School of Computing & I.T

Department of Computer Science & Engineering

B.TECH PROGRAMME STRUCTURE

2016 – 2020 (3rd Semester onwards)

No. of Credits: 175 Credits

B.TECH COURSE STRUCTURE REVAMP(CSE) 2016-2020

Third Semester

Course Code	Course Name	L	T	P	C	End Term Exam. Duration		Relative weightage (%)				
						Th	P	CWS	PRS	MTE	ETE	PRE
Hum. Dep*	Value Ethics and Governance	2	0	0	2	2		30	-	30	40	-
MA1307	Engineering Mathematics-III	3	0	0	3	3		30	-	30	40	-
CS1301	Computer Organization & Architecture	3	1	0	4	3		30	-	30	40	-
CS1302	Switching Theory & Logic Design	3	1	0	4	3		30	-	30	40	-
CS1303	Data Structures	3	1	0	4	3		30	-	30	40	-
CS1304	Object Oriented Programming using Java	3	1	0	4	3		30	-	30	40	
CS1331	Data Structures Lab	0	0	2	1		2	-	60	-	-	40
CS1332	Object Oriented Programming using Java Lab	0	0	2	1		2	-	60	-	-	40
	Total	**17**	**4**	**4**	**23**							

Fourth Semester

Course Code	Course Name	L	T	P	C	End Term Exam. Duration		Relative weightage (%)				
						Th	P	CWS	PRS	MTE	ETE	PRE
*HS1401	Economics	3	0	0	3	3		30	-	30	40	-
MA1406	Engineering Mathematics-IV	3	0	0	3	3		30	-	30	40	-
CS1401	Operating Systems	3	1	0	4	3		30	-	30	40	-
CS1402	Relational Database Management Systems	3	1	0	4	3		30	-	30	40	-
CS1403	Microprocessor & Microcontrollers	3	0	0	3	3		30	-	30	40	-
-----	Open Elective-I	3	0	0	3	3		30	-	30	40	
CS1431	Operating Systems Lab	0	0	2	1		2	-	60	-	-	40
CS1432	Relational Database Management Systems Lab	0	0	2	1		2	-	60	-	-	40
CS1433	Microprocessor & Microcontroller Lab	0	0	2	1		2	-	60	-	-	40
	Total	**18**	**2**	**6**	**23**							

ABBREVIATIONS	
L	Lecture
T	Tutorial
P	Practical
C	Number of Credits
CWS	Class Work Sessional
MTE	Mid-Term Exam
PRE	End Term Practical Exam
PRS	Practical Sessional
ETE	End Term Exam

LIST OF OPEN ELECTIVE COURSES		
1	CS1490	Basics of Linux Programming
2	CS1491	OOPS using Java
3	CS1492	Data Structures & Algorithms
4	CS1493	Databases & ERP
5	CS1690	Web Technologies
6	CS1691	Soft Computing Techniques
7	CS1692	Numerical Methods in C
8	CS1693	Introduction to Cyber Security

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	B.TECH COURSE STRUCTURE REVAMP(CSE) 2016-2020												
Fifth Semester													
Course Code	**Course Name**	**L**	**T**	**P**	**C**	**End Term Exam.**		**Relative weightage (%)**					
						Duration							
						Th	**P**	**CWS**	**PRS**	**MTE**	**ETE**	**PRE**	
CS1501	Design & Analysis of Algorithms	3	1	0	4	3		30	-	30	40	-	
CS1502	Software Engineering	3	1	0	4	3		30	-	30	40	-	
IT1504	Data Communications	3	1	0	4	3		30	-	30	40	-	
CS1505	Automata & Compiler Design	3	1	0	4	3		30	-	30	40		
Department Elective 1	****	3	0	0	3	3		30	-	30	40	-	
Open Elective 2	****	3	0	0	3	3		30	-	30	40	-	
CS1530	Design & Analysis of Algorithms Lab	0	0	2	1		2	-	70	-	-	30	
CS1532	Software Engineering Lab	0	0	2	1		2	-	70	-	-	30	
CS1535	Automata & Compiler Design Lab	0	0	2	1		2	-	70	-	-	30	
	Total	**18**	**4**	**6**	**25**								

ABBREVIATIONS			
L	Lecture	MTE	Mid-Term Exam
T	Tutorial	PRE	End Term Practical Exam
P	Practical	PRS	Practical Sessional
C	Number of Credits	ETE	End Term Exam
CWS	Class Work Sessional		

Course Code	Department Elective 1
CS1551	Linux System and Shell Programming
CS1553	Digital Image Processing
CC1551	Web Technologies
CC1552	Embedded Systems
IT1551	Graph Theory
IT1552	Python Programming
Course Code	Open Elective 2
CS1593	Principles of Programing Languages
CS1594	Enterprise Resource Planning
IT1591	Introduction to Python Programming
IT1590	Cryptography
CC1590	Introduction to Web Technology
CC1591	Software Testing

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B.TECH COURSE STRUCTURE REVAMP(CSE) 2016-2020

Sixth Semester

Course Code	Course Name	L	T	P	C	End Term Exam Duration		Relative weightage (%)				
						Th	P	CWS	PRS	MTE	ETE	PRE
MB**	Management	3	0	0	3	3		30		30	40	
CS1602	Computer Networks	3	1	0	4	3		30		30	40	-
CS1604	Computer Graphics & Multimedia	3	1	0	4	3		30		30	40	-
Department Elective 2	****	3	0	0	3	3		30		30	40	-
Open Elective Course 3	****	3	0	0	3	3		30		30	40	-
CS1631	Computer Networks lab	0	0	2	1		2	-	70	-	-	30
CS1633	Computer Graphics & Multimedia Lab	0	0	2	1		2	-	70	-	-	30
CS1634	Minor Project	0	0	6	3		-		70			30
	Total	15	2	10	22							

ABBREVIATIONS

L	Lecture
T	Tutorial
P	Practical
C	Number of Credits
CWS	Class Work Sessional
MTE	Mid-Term Exam
PRE	End Term Practical Exam
PRS	Practical Sessional
ETE	End Term Exam

Program Structure of B.Tech (CSE)

Course Code	Department Electives - 2
CC1651	Distributed Systems
CC1652	Advance Internet Technologies
CC1653	Internet of Things
CC1654	Principles of Software Engineering
CS1650	Distributed Databases
CS1653	Cloud Computing & Infrastructure Services
CS1654	Parallel Processing
CS1655	Agile Methodology
IT1652	Software Quality and Testing
IT1653	Artificial Intelligence
IT1654	Data Science

Course Code	Open Elective – 3
CS1694	Process Mining
CS1698	Android Programming & App Development
IT1692	Introduction to Data Science
IT1693	Advance Topics in Computing
CC 1690	Open Source Techniques
CC 1691	Soft Computing Techniques

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B.TECH COURSE STRUCTURE REVAMP(CSE) 2016-2020

Seventh Semester

Course Code	Course Name	L	T	P	C	End Term Exam. Duration		Relative weightage (%)				
						Th	P	CWS	PRS	MTE	ETE	PRE
CS1704	Information Systems Security	3	1	0	4	4		30	-	30	40	
CS1701	Big data Analytics	3	1	0	4	4		30	-	30	40	-
******	Department Elective 3	3	0	0	3	3		30	-	30	40	-
******	Department Elective 4	3	0	0	3	3		30	-	30	40	-
******	Department Elective 5	3	0	0	3	3		30	-	30	40	-
******	Open Elective	3	0	0	3	3		30	-	30	40	-
CS1730	Big data Analytics Lab	0	0	2	1		2	-	70	-	-	30
	Total	**18**	**2**	**2**	**21**							

Eight Semester

Course Code	Course Name	L	T	P	C	End Term Exam. Duration		Relative weightage (%)				
						Th	P	CWS	PRS	MTE	ETE	PRE
CS1881	MFP	0	0	24	12			30		40		30
	Total	**0**	**0**	**24**	**12**							

*Internal students will do project and take one audit course

ABBREVIATIONS	
L	Lecture
T	Tutorial
P	Practical
C	Number of Credits
CWS	Class Work Sessional
MTE	Mid-Term Exam
PRE	End Term Practical Exam
PRS	Practical Sessional
ETE	End Term Exam
MFP	Major Final Year Project
Course Code	**Department Electives III-7th sem**
CC1751	Compiler Design
IT1754	Software Define Networks
CS1756	Advanced Computer Networks
CS1757	Advanced Data Structure
Course Code	**Department Electives IV-7th sem**
IT1759	Social Network Analysis
CS1758	Real Time System
CS1750	Machine Learning
Course Code	**Department Electives V-7th sem**
CC1755	Wireless Sensors & Adhoc Network
CS1759	Information Retrieval
CS1760	Principles of Distributed Computing
Course Code	**Open Electives 4-7th sem**
CS1790	Introduction to Data Mining
CC1791	Introduction to Internet of Things
IT1791	Introduction to Real Time System
IT1792	Information & Web Security

B.TECH COURSE STRUCTURE REVAMP(CSE)

Third Semester												
Course Code	**Course Name**	**L**	**T**	**P**	**C**	**End Term Exam. Duration**		**Relative weightage (%)**				
						Th	**P**	**CWS**	**PRS**	**MTE**	**ETE**	**PRE**
HS1101	Value Ethics and Governance	2	0	0	2	2		30	-	30	40	-
MA1307	Engineering Mathematics-III	3	0	0	3	3		30	-	30	40	-
CS1301	Computer Organization & Architecture	3	1	0	4	3		30	-	30	40	-
CS1302	Switching Theory & Logic Design	3	1	0	4	3		30	-	30	40	-
CS1303	Data Structures	3	1	0	4	3		30	-	30	40	-
CS1304	Object Oriented Programming using Java	3	1	0	4	3		30	-	30	40	
CS1331	Data Structures Lab	0	0	2	1		2	-	60	-	-	40
CS1332	Object Oriented Programming using Java Lab	0	0	2	1		2	-	60	-	-	40
	Total	**17**	**4**	**4**	**23**							

