GANDHI INSTITUTE OF TECHNOLOGY AND MANAGEMENT (GITAM)

(Deemed to be University) (Estd. u/s 3 of the UGC Act, 1956)

VISAKHAPATNAM ★ HYDERABAD ★ BENGALURU

NAAC accredited with 'A+' Grade

REGULATIONS AND SYLLABUS
of
Bachelor of Technology
in
Computer Science and Technology

(w.e.f 2017-18 admitted batch)

GITAM Committed to Excellence

VISION

To become a global leader in higher education.

MISSION

To impart futuristic and comprehensive education of global standards with a high sense of discipline and social relevance in a serene and invigorating environment.

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OF

M.Tech. in

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M.Tech.in Computer Science & Technology
REGULATIONS
(w.e.f. 2017-18 admitted batch)

1. ADMISSION

1.1 Admission into M.Tech. in CST program of GITAM is governed by GITAM admission regulations.

2. ELIGIBILITY CRITERIA

2.1
- First class or equivalent grade in the qualifying examination from recognized university with a minimum of 60% aggregate marks and rank obtained in GAT (PGT).
- B.E./B.Tech./AMIE in any branch of engineering or its equivalent.

2.2 Admissions into M.Tech. will be based on the following:

(i) Score obtained in GAT (PG), if conducted.

(ii) Performance in Qualifying Examination / Interview.

2.3 The actual weightage to be given to the above items will be decided by the authorities before the commencement of the academic year. Candidates with valid GATE score shall be exempted from appearing for GAT (PG).

3. CHOICE BASED CREDIT SYSTEM

3.1 Choice Based Credit System (CBCS) is introduced with effect from the admitted Batch of 2015-16 based on UGC guidelines in order to promote:

- Student Centered Learning
- Cafeteria approach
- Students to learn courses of their choice
- Learning at their own pace
- Inter-disciplinary learning

3.2 Learning goals/ objectives and outcomes are specified leading to what a student should be able to do at the end of the program.

4. STRUCTURE OF THE PROGRAM

4.1 The Program Consists of

i) Core Courses (compulsory) which give general exposure to a Student in CST and subject related area.

ii) Programme Electives.

iii) Interdisciplinary Electives.

4.2 Each course is assigned a certain number of credits depending upon the number of contact hours (lectures/tutorials/practical) per week.

4.3 In general, credits are assigned to the courses based on the following contact hours per week per semester.

- One credit for each Lecture / Tutorial hour per week.
- One credit for two hours of Practicals per week.
- Two credits for three (or more) hours of Practicals per week.

5. MEDIUM OF INSTRUCTION

The medium of instruction (including examinations and project reports) shall be English.

6. REGISTRATION

Every student has to register himself/herself for each semester individually at the time specified by the Institute / University.

7. ATTENDANCE REQUIREMENTS

7.1 A student whose attendance is less than 75% in all the courses put together in any semester will not be permitted to attend the end - semester examination and he/she will not be allowed to register for subsequent semester of study. He/she has to repeat the semester along with his / her juniors.

7.2 However, the Vice Chancellor on the recommendation of the Principal / Director of the Institute/School may condone the shortage of attendance to the students whose attendance is between 66% and 74% on genuine grounds and on payment of prescribed fee.

8. EVALUATION

8.1 The assessment of the student's performance in a Theory course shall be based on two components: Continuous Evaluation (40 marks) and Semester-end examination (60 marks).

8.2 A student has to secure an aggregate of 40% in the course in the two components put together to be declared to have passed the course, subject to the condition that the candidate must have secured a minimum of 24 marks (i.e. 40%) in the theory component at the semester-end examination.

8.3 Practical/ Project Work/ Industrial Training/ Viva voce/ Seminar etc. course are completely assessed under Continuous Evaluation for a maximum of 100 marks, and a student has to obtain a minimum of 40% to secure Pass Grade. Details of Assessment Procedure are furnished below in Table 1.

Table 1: Assessment Procedure

S.No.	Component of Assessment	Marks Allotted	Type of Assessment	Scheme of Evaluation
1	Theory	40	Continuous Evaluation	i) Thirty (30) marks for mid Semester examinations. Three mid examinations shall be conducted for 15 marks each; performance in best two shall be taken into consideration. ii) Ten (10) marks for Quizzes, Assignments and Presentations.
		60	Semester-end Examination	Sixty (60) marks for Semester-end examinations
	Total	100		
2	Practicals	100	Continuous Evaluation	i) Fifty (50) marks for regularity and performance, records and oral presentations in the laboratory. Weightage for each component shall be announced at the beginning of the Semester. ii) Ten (10) marks for case studies. iii) Forty (40) marks for two tests of 20 marks each (one at the mid-term and the other towards the end of the Semester) conducted by the concerned lab Teacher.
3	Project work (III Semester)	100	Continuous Evaluation	i) Forty (40) marks for periodic evaluation on originality, innovation, sincerity and progress of the work, assessed by the Project Supervisor. ii) Thirty (30) marks for mid-term evaluation for defending the Project, before a panel of examiners. iii) Thirty (30) marks for final Report presentation and Viva-voce, by a panel of examiners
4	Project work (IV Semester)	50	Continuous Evaluation	i) Twenty (20) marks for Periodic evaluation on originality innovation, sincerity and progress of the work, assessed by the Project Supervisor. ii) Fifteen (15) marks for mid-term evaluation for defending the Project, before a panel of examiners*.

		50	Semester-end Examination	iii) Fifteen (15) marks for interim Report presentation and Viva-voce. Fifty (50) marks for final Report presentation and Viva-voce assessed by external examiners.
	Total	100		
5	Technical Seminar	100	Continuous Evaluation	
6	Comprehensive Viva-voce (II Semester)	100	Continuous Evaluation	Through five periodic Viva-voce exams for 20 marks each, conducted by a panel of examiners. The course content for Viva exams shall be announced at the beginning of the Semester.

**Panel of Examiners shall be appointed by the concerned Head of the Department*

9. REAPPEARANCE

9.1 A student who has secured 'F' grade in a Theory course shall have to reappear at the subsequent Semester end examination held for that course.

9.2 A student who has secured 'F' grade in a Practical course shall have to attend Special Instruction Classes held during summer.

9.3 A student who has secured 'F' Grade in Project work / Industrial Training etc shall have to improve his/her report and reappear for Viva – voce at the time of Special Examination to be conducted in the summer vacation.

10. SPECIAL EXAMINATION

10.1 A student who has completed his/her period of study and still has "F" grade in a maximum of three theory courses is eligible to appear for Special Examination normally held during summer vacation.

11. BETTERMENT OF GRADES

A student who has secured only a Pass or Second class and desires to improve his/her Class can appear for Betterment Examinations only in Theory courses of any Semester of his/her choice, conducted in Summer Vacation along with the Special Examinations. Betterment of Grades is permitted 'only once' immediately after completion of the program of study.

12. GRADING SYSTEM

12.1 Based on the student performance during a given semester, a final letter grade will be awarded at the end of the semester in each course. The letter grades and the corresponding grade points are as given in Table 2.

Table 2: Grades & Grade Points

Sl.No.	Grade	Grade Points	Absolute Marks
1	O (outstanding)	10	90 and above
2	A+ (Excellent)	9	80 to 89
3	A (Very Good)	8	70 to 79
4	B+ (Good)	7	60 to 69
5	B (Above Average)	6	50 to 59
6	C (Average)	5	45 to 49
7	P (Pass)	4	40 to 44
8	F (Fail)	0	Less than 40
9	Ab. (Absent)	0	-

12.2 A student who earns a minimum of 4 grade points (P grade) in a course is declared to have successfully completed the course, and is deemed to have earned the credits assigned to that course, subject to securing a GPA of 5 for a Pass in the semester.

13. GRADE POINT AVERAGE

13.1 A Grade Point Average (GPA) for the semester will be calculated according to the formula:

$$\text{GPA} = \frac{\Sigma_i C_i G_i}{\Sigma_i G_i}$$

Where

C_i = number of credits obtained for the ith course
G_i = number of credits obtained for the ith course

13.2 To arrive at Cumulative Grade Point Average (CGPA), a similar formula is used considering the student's performance in all the courses taken, in all the semesters up to the particular point of time.

13.3 CGPA required for classification of class after the successful completion of the program is shown in Table 3.

Table 3: CGPA required for award of Class

Class	CGPA Required
First Class with Distinction	> 8.0*
First Class	> 6.5
Second Class	> 5.5
Pass Class	> 5.0

* In addition to the required CGPA of 8.0 or more, the student must have necessarily passed all the courses of every semester in first attempt.

14. ELIGIBILITY FOR AWARD OF THE M.Tech. DEGREE

14.1 Duration of the program: A student is ordinarily expected to complete the M.Tech. program in four semesters of two years. However a student may complete the program in not more than four years including study period.

14.2 However the above regulation may be relaxed by the Vice Chancellor in individual cases for cogent and sufficient reasons.

