# Master of Technology in Computer Science & Technology

## Course Structure and Syllabus

## 1st to 4th Semester

## Academic Session 2018-19


**Department of Computer Science & Technology**

**Central University of Punjab**

**Bathinda**

## Master's Programme Course Structure

| School: Engineering & Technology | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Department: Computer Science & Technology** | | | | | | | |
| **Programme: M-Tech. Computer Science & Technology** | | | | | | | |
| **Batch: 2018-19** | | | | | | | |
| **Semester : I** | | | | | | | |
| **S. No.** | **Course Code** | **Course Title** | **Course Type** | **Credit Hours** | | | |
| | | | | **L** | **T** | **P** | **Total credit** |
| 1. | CST-506 | Advanced Data Structure and Algorithms | Core-I | 4 | 0 | 0 | 4 |
| 2. | CST-507 | Mathematical Foundation of Computer Science | Core-II | 4 | 0 | 0 | 4 |
| 3. | CST.508 | Machine Learning | Elective-I | 4 | 0 | 0 | 4 |
| | CST.509 | Wireless Sensors Networks | | | | | |
| | CST.510 | Compiler for HPC | | | | | |
| 4. | CST.511 | Distributed System | Elective-II | 4 | 0 | 0 | 4 |
| | CST.512 | Information Security | | | | | |
| | CST.513 | Software Testing & Maintenance | | | | | |
| 5. | CST.514 | Research Methodology | Foundation | 4 | 0 | 0 | 4 |
| 6. | XXX.YYY | Opt any one course from the courses offered by the University | IDC | 2 | 0 | 0 | 2 |
| 7. | XXX.YYY | Opt any one course from the courses offered by the University | Value Added | 2 | 0 | 0 | 2 |
| 8. | CST.515 | Advanced Data Structure - Lab | Laboratory-I | 0 | 0 | 4 | 2 |
| 9. | CST.516 | Wireless Sensors Networks Lab | Laboratory-II | 0 | 0 | 4 | 2 |
| | CST.517 | Machine Learning Lab | | | | | |
| | CST.518 | Compiler for HPC-Lab | | | | | |
| | | | **Total** | **24** | | **8** | **28** |

| Semester : II | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. No.** | **Course Code** | **Course Title** | **Course Type** | **Credit Hours** | | | |
| | | | | **L** | **T** | **P** | **Total credit** |
| 1. | CST-521 | Advance Algorithm | Core-III | 4 | 0 | 0 | 4 |
| 2. | CST-522 | Soft Computing | Core-IV | 4 | 0 | 0 | 4 |
| 3. | CST-523 | Computer Vision | Elective-III | 4 | 0 | 0 | 4 |
| | CBS-524 | Big Data Analysis and Visualization | | | | | |
| | CBS-523 | Secure Software Design | | | | | |
| | CST-524 | IOT (Internet of Things) | | | | | |
| 4. | CBS-527 | Digital Forensics | Elective-IV | 4 | 0 | 0 | 4 |
| | CBS-525 | Secure Coding | | | | | |
| | CST-525 | GPU Computing | | | | | |
| 5. | CST-526 | Python Programming for Data Sciences | Skill Development | 4 | 0 | 0 | 4 |
| 6. | XXX.YYY | Inter Disciplinary Course (IDC) | IDC | 2 | 0 | 0 | 2 |
| 7. | CST-527 | Soft Computing-Lab | Laboratory-III | 0 | 0 | 2 | 2 |
| 8. | CST-528 | Python Programming for Data Science - Lab | Laboratory-IV | 0 | 0 | 2 | 2 |
| | | | **Total** | **22** | **0** | **4** | **26** |

| Semester : III | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. No.** | **Course Code** | **Course Title** | **Course Type** | **Credit Hours** | | | |
| | | | | **L** | **T** | **P** | **Total credit** |
| 1. | CST-551 | Optimization Techniques | Elective | 4 | 0 | 0 | 4 |
| | CST-552 | Data Warehousing and Data Mining | | | | | |
| | CST.553 | Introduction to Intelligent System | | | | | |
| | CST.554 | Mobile Applications & Services | | | | | |
| 2. | CBS-552 | Cyber Threat Intelligence | Open Elective | 4 | 0 | 0 | 4 |
| | CST.555 | Operations Research | | | | | |
| | CST.556 | Cost Management of Engineering Projects | | | | | |
| | CBS-553 | Cyber Law | | | | | |
| | CST.557 | Software Metrics | | | | | |
| 3. | CST.543 | Seminar with Minor Project | | 0 | 0 | 2 | 2 |
| 4. | CST.600 | Dissertation/ Industrial Project | | 0 | 0 | 10 | 10 |
| | | | **Total** | 8 | 0 | 12 | **20** |



*Students going for Industrial Project/Thesis will complete these courses through MOOCs.

| Semester : IV | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. No.** | **Course Code** | **Course Title** | **Course Type** | **Credit Hours** | | | |
| | | | | **L** | **T** | **P** | **Total credit** |
| 1. | CST.600 | Dissertation | | | | 16 | 16 |
| | | | **Total** | | | 16 | **16** |

A: Continuous Assessment: Based on Objective Type Tests, Term paper and Assignments
B: Pre-Scheduled Test-1: Based on Objective Type & Subjective Type Test (By Enlarged Subjective Type)
C: Pre-Scheduled Test-2: Based on Objective Type & Subjective Type Test (By Enlarged Subjective Type)
D: End-Term Exam (Final): Based on Objective Type Tests
E: Total Marks
**L: Lectures T: Tutorial P: Practical Cr: Credits**

**The following Transaction Modes are used for each subjects:**

**Modes of classroom transaction**

1) Lecture
2) Demonstration
3) Project Method
4) Inquiry training
5) Seminar
6) Group discussion
7) Flipped learning
8) Tutorial
9) Self-learning
10) Case study

The following **tools** can be used in **different transactional modes**:

1. PPT
2. Video
3. e-content
4. google drive

**Course Code** **CST-506**
**Course Name** **Advanced Data Structures and Algorithms**
**Credits** **4**

**Course Objectives:**

- 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.

**Course Outcomes:**

After completion of course, students would be able to:

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



**CONTENTS**

**Unit 1** **14 hours**

**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.

**Unit 2** **16 hours**

**Advanced Data Structures:** Binary search trees, Red-Black Trees, B-trees, Fibonacci heaps, Data Structures for Disjoint Sets.

**Design Strategies:** Divide-and-conquer, Dynamic Programming, and Greedy Method.

**Unit 3** **16 hours**

**Text Processing:** The naive string-matching algorithm, Rabin-Karp, String matching with finite automaton, Knuth-Morris-Pratt algorithm.

**Skip Lists:** Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists

**Unit 4** **15 hours**

**Graph Algorithms:** Elementary graph algorithms, Minimum spanning trees, shortest path algorithms: single source and all pair.

**Computational Geometry:** One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quadtrees, k-D Trees.

**Suggested Readings**


1. T.H. Cormen, C. E. Leiserson, RL Rivest and C Stein, Introduction to Algorithms, 3rd Edition, MIT Press, Alan Tucker, 2010.
2. Sridhar, S., Design and Analysis of Algorithms. Oxford University Press India, 1st Edition, 2014.
3. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.
4. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 1st Edition, 2002.
5. Aho, A.V., Hopcroft, J.E. and Ullman, J. D., Data Structures and Algorithms. India: Pearson Education, 2nd Edition, 2009.
6. Horowitz, E., Sahni, S. and Rajasekaran, S., Fundamentals of Computer Algorithms, Galgotia Publications, 2nd Edition, 2010.




