 and 7
6.	Querying in RDF. OWL language – OWL Syntax and Intuitive Semantics, OWL Species, examples.	3	C,D	2	1,23,5,6`and 7,
UNIT III : ONTOLOGY RULES AND QUERYING		**9**			
7.	Ontology tools- Ontology development using protégé, Description Logics, Automated Reasoning with OWL	2	C,D	2	1,2,3,4,5,6and 7,
8.	Exercises – First-Order Rule Language, Combining Rules with OWL DL.	4	C ,D, I	2	1,2 3,4,5,6and 7,
9.	SPARQL: Query Language for RDF, Conjunctive Queries for OWL DL, Exercises, Ontology Engineering.	3	C ,D,I	2	1,2 3,4,5,6and 7,
UNIT IV: SEMANTIC WEB SERVICE		**9**			
10.	Semantic web service concepts	3	C	1	5 and 6
11.	Representation mechanisms for semantic web services	3	C ,D	1	5 and 6
12.	WSMO – WSDL-S – Related work in the area of semantic web service frameworks.	3	C, D	3	5 and 6
UNIT V: SEMANTIC WEB SERVICE DISCOVERY		**9**			
13	Shortcomings and limitation of conventional web service discovery	2	C	3	5 and 6
14	Centralized discovery architecture – P2P discovery architecture – Algorithm approaches	4	C,D	3	5 and 6
15	Web service modeling ontology – Conceptual model for service discovery –Discovery based on semantic descriptions	3	C ,D	3	5 and 6
Total contact hours		**45***			

LEARNING RESOURCES	
1.	Grigoris Antoniou and Frank Van Harmelen, "A Semantic Web Primer", The MIT Press, Cambridge, Massachusetts London, England, 2004.
2.	Pascal Hitzler, Markus Krötzschand Sebastian Rudolph ,"Foundations of Semantic Web Technologies" Chapman & Hall/CRC, 2009.
3.	Toby Segaran, Colin Evans, Jamie Taylor, "Programming the Semantic Web Build Flexible Applications with Graph Data," O'Reilly Media,2009.
4.	www.semanticweb.org
5.	Frank. P. Coyle, "XML, Web Services and the data revolution", Pearson Education, 2002.
6.	Jorge Cardoso, "Semantic web services: Theory, tools and applications", Information science, 2007.
7.	Michael C, Daconta, Leo J. Obrst and Kevin T. Smith, "The semantic Web: A guide to the future of XML, web services, and knowledge management", John wiley& sons, 2003.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS425E	Service Oriented Architecture	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer Science & Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	To gain the basic principles of service orientated architecture							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Learn service oriented analysis techniques	a						
2.	Learn technology underlying the service design	k						
3.	Learn advanced concepts in building SOA	c						
4.	Understand the Java Web services	a						
5.	To know about various Web services specification standards	b						

Session	Description of Topics	Contact hours	C D I O	IOs	Reference
UNIT I : FUNDAMENTAL OF SOA		**9**			
1.	**Understand the Fundamental of SOA and Defining SOA**: Introduction to SOA , Understand the necessity of SOA, Defining	1	C	1	1
2.	**Explain the Evolution of SOA**: Analyze the SOA timeline from XML to Web services to SOA , Describe a brief history about XML, Web Services and SOA	1	C	1	1
3.	**Introduction to Service Oriented Enterprise (SOE):**	1	C	1	1
4.	**Comparing SOA to past architectures :** Analyze the past architectures	1	C	1	1
5.	**Understand the Basic concepts of SOA Architecture: Understand** the Scope Of SOA and **Analyze** the SOA Reference Model	1	C	1	1
6.	**Understand the Key Service characteristics of SOA: List** the Key Service characteristics of SOA	1	C	1	1
7.	**Understand the Anatomy of SOA :** Analyze SOA architecture and Receive knowledge to establish the SOA environment	1	C	1	1
8.	**Analyze how components in an SOA interrelate: Understand the** SOA component and **Analyze** specific behaviors, and relationships among these components	1	C	1	1
9.	**Understand the Technical Benefits and Business Benefits of SOA:** List the Technical Benefits of SOA ,and **Assess** Business Benefits of SOA	1	C	1	1
UNIT II : WEB SERVICE AND SOA		**9**			
10.	**Introduction to Web Services and Primitive SOA:** Understand Web Service Framework with respect to SOA and List the Logical components of the Web services framework	1	C	2	1
11.	**Explain Service descriptions with WSDL layout** :Analyze the WSDL Services with SOA and Identify and Categorize the Meta data and service contracts	1	C	2	1
12.	**Explain Messaging with SOAP :** Analyze the SOAP Protocol and SOA and Describe the SOAP nodes and message path	1	C	2	1
13.	**Understand the Message exchange Patterns and Coordination**: Analyze the Web Services a Activity Management, Coordination types and coordination protocols	1	C	2	1
14.	**Explain about Atomic Transactions:** categorize the ACID properties and analyze atomic transaction with SOA	1	C	2	1