Fourth Semester												
Course Code	**Course Name**	**L**	**T**	**P**	**C**	**End Term Exam. Duration**		**Relative weightage (%)**				
						Th	**P**	**CWS**	**PRS**	**MTE**	**ETE**	**PRE**
*HS1401	Economics	3	0	0	3	3		30	-	30	40	-
MA1406	Engineering Mathematics-IV	3	0	0	3	3		30	-	30	40	-
CS1401	Operating Systems	3	1	0	4	3		30	-	30	40	-
CS1402	Relational Database Management Systems	3	1	0	4	3		30	-	30	40	-
CS1403	Microprocessor & Microcontrollers	3	0	0	3	3		30	-	30	40	-
-----	Open Elective-I	3	0	0	3	3		30	-	30	40	
CS1431	Operating Systems Lab	0	0	2	1		2	-	60	-	-	40
CS1432	Relational Database Management Systems Lab	0	0	2	1		2	-	60	-	-	40
CS1433	Microprocessor & Microcontroller Lab	0	0	2	1		2	-	60	-	-	40
	Total	**18**	**2**	**6**	**23**							

HS1101	**VALUE, ETHICS & GOVERNANCE**	**[2 0 0 2]**
Objective:		
To improve understanding of values ethics & corporate governance so ensure that we produce responsible citizens for the larger society.		
Contents:		
Values: Meaning of value education, Three Gunas and their relevance, Nature and kinds of value, Understanding Harmony at various Levels: Nature, in existence; **Ethics and Business:** Values and attitudes for professional accountants, Legal frameworks, regulations and standards for business, Nature of ethics and its relevance; Rules-based and framework approaches to ethics; Personal development and lifelong learning; Personal qualities; Ethical principles; Concepts of independence, skepticism, accountability and social responsibility; **Ethical Conflict:** Relationship between ethics, governance, the law and social responsibility, Unethical behaviour, Ethical dilemmas and conflicts of interest; **Corporate Governance:** The role and key objectives of organizattional governance in relation to ethics and the law; development of organizattional governance internationally; the role of directors in relation to corporate governance; the role of the board, Types of board structures and corporate governance issues, Policies and procedures for 'best practice' companies, Rules and principles based approaches to corporate governance		
Text / Reference Books:		
1. Gaur R.R., Sangal R. and. Bagaria, G.P: "*A Foundation Course in Human Values Professional Ethics,"* Excel Books, 2010. 2. Sadri S & Sadri, J *Business Excellence Through Ethics & Governance*, 2nd edition, 2015. 3. Mathur, U C *Corporate Governance and business ethics,* MacMillan India Ltd, 2009. 4. Baxi, C V: *Corporate Governance*, Excel Books, 2009 5. Sadri S, Sinha A K and Bonnerjee, P: *Business Ethics: concepts and cases*, TMH, 1998.		

MA1307	**Engineering Mathematics III**	[3 0 0 3]

Sets, relations and functions: Sets and set operations, functions, binary relations, partial ordering relations and Hasse diagram, equivalence relations. Principle of mathematical induction. **Basic counting techniques**: pigeon-hole principle, inclusion and exclusion principle, permutations and combinations. Discrete numeric functions, recurrence relations and generating function. **Propositional Calculus:** propositions and logical operations, conditional statements, logical equivalence of statements, tautology and contradiction, Predicates and Quantifiers, rules of inference. **Algebraic structures**: Semi-group, monoid, group, cyclic group, permutation group, Boolean algebra. **Introduction to graph theory:** Graphs and graph models, graph terminology and types of graphs, Handshaking theorem, regular graph, complete graph, bipartite graph, graph isomorphism, subgraphs, walk, path, cycle, Eulerian graph.

Text Books:

1. K. H. Rosen, "Discrete Mathematics and its applications", Seventh Edition, McGraw Hill, 2014.
2. N. Deo, "Graph Theory with applications to engineering and Computer Science", PHI, 2004.

Reference Books:

1. R. Diestel, "Graph Theory", Springer International Edition, 2005.
2. B. Kolman, R. C. Busby, S. C. Ross, "Discrete Mathematical Structures", Pearson Education, 2004.
3. J.P. Tremblay, R. Manohar, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw-Hill, 2006.

CS1301	COMPUTER ORGANIZATION AND ARCHITECTURE	[3 1 0 4]

Basic Structure of computers: Computer types, functional units, basic operational concepts, bus structures, software, performance; **Machine Instructions and programs**: Numbers, arithmetic operations and characters, Memory locations and addresses; Memory operations, Addressing modes; **Arithmetic**: Addition and subtraction of signed numbers, Adders, ALU design, Bit slice processor, Multiplication of positive numbers Signed operand multiplication, Fast multiplication, Integer division, Floating point numbers and operations; **Memory Systems**: Introduction, Basic concepts, Design methods; RAM memories, Read only memories, Speed size and cost, Cache memories, Performance considerations, Virtual memories, Memory, Management Requirements, Secondary storage; **Input / Output organization**: Accessing I/O devices, Interrupts, Direct memory access, Buses, Interface circuits; **Introduction to Parallel Processing:** Flynn Classification, Multi-Core Architecture, Pipelining.

Text Books:

1. C. Hamacher, Z. Vranesic, "*Computer Organization*", Tata McGraw Hill (TMH), 5th Edition, 2002.

2. W. Stallings, "*Computer Organization and Architecture –Designing for Performance*",PHI, 2009.

Reference Books:

1. David A. Patterson and John L. Hennessy, "*Computer Organization and Design: The Hardware/Software Interface*", 2003.

2. John P. Hayes, "*Computer Architecture and Organization*", Tata McGraw Hill (TMH) Publication, TMH, 3rd Edition, 1998.

CS1302	SWITCHING THEORY & LOGIC DESIGN	[3 1 0 4]

Introduction to logic circuits: Variables and functions, Inversion, Truth tables, Logic gates and networks, Boolean algebra, **Introduction to VHDL:** Optimized implementation of logic functions, Synthesis using AND OR and NOT gates, Karnaugh map, Strategy for minimization, Minimization of POS forms, Incompletely Specified Functions, Multiple output circuits NAND and NOR logic networks, multilevel NAND and NOR circuits, Analysis of multilevel circuits; **Number representation and arithmetic circuits:** Positional number representation, Addition of unsigned numbers, Signed numbers, Fast adders, Design of arithmetic circuits using VHDL, BCD representation; **Combinational-Circuit building blocks:** Multiplexer, decoder, Encoder, Code converter, Arithmetic comparison circuits, VHDL for Combinational Circuits; Flip Flops, Registers, Counters; **Overview of semiconductor diode:** BJT, MOSFET, TTL–standard, High speed, low-power, low-power scotty, CMOS logic-NAND, NOR

Text Books:

1. S. Brown , Z. Vranesic, "*Fundamentals of Digital Logic with VHDL Design*", TMH, 2000.

2. M. Mano, "*Digital Design*", PHI Pvt. Ltd., 3rd Edition, 2000.

Reference Books:

1. P. Leach, A. Malvino and G. Saha, "*Digital Principles and Applications*", TMH, 6th Edition, 2006.

2. J. Bhasker, "*A VHDL Primer*", PHI Pvt. Ltd., 3rd Ed., 2005.

CS1303	DATA STRUCTURES	[3 1 0 4]

Introduction: Algorithm specification; **Performance Analysis:** Time and Space Complexity, Asymptotic notation; pointer declaration and definition, memory allocation functions, array of pointers; The type definition, enumerated types, accessing structures, complex structures, arrays of structures, structures and functions; Recursive definition & processes, Recursion in C, writing recursive programs efficiency of recursion, **Examples:** Tower of Hanoi, GCD, Fibonacci Definition and examples, Representing stacks in C, Evaluation of expressions, multiple stacks and queues; **Applications:** infix, postfix and prefix and their conversions Linked lists representations, Singly, doubly, header node, circular, linked stacks and queues, polynomial and long integer arithmetic, union, intersection, Basic terminologies, binary tree representation, recursive/ non recursive, Binary search tree, AVL trees; **Applications:** Expression trees, inserting, deleting, searching, height of BST Terminology and representations, Graph operations, spanning trees, minimum cost spanning tree, shortest path and transitive closure, Binary and linear search, insertion, quick, merge, heap, radix sort Static Hashing

Text Books:

1. A. Forouzan, R. F. Gilberg, "*A Structured Programming Approach Using C*", Thomson, 2003.

2. A. Tannenbaum, J. Augenstein, "*Data Structures using C",* Pearson Education, 2006.

Reference Books:

1. E. Horowitz, S. Sahni, "*Fundamentals of Data Structures in C*", Silicon Press, 2nd Ed., 2007.

CS1304 **OBJECT ORIENTED PROGRAMMING USING JAVA**	**[3 1 0 4]**

The History and Evolution of java: The Creation of Java, how java changed the internet, Java's Magic, Servlets, The java Buzzwords; An Overview of Java, arrays; **Introduction to classes**: Class fundamentals, declaring objects, Assigning Object reference variables, Introduction to methods, Constructors, this keyword, Garbage collection, finalize() method, Overloading, objects as parameters, argument passing, returning objects, recursion, access control, final, nested and inner classes, string class; **I/O Basics:** Reading Console Input, Writing Console Output, Files, Applet fundamentals; **Inheritance:** basics, super, multilevel hierarchy, overriding, abstract classes, final with inheritance; **Packages and Interfaces**: Exception Handling, Multithreaded programming; String Handling, Applet Class, Event Handling; **Introduction to AWT:** Classes, component, Container, Panel, Window, frame, Canvas, working with frame, working with Graphics, using AWT Controls.

Text Books:

1. H. Schildt, "*The Complete Reference Java Eight Edition*", Tata McGraw-Hill, reprint 2011.

Reference Books:

1. S. Holzner**,** "*Java 2 programming black book*", Dream Tech, New Delhi, reprint: 2005.

CS1331	DATA STRUCTURES LAB	[0 0 1 1]
Review of C and programs on Recursion, Stacks, Stacks, Queues, lists, Trees, Graphs, using C language.		