**Course Code** **CST-507**
**Course Name** **Mathematical Foundation of Computer Science**
**Credits** **4**

**Objectives:** 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.

**Course Outcomes:** On completion of the course the students should be able to

- 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.

**CONTENTS**

**Unit 1** **17 hours**

**Distribution Function:** Probability mass, density, and cumulative distribution functions, Conditional Probability, Expected value,
Applications of the Univariate and Multivariate problems. Probabilistic inequalities, Random samples, sampling distributions of estimators and

Maximum Likelihood

**Unit 2** **15 hours**

Statistical inference**:** Descriptive Statisctics**,** Introduction to multivariate statistical models, Multivariate Regression, Multinominal regression and classification problems, principal components analysis**,** The problem of overfitting model assessment.

**Unit 3 16 hours**

**Graph Theory:** Isomorphism, Planar graphs, graph colouring, hamilton circuits and eulercycles.

Specialized techniques to solve combinatorial enumeration problems Graph Theory: Isomorphism, Planar graphs, graph colouring, hamilton circuits and euler cycles. Specialized techniques to solve combinatorial enumeration problems

**Unit 4** **16 hours**

**Computer science and engineering applications with any of following area:** Data mining, Computer security, Software engineering, Computer architecture, Bioinformatics, Machine learning.

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



**Suggested Readings**

1. John Vince, Foundation Mathematics for Computer Science, Springer International Publishing, Edition 1, 2015.
2. Kishor S. Trivedi, Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley, Second Edition, Nov 2001, ISBN:978-0-471-33341-8
3. Michel Mitzenmacher and E. Upfal. Probability and Computing: Randomized Algorithms and Probabilistic Analysis, Cambrige University Press, January 31, 2005, ISBN: 978-0521835404
4. Alan Tucker, Applied Combinatorics, Wiley, 6th Edition, Feb 1, 2012, ISBN: 978-0470458389

**Course Code** **CST-508**
**Course Name** **Machine Learning**
**Credits** **4**

**Course Objectives:**

- To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes.
- To design and analyze 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.

**Course Outcomes:**

After completion of course, students would be able to:

- 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 analyze various machine learning approaches and paradigms.

**CONTENTS**

**Unit 1** **16 hours**

**Introduction to learning Techniques: 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** **15 hours**

**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)

**Unit 3** **14 hours**

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

**Unit 4** **18 hours**

Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference

**Simulation Tool for Machine Learning, Hands on with recent tools WEKA, R, MATLAB**

Recent trends in various learning techniques of machine learning and

classification methods for IOT applications. Various models for IOT applications.

**Suggested Readings**

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.

**Course Code** **CST-509**
**Course Name** **Wireless Sensors Networks**
**Credits** **4**

**Course Objectives:**

- Architect sensor networks for various application setups.
- Devise appropriate data dissemination protocols and model links cost.
- Understanding of the fundamental concepts of wireless sensor networks and have a basic knowledge of the various protocols at various layers.
- Evaluate the performance of sensor networks and identify bottlenecks.

**Course Outcomes:**

**After completion of course, students would be able to:**

- Describe and explain radio standards and communication protocols for wireless sensor networks.
- Explain the function of the node architecture and use of sensors for various applications.
- Be familiar with architectures, functions and performance of wireless sensor networks systems and platforms.

**CONTENTS**

**Unit 1** **15 hours**

**Introduction to Wireless Sensor Networks:** Course Information, Introduction to Wireless Sensor Networks: Motivations, Applications, Performance metrics, History and Design factors

**Network Architecture:** Traditional layered stack, Cross-layer designs, Sensor Network Architecture

**Hardware Platforms:** Motes, Hardware parameters

**Unit 2** **14 hours**

**Introduction to Network Simulations: I**ntroduction to Network Simulator, Description of the module and simulation example.

**Medium Access Control Protocol design:** Fixed Access, Random Access, WSN protocols: synchronized, duty-cycled

**Introduction to Markov Chain:** Discrete time Markov Chain definition, properties, classification and analysis

**MAC Protocol Analysis:** Asynchronous duty-cycled. X-MAC Analysis (Markov Chain)

**Unit 3** **15 hours**

**Security**: Possible attacks, countermeasures, SPINS, Static and dynamic key Distribution

**Routing protocols:** Introduction, MANET protocols

**Unit 4** **15 hours**

**Routing protocols for WSN**: Resource-aware routing, Data-centric, Geographic Routing, Broadcast, Multicast

**Opportunistic Routing Analysis**: Analysis of opportunistic routing (Markov Chain)

Advanced topics in wireless sensor networks.

**Advanced Topics:** Recent development in WSN standards, software applications.

**Suggested Readings**


1. W. Dargie and C. Poellabauer, "Fundamentals of Wireless Sensor Networks –Theory and Practice", Wiley 2010
2. KazemSohraby, Daniel Minoli and TaiebZnati, "wireless sensor networks - Technology, Protocols, and Applications", Wiley Interscience 2007
3. Takahiro Hara,Vladimir I. Zadorozhny, and Erik Buchmann, "Wireless Sensor Network Technologies for the Information Explosion Era", springer 2010
4. Murthy, C.S. R. and Manoj, B.S. (2007). Ad hoc Wireless Networks Architectures and protocols,2nd edition, Pearson Education.
5. ObaidatM. S.andMisra, S. Principles of Wireless Sensor Networks,Cambridge University Press, U.K.
6. Vijay Madisetti, ArshdeepBahga, "Internet of Things: A Hands-On Approach"ChristianPoellabauer, "Fundamentals of Wireless Sensor Networks: TheoryandPractice"
7. Toh, C.K. Ad Hoc Wireless Networks: Protocols and Systems, Prentice Hall PTR Upper Saddle River, NJ, USA.
8. Misra,S., Woungang, I. and Misra S. C. Guide to Wireless Sensor Networks, Computer Communications and Networks Series, Springer-Verlag, London, U.K.
9. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1 st Edition, Apress Publications, 2013.
10. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014.

**Course Code** **CST-510**
**Course Name** **Compiler for HPC**
**Credits** **4**

**Course Objectives:**
The objective of this course is to introduce structure of compilers and high performance compiler design for students. Concepts of cache coherence and parallel loops in compilers are included.

**Course Outcomes:**
**After completion of course, students would be:**

- Familiar with the structure of compiler.
- Parallel loops, data dependency and exception handling and debugging in compiler.

**CONTENTS**

**Unit 1** **16 hours**

**High Performance Systems,** Structure of a Compiler, Programming Language Features, Languages for High Performance.

**Data Dependence:** Data Dependence in Loops, Data Dependence in Conditionals, Data Dependence in Parallel Loops, Program Dependence Graph.

**Scalar Analysis with Factored Use-Def Chains:** Constructing Factored Use-Def Chains, FUD Chains for Arrays, Induction Variables Using FUD Chains, Constant Propagation with FUD Chains, Data Dependence for Scalars. Data Dependence Analysis for Arrays.