15.	**Understand Business activities with SOA:** analyze business activities and protocols	1	C	2	1
16.	**Understand the advanced concepts of Orchestration and Choreography: Receive** knowledge on advanced concepts of Orchestration and Choreography	1	C,I	2	1
17.	**Understand Service layer abstraction:** Analyze the Service layer configuration scenarios	1	C,I	2	1
18.	**Understand Application Service Layer :** problems solved by layering services **Analyze Business Service Layer and Orchestration Service Layer**: Analyze the case study Scenarios	1	C,I	2	1
UNIT III : BUILDING SOA		**9**			
19.	**Understand basic phases of the SOA delivery lifecycle:** Explain the various SOA Delivery Strategies and analyze top- down strategy , bottom-up strategy and agile strategy with Pros and cons	1	C,D	3	1
20.	**Introduction to service-oriented analysis and process steps:** Analyze the Objectives and service-oriented process steps	1	C,D	3	1
21.	**Understand the Business-centric SOA and Deriving business services-service modelling**: List the Benefits of a business-centric SOA and Identify Sources from which business	1	C-D	3	1
22.	**Introduction to service-oriented design** :Objectives of service- oriented design and Understand various technology underlying the	1	C-D	3	1
23.	**Introduction to WSDL language basics** :Define the structure of WSDL and implement sample WSDL file	1	C	3	1
24.	**Introduction to SOAP basics** : Recognize SOAP language basics Define the structure of SOAP and Implement SOAP style web services in Java.	1	C	3	1
25.	**Understand SOA composition guidelines:** List the SOA Composition Guidelines and Evaluate the preliminary steps to composing SOA and choosing service layers and standards	1	C	3	1
26.	**Understand the Entity-centric business service design**: List the step-by-step process	1	C	3	1
27.	**Explain Application service design:** List the Application service design process steps **Describe Task centric business service design**: categorize the Task-centric business service design process steps	1	C	3	1
UNIT IV: JAVA WEB SERVICES		**9**			
28. .	**Introduction to SOA support in J2EE**: Understand the SOA platform basics and building blocks	1	C	4	1-4
29. .	**Overview of Java API for XML-based web services(JAX-WS):** Receive knowledge on creation of SOA compliant web service using Java API for XML-based web services (JAX-WS) and acquire hands-on experience.	1	C	4	1-4
30. .	**Introduction to Java Architecture for XML binding (JAXB):** Building web services and client with examples	1	C	4	1-4
31. .	**Introduction to** Java API for XML Registries(JAXR)	1	C	4	1-4
32. .	**Overview of** Java API for XML based RPC (JAX-RPC)	1	C	4	1-4
33.	**Explain** Web Services Interoperability	1	C	4	1-4
34.	**Introduction to** SOA support in .NET: Receive knowledge on .NET Platform overview	1	C	4	1-4
35.	**Overview of ASP.NET web services**: Understand the ASP.NET Programming Basics and Creating a Web Site Using Visual Studio IDE	1	C	4	1-4
36. .	**Analyze the Case Studies:** Implement the Small Business Customer Management application as a web applications using ASP.NET **Overview of** Web Services Enhancements (WSE)	1	C	4	6

UNIT V: WS* SPECIFICATION STANDARDS & SECURITY		9			
37. .	**Introduction to WS-BPEL basics:** Basic terms used in the BPEL terminology	1	C	5	1-7
38. .	WS-Coordination overview	1	C	5	1-7
39. .	**Introduction to** WS-Choreography	1	C	5	1-7
40. .	**Describe the** WS-Policy with SOA	1	C	5	1-7
41. .	**Overview of** WS Security	1	C	5	1-7
42. .	**Overview of** Notification and Eventing	1	C	5	1-7
43. .	**Explain about** Transaction Management	1	C	5	4
44. .	**Analyze the** Case study-SOA in cloud	1	C	5	4
45.	**Research issues:** Analyze the research focus on SOA and issues **Comparative Analysis** of SOA and Cloud Computing	1	C	5	4
Total contact hours		**45***			

LEARNING RESOURCES	
Sl.No.	**TEXT BOOKS**
1.	Thomas Erl, "Service-Oriented Architecture: Concepts, Technology, and Design", Pearson Education, 2009.
2.	Eric Newcomer, Lomow, "Understanding SOA with Web Services", Pearson Education, 2005
3.	JamesMcGovern,Sameer Tyagi,Michael E Stevens,Sunil Mathew,"Java Web Services Architecture",Elsevier,2003.
	REFERENCE BOOKS/OTHER READING MATERIAL
4.	Achieving Service-Oriented Architecture: Applying an Enterprise Architecture Approach, Rick Sweeney, 2010
5.	Shankar Kambhampaly, "Service –Oriented Architecture for Enterprise Applications", Wiley India Pvt Ltd, 2008.
6.	Newcomer, Lomow, "Understanding SOA with Web Services", Pearson Education, 2005
7.	Sandeep Chatterjee, James Webber, "Developing Enterprise Web Services, An Architect's Guide", Pearson Education, 2005.