CS1332 OBJECT ORIENTED PROGRAMMING USING JAVA LAB	[0 0 1 1]
Control statements and arrays, Stacks and Lists, Strings, Classes and methods, Inheritance, Packages, Interfaces, Exception Handling, Threads, Input/Output, Event Handling, Applets, involving AWT, Programs involving AWT	

IV SEMESTER

HS1401	ECONOMICS	[3 0 0 3]
Definition, nature and scope of Economics. Introduction to Micro and Macro Economics. Law of demand and supply, Elasticity of demand and supply. Cardinal and ordinal approaches of Utility. Production: Laws of production, Cost and revenue analysis various market situations, Break-even analysis, Capital Budgeting Macro Economics: National Income and it's Concepts, Value of money and its Changes, Foreign Exchange Rate, Monetary and fiscal Policies and other Macro concepts (Balance of Payment, Business Cycle etc.)		
Text Book:		
1. Peterson H C et.al. , "*Managerial Economics*", Pearson 9th edition, 2012.		
References:		
1. P L Mehta, "*Managerial Economics*", Sultan Chand & Sons New Delhi (Latest Edition). 2. G. J. Tuesen, H. G. Tuesen, "*Engineering Economy*", PHI, New Delhi (Latest Edition).		

MA1406	Engineering Mathematics IV	[3 0 0 3]

Statistics: Probability, Random variables and generating functions, probability distributions: binomial, Poisson, normal, gamma and exponential distributions. Sampling distributions: t and F distributions. Testing of hypotheses. Markov chain, Queuing Theory. Integral Transforms: Laplace transforms of elementary functions, inverse transforms, convolution theorem, Application in solving ordinary and partial differential equations. Fourier transforms. Numerical Methods: Interpolation, Numerical differentiation, Numerical integration: Trapezoidal, Simpson's 1/3 and 3/8 Rule. Solution of system of linear algebraic equations: Gauss Jacobi, Gauss-Seidel methods.

Text Books:

1. V. Sundarapandian, "Probability, Statistics and Queuing Theory", PHI, 2013.
2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, Delhi, 2006
3. E. Kreyszig, "Advanced Engineering Mathematics", Wiley India Eastern, 2006.

Reference Books:

1. S. Pal, S. C. Bhunia, "Engineering Mathematics", Oxford University Press, 2015.
2. P. Kousalya, "Probability, Statistics and Random Processes", Pearson, 2013.
3. R. A. Johnson, C.B. Gupta, "Probability and Statistics for Engineers", Pearson Education, 2009.
4. S. S. Sastry, "Introductory Methods of Numerical Analysis", PHI, 2005

CS1401	OPERATING SYSTEMS	[3 1 0 4]
Introduction: Functions, Classification of Operating System, Operating System Structure and Operations, Process Management, Memory Management, Storage Management, Protection and Security, Special Purpose Systems, Operating System Services, User Operating System Interfaces, System Calls, Types of System Calls, System Programs, Operating System Structure, Virtual Machines, System Boot; **Processes:** Concept, Process Scheduling, Operations on Processes, Inter-process Communication Overview, Multithreaded Models, Thread Libraries, Threading Issues, Linux Threads, Basic Concepts; **CPU Scheduling:** Basic Concept, Scheduling Algorithms, Thread Scheduling, Linux Scheduling: **Process Synchronization** : Concept of Synchronization, Critical Section Problem, Peterson's Solution, Synchronization Hardware, Semaphores, Classical problems on Synchronization, Monitors; **Deadlock:** Deadlock Concept, Deadlock Characterization, Methods for Handling Deadlock, Prevention, Avoidance, Detection, Recovery from Deadlock, Exercises; **Memory Management:** Concept of logical and Physical memory, Swapping, Contiguous Memory Allocation, Paging, Page Table Structure, Segmentation, Examples on The Intel Pentium; **Virtual Memory Management**: Demand Paging, Copy-On-Write, Page Replacement, Allocation of Frames, Thrashing, Memory Mapped Files, Allocating Kernel Memory; **Files:** File concept, Access Methods, Directory Structure, File System Mounting, File Sharing; **Security Problem:** The security problem, Program Threats, System and Network threats, User Authentication Design Principles, Firewalling to Protect Systems.; **Case study on Linux System**.		
Text Books:		
1. A. Silberschatz, P. B. Galvin, "*Operating System Concepts",* International student version, Wiley, 8th Edition, 2009. 2. W. Stallings, "*Operating Systems: Internals and Design Principles",* Pearson Ed., 2009.		
Reference Books:		
1. J. Harris, "*Operating Systems*", Tata McGraw-Hill publications, 2002.		

CS1402	RELATIONAL DATABASE MANAGEMENT SYSTEMS	[3 1 0 4]

Introduction: Database-System Applications, Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture; **Relational Algebra**: Fundamental Relational-Algebra Operations, Extended Relational-Algebra Operations, Null Values, Modification of the Database; **SQL:** Data Definition Language, Data manipulation language , SQL Data Types and Schemas, Integrity Constraints, Basic Structure of SQL Queries, Set Operations, Aggregate Functions, Null Values, Nested Sub-queries, Complex Queries, Views, Modification of the Database, Joined Relations, Authorization, Overview of the Design Process; **The Entity-Relationship Model:** Constraints, Entity-Relationship Diagrams, Entity-Relationship Design Issues, Weak Entity Sets, Extended E-R Features; **Normalization:** Anomalies, Referential integrity, 1NF, Functional Dependency, 2NF, 3NF, BCNF; **Hashing Techniques:** Dynamic Hashing; **Transactions:** Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for Serializability, Lock-Based Protocols, Log-Based Recovery, Recovery algorithms

Text Books:

1. S. Korth, "*Database System Concepts*", Mc-GrawHill, 6th Edition, 2011.

2. R. Elmasri and S. Navathe, "*Fundamentals of Database Systems*", Pearson Education, 2006.

Reference Books:

1. T. Connolly, C. Begg, "*Database Systems–A Practical Approach to Design, Implementation and Management*", Pearson Education, 3rd Edition, 2002.

CS1403	MICROPROCESSOR & MICROCONTROLLER SYSTEMS	[3 0 03]

8086: internal architecture, programming the 8086, Addressing modes, Flags; Instruction Set: assembler and Assembler directives, Simple sequence programs, Jumps and conditional jumps, Loop instructions, Instruction timing and delay loops; String instructions, Writing and Using Procedures and Macros, 8255: Programmable Parallel ports and Handshake Input/ Output; Interrupts and Interrupt Responses: 8259 Priority Interrupt Controller, 8254 Software-Programmable Timer/counter; Software interrupts, Intel 8096-16-bitMicrocontroller: Overview; Instruction Set and Programming; Hardware features, , iRMX, ARM processor, Real-Time Executive: iRTX

Text Books:

1.   D. V. Hall, "Microprocessors and Interfacing", TMH, Revised Second Edition, 2006.

2.   N. S. Kumar, M. Saravanan, et. al. "Microprocessors and Microcontrollers", Oxford Higher Education, 2015.

3.   C. Hamacher, Z. Vranesic, "Computer Organization", TMH, 2002.

4.   Y. Liu, G.A. Gibson, "Microcomputer Systems- The 8086/8088 Family", PHI Learning private Ltd., 2011.

Reference Books:

1.   B. B. Brey, "The Intel Microprocessors", Seventh Edition, Prentice Hall India, 2005.

2.   A. Clements, "Microprocessor system design 68000 Hardware", Software, and Interfacing, PWS Publishing Company, Third Edition, 1997.

CS1431	OPERATING SYSTEMS LAB	[0 0 1 1]

Testing the use of UNIX commands, UNIX shell commands, Basics of Shell Programming, UNIX System Calls, CPU Scheduling Algorithms, Deadlock Detection Algorithms, Deadlock Avoidance Algorithms, Page Replacement Algorithms, Memory Allocation Algorithms, Disk Scheduling Algorithms, and UNIX Inter Process Communication.

CS1432	RELATIONAL DBMS LAB	[0 0 1 1]

DB application development with MS Access, Experiments on DDL and Basic SQL, Advanced SQL, ER diagrams using DIA tool, Data Integrity Constraints and Built-in Functions, Design and Implementing the data requirements of a simple DB application, Experiments on Basic PL/SQL, PL/SQL Exceptions and Transactions, PL/SQL Cursors, PL/SQL Procedures, Functions and Packages, DB application development with Java as front end

CS1433	Microprocessor & Microcontroller Lab	[0 0 1 1]

Data and Address transfer Instructions, Simple Arithmetic Instructions, Arithmetic Instructions, BIT Manipulation Instructions: Program execution transfer Instructions, Program execution transfer Instructions, Array operations, String Operations

CS 1490	INTRODUCTION TO LINUX PROGRAMMING	[3 0 0 3]

Introduction: UNIX System Overview, Program and Processes, Error Handling, User Identification, Signals, System Calls and Library Functions.: **File I/O:** File Descriptors, Function for File Modification, I/O Efficiency, File Sharing, Atomic Operations.; **Directories:** Stat, Fstat, and Lstat Functions, File Types, Set-User-ID and Set-Group-ID, File Access Permissions , Function for modifying file permission and ownership, Symbolic Links, **System Data Files and Information:** Password File, Shadow Passwords and Other Data Files.; **Process Environment**: Process Termination, Memory Layout of a C Program, Memory Allocation, setjmp and longjmp Functions.; **Process Control:** fork Function, vfork Function, exit Functions, wait and waitpid Functions, Race Conditions, Changing User IDs and Group IDs.; **Process Relationship:** Logins, Process Groups, Sessions, Controlling Terminal, Job Control.; **Signals:** Signal Concepts, Functions to raise and handle Signals, Program Termination, abort and system functions.; **Threads:** Thread Concepts, Creation, Termination and Synchronization, Threads Control, Threads and Signals, Threads and fork, Threads and I/O.

Text Books:

1. W. R. Steven, S. A. Rago *"Advanced Programming in the Unix environment"*, Addison Wesley, 2011

Reference Books:

1. Y. P. Kanetkar *"Unix Shell Programming"*. BPB Publication, 2009.

CS 1491	OOPS USING JAVA	[3 0 0 3]

Introduction to OOP: Features of Java, How Java is different from C++, Data types, Control Statements, identifiers, arrays, and operators. **Inheritance**: Multilevel hierarchy, method overriding, abstract classes, Final classes, String Class. **Packages and Interfaces**: Defining, Implementing and Importing Packages. **Exceptions**: Fundamentals, Types, Uncaught Exceptions, Multiple catch Clauses, Java's Built-in Exception. **Multithreading**: Creating, Implementing and Extending thread, thread priorities, synchronization suspending, resuming and stopping Threads. **String**: String Constructors, Various Types of String Operations. **Basic Packages of Java**: Java. Lang, Java.util, Java.i.o. **Event Handling:** Event Model, Event Classes, Sources of Events, Event Listener Interfaces **AWT**: Working with Windows, AWT Controls, Layout Managers Applet Class, Architecture, Skeleton, Display Methods. **Swings**: Japplet, Icons, labels, Text Fields, Buttons, Combo Boxes.

