Post Graduate Course

M. Tech. (Computer Science and Technology)

(w.e.f. Session July 2021/22)

Department of Computer Science and Technology

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Central University of Jharkhand

Established by the Act of Parliament of India, 2009

Ranchi

Course Name: Master of Technology in Computer Science and Technology
M. Tech.(CST)

Level of Course: Post Graduate
Type: Degree

Duration : 2 Years

Eligibility: Minimum 55% Marks in Bachelor's degree in Engineering / Technology (IT/CS/CSE) **OR** An equivalent degree in an appropriate area **OR**
M. Sc (Computer Science/Information Technology) **OR** MCA**.**
(Relaxation as per the GoI norms)

Intake: 28

Introduction

M. Tech. (Computer Science and Technology) or Master of Technology in Computer Science and Technology is a postgraduate program. The Program is designed to equip with the knowledge and skill to develop innovative solutions which the modern computing industry requires. The focus is on understanding and making the right choice of abstraction thus making it possible to implement IT and computing from existing and future components.

After passing Master Degree students will have potential to be recruited in industry, academia, and public service, research, business and commercial organizations including manufacturing sectors.

Methodology: Lecture, laboratory work, tutorials, class exercises, project work, real-life experiences.

Credit Requirements:

Minimum Credit requirement:	**74**
Compulsory Course:	22
Electives:	12
Interdisciplinary Course (Open Elective)	03
Seminar:	01
Dissertation:	36

Program Structure and Evaluation Scheme

M. Tech.(CST): **First Semester**						
Sl.No.	**Code**	**Course Name**	**L**	**T**	**P**	**Total Credit**
1	CST611010	Mathematical Foundations of Computer Science	4	0	0	4
2	**CST611040**	**Advanced Data Structures and Algorithm**	3	0	0	3
3	**CST611050**	**Introduction to Artificial Intelligence**	3	0	0	3
4	CST6160xx	Elective - I				3
5	ST6160xx	Elective - II				3
6	**CST612060**	**Advanced Data Structure and Algorithm Lab**	0	0	4	2
					Total	18

M. Tech.(CST): **Second Semester**						
Sl.No.	**Code**	**Course Name**	**L**	**T**	**P**	**Total Credit**
1	**CST621060**	**Machine Learning**	3	0	0	3
2	CST621020	Soft Computing	3	0	0	3
3	ST6260xx	Elective - III				3
4	ST6260xx	Elective - IV				3
5	*	Elective - V (Open Elective)				3
6	**CST622070**	**Machine Learning Programming using Python**	0	0	4	2
7	CST623030	Seminar				1
8.	CST621030	Academic Ethics and Research Writing	2	0	0	2
					Total	20

* Code will be provided by the concerned department offering open elective.

M. Tech.(CST): **Third Semester**						
Sl.No.	**Code**	**Course Name**	**L**	**T**	**P**	**Total Credit**
1	CST717010	Dissertation - I				16
					Total	16

M. Tech.(CST): **Fourth Semester**						
Sl.No.	**Code**	**Course Name**	**L**	**T**	**P**	**Total Credit**
1	CST727010	Dissertation - II				20
					Total	20

Guidelines for Seminar/Dissertation-I/Dissertation-II

The M.Tech. Course curriculum contains the series of methodology to facilitate research exposure to students. Three subsequent credit organized over three consecutive semesters are; Seminar, Dissertation-I and Dissertation-II. A Brief of guideline is mentioned below.

A. Seminar (Semester-II):

-Students need to select a broader area of interest and send a tentative request to a supervisor.
-Upon acceptance from potential supervisors they need to work on the domain and need to present the domain fundamentals through seminar, Student are required to submit write up in prescribed format.
-Supervisors need to evaluate the competence of candidate and send a preference list to Master Research Committee (MRC).
-Each student would also submit a preference list to MRC.
-Based on both the preference list MRC will finalize the allotment.
-Based on the Master Research Committee (MRC) report students-supervisor allotment list will be displayed by the head of department (before end of the second semester)

B. Dissertation-I (Semester -III): Students are expected to perform the literature study in the preferred domain and present the proposal including research methodology, tools and techniques used. Submission of duly signed proposal/study in prescribed format is required.

C. Dissertation-II (Semester-IV) : Extending the work proposed in Dissertation-I, Dissertation-II additionally expected to include implementation, Evaluation, Results and Comparison study along with future scope of the work. Finally, it is required to submit the duly signed complete dissertation in prescribed format to the MRC.

Note: Dissertation is strictly being carried out individually. Five copies (Student Copy, Supervisor Copy, University Library, Departmental Record, and External Examiner Copy) of final dissertation are required to submit on or before the deadline announced by MRC.

Evaluation Scheme

- End semester examination will be conducted as per the guideline of CUJ.
- Lab examination in *Advance Data Structure* and *Advance Algorithm* should be evaluated by an external examiner. It comprises of 100 marks out of which 50 marks will be evaluated by course instructor (following continue evaluation) and 50 marks will be evaluated by external examiner.
- Seminar: Open Seminar will be conducted by the department and it should be evaluated by MRC.
- Dissertation-I : Viva-voce will comprises of 100 marks out of which for 50 marks there will be an *internal examiner/* subject expert from University and Supervisor/guide for the rest 50 marks.
- Dissertation-II : Viva-voce will comprises of 100 marks out of which for 50 marks there will be an *external examiner*/ subject expert from other University/ Reputed Institution and Supervisor/guide for the rest 50 marks.

List of Elective Courses *

First Semester						
S. No	**Code**	**Course**	**L**	**T**	**P**	**Total**
1	CST616010	Internet of Things	3	0	0	3
2	**CST616021**	**Advance Computer Network**	3	0	0	3
3	CST616030	Advanced Database System	3	0	0	3
4	CST616040	Data Warehousing and Mining	3	0	0	3
5	CST616050	Data Security	3	0	0	3
6	CST616060	Network Security	3	0	0	3
7	CST616070	Ethical Hacking and Cyber Crime	3	0	0	3
8	CST616080	Block Chain Technology	3	0	0	3
Second Semester						
S. No	**Code**	**Course**	**L**	**T**	**P**	**Total**
1	CST626010	Knowledge Representation & Reasoning	3	0	0	3
2	**CST626021**	**Natural Language Processing**	3	0	0	3
3	CST626030	Computer Vision and pattern recognition	3	0	0	3
4	CST626050	Information Theory and Coding	3	0	0	3
5	CST626060	Digital Forensics and Biometrics	3	0	0	3
6	**CST626071**	**Mobile Computing**	3	0	0	3
7	CST626080	Web Search and Information Retrieval	3	0	0	3
8	**CST626090**	**Quantum Computing**	3	0	0	3
9	**CST626100**	**Big Data Analytics**	3	0	0	3

*** The elective papers will be offered by the department based on availability of subject experts.**

Syllabus (M. Tech (CST))

First Semester (Core Courses/Papers)

Course Code	CST611010
Course Name	Mathematical foundations of Computer Science
Credit	4
Pre-Requisites	Discrete Mathematics
Total Number of Lectures	45

COURSE OBJECTIVE

- To understand the mathematical fundamentals that is prerequisites for a variety of courses like Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning.
- To develop the understanding of the mathematical and logical basis to many modern techniques in information technology like machine learning, programming language Design and concurrency.