14.3 A student shall be eligible for award of the M.Tech. Degree if he / she fulfills all the following conditions.

a) Registered and successfully completed all the courses and projects.

b) Successfully acquired the minimum required credits as specified in the curriculum corresponding to the branch of his/her study within the stipulated time.

c) Has no dues to the Institute, hostels, Libraries, NCC / NSS etc, and

d) No disciplinary action is pending against him / her.

15. DISCRETIONARY POWER

Not withstanding anything contained in the above sections, the Vice Chancellor may review all exceptional cases, and give his decision, which will be final and binding.

M.Tech.in Computer Science & Technology(CST)

Department of Computer Science and Engineering

Effective from academic year 2017-2018 admitted batch

Semester I

S. No.	Course Code	Course Title	Category	L	T	P	C
1	ECS701	Advanced Data Structures and Algorithms	CE	4	0	0	4
2	ECS703	Advanced Operating Systems	CE	4	0	0	4
3	ECS705	Data Mining and Data Warehousing	CE	4	0	0	4
4	ECS7XX	Program Elective-I	PE	3	0	0	3
5	ECS7XX	Program Elective-II	PE	3	0	0	3
6	EID7XX	Interdisciplinary Elective-I	IDE	3	0	0	3
7	ECS721	Advanced Data Structures and Algorithms Lab	CE	0	0	3	2
8	ECS723	Data Analytics Lab	CE	0	0	3	2
							25

Semester II

S. No.	Course Code	Course Title	Category	L	T	P	C
1	ECS702	Advanced Computer Networks	CE	4	0	0	4
2	ECS704	Real Time Systems	CE	4	0	0	4
3	ECS706	Cryptography and Network Security	CE	4	0	0	4
4	ECS7XX	Program Elective -III	PE	3	0	0	3
5	ECS7XX	Program Elective -IV	PE	3	0	0	3
6	ECS7XX/ EID7XX	Interdisciplinary Elective-II	IDE	3	0	0	3
7	ECS722	Advanced Computer Networks Lab	CE	0	0	3	2
8	ECS724	Programming with Scripting Languages: Python and R	CE	0	0	3	2
9	ECS792	Technical Seminar	CE	0	0	3	2
							27

Semester III

S. No.	Course Code	Course Title	Category	L	T	P	C
1	ECS891	Project Work-I	PW				8
2	ECS893	Comprehensive Viva Voce	CE				2
							10

Semester IV

S. No.	Course Code	Course Title	Category	L	T	P	C
1	ECS892	Project work-II	PW				14
							14

Number of Credits:

Semester	I	II	III	IV	Total
Credits	25	27	10	14	76

Interdisciplinary Elective - I

S. No.	Course Code	Course Title	Category	L	T	P	C
1.	EID758	Statistics for Data Science	IDE	3	0	0	3
2.	EID759	Open Source Software Development	IDE	3	0	0	3
3.	EID760	Programming with R	IDE	3	0	0	3

Interdisciplinary Elective - II

S. No.	Course Code	Course Title	Category	L	T	P	C
1.	ECS762	Business Intelligence	IDE	3	0	0	3
2.	EID762	Design Patterns	IDE	3	0	0	3
3.	EID763	Multivariate Techniques for Data Analysis	IDE	3	0	0	3

PROGRAMME ELECTIVES

Programme Elective-I

S. No.	Course Code	Course Title	Category	L	T	P	C
1	ECS741	Information Retrieval	PE	3	0	0	3
2	ECS743	Introduction to Embedded Systems	PE	3	0	0	3
3	ECS745	Parallel and Distributed Algorithms	PE	3	0	0	3

Programme Elective-II

S. No.	Course Code	Course Title	Category	L	T	P	C
1	ECS747	Agile Software Development	PE	3	0	0	3
2	ECS749	Internet of Things	PE	3	0	0	3
3	ECS751	Service Oriented Architecture	PE	3	0	0	3

Programme Elective-III

S. No.	Course Code	Course Title	Category	L	T	P	C
1	ECS742	Introduction to Big Data Analytics	PE	3	0	0	3
2	ECS744	Software Verification and Validation	PE	3	0	0	3
3	ECS746	Natural language Processing	PE	3	0	0	3

Programme Elective-IV

S. No.	Course Code	Course Title	Category	L	T	P	C
1	ECS748	Cloud Computing	PE	3	0	0	3
2	ECS750	Game Programming	PE	3	0	0	3
3	ECS752	Theory and Applications of Ontologies	PE	3	0	0	3

ECS701: ADVANCED DATA STRUCTURES AND ALGORITHMS

L	T	P	C
4	0	0	4

Module I **12hrs**

Introduction to Data Structures and Algorithms, Performance Analysis: Time Complexity, Space Complexity, Amortized Complexity, Asymptotic Notations, Randomized Algorithms, Linked List, Stacks, Queues, Sparse Matrices. Algebraic Problems: General Method, Evaluation and Interpolation.

Module II **10hrs**

Introduction to Graphs, Graph Traversal. Introduction to Trees and Tree Traversals, Binary Search Trees, AVL Trees, B-Trees, Priority Queues.

Module III **10hrs**

Divide and Conquer: General Method, Selection Problem, Strassen's Matrix Multiplication, and Convex Hull Problem. The Greedy Method: General Method, Knapsack, Job Sequencing with Dead Lines, Minimum Cost Spanning Trees using Kruskal's Algorithm, using union and find, Dijkstra's algorithm for single source shortest path.

Module IV **10hrs**

Dynamic Programming: General Method, Matrix Chain Multiplication, Longest Common Subsequence, Reliability Design, Traveling Sales Person Problem. Back Tracking: General Method, 8 Queens Problem, Hamiltonian Cycle, Graph Coloring Problem.

Module V **10hrs**

Branch-and-Bound: General Method, FIFO Branch and Bound, LIFO Branch and Bound, LC Branch and Bound, Traveling Sales Person Problem. P-Class Problem, NP-Class Problems, NP-Complete Problems, NP-Hard problems.

Text Book(s)

1. Ellis Horowitz, Sartaz Sahni, Sanguthevar Rajasekharan , Fundamentals of Computer Algorithms , 2/e, University Press.
2. Sartaj Sahni, Data Structures, Algorithms and Applications in C++, 2/e, Universities Press.
3. Varsha H Patil, Data Structures using C++, Oxford Higher Education.

References

1. Thomas H. Cormen, et al., Introduction to Algorithms,3/e, MIT Press.
2. Mark Allen Weiss, Data Structures and Algorithms.
3. Adam Drozdek, Data Structures and Algorithms in C++, 3/e, Cengage Learning.
4. Michel T. Goddrich,Roberto Tamassia, Algorithm Design, John Weily and Sons.

Web Resources

http://www.personal.kent.edu/~rmuhamma/Algorithms/ algorithm.html

ECS702: ADVANCED COMPUTER NETWORKS

L	T	P	C
4	0	0	4

Module I **10 hrs**

Introduction - Building a Network, Applications, Requirements, Connectivity, Cost-Effective Resource Sharing, Support for Common Services, Network Architecture, Layering and Protocols, OSI Architecture, Internet Architecture, Implementing Network Software, Application Programming Interface (Sockets), Protocol Implementation Issues, Performance, Bandwidth and Latency, Delay × Bandwidth Product, High-Speed Networks, Application Performance Needs, Ubiquitous Networking.

Module II **10 hrs**

Direct Link Networks - Reliable Transmission - Stop-and-Wait, Sliding Window, Concurrent Logical Channels; Ethernet (802.3) - Physical Properties, Access Protocol, Experience with Ethernet; Rings - Token Ring Media Access Control, Token Ring Maintenance, FDDI, Resilient Packet Ring (802.17); Wireless -Bluetooth (802.15.1), Wi-Fi (802.11), WiMAX (802.16), Cell Phone Technologies; Sensor Networks; Packet Switching - Switching and Forwarding, Datagrams, Virtual Circuit Switching, Source Routing; Bridges and LAN Switches - Learning Bridges, Spanning Tree Algorithm, Broadcast and Multicast, Limitations of Bridges.

Module III **10 hrs**

Internetworking - Simple Internetworking (IP) - What Is an Internetwork? Service Model, Global Addresses, Datagram Forwarding in IP, Address Translation (ARP), Host Configuration (DHCP), Error Reporting (ICMP), Virtual Networks and Tunnels; Routing - Network as a Graph, Distance Vector (RIP), Link State (OSPF), Metrics, Routing for Mobile Hosts, Subnetting - Classless Routing (CIDR),Inter- domain Routing (BGP), Routing Areas, IP Version 6 (IPv6); Multiprotocol Label Switching - Destination-Based Forwarding, Explicit Routing, Virtual Private Networks and Tunnels ;Deployment of IPv6.