Text Books:

1. H. Schildt, *"Java the Complete Reference"*, 8th Edition, TMH, 2008.
2. E. Balaguruswamy, *"Introduction to JAVA Programming"*, TMH, 2009.

Reference Books:

1. D. Young, *"Introduction to JAVA Programming"*, PHI, 2008.

CS 1492	DATA STRUCTURES AND ALGORITHMS	[3 0 0 3]

Introduction, Algorithm specification; **Performance Analysis**: Time and Space Complexity, Asymptotic notation; pointer declaration and definition, memory allocation functions, array of pointers; The type definition, enumerated types, accessing structures, complex structures, arrays of structures, structures and functions; **Recursion:** Recursive definition & processes, Recursion in C, writing recursive programs efficiency of recursion, Example of Tower of Hanoi, GCD, Fibonacci Definition and examples, Representing stacks in C, Evaluation of expressions, multiple stacks and queues; **Applications**: infix, postfix and prefix and their conversions Linked lists representations, Singly, doubly, header node, circular, Applications: linked stacks and queues, polynomial and long integer arithmetic, union, intersection, Basic terminologies, binary tree representation, recursive/ non recursive, Binary search tree, AVL trees; **Applications**: Expression trees, inserting, deleting, searching, height of BST Terminology and representations, Graph operations, spanning trees, minimum cost spanning tree, shortest path and transitive closure, Binary and linear search, insertion, quick, merge, heap, radix sort Static Hashing

TEXT BOOKS:

1. S. Lipschutz, "*Data Structures with C*", Tata McGraw Hill Education, 2010

REFERENCES:

1. D.Forouzan, R. F. Gilberg, "*A Structured Programming Approach Using C*", Thomson, 2003.
2. A.S. Tenenbaum, J. Augenstein, "*Data Structures using C*", Pearson Education, 2006.
3. E. Horowitz, S. Sahni, "*Fundamentals of Data Structures in C*", Silicon Press, Second Edition, 2007.

CS 1493	DATABASES & ERP	[3 0 0 3]

Introduction to Databases and Transactions: What is database system, purpose of database system, view of data, relational databases, database architecture, transaction management; **Data Models:** The importance of data models, Basic building blocks, Business rules, The evolution of data models, Degrees of data abstraction; Database Design ,**ER-Diagram and Unified Modeling Language:** Database design and ER Model: overview, ER-Model, Constraints, ER-Diagrams, ERD Issues, weak entity sets, Codd's rules, Relational Schemas; Relational Database design: features of good relational database design, atomic domain and Normalization (1NF, 2NF, 3NF, BCNF); **Relational Algebra and Calculus:** What is constraints, types of constrains, Integrity constraints; **SQL:** data definition, aggregate function, Null Values, nested sub queries, Joined relations. Triggers; **Transaction management and Concurrency control**: Transaction management, ACID properties, Serializability and concurrency control, Lock based concurrency control (2PL, Deadlocks),Time stamping methods, optimistic methods, database recovery management; **ERP an Overview**: Enterprise – An Overview, Benefits of ERP, Origin, Evolution and Structure: Conceptual Model of ERP, the Evolution of ERP, the Structure of ERP. ERP and Related Technologies, Business Process Reengineering (BPR).

TEXT BOOKS:

1. S. Korth, "Database System Concepts", Mc-GrawHill, 6th Edition, 2011.
2. R. Elmasri and S. Navathe, "Fundamentals of Database Systems", Pearson Education, 2006.
3. A. Leon, "ERP Demystified", Tata McGraw Hill, New Delhi, 2000

REFERENCES:

1. D.Forouzan, R. F. Gilberg, "*A Structured Programming Approach Using C*", Thomson, 2003.
2. A.S. Tenenbaum, J. Augenstein, "*Data Structures using C*", Pearson Education, 2006.
3. E. Horowitz, S. Sahni, "*Fundamentals of Data Structures in C''*, Silicon Press, Second Edition, 2007.
4. T. Connolly, C. Begg, "*Database Systems–A Practical Approach to Design, Implementation and Management*", Pearson Education, 3rd Edition, 2002.

SCHOOL OF COMPUTING & IT												
B. TECH COURSE STRUCTURE REVAMP(CSE)												

Fifth Semester

Course Code	Course Name	L	T	P	C	End Term Exam. Duration		Relative weightage (%)				
						Th	P	CWS	PRS	MTE	ETE	PRE
CS1501	Design & Analysis of Algorithms	3	1	0	4	3		30	-	30	40	-
CS1502	Software Engineering	3	1	0	4	3		30	-	30	40	-
IT1504	Data Communications	3	1	0	4	3		30	-	30	40	-
CS1505	Automata & Compiler Design	3	1	0	4	3		30	-	30	40	
Department Elective 1	****	3	0	0	3	3		30	-	30	40	-
Open Elective 2	****	3	0	0	3	3		30	-	30	40	-
CS1530	Design & Analysis of Algorithms Lab	0	0	2	1		2	-	70	-	-	30
CS1532	Software Engineering Lab	0	0	2	1		2	-	70	-	-	30
CS1535	Automata & Compiler Design Lab	0	0	2	1		2	-	70	-	-	30
	Total	**18**	**4**	**6**	**25**							

Sixth Semester

Course Code	Course Name	L	T	P	C	End Term Exam Duration		Relative weightage (%)				
						Th	P	CWS	PRS	MTE	ETE	PRE
MB**	Management	3	0	0	3	3		30		30	40	
CS1602	Computer Networks	3	1	0	4	3		30		30	40	-
CS1604	Computer Graphics & Multimedia	3	1	0	4	3		30		30	40	-
Department Elective 2	****	3	0	0	3	3		30		30	40	-
Open Elective Course 3	****	3	0	0	3	3		30		30	40	-
CS1631	Computer Networks lab	0	0	2	1		2	-	70	-	-	30
CS1633	Computer Graphics & Multimedia Lab	0	0	2	1		2	-	70	-	-	30
CS1634	Minor Project	0	0	6	3		-		70			30
	Total	15	2	10	22							

V SEMESTER

CS1501	Design and Analysis of Algorithms	[3 1 0 4]

Prerequisites: Programming in C, Data Structures

Algorithm Analysis: A priori and a posteriori Analysis, Time Space Tradeoff, Asymptotic Notations, Properties of asymptotic notations, Recurrence equations, Solving recurrence equations using Substitution method and Master's method; **Trees:** B-Tree, Red Black Tree; **Divide and Conquer:** Binary Search, Finding Maximum and Minimum, Merge Sort, Quick Sort, Matrix Multiplication; **Greedy Algorithms:** Knapsack Problem, Job Sequencing with deadline, Optimal Merge Pattern, Single Source Shortest Path, Minimum Cost Spanning tree; **Dynamic Programming:** Multistage Graphs, Matrix Chain Multiplication, All-Pair shortest paths, Optimal binary search trees, 0/1 Knapsack, Travelling salesperson problem, Graph Traversals, Connected Components, Spanning Trees, Bi-connected components; **Complexity Classes**: Introduction to NP-Hard and NP-Completeness; **Approximation Algorithm**, **Randomized Algorithm.**

Text Books:

1. E. Horowitz, S. Sahni and S. Rajasekaran, *"Computer Algorithms"*, 2nd Edition, University Press, 2007.
2. T. H. Cormen, C. E. Leiserson, R.L.Rivest, and C. Stein, *"Introduction to Algorithms"*, 3rd Edition, MIT press, 2009.

Reference Book:

1. A. V. Aho, J. E. Hopcroft and J. D. Ullman, *"The Design and Analysis of Computer Algorithms"*, 1st Edition, Pearson Education, 1999.

CS1502	Software Engineering	[3 1 0 4]

Software Engineering: Introduction, Importance, Evaluation, Characteristics, Components. Software Application; **Software Development Process Models:** Waterfall Model, Prototyping Model, Spiral Model, RAD Model, etc., Agile Modelling; **Requirement Engineering:** Problem Analysis, Requirement Verification, Requirement Validation Modularity; **Software Project Management:** Cost Estimation Project Scheduling, Risk Management, Quality Assurance, Project Monitoring; **Estimation Techniques:** Size estimation- LOC Estimation, Function Count, Cost Estimation, Halstead Size Estimation, **Software Design:** Analysis Modeling, Functional modeling, Behavioral Modeling; Unified modeling language; **Software Architecture:** Data Design: Data modeling, data structures; **Software Maintenance:** Maintenances Characteristics, Maintainability, Maintenances Tasks, Maintenances Side Effects, Current trends**- DevOps.**

Text Books:

1. R. Mall, *"Fundamental of Software Engineering"*, 4th Edition, PHI, 2014

2. S. lan, "*Software Engineering",* 9th Edition, Addition Wesley, 2002.

Reference Book:

1. P. Jalote, "*Software Engineering a Precise Approach*", Wiley, 2010.

2. R. S. Pressman, "*Software Engineering: A Practitioners Approach",* 7th Edition, TMH, 2016.

IT1504	Data Communications	[3 1 0 4]

Data Transmission: Concepts and Terminology, Analog and Digital Data Transmission, Transmission Impairments, Channel Capacity; **Transmission Media**: Guided Transmission Media, Wireless Transmission, Wireless Propagation, Line-of-Sight Transmission; **Signal Encoding Techniques**: Analog and Digital Signals, Digital-To-Digital Conversion: Line Coding Schemes, Block Coding, Scrambling, Analog-To-Digital Conversion; **Digital Data Communication Techniques**: Asynchronous and Synchronous Transmission, Types of Errors, Error Detection, Error Correction, Line Configurations; **Data Link Control Protocols**: Flow Control, Error Control, High-Level Data Link Control (HDLC); **Multiplexing:** FDM, TDM, CDMA, SDM; **Spread Spectrum**: FHSS, DSSS; **Cellular Wireless Communication Techniques:** Introduction, Generations: 1G, 2G, 3G, 4G, and 5G.

