Proposal for Post Graduate Course

M. Tech. (Computer Science and Technology)

(w.e.f. Session July 2019/20)

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	CST611020	Advanced Data Structures	3	0	0	3
3	CST611030	Introduction to Intelligent Computing	3	0	0	3
4	CST6160xx	Elective - I				3
5	ST6160xx	Elective - II				3
6	CST612040	Advanced Data Structures Lab	0	0	4	2
					Total	18

M. Tech.(CST): **Second Semester**						
Sl.No.	**Code**	**Course Name**	**L**	**T**	**P**	**Total Credit**
1	CST621010	Advanced Algorithm	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	CST622040	Advanced Algorithm Lab	0	0	4	2
7	CST623030	Seminar				1
8.	CST623050	Academic Ethics and Research Writing	2	0	0	2
					Total	20

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

M. Tech.(CST): **Third Semester**						
Sl.No.	**Code**	**Course Name**	**L**	**T**	**P**	**Total Credit**
1	CST717020	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	CST616020	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 Encryption and Compression	3	0	0	3
6	CST616060	Network Security and Cryptography	3	0	0	3
7	CST616070	Ethical Hacking and Cyber Crime	3	0	0	3
Second Semester						
S. No	**Code**	**Course**	**L**	**T**	**P**	**Total**
1	CST626010	Knowledge Representation & Reasoning	3	0	0	3
2	CST626020	Natural Language Processing	3	0	0	3
3	CST626030	Computer Vision and pattern recognition	3	0	0	3
4	CST626040	Machine Learning	3	0	0	3
5	CST626050	Information Theory and Coding	3	0	0	3
6	CST626060	Digital Forensics and Biometrics	3	0	0	3
7	CST626070	Mobile Computing	3	0	0	3
8	CST626080	Web Search and Information Retrieval	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	
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

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

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.

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.

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	
Course Name	Advanced Data Structures
Credit	3
Pre-Requisites	UG level course in Data Structures
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.
- Students should be able to understand the necessary mathematical abstraction to solve problems.
- To familiarize students with advanced paradigms and data structure used to solve algorithmic problems.
- Student should be able to come up with analysis of efficiency and proofs of correctness.

SYLLABUS

Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries

Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.

Skip Lists and Trees.

Text Processing and Computational Geometry : string operation, tries, Range searching, Priority search tree.

Recent Trends in Hashing, Trees, and various computational geometry methods for efficiently solving the new evolving problem.

References

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.
2. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.
3. Brass, Peter. *Advanced data structures*. Vol. 193. Cambridge: Cambridge University Press, 2008.
4. Feldman, Ronen, and James Sanger. *The text mining handbook: advanced approaches in analyzing unstructured data*. Cambridge university press, 2007.

COURSE OUTCOMES

- Understand the implementation of symbol table using hashing techniques.
- Develop and analyze algorithms for red-black trees, B-trees and Splay trees.
- Develop algorithms for text processing applications.
- Identify suitable data structures and develop algorithms for computational geometry problems.

Course Code	
Course Name	Introduction to Intelligent Computing
Credit	3
Pre-Requisites	
Total Number of Lectures	45

COURSE OBJECTIVE

The aim of the course is to introduce to the field of Artificial Intelligence (AI) with emphasis on its use to solve real world problems for which solutions are difficult to express using the traditional algorithmic approach. It explores the essential theory behind methodologies for developing systems that demonstrate intelligent behaviour including dealing with uncertainty, learning from experience and following problem solving strategies found in nature.

SYLLABUS

Biological foundations to intelligent systems: Artificial neural networks, Back-propagation networks, Radial basis function networks, and recurrent networks

Introduction to Fuzzy set and fuzzy logic, knowledge Representation and inference mechanism, genetic algorithm, and fuzzy neural networks.

Search Methods Basic concepts of graph and tree search. Search methods: breadth-first search, depth-first search, iterative deepening search.

Heuristic search methods: best-first search, admissible evaluation functions, hill-climbing search. Optimization and search such as stochastic annealing and genetic algorithm.