SYLLABUS

Unit 1

Probability mass, density, and cumulative distribution functions, Parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Markov chains

Unit 2

Random samples, sampling distributions of estimators**,** Methods of Moments and Maximum Likelihood**,** Statistical inference**,** Introduction to multivariate statistical models: regression and classification problems, principal components analysis**,** The problem of overfitting model assessment.

Unit 3

Graph Theory: Isomorphism, Planar graphs, graph colouring, hamilton circuits and euler cycles. Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems.

Unit 4

Recent Trends in various distribution functions in mathematical field of computer Science for varying fields like bioinformatics, soft computing, and computer vision.

References

1. John Vince, Foundation Mathematics for Computer Science, Springer.

2. K. Trivedi.Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley.
3. M. Mitzenmacher and E. Upfal.Probability and Computing: Randomized Algorithms and Probabilistic Analysis.
4. Alan Tucker, Applied Combinatorics, Wiley

COURSE OUTCOMES

- To understand the basic notions of discrete and continuous probability.
- To understand the methods of statistical inference, and the role that sampling distributions play in those methods.
- To be able to perform correct and meaningful statistical analyses of simple to moderate Complexity.

Course Code	CST611040
Course Name	Advanced Data Structures and Algorithm
Credit	3
Pre-Requisites	
Total Number of Lectures	45

COURSE OBJECTIVE

- The student should be able to choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem.
- Introduce students to the advanced methods of designing and analyzing algorithms.
- The student should be able to choose appropriate algorithms and use it for a specific problem.
- Student should be able to come up with analysis of efficiency and proofs of correctness.
- To introduce the students to recent developments in the area of algorithmic design.

SYLLABUS

Unit-1

Analysis of Algorithms: Introduction to Data Structure, Types of Data Structure; Asymptotic Notations – Performance of the Algorithms: Time Complexity, Space Complexity; Recurrence Relation- Substitution Method, Master's Theorem.

Unit-2

Searching & Sorting: Algorithm and Complexity- Insertion Sort, Bubble Sort, Selection Sort, Shell Sort; Divide and Conquer Strategy: Finding maximum and minimum element, Binary Search, Merge-Sort, Quick Sort with average case analysis. Lower bound on comparison –based sorting

Unit-3

Advanced search Structures: Representation, Insertion and Deletion operations on Red-Black trees, B-Trees

Heaps: Definition, Basic Operations, Min heap and Max heap Construction, Heap Sort.

Greedy Techniques: Job sequencing with deadlines, Knapsack Problem, Huffman Coding, Optimal Merge Pattern, Minimum Cost Spanning Tree, Single Source Shortest Path.

Dynamic programming: Matrix Chain Multiplications, Longest Common Subsequence, 0/1 Knapsack Problem, Fibonacci Series, etc.

Unit-4

Hashing: Review of Hashing, Hash Function, Hash Table, Collision Resolution Techniques in Hashing

Computational Complexity classes: Tractable and Intractable Problems, Decidable and Undecidable problems, Reduction, Reduction of Maximal Matching to Perfect Matching, Reduction of Perfect Matching to Maximal Matching; P, NP and NP complete, Cooks Theorem.

References

1. Mark Allen Weiss, "Data structures and algorithm analysis in C", 2nd edition, Pearson education, 2013.
2. Seymour Lipschutz, "Data Structures" Revised First Edition, MC Grew Hill Education, 2014
3. Coreman ,Leiserson and Rivest, Introduction to Algorithms, MIT Press
4. E. Horowithz and S. Sahni , Fundamentals of Computer Algorithm, Galgottia
5. Donald Knuth,, The Art of Computing Programming –vol-1 and 3 ,Pearson
6. V.Aho, J.E.Hopcroft and Ullman, Design and Analysis of Computer Algorithm ,Addison Wesley

COURSE OUTCOMES

After completion of course, students would be able to:

- Understanding the fundamental analysis and time complexity for a given problem.
- Applying a suitable algorithm for searching and sorting.
- Develop and analyze algorithms for red-black trees, B-trees.
- Understanding the algorithmic solutions to real-world problem from various domains.
- Analyze the complexity/performance of different algorithms.
- Categorize the different problems in various classes according to their complexity.

- Students should have an insight of recent activities in the field of the advanced data structure.

Course Code	CST611050
Course Name	Introduction to Artificial Intelligence
Credit	3
Pre-Requisites	
Total Number of Lectures	45

COURSE OBJECTIVE

- Build the basics of fundamental understanding in artificial intelligence
- Provide students with a practical approach to involve perception, reasoning and learning in problem solving

SYLLABUS

Unit 1: Search

Human Intelligence, Intelligent Agents, Cognitive Intelligence, Human Mind, Learning and Problem Solving, Rules & Behavior.

State and space, Production systems, Search, Basic search methods, Random search, closed and open list search, Uniform cost search, Heuristic search methods.

Unit 2: Knowledge

Information and knowledge, Knowledge representation, Attributes and mappings, General Problem Solver, Object structure and frame, Procedural & declarative knowledge, Syntactic-semantic spectrum

Unit 3: Logic

Learning theory and common sense, Rules of propositional and predicate logic, Ontology and description logic, Fuzzy sets and fuzzy logic, Reasoning and ontology

Unit 4: Data and biological foundation

Understanding data, structure, value and quality; Pre and post processing of data, Data driven platforms & business applications

Nature and Innovation, Human brain and Neurons, Nature's inspired operators and Algorithms, Neural nets and artificial neural network

References
1. Stewart Russell and Peter Norvig. " Artificial Intelligence-A Modern Approach ", 3rd Edition, Pearson Education/ Prentice Hall of India, 2009 2. Elaine Rich and Kevin Knight, "Artificial Intelligence", 3rd Edition, Tata McGraw-Hill, 2009. 3. George F. Luger, "Artificial Intelligence-Structures and Strategies For Complex Problem Solving", Pearson Education / PHI, 2008 4. Khemani, Deepak. A first course in artificial intelligence. McGraw-Hill Education, 2013 5. Rich, Elaine, and Kevin Knight. "Artificial intelligence." McGraw-Hill, New (1991)
COURSE OUTCOMES
After completion of course, students would be able to: • Understanding of the field or artificial intelligence • Real world applications of artificial intelligence and problem formalism • Designing solutions for real world problems through the understanding of information, knowledge and data • Transfer learning for applications into interdisciplinary domains involving perception, reasoning and learning

First Semester (Practical / Lab)

Course Code	CST612060
Course Name	Advanced Data Structure and Algorithm Lab
Credit	2
Pre-Requisites	Basic programming skills
Suggested List of laboratory exercises	Program on Sorting Algorithms (Greedy, Merge Sort, etc.) Operation on Graph & Tree (BST, AVL, B Tree, etc.) Graph & Tree Traversal Minimum Cost Spanning Tree Hashing with chaining Greedy algorithms Dynamic programming

Second Semester (Core Courses/Papers)

Course Code	CST621060
Course Name	Machine Learning
Credit	3

Pre-Requisites	
Total Number of Lectures	45

COURSE OBJECTIVE

- To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes.
- To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
- Explore supervised and unsupervised learning paradigms of machine learning.
- To explore Deep learning technique and various feature extraction strategies.