Text Books:

1. W. Stallings, "*Data and Computer Communications*", 8th Edition, Pearson Education, 2007.
2. B. Forouzan, *"Data Communications & Networking*", 5th Edition, MGH, 2012.

Reference Books:

1. T. Bertsekas, K. Dimitri, G. Gallager and T. Robert, "*Data Networks*", 2nd Edition, Prentice Hall India, 2011.
2. L. Peterson and T. Davie "*Computer Networks: A Systems Approach*", 5th Edition, Morgan Kaufmann Publishers, 2012.

CS1505	Automata & Compiler Design	[3 1 0 4]

Automata Theory : Mathematical Preliminaries and Notation: Review of set theory, function, relation; **Introduction to Compiler Design:** Structure of a Compiler; Lexical Analysis, Recognition of Tokens, **Finite Automata:** Deterministic and Non Deterministic Finite Automata (FA), Regular languages, Mealy and Moore machine; **Regular Sets and Regular Grammars:** Chomsky Hierarchy, Regular Expressions, Regular Grammar and FA, Pumping Lemma for Regular Languages; **Context Free Languages (CFL) and Grammars:** Ambiguity, Methods for Transforming Grammars; **Push Down Automata:** Nondeterministic Pushdown Automata (NPDA), Design of NPDA, PDA and CFLs; **Introduction to LR Parsing**: Simple LR, More Powerful LR Parsers, Using Ambiguous Grammars, Parser Generators; **Translation of Expressions:** Operations within Expressions, **Type Checking:** Rules for Type Checking, Storage Organization; **Introduction to Turing machine**

Text Books

1. P. Linz, "*An Introduction to Formal Languages and Automata*", 6th Edition, Jones and Bartlett, 2017.
2. A. Aho, J. Ullman, M. S. Lam, R. Sethi, "*Compilers Principles, Techniques and Tools*", 2nd Edition, Pearson Education, 2007.

Reference Books

1. M. Sipser, "*Introduction to the Theory of Computation*", 3rd Edition, Cengage Learning, 2012.
2. J. Martin, "*Introduction to Languages and the Theory of Computation*", 4th Edition., Tata McGraw Hill, 2010.
3. J. E. Hopcroft, R. Motwani, J. Ullman, "*Introduction to Automata Theory, Languages and Computations*", 3rd Edition, Pearson Education, 2006.

CS1530	**Design and Analysis of Algorithms Lab**	**[0 0 2 1]**

Prerequisites: Programming in C, Data Structures, Discrete Mathematics

Sorting & Searching Algorithm –insertion sort, selection sort, binary search. **Basic data structures** stacks and queues, graphs and trees, binary trees. **Algorithmic paradigms -** Recursion, divide-and-conquer – Merge sort, Quick sort, Greedy – Knapsack, Huffman encoding, **Dynamic programming**, lower bounds and optimal algorithms. **Heaps** - Heaps, priority queues, min-max heaps, heap sort. **Dynamic search structures** - Binary search trees, height balancing, B-trees, skip lists, hashing. **Algorithms on arrays** - Linear-time median finding, sorting in linear time (counting sort, radix sort, bucket sort), **String matching** (Rabin-Karp and Knuth-Morris-Pratt algorithms). **Graph algorithms** Traversal (BFS, DFS, topological sort), **Minimum spanning trees** (Prim and Kruskal algorithms), shortest paths (Dijkstra's and Floyd-Warshal algorithms); **Mini-Projects & Case Studies.**

Reference Books:

1. E. Horowitz, S. Sahni and S. Rajasekaran, "Fundamental of Computer Algorithms", 2nd Edition, Universities Press, 2007.

2. T. H. Cormen, C. E. Leiserson, R.L. Rivest and C. Stein, "Introduction to Algorithms", 3rd Edition, MIT press, 2009.

CS1532	**Software Engineering Lab**	**[0 0 2 1]**
Introduction to Unified Modeling Language (UML 2.0), Use case diagrams, Class diagram, Object diagram, Activity diagram, sequence diagram, component diagram, deployment diagram, state chart diagram, ER Diagrams and DFD Designing Test Cases, **Mini-Projects & Case Studies.**		
References:		
1. W. Boggs and M. Boggs, "Mastering UML with Rational Rose with CDROM" SYBEX Inc., Alameda, CA, USA, 1999.		

CS1535	**Automata and Compiler Design Lab**	**[0 0 2 1]**
Implementation of finite automata systems in gcc compiler/eclipse platform; Implementation of lexical analyser in gcc compiler/eclipse platform; Computation of FIRST and FOLLOW for different types of parsing techniques; Demonstration and use of LEX and YACC tools for compiler design; **Mini-Projects & Case Studies.**		
Reference Books:		
1. J. R Levine, T. Mason and D. Brown, "*lex & yacc",* 2nd Edition, O' Reilly Publishing, 1992.		
2. A. Aho, R. Sethi and J. Ullman, "*Compilers Principles, Techniques, and Tools*", 2nd Edition, Pearson Publication, 2011.		

DEPARTMENT ELECTIVES

CS1551	Linux System and Shell Programming	[3 0 0 3]
Prerequisites: Programming in C, Operating Systems		
Fundamentals: Processes in Linux, I/O system calls, select and poll Functions, Filters and redirection, Linux File system navigation, Directory access, File system implementation, Hard links and symbolic links; **Asynchronous events:** Manipulating signal masks and signal sets, Catching and ignoring signals, Waiting for signals; **Inter-process communication:** Sockets, Remote procedure calls, Network file system; **Concurrency:** POSIX thread attributes, Synchronization functions, Mutex locks, Condition variables, Signal handling and threads; **Character device driver development:** Driver concepts, Writing character drivers, Interrupt handling, Interfacing with hardware; **Shell scripting:** Loops, Conditional statements, Command line arguments, test command, expr command,; **Advanced scripting techniques:** Providing command line options to scripts, Exporting variables, Arrays, Remote shell execution, Connecting to MySQL using shell, Essential System Administration jobs.		
Text Books:		
1. W. R. Stevens and S. A. Rago, "*Advanced Programming in the UNIX Environment*", 3rd Edition, Addison-Wesley, 2013. 2. S. Das, "Unix Concepts and Applications", 4th Edition, McGraw Hill, 2006.		
Reference Books:		
1. W. R. Stevens and B. Fenner, "*UNIX Network Programming, Volume 1: The Sockets Networking API*", 3rd Edition, Pearson Education, 2003. 2. W. R. Stevens, "*UNIX Network Programming, Volume 2: Interprocess Communications*", 2nd Edition, Pearson Education, 1998. 3. R. Love, "*Linux System Programming: Talking Directly to the Kernel and C Library*", O'Reilly, 2007.		

CS1553	Digital Image Processing	[3 0 0 3]

Prerequisites: Basic knowledge of Coordinate Geometry, Linear algebra and matrix operations.

Fundamentals of Image Processing: Steps in image processing, Image file formats, Basic relationships between pixels. Image Histogram. Color fundamentals & models – RGB, HSI YIQ; **Image Enhancement and Restoration; Spatial domain enhancement**: Point Operations-Log transformation, Power-law transformation. **Frequency domain enhancement**: introduction to image transform, Fourier transform, 2D DFT. **Restoration:** Noise models, Restoration using Inverse filtering and Wiener filtering; **Image Coding and Compression** Lossless compression, Lossy compression, JPEG, MPEG; **Image Segmentation and Representation and descriptions** : Grey level features edges and lines: Similarity and correlation, Template matching, Edge detection using templates; **Representation** scheme, Boundary Descriptors, Regional Descriptors; **Overview of Applications:** Biometric Authentication.

Text Books:

1. R. C. Gonzalez and R. E. Woods, "*Digital Image Processing*", 3rd Edition, Pearson Education, 2009.
2. A.K Jain, "*Fundamentals of Digital Image Processing"*, Prentice Hall of India, 1994.

Reference Books:

1. K. R. Castleman, "*Digital Image Processing*", 1st Ed. Pearson Education, 2007.
2. A. McAndrew, "*Introduction to Image processing using Matlab*", Cengage Learning Publisher, 2009.

OPEN ELECTIVES

CS1593	Principles of Programming Languages	[3 0 0 3]
Preliminary Concepts: Concepts of programming languages; **Syntax and Semantics:** general Problem of describing Syntax and Semantics ;**Data types:** Primitive, character, user defined, array, associative record, union, pointer and reference types; **Expressions and Statements:** Assignment Statements, Control Structures; **Subprograms and Blocks:** Fundamentals of sub-programs, Scope of life time of variables, static and dynamic scope, design issues of sub-programs and operations; **Abstract Data types:** Abstractions and encapsulation, introductions to data abstraction, design issues, language examples; **Concurrency:** Subprogram level concurrency, semaphores, monitors, massage passing, Java threads, C# threads, **Exception handling:** Exceptions, exception Propagation, Exception handler in Ada, C++ and Java, **Logic Programming Language:** Introduction and overview of logic programming.		
Text Books:		
1. R. W. Sebesta, "*Concepts of Programming Languages*", 8th Edition, Pearson Education, 2008. 2. D. A. Watt," *Programming Language Design Concepts*", Wiley, 2007.		
Reference Books:		
1. A. B. Tucker, R. E. Noonan, "*Programming Languages*", 2nd Edition, TMH, 2007. 2. K. C. Louden, "*Programming Languages*", 2nd Edition, Thomson, 2003. 3. T. W. Pratt, *"Programming Languages",* 4th Edition, PHI, 2006		

CS1594	Enterprise Resource Planning (ERP)	[3 0 0 3]

ERP Overview: Benefit, Business Process Reengineering, Data ware Housing, Data Mining, LAP, Supply chain Management; **ERP –A Manufacturing Perspective**: ERP Module, ERP Market, ERP implementation life cycle, Options of various paradigms, Identification of suitable platforms, Role of SDLC/SSAD, Object oriented architecture; **ERP Implementation:** introduction, pre evaluation screening, package evaluation, project planning phase. Gap analysis. Hidden costs, Vendors, Consultant Employees, Human Resource; **ERP & E-Commerce**: Future Directives- in ERP, ERP and Internet, Critical Factors guiding selection and evaluation, Strategies for successful implementation, Impediments and initiatives to achieve success, Critical success and failure factors, Integrating ERP into organizational culture; **Using ERP tool**: Case study of a system using SAP or ORACLE.