Module IV **12 hrs**

End-to-End Protocols - Simple Demultiplexer (UDP); Reliable Byte Stream (TCP) - End-to-End Issues, Segment Format, Connection Establishment and Termination, Sliding Window Revisited, Triggering Transmission,

Adaptive Retransmission, Record Boundaries, TCP Extensions, Alternative Design Choices; Transport for Real-Time Applications (RTP) - Requirements, RTP Details, Control Protocol ; Performance; Application-Specific Protocols; Congestion Control and Resource Allocation - Issues in Resource Allocation - Network Model, Taxonomy, Evaluation Criteria; Queuing Disciplines - FIFO, Fair Queuing; TCP Congestion Control - Additive Increase/Multiplicative Decrease, Slow Start, Fast Retransmit and Fast Recovery; Congestion-Avoidance Mechanisms - DECbit, Random Early Detection (RED), Source-Based Congestion Avoidance; Quality of Service - Application Requirements, Integrated Services (RSVP), Differentiated Services (EF, AF), Equation-Based Congestion Control; Inside versus Outside the Network.

Module V **10 hrs**

Applications - Traditional Applications - Electronic Mail (SMTP, MIME, IMAP), World Wide Web (HTTP), Name Service (DNS), Network Management (SNMP); Web Services - Custom Application Protocols (WSDL, SOAP), A Generic Application Protocol (REST), Multimedia Applications, Session Control and Call Control (SDP, SIP, H.323), Resource Allocation for Multimedia Applications; Overlay Networks - Routing Overlays, Peer-to-Peer Networks (Gnutella, BitTorrent), Content Distribution Networks.

Text Book(s)

1. Larry L. Peterson,Bruce S. Davie, Computer Networks, A Systems Approach, 4/e, Morgan Kaufmann.
2. D. Bertsekas, R. Gallager, Data Networks, PHI.

References

1. W.R. Stevens, Unix Network Programming, Vol.1, Pearson Education
2. J.Walrand, P. Varaiya, High Performance Communication Networks, Morgan Kaufmann
3. Y. Zheng, S. Akhtar, Networks for Computer Scientists and Engineers,. Oxford.
4. A.S. Tanenbaum, Computer Networks, 4/e, Prentice Hall.
5. James D. McCabe, Practical Computer Analysis and Design, Harcourt Asia.
6. Darren L Spohn, Data Network Design, TMH.

ECS703: ADVANCED OPERATING SYSTEMS

L	T	P	C
4	0	0	4

Module I **11 hrs**

Introduction : Overview, Functions of an Operating System, Design Approaches, Types of Advanced Operating System, Synchronization Mechanisms, Concept of a Process, Concurrent Processes, The Critical Section Problem, Other Synchronization Problems, Language Mechanisms for Synchronization, Axiomatic Verification of Parallel Programs,Process Deadlocks : Preliminaries, Models of Deadlocks, Resources, System State,Necessary and Sufficient conditions for a Deadlock, Systems with Single-Unit Requests, consumable Resources, Reusable Resources.

Module II **11 hrs**

Distributed Operating Systems: Introduction, Issues, Communication Primitives, Inherent Limitations, Lamport's Logical Clock; Vector Clock; Causal Ordering; Global State; Cuts; Termination Detection. Distributed Mutual Exclusion : Non-Token Based Algorithms, Lamport's Algorithm , Token-Based Algorithms, Suzuki-Kasami's Broadcast Algorithm.

Distributed Deadlock Detection: Issues, Centralized Deadlock Detection Algorithms, Distributed Deadlock Detection Algorithms, Agreement Protocols: Classification , Solutions , Applications.

Module III **10 hrs**

Distributed Resource Management: Distributed File systems, Architecture, Mechanisms, Design Issues, Distributed Shared Memory: Architecture, Algorithm, Protocols, Design Issues , Distributed Scheduling: Issues, Components, Algorithms.

Module IV **10 hrs**

Failure Recovery And Fault Tolerance: Basic Concepts, Classification of Failures, Basic Approaches to Recovery, Recovery in Concurrent System, Synchronous and Asynchronous Check pointing and Recovery, Check pointing in Distributed Database Systems, Fault Tolerance, Issues, Two-phase and Non-blocking Commit Protocols, Voting Protocols, Dynamic Voting Protocols;

Module V **10hrs**

Multiprocessor and Database Operating Systems: Structures, Design Issues, Threads , Process Synchronization , Processor Scheduling, Memory Management , Reliability / Fault Tolerance. Database Operating Systems : Introduction , Concurrency Control , Distributed Database Systems, Concurrency Control Algorithms.

Text Book

1. Mukesh Singhal and N. G. Shivaratri, Advanced Concepts in Operating Systems, McGraw- Hill, 2000

References

1. Abraham Silberschatz, Peter B. Galvin, G. Gagne, Operating System Concepts, 6/e, Addison Wesley 2003.
2. Andrew S. Tanenbaum, Modern Operating Systems, 2/e, Addison Wesley, 2001.

ECS704: REAL TIME SYSTEMS

L	T	P	C
4	0	0	4

Module I **10 hrs**

Introduction: what is real time, applications of real-time systems, a basic model of a real-time system, characteristics of real-time systems, safety and reliability, types of real-time tasks

Module II **10 hrs**

Real-time task scheduling, types of real-time tasks and their characteristics, task scheduling, clock-driven scheduling, hybrid schedulers, event-driven scheduling, earliest deadline first (edf) scheduling

Module III **11 hrs**

Handling resource sharing and dependencies among Real-time tasks: resource sharing among real-time tasks, priority inversion, priority inheritance protocol (pip), highest locker protocol (hlp), priority ceiling protocol (pcp), different types of priority inversions under pcp, important features of pcp

Module IV **11 hrs**

Scheduling real-time tasks in Multiprocessor and Distributed Systems: multiprocessor task allocation, dynamic allocation of tasks, real-time communication: basic concepts, real-time communication in a Lan, soft real-time communication in a Lan, hard real-time communication in a Lan

Module V **10 hrs**

Real-time Databases: basic database concepts, real-time databases, characteristics of temporal data, concurrency control in real-time databases, commercial real time operating systems: Time Services, features of RTOS, UNIX as a RTOS, windows as a RTOS

Text Book(s)

1. Rajib mall, Real-Time Systems, Pearson Education India, 2007.

Reference

1. Ernst-Rüdiger Olderog, Real-Time Systems, Cambridge University Press, 2008.

ECS705:DATAMINING AND DATA WAREHOUSING

L	T	P	C
4	0	0	4

Module I **10 hrs**

Introduction to Data Mining: What is Data Mining, Motivating Challenges, The origins of Data Mining, Data Mining Tasks. Data: Types of Data, Data quality, Data Preprocessing, Measures of Similarity and Dissimilarity

Module II 11 hrs

Data Warehouse and OLAP Technology for Data Mining: What is a Data Warehouse? Multi-Dimensional Data Model, Data Warehouse Architecture, Data Warehouse Implementation, Development of Data Cube Technology, Data Warehousing to Data Mining.

Module III **11 hrs**

Classification: Basic Concepts, Decision Trees, and Model Evaluation Preliminaries, General Approach to solving a classification Problem, Decision Tree Induction, Model Overfitting, Evaluating the performance of a classifier . Classification: Alternate Techniques - Rule-based Classifier, Nearest-Neighbor Classifiers, Bayesian Classifiers.

Module IV **11 hrs**

Association Analysis: Basic Concepts and Algorithms , Problem Definition, Frequent Itemset Generation, Compact Representation of Frequent Itemsets, Alternative Methods for generating Frequent Itemsets, Evaluation of Association Patterns

Module V **09 hrs**

Cluster Analysis: Basic Concepts and Algorithms, Overview, K-Means, Agglomerative Hierarchical Clustering, DBSCAN, Cluster Evaluation

Text Book(s)

1. Tan,Steinbach, Vipin Kumar, Introduction to Data Mining, Pearson Education,2006
2. Jiawei Han, Micheline Kamber, Data Mining Concepts and Techniques,Morgan Kaufman Publications.

References

1. Margaret H Dunhan, Data Mining Introductory and Advanced Topics,Pearson Education.
2. Ian H. Witten Eibe Frank, Data Mining, Morgan Kaufman Publications.

ECS706: CRYPTOGRAPHY AND NETWORK SECURITY

L	T	P	C
4	0	0	4

Module I **10 hrs**

Introduction: Cryptography, Cryptanalysis, Attacks, Services, Security Mechanisms.

Classical Encryption Techniques: Symmetric Key Cryptography- Caesar cipher, monoalphabetic Cipher, Play fair Cipher, Hill Cipher, Poly-alphabetic Cipher, OTP, Transposition techniques, Rotor Machines, Steganography.

Module II **11 hrs**

Block Ciphers : Block Ciphers and the Data Encryption Standard: DES Algorithm, Differential and linear cryptanalysis, Triple DES.Block cipher design principles, Block cipher modes of operation, Advanced Encryption Standard, RC6

Module III **11 hrs**

Arithmetic for Cryptography: Pseudorandom Number Generation, Prime Numbers, Euler's Theorem and CRT. Stream Ciphers: RC4 Public Key Cryptography : Principles of Public Key Cryptosystem, RSA Algorithm, Security of RSA. Diffie-Hellman key exchange, Elliptical curve cryptography.

Module IV **10 hrs**

Cryptographic Hash Functions: Applications of Hash Functions, Two Simple Hash Functions, Secured Hashing Algorithm - 3.MAC & Digital Signatures: Message Authentication Requirements, Message Authentication Functions, MAC, Security of MAC, HMAC, Digital Signatures, Digital Signature Standard.