SYLLABUS

Unit 1

Supervised Learning (Regression/Classification) : Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes Linear models: Linear Regression, Logistic Regression, Generalized Linear Models Support Vector Machines, Nonlinearity and Kernel Methods Beyond Binary Classification: Multi-class/Structured Outputs, Ranking.

Unit 2

Unsupervised Learning Clustering: K-means/Kernel K-means,etc, Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory

Unit 3

Dimensionality Reduction: PCA and kernel PCA Matrix Factorization and Matrix Completion Generative Models (mixture models and latent factor models).

Unit 4

Ensemble Methods (Boosting, Bagging, Random Forests). Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning.

COURSE OUTCOMES

- Extract features that can be used for a particular machine learning approach in various IOT applications.
- To compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach.
- To mathematically analyse various machine learning approaches and paradigms.

References

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning,Springer 2009 (freely available online)
2. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.
4. Nasrabadi, Nasser M. "Pattern recognition and machine learning." Journal of electronic imaging 16.4 (2007): 049901.

Course Code	CST621020
Course Name	Soft Computing
Credit	3
Pre-Requisites	Basic knowledge of Mathematics
Total Number of Lectures	45

COURSE OBJECTIVE

- To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario.
- To implement soft computing based solutions for real-world problems.
- To give students knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, genetic algorithms.
- To provide studentan hand-on experience on MATLAB to implement various strategies.

SYLLABUS

Unit 1

INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORKS: Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics

Unit 2

FUZZY LOGIC: Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations,Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.

Unit 3

NEURAL NETWORKS: Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Reinforcement Learning,Unsupervised Learning Neural Networks, Adaptive Resonance architectures

Unit 4

GENETIC ALGORITHMS: Introduction to Genetic Algorithms (GA),Applications of GA in Machine Learning ;Machine Learning Approach to Knowledge Acquisition.

COURSE OUTCOMES

After completion of course, students would be able to:

- Identify and describe soft computing techniques and their roles in building intelligent machines.
- Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.
- Apply genetic algorithms to combinatorial optimization problems.
- Evaluate and compare solutions by various soft computing approaches for a given problem.

References

1. Jyh:Shing Roger Jang, Chuen:Tsai Sun, Eiji Mizutani, Neuro:Fuzzy and Soft Computing ,Prentice:Hall of India, 2003.
2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic:Theory and Applications ,Prentice Hall, 1995.
3. MATLAB Toolkit Manual
4. Zadeh, Lotfi A. "Soft computing and fuzzy logic." Fuzzy Sets, Fuzzy Logic, and Fuzzy Systems: Selected Papers by Lotfi a Zadeh. 1996. 796-804.
5. Sivanandam, S. N., and S. N. Deepa. Principles of Soft Computing (With CD). John Wiley & Sons, 2007.

Course Code	CST621030
Course Name	Academic Ethics and Research Writing
Credit	2
Pre-Requisites	
Total Number of Lectures	45

COURSE OBJECTIVE

- Students will demonstrate understanding of the ethical principles in general or in application of specialized knowledge, results of research, creative expression, or design processes.
- Students will demonstrate an ability to recognize, articulate, and apply ethical principles in various academic, professional, social, or personal contexts.

SYLLABUS

Unit 1

Science and Research, Basic steps of doing research, formulation of research problem.

Unit 2

Significance of literature review, writing scientific report, structure and component of research reports, revision, writing project proposal, writing a research paper.

Unit 3

Citation and impact factor, Indexing-science citation index(SCI), science citation index expanded(SCIE), scopus. H-index, i-index.

Unit 4

Plagiarism, Intellectual property rights and patent laws.

COURSE OUTCOMES

- Students will demonstrate understanding of the ethical principles in general or in application of specialized knowledge, results of research, creative expression, or design processes.

References

1. Marder, Michael P. *Research methods for science*. Cambridge University Press, 2011.
2. Oliver, Paul. *Writing your thesis*. Sage, 2013.
3. Gregory, Ian. *Ethics in research*. A&C Black, 2003.

Second Semester (Practical / Lab)

Course Code	CST622070
Course Name	Machine Learning Programming using Python
Credit	2
Pre-Requisites	

COURSE OBJECTIVE

- To understand the installation process
- To provide fundamental knowledge of Python programming concepts to solve basic problem
- To understand data preprocessing task
- To be able to implement various Machine Learning Techniques

SYLLABUS

Unit-1

Introduction to predefined functions and modules, Basic data types in python, strings, Operators, Control Flow Statements, Functions.

Unit-2

List: Creation, Built in functions for list, Methods of list, List comprehension.

Tuple: Creation, Function used with tuple, Conversion of list to tuple

Sets: Creation of sets and their various functions

Dictionary: Creation, Functions used in dictionary, Dictionary methods, Dictionary Comprehension.

Unit-3

Importing various file formats, Indexes**,** Filtering data, Updating Row and columns, Sorting data, Grouping and aggregation, Cleaning data, Reading /writing data

Hands-on on Supervised and Unsupervised Machine Learning Techniques- Linear Regression, Non-linear Regression, K-Nearest Neighbour, Decision Trees, Logistic Regression, Support Vector Machines, K-Means Clustering, Hierarchical Clustering, etc.

Unit-4

Case Studies

Real Time Project

References

1. Kenneth A Lambert., Fundamentals of Python : First Programs, 2/e, Cengage Publishing, 2016
2. Wes McKinney, Python for Data Analysis, 2/e, Shroff / O'Reilly Publishers, 2017
3. Frank Pane, "Hands on Data Science and Python Machine Learning", Packt Publishers, 2017.

COURSE OUTCOMES

After completion of course, students would be able to:

- Write, test and debug Python programs
- Understand the various Data Structures
- Develop programs by utilizing the modules Lists, Tuples, Sets and Dictionaries in Python
- Convert the real time data into suitable form for analysis
- Learn to apply Python features for Machine Learning

First Semester
(Elective Courses/Papers)

Course Code	CST616010
Course Name	Internet of Things
Credit	3
Pre-Requisites	

Total Number of Lectures	45

COURSE OBJECTIVE

- Able to understand the application areas of IOT.
- Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks.
- Able to understand building blocks of Internet of Things and characteristics.

SYLLABUS

Unit 1

Clouds: Introduction to Cloud Computing, Software as a Service SAAS, Infrastructure as a Service IAAS, Platform as a service PAAS, Desktop as a service DAAS

Unit 2

FUNDAMENTALS OF IoT: Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT

Unit 3

Architecture and Core IoT Functional Stack -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects.

Unit 4

IoT PROTOCOLS : IoT Access Technologies; Physical and MAC layers, topology and Security of

Unit 5

DESIGN AND DEVELOPMENT : Design Methodology ,Microcontroller, System on Chips
IoT system building blocks;

COURSE OUTCOMES

On completion of the course the student should be able to

- Understand the vision of IoT from a global context.
- Determine the Market perspective of IoT.
- Use of Devices, Gateways and Data Management in IoT.
- Application of IoT in Industrial and Commercial Building Automation and Real World Design Constraints.
- Building state of the art architecture in IoT.