Text Books:

1. S. R. Magal, J. Word "*Integrated Business Processes with ERP Systems*" *John Wiley & Sons, 2011.*

2. M. Sumner "*Enterprise Resource Planning*" , Pearson Education, 2nd Edition 2006

Reference Book:

1. K. E. Kurbel "*Enterprise Resource Planning and Supply Chain Management: Functions, Business Processes and Software for Manufacturing Companies"* ,Springer 2016.

CS1602	Computer Networks	[3 1 0 4]

Prerequisites: Data Communications

Network Layer: Network layer design issues, routing algorithms, congestion control algorithms, Quality of service, MPLS. Classfull addressing, Sub-netting, Classless addressing; *Protocols***:** *ARP & DHCP*: Introduction, Packet Format, message types, IPV4 header format, fragmentation, options, checksum. *ICMP*: Message format, message types. *Dynamic routing protocols*: RIP, OSPF & BGP, *Multicasting Protocol*: IGMP, Introduction to IPV6.**Transport Layer:** Transport services, state diagram, *Elements of Transport Protocols*: addressing, Connection establishment, connection release, Error control and Flow Control, Multiplexing, *Congestion Control:* Bandwidth allocation, regulating the sending rate, *UDP,TCP*; **Application Layer:** *DNS*: Name space, domain resource records, *Electronic Mail:* SMTP, POP, IMAP, MIME, HTTP, HTTPS, SNMP; **Network Security:** Security Goals, Attacks, Attack prevention techniques, Firewall, IDS, DMZ, IPsec.

Text Books:

1. A. S. Tanenbaum, "*Computer Networks*", 5th Ed., Pearson, 2010.
2. B.A. Forouzan, "*TCP/IP Protocol Suite*", 4th Ed., TMH, 2010.

References:

1. D. E. Comer, "*Internetworking with TCP/IP Principles, Protocols and Architecture,*" 6th Ed., Pearson Pubs, 2013.

CS1604	Computer Graphics & Multimedia	[3 1 0 4]

Pre-requisite(s): Digital Image Processing

Basics of Computer Graphics: Pixel, frame, buffer, application of computer graphics, Raster Graphics fundamentals. **Graphic Devices:** Cathode Ray Tube, Random Scan, Raster Scan, The Shadow; **Drawing Methods**: Line Generation- Digital Differential Analyzer (DDA), Bresenham's Algorithm, Algorithms for Circle Generation-Mid Point Algorithm, Polygon generation and filling algorithms, Anti-aliasing; **Transformations:** Introduction, Homogeneous representation of points, Basic transformation-Translation, Rotation, Scaling, Reflection, Shear, Clipping and Windowing: Point and Line Clipping, Cohen – Sutherland Algorithm, Sutherland - Hodgman Algorithm, Three-Dimensional Geometric Transformations, Three-Dimensional Viewing; **Introduction to Multimedia:** Concepts and uses, hypertext and hypermedia; Image, video and audio standards; **Audio:** digital audio, MIDI, processing sound, sampling, compression; **Video**: MPEG compression standards, inter-frame and intraframe compression; **Animation:** types, techniques, key frame animation, utility, morphing.

Text Books:

1. D. Hearn and M. P. Baker, "*Computer Graphics C version*", 4th Edition, Pearson Education, 2011.
2. R. Steinmetz, "*Multimedia: Computing, Communications, and Applications*", Prentice Hall, 1995

Reference Books:

1. J. F. Hughes and J. D. Foley, "*Computer Graphics Principles &Practice*", Pearson Education.Addison-Wesley, 2014.
2. R. Steinmetz and K.Nahrstedt, "*Multimedia Fundamentals, Volume 1: Media Coding and Content Processing*", Pearson Education, 2002
3. D. F. Rogers, "*Procedural Elements for Computer Graphics*", 2nd Edition, Tata McGraw Hill, 1998

CS1631	Computer Networks Lab	[0 0 2 1]

Flow control protocols, error detection and correction techniques, Bit stuffing and character stuffing. Implementation of link state routing protocol, distance vector routing protocol and other routing protocols. TCP and UDP socket programming. Remote method invocation (RMI). Packet analyzer- Wireshark. Network Simulator - 3 Tool.

References:

1. A. S. Tanenbaum, *"Computer Networks"*, 5th Edition, Pearson, 2010.
2. B.A. Forouzan, "*TCP/IP Protocol Suite*", 4th Edition, TMH, 2010.
3. L. Chappell, J. Aragon and G. Combs*, "Troubleshooting with Wireshark: Locate the Source of performance Problems*", Laura Chappell University, 2014.
4. Network Simulator – 3 User Manual.

CS1633	Computer Graphics and Multimedia Lab	[0 0 2 1]

Introduction to Graphics Commands in Turbo C. Use of Glut, Glew libraries and functions of OpenGL for line, circle and polygon, Transformation, Multimedia and Animation, 3D Modelling, multimedia tool - Multimedia Learning Object Authoring Tool, WINK etc, Using MATLAB

References:

1. D. Hearn and M. P. Baker, "*Computer Graphics with OpenGL*", 4thEdition, Pearson Education, 2011.
2. J. F. Hughes and J. D. Foley, "*Computer Graphics Principles & practice*"*,* 3rd Edition, Addison-Wesley Professional, 2014.

DEPARTMENT ELECTIVES

CS1653	Cloud Computing & Infrastructure Services	[3 0 0 3]

Prerequisites: Data Communication

Introduction: Clouds and Cloud Computing: Basic Concepts,Types of Services, deployment models**; Classic Data Center (CDC)**: DBMS concepts, CDC drawbacks, CDC Management and case studies; **Virtualized Data Center (VDC):**Compute virtualization overview, Compute virtualization techniques, Virtual Machines, VM Resource management techniques, Virtual Infrastructure Requirements; **Storage:** Storage virtualization overview, Virtual Machine Storage, Virtual provisioning and automated storage tiering; **Networking:** VDC networking overview, VDC networking components, VLAN and VSAN technologies; **Desktop and Application:** Desktop virtualization, Application virtualization, Business Continuity in VDC, Fault tolerance mechanism in VDC; **CloudSecurity:** Access control and identitymanagement in Cloud, Governance, risk, and compliance, Security best practices for Cloud, Cloud Migration; **Issues in Cloud Development**: Migration etc.

Text Books

1. Course materials from EMC² Education Services
2. M. Miller, "*Cloud Computing*", 8ᵗʰEdition, Que Publishers 2008.

Reference Books

1. B. Jackson and K. Saurabh, "*Cloud Computing*", 2ⁿᵈ Edition, Wiley India,2012.
2. V. Joysula, M. Orr and G. Page, "*Cloud Computing: Automating the Virtualized Data Center*", Cisco Press, 2012.
3. R. K. Buyya, "*Cloud Computing: Principles and Paradigms*", Wiley Press, 2011.

CS1655	Agile Methodology	[3 0 0 3]

Pre-requisites – Software Engineering

Introduction to AgilePrinciples: Agile Project Management,Principles behind Agile Manifesto, Change Management, Prioritization, Stakeholder Expectations, Levels of Planning Adaptation; **Lean Approach:** Waste Management, Kaizen and Kanban; **Agile Methods:** Agile Manifesto Principles, practices and frameworks of Scrum and Extreme Programming, Value-Driven Development; **Agile Estimation:** Varied circumstances & factors considered in agile estimation, best tools and techniques, role of agile management in an agile project; **Adaptive Planning and Design:** Soft Skills and Leadership, Team Formation and Boosting Team Performance, Communication in Agile Projects, Problem Detection;**Agile Architecture:** Feature Driven Development; **Agile Quality & Issues:** Agile Quality and Earned Value Management, Continual Improvement; **Agile Testing:** Test Driven Development, User Acceptance Test; **Scaling Agile for large projects**: Scrum of Scrums, Team collaborations

Text Book:

1. A. Stellman and J.P. Greene, "*Learning Agile: Understanding Scrum, XP, Lean, and Kanban*", O'Reilly Media, Incorporated, 2014.

CS1653	Distributed Databases	[3 0 0 3]

Prerequisites: Data Structures, Database Management System

Introduction: Distributed Data Processing, Complicating Factors, and Problem Areas; **Distributed DBMS Architecture:** DBMS Standardization, Distributed DBMS Architecture; **Distributed Database Design:** Alternative Design Strategies, Distribution Design Issues, Fragmentation, Distribution Transparency, Allocation; **Semantic Data Control:** Authentication and Access rights, View Management, Semantic Integrity control & its enforcement; **Overview of Query Processing:** Query Processing Problem, Objective of Query Processing, Complexity of Relational Algebra Operations, Characterization of Query Processors, Layers of Query Processing; **Distributed Concurrency Control:** Serializability Theory, Deadlock Management, Relaxed Concurrency Control; **Distributed DBMS Reliability:** Reliability Concepts & Measures, Failures & Fault Tolerance in Distributed systems, Dealing with site failures, Network Partitioning; **Parallel Database Systems:** Database Servers, Parallel Architectures, Parallel DBMS Techniques, Parallel Execution problems; **Database Interoperability:** Database Integration, Query Processing, Transaction Management, Object Orientation & Interoperability; **Current Issues:** World Wide Web, Push-based Technologies, Mobile Databases.

Text Book:

1. M. T. Ozsu and P. Valduriez, "*Principles of Distributed Database Systems*", 3rd Edition, Springer Publishing, 2011.

Reference Book:

1. S. K. Rahimi and Frank S Haug, "*Distributed Database Management Systems-A Practical Approach*", Wiley Publication, 2010.
2. C. M. Ricardo, "*Database Systems: Principles, Design, and Implementation*", 8th Edition, McMillan, 1990.