Module V **10 hrs**

Authentication Protocols: Remote User Authentication Principles, Kerberos, Federated Identity Management. Email Security: Pretty Good Privacy (PGP), S/MIME. IP Security: IP Security overview, IP Security Policy. Malicious Software, Firewalls: Need for firewalls, Firewall characteristics, Types of Firewalls

Text Book

1. William Stallings, Cryptography and Network Security, 5/e, Pearson education

References

1. Mao, Modern cryptography: theory and practice, Pearson education.
2. Behrouz A . Forouzan, Cryptography and Network Security, TMH
3. Atul Kahate, Cryptography and Network Security, 2/e, TMH

ECS721: ADVANCED DATA STRUCTURES AND ALGORITHMS LAB

L	T	P	C
0	0	3	2

1. Program to perform insertion, deletion and search operations on the following:
   a. Single Linked List b. Doubly Linked List c. Circular Linked List

2. Develop programs to demonstrate at least 3 applications of Stacks.

3. Develop a program to demonstrate the concept of double ended queue.

4. Program to represent a graph by using Adjacency Matrix and Adjacency List representation for the given set of Vertices and Edges. Traverse it by using Breadth First Search and Depth First Search Techniques.

5. Develop a program to perform insertion, deletion and search operationson the following Trees
   a. Binary Search Tree b. AVL Tree

6. Develop programs for
   a) Heap Sort b) Merge Sort c) Quick sort by taking random element as pivot d) Selection

7. Implement the code for the following problems by using Greedy Method:
   a. Finding Minimum Cost Spanning Tree by using Kruskal's Algorithm.
   b. Single Source Shortest Path Problem.

8. Implement the code for the following problems using Dynamic Programming:
   a. Matrix Chain Multiplication Problem.
   b. String Editing.
   c. Traveling Sales man Problem

9. Implement code for the following problems by using Back-Tracking:
   a. Hamiltonian Cycle b. 8 Queens Problem

10. Implement code for Traveling Salesperson Problem by using Least-Cost Branch-and- Bound

ECS722: ADVANCED COMPUTER NETWORKS LAB

L	T	P	C
0	0	3	2

1. Write a program to
   a. Print the IP address of www.yahoo.com
   b. Print the url of 205.163.22.104
   c. Print all the addresses of www.apple.com
   d. Print the IP address of the local machine
   e. Print the hostname of the local machine
2. Write a program to Identify the well known ports on a Remote System By trying to listen to the various well known ports by opening client connections. If the exception does not occur then the remote port is active else the remote port is inactive.
3. Given a URL, write a program to print the parts of URL.
4. Write a program to display the socket's port and IP address.
5. Write a program to send & Receive data from DatagramPacket
6. Write a program for Multicast Sniffer
7. Write a program for Multicast sender
8. Write a program for a Chat Application
   One-One: By opening socket connection and displaying what is written by one party to the other. Many-Many (Broadcast): Each client opens a socket connection to the chat server and writes to the socket. Whatever is written by one party can be seen by all other parties.
9. Write a program for the Data Retrieval from a Remote Database At the remote database a server listens for client connections. This server accepts SQL queries from the client, executes it on the database and sends the response to the client.
10. Write a program for the Mail Client POP Client : Gives the server name , user name and password, retrieve the mails and allow manipulation of mail box using POP commands. SMTP Client: Gives the server name, send e-mail to the recipient using SMTP commands.
11. Write a program for the Simulation of Telnet Provide a user interface to contact well-known ports, so that client-server interaction can be seen by the user.

12. Write a program for the Simple file transfer between two systems By opening socket connection to our server on one system and sending a file from one system to another.
13. Write a program for the TFTP-Client To develop a TFTP client for file transfer. (Unix Network programming- Stevens)
14. Write a program for the HTTP-Server Develop a HTTP server to implement the following commands GET, POST, HEAD, DELETE. The server must handle multiple clients.

References:

1. Java Network Programming, Harold Orielly
2. An Introduction to Computer Networking, Kenneth C. Mansfield Jr and James Antonakos Pearson Education Asia

Web Resource:

1. http://www.cafeaulait.org/books/jnp/javanetexamples/index.html

ECS723: DATA ANALYTICS LAB

L	T	P	C
0	0	3	2

Part-I: Fundamentals of Big Data Analysis Environment

Distributed and Parallel System Architecture and Configuration: Single and Multi node Hadoop cluster setup

MapReduce on Word Counting NoSQL

Machine learning and Reasoning with Mahout

Part II: Big data analysis for security

Deny of Service Attack Analysis

Tutorials and Hands-on Practice labs are available at:

https://sites.google.com/site/bigdatansalabware/

References:

http://www-01.ibm.com/software/data/bigdata/use-cases/security-intelligence.html http://blogs.cisco.com/security/big-data-in-security-part-i-trac-tools/ http://blogs.cisco.com/security/big-data-in-security-part-ii-the-amplab-stack/ http://blogs.cisco.com/security/big-data-in-security-part-v-anti-phishing-in-the-cloud/

Email scam

http://blogs.igalia.com/dpino/2012/08/07/metamail-email-analysis-with-hadoop/ http://blogs.cisco.com/security/big-data-in-security-part-iv-email-auto-rule-scoring-on-hadoop/

Security analysis

http://healthitsecurity.com/2013/10/11/csa-report-big-data-analytics-can-improve-it-security/

http://www.cisco.com/web/ME/connect2014/saudiarabia/pdf/ahmed_fakahany_ibm_sbm_big_data_internet_of_things.pdf http://bigdatablog.emc.com/2013/01/30/rsa-security-analytics/ http://cybersecurity.mit.edu/2013/11/mobile-malware-analysis-in-hadoop/ http://blogs.cisco.com/security/threat-detection-a-big-data-approach-to-security/
Reasoning Reference:

http://machinelearningbigdata.blogspot.com/ http://www.bigdatatraining.in/machine-learning-training/ http://www.slideshare.net/Cataldo/apache-mahout-tutorial-recommendation-20132014

Big data sets:
http://www.kdnuggets.com/2011/02/free-public-datasets.html http://aws.amazon.com/publicdatasets/ http://www.quora.com/Where-can-I-find-large-datasets-open-to-the-public http://stackoverflow.com/questions/2674421/free-large-datasets-to-experiment-with-hadoop http://www.ll.mit.edu/mission/communications/cyber/CSTcorpora/ideval/data/

ECS724: PROGRAMMING WITH SCRIPTING LANGUAGES - PYTHON AND R LAB

L	T	P	C
0	0	3	2

1. Write a python script demonstrate all arithmetic operations.

2. Create a script which uses the function to read a string from the keyboard. Attempt to convert the string to a float using float(x) and also to an integer using int(x). Print out the resulting float and integer.

3. Write a python script , Convert the string to a list of words using the string split method and Sort the list into reverse alphabetical order using some of the list methods

4. Write a function that takes two integer arguments and prints out whether the first is divisible by the second.

5. Write a function which takes a string argument and returns a string which is the same as the argument except only the first occurrence of each letter is present.(Hint: apple ? aple and Mississippi ? Misp)

6. Write a function takes two lists of numbers of the same length, and returns anew list containing the sums of the corresponding elements of each.

7. Write a python script to demonstrate dictionary methods?

8. Write R Script to demonstrate Vector operations

9. Write R Script to demonstrate control statements on data frames

10. Write R Script to demonstrate Math functions

11. Write R Script to read data from file and write total number of characters into another file

ECS741: INFORMATION RETRIEVAL

L	T	P	C
3	0	0	3

Module I **10 hrs**

Introduction To IRS & Cataloguing And Indexing, Definition, Objectives, Functional Overview, Relationship to DBMS, Digital Libraries and Data Warehouses, Information System Capabilities-Search, Browse, Miscellaneous. Objectives, Indexing Process, Automatic Indexing, Information Extraction.

Module II **10 hrs**

Data Structure & Automatic Indexing, Introduction, Stemming Algorithms, Inverted file structures, N-gram data structure, PAT data structure, Signature file structure, Hyper data structure. Classes of automatic indexing, Statistical indexing, Natural Language, Concept Indexing, Hypertext linkages.

Module III **12 hrs**

Document & Term Clustering & User Search Techniques, Introduction, Thesaurus generation, Item clustering, Hierarchy of clusters. Search statements and binding, Similarity measures and ranking, Relevance feedback, Selective dissemination of information search, Weighted searches of Boolean systems, Searching the Internet and hypertext.

Module IV **10 hrs**

Information Visualization & Text Search Algorithms, Introduction, Cognition and perception, Information visualization technologies. Introduction, Software text search algorithms, Hardware text search systems.