**Unit 2** **16 hours**

Array Region Analysis, Pointer Analysis, I/O Dependence, Procedure Calls, Inter-procedural Analysis.

**Loop Restructuring:** Simple Transformations, Loop Fusion, Loop Fission, Loop Reversal, Loop Interchanging, Loop Skewing, Linear Loop. Transformations, Strip-Mining, Loop Tiling, Other Loop Transformations, and Inter-procedural Transformations.

**Optimizing for Locality:** Single Reference to Each Array, Multiple References, General Tiling, Fission and Fusion for Locality.

**Unit 3** **14 hours**

**Concurrency Analysis:** Concurrency from Sequential Loops, Concurrency from Parallel Loops, Nested Loops, Round off Error, Exceptions and Debuggers.

**Vector Analysis:** Vector Code, Vector Code from Sequential Loops, Vector Code from For all Loops, Nested Loops, Round off Error, Exceptions, and Debuggers, Multi-vector Computers.

**Unit 4** **17 hours**

**Message-Passing Machines:** SIMD Machines, MIMD Machines, Data Layout, Parallel Code for Array Assignment, Remote Data Access, Automatic Data Layout, Multiple Array Assignments, Other Topics.

**Scalable Shared-Memory Machines:** Global Cache Coherence, Local Cache Coherence, Latency Tolerant Machines.

Recent trends in compiler design for high performance computing and message passing machines and scalable shared memory machine.

**Suggested Readings**

1. Michael Wolfe, High-Performance Compilers for Parallel Computing, Pearson

**Course Code** **CST-511**
**Course Name** **Distributed System**
**Credits** **4**

**COURSE OBJECTIVES:**

To introduce the fundamental concepts and issues of managing large volume of shared data in a parallel and distributed environment, and to provide insight into related research problems.

**COURSE OUTCOMES:**

**After completion of course, students would be:**

- Design trends in distributed systems.
- Apply network virtualization.
- Apply remote method invocation and objects.



**CONTENTS**

**Unit 1** **14 hours**

**Introduction:** Distributed data processing; What is a DDBS; Advantages and disadvantages of DDBS; Problem areas; Overview of database and computer network concepts

**Distributed Database Management System Architecture:** Transparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issues.

**Unit 2** **15 hours**

**Distributed Database Design:** Alternative design strategies; Distributed design issues; Fragmentation; Data allocation

**Semantics Data Control:** View management; Data security; Semantic Integrity Control

**Query Processing Issues:** Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data

**Unit 3** **17 hours**

**Distributed Query Optimization:** Factors governing query optimization; Centralized query optimization; Ordering of fragment queries; Distributed query optimization algorithms.

**Transaction Management:** The transaction concept; Goals of transaction management; Characteristics of transactions; Taxonomy of transaction models

**Concurrency Control:** Concurrency control in centralized database systems;

Concurrency control in DDBSs; Distributed concurrency control algorithms; Deadlock management

**Unit 4** **16 hours**

**Reliability:** Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit
protocols; Recovery protocols

**Parallel Database Systems:** Parallel architectures; parallel query processing and optimization; load balancing

**Introduction to cloud computing, Advanced Topics:** Mobile Databases, Distributed Object Management, Multi-databases

**Suggested Readings**

1. Principles of Distributed Database Systems, M.T. Ozsu and P. Valduriez, Prentice-Hall, 1991.
2. Distributed Database Systems, D. Bell and J. Grimson, Addison-Wesley, 1992.

**Course Code** **CST-512**
**Course Name** **Information Security**
**Credits** **4**



**Objective:** This course will cover the information systems, concept of security, encryption, Hash Algorithms and Internet Security Protocol.

**Course Outcomes:** Upon completion of this course, the students will be able to:

- Explain the principles of information security and its significance
- Identify the domain specific security issues
- Describe the design and working of different cryptographic methods
- Understand the concept of Internet Security Protocol.

**CONTENTS**

**Unit 1** **13 hours**

**History of Information Systems:** Importance of Information Systems, Basics of Information Systems, Changing Nature of Information Systems, Global Information Systems.

**Essential Security Terminologies:** Hardware, Software, Defining Security, Need for Security, Cyber-Crimes, Three Pillars of Security.

**Unit 2** **16 hours**

**Encryption and Decryption:** Attackers and Types of Threats, Encryption Techniques, Classical Cryptographic Algorithms: Monoalphabetic Substitutions such as the Caesar Cipher, Cryptanalysis of Monoalphabetic ciphers, Polyalphabetic Ciphers such as Vigenere, Vernam Cipher, Stream and Block Ciphers.

**Symmetric Key Systems**: Data encryption Standard (DES), DES Structure, DES Analysis, Multiple DES, Advance Encryption Standard (AES).

**Unit 3** **15 hours**

**Key Management Protocols:** Solving Key Distribution Problem, Diffie-Hellman Key Exchange Algorithm.

**Public Key Encryption Systems:** Concept and Characteristics of Public Key Encryption System, Rivest-Shamir-Adleman (RSA) Encryption.

**Hash Algorithms:** Hash concept, Description of Hash Algorithms (MD5 and SHA-1), Digital Signature/Certificate.

**Unit 4** **14 hours**

**Internet Security Protocol:** Introduction, Secure Socket Layer, Transport Layer Security, Secure Electronic Transaction, 3-D Secure Protocol, Electronic Money, Email Security, Wireless Application Protocol (WAP) Security.

**Suggested Readings**


1. Forouzan, B.A. (2010). Cryptography & Network Security. Tata McGraw-Hill Education.
2. Kahate, A. (2009). Cryptography and Network Security. McGraw-Hill Higher Ed.
3. Godbole, N. (2009). Information Systems Security: Security Management, Metrics, frameworks and Best Practices. 1st Ed. John Wiley & Sons India.
4. Stallings, W. (2007). Network Security Essentials: applications and standards. 3rd ed. Pearson Education India.
5. Stallings, W. (2014). Cryptography and Network Security: Principles and Practice. 6th ed. Pearson.
6. Kim, D., and Solomon, M. G. (2010). Fundamentals of Information Systems Security. Jones & Bartlett Learning.




| | |
|---|---|
| **Course Code** | **CST-513** |
| **Course Name** | **Software Testing & Maintenance** |
| **Credits** | **4** |

**Objective:** This course is designed to enable a clear understanding and knowledge of the foundations, techniques, and tools in the area of software testing and its practice in the industry. The course will prepare students to be leaders in software testing.

**Course Outcomes:** Upon completion of this course, the students will be able to:

- Able to apply software testing knowledge, verification & validation and engineering methods.
- Design and conduct a software test process for a quality software test.
- Understand and identify various software testing problems, and solve these problems by designing and selecting software test models, criteria, strategies, and methods.