Knowledge representation and reasoning. Reasoning under uncertainty

References

1. Luger G.F. and Stubblefield W.A. (2008). Artificial Intelligence: Structures and strategies for Complex Problem Solving. Addison Wesley, 6th edition.
2. Russell S. and Norvig P. (2009). Artificial Intelligence: A Modern Approach. Prentice-Hall, 3r dedition
3. Khemani, Deepak. *A first course in artificial intelligence*. McGraw-Hill Education, 2013.
4. Rich, Elaine, and Kevin Knight. "Artificial intelligence." *McGraw-Hill, New* (1991).

COURSE OUTCOMES

- After completion of course, students would be able to Demonstrate knowledge of the fundamental principles of intelligent systems and would be able to analyse and compare the relative merits of a variety of AI problem solving techniques

First Semester (Practical / Lab)

Course Code	
Course Name	**Advanced Data Structures Lab**
Credit	2
Pre-Requisites	Basic programming skills
Suggested List of laboratory exercises	Program on BST and Threaded Trees, AVL Trees, B-Trees, Min-Max Heaps, Binomial Heaps and Fibonacci Heaps, Disjoint Sets, Graphs Algorithms, String Matching, Priority search tree.

Second Semester (Core Courses/Papers)

Course Code	
Course Name	Advanced Algorithms
Credit	3
Pre-Requisites	UG level course in Algorithm Design and Analysis
Total Number of Lectures	45

COURSE OBJECTIVE

- 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.
- To familiarize students with basic paradigms and data structures used to solve advanced algorithmic problems.
- Students should be able to understand different classes of problems concerning their computation difficulties.
- To introduce the students to recent developments in the area of algorithmic design.

SYLLABUS

Sorting: Review of various sorting algorithms, topological sorting; Definitions and Elementary Algorithms of Graph.

Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set, Graph Matching.

Flow-Networks: Maxflow-mincut theorem, Matrix Computations, LUP-decomposition.
shortest Path in Graphs: Introduction to dynamic programming paradigm,Modulo Representation of integers/polynomials; Chinese Remainder Theorem.

Linear Programming: Geometry of the feasibility region and Simplex algorithm;
NP-completeness, proof of NP-hardness and NP-completeness.

References

1. Introduction to Algorithms by Cormen, Leiserson, Rivest, Stein.
2. The Design and Analysis of Computer Algorithms by Aho, Hopcroft, Ullman.
3. Algorithm Design by Kleinberg and Tardos.
4. Skiena, Steven S. The algorithm design manual: Text. Vol. 1. Springer Science & Business Media, 1998.

COURSE OUTCOMES

After completion of course, students would be able to:

- Analyze the complexity/performance of different algorithms.
- Determine the appropriate data structure for solving a particular set of problems.
- 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	
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

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

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.

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

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.

Second Semester (Practical / Lab)

Course Code	
Course Name	**Advanced Algorithm Lab**
Credit	2
Pre-Requisites	Basic programming skills
List of suggested Laboratory exercises	Program and analysis of sorting algorithm, Graph algorithms, greedy algorithms, Matrix multiplication, Shortest path, Dynamic programming and linear programming algorithms.

Third Semester (Core Courses/Papers)

Course Code	
Course Name	Academic Ethics and Research Writing
Credit	3
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

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

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

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

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.

First Semester
(Elective Courses/Papers)

Course Code	
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

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

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

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.

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

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

COURSE OBJECTIVE

- Provide an in depth study of different protocols .
- To get familiar with key concepts of wireless networks, standards, technologies and their basic operations.
- The students should get familiar with the wireless/mobile market and the future needs and challenges.
- Explore network security and how they are implemented in real world.
- Deployments of nodes and link with packet analysis using different software's and tool.
- To learn how to evaluate MAC and network protocols using network simulation software tools.

SYLLABUS

INTRODUCTION: Wireless Networking Trends, Key Wireless Physical Layer Concepts;

Multiple Access Technologies -CDMA, FDMA, TDMA, Spread Spectrum technologies, Frequency reuse, Radio Propagation and Modeling, Challenges in Mobile Computing.

WIRELESS LOCAL AREA NETWORKS: Architecture & protocols.
WIRELESS CELLULAR NETWORKS: Architecture
Spread spectrum Technologies; WIRELESS SENSOR NETWORKS;

SECURITY Security in wireless Networks Vulnerabilities, Security techniques, Wi-Fi Security, DoS in wireless communication.