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS426E	Pattern Recognition Techniques	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer Science Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	This course provide a way to learn the various pattern recognition techniques and their applications							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, students will be able to		a						
1.	Understand the fundamentals of Pattern Recognition techniques	a						
2.	Learn Statistical models of Pattern Recognition	a						
3.	Understand the principles of Clustering approaches to Pattern Recognition	a						
4.	Understand the Syntactic Pattern Recognition techniques	a	c	k				
5.	Understand the Neural Network approach to Pattern Recognition	a	c	k				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
UNIT I: INTRODUCTION TO PATTERN RECOGNITION		**8**			
1.	Pattern and features , Classification, Description, Pattern Mappings	1	C	1	1,2,3
2.	Patterns and Feature Extraction with examples	1	C	1	1,2,3
3.	Classifiers, Decision Regions, Boundaries	1	C	1	1,2,3
4.	Training and learning in pattern recognition systems	1	C	1	1,2,3
5.	Pattern recognition approaches , Statistical pattern recognition , Syntactic pattern recognition , Neural pattern recognition , Comparison	2	C	1	1
6.	Black Box approaches , Reasoning driven pattern recognition	1	C	1	1,2
UNIT II: STATISTICAL PATTERN RECOGNITION		**10**			
7.	Introduction to StatPR, Statistical models, Gaussian case and Class Dependence	1	C	2	1
8.	Discriminant Functions- Uniform Densities – Classifier Performance, Risk and Errors	1	C	2	1
9.	Supervised learning – Parametric estimation – Maximum Likelihood Estimation	1	C	2	1
10.	Bayesian parameter estimation	1	C	2	1
11.	Nonparametric approaches- Density estimation	1	C	2	1
12.	Parzen Windows , k-nn Nonparametric estimation	1	C	2	1
13.	Nearest Neighbor Rule	1	C	2	1
14.	Linear Discrimant Functions, Fisher's Linear Discriminant – Discrete and Binary Classification problems	2	C	2	1
15.	Techniques to directly obtain Linear Classifiers	1	C	2	1
UNIT III: UNSUPERVISED LEARNING AND CLUSTERING		**8**			
16.	Formulation of unsupervised problems, Unsupervised Learning Approaches	2	C	3	1
17.	Clustering for unsupervised learning and classification, c-means algorithm	1	C	3	1
18.	Learning Vector Quantization, Formal Characterization of General Clustering Procedures	2	C	3	1
19.	Clustering Strategies , Cluster Swapping Approaches	1	C	3	1
20.	Hierarchical clustering procedure	1	C	3	1
UNIT IV: SYNTACTIC PATTERN RECOGNITION		**11**			
21.	Syntactic Pattern Recognition, Grammar based approaches, Formal Grammars, Types of Grammars	2	C	4	1

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
22.	String generation as Pattern Description	1	C	4	1
23.	Recognition by String Matching and Parsing,	1	C	4	1
24.	Cocke-Younger-Kasami (CYK) Parsing Algorithm	1	C,D	4	1
25.	Augmented Transition Networks, High Dimensional Grammars, Stochastic Grammars and applications	2	C	4	1
26.	Graph based structural representations ,Graph Isomorphism	2	C	4	1
27.	Attributed Graphs, Match Graphs, Cliques, Structural Unification using attributed graphs	2	C,D	4	1
UNIT V: NEURAL PATTERN RECOGNITION		**9**			
28.	Neural Networks fundamentals, Learning in Neural networks, Physical Neural Networks	1	C	5	1
29.	Artificial Neural Networks model, activation functions, weights,	1	C	5	1
30.	Neural Network based Pattern Associators, CAM , Linear Associative Mappings, Different approaches	2	C	5	1
31.	Heteroassociative memory design, Hebbian learning	1	C,D	5	1
32.	Feedforward Network Architecture, Training in Feedforward networks, GDR, Derivation of Delta Rule	2	C,D	5	1
33.	Backpropagation Algorithm, Pattern Associator for Character Classification	2	C,D	5	1
Total contact hours		**45***			

LEARNING RESOURCES	
Sl. No.	**TEXT BOOK**
1.	Robert J, Schalkoff, "Pattern Recognition: Statistical, Structural and Neural Approaches", John Wiley & Sons Inc., New York, Reprint 2014.
	REFERENCE BOOKS/OTHER READING MATERIAL
2.	Earl Gose, Richard Johnsonbaugh, Steve Jost, "Pattern Recognition and Image Analysis", Prentice Hall of India Private Ltd., New Delhi – 110 001, 1999.
3.	Duda R.O. and Hart P.E., "Pattern Classification and Scene Analysis", Wiley, New York, 1973

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS427E	Nature Inspired Computing Techniques	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer Science Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	To understand the fundamentals of nature inspired techniques which influence computing, study the Swarm Intelligence and Immuno computing techniques and familiarize the DNA Computing

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student willhave an understanding of								
1.	The basics Natural systems.	a						
2.	The concepts of Natural systems and its applications.	a	c	e				
3.	Basic Natural systems functions(operations)	a	c	e				
4.	Natural design considerations.	a	c					
5.	Integration of Hardware and software in Natural applications.	a	c					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
UNIT I: INTRODUCTION		**8**			
1.	Introduction	1	C	1,2	1
2.	From Nature to Nature Computing	1	C	1,2	1
3.	Philosophy	1	C	1,2	1
4.	Three Branches: A Brief Overview	1	C	1,2	1
5.	Individuals, Entities and agents - Parallelism and Distributivity Interactivity	1	C	1,2	1
6.	Adaptation- Feedback-Self-Organization-Complexity, Emergence and	1	C,D	1,3	1
7.	Bottom-up Vs Top-Down- Determination	1	C	1	1
8.	Chaos and Fractals.	1	C,D	1	1
UNIT II: Computing Inspired by Nature		**9**			
9.	Evolutionary Computing	1	C	1,2	1,3
10.	Hill Climbing and Simulated Annealing	1	C,D,I	1,4	1
11.	Darwin's Dangerous Idea	1	C	1,2	1
12.	Genetics Principles	1	C	1,2	1
13.	Standard Evolutionary Algorithm -Genetic Algorithms	1	C,D,I	1,4	1
14.	Reproduction-Crossover	1	C	1,2	1
15.	Mutation	1	C	1,3	2
16.	Evolutionary Programming	1	C,D,I	1,4	1
17.	Genetic Programming	1	C,D,I	1,4	1,2
UNIT III: SWARM INTELLIGENCE		**9**			
18.	Introduction - Ant Colonies	1	C	1	1
19.	Ant Foraging Behaviour	1	D	1,3,4	1,4
20.	Ant Colony Optimization	1	D	1,2,4	1,4
21.	SACO and scope of ACO algorithms	1	C,D	2	1,4
22.	Ant Colony Algorithm (ACA)	1	D,I	1,4	1,4
23.	Swarm Robotics	1	C,D	1,2	1
24.	Foraging for food	1	C	2,4	1
25.	Social Adaptation of Knowledge	1	C	5	1
26.	Particle Swarm Optimization (PSO)	1	C,D	5	1,2
UNIT IV: IMMUNOCOMPUTING		**9**			
27.	Introduction- Immune System	1	C	1	1
28.	Physiology and main components	1	C	2,3	1