References

1. Cloud Computing: SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and More Paperback – 2013
2. Olivier Hersent, David Boswarthick, Omar Elloumi , —The Internet of Things – Key applications and Protocols, Wiley, 2012 (for Unit 2).
3. Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Elsevier, 2014.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), —Architecting the Internet of Things, Springer, 2011.
5. Arshdeep Bahga, Vijay Madisetti, —Internet of Things – A hands-on approach, Universities Press, 2015

6. Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, O'Reilly Media, 2011.

Course Code	CST616021
Course Name	Advance Computer Network
Credit	3
Pre-Requisites	Basics in Computer Networking, Computer Architecture
Total Number of Lectures	45

COURSE OBJECTIVE

- Acquire knowledge of division of network functionalities into layers.
- To get familiar with the fundamental concepts of computer networking, standards, protocols, architectures, and applications
- Provide an in-depth study of different protocol.
- Deployments of nodes and link with packet analysis using different software and tools
- To learn how to evaluate MAC and network protocols using network simulation software tools.

SYLLABUS

Unit-1: Overview

Review of Layered Network Architecture, Virtual Circuit Networks, Layer 2 Switches

IEEE 802.3U(Fast Ethernet) and IEEE 802.3Z(Gigabit Ethernet), Virtual LAN, Wireless LAN: IEEE 802.11, Broadband Wireless LAN : 802.16, WIMAX

Host configuration: DHCP, DNS.

Unit-2 Physical and Link Layer

Transmission Impairments, Line Encoding, Error Detection and Correction, Flow Control Protocols: Protocols for Noiseless Channels and Noisy Channels, Access Control Protocols, TDMA, FDMA, CDMA.

Unit 3 Addressing and Routing

Internet Routing Protocols: OSPF, BGP, Broadcast and Multicast Routing: Flooding, Reverse Path Forwarding, Pruning, Core based trees, PIM, IP Addressing Scheme, Subnet Addressing, Subnet Masks, IPV4 Addressing, IPV6, ARP, RARP Unicast Routing: Routing Characteristics, Routing Algorithms: Distance Vector Routing Protocol, Link State Routing Protocol.

Unit 4 Transport and Application Layer

Review of UDP, TCP, SCTP, Real Time Application: Voice and Video over IP, Transport Layer Security Protocols: SSL, TLS, Flow Control, Congestion Control, Simple Mail Transfer Protocol (SMTP), File Transfer Protocol (FTP), TELNET, SNMP,DNS, Hypertext Transfer Protocol (HTTP), World Wide Web (WWW), Security in Internet, E-mail Security. Security Issues

References

1. Srinivasan Keshav, An Engineering Approach To Computer Networking, Pearson
2. W. Richard Stevens, TCP/IP ILLustrated -Vol1 Pearson
3. D. Bertsekas , R Gallagar ,Data Networks and Internets PHI
4. W. Stalling, High Speed Networks and Internets, Pearson
5. A. Tanenenbaum, Computer Network,PHI
6. Behrouz A. Forouzan, TCP/IP Protocol Suite,Tata McGraw Hill edition, Fourth Edition. 2015.
7. James F. Kuross, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Third Edition, Addison Wesley, 2004.
8. Forouzan, A. Behrouz. Data Communications & Networking (sie). Tata McGrawHill Education, 2006
9. Peterson and Bruce S. Davie Larry L.,Computer Networks – A Systems approach - , Morgan Kaufmann Publishers, Elsevier, 5th edition, 2012
10. Larry Peterson and Bruce Davie, Computer Networks: A Systems Approach, 5th Ed, Elsevier, 2011.
11. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, Computer Networks: An Open Source Approach, McGraw Hill, 2012. Andrew S Tanenbaum, “Computer Networks”, 5th Edition, Pearson, 2011.

COURSE OUTCOMES

After completion of course, students would be able to:

- Explore the basics of Computer Networks and various protocols.
- Analysis of different types of network topologies, error and flow control mechanisms
- Describe the functions of Network Layer i.e. Logical addressing, subnetting & Routing Mechanism
- Compare various congestion control mechanisms and identify suitable Transport layer protocol for real time applications
- Demonstrate knowledge of protocols used in Application layer.

- Design and Implement various Network protocols and performance analysis

Course Code	CST616030
Course Name	Advanced Database System
Credit	3
Pre-Requisites	Database Management, Network Security, OOPS concept.
Total Number of Lectures	45

COURSE OBJECTIVE

The objective of course is to provide insight to distributed database, normalization techniques and integrity rules. It also includes parallel database systems along with object oriented

SYLLABUS

Unit 1

Processing: Various Operations such as Join, Selection, sorting, expression evaluation, etc

Concurrency Control Mechanism: Protocols, Multiple Granularity, Multi-version schemes, Deadlock handling,

Unit 2

Recovery: Recovery and atomicity, various techniques, buffer management, Advanced Recovery Techniques;

Unit 3

Database Security: Authentication, Various Access Control Mechanisms, etc

Unit 4

Client-Server Approach; Distributed Databases; Object Oriented Database; Object Relational Databases; Spatial Databases, Multimedia Databases

COURSE OUTCOMES

After completion of course, students would be:

- Abe to understand relational database management systems, normalization to make efficient retrieval from database and query

References

References:

1. Silberschatz and Korth, Database system concepts, McGraw Hill.
2. Elmasri and Navathe, Fundamentals of database systems; Narosa Publishing Co.
3. John G Hughes, Object Oriented Databases; Prentice Hall Int nl Series in Computer Science
4. Andleigh and Thakrar, Multimedia Systems Design, Prentice Hall PTR
5. R Raghurama krishnan & J Gehrke, Database Management System
6. Alhir, UML: In A Nutshell, O Reilly.

7. Özsu, M. Tamer, and Patrick Valduriez. Principles of distributed database systems. Springer Science & Business Media, 2011.

Course Code	CST616040
Course Name	Data Warehousing and Mining
Credit	3
Pre-Requisites	
Total Number of Lectures	45

COURSE OBJECTIVE

- The objective of this course is to introduce data warehousing and mining techniques. Application of data mining in web mining, pattern matching and cluster analysis is included to aware students of broad data mining areas.

SYLLABUS

Unit 1

Introduction to Data Warehousing; Data Mining: Mining frequent patterns, association and correlations; Sequential Pattern Mining concepts, primitives, scalable methods;

Unit 2

Classification and prediction; Cluster Analysis , Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis;

Unit 3

Mining Data Streams, Methodologies for stream data processing and stream data systems,

Unit 4

Web Mining, Distributed Data Mining; Recent trends in Distributed Warehousing and Data Mining,

COURSE OUTCOMES

After completion of course, students would be:

- Study of different sequential pattern algorithms.
- Study the technique to extract patterns from time series data and it application in real world.
- Can extend the Graph mining algorithms to Web mining.
- Help in identifying the computing framework for Big Data

References

1. Thuraisingham, Bhavani. *Data mining: technologies, techniques, tools, and trends*. CRC press, 2014.
2. Aggarwal, Charu C. *Data mining: the textbook*. Springer, 2015.
3. Fayyad, Usama M., et al. "Advances in knowledge discovery and data mining." (1996).
4. Berson, Alex, and Stephen J. Smith. *Data warehousing, data mining, and OLAP*. McGraw-Hill, Inc., 1997.