COURSE OUTCOMES

After completion of course, students would be able to:

- To have an understanding of Node, links and its deployment.
- Demonstrate advanced knowledge of networking and wireless networking and understand various types of wireless networks, standards, operations and use cases.
- Demonstrate knowledge of protocols used in wireless networks and learn simulating wireless networks.
- Be able to design WLAN, WPAN, WWAN, Cellular based upon underlying propagation and performance analysis.

References

1. Schiller J., Mobile Communications, Addison Wesley 2000
2. Stallings W., Wireless Communications and Networks, Pearson Education 2005
3. Stojmenic Ivan, Handbook of Wireless Networks and Mobile Computing, John Wiley and Sons Inc 2002
4. Yi Bing Lin and Imrich Chlamtac, Wireless and Mobile Network Architectures, John Wiley and Sons Inc 2000
5. Pandya Raj, Mobile and Personal Communications Systems and Services, PHI 200.
6. Peterson, Larry L., and Bruce S. Davie. *Computer networks: a systems approach*.

Elsevier, 2007.
7. Kurose, James F. Computer networking: A top-down approach featuring the internet, 3/E. Pearson Education India, 2005.

Course Code	
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

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

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

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

Database Security: Authentication, Various Access Control Mechanisms, etc

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	
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

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

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

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

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	
Course Name	Data Encryption and Compression
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

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

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

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.

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	
Course Name	Network Security and Cryptography
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

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

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

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

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	
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

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

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

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

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."

Second Semester
(Elective Courses/Papers)

Course Code	
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

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

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.

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

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	
Course Name	Natural Language Processing
Credit	3
Pre-Requisites	
Total Number of Lectures	45

COURSE OBJECTIVE

This course presents an introduction to the computational modeling of natural language. Topics covered include: computational morphology, language modeling, syntactic parsing, lexical and compositional semantics, and discourse analysis. We will consider selected applications such as automatic summarization, machine translation, and speech processing. We will also study machine learning algorithms that are used in natural language processing.

SYLLABUS

Introduction to NLP. Computational morphology.

Finite-state machines. Language modeling. Syntax and parsing. POS tagging.

Lexical semantics. Compositional semantics. Computational discourse.

NLP applications. Computational linguistics proper (e.g., historical linguistics, language acquisition). Machine learning for NLP.

COURSE OUTCOMES

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

- the field of natural language processing.
- They should have a sense of the capabilities and limitations of current natural language technologies, and some of the algorithms and techniques that underlie these technologies.
- They should also understand the theoretical underpinnings of natural language processing in linguistics and formal language theory.

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 research* 12.Aug (2011): 2493-2537.
4. Manning, Christopher D., Christopher D. Manning, and Hinrich Schütze. *Foundations of statistical natural language processing*. MIT press, 1999.

Course Code	
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

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

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

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

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	
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

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.

Unsupervised Learning Clustering: K-means/Kernel K-means Dimensionality Reduction: PCA and kernel PCA Matrix Factorization and Matrix Completion Generative Models (mixture models and latent factor models).

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, 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	
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

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.

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

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

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	
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

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

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.

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.

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

COURSE OBJECTIVE

To study the specifications and functionalities of various protocols/standards of mobile networks.

SYLLABUS

Mobile computing: Mechanisms for adaptation and incorporating adaptations, mobility management, location management principle and techniques.

Data dissemination and management, mobile cache maintenance schemes, Mobile Web Caching; Mobile middleware application development, Service Discovery Middleware,

Mobile IP, Mobile TCP, Database systems in mobile environments, World Wide Web and mobility.

Mobile Ad Hoc Networks, localization, MAC issues, Routing protocols, global state routing (GSR)

COURSE OUTCOMES

- an ability to function on multidisciplinary teams
- a recognition of the need for, and an ability to engage in lifelong learning
- an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

References

1. Jochen Schiller, "Mobile Communications", Pearson Education, Second Edition 2002.
2. C.K. Toh, "Ad Hoc Mobile Wireless Networks: Protocols and Systems", Pearson Education, 2002.
3. William Stallings, "Wireless Communications and Networks", Pearson Education 2002.

Course Code	
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

Information retrieval model, Information retrieval evaluation, Searching the Web

Document Representation, Query languages and query operation, Metadata search

Indexing and searching, Scoring and ranking feature vectors

Ontology, domain specific search, parallel and distributed information retrieval

Text and multimedia languages, Social networks.

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).