OPEN ELECTIVES

CS1694	Process Mining	[3 0 0 3]

Process Mining: background and introduction, applications of process mining, event logs, types of process mining**; Process Models:** concept of process models, characteristics of process models, soundness of process models, process discovery, process model quality, alpha-miner, heuristics miner, inductive miner, fuzzy miner; **Conformance Checking:** conformance checking and performance analysis, social network analysis, process mining activities and process types; **Process Mining Tools:** an overview of various tools available e.g. Disco, PROM etc., using PROMLite tool and carrying hands-on exercises, event log file formats, importing and exporting event log data, visualising event log data, exploring and filtering event logs, advanced features of Prom Lite tool, process analysis; **Case studies on Process Mining**

Textbook:

1. W.M.P. Aalst, "*Process Mining: Discovery, Conformance and Enhancement of Business Processes*", Springer Verlag, 2011.

Reference Book:

1. W. M. P. Aalst ,*"Process Mining: Data Science in Action",* 2nd Edition, Springer, 2016

CS1698   **Android Programming & App Development**   **[3 0 0 3]**
Prerequisites: Java, Basic knowledge of Networking
Introduction: Overview, Introduction to the android platform,Introduction to XML, Introduction to generics classes. **Android Development Environment:** Introduction to Android Studio, Introduction to Android Manifest File, Introduction to Resource File, Introduction to Graddle, Adding Dependencies to module and project. **Android Operating System:**Android Architecture, life Cycle, The Activity Class, Creating and Invoking Activity, Intent Class, Intent Filters, switching between Activities, Granting Permission to User, Layout Manager, Design Component, Fragment Class, Introduction to Multi-threading, Background Services, AsyncTask, Networking, User Notification, BroadCastReceiver, SystemIntent: Calling, messaging, using camera, using Wi-Fi. **Using Different API:** Google Map API, Facebook Graph API, Facebook Login API, Mailing API, signing APP for Publishing on Google Play; Security issues.
Text Books:
1. D. Griffiths, *"Head First Android Development"*, Shroff Publication, 2015.
2. J.F. D. Marzio, *"Beginning Android Programming with Android Studio*", 4th Edition, Wiley Publication, 2016.
Reference Book:
1.   P. Kothari, "*Android Application Development Black Book"*, Dreamtech Press, 2014.

CS1699	Introduction to Cloud Computing	[3 0 0 3]

Prerequisites: Data Communication, Computer Network

Introduction: Clouds and Cloud Computing: Basic Concepts, Cloud Classifications, and Types of Services, deployment models**; Classic Data Center (CDC)**: DBMS concepts, CDC drawbacks and need of Cloud Resources, CDC Management and case studies; **Virtualized Data Center (VDC):** Compute and Storage, Virtual Machines, VMs Resource management techniques, Physical to virtual conversion, Virtual Infrastructure Requirements; **Storage:** Storage virtualization overview, Virtual Machine Storage, Block level and File level virtualization, Virtual provisioning and automated storage tiering; **Desktop and Application:** Desktop virtualization, Application virtualization, Business Continuity in VDC, Fault tolerance mechanism in VDC, Cloud infrastructure and service creation, Cloud service management; **CloudSecurity:** Security basics, Cloud security concerns and threats, Governance, risk, and compliance, Security best practices for Cloud, Cloud Migration.

Text Book:

1.   Course materials from EMC² Education Services

2.   M. Miller, "*Cloud Computing*", 8thEdition, Que Publishers 2008.

Reference Books

1.   B. Jackson, K. Saurabh, "*Cloud Computing*", 2nd Edition., Wiley India, 2012.

2. V. Joysula, M. Orr, G. Page, "*Cloud Computing: Automating the Virtualized Data Center*", Cisco Press, 2012

3. R. K. Buyya, "*Cloud Computing: Principles and Paradigms*", Wiley Press, 2011.

SCHOOL OF COMPUTING & IT												
B.TECH COURSE STRUCTURE REVAMP (CSE)												
Seventh Semester												
Course Code	**Course Name**	**L**	**T**	**P**	**C**	**End Term Exam. Duration**		**Relative weightage (%)**				
						Th	**P**	**CWS**	**PRS**	**MTE**	**ETE**	**PRE**
CS1704	Information Systems Security	3	1	0	4	4		30	-	30	40	
CS1701	Big data Analytics	3	1	0	4	4		30	-	30	40	-
******	Department Elective 3	3	0	0	3	3		30	-	30	40	-
******	Department Elective 4	3	0	0	3	3		30	-	30	40	-
******	Department Elective 5	3	0	0	3	3		30	-	30	40	-
******	Open Elective	3	0	0	3	3		30	-	30	40	-
CS1730	Big data Analytics Lab	0	0	2	1		2	-	70	-	-	30
	Total	**18**	**2**	**2**	**21**							

Eight Semester												
Course Code	**Course Name**	**L**	**T**	**P**	**C**	**End Term Exam. Duration**		**Relative weightage (%)**				
						Th	**P**	**CWS**	**PRS**	**MTE**	**ETE**	**PRE**
CS1881	MFP	0	0	24	12			30		40		30
	Total	**0**	**0**	**24**	**12**							

*Internal students will do project and take one audit course

CS1704   Information Systems Security [3 1 0 4]

Introduction: Basic objectives of cryptography, secret-key and public-key cryptography, one-way and trapdoor one-way functions, cryptanalysis, attack models, classical cryptography; **Block ciphers:** Modes of operation, DES and its variants, AES, linear and differential cryptanalysis; **Message digest:** Properties of hash functions, MD2, MD5 and SHA-1, keyed hash functions, attacks on hash functions; **Public-key parameters:** Modular arithmetic, gcd, primality testing, Chinese remainder theorem, modular square roots, finite fields; **Intractable problems:** Integer factorization problem, RSA problem, modular square root problem, discrete logarithm problem, Diffie-Hellman problem, known algorithms for solving the intractable problems; **Public-key encryption:** RSA, Rabin and EIGamal schemes, side channel attacks; **Key exchange:** Diffie-Hellman and MQV; **Digital signatures:** RSA, DSA and NR signature schemes, blind and undeniable signatures; **Entity authentication:** Passwords, challenge-response algorithms, zero-knowledge protocols; **Standards:** IEEE, RSA and ISO standards.**Network security:** Certification, public-key infra-structure (PKI), secure socket layer (SSL), Kerberos; **Advanced topics:** Elliptic and hyper-elliptic curve cryptography, number field sieve, lattices and their applications in cryptography, hidden monomial cryptosystems, cryptographically secure random number generators.

Text Book

1. William Stallings, Cryptography and Network Security: Principles and Practice, Prentice Hall of India.

References

1. Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone, Handbook of Applied Cryptography, CRC Press.
2. Neal Koblitz, A course in number theory and cryptography, Springer.
3. Johannes A. Buchmann, Introduction to Cryptography, Undergraduate Text in Mathematics, Springer.
4. Doug Stinson, Cryptography Theory and Practice, CRC Press.

CS1701	BIG DATA ANALYTICS	[3 1 0 4]

Introduction to big data, definition, need and evolution of BDA, applications of Big Data, Big Data Analytics: analyzing big data, sources of big data, characteristics of big data (4 V's), Drivers of BDA, types of data, structured vs. unstructured data, data marts, Case study based tutorial, Differences between traditional DWDM and BDA, Limitations of traditional RDBMSs to store and analyze Big Data, Data science, definition and concepts, data scientists: key competencies and characteristics of data scientists, More discussions on data science: data wrangling, data munging, data jujitsu, Tutorial based on data science applications, Big Data Analytics Ecosystem, State of the Practice in Analytics: Data Analytics Lifecycle and discussions, Roles for a Successful Analytics Project; Case Study to apply the data analytics lifecycle, Analytical databases and DW appliances; Hadoop distributions – Comparing various BDA tools, Analyzing and Exploring the Data: Challenges when managing and analyzing big data, The role of Data Virtualization in a Big Data environment; Why to visualize data. Statistics for Model Building and Evaluation: Statistics in the Analytic Lifecycle, Hypothesis Testing, Difference of means, Advanced Analytics – Theory and Methods Overview: K-means clustering, Association Rules, Linear Regression, Logistic Regression, Naïve Bayesian Classifiers , Tutorial based on advanced analytics, Decision Trees, Time Series Analysis, Text Analytics; Tutorial based on analytics, Big Data Platforms and Storage Options: The new multi-platform Analytical Ecosystem; Beyond the Data Warehouse - Analytical databases, Hadoop and NoSQL DBMSs

References:

1. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data, EMC Education Services.
2. Michael Minelli, Michele Chambers, Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends", john wiley,2013

CS1730	BIG DATA ANALYTICS LAB	[0 0 2 1]

Introduction to data environment accessing lab environment, database environment-retail data, census data**; Introduciton to R; Basic Statistics, visualization and hypothesis tests; K-means clustering; Association rules; Linear regression; logistic regression; naïve Bayesian classifier** building naïve Bayesian classifier, census data; Decision trees; time series analysis with arima; HADOOP, HDFS, MAPREDUCE and PIG; In-database analytics click stream data, computation of ordered aggregates, logistic regression with MADLIB; Case study.

References:

1. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data, EMC Education Services.
2. Michael Minelli, Michele Chambers, Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends", john wiley,2013

Department Electives

CS1756   Advanced Computer Networks [3 0 0 3]
Introduction – network architecture - protocol implementation issues – Quantitative performance metrics - network design. Reference models- The OSI Reference Model- The TCP/IP Reference Model - A Comparison of the OSI and TCP/IP Reference Models Low level network technologies-Ethernet to token ring to wireless-Issues wit data link protocols Encoding framing and error detection and correction-sliding window protocol Medium access control sub layer-Basic models of switched networks-Datagrams versus virtual circuits witching technologies-Switched Ethernet and ATM- The design of hardware based switches Network layer – network layer design issues-Touting algorithms-Congestion control algorithms-Internetworking- The network layer in the internet-Internet Protocol (IP).-Unicast, multicast, and inter domain routing Transport layer-Elements of transport protocol Congestion control – Performance issues The Internet's Trans-mission Control Protocol (TCP)- Remote Procedure Call (RPC)- –Implementation semantics of RPC -client-server applications- The Real-time Transport Protocol(RTP) - Multimedia applications- Congestion control and resource allocation.-congestion control in TCP–UDP –Quality of service in IP. Application layer-Domain name server-World wide web-Hyper text transfer protocol Presentation formatting and data compression- Network security- crypto graphic tools- the problems of key distribution – General authentication techniques - Pretty Good Privacy (PGP)- Secure Shell (SSH),- IP Security architecture(IPSEC).-Firewalls .Network applications and the protocols-File transfer protocol - email and the Web, multimedia applications such as IP telephony and video streaming- Overlay networks like peer-to-peer file sharing and content distribution networks- Web Services architectures for developing new application protocols.
Reference: 1. Larry L Peterson, Bruce S Davis, *Computer Networks*, 5th Edition, Elsevier, 2012. 2. Andrew S. Tanenbaum, David J Wetherall, *Computer Networks*, 5th Edition, Pearson Edu, 2010.