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
29.	Pattern Recognition and Binding	1	C,D	1,3	1
30.	Immune Network Theory- Danger Theory	1	C,D	1,4	1
31.	Evaluation Interaction- Immune Algorithms	1	I	1,4	1
32.	Introduction – Genetic algorithms	1	C	1	1
33.	Bone Marrow Models	1	C	1	3,4
34.	Forest's Algorithm	1	CD,	5	1
35.	Artificial Immune Networks	1	C,D,I	1,3	1,3,4
UNIT V: COMPUTING WITH NEW NATURAL MATERIALS		**10**			
36.	DNA Computing: Motivation	1	C	1	1
37.	DNA Molecule	1	C	1	1
38.	Adleman's experiment	1	C,D	1,3	1
39.	Test tube programming language	1	C,D	1,2,5	1
40.	Universal DNA Computers	1	C,D	1,5	1
41.	PAM Model	1	C	1,3	1
42.	Splicing Systems	1	C,D	1,3	1
43.	Lipton's Solution to SAT Problem	1	C,D	1,3	1
44.	Scope of DNA Computing	1	C,D	1	1
45.	From Classical to DNA Computing	1	C,D	1	1
Total contact hours		**45***			

LEARNING RESOURCES	
Sl.No.	**TEXT BOOK**
1.	Leandro Nunes de Castro, " Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications", Chapman & Hall/ CRC, Taylor and Francis Group, 2007
	REFERENCE BOOKS/OTHER READING MATERIAL
2.	Floreano D. and Mattiussi C., "Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies", MIT Press, Cambridge, MA, 2008.
3.	Albert Y.Zomaya, "Handbook of Nature-Inspired and Innovative Computing", Springer, 2006.
4.	Marco Dorrigo, Thomas Stutzle," Ant Colony Optimization", PHI,2005

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle test III	Surprise Test	**QUIZ**	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS428E	Optical Networks	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	15IT303J				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	To introduce the concepts of Optical Networks and the algorithms related to connectivity. This course also aims to describe packet switching and queuing terminologies and technologies used in optical fiber communication.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	To understand the concepts of optical communications	a						
2.	To study the functions wavelength routing networks	a						
3.	To study and understand of GMPLS networks	a						
4.	To get familiarized with network design and management	a						

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
UNIT I: OVERVIEW OF OPTICAL NETWORKING		**9**			
1.	Introduction to Optical Network; Telecommunication network architecture; Services & switching	1	C	1	1
2.	Multiplexing; Layered view of second generation optical networks	1	C	1	1
3.	Optical packet switching; Transmission Basics	1	C,I	1	1
4.	Modes of Fiber; Propagation of signal in Fiber	1	C	1	1
5.	Propagation of signal in Fiber	1	C	1	1
6.	Optical network components	1	C	1	1
7.	Error detection & correction	1	C,I	1	1
8.	Transmission system; Overall system design considerations	1	C,D	1	1
9.	Case study: 1 – National Optical Fiber Network of India	1	C,D	1	4
UNIT II : OPTICAL NETWORK ARCHITECTURES (I)		**9**			
10.	SONET: Architecture, Frames	1	C,D	1,2	2
11.	SONET: VTs, Tus, STS	1	C,D	1,2	2
12.	SONET vs. SDH	1	C	1,2	2
13.	WDM network elements: OLTs, OADMs	1	C,D	1,2	2
14.	WDM: ROADMs, Optical cross connects; All optical OXC	1	C,D	1,2	2
15.	WDM network design: RWA	1	C,D,I	1,2	2
16.	WDM network design: Virtual topology design	1	C,D	1,2	2
17.	Case study: 2 – TJ1100 vs MSPP TJ1600	1	C,D	1,2	5,6
18.	Case study: 3 – A 22,000 km 100G deployment, Xtera Communications	1	C,D	1,2	7
UNIT III : OPTICAL NETWORK ARCHITECTURES (II)		**9**			
19.	DWDM: Introduction, network topologies, ONI	1	C,D	2,4	2
20.	DWDM: network switching, timing & synchronization, channel & link protection, routing	1	C,D,I	2,4	2
21.	Access WDM systems: General PON, CWDM PON	1	C,D	2,4	2
22.	Access WDM systems: CWDM PON, TDM-PON, WDM-PON, hCT-PON	1	C,D	2,4	2
23.	OTN: Layers, FEC in OTN, OTN Frame structure	1	C,D	2,4	2
24.	OTN & DWDM, OTN management	1	C,D	2,4	2
25.	Case study: 4 – Arista DWDM solution	1	C,D	2,4	8
26.	Case study: 5 – GPON deployment in enterprise environment	1	C,D	2,4	9