Course Code	CST616050
Course Name	Data Security
Credit	3
Pre-Requisites	Computer Communication and Network
Total Number of Lectures	45

COURSE OBJECTIVE

To teach the students:

- Lossless and Lossy compression techniques for different types of data.
- Understand data encryption techniques Network security and ethical hacking.

SYLLABUS

Unit 1

Introduction to Data Compression Data Compression; Modeling and Coding, Statistical Modeling, Dictionary Schemes.

Unit 2

Image Compression; Video and Audio Compression, Analog Video, Digital Video, Digital Audio. Data Security Goals, Cryptographic Attacks.

Unit 3

Number Theory and Asymmetric Key Cryptography, Fermat's and Euler's Theorem, Discrete Logarithms Principles of Public Key Cryptosystem, Message Authentication and Hash Functions, Digital Signature Standards.

Unit 4

Network Security Email, PGP, S/MIME, Intrusion Detection System Web Security Considerations, SSL Architecture, SSL Message Formats, TLS, Secure Electronic Transactions Kerberos.

COURSE OUTCOMES

Student will able to :

- Implement text, audio and video compression techniques.
- Understand symmetric and asymmetric key cryptography schemes.
- Understand network security and ethical hacking.

References

1. Khalid Sayood, ― Introduction to Data Compression‖ ,Morgan Kaufmann, 2000
2. David Salomon, ―Data Compression: The complete reference‖ , Springer publication
3. Behrouz Forouzan, ―Cryptography and Network Security‖, Tata Mc Graw –Hill Education 2011
4. Berard Menezes, ―Network Security and Cryptography‖, learning publication Cengage
5. William Stallings, ―Cryptography and Network Security‖, Pearson Education Asia Publication, 5th edition

Course Code	CST616060
Course Name	Network Security
Credit	3
Pre-Requisites	
Total Number of Lectures	45

COURSE OBJECTIVE

- To learn the basics of security and various types of security issues.
- To study different cryptography techniques available and various security attacks.
- Explore network security and how they are implemented in real world.
- The concept of security, types of attack experienced, encryption and authentication for deal with attacks, what is data compression, need and techniques of data compression.

SYLLABUS

Unit 1

Network Security, Attacks on network security. Encryption algorithms, The Data Encryption Standard.

Unit 2

Introduction to Number Theory: Divisibility theory in integers; Modular Arithmetic: exponentiation and inversion. Fermat's Little Theorem, Euler's Theorem. Solution to congruence.

Unit 3

Asymmetric cryptography: Public Key Encryption, The RSA algorithm; Message Authentication: Authentication Requirements, Authentication Functions, Digital Signatures and Authentication Protocols.

Unit 4

Network security: Electronic Mail Security-PGP and S/MIME, IP Security, IP security Overview, IP Security Architecture, Authentication Header (AH), Encapsulating Security Payload (ESP), Firewalls.

COURSE OUTCOMES

- To have an understanding of basics of security and issues related to it.
- Learn mechanisms for transport and network security.

References

1. William Stallings, Cryptography and Network Security, Principles and Practice, Pearson.
2. A. S. Tanenbaum, Computer Networks, Prentice Hall.
3. D. Stinson, Cryptography, Theory and Practice, CRC Press.
4. Atul Kahate, Cryptography and Network Security, McGraw Hill

Course Code	CST616070
Course Name	Ethical Hacking and Cyber Crime
Credit	3
Pre-Requisites	
Total Number of Lectures	45

COURSE OBJECTIVE

- This module introduces the concepts of Ethical Hacking.

- It gives the students the opportunity to learn about different tools and techniques in Ethical hacking and security and practically apply some of the tools.

SYLLABUS

Unit 1

Ethical Hacking: Introduction to ethical hacking; Network hacking; Web hacking; password hacking; Viruses, Worms, Trojan Horse, Bombs, Trapdoors, Spoofs, Keyloggers and Spyware;

Unit 2

Risk Analysis and Ethical Hacking: Risk Analysis and Ethical Hacking; Preparing for a Hack: Technical Preparation, Managing the Engagement.

Unit 3

Cyber Crime: Introduction to Cyber Crime, Cyber Crimes against Individuals, Institution and State; Digital Forgery.

Unit 4

Types of Cyber Crime: Cyber Stalking/Harassment, Cyber Pornography, Identity Theft & Fraud, Cyber Terrorism, Cyber Defamation, cyber espionage, cyber warfare.

COURSE OUTCOMES

A student passing this module should be able to:

- Identify and analyze the stages an ethical hacker requires to take in order to compromise a target system.
- Identify tools and techniques to carry out a penetration testing.
- Critically evaluate security techniques used to protect system and user data.
- Demonstrate systematic understanding of the concepts of security at the level of policy and strategy in a computer system.

References

1. Engebretson, Patrick. The basics of hacking and penetration testing: ethical hacking and Penetration testing made easy. Elsevier, 2013.
2. Wall, David. Cybercrime: The transformation of crime in the information age. Vol. 4.Polity, 2007.
3. Clough, Jonathan, and Albert Einstein. "Principles of Cybercrime."

Course Code	CST616080
Course Name	Block Chain Technology
Credit	3
Pre-Requisites	
Total Number of Lectures	45

COURSE OBJECTIVE

- Familiarize the functional/operational aspects of crypto currency ECOSYSTEM.
- Understand emerging abstract models for Blockchain Technology.
- Identify major research challenges and technical gaps existing between theory and practice in crypto currency domain

SYLLABUS

UNIT 1 - The consensus problem - Asynchronous Byzantine Agreement - AAP protocol and its analysis - Nakamoto Consensus on permission-less, nameless, peer-to-peer network - Abstract Models for BLOCKCHAIN - GARAY model - RLA Model - Proof of Work (PoW) as random oracle - formal treatment of consistency, liveness and fairness - Proof of Stake (PoS) based Chains - Hybrid models (PoW + PoS) .

UNIT 2 - cryptographic basics for cryptocurrency - a short overview of Hashing, signature schemes, encryption schemes and elliptic curve cryptography

UNIT 3 - Bitcoin - Wallet - Blocks - Merkley Tree - hardness of mining - transaction verifiability - anonymity - forks - double spending - mathematical analysis of properties of Bitcoin.

UNIT 4 - Ethereum - Ethereum Virtual Machine (EVM) - Wallets for Ethereum - Solidity - Smart Contracts - some attacks on smart contracts.

UNIT 5 - (Trends and Topics) - Zero Knowledge proofs and protocols in Blockchain - Succinct non interactive argument for Knowledge (SNARK) - pairing on Elliptic curves - Zcash.

References

1. Joseph Bonneau et al, SoK: Research perspectives and challenges for Bitcoin and cryptocurrency, IEEE Symposium on security and Privacy, 2015 (article available for free download) { curtain raiser kind of generic article, written by seasoned experts and pioneers}.
2. J.A.Garay et al, The bitcoin backbone protocol - analysis and applications EUROCRYPT 2015 LNCS VOl 9057, (VOLII), pp 281-310. (Also available at eprint.iacr.org/2016/1048) . (serious beginning of discussions related to formal models for bitcoin protocols).
3. R.Pass et al, Analysis of Blockchain protocol in Asynchronous networks , EUROCRYPT 2017, (eprint.iacr.org/2016/454) . A significant progress and consolidation of several principles).
4. R.Pass et al, Fruitchain, a fair blockchain, PODC 2017 (eprint.iacr.org/2016/916).