CS1757   **Advanced Data Structures [3 0 0 3]**
Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. **Hashing:** Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing. **Skip Lists:** Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists **Splay Trees:** Splaying, Search and Update Operations on Splay Trees, Amortized Analysis of Splaying. **Text Processing:** Sting Operations, Brute-Force Pattern Matching, The Boyer-Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem. **Computational Geometry:** One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees,Quadtrees,k-DTrees.   **Reference:**   1. Mark Allen Weiss, Data *Structures and Algorithm Analysis in C++*, 2nd Edition, Pearson, 2004.   2. M T Goodrich, *Roberto Tamassia, Algorithm Design*, John Wiley, 2002.

CS 1758   Real time System   [3 0 0 3]
Introduction to real-time systems, Modeling of a Real-Time System, Task assignment and scheduling, Resource management, Real-time operating systems, RTOS services, Programming language with real-time support, System design techniques, Inter task communication, Fault tolerant techniques, Reliability evaluation methods; Performance analysis, Case studies of real-time systems.
Text Books:
1.   Liu, Jane W.S., Real Time Systems, Pearson Education, 2000.
2.   Laplante, Phillip A., Real-Time Systems Design and Analysis, WSE, 3rd Ed., 2004.
References:
1.   Li Quing, Real-Time Concepts for Embedded Systems, CMP books, paperback 2003 2.   Burns Allen and Wellings Andy, Concurrent and Real-Time Programming in ADA, Cambridge University Press, paperback 2007

CS1750	Machine Learning	[3 0 0 3]

Introduction, concept learning and decision trees: Learning Problems, Designing Learning systems, Perspectives and Issues, Decision Tree learning, Heuristic Space Search; **Neural networks and genetic algorithms**: Neural Network Representation, Problems, Perceptrons, Multilayer Networks and Back Propagation Algorithms, Advanced Topics, Genetic Algorithms, Hypothesis, Space Search, **Bayesian and computational learning:** Bayes Theorem, Maximum Likelihood, Minimum Description, Length Principle, Bayes Optimal Classifier, Gibbs Algorithm, Naïve Bayes Classifier, Bayesian Belief Network – EM Algorithm – Probably Learning; **Evaluation Hypothesis**: Sampling Theory- Mean, Bias, Variance; **Instant based learning and learning set of rules:** K- Nearest Neighbor Learning, Locally Weighted Regression, Case-Based Reasoning, Sequential Covering Algorithms, Learning Rule Sets, LearningFirst Order Rules, Learning Sets of First Order Rules; **Analytical learning and reinforced learning:** Perfect Domain Theories, Explanation Based Learning, Inductive-Analytical Approaches, Reinforcement Learning, Task, Q-Learning, Temporal Difference Learning

Text Bok:

1. Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (INDIAN EDITION), 2013.

REFERENCES:

1. EthemAlpaydin, "Introduction to Machine Learning", 2nd Ed., PHI Learning Pvt. Ltd., 2013.

2. T. Hastie, R. Tibshirani, J. H. Friedman, "The Elements of Statistical Learning", Springer; 1st edition, 2001.

CS1759	Information Retrieval Systems	[3 0 0 3]

Boolean retrieval - The term vocabulary and postings lists. Dictionaries and tolerant retrieval. Index construction. Index compression. **Rank retrieval** - Scoring, term weighting and the vector space model. Computing scores in a complete search system. Evaluation in information retrieval. Relevance feedback and query expansion. **XML retrieval**- Probabilistic information retrieval. Language models for information retrieval. Text classification. Vector space classification. **Support vector machines**- and machine learning on documents, flat clustering, Hierarchical clustering, Matrix decompositions and latent semantic indexing. **Web search basic -** Searching the Web, Challenges, Characterizing the Web, Search Engines, Browsing, Mata searchers, Web crawlers, robot exclusion, Web data mining, Metacrawler, Collaborative filtering, Web agents (web shopping, bargain finder), Economic, ethical, legal and political issues.

TEXT BOOK:

1. Introduction to Information Retrieval , Christopher D. Manning and PrabhakarRaghavan and HinrichSchütze, Cambridge University Press, 2008.

REFERENCE BOOKS:

1. Information Storage and Retrieval Systems: Theory and Implementation, Kowalski, Gerald, Mark T Maybury, Springer.
2. Modern Information Retrieval, Ricardo Baeza-Yates, Pearson Education, 2007.
3. Information Retrieval: Algorithms and Heuristics, David A Grossman and Ophir Frieder, 2nd Edition, Springer, 2004.
4. Information Retrieval Data Structures and Algorithms, William B Frakes, Ricardo BaezaYates, Pearson Education, 1992. 5. Information Storage &Retieval, Robert Korfhage, John Wiley & Sons.

CS1760   Principles of Distributed Systems [3 0 0 3]
Introduction concepts related to distributed computing and distributed operating systems. Communication via Message Passing and Various Message Passing Models, Logical Time, Physical Time and Local and Global State, Ordering of Messages (Causal Ordering) and Group Communication via Broadcasting of Messages, Termination Detection, Global Predicate Detection, Distributed Mutual Exclusion Algorithms, Distributed Deadlock Detection Algorithms, Distributed Shared Memory Systems, Check pointing and Rollback Recovery, Consensus and Agreement Algorithms, Failure Detection and Self Stabilization, etc. The design aspects of various advanced distributed computing models like Cluster of cooperative computers, Grid computing, Peer-to-Peer networks, and Internet of Things.
TEXT BOOK
1. Ajay D. Kshemkalyani, and Mukesh Singhal "Distributed Computing: Principles, Algorithms, and Systems", Cambridge University Press, 2008 (Reprint 2013).
REFERENCE BOOKS
1.   Kai Hwang, Geoffrey C. Fox, and Jack J. Dongarra, "Distributed and Cloud Computing: From Parallel processing to the Internet of Things", Morgan Kaufmann, 2012 Elsevier Inc.   2.   John F. Buford, Heather Yu, and Eng K. Lua, "P2P Networking and Applications", Morgan Kaufmann, 2009 Elsevier Inc.   3.   Joshy Joseph, and Craif Fellenstein, "Grid Computing", IBM Press, Pearson education, 2011.

Open Elective

CS1790	Introduction to Data Mining	[3 0 0 3]
Data mining: Introduction to Data mining, Types of Data, Data Mining Functionalities,Interestingness of Patterns, Classification of Data Mining Systems, Data Mining Task Primitives, Integration of a Data Mining System with a Data Warehouse, Issues, Data, Pre-processing; association rule mining and classification: Mining Frequent Patterns, Mining Various Kinds of Association Rules, Correlation Analysis, Constraint Based Association Mining, Classification and Prediction : Basic Concepts , Decision Tree, Induction , Bayesian Classification , Rule Based Classification , Support Vector Machines, Apriori algorithm, FP-Growth algorithm, Associative Classification , Lazy Learners, Other Classification Methods, Prediction; clustering and applications and trends in data mining: Cluster Analysis, Types of Data, Categorization of Major Clustering Methods: K-means, Partitioning Methods , Hierarchical Methods, Density Based Methods, Model-Based Clustering- Web Mining, Text Mining, Spatial Mining, Case study on Data mining with data sets.		
Text Books		
Data Mining: Concepts and TechniquesBook by Jiawei Han		
Reference Books		
Data Mining: Practical Machine Learning Tools and TechniquesBook by Eibe Frank and Ian H. Witten		

SPECIMEN AUDIT COURSE for 8th Semester

Simulation and Modelling   [3 0 0 0]
Introduction to Simulation: Simulation, Advantages, Disadvantages, Areas of application, System environment, components of a system, Model of a system, types of models, steps in a simulation study; **Simulation Examples:** Simulation of Queuing systems, Simulation of Inventory System, Other simulation examples; **General Principles:** Concepts in discrete - event simulation, event scheduling/ Time advance algorithm, simulation using event scheduling; **Random Numbers:** Properties, Generations methods, Tests for Random number-Frequency test, Runs test, Autocorrelation test; **Random Variety Generation:** Inverse Transform Technique- Exponential, Uniform, Weibull, Triangular distributions, Direct transformation for Normal and log normal Distributions, convolution methods- Erlang distribution, Acceptance Rejection Technique; **Optimization Via Simulation:** Meaning, difficulty, Robust Heuristics, Random Search. **Analysis of Simulation Data Input Modelling:** Data collection, Identification and distribution with data, parameter estimation, Goodness of fit tests, Selection of input models without data, Multivariate and time series analysis; **Verification and Validation of Model**: Model Building, Verification, Calibration and Validation of Models; **Output Analysis:** Types of Simulations with Respect to Output Analysis, Stochastic Nature of output data, Measures of Performance and their estimation, Output analysis of terminating simulation, Output analysis of steady state simulations**; Simulation Softwares:** Selection of Simulation Software, Simulation packages, Trend in Simulation Software.
Text Books:
1. J. Banks, et.al, *"Discrete Event system Simulation"*, Pearson Education, Asia, 4th Edition, 2007 2. G. Gordon, *"System Simulation"*, Prentice Hall publication, 2nd Edition, 1978
Reference Books:
1. A. M. Law, W. D. Kelton, *"Simulation Modelling & Analysis"*, McGraw Hill International Editions – Industrial Engineering series, 2007. 2. N. Deo, *"Systems Simulation with Digital Computer"*, PHI Publication (EEE), 3rd Edition, 2004.