**CONTENTS**

**Unit 1** **14 hours**

**Overview of Software Engineering:** Phases in development of Software, Software Engineering Ethics, Life cycle Revisited (Incremental Development, Agile Methods, RAD), Model-Driven Architecture, Software Product Line, Process Modelling**.**

**Project Management:** Project Planning, Project Control (Work Break Down Structure, GANTT Charts, PERT Charts) Project Team Organization, Risk Management, CMM

**Unit 2** **15 hours**

**Testing of OO systems:** Objects and Classes, OO Testing, Class Testing, Regression Testing, Non-Functional Testing, Acceptance Testing

**Software Testing**: Levels of testing, Module, Integration, System, Regression, Testing techniques and their Applicability, Functional testing and Analysis Structural testing and Analysis, Error Oriented testing and Analysis, Hybrid Approaches, Integration Strategies, Transaction Flow Analysis, Stress Analysis, Failure Analysis, Concurrency Analysis

**Unit 3** **17 hours**

**Overview of Software Metrics:** Measurement in Software Engineering, Scope of Software Metrics, Measurement and Models Meaningfulness in measurement, Measurement quality, Measurement process, Scale, Measurement validation, Object-oriented measurements.

**Measuring Internal External Product Attributes:** Measuring size, aspects of software size, length, functionality and complexity, measuring structure, types of structural measures,

Modeling software quality, measuring aspects of software quality, software reliability, basics of software reliability

**Unit 4** **16 hours**

**Software Maintenance:** Maintenance Categories, Major causes of Maintenance Problems, Reverse Engineering, Software Evolutions, Organizational and Managerial Issues of Maintenance activities, Maintenance Measurements

**Software Refactoring:** Principles of Refactoring, Bad Smells in code, Composing Methods of Refactoring, Moving features between objects.

**Suggested Readings**


1. Pressman Roger S. (2014). Software Engineering a Practitioners Approach, Latest Edition, McGraw-Hill Singapore
2. Peters, James S. Witold Pedrycz, (2011). Software engineering an engineering approach, Wiley India,.
3. Anirban Basu, (2015). Software Quality Assurance, Testing and Metrics, Latest Edition, PHI India.
4. Vliet Hans Van, (2015). Software Engineering Principles and Practice, Latest Edition, John Wiley & Sons

5. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandriolo,(2003). Fundamental of Software Engineering. Latest Edition, Printice Hall India

**Course Code CST.514**
**Course Name Research Methodology**
**Credits 4**

**Course Objectives:**

- Understand research problem formulation.
- Analyze research related information
- Follow research ethics

**Course Outcomes:**

At the end of this course, students will be able to

- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.



**CONTENTS**

**Unit 1** **14 hours**

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

**Unit 2** **15 hours**

Effective literature studies approaches, analysis Plagiarism, Research ethics,
Effective technical writing, how to write report, Paper
Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

**Unit 3** **14 hours**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of
Patenting and Development: technological research, innovation, patenting, development.
International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

**Unit 4** **16 hours**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

New Developments in IPR: Administration of Patent System. New developments in

IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies.

**Suggested Readings**


1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2 ndEdition , "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov , "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008




**Course Code** **CST-515**
**Course Name** **Advanced Data Structure – Lab**
**Credits**

**Lab Assignments will be based on topics studied in CST-507**

**Lab Evaluation:**

The evaluation of lab criteria will be based on following parameters:

| **Evaluation Parameters** | **Marks** |
|---|---|
| Practical File | 5 |
| Implementation | 15 |
| Viva-voce | 30 |
| **Total** | **50** |

**Course Code** CST-516
**Course Name** **Wireless Sensors Networks Lab**
**Credits**

**List of Practical will be based on Elective – I subject opted by the students**

**Lab Evaluation:**
The evaluation of lab criteria will be based on following parameters:

| **Evaluation Parameters** | **Marks** |
|---|---|
| Practical File | 5 |
| Implementation | 15 |
| Viva-voce | 30 |
| **Total** | **50** |

**Course Code** **CST-517**
**Course Name** **Machine Learning Lab**
**Credits**

**List of Practical will be based on Elective – I subject opted by the students**

**Lab Evaluation:**
The evaluation of lab criteria will be based on following parameters:

| **Evaluation Parameters** | **Marks** |
|---|---|
| Practical File | 5 |
| Implementation | 15 |
| Viva-voce | 30 |
| **Total** | **50** |



**Course Code** **CST-518**
**Course Name** **Complier For HPC Lab**
**Credits**

**List of Practical will be based on Elective – I subject opted by the students**

**Lab Evaluation:**
The evaluation of lab criteria will be based on following parameters:

| **Evaluation Parameters** | **Marks** |
|---|---|
| Practical File | 5 |
| Implementation | 15 |
| Viva-voce | 30 |
| **Total** | **50** |

**Course Code** **CST-521**
**Course Name** **Advance Algorithm**
**Credits** **4**
**Course Objective:**
To familiarize students with basic paradigms and data structures used to solve advanced algorithmic problems and To introduce the students to recent developments in the area of algorithmic design.

**Course Outcomes:** On completion of the course the students should 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.

**CONTENTS**

**Unit 1** **16 hours**

**Sorting:** Review of various sorting algorithms, topological sorting
**Graph:** Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components,
Emphasis on correctness proof of the algorithm and time/space analysis,
Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST.



**Unit 2** **14 hours**

Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations.
Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming.

**Unit 3** **15 hours**

**Linear Programming:** Geometry of the feasibility region and Simplex algorithm, Decision Poblems: P, NP, **NP Complete, NP-Hard,**
**NP Hard with** Examples, Proof of NP-hardness and NP-completeness.

**Unit 4** **16 hours**

**One or more of the following topics based on time and interest**
Approximation algorithms, Randomized Algorithms, Interior Point Method,
Recent Trends in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

**Suggested Readings**

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.

**Course Code** **CST-522**
**Course Name** **Soft Computing**
**Credits** **4**

**Course Objectives:**

- 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 student hand-on experience on MATLAB to implement various strategies.

**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.



**CONTENTS**

**Unit 1** **14 hours**

**Introduction to Soft Computing and Neural Networks:** Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics. Adaptive Resonance architectures, Advances in Neural networks

**Neural Networks:** Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks: Reinforcement Learning, Unsupervised, and Learning Neural Networks.

**Unit 2** **14 hours**

Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.

**Fuzzy Logic:** Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions.

**Unit 3** **16 hours**

**Genetic Algorithms:** Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning: Machine Learning Approach to Knowledge Acquisition. Introduction to other optimization techniques.

**Matlab/Python Lib:** Introduction to Matlab/Python, Arrays and array operations, Functions and Files

**Unit 4** **14 hours**

Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic

Recent Trands in deep learning, various classifiers, neural networks and genetic algorithm.

Implementation of recently proposed soft computing techniques.

**Suggested Readings**


1. Jyh:Shing Roger Jang, Chuen:Tsai Sun, EijiMizutani, Neuro:Fuzzy and Soft Computing□,
2. Prentice:Hall of India, 2003.
3. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic:Theory and Applications□, Prentice Hall, 1995.
4. MATLAB Toolkit Manual
5. Ross J.T., (2009). Fuzzy Logic with Engineering Applications John Wiley & Sons.
6. Rajasekaran, S.VijayalakshmiPai, G.A. (2003). Neural Networks, Fuzzy Logic and Genetic Algorithms PHI Learning.
7. Priddy L.K., Keller E.P., (2005). Artificial Neural Networks: An Introduction SPIE Press.
8. Gen, M. Cheng, R. (2000). Genetic Algorithms and Engineering Optimization John Wiley & Sons.