Module V **10 hrs**

Information System Evaluation & Multimedia Information Retrieval, Introduction, Measures used in system evaluation, Measurement example - TREC results. Models and Languages: Data Modelling. Query Languages, Indexing and Searching

Text Book(s)

1. Kowalski, Gerald, Mark T Maybury, Information Retrieval Systems: Theory and Implementation, Kluwer Academic Press.

References

1. Ricardo Baeza-Yates, Modern Information Retrieval, Pearson Education.
2. Robert Korfhage, Information Storage & Retrieval, John Wiley & Sons.
3. C. J. van Rijsbergen, Information Retrieval, (PDF Version)

ECS742: INTRODUCTION TO BIG DATA ANALYTICS

L	T	P	C
3	0	0	3

Module I **10 hrs**

Introduction: What Is Big Data and Why Is It Important, A Flood of Mythic Start-Up Proportions, Big Data Is More Than Merely Big Why Now? A Convergence of Key Trends , Relatively Speaking , A Wider Variety of Data,The Expanding Universe of Unstructured Data. Industry Examples of Big Data: DigitalMarketing and the Non-line World, The Right Approach: Cross-Channel Lifecycle Marketing.

Module II **11 hrs**

Big Data Technology: The Elephant in the Room: Hadoop's Parallel World.Old vs. New Approaches, Data Discovery: Work the Way People's Minds Work, Open-Source Technology for Big Data Analytics, The Cloud and Big Data, Predictive Analytics Moves into the Limelight. A Brief History of Hadoop, Apache Hadoop and the Hadoop Ecosystem.

Module III **11 hrs**

MapReduce: Analyzing the Data with Hadoop, Map and Reduce, Java MapReduce, Scaling Out, Data Flow, Combiner Functions, Running a Distributed MapReduce Job, Hadoop Streaming, The Hadoop Distributed File system ,The Design of HDFS, HDFS Concepts, Blocks, Namenodes and Datanodes, HDFS Federation, HDFS High-Availability, The Command-Line Interface, Basic Filesystem Operations, Hadoop Filesystems.

Module IV **10 hrs**

Information Management: The Big Data Foundation, Big Data Computing Platforms, Big Data Computation, More on Big Data Storage, Big Data Computational Limitations, Big Data Emerging Technologies, Business Analytics : The Last Mile in Data Analysis, Geospatial Intelligence Will Make Your Life Better, Consumption of Analytics, From Creation to Consumption, Visualizing: How to Make It Consumable, Organizations Are Using Data Visualization as a Way to Take Immediate Action.

Module V **10 hrs**

Data Privacy and Ethics : The Privacy Landscape, The Great Data Grab Isn't New, Preferences, Personalization, and Relationships, Rights and

Responsibility, Playing in a Global Sandbox , Conscientious and Conscious Responsibility, Privacy May Be the Wrong Focus Can Data Be Anonymized, Balancing for Counter intelligence.

Text Book(s)

1. Michael Minelli, Michele Chambers, Big Data, Big Analytics, Wiley Publications, 2013
2. Tom White, Hadoop: The Definitive Guide, 3/e, O'Reilly Publications. (MODULE -III)

References

1. Bill Franks, Taming The Big Data Tidal Wave, 1/e, Wiley, 2012.
2. Frank J. Ohlhorst, Big Data Analytics, 1/e, Wiley, 2012

ECS743: INTRODUCTION TO EMBEDDED SYSTEMS

L	T	P	C
3	0	0	3

Module I **9 hrs**

Embedded computing: Introduction, Complex Systems and Microprocessor. The Embedded System Design Process, Formalisms for System Design, Design Examples.

The 8051 Architecture : Introduction, 8051 Micro controller Hardware, Input / Output Ports and Circuits, External Memory, Counter and Timers, Serial data Input/Output, Interrupts.

Module II **10 hrs**

Basic Assembly Language Programming Concepts: The Assembly Language Programming Process, Data Transfer and Logical Instructions, Arithmetic Operations, Decimal Arithmetic. Jump and Call Instructions Applications: Interfacing with Keyboards, D/A and A/D Conversions, Serial Data Communication.

Module III **9 hrs**

Introduction to Real - Time Operating Systems: Tasks and Task States, Tasks and Data, Semaphores, and Shared Data; Message Queues, Mailboxes and Pipes, Timer Functions, Events, Memory Management, Interrupt Routines in an RTOS Environment

Module IV **10 hrs**

Basic Design Using a Real-Time Operating System: Principles, Semaphores and Queues, Hard Real-Time Scheduling Considerations, Saving Memory and Power, Embedded Software Development Tools: Host and Target machines, Linker/Locators for Embedded Software, Getting Embedded Software into the Target System; Debugging Techniques: Testing on Host Machine, Using Laboratory Tools, An Example System.

Module V **9 hrs**

Introduction to advanced architectures: ARM and SHARC, Processor and memory organization and Instruction level parallelism; Networked embedded systems: Bus protocols, I2C bus and CAN bus; Internet-Enabled Systems, Design Example-Elevator Controller.

Text Book(s)

1. Computers and Components, Wayne Wolf, Elseveir Publisher.
2. The 8051 Microcontroller, Third Edition, Kenneth J.Ayala, Thomson Publisher.
3. An Embedded Software Primer, David E. Simon, Pearson Education.

References

1. Embedding system building blocks, Labrosse, via CMP publishers.
2. Embedded Systems, Raj Kamal, TMH.
3. Micro Controllers, Ajay V Deshmukhi, TMH.
4. Embedded System Design, Frank Vahid, Tony Givargis, John Wiley.
5. Microcontrollers, Raj Kamal, Pearson Education.

ECS744: SOFTWARE VERIFICATION AND VALIDATION

L	T	P	C
3	0	0	3

Module I **9 hrs**

Software Verification and Validation: Introduction, Verification, Method of Verification, Validation, Level of Validation, Principle of testing, context of testing in producing software, White Box testing,Definition, Static testing, Structural testing, Black box testing.

Module II **10 hrs**

Integration Testing- Scenario Testing, Defect bash, System and acceptance testing,functional, non-functional testing, Performance testing methodology, tools & Process.

Module III **12 hrs**

Regression Testing, Internationalization Testing-Introduction, Test Phases of Internationalization testing, Enabling testing, Locale Testing, Language testing, Localization testing, Ad-hoc testing- Overview, Buddy testing, Pair Testing, Exploratory Testing, Iterative testing Agile and Extreme Testing

Module IV **10 hrs**

Testing Of Object-oriented systems: Introduction, Primer on object oriented software, Differences in OO testing. Usability And Accessibility Testing: what is usability testing, approach to usability, when to do usability testing, how to achieve usability, quality factors for usability, accessibility testing, tools for usability.

Module V **10 hrs**

Test planning, Test Management, Test Process and reporting, Software Test Automation, Scope of Automation, Design and Architecture of automation, Process Model for Automation, Test matrices and measurement, Type of Metrics, Project Metrics, Productivity Metrics, Progress Metrics, Release Metrics

Text Book

1. Srinivasan D., Gopalswami R, Software testing, Pearson Education

References

1. M G Limaye, Software Testing, TMH.
2. Ian Sommerville, Software Engineering, Pearson Education.

ECS745: PARALLEL AND DISTRIBUTED ALGORITHMS

L	T	P	C
3	0	0	3

Module I **8 hrs**

Motivation and History: Introduction to parallel computing, modern scientific method, evolution of supercomputing, modem parallel computers, seeking concurrency, data clustering, programming parallel computers. Parallel Architectures: Interconnection networks, processor arrays, multiprocessors, multicomputer, Flynn's taxonomy,

Module II **8 hrs**

Parallel Algorithm Design: The task/channel model, foster's design methodology: partitioning, communication, agglomeration, mapping, finding the maximum: partitioning, communication, agglomeration, mapping, analysis, adding data input: communication, analysis.

Module III **8 hrs**

Introduction to distributed systems, what is distributed systems? hard ware concepts, software concepts, design issues, communication in distributed systems layered protocols, ATM networks, the client-server model, remote procedure call, group communication.

Module IV **8 hrs**

Process and processors in distributed system threads, system models, processors allocation, scheduling in distributed systems, fault tolerance, real time distributed system.

Module V **8 hrs**

Distributed file systems, distributed file system design, distributed file system implementation, trends in distributed file system, distributed shared memory.

Text Book(s)

1. M.J. Quinn, Parallel Programming in C with MPI and OpenMP, McGraw Hill, 2008.

References

1. Grama, George Karypis, Vipin Kumar, and Anshul Gupta, Introduction to Parallel Computing by Ananth , Thompson publications, 2002.
2. S. Tanenbaum and Maarten Van Steen, Distributed Systems, Principles and paradigms, 2/e, Prentice Hall India Publications, 2006.
3. Andrew S. Tanenbaum, Distributed Operating Systems, Prentice Hall India Publications, 2009.
4. Barry Wilkinson, Michael Allen, Parallel Programming, 2/e, Pearson, 2006.
5. M.J. Quinn, Parallel Computing Theory and Practice , McGraw Hill, 2002.

ECS746: NATURAL LANGUAGE PROCESSING

L	T	P	C
3	0	0	3

Module I **8 hrs**

Overview: Origins and challenges of NLP, Theory of Language,Features of Indian Languages, Issues in Font -Models and Algorithms, NLP Applications.

Module II **8 hrs**

Morphology and Parts-of-Speech: Phonology, Computational Phonology , Words and Morphemes, Segmentation , Categorization and Lemmatisation, Word Form Recognition , Valency Agreement, Regular Expressions, Finite State Automata, Morphology, Morphological issues of Indian Languages, Transliteration.