COURSE OUTCOMES

- To understand the basics of Block chain technologies.
- To understand aspects of crypto currency and Virtual Machine.

Second Semester
(Elective Courses/Papers)

Course Code	CST626010
Course Name	Knowledge Representation & Reasoning
Credit	4
Pre-Requisites	Introduction to intelligent computing
Total Number of Lectures	45

COURSE OBJECTIVE

The course introduces the principles of logic-based knowledge representation and reasoning, as well as other important symbolic approaches to representing and reasoning about knowledge

such as production systems, frames, taxonomies and Kripke models. How to represent different sorts of knowledge, such as uncertain or incomplete knowledge, knowledge about action and change, and knowledge about default situations, is discussed. Various types of reasoning are discussed, such as logical entailment, explanation and planning.

SYLLABUS

Unit 1

Introduction. Propositional Logic Language, First Order Logic (FOL) ,Representation in FOL, Solemnization

Unit 2

Programming in Logic Deductive Retrieval in Backward Chaining, Logic Programming, Prolog. Theorem Proving in FOL Incompleteness of Forward and Backward Chaining, The Resolution Refutation Method for FOL. Knowledge Structures Semantic Nets.

Unit 3

Ontology and Description Logics. Inheritance Taxonomies and Inheritance. Default Reasoning Introduction to Default Reasoning, Circumscription, The Event Calculus Revisited, Default Logic, Auto epistemic Logic.

Unit 4

Reasoning in Multi-agent Systems Epistemic Logic: Kripke Semantics in a Multi Agent Scenario.

COURSE OUTCOMES

A student who has completed the course should have the following learning outcomes. The candidate

- has theoretical knowledge about principles for logic-based representation and reasoning.
- has a basic understanding of production systems, frames, inheritance systems and approaches to handling uncertain or incomplete knowledge.
- has a basic understanding of principles for reasoning with respect to explanation and planning.
- has a broad understanding of how knowledge based systems work which provides a solid foundation for further studies and for assessing when knowledge based approaches to problem solving are appropriate.

References

1. Ronald J. Brachman, Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.
2. Schank, Roger C., Robert P. Abelson: Scripts, Plans, Goals, and Understanding: An Inquiry into Human Knowledge Structures. Hillsdale, NJ: Lawrence Erlbaum, 1977.
3. R. C. Schank and C. K. Riesbeck: Inside Computer Understanding: Five ProgramsP lus Miniatures, Lawrence Erlbaum, 1981.

Course Code	CST626021
Course Name	Natural Language Processing
Credit	3

Pre-Requisites	
Total Number of Lectures	45

COURSE OBJECTIVE

- Introduction of the fundamental concepts of natural language, natural language understanding and generation
- Understanding of the computational properties of natural language and language modeling applications

SYLLABUS

Unit 1: Language

Historical linguistics: symbolic, statistical and neural, Number system and evolution of language, Specification and description language, Unified modeling language, Understanding and generation in natural language processing

Unit 2: Morphology

Word formation and aphorism, stems, roots, prefixes, suffixes, parts of speech, intonation, stress, Morphological typology, Lexicology

Unit 3: NLP Problems

Basic NLP problems, Computational Morphology: Lemmatization, Morphological segmentation, parts of speech tagging, stemming; Syntactic analysis, Lexical semantics, Discourse

Unit 4: Language Modeling

Regular expression, Formal language theory, Language Modeling, N-gram language Model, Machine translation, Information extraction, Chatbot and dialogue system, Phonetics

COURSE OUTCOMES

By the end of the course, students should have a broad understanding of

- Broader understanding of the field of natural language processing
- Exploration of the hard problems in natural language processing
- Tools and techniques in NLP Applications
- Wider knowledge of the language modeling techniques

References

1. Daniel Jurafsky and James H Martin. Speech and Language Processing, 2e, Pearson Education, 2009
2. Bharati A., Sangal R., Chaitanya V.. Natural language processing: A Paninian perspective, PHI, 2000
3. Collobert, Ronan, et al. "Natural language processing (almost from scratch." Journal of machine learning research12.Aug(2011): 2493-2537
4. Manning, Christopher D., and Hinrich Schutze.. Foundations of Statistical natural language processing. MIT press, 1999

Course Code	CST626030
Course Name	Computer Vision and Pattern Recognition
Credit	3
Pre-Requisites	Linear algebra, vector calculus, Data structures and Programming.
Total Number of Lectures	45

COURSE OBJECTIVE

- Be familiar with both the theoretical and practical aspects of computing with images.

- Have described the foundation of image formation, measurement, and analysis.
- Understand the geometric relationships between 2D images and the 3D world.
- Grasp the principles of state-of-the-art deep neural networks.

SYLLABUS

Unit 1

Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and Binary image analysis.

Unit 2

Edge detection, Edge detection performance, Hough transform, corner detection. Segmentation, Morphological filtering, Fourier transforms.

Unit 3

Feature extraction, shape, histogram, color, spectral, texture, using CVIP tools, Feature analysis, feature vectors, distance /similarity measures, data pre-processing.

Unit 4

Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA,ICA, and Non-parametric methods.

COURSE OUTCOMES

After completion of course, students would be able to:

- Developed the practical skills necessary to build computer vision applications.
- To have gained exposure to object and scene recognition and categorization from images.

References

1. Computer Vision: Algorithms and Applications by Richard Szeliski .
2. Deep Learning, by Goodfellow, Bengio, and Courville.
3. Dictionary of Computer Vision and Image Processing, by Fisher et al.
4. Chen, Chi-hau. Handbook of pattern recognition and computer vision. World Scientific, 2015.

Course Code	CST626050
Course Name	Information Theory and Coding
Credit	3
Pre-Requisites	
Total Number of Lectures	45

COURSE OBJECTIVE

The objective of this course is to provide an insight to information coding techniques, error correction mechanism. Various compression techniques for text, video and image are covered for thorough knowledge of efficient information conveying systems.

SYLLABUS

Unit 1

Information and entropy information measures, Shannon's concept of Information. Channel coding. Theorem for discrete memory less channel, information capacity theorem, Error detecting and error correcting codes.

Unit 2

Types of codes, block codes, Hamming and Lee metrics, description of linear block codes, parity check Codes, cyclic code, Masking techniques.

Unit 3

Compression: lossless and lossy, Huffman codes, Binary Image compression schemes, run length encoding.

Unit 4

Convolutional codes, sequential decoding. Video image Compression: audio (speech) Compression. Cryptography and cipher.

COURSE OUTCOMES

After completion of course, students would be:

- The aim of this course is to introduce the principles and applications of information theory.
- The course will study how information is measured in terms of probability and entropy.
- The students learn coding schemes, including error correcting codes, The Fourier perspective; and extensions to wavelets, complexity, compression, and efficient coding of audio-visual information.