**Course Code** **CST-523**
**Course Name** **Computer Vision**
**Credits** **4**

**COURSE OBJECTIVES:**

- 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 feature extraction and classification techniques

**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.

**CONTENTS**

**Unit 1** **15 hours**

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

**Unit 2** **16 hours**

Segmentation, Morphological filtering, Fourier transform
Feature extraction, shape, histogram, color, spectral, texture, using CVIP tools,

**Unit 3** **16 hours**

Feature analysis, feature vectors, distance /similarity measures, data preprocessing
Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians
Classification: Discriminant Function, Supervised, Un-supervised, Semi supervised

**Unit 4** **14 hours**

Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA, and Non-parametric methods.
Recent trends in Activity Recognition, computational photography, Biometrics.



**Suggested Readings**

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.

**Course Code** **CBS-523**
**Course Name** **Secure Software Design**
**Credits** **4**

**COURSE OBJECTIVES:**

- To fix software flaws and bugs in various software.
- To make students aware of various issues like weak random number generation, information leakage, poor usability, and weak or no encryption on data traffic
- Techniques for successfully implementing and supporting network services on an enterprise scale and heterogeneous systems environment.
- Methodologies and tools to design and develop secure software containing minimum vulnerabilities and flaws.

**COURSE OUTCOMES:**

**After completion of course, students would be able to:**

- Differentiate between various software vulnerabilities.
- Software process vulnerabilities for an organization.
- Monitor resources consumption in a software.
- Interrelate security and software development process.

**CONTENTS**

**Unit 1** **13 hours**

**Secure Software Design**

Identify software vulnerabilities and perform software security analysis, Master security programming practices, Master fundamental software security design concepts, Perform security testing and quality assurance.

**Unit 2** **15 hours**

**Enterprise Application Development**

Describe the nature and scope of enterprise software applications, Design distributed N-tier software application, Research technologies available for the presentation, business and data tiers of an enterprise software application, Design and build a database using an enterprise database system, Develop components at the different tiers in an enterprise system, Design and develop a multi-tier solution to a problem using technologies used in enterprise system, Present software solution.

**Unit 3** **16 hours**

**Enterprise Systems Administration**

Design, implement and maintain a directory-based server infrastructure in a heterogeneous systems environment, Monitor server resource utilization for system reliability and availability, Install and administer network services (DNS/DHCP/Terminal Services/Clustering/Web/Email).

**Unit 4** **17 hours**

Obtain the ability to manage and troubleshoot a network running multiple services, Understand the requirements of an enterprise network and how to go about managing them.

Handle insecure exceptions and command/SQL injection, Defend web and mobile applications against attackers, software containing minimum vulnerabilities and flaws.

Case study of DNS server, DHCP configuration and SQL injection attack.

**Suggested Readings**


1. Theodor Richardson, Charles N Thies, Secure Software Design, Jones & Bartlett
2. Kenneth R. van Wyk, Mark G. Graff, Dan S. Peters, Diana L. Burley, Enterprise Software Security, Addison Wesley.

**Course Code** **CST-524**
**Course Name** **IOT (Internet of Things )**
**Credits** **4**

**Objective:** The objective of this course is to introduce students to the use of Devices in IoT Technology, Real World IoT Design Constraints, Industrial Automation and Commercial Building Automation in IoT.

**Course Outcomes:**

On completion of the course the students should be able to

- Understand the concepts of Internet of Things
- Building state of the art architecture in IoT.
- Design IoT applications in different domain and be able to analyze their performance
- Implement basic IoT applications on embedded platform

**CONTENTS**

**Unit 1** **10 hours**

**Introduction to IoT** Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models and APIs

**IoT and M2M**, Difference between IoT and M2M, Software define Network.

**Unit 2** **12 hours**

**Network and Communication aspects:** Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment, Node discovery, Data aggregation and Dissemination

**Unit 3** **15 hours**

**Challenges in IoT Design**: challenges, Development challenges, Security challenges, Other
Challenges

**Domain specific applications:**IoT Home automation, Industry applications, Surveillance
applications, Other IoT applications

**Unit 4** **16 hours**

**Developing IoTs**: Introduction to Python, Introduction to different IoT tools, Developing
applications through IoT tools, Developing sensor based application through embedded
system platform, Implementing IoT concepts with python

**Suggested Readings**

1. Vijay Madisetti, Arshdeep Bahga, “Internet of Things: A Hands-On Approach”

2. Waltenegus Dargie,Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice
3. Francis daCosta, **"Rethinking the Internet of Things: A Scalable Approach to Connecting Everything",** 1st Edition, Apress Publications, 2013
4. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, **"From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence",** 1st Edition, Academic Press, 2014.

**Course Code** **CBS-524**
**Course Name** **Big Data Analysis and Visualization**
**Credits** **4**

**Course Objective:**
To prepare the data for analysis and develop meaningful Data Visualizations
**Course Outcomes:**
**After completion of course, students would be:**
Able to extract the data for performing the Analysis.



**CONTENTS**

**Unit 1** **15 hours**

**Data Gathering and Preparation:** Data formats, parsing and transformation, Scalability and real-time issues, **Data Cleaning:** Consistency checking, Heterogeneous and missing data, Data Transformation and segmentation

**Unit 2** **16 hours**

**Exploratory Analysis:** Descriptive and comparative statistics, Clustering and association, Hypothesis Generation,
**Visualization:** Designing visualizations, Time series, Geo-located data, Correlations and connections, Hierarchies and networks, interactivity

**Unit 3** **15 hours**

**Big Data Technology:** Fundamental of Big Data Types, Big data Technology Components, Big Data Architecture, Big Data Warehouse, Funcional Vs. Procedural Programming Models for Big Data

**Unit 4** **15 hours**

**Big Data Tools: Hadoop:** Introduction to Hadoop Ecosystem, HDFS, Map-Reduce programming, Spark, PIG, JAQL, Understanding Text Analytics and Big Data, Predictive Analysis of Big Data, Role of Data Analyst

**Suggested Readings**

1. Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, by GlennJ. Myatt
2. Data Analytics Make Accesible By A. Maheshwari, Orilley Publications
3. Lean Analytics: Use Data to Build a Better Startup Faster, by A. Croll and B. Yoskovitz
4. Oreilley Publications, 1 st Edition, 2013

**Course Code CST-525**
**Course Name GPU Computing**
**Credits 4**

**COURSE OBJECTIVES:**
To learn parallel programming with Graphics Processing Units (GPUs).

**COURSE OUTCOMES:**
**After completion of course, students would be:**
Students would learn concepts in parallel programming, implementation of programs on GPUs, debugging and profiling parallel programs.



**CONTENTS**

**Unit 1** **14 hours**

**Introduction**: History, Graphics Processors, Graphics Processing Units, GPGPUs. Clock speeds, CPU / GPU comparisons, Heterogeneity, Accelerators, Parallel programming, CUDA Open CL / Open ACC, Hello World Computation Kernels, Launch parameters, Thread hierarchy, Warps / Wave fronts, Thread blocks / Workgroups, Streaming multiprocessors, 1D / 2D /3D thread mapping, Device properties, Simple Programs

**Unit 2** **14 hours**

**Memory**: Memory hierarchy, DRAM / global, local / shared, private / local, textures, Constant Memory, Pointers, Parameter Passing, Arrays and dynamic Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories

**Unit 3** **16 hours**

**Synchronization**: Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists. Synchronization across CPU and GPU
**Functions**: Device functions, Host functions, Kernels functions, Using libraries (such as Thrust), and developing libraries.