Module III **8 hrs**

Probabilistic Models: Probabilistic Models of Pronunciation and Spelling, Weighted Automata, N- Grams , Corpus Analysis, Smoothing, Entropy, Parts-of-Speech, Taggers, Rule based Hidden Markov Models, Speech Recognition.

Module IV **8 hrs**

Syntax: Basic Concepts of Syntax, Parsing Techniques, General Grammar rules for Indian Languages, Context Free Grammar , Parsing with Context Free Grammars, Top Down Parser , Earley Algorithm , Features and Unification , Lexicalised and Probabilistic Parsing.

Module V **8 hrs**

Semantics and Pragmatics: Representing Meaning, Computational Representation, Meaning Structure of Language ,Semantic Analysis, Lexical Semantics, WordNet, Pragmatics, Discourse, Reference Resolution, Text Coherence, Dialogue Conversational Agents.

Text Book(s)

1. Daniel Jurafskey, James H. Martin, Speech and Language Processing, Prentice Hall, 2009.
2. Christopher D.Manning, Hinrich Schutze, Foundation of Statistical Natural Language Processing, MIT Press, 1999.
3. Ronald Hausser, Foundations of Computational Linguistics, Springer-Verleg, 1999.

References

1. James Allen, Benjamin, Cummings, Natural Language Understanding, Publishing Co.1995.
2. Steve Young , Gerrit Bloothooft, Corpus Based Methods in Language and Speech Processing, Kluwer Academic Publishers, 1997.

ECS747: AGILE SOFTWARE DEVELOPMENT

L	T	P	C
3	0	0	3

Module I **10 hrs**

Introduction: Agile Methods, Agile Manifesto, and Agile Modelling Introduction, What Is Agile, The Agile Manifesto, Agile Methods,XP: Extreme Programming, DSDM,SCRUM, Feature-Driven Development, Modelling Misconceptions, Agile Modelling, Tools of Misconceptions, Updating Agile Models

Module II **10 hrs**

Extreme Programming: Introduction, Core XP Values, The Twelve XP Practices, About Extreme Programming, Planning XP Projects, Test First Coding, Making Pair Programming Work

Module III **10 hrs**

Agile Modelling and XP: Introduction, The Fit, Common Practices, Modelling Specific Practises, XP Objections to Agile Modelling, Agile Modelling and Planning XP Projects, XP Implementation Phase

Module IV **10 hrs**

Feature-Driven Development: Introduction, Incremental Software Development, Regaining Control: The Motivation Behind FDD, Planning an Iterative Project, Architecture Centric,FDD and XP,

Module V **12 hrs**

Agile Methods with RUP and PRINCE2 and Tools and Obstacles: Agile Modelling and RUP, FDD and RUP, Agile Methods and Prince2, Tools to Help with Agile Development, Eclipse: An Agile IDE,Obstacles to Agile SoftwareDevelopment, Management Intransigence, The Failed Project Syndrome, Contractual Difficulties, Familiarity with Agility

Text Book(s)

1. John hunt, Agile software construction,1/e, springer ,2005
2. Craig Larman, Agile and Iterative Development: a manager's guide , Addison-Wesley [Pearson Education] - 2004.

References

1. Pearson, Robert C. Martin, Juli , James Shore, Chromatic 2013, The Art of Agile Development, O'Reilly Media.
2.. Elisabeth Hendrickson, Agile Testing, Quality Tree Software Inc 2008.

ECS748: CLOUD COMPUTING

L	T	P	C
3	0	0	3

Module I **10 hrs**

Understanding Cloud Computing: Cloud Origins and Influences, Basic Concepts and Terminology, Goals and Benefits, Risks and ChallengesFundamental Concepts and Models: Roles and Boundaries, Cloud Characteristics, Cloud Delivery Models, Cloud Deployment Models.

Module II **08 hrs**

Cloud-Enabling Technology: Data Center Technology, Virtualization Technology, Web Technology, Multitenant Technology, Service Technology

Module III **08 hrs**

Cloud Infrastructure Mechanisms: Logical Network Perimeter, Virtual Server, Cloud Storage Device, Cloud Usage Monitor, Resource Replication

Module IV **12 hrs**

Fundamental Cloud Architectures: Workload Distribution Architecture, Resource Pooling Architecture, Dynamic Scalability Architecture, Elastic Resource Capacity Architecture, Service Load Balancing Architecture, Cloud Bursting Architecture, Elastic Disk Provisioning Architecture, Redundant Storage Architecture.

Module V **12 hrs**

Cloud Delivery Model Considerations: The Cloud Provider Perspective: Building IaaS Environments, Equipping PaaS Environments, Optimizing SaaS Environments. The Cloud Consumer Perspective: Working with IaaS Environments, Working with PaaS Environments, Working with SaaS Services

Text Book

1. Thomas Erl, Ricardo Puttini, Zaigham Mahmood, Cloud Computing: Concepts, Technology & Architecture, Prentice Hall 2013.

References

1. John W. Rittinghouse, James F.Ransome, Cloud Computing: Implementation, Management and Security, CRC Press, rp2012.
2. Anthony T.Velte, Toby J Velte Robert Elsenpeter, Cloud Computing a practical approach, TMH 2010
3. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, August 2008.
4. Haley Beard, Cloud Computing Best Practices for Managing and Measuring Processes for On-demand Computing, Applications and Data Centers in the Cloud with SLAs, Emereo Pty Limited, July 2008.
5. Gautam Shroff, Enterprise Cloud Computing: Technology, Architecture, applications, Cambridge University Press, 2010.
6. Ronald Krutz Russell Dean Vines, Cloud Security

ECS749: INTERNET OF THINGS

L	T	P	C
3	0	0	3

Module I **10 hrs**

Introduction: The Internet of Things, An Overview, the flavour of the internet of things, the internet of things, the technology of the internet of things, enchanted objects, who is making the internet of things,Design principles for connected devices: Calm and ambient technology, magicas metaphor, privacy, web thinking for connected devices, affordances.

Module II **10 hrs**

Internet Principles: Internet communications,An overview (IP, TCP, the IP protocol suite (TCP/IP), UDP), IP addresses (DNS, Static IP Address assignment, dynamic IP address assignment,IPv6), MAC addresses, TCP and UDP ports, application layer protocols.

Module III **10 hrs**

Prototyping: Thinking About Prototyping: Sketching, familiarity, costs versus ease of prototyping, prototypes and production, open source versus closed source, tapping into the community.Prototyping embedded devices : Electronics, embedded computing basics, developing on the arduino, raspberry pi beaglebone black, electric imp, mobile phone and tablets, plug computing, always on internet of things.

Module IV **10 hrs**

Prototyping the Physical Design: Preparation, sketch, iterate and explore, non digital methods, laser cutting, 3D printing, CNC milling, repurposing/ recycling.Techniques for Writing Embedded Code: Memory management, performance and battery life, libraries, debugging.

Module V **10 hrs**

Prototype to Reality: Business Models,A short history of business models, the business model canvas, models, funding an internet of things startup, lean startups.Moving to manufacture : Designing kits, designing printed circuit boards, manufacturing printed circuit boards, mass producing the case and other fixtures, certification, costs, scaling up software.

Text Book

1. Adrian McEwen, Hakim Cassimally, Designing the Internet of Things, 1/e, Wiley publication, 2013

References

1. Charalampos Doukas , Building Internet of Things with the Arduino, Create space, 2002.
2. Dieter Uckelmann (et.al), Architecting the Internet of Things, Springer, 2011.
3. Luigi Atzor (et.al), The Internet of Things: A survey, Journal on Networks, Elsevier Publications, 2010.

ECS750: GAME PROGRAMMING

L	T	P	C
3	0	0	3

Module I **10 hrs**

Introduction to Game Programming, suitable languages for developing games and reasons, Animation framework, worms in windows and applets, full-screen worms.

Module II **9 hrs**

Introduction to java imaging, image loading, visual effects, and animation. Loading and playing sounds, audio effects and synthesis, and Sprites.

Module III **10 hrs**

Side- Scroller, Isometric Tile Game, 3-D check board and checkers3-D, loading and managing external models, lathe to make shapes, 3D- Sprites

Module IV **10 hrs**

Networking basics, Network chat, networked two-person game, networked virtual environment.

Module V **9 hrs**

Game production and project management, Game Industry roles and economics, the publisher-developer relationship, marketing.

Text Book(s)

1. Killer Game programming in Java by Andrew Davison, O'Reilly Publishers
2. Introduction to Game Development, by Steve Rabin, CENGAGE Technology

References

1. David Brackeen, Developing Games in Java
2. David M Bourg,Glenn Seemann AI for Game Developers,O'Reilly Publishers.

Web Resource

1. http://www3.ntu.edu.sg/home/ehchua/programming/java/J8d_Game_Framework.html

ECS751: SERVICE ORIENTED ARCHITECTURE

L	T	P	C
3	0	0	3

Module I **8 hrs**

Fundamentals of SOA: Introduction, defining SOA, evolution of SOA, service oriented enterprise, comparing SOA to client server and distributed internet architectures, basic SOA architecture concepts, key service characteristics, technical benefits, business benefits.