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
27.	Case study: 6 – Ciena expert series, OTN	1	C,D	2,4	10
UNIT IV : GENERALIZED MULTI-PROTOCOL LABEL SWITCHING (GMPLS)		**9**			
28.	MPLS: LSP, LSP tunnel, Signaling protocol	1	C,D	3	3
29.	Overview of transport network: GbE, TDM, WDM, transport network topologies	1	C,D	3	3
30.	From MPLS to GMPLS: related concepts	1	C,D	3	3
31.	GMPLS Signaling: Sessions, tunnels & LSPs, RSVP-TE, LSP establishment, maintenance & modification	1	C,D,I	3	3
32.	GMPLS Routing: TE information, OSPF-TE	1	C,D,I	3	3
33.	Link management: LMP protocol	1	C,D	3	3
34.	TE in GMPLS, TE Link attributes	1	C,D	3	3
35.	GMPLS PCE & PCE protocol	1	C,D	3	3
36.	Case study: 7 – Cisco nLight technology	1	C,D	3	11
UNIT V: NETWORK MANAGEMENT & SURVIVABILITY		**9**			
37.	Network management functions & framework	1	C,D	4	1
38.	Management protocol: SNMP	1	C,D	4	1
39.	Performance & fault management	1	C	4	1
40.	Connection & Adaptation management	1	C	4	1
41.	Optical safety: OFC protocol	1	C,D	4	1
42.	Network survivability basic concepts	1	C	4	1
43.	Protection in SONET / SDH	1	C,D	4	1
44.	Optical layer protection schemes	1	C,D	4	1
45.	Case study: 8 – TJ5500 EMS	1	C,D	4	12
Total contact hours		**45***			

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Rajiv Ramaswami, Kumar N. Sivarajan, Galen H. Sasaki, "Optical Networks-A practical perspective", Elsevier publication, Third edition, 2009.
2.	Stamatios Kartalopoulos, "Next generation Intelligent Optical Networks-From access to backbone", Springer publication, 2008.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Adrian Farrel, Igor Bryskin, "GMPLS architecture and applications", Elsevier publication, 2006.
4.	http://broadbandasia.info/wp-content/uploads/2014/04/NOFN-India_11-April.pdf
5.	http://www.tejasnetworks.com/products_mspp_TJ1100.html
6.	http://www.tejasnetworks.com/products_mspp_TJ1600.html
7.	http://www.xtera.com/wp-content/uploads/2015/10/CP-22000km-100G-2012.pdf
8.	https://www.arista.com/assets/data/pdf/Whitepapers/7500E_DWDM_Use_Cases_White_Paper.pdf
9.	http://ojs.academypublisher.com/index.php/jnw/article/viewFile/jnw09014247/8352
10.	http://www.ciena.com/resources/ebooks/Optical-Transport-Networking-OTN-eBook.html
11.	http://www.cisco.com/c/en/us/products/collateral/switches/catalyst-3750-series-switches/whitepaper_c11-718852.pdf
12.	http://www.tejasnetworks.com/products_network_management_TJ5500.html

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS429E	Computational Linguistics	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	This Course deals with the fundamentals required for developing a Computational Linguistics model.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	To learn the fundamentals required for Computational Linguistics.	a	b					
2.	To understand the concepts of Language structure, Analysis and their applications.	a	b					
3.	To study various Linguistic Models.	a	b	k				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
UNIT I: INTRODUCTION		**9**			
1.	Introduction about Computational Linguistics	1	C	1	1,5
2.	Issues - Motivation – Theory of Language	4	C	1	1,5
3.	Features of Indian Languages	2	C	1	4
4.	Issues in Font- Coding Techniques	2	C,D	1	4
UNIT II: MORPHOLOGY AND PARTS-OF-SPEECH		**9**			
5.	Phonology – Computational Phonology	1	C,D	2	1,5
6.	Words and Morphemes – Segmentation	2	C,D	2	1,2,5
7.	Categorization and Lemmatisation – Word Form Recognition	2	D,I	2	1,5
8.	Valency - Agreement - Regular Expressions and Automata	2	D	2	1,2,5
9.	Morphological issues of Indian Languages – Transliteration	2	D	2	4
UNIT III: PROBABILISTIC MODELS		**9**			
10.	Probabilistic Models of Pronunciation and Spelling	1	C,D	3	1,2
11.	Weighted Automata – N- Grams - Corpus Analysis	2	C,D,I	3	1,2
12.	Smoothing – Entropy - Parts-of-Speech – Taggers	2	C,D	3	1,2
13.	Rule based – Hidden Markov Models	2	C,I	3	1,2
14.	Speech Recognition	2	C,D	3	1
UNIT IV: SYNTAX		**9**			
15.	Basic Concepts of Syntax – Parsing Techniques	1	C	3	1
16.	General Grammar rules for Indian Languages	2	D,I	3	1,2
17.	Context Free Grammar – Parsing with Context Free Grammars	2	D,I	3	1,2
18.	Top Down Parser – Earley Algorithm	2	D,I	3	1
19.	Features and Unification - Lexicalised and Probabilistic Parsing.	2	D,I	3	1
UNIT V: SEMANTICS AND PRAGMATICS		**9**			
20.	Representing Meaning – Computational Representation	1	D,I	3	3
21.	Meaning Structure of Language – Semantic Analysis	2	C,D	3	3
22.	Lexical Semantics – WordNet – Pragmatics	2	C,D,I	3	3
23.	Discourse – Reference Resolution	2	D,I	3	3
24.	Text Coherence – Dialogue Conversational Agents	2	D,I	3	3
Total contact hours		**45***			