**Unit 4** **15 hours**

**Support**: Debugging GPU Programs. Profiling, Profile tools, Performance

aspects

**Streams**: Asynchronous processing, tasks, Task-dependence, Overlapped data transfers, Default Stream, Synchronization with streams. Events, Event-based-Synchronization - Overlapping data transfer and kernel execution, pitfalls.

**Case Studies**: Image Processing, Graph algorithms, Simulations, Deep Learning

**Advanced topics**: Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous processing

**Suggested Readings**


1. Programming Massively Parallel Processors: A Hands-on Approach; David Kirk, Wen-meiHwu; Morgan Kaufman; 2010 (ISBN: 978-0123814722)
2. CUDA Programming: A Developer's Guide to Parallel Computing with GPUs; Shane Cook; Morgan Kaufman; 2012 (ISBN: 978-0124159334)


**Course Code** **CBS-525**
**Course Tag** **Secure Coding**
**Credits** **4**

**Course Objectives:**

- Understand the most frequent programming errors leading to software vulnerabilities.
- Identify and analyse security problems in software.
- Understand and protect against security threats and software vulnerabilities.
- Effectively apply their knowledge to the construction of secure software systems

**Course Outcomes:**

**After completion of course, students would be able to:**

- Write secure programs and various risk in the softwares.
- Describe various possible security attacks
- Classify various errors that lead to vulnerabilities
- Real time software and vulnerabilities associated with them.

**CONTENTS**

**Unit 1** **11 hours**

**Software Security:** Security Concepts, Security Policy, Security Flaws, Vulnerabilities, Exploitation and Mitigations. Software Security problems, Classification of Vulnerabilities.

**Security Analysis:** Problem Solving with static analysis: Type Checking, Style Checking, Program understanding, verifications and property checking, Bug finding and Security Review.

**Unit 2** **14 hours**

**Strings:** Common String manipulating Errors, String Vulnerabilities and

Exploits, Mitigation Strategies for strings, String handling functions, Runtime protecting strategies, Notable Vulnerabilities.
**Integer Security:** Integer data Type, Integer Conversions, Integer Operations, Integer Vulnerabilities, Mitigation Strategies.

**Unit 3** **15 hours**

**Handling Inputs:** What to validate, How to validate, Preventing metadata Vulnerabilities,
**Buffer Overflow**: Introduction, Exploiting buffer overflow vulnerabilities, Buffer allocation strategies**,** Tracking buffer sizes, buffer overflow in strings, Buffer overflow in Integers Runtime protections
**Errors and Exceptions:** Handling Error with return code, Managing exceptions, Preventing Resource leaks, Logging and debugging

**Unit 4** **13 hours**

Web Applications: Input and Output Validation for the Web: Expect That the Browser Has Been Subverted, HTTP Considerations: Use POST, Not GET, Request Ordering, Error Handling, Request Provenance
Maintaining Session State: Use Strong Session Identifiers, Enforce a Session Idle Timeout and a Maximum Session Lifetime, Begin a New Session upon Authentication.



**Suggested Readings**

1. Seacord, R. C. (2013). Secure Coding in C and C++. 2nd edition. Addison Wisley for Software Engineering Institute,
2. Chess, B., and West, J. (2007). Secure Programming with static Analysis. Addison Wisley Software Security Series.
3. Seacord, R. C. (2009). The CERT C Secure Coding Standard. Pearson Education.
4. Howard, M., LeBlanc, D. (2002). Writing Secure Code. 2ndEdition. Pearson Education.

**Course Code CBS-527**
**Course Name Digital Forensics**
**Credits 4**

**Course Objectives:**

- 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

**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

**CONTENTS**

**Unit 1** **15 hours**

Digital Forensics Science: Forensics science, computer forensics, and digital forensics.

Computer Crime: Criminalistics as it relates to the investigative process, analysis of cyber-criminalistics area, holistic approach to cyber-forensics.

Legal Aspects of Digital Forensics: IT Act 2000, amendment of IT Act 2008.

**Unit 2** **14 hours**

Incident- Response Methodology, Cyber Crime Scene Analysis: Discuss the various court orders etc., methods to search and seizure electronic evidence, retrieved and un-retrieved communications, Discuss the importance of understanding what court documents would be required for a criminal investigation.



**Unit 3** **12 hours**

Image Capturing, Authenticating Evidence, Hidden Data Extraction, Data Storage, File Systems, Recovery of deleted files, Cracking Passwords,

Internet Crime Investigations, Web Attack Investigations.

**Unit 4** **16 hours**

Computer Forensics: Prepare a case, Begin an investigation, Understand computer forensics workstations and software, Conduct an investigation, Complete a case, Critique a case.

Network Forensics: open-source security tools for network forensic analysis, requirements for preservation of network data.

Mobile Forensics: mobile forensics techniques, mobile forensics tools

**Suggested Readings**

1. John Sammons, The Basics of Digital Forensics, Elsevier
2. Davidoff, S. and Ham, J. (2012). Network Forensics Tracking Hackers through Cyberspace, Prentice Hall.
3. Michael G. Solomon , K Rudolph, Ed Tittel, Broom N., and Barrett, D. (2011),Computer Forensics Jump Start, Willey Publishing, Inc.

4. Marcella, Albert J., Cyber forensics: A field mannual for collecting, examining and preserving evidence of computer crimes(2008), New York, Auerbach publications, 2008.
5. Davidoff, Sherri, Network forensics: Tracking hackers through cyberspace (2017), Pearson education India private limited.

**Course Code** **CST-525**
**Course Name** **Python Programing for Data Sciences**
**Credits** **4**

**Objective:** The objective of this course is to introduce students to the Python programming language.
**Course Outcomes:** On completion of the course the students should be able to

- Define python environment and constructs of Python language.
- Construct scripts in Python language.
- Analyse data with Python Libraries

**CONTENTS**

**Unit I** **16 hours**

**Python Introduction:** Installing and setting Python environment in Windows and Linux, basics of Python interpreter, Execution of python program, Editor for Python code, syntax, variable, types. Flow control: if, if-else, for, while, range() function, continue, pass, break. Strings: Sequence operations, String Methods, Pattern Matching.



**Unit II** **16 hours**

**Lists:** Basic Operations, Iteration, Indexing, Slicing and Matrixes; Dictionaries: Basic dictionary operations; **Tuples:** Basic Operations, Iteration, Indexing, Slicing; **Functions:** Definition, Call, Arguments, Scope rules and Name resolution;
**Modules:** Module Coding Basics, Importing Programs as Modules, Executing Modules as Scripts, Compiled Python files(.pyc), Standard Modules: OS and SYS, The dir() Function, Packages.

**Unit –III** **14 hours**

Object Oriented Programming in Python: Classes, Objects, Inheritance, Operator Overloading,
File Handling: Errors and Exceptions Handling (try and except) User-Defined Exception Objects, Regular expressions, User Defined Package with Python.