References

1. Fundamentals in information theory and coding, Monica Borda, Springer.
2. Communication Systems: Analog and digital, Singh and Sapre, Tata McGraw Hill.
3. Multimedia Communications Fred Hassall.

Course Code	CST626060
Course Name	Digital Forensics and Biometrics
Credit	3
Pre-Requisites	
Total Number of Lectures	45

COURSE OBJECTIVE

- Provides an in-depth study of the rapidly changing and fascinating field of computer forensics.
- Combines both the technical expertise and the knowledge required to investigate, detect and prevent digital crimes.
- Knowledge on digital forensics legislations, digital crime, forensics processes and procedures, data acquisition and validation, e-discovery tools.
- E-evidence collection and preservation, investigating operating systems and file systems, network forensics, art of steganography and mobile device forensics

SYLLABUS

Unit 1

Digital Forensics Science: Forensics science, computer forensics, and digital forensics. Holistic approach to cyber-forensics.

Unit 2

Cyber Crime Scene Analysis, methods to search and seizure electronic evidence, retrieved and un-retrieved communications. Evidence Management & Presentation. Computer Forensics. Network Forensics. Mobile Forensics.

Unit 3

Introduction and Definitions of biometrics, Traditional authenticated methods and technologies. Biometric technologies: Fingerprint, Face, Iris, Hand Geometry, Gait Recognition, Ear, Voice, Palm print, On-Line Signature Verification, 3D Face Recognition, Dental Identification and DNA.

Unit 4

Bio-metric Transaction. Bio-metric System Vulnerabilities.

COURSE OUTCOMES

After completion of course, students would be able to:

- Understand relevant legislation and codes of ethics.
- Computer forensics and digital detective and various processes, policies and procedures.
- E-discovery, guidelines and standards, E-evidence, tools and environment..
- Email and web forensics and network forensics.

References

1. John Sammons, The Basics of Digital Forensics, Elsevier.
2. John Vacca, Computer Forensics: Computer Crime Scene Investigation, Laxmi Publications
3. Biometrics for network security, Paul Reid, Hand book of Pearson
4. D. Maltoni, D. Maio, A. K. Jain, and S. Prabhakar, Handbook of Fingerprint Recognition,Springer Verlag, 2003.

Course Code	CST626071
Course Name	Mobile Computing
Credit	3
Pre-Requisites	
Total Number of Lectures	45

COURSE OBJECTIVE

- To study the specifications and functionalities of various protocols/standard of mobile networks, technologies and their basic operations.
- To study about advanced wireless network, LTE, 4G and Evolutions from LTE to LTEA.
- To study about wireless protocols, Mobility Management and Wireless Security and how they are implemented in real world.
- The students should get familiar with the wireless/mobile market and the future need and challenges.

SYLLABUS

Unit 1 Introduction and Wireless MAC

Basic Concepts, Principles of Cellular Communication, Motivation for IP Based Wireess Networks, GSM: Mobile Services, System Architecture, Radio Interface, Protocols, Localization and calling, Handover, Bluetooth Technologies, Motivation for Specialized MAC, SDMA, FDMA, TDMA, CDMA

Unit 2 Mobile Network Layer & Transport Layer

Mobile IP : Goals, assumptions, ,entities and terminology, IP Packet delivery, agent advertisement and discovery, registration, tunneling and encapsulation, optimization, DHCP, Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission/time-out freezing, Selective Retransmission, Database Issues: Hoarding techniques, cache invalidation mechanisms, client server computing with adaptation, power-aware and context aware computing, transactional models, query processing, quality of service issues.

Unit 3 Data Dissemination

Data Dissemination and Management, Mobile cache maintenance schemes, Mobile Web Caching; Middleware application development, Service Discovery Middleware, Wireless Application Protocol-WAP, Mobile Ad-hoc Networks (MANETs), MAC Issues, Routing Protocols

Unit 4 Wireless Network Security

Security in Wireless Network, Wi-Fi Security, DoS in Wireless Communication, Issues and Challenges in Security Provisioning, Network Security Attacks, Layer wise attacks in wireless networks, possible solutions for jamming, tampering, black hole attack, flooding attack. Key Distribution and Management, Secure Routing

References

1. Richard Wheeler, Mobility: Processes, Computers and Agents, Pearson
2. Charles Perkins et.al.,Mobile IP: Design Principles and Practices, Pearson
3. Tomasz Imielinski, Mobile Computing, Springer Verlag
4. Ayman ElNashar, Mohamed El-saidny, Mahmoud Sherif., Design, Deployment and Performance of 4G-LTE Networks: A Practical Approach", John Wiley & Sons, 2014.
5. W. Stallings, Wireless Communications and Networks, 2nd edition, Pearson Education, 2013
6. Dharma Prakash Agrawal and Qing-An Zeng, Introduction to Wireless and Mobile Systems, 3rd edition, Tomson, 2011
7. Theodore S. Rappaport, Wireless Communications -Principles Practice,2nd edition, Prentice Hall of India, New Delhi, 2010.
8. Jochen Schiller, Mobile Communications, Pearson Education, Second Edition 2002.
9. C.K.Toh, Adhoc Mobile Wireless Networks: Protocols and Systems, Pearson, 2002.

COURSE OUTCOMES

After completion of course, students would be able to:

- Demonstrate advanced knowledge of networking and wireless networking and understand various types of wireless networks, standards, design, operation and use cases.
- Learn the latest 4G networks and LTE
- Understand about the wireless network architecture and protocols.
- Understand about the mobility management and cellular network.
- Learn the security concepts of wireless networks and also the recent trends
- Demonstrate knowledge of protocols used in wireless networks and learn simulating wireless networks.

Course Code	CST626080
Course Name	Web Search and Information Retrieval
Credit	3
Pre-Requisites	Probability Theory, Database Management, Web Programming
Total Number of Lectures	45

COURSE OBJECTIVE

The objective of the course is to introduce information retrieval models and query languages. Application of web search and information retrieval in social networks is also included.

SYLLABUS

Unit 1

Information retrieval model, Information retrieval evaluation, Searching the Web

Unit 2

Document Representation, Query languages and query operation, Metadata search

Indexing and searching, Scoring and ranking feature vectors

Unit 3

Ontology, domain specific search, parallel and distributed information retrieval

Text and multimedia languages, Social networks.

Unit 4

Recent trends in Web search and Information retrieval techniques.

COURSE OUTCOMES

After completion of course, students would be:

- To identify basic theories and analysis tools as they apply to information retrieval.
- To develop understanding of problems and potentials of current IR systems.
- To learn and appreciate different retrieval algorithms and systems.

- To apply various indexing, matching, organizing, and evaluating methods to IR problem. To become aware of current experimental and theoretical IR research.

References

1. C. D. Manning, P. Raghavan and H. Schütze, Introduction to Information Retrieval, Cambridge University Press, 2008
2. Chakrabarti, S. (2002). Mining the web: Mining the Web: Discovering knowledge from hypertext data. Morgan-kaufman.
3. B. Croft, D. Metzler, T. Strohman, Search Engines: Information Retrieval in Practice, Addison- Wesley, 2009
4. R. Baeza-Yates, B. Ribeiro-Neto, Modern Information Retrieval, Addison-Wesley, 2011 (2nd Edition).