LEARNING RESOURCES	
1.	Daniel Jurafskey and James H. Martin “Speech and Language Processing”, Prentice Hall, 2000.
2.	Ronald Hausser “Foundations of Computational Linguistics”, Springer-Verleg, 1999.
3.	James Allen “Natural Language Understanding”, Benjamin/Cummings Publishing Co. 1995.
4.	Tanveer Siddiqui, U.S. Tiwary, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2008.
5.	Steve Young and Gerrit Bloothooft “Corpus – Based Methods in Language and Speech Processing”, Kluwer Academic Publishers, 1997.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS430E	Bioinformatics	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer Science Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	To explore how biological information could be stored in digital form to create bioinformatics resources and how the same may be processed.

INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, students will be able to		a						
1.	Understand the fundamentals of Bioinformatics	a						
2.	Learn the sequence alignment and the tools used for it	a	b	k				
3.	Understand the principles of Gene Prediction expression and microarrays	a						
4.	Understand the Protein structure prediction techniques	a	b	k				
5.	Understand the Proteomics and Drug delivery techniques	a	b	k				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
UNIT I: INTRODUCTION TO BIOINFORMATICS		**7**			
1.	Introduction, Major Databases in Bioinformatics, Molecular Biology, Central Dogma of Molecular Biology	1	C	1	1,2,3
2.	Information Search and Data Retrieval, Tools for web search, Data Retrieval tools, Data Mining of Biological Databases	1	C	1	1,3
3.	Genome Analysis, Genome Mapping,	2	C	1	1,3
4.	Sequence Assembly Problem, Genetic Mapping and Linkage Analysis	1	C	1	1,2,3
5.	Cloning, Genome Sequencing,Sequence assembly tools, Human Genome Project	2	C	1	1,2,3
UNIT II: ALIGNMENT OF SEQUENCES AND TOOLS		**11**			
6.	Alignment of Pair of Sequences, Methods, Scoring Matrices, Measuring sequence detection efficiency	2	C	2	1,2,3
7.	Alignment of Multiple Sequences, Methods, Evaluating Multiple Alignments, Applications	2	C	2	1,2,3
8.	Phylogenetic Analysis, Methods,	1	C	2	1
9.	True Evaluation, Problems in Phylogenetic Analysis, Automated tools	1	C	2	1
10.	Tools for Similarity search and sequence alignment, Working with FASTA	2	C	2	1
11.	Working with BLAST, Filtering and Gapped BLAST	2	C	2	1
12.	Comparison of FASTA and BLAST, Case study	1	C	2	1
UNIT III: GENE PREDICTION, EXPRESSION AND MICROARRAYS		**7**			
13.	Basics of Gene Prediction, Pattern Recognition,	1	C	3	1,3
14.	Gene Prediction methods, Tools	2	C	3	1
15.	Gene Expression, Working with DNA Microarrays, Clustering Gene expression Profiles	2	C	3	1,2
16.	Data Sources and Tools for for Microarray Analysis, Applications	2	C	3	1
UNIT IV: PROTEIN CLASSIFICATION AND STRUCTURE PREDICTION		**10**			
17.	Overview of Protein Structure, Protein Structure Visualization	1	C	4	1,3
18.	Structure based Protein Classification, Protein structure Databases, Tools	1	C	4	1

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
19.	Protein Structure Alignment, Domain Architecture Databases, Tools	1	C	4	1
20.	Protein Classification Approaches	1	C	4	1
21.	Protein Identification and Characterization	1	C	4	1
22.	Primary Structure Analysis and Prediction	1	C,D	4	1
23.	Secondary Structure Analysis and Prediction	1	C,D	4	1,2
24.	Motifs, Profiles, Patterns, Fingerprints search	1	C	4	1
25.	Methods of sequence based protein prediction, 2D structure prediction, Protein function prediction	2	C,D	4	1
UNIT V: PROTEOMICS AND DRUG DISCOVERY		**10**			
26.	Protein Classification	1	C	5	1,2
27.	Tools and Techniques in Proteomics	2	C,D	5	1,2
28.	Protein-Protein Interactions, Methods of Gene family identification	1	C	5	1,2
29.	Post Translational modification prediction	1	C	5	1,2
30.	Areas influencing Drug Discovery, Pharmacogenetics, Applications	1	C	5	1,2
31.	Analysis of Single Nucleotide Polymorphisms, Parameters in Drug Discovery.	1	C	5	1,2
32.	Drug Discovery Technologies, Target Discovery Strategy	1	C,D	5	1,2
33.	Case Study	2	C,D,I	5	1,2
Total contact hours		**45***			

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	S.C Rostogi , Mendiratta, P.Rasogi, " BioInformatics: Methods and Applications ",second edition, PHI 2006.
2.	Dan E.Krane, Michael L.Raymer, "Fundamental concepts of BioInformatics", Pearson Education, 2004.
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	T.K. Attwood and D.J Perry Smith, " Introduction to Bio Informatics", Pearson Education, 1st Edition, 2001.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS432E	Data Centric Networks	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	15IT303J				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	To acquire an knowledge that deals with current data center architectures, new technologies adopted to create modern data center architectures.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Critically discuss data centre networking technologies and protocols.	A	b					
2.	Evaluate key concepts in modern Layer 2 & Layer 3 data centre networks	a	c					
3.	Concepts related to networking technologies in modern data centers.	A	c					
4.	Design, build and configure complex routed and switched networks	a	b					
5.	Expose to implementing the networking solutions in a virtualized environment	a	c					