**Unit –IV** **17 hours**

**Pyhton Packages for Data Sciences:** Mathematical and Statistical Analysis with NumPy, Manuplating and Visulisation of Data with SciPy, shaping, merging, reshaping, slicing datasets and Datastructure with Pandas Library , 2d Plot with matplotlib and seaborn, Learning Package: sklearn

**Suggested Readings**


1. Mark Lutz.,(2009). "Learning Python", Latest Edition, O'REILLY Media, Inc.
2. Paul Berry. (2011). Head First Python. O'REILLY Media, Inc.
3. Jeeva Jose & P. SojanLal., (2016). Introduction to Computing & Problem Solving With Python.


**Course Code CST-527**
**Course Name Soft Computing Lab**
**Credits**

Students will implement the lab practical as per the syllabus of the subject.

**List of Practical based on:**

**Lab Evaluation:**

The evaluation of lab criteria will be based on following parameters:

| **Evaluation Parameters** | **Marks** |
|---|---|
| Practical File | 5 |
| Implementation | 15 |
| Viva-voce | 30 |
| **Total** | **50** |



**Course Code CST-528**
**Course Name Python Programming for Data Sciences Lab**
**Credits**

Students will implement the lab practical as per the syllabus of the subject.

**List of Practical based on:**

**Lab Evaluation:**

The evaluation of lab criteria will be based on following parameters:

| **Evaluation Parameters** | **Marks** |
|---|---|
| Practical File | 5 |
| Implementation | 15 |
| Viva-voce | 30 |
| **Total** | **50** |

**Semester -III**

**Course Code** **CST-551**
**Course Name** **Optimization Techniques**
**Credits** **4**

**Course Objective:**
The objective of this course is to provide insight to the mathematical formulation of real world problems. To optimize these mathematical problems using nature based algorithms. And the solution is useful specially for NP-Hard problems.

**Course Outcomes:**
**After completion of course, students would be:**

- Formulate optimization problems.
- Understand and apply the concept of optimality criteria for various types of optimization problems.
- Solve various constrained and unconstrained problems in Single variable as well as multivariable.
- Apply the methods of optimization in real life situation.



**CONTENTS**

**Unit 1** **14 hours**

Engineering application of Optimization, Formulation of design problems as mathematical programming problems.
General Structure of Optimization Algorithms, Constraints, The Feasible Region.

**Unit 2** **12 hours**

Branches of Mathematical Programming: Optimization using calculus, Graphical Optimization, Linear Programming, Quadratic Programming, Integer Programming, Semi Definite Programming.

**Unit 3** **16 hours**

Optimization Algorithms like Genetic Optimization, Particle Swarm Optimization, Ant Colony Optimization etc.

**Unit 4** **14 hours**

Real life Problems and their mathematical formulation as standard programming problems.
Recent trends: Applications of ant colony optimization, genetics and linear and quadratic programming in real world applications.

**Suggested Readings**

1. LaurenceA.Wolsey(1998).Integerprogramming.Wiley.ISBN978-0-471-28366-9.
2.PracticalOptimizationAlgorithmsandEngineeringApplicationsAndreasAn

toniou.
3. AnIntroductiontoOptimizationEdwinK.,P.Chong&Stanislawh.Zak.
4. Dimitris Bertsimas; Robert Weismantel (2005). Optimization over integers. Dynamic Ideas. ISBN 978-0-9759146-2-5.
5. John K. Karlof (2006). Integer programming: theory and practice.CRC Press. ISBN 978-0-8493- 1914-3.
6.H.PaulWilliams(2009).LogicandIntegerProgramming.Springer.ISBN978-0-387-92279-9.
7. Michael Jünger; Thomas M. Liebling; Denis Naddef; George Nemhauser; William R. Pulleyblank; Gerhard Reinelt; Giovanni Rinaldi; Laurence A. Wolsey, eds. (2009). 50 Years of Integer Programming 1958-2008: From the Early Years to the State-of-the- Art. Springer. ISBN 978-3- 540-68274-5.
8. Der-San Chen; Robert G. Batson; Yu Dang (2010). Applied Integer Programming: Modeling and Solution. John Wiley and Sons. ISBN 978-0-470-37306-4.

**Course Code** **CST-552**
**Course Name** **Data Warehousing and Data Mining**
**Credits** **4**



**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.

**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

**CONTENTS**

**Unit 1** **14 hours**

Introduction to Data Warehousing: Data warehousing Architecture, OLAP Server, Data warehouse Implementation.

**Unit 2** **15 hours**

Data Mining: Mining frequent patterns, association and correlations; Sequential Pattern Mining concepts, primitives, scalable methods;
Classification and prediction; Cluster Analysis – Types of Data in Cluster Analysis, Partitioning methods, Hierarchical Methods; Transactional Patterns and other temporal based frequent patterns,

**Unit 3** **16 hours**

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, Frequent pattern mining in stream data, Sequential Pattern Mining in Data Streams, Classification of dynamic data streams.

**Unit 4** **17 hours**

Web Mining, Mining the web page layout structure, mining web link structure, mining multimedia data on the web, Automatic classification of web documents and web usage mining; Distributed Data Mining.
Recent trends in Distributed Warehousing and Data Mining, Class Imbalance Problem; Graph Mining; Social Network Analysis

**Suggested Readings**


1. Jiawei Han and M Kamber, Data Mining Concepts and Techniques,, Second Edition, ElsevierPublication, 2011
2. Vipin Kumar, Introduction to Data Mining - Pang-Ning Tan, Michael Steinbach, Addison Wesley,2006.
3. G Dong and J Pei, Sequence Data Mining, Springer, 2007.




**Course Code** **CST-553**
**Course Name** **Introduction to Intelligent Systems**
**Credits** **4**

**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.

**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.

**CONTENTS**

**Unit 1** **15 hours**

Search Methods Basic concepts of graph and tree search. Three simple search methods: breadth-first search, depth-first search, iterative deepening search. Heuristic search methods: best-first search, admissible evaluation functions, hill climbing search. Optimisation and search such as stochastic annealing and genetic algorithm.

**Unit 2** **15 hours**

Knowledge representation and logical inference Issues in knowledge representation. Structured representation, such as frames, and scripts, semantic networks and conceptual graphs. Formal logic and logical inference. Knowledge-based systems structures, its basic components. Ideas of Blackboard architectures.

**Unit 3** **15 hours**

Reasoning under uncertainty and Learning Techniques on uncertainty reasoning such as Bayesian reasoning, Certainty factors and Dempster-Shafer Theory of Evidential reasoning, A study of different learning and evolutionary algorithms, such as statistical learning and induction learning.

**Unit 4** **15 hours**

Biological foundations to intelligent systems I: Artificial neural networks, Backpropagation
Networks, Radial basis function networks, and recurrent networks.
Biological foundations to intelligent systems II: Fuzzy logic, knowledgeRepresentation and inference mechanism, genetic algorithm, and fuzzy neural networks.
Recent trends in Fuzzy logic, Knowledge Representation



**Suggested Readings**

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, 3rd edition.