Course Code	CST626090
Course Name	Quantum Computing
Credit	3
Pre-Requisites	Basic probability theory, Basic Linear Algebra, Trigonometry and complex number , Python
Total Number of Lectures	45

COURSE OBJECTIVE

- Introduction of the fundamental Concepts of Quantum Models of Computing
- Understanding of basic quantum algorithms and their analysis
- Understand of basic quantum protocols such as teleportation and superdense coding

SYLLABUS

Unit 1 Overview of Classical Computing

Classical Computer Hardware, Digital Logic and Operations, Classical Logic Gates, Constructing Classical Circuits, Algorithms Complexity

Primary Concepts of Quantum Mechanics, Interference and Wave particles Duality, Young's Double Slit Experiment, Wavefunctions and Hamiltonians, Schrodinger Equation, Stern Gerlach Experiment, Measurement and Entanglements, Populates of Quantum Mechanics

Unit 2 Introduction to Quantum Computing

Introduction Quantum Bits-Single Qubits, The Bra-Ket Notation, Mathematics behind Single Qubits, Visualization of Single Qubits-The Bloch Sphere, Computational Basis or Z Basis, Diagonal Basics or X Basis, Circular Basis or Y Basis, Change of Basis, Mathematics behind the Bloch Sphere

Unit 3 Single & Multiple Qubit Quantum Logic Gates

: Pauli I Gates- Identity Gate, Pauli X Gate- X Gate, Pauli Y Gate-Y Gate, Pauli Z Gate – Z Gate, Hadamard Gate- H Gate, S and S-Dagger Gates, T and T-Dagger Gates, Rotation Gates, Universal Gates, Multiple Qubits and Multi Qubit Quantum Logic Gates : Phenomena of Entanglement, CX/CNOT Gate, CZ and CY Gates, Controlled Rotation Gates, SWAP Gate, Toffoli/CCNOT Gate, Fredkin/CSWAP Gate, Hadamard Gate Applied to n Qubits, Constructing Classical Gates using Quantum Gates : AND, OR and NOT gates, XOR and NAND Gates, Half Adder Circuits using Quantum Gates, Full adder circuit using Quantum Gates

Unit 4 Quantum Algorithms

Quantum Teleportation and Superdense Coding , Quantum Algorithm: Deutsch-Jozsa Algorithm, Bernstein-Vazirani Algorithm, Simon's Algorithm, Quantum Fourier transform Algorithm, Shor Algorithm, Grover's Search Algorithm, Applications of Quantum Computing: Solving Liners of Equations with HHL, Porfolio Optimization, Quantum Machine Learning

References

1) Nielsen, Michael A., and Issac L. Chuang, Quantum Computation and Quantum Information, Cambridge, UK: Cambridge University Press, September 2000, ISBN: 9780521635035
2) Peres, Asher, Quantum Theory: Concepts and Methods. New York, NY: Springer, 1993, ISBN: 9780792325499
3) Benenti G., Casati G and Strini G., Principles of Quantum Computation and Information, Vol. I: Basis Concepts, Vol II: Basic Tools and Special Topics, World Scientific, 2004
4) Pittenger A.O., An Introduction to Quantum Computing Algorithms, 2000
5) Noson S. Yanofsky and Mirco A. Mannucci, Quantum Computing for Computer Scientists, 2008.
6) 2 Abraham Asfaw et al, Learn Quantum Computation using Qiskit, http:// qiskit.org/textbook, 2020.
7) 3 Rishwi Thimmaraju and Harika Vajha. Beyond Classical: A crash course on Quantum Computing using Qiskit and IBM, 2020.
8) Kaye P., Laflamme R., Mosca M. (2007). An Introduction to Quantum Computing. Oxford University Press
9) Nielsen M.A., Chuang I.L. (2010). Quantum Computation and Quantum Information. *Cambridge University Press.*
10) Mermin N.D. (2007). Quantum Computer Science*: An Introduction*. Cambridge University Press.
11) Hirvensalo M. (2001). Quantum Computing. Springer.

COURSE OUTCOMES

After completion of course, students would be able to:

- Be familiar with subset of linear algebra to express quantum concepts.
- Define concepts in quantum theory and be able to elicit the consequences of different quantum scenarios.
- Interpret and analyse simple quantum circuits and identify fault-tolerant quantum devices.

- write code in Qiskit to implement quantum algorithms
- To understand the applications of Quantum Computing.

Course Code	CST626100
Course Name	Big Data Analytics
Credit	3
Pre-Requisites	
Total Number of Lectures	45

COURSE OBJECTIVE

- To understand the needs of Big Data, challenges and their solutions
- To understand the Installation process of Hadoop Architecture and its eco systems
- Analyzing basic file modes and operations
- Able to construct real world application with data storage and retrieval
- To Understand way to handle large datasets in main memory

SYLLABUS

Unit-1

Data Storage and Analysis - Characteristics of Big Data – Big Data Analytics - Typical Analytical Architecture – Requirement for new analytical architecture – Challenges in Big Data Analytics – Need of big data frameworks

Unit-2

Hadoop – Requirement of Hadoop Framework, HDFS (Hadoop Distributed File System)**,** HDFS Architecture: Name Node, Secondary Name Node, Data Node, Data storage in HDFS, HDFS Block Size, HDFS Commands, Configuration of Hadoop Cluster

MapReduce: Map Reduce architecture, Job Tracker, Task Tracker, Data Types in hadoop, Mapper, Reducer, Combiner, Partitioner, Distributed Cache, Counters, Joins, Compression Technique, Map Reduce Schedulers, Map Reduce programming model, Debuggind Map reduce jobs, YARN (Next Generation Map Reduce), Data locality, Speculative execution

Unit-3

Introduction to Hadoop ecosystem technologies: Serialization: AVRO, Co-ordination: Zookeeper, Databases: HBase, Hive, Scripting language: Pig, Streaming: Flink, Storm

Introduction to GPU Computing, CUDA Programming Model, CUDA API, Simple Matrix, Multiplication in CUDA, CUDA Memory Model, Shared Memory Matrix Multiplication, Additional CUDA API Features.

Unit-4

Advanced and new technologies architecture discussions: Spark, Storm (Real time data streaming), Cassandra (NOSQL database), Mongo DB (NOSQL database), Scala, Cloudera, Hortonworks, mapR, Amazon EMR (Distributions)

References

1. Tom White,"Hadoop: The Definitive Guide", O' Reilly, 4th Edition, 2015.
2. Mohammed Guller, Big Data Analytics with Spark, Apress, 2015
3. Donald Miner, Adam Shook, "Map Reduce Design Pattern", O'Reilly, 2012
4. Chuck Lam, "Hadoop in Action", Manning Publications, 2010.
5. Seema Acharya, Subhashini Chellapan, "Big Data and Analytics", Wiley, 2015

COURSE OUTCOMES

After completion of course, students would be able to:

- Analyse the Big Data using Map-reduce programming in Both Hadoop and Spark framework.
- Develop Big Data solution using Hadoop Framework and its eco systems.
- Develop and implement different frame work tools by taking sample data sets.
- Develop efficient algorithm to analyse live streaming data using Spark
- Develop efficient algorithms for mining the data from high volumes.