Session	Description of Topic (Theory)	Contact hours	C-D-I-O	IOs	Reference
UNIT I: INTRODUCTION TO DATA- CENTRIC NETWORKING		**9**			
1.	Data centric networking from different perspectives	3	C	1	1,2
2.	Content-Centric Networking (CCN) and Content Distribution Networks (CDN)	2	C	1	1,2
3.	Requirements for modern data centers	2	C,D	1,3	1,2
4.	Design for flexibility, scalability, environmental control, electrical power, flooring in data centers	2	C	1	1,3
UNIT II: DATA CENTRE ARCHITECTURES		**9**			
5.	Top of rack (TOR), End of rack(EOR) network connectivity	3	C,D	5	3
6.	Solutions that reduce power and cabling in architecture	2	C	5	3
7.	TIA/EIA-942. Structured cabling standards	2	C	5	3
8.	Cable management, bandwidth requirements, I/O connectivity	2	C	5	3,7
UNIT III: SERVER ARCHITECTURES		**9**			
9.	Stand-alone blades	2	C	5	2
10.	Clustering, scaling& optimization in server architectures	2	C	5	2
11.	Redundant Layer 2 and Layer 3 designs	2	C,D	3,2	2,4
12.	Limitation of traditional server deployments	2	C	3	2,3
13.	Case study	1	C	3	2,3
UNIT IV: LAYER 2 NETWORKS		**9**			
14.	IEEE 802.3ba; 40 Gbps and 100 Gbps Ethernet	3	C	4,2	2,4
15.	IEEE 802.1D Spanning Tree Protocol (STP), RSTP, PVST, MSTP. TRILL protocols	3	C,D	4,2	2,5
16.	IEEE 802.1Qbg Edge Virtual Bridging, 802.1Qbh Bridge Port Extension. Fiber Channel over Ethernet (FcoE) vs Internet	3	C	4,2	6,7,8
UNIT V: LAYER 3 NETWORKS		**9**			
17.	Layer 3 Data Centre technologies	3	C	5,2	2,3
18.	Locator Identifier Separation Protocol (LISP). Layer 3 Multicasting..	3	C	5,2	2,5
19.	Protocols; Ipv4, Ipv6, MPLS, OSPF, IS-IS, BGP. OTV, VPLS layer 2 extension	3	C,D	5,2	2,3
	Total contact hours	**45***			

LEARNING RESOURCES	
Sl.No.	**TEXT BOOKS**
1.	Mouricio Arregoces, "Data Centre Fundamentals", Cisco Press ,2003
	REFERENCE BOOKS/OTHER READING MATERIAL
2.	SilvanoGai, Claudio DeSanti,"I/O Consolidation in the Data Center" Cisco Press; 1 edition [ISBN: 9781587058882]. 2009.
3.	Kevin Corbin, Ron Fuller, David Jansen, "NX-OS and Cisco Nexus Switching: Next-Generation Data Center Architectures" Cisco Press; 1 edition [ISBN: 9781587058929], 2010.
4.	SilvanoGai, TommiSalli, Roger Andersson, "Cisco Unified Computing System" Cisco Press; 1 edition, [ISBN: 9781587141935], 2010.
5.	Nash Darukhanawalla, Patrice Bellagamba, "Interconnecting Data Centers Using VPLS" Cisco Press; 1 edition, [ISBN: 9781587059926], 2009.
6.	Robert W. Kembel, Roger Cummings (Introduction), "The Fibre Channel Consultant" Northwest Learning Assoc; 3rd edition, [ISBN: 0931836840], 1998.
7.	Robert W Kembal"Fiber Channel Switched Fabric" Northwest Learning Associates, inc. [ISBN: 0931836719], 2009.
8.	John L. Hufferd, "ISCSI", Addison-Wesley Boston [ISBN: 978- 0201784190], 2003.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS433E	Network Design And Management	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	To give understanding of how to design, manage and secure a computer network and how to capture and analyze the network and network data.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Understand the various type of networks and the network management basics	a						
2.	Understand the architecture behind standards based network management	a						
3.	Understand the Simple Network Management Protocol	a						
4.	Use the network management Tools	a	i					
5.	Design and troubleshooting the network	a	c					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
UNIT I: NETWORK MANAGEMENT OVERVIEW		**8**			
1.	Telephone network and management, Distributed computing Environment, Internet and Intranet	1	C	1	1
2.	Communication protocols and standards, Network, systems and services, Challenges in IT Managers	2	C	1	1
3.	Network Management and Architecture	1	C	1	1
4.	Network management perceptive, Current status and future of network management	1	C	1	1
5.	Network Management standards and model, Organizational model, Information model, Communication model, Functional model, ASN.1	3	C	1	1
UNIT II: SNMPv1, SNMPv2, SNMPv3		**10**			
6.	SNMP v1 model, Organization Model, System overview	1	C	2	1,5
7.	SNMP v1 Information model	2	C	2	1,5
8.	SNMPv1 Communication model and Functional model	2	C	2	1,5
9.	SNMPv2	3	C	2	1,5
10.	SNMPv3	2	C	2	1,5
UNIT III: REMOTE MONITORING, NETWORK MANAGEMENT TOOLS AND ENGINEERING		**9**			
11.	RMON1	1	C,I	3	1
12.	RMON2	1	C,I	3	1
13.	System Utilities for management	1	C,I	3	1
14.	Network Statistics Measurement systems	1	C,I	3	1
15.	MIB Engineering	1	C,I	2	1
16.	Network Management System Design	2	C,I	2	1
17.	Network Management Applications	2	C,I	1	1
UNIT IV: FAULT MANAGEMENT, CONFIGURATION MANAGEMENT, PERFORMANCE MANAGEMENT AND ACCOUNT MANAGEMENT		**9**			
18.	Fault management architecture, Algorithm, Self-healing, Avoiding failures,	3	C	1	2,6
19.	Configuration setting, Configuration discovery and Change Control, Configuration management applications, Patch management	3	C	1	2,6