Module II **10 hrs**

Combining SOA and Web Services: Web services , service descriptions , messaging with SOAP ,message exchange patterns, web service platform, service contract, service level data model, service discovery, service level security, service level interaction patterns, atomic and composite services, service enabling legacy system, enterprise service bus pattern.

Module III **10 hrs**

Multi Channel Access and Web Services Composition: SOA for multi, channel access, business benefits, tiers, business process management, web service composition, BPEL, RESTFUL services, comparison of BPEL and RESTFUL services.

Module IV **10 hrs**

Java Web Services:SOA support in J2EE , Java API for XML, basedweb services(JAX,WS), Java architecture for XML binding (JAXB) , Java API for XML registries(JAXR), Java API for XML based RPC (JAX,RPC), web services interoperability, SOA support in .NET , ASP.NET web services, case studies, web services enhancements (WSE).

Module V **8 hrs**

Web Services Security and Transaction: Meta datamanagement, advanced messaging, addressing , reliable messaging, policies, WS- policy, security, WS- security, notification and eventing, transaction management.

Text Book(s)

1. Eric Newcomer, Lomow, Understanding SOA with Web Services, Pearson Education, 2005.
2. James McGovern, Sameer Tyagi, Michael E Stevens, Sunil Mathew, Java Web Services Architecture, Elsevier, 2003.

References

1. Thomas Erl, Service Oriented Architecture, Pearson Education, 2005.
2. Sandeep Chatterjee, James Webber, Developing Enterprise Web Services, An Architect's Guide, Pearson Education, 2005.
3. Dan Woods and Thomas Mattern, Enterprise SOA: Designing IT for Business Innovation, O'REILLY, 1/e, 2006.
4. Frank Cohen, FastSOA, Elsevier, 2007.
5. Jeff Davies, The Definitive Guide to SOA, Apress, 2007.

ECS752: THEORY AND APPLICATIONS OF ONTOLOGIES

L	T	P	C
3	0	0	3

Module I **10 hrs**

Semi-structured Data and the XML framework: Need for semi-structured data, Relevance as a data model and in data integration, the XML framework, Document Type Definitions (DTDs), XML Schema, Storing and querying XML data, XPATH, XSLT, XQUERY languages. Limitations of the XML framework.

Module II **10 hrs**

Theory behind Ontologies: Description Logics (DLs), the attributive language with complement (ALC), ALC with Negation (ALCN), Specific DLs - SROIQ, and SHIQ; Semantics of Description Logics; Inference in DLs, the tableaux algorithms.

Module III **10 hrs**

Semantic Models and Knowledge Bases: Elements of Semantic Web Technology - Resource Description Framework (RDF); Ontology Frameworks - RDF Schema, Ontology Web Language (OWL); Ontology tools - Protégé; Query languages for semantic data - SPARQL language; Principles of Linked Data, Linked Data Cloud; Triple stores and indexing RDF data.

Module IV **9 hrs**

Applications of Ontologies: Semantic search, ontologies for information integration, ontologies for question answering systems.

Module V **9 hrs**

Programming assignments: Developing DTDs, Using XPATH 2.0, XQUERY and XSLT; Developing ontologies using OWL and Protégé, Querying using SPARQL, OWLAPI etc

Text Book(s)

1. Semantic Web for the Working Ontologist - Effective modeling in RDFS and OWL (Second Edition), Dean Allemang and Jim Hendler, Morgan Kaufman, 2011.
2. Foundations of Semantic Web Technologies, Pascal Hitzler, Sebastian Rudolph and Markus Kroetzsch, Chapman & Hall / CRC Textbooks in CS, 2010.

Reference

1 The Semantic Web Primer (Second Edition), Grigoris Antoniou and Frank van Harmelen, MIT Press, 2008.

ECS762: BUSINESS INTELLIGENCE

L	T	P	C
3	0	0	3

Module I **9 hrs**

Introduction to Business intelligence : Effective and timely decisions, Data, information and knowledge, The role of mathematical models, Business intelligence architectures, Cycle of a business intelligence analysis, Enabling factors in business intelligence projects, Development of a business intelligence system, Ethics and business intelligence.

Module II **10 hrs**

Decision support systems: Definition of system, Representation of the decision-making process, Rationality and problem solving, the decision-making process, Types of decisions, Approaches to the decision-making process, Evolution of information systems, Definition of decision support system, Development of a decision support system

Module III **9 hrs**

Mathematical models for decision making: Structure of mathematical models, Development of a model, Classes of models. Data exploration : Univariate analysis, Graphical analysis of categorical attributes, Graphical analysis of numerical attributes, Measures of central tendency for numerical attributes, Measures of dispersion for numerical attributes , Measures of relative location for numerical attributes, Identification of outliers for numerical attributes, Measures of heterogeneity for categorical attributes, Analysis of the empirical density, Bivariate analysis, Graphical analysis, Measures of correlation for numerical attributes, Contingency tables for categorical attributes, Multivariate analysis, Graphical analysis, Measures of correlation for numerical attributes. Regression : Structure of regression models, Simple linear regression, Calculating the regression line, Multiple linear regression, Calculating the regression coefficients, Assumptions on the residuals, Treatment of categorical predictive attributes, Ridge regression, Generalized linear regression, Validation of regression models, Normality and independence of the residuals, Significance of the coefficients Analysis of variance, Coefficient of determination, Coefficient of linear correlation, Multi-collinearity of the independent variables, Confidence and prediction limits.

Module IV **9 hrs**

Time series Data in BI : Definition of time series, Index numbers, Evaluating time series models Distortion measures Dispersion measures, Tracking signal, Analysis of the components of time series Moving average, Decomposition of a time series, Exponential smoothing models, Simple exponential smoothing, Exponential smoothing with trend adjustment, Exponential smoothing with trend and seasonality, Simple adaptive exponential smoothing, Exponential smoothing with damped trend, Initial values for exponential smoothing models, Removal of trend and seasonality, Autoregressive models, Moving average models, Autoregressive moving average models, Autoregressive integrated moving average models, Identification of autoregressive models, Combination of predictive models, the forecasting process, Characteristics of the forecasting process, Selection of a forecasting method.

Module V **9 hrs**

Business intelligence applications: Marketing models -Relational marketing, Motivations and objectives, An environment for relational marketing analysis, Lifetime value, The effect of latency in predictive models, Acquisition, Retention, Cross-selling and up-selling, Market basket analysis, Web mining, Sales force management, Decision processes in sales force management, Models for sales force management, Response functions, Sales territory design, Calls and product presentations planning, Business case studies, Retention in telecommunications, Acquisition in the automotive industry, Cross-selling in the retail industry.

Text Book

1. Carlo Vercellis, Business Intelligence, John Wiley & sons, 2009

References

1. Elizabeth Vitt, Michael Luckevich, Business Intelligence: Making Better Decision, Microsoft Press, 2002
2. Larissa T. Moss, ShakuAtre, Business Intelligence Roadmap: The Complete Project Life cycle for Decision Support systems,Addison - Wesley Information Technology Series, 2008.

EID758: STATISTICS FOR DATA SCIENCE

L	T	P	C
3	0	0	3

Module I **8 hrs**

Introduction to probability, random experiment, event- definition, axiomatic approach to probability, addition law, Compound Law of probabilities, conditional probability, Bayes theorem - applications, concept of random variable (r.v) discrete and continuous random variables- examples, probability functions: mass function, density function and distribution functions, expected value of r.v, concept of moments and central moments- expected value of random variable: E(X), Variance of random variable, some popular distributions of random variables- Bernoulli, binomial distribution, Poisson distribution, Uniform, normal (Gaussian) distribution, exponential distribution, central limit theorem - applications.

Module II **9 hrs**

Sampling: sample, populations, statistic, parameter, sampling distribution and standard error. Testing of hypothesis: Null hypothesis, critical regions, level of significance and power of the test. Large sample tests (Z-test): based on means, standard deviations, proportions, interval estimates, Small sample tests: t-test (single mean, two means paired t-test, test for population correlation coefficient), ?2 - test for variance, goodness of fit, ?2 - test for attributes, Test of equality of variances (F-test), Analysis of variance (ANOVA), Post hoc tests.

Module III **10 hrs**

Correlation, linear regression - simple linear regression, multiple linear regression- estimating the regression coefficients, assessing the accuracy of the coefficient estimates and model, other considerations in the regression model- qualitative predictors, potential problems. Logistic regression- the logistic model, estimating the regression coefficients, multiple logistic regression, logistic regression for >2 response classes, linear discriminant analysis- using bayes' theorem for classification, linear discriminant analysis for p=1, linear discriminant analysis for p>1, quadratic discriminant analysis, a comparison of classification methods.

Module IV **8 hrs**

Resampling methods- cross validation, the validation set approach, leave one out cross validation, k-fold cross validation, bias variance trade off fork fold cross validation, cross validation on classification problems, the bootstrap.

Module V **10 hrs**

Linear model selection and regularization- subset selection- best subset selection, stepwise selection, choosing the optimal model, shrinkage methods- ridge regression, the lasso, selecting the tuning parameter, dimension reduction methods- principal components regression, partial least squares, considerations in high dimensions- high-dimensional data, regression in high dimensions, interpreting results in high dimensions.

Text Book(s)

1. Modern Mathematical Statistics with Applications Jay L. Devore, Kenneth N. Berk Springer Second edition ,
2. Walter A. Rosencrantz, Introduction to Probability and statistics for scientists and engineers", McGraw-Hill.
3. Gareth James, Daniela Witten, Trevor Hastie Robert Tibshirani, An Introduction to Statistical Learning with Applications in R, Springer

References

1. Joel Grus, Data Science from Scratch First Principles with Python, O'Reilly.
2. Mike Loukides, What Is Data Science? ,O'Reilly.

EID759: OPEN SOURCE SOFTWARE DEVELOPMENT

L	T	P	C
3	0	0	3

Module I **8 hrs**

Introduction: Overview of open source software: what is software source code? the open source definition, need, applications, examples of OSD, compliant licenses, examples of open source software products, the open source software development process.

A History of open source software: The Berkeley software distribution, tex, the free software foundation, GNU unix, linux, apache.

Module II **8 hrs**

Python Programming, Introduction: Features, using the python interpreter, an introduction to python, control statements, functions, input and output, reading and writing files.

Module III **8 hrs**

Python Programming: Data structures, Modules, standard Modules, packages, errors and exceptions, handling exceptions, user defined exceptions.

Module IV **8 hrs**

Python Programming: Classes, inheritance, generators, standard library (part I), command line arguments, string pattern matching, internet access, data compression.

Module V **8 hrs**

Python Programming, Standard Library (Part II): Output formatting , templating, working with binary data record layouts, multithreading, logging

Text Book(s)

1. Joseph Feller, Brian Fitzgerald, Understanding Open Source Software development, Pearson Education, 2001.
2. Bill Lubanovic, Introducing Python, Oreilly, 2014.

Reference

1. Mark Pilgrim, Dive into Python, http://www.diveintopython.net/

Web Resource

1. Python Tutorial: http://docs.python.org/tutorial/

EID760: PROGRAMMING WITH R

L	T	P	C
3	0	0	3

Module I **10 hrs**

Introduction to R programming, Introduction to Functions, Preview of Important R Data Structures, Vectors, Recycling, Common Vector Operations, Vectorized Operations, Filtering Matrices and Arrays

Module II **9 hrs**

Lists, Creating Lists, General List Operations Accessing List Components and Values, Applying Functions to Lists, Recursive Lists, Data Frames, Creating Data Frames, Other Matrix-Like Operations, Merging Data Frames, Applying Functions to Data Frames, Factors and Tables, Factors and Levels, Common Functions Used with Factors, Working with Table,Table-Related Functions

Module III **10 hrs**

R Programming Structures, Control Statements, Arithmetic and Boolean Operators and Values, Default Values for Arguments, Environment and Scope Issues, Recursion Replacement Functions, Anonymous Functions Data Frames, Creating Data Frames, Other Matrix-Like Operations, Merging Data Frames, Applying Functions to Data Frames, Factors and Tables Factors and Levels, Common Functions Used with Factors, Working with Table, Table- Related Functions, R Programming Structures, Control Statements Arithmetic and Boolean Operators and Values, Default Values for Arguments, Environment and Scope Issues, Recursion Replacement Functions, Anonymous Functions Corporate Digital Library - Document Library, digital Document types, corporate Data Warehouses.

Module IV **9 hrs**

Math and Simulations in R, Math Functions,Functions for Statistical Distributions, Sorting,Linear Algebra Operations on Vectors and Matrices, Set Operations, Simulation Programming in R, Object-Oriented Programming, S3 Classes, S4 Classes, S3 Versus S4, Managing Your Objects

ModuleV **10 hrs**

Input/Output, Accessing the Keyboard and Monitor, Reading and Writing Files, Accessing the Internet,String Manipulation, String-Manipulation

Functions, Regular Expressions, Use of String Utilities in the edtdbg Debugging Tool, Creating Graphs, Customizing Graphs, Saving Graphs to Files Creating Three-Dimensional Plots

Text Book

1. Norman Matloff, Art of R programming, Safari books online Publisher, Nostarch Press

References

1. Mark gardener, Beginning R: The Statistical Programming Language , Wrox publication
2. lary pace, Beginning R, Appress Publishers
3. Andrie De Vries and Joris Meys, R Programming for Dummies, 1/e, Wiley India Private Limited,

EID762: DESIGN PATTERNS

L	T	P	C
3	0	0	3

Module I **10 hrs**

Introduction: History and Origin of Patterns,Design Patterns in MVC, Describing Design Patterns,How Design Patterns Solve Design Problems,Selecting a Design Pattern,Using a Design Pattern

Module II **10 hrs**

Design Patterns-1: Creational, Abstract Factory-Builder, Factory Method, Prototype-Singleton

Module III **10 hrs**

Design Patterns-2: Structural Patterns: Adapter, Bridge, Composite Decorator , Façade, Flyweight, Proxy

Module IV **10 hrs**

Design Patterns-3: Behavioral Patterns, Chain of Responsibility, Command-Interpreter, Iterator- Mediator, Memento, Observer, State, Strategy, Template Method, Visitor

Module V **12 hrs**

Advanced Patterns: Pattern Catalogs and Writing Patterns, Patterns and Case Study: Designing a Document Editor Anti-Patterns - Case Studies in UML and CORBA, Pattern Community.

Text Book(s)

1. Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, Design patterns: Elements of Reusable object-oriented software, Addison-Wesley, 1995.
2. James W Cooper, Java Design Patterns - A Tutorial, Addison-Wesley, 2000.

References

1. Craig Larman Second Edition, Applying UML and Patterns: An Introduction to object-oriented Analysis and Design and iterative development ,3/e, Pearson, 2005.
2. Thomas J Mowbray and Raphael Malveau, CORBA and Design Patterns , JohnWiley, 1997.
3. William J Brown, Anti-Patterns: Refactoring Software, Architectures and Projects in Crisis, John Wiley, 1998.

EID763: MULTIVARIATE TECHNIQUES FOR DATA ANALYSIS

L	T	P	C
3	0	0	3

Module I **8 hrs**

Introduction To Multivariate Analysis: Meaning of Multivariate Analysis, Measurements Scales - Metric measurement scales and Non- metric measurement scales, Classification of multivariate techniques (Dependence Techniques and Inter-dependence Techniques), Applications of Multivariate Techniques in different disciplines.

Module II **8 hrs**

Factor Analysis: Meanings, Objectives and Assumptions, Designing a factor analysis, Deriving factors and assessing overall factors, Interpreting the factors and validation of factor analysis.

Module III **8 hrs**

Cluster Analysis: Objectives and Assumptions, Research design in cluster analysis, Deriving clusters and assessing overall fit (Hierarchical methods, Non Hierarchical Methods and Combinations), Interpretation of clusters and validation of profiling of the clusters.

Module IV **8 hrs**

Discriminant Analysis- concept, objective and applications. Procedure for conducting discriminant analysis. Stepwise discriminate analysis and Mahalanobis procedure. Logit model.

Module V **8 hrs**

Linear Programming problem - Formulation, graphical method, simplex method. Integer Programming. Transportation and Assignment problem.

Text Book(s)

1. Joseph F Hair, William C Black, Multivariate Data Analysis, Pearson Education,7/e, 2013.

References

1. T. W. Anderson, An Introduction to Multivariate Statistical Analysis, Wiley, 2003.
2. William r Dillon, Multivariate Analysis methods and applications, Wiley, 1984.
3. Hamdy A Taha, Operations Research, Pearson, 2012.

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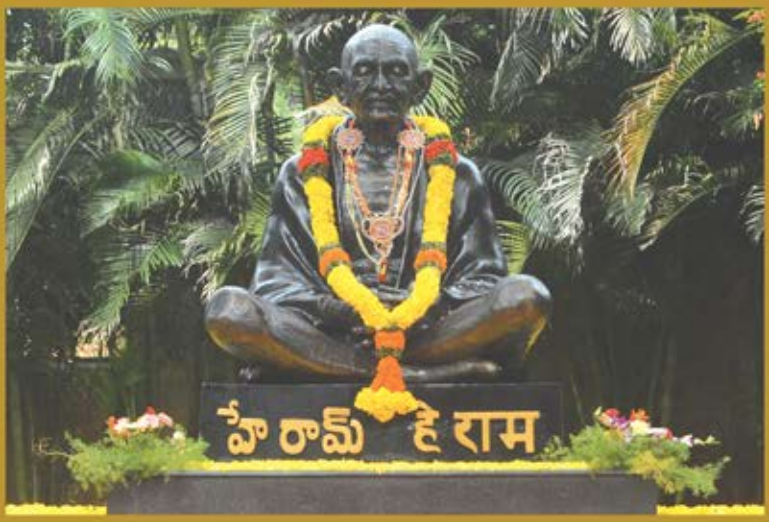

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