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
20.	Approaches for performance management, Performance monitoring and reporting, Performance trouble shooting, Capacity Planning, Account management	3	C	1	2,6
UNIT V: SECURITY MANAGEMENT		**9**			
21.	Small Business Network	2	C	4,5	3,4
22.	Network Administration and Support	2	C	4,5	3,4
23.	Enterprise and Wide Area Networks	2	C	4,5	3,4
24.	Solving Network Problems	3	C,I	4,5	3,4
Total contact hours		**45***			

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Mani Subramanian "Network Management Principles and Practice", Second Edition, Pearson Publication, 2012
2.	Dinesh Chandra Verma, "Principles of Computer Systems and Network Management", Springer, 2009
3.	Greg Tomsho, Ed Tittel, David Johnson, "Guide to Network Essentials", Fifth Edition, Cengage Learning, 2010
	REFERENCE BOOKS/OTHER READING MATERIAL
4.	Brijendra Singh, "Network Security and Management", Third Edition, PHI Learning Private Limited, 2015
5.	Stallings Williams, "SNMP, SNMPv2, SNMPv3 and RMON 1 and 2", Pearson publication, 2012
6.	Kauffel, "Network Management Problems standards and stretegies", Addison Wesley, 1992

Course nature		**Theory**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours

15CS434E	Network Security	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	P Professional Elective				
Course designed by	Department of Computer Science and Engineering				
Approval	32nd Academic Council Meeting , 23rd July 2016				

PURPOSE	To understand the various types services i.e. Confidentiality, Authentication, Data Integrity, Non-Repudiation and Access control and the mechanisms used to mitigate the security risks							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Ability to understand the application of mathematics in cryptography	a						
2.	Understand the mechanism used in the classical encryption system and different type of block cipher mode of operation	a	b					
3.	Ability to encrypt/decrypt a message using Secret Key and Public Key	a	b					
4.	Understand the various types of authentication algorithm	a						
5.	Understand the security measure taken over Internet security	j						
6.	Understand the various types of vulnerabilities and detection system	j						

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
UNIT I: SECRET KEY CRYPTOGRAPHY		**9**			
1.	Classical Encryption Techniques, SDES	3	D,I	1,2	1,3,5
2.	Block Cipher and Data Encryption Standard (DES)	3	D	2,3	1,3,5
3.	Attack, Linear Cryptanalysis	1	D	3	2,5
4.	Block Cipher Operation and AES	2	D	2,3	1,3,5
UNIT II: PUBLIC KEY CRYPTOGRAPHY		**9**			
5.	Mathematical Background for Cryptography	3	C	1	2,3
6.	Fermat's and Euler's Theorems, Testing for Primality	1	C	1	1,3
7.	Public Key Cryptography and RSA	2	D,I	3	1,2,3
8.	Discrete Logarithm and its application	1	C	1	2,3
9.	Elliptic Curve Cryptography	2	C,D,I	3	2.3
UNIT III: AUTHENTICATION		**9**			
10.	Cryptographic Hash	1	D,I	4	2,4,5
11.	Key Management	2	D,I	3	2,4,5
12.	Authentication	4	D,I	4	2,4,5
13.	Secure Hash Algorithm (SHA)	2	D,I	4	1,4,5
UNIT IV: INTERNET SECURITY		**9**			
14.	IP Security – IPSec	2	C	5	2,4
15.	Transport Layer Security	1	C	5	2,4
16.	Wireless LAN Security	2	C	5	2,4
17.	Cell Phone Security	1	C	5	2,4
18.	Web Service Security	3	C	5	2,4
UNIT V: VULNERABILITY AND INTRUSION DETECTION SYSTEM		**9**			
19.	Non-Cryptographic Protocol Vulnerabilities	2	C	6	2
20.	Software Vulnerabilities	2	C	6	2
21.	Virus, Worms and other Malwares	2	C	6	2
22.	Firewall	1	C	6	2
23.	Intrusion Prevention and Detection	2	C	6	2
	Total contact hours	**45***			

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	Williams Stallings “Cryptography and Network Security – Principles and Practice”, Sixth Edition, Pearson Publication, 2016
2.	Bernard Menezes “Network Security and Cryptography”, Cengage Learning, Third Impression 2014
	REFERENCE BOOKS/OTHER READING MATERIAL
3.	Atul Kahate “Cryptography and Network Security”, Tata McGraw Hill Publication Company Limited, 2006
4.	Charlie Kaufman et al “Network Security – Private Communication in a Public World”, Second Edition, PHI Learning Private Limited, 2011
5.	Charles P. Pfleeger et al “Security in Computing “, Third Edition, Pearson Education, 2004

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage :							**50%**

* Excluding Assessment Hours