**Course Code** **CST-554**
**Course Name** **Mobile Applications & Services**
**Credits** **4**

**Course Objectives:**

- This course presents the three main mobile platforms and their ecosystems, namely Android, iOS, and PhoneGap/WebOS.
- It explores emerging technologies and tools used to design and implement feature-rich mobile applications for smartphones and tablets

**Course Outcomes**

- On completion of the course the student should be able to identify the target platform and users and be able to define and sketch a mobile application
- understand the fundamentals, frameworks, and development lifecycle of mobile application platforms including iOS, Android, and PhoneGap
- Design and develop a mobile application prototype in one of the platform (challenge project)

**CONTENTS**

**Unit 1** **14 hours**

Introduction: Introduction to Mobile Computing, Introduction to Android Development Environment, Factors in Developing Mobile Applications, Mobile Software Engineering, Frameworks and Tools, Generic UI Development Android User

**Unit 2** **15 hours**

More on Uis: VUIs and Mobile Apps, Text-to-Speech Techniques, Designing the Right UI, Multichannel and Multimodal Uis, . Storing and Retrieving Data, Synchronization and Replication of Mobile Data, Getting the Model Right, Android Storing and Retrieving Data, Working with a Content Provider

**Unit 3** **16 hours**

Communications via Network and the Web:State Machine, Correct Communications Model, Android Networking and Web, Telephony Deciding Scope of an App, Wireless Connectivity and Mobile Apps, Android Telephony
Notifications and Alarms:Performance, Performance and Memory Management, Android Notifications and Alarms, Graphics, Performance and Multithreading, Graphics and UI Performance, Android Graphics

**Unit 4** **17 hours**

Putting It All Together : Packaging and Deploying, Performance Best Practices, Android Field Service App, Location Mobility and Location Based Services Android Multimedia: Mobile Agents and Peer-to-Peer Architecture, Android Multimedia
Platforms and Additional Issues : Development Process, Architecture, Design, Technology Selection, Mobile App Development Hurdles, Testing, Security and Hacking , Active Transactions, More on Security, Hacking Android
Recent trends inCommunication protocols for IOT nodes, mobile computimng techniques in IOT, agents based communications in IOT

**Suggested Readings**

1. Wei-Meng Lee, Beginning AndroidTM 4 Application Development, 2012 by John Wiley & Sons

**Course Code** **CBS.552**
**Course Name** **Cyber threat Intelligence**
**Credits** **4**

**Course objective**

- By understanding the myriad cyber threats and actor motivations, leaders ca guide organizations in accurately accessing threats, risks, and vulnerabilities, minimize the potential for incidents and, when necessary, provide more thoug responses

**Course Outcomes**

**After completion of course, students would be:**

- Study of different Cyber Threat
- Study the technique to Develop Cyber Threat Intelligence Requirements.
- Can Collect Cyber Threat Information
- Help in Analyzing and Disseminating Cyber Threat Intelligence

**CONTENTS**

**Unit 1** **15 hours**

**Defining Cyber Threat Intelligence:** The Need for Cyber Threat Intelligence: The menace of targeted attacks, The monitor-and-respond strategy, Why the strategy is failing, Cyber Threat Intelligence Defned, Key Characteristics: Adversary based, Risk focused, Process oriented, Tailored for diverse consumers, The Benefts of Cyber Threat Intelligence

**Unit 2** **14 hours**

**Developing Cyber Threat Intelligence Requirements:** Assets That Must Be Prioritized: Personal information, Intellectual property, Confdential business information, Credentials and IT systems information, Operational systems. Adversaries: Cybercriminals, Competitors and cyber espionage agents, Hacktivists. Intelligence Consumers: Tactical users, Operational users, Strategic users



**Unit 3** **17 hours**

**Collecting Cyber Threat Information:** Level 1: Threat Indicators, File hashes and reputation data, Technical sources: honeypots and scanners, Industry sources: malware and reputation feeds. Level 2: Threat Data Feeds, Cyber threat statistics, reports, and surveys, Malware analysis. Level 3: Strategic Cyber Threat Intelligence, Monitoring the underground, Motivation and intentions, Tactics, techniques, and procedures.

**Analyzing and Disseminating Cyber Threat Intelligence:** Information versus Intelligence, Validation and Prioritization: Risk scores, Tags for context, Human assessment. Interpretation and Analysis: Reports, Analyst skills, Intelligence platform, Customization. Dissemination: Automated feeds and APIs, Searchable knowledge base, Tailored reports.

**Unit 4** **16 hours**

**Selecting the Right Cyber Threat Intelligence Partner:** Types of Partners: Providers of threat indicators, Providers of threat data feeds, Providers of comprehensive cyber threat intelligence. Important Selection Criteria: Global and cultural reach, Historical data and knowledge, Range of intelligence deliverables, APIs and integrations, Intelligence platform, knowledge base, and portal, Client services, Access to experts. Intelligence-driven Security.

**Suggested Readings**

2. Jon Friedman. Mark Bouchard, CISSP. Foreword by John P. Watters. (2015) **Cyber Threat** Intelligence.**Definitive** GuideTM.

**Course Code** **CST. 555**
**Course Name** **Operations Research**
**Credits** **4**

**Course Outcomes:**
At the end of the course, the student should be able to
Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
Students should able to apply the concept of non-linear programming
Students should able to carry out sensitivity analysis
Student should able to model the real world problem and simulate it.



**CONTENTS**

**Unit 1** **9 hours**

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

**Unit 2** **10 hours**

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

**Unit 3** **14 hours**

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

**Unit 4** **15 hours**

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.
Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

**Suggested Readings**

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008

4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

**Course Code** **CST.556**
**Course Name** **Cost Management of Engineering Projects**
**Credits** **4**

**CONTENTS**

**Unit 1** **11 hours**

**Introduction and Overview of the Strategic Cost Management Process**

Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

**Unit 2** **14 hours**

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance.

Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process



**Unit 3** **14 hours**

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints.

**Unit 4** **15 hours**

Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

**Suggested Readings**

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

**Course Code** **CBS.553**
**Course Name** **Cyber Law**
**Credits** **4**

**Objective:** The objective of this course is to provide knowledge about the basic information on IT Act and Cyber law as well as the legislative and judicial development in the area.

**Course Outcomes:** By the end of this Course, students should be able to:

- Analyze fundamentals of Cyber Law
- Discuss IT Act & its Amendments
- Relate Cyber laws with security incidents.



**CONTENTS**

**UNIT–I** **9 hours**

Concept of Cyberspace, Issues of Jurisdiction in Cyberspace: Jurisdiction Principles under International law, Jurisdiction in different states, Position in India. Conflict of Laws in Cyberspace, International Efforts for harmonization Privacy in Cyberspace.

**UNIT – II** **13 hours**

Electronic Commerce, Cyber Contract, Intellectual Property Rights and Cyber Laws

UNCITRAL Model Law, Digital Signature and Digital Signature Certificates, E-Governance and Records.

**UNIT – III** **14 hours**

Define Crime, *Mens Rea*, Crime in Context of Internet, Types of Cyber Crime, Computing Damage in Internet Crime, Offences under IPC (Indian Panel Code, 1860), Offences & Penalties under IT Act 2000, IT Act Amendments, Investigation & adjudication issues, Digital Evidence.

**UNIT–IV** **14 hours**

Obscenity and Pornography, Internet and potential of Obscenity, International and National Instruments on Obscenity & Pornography, Child Pornography, Important Case Studies.

**Suggested Readings**


1. Cyber Law in India – Dr. Farooq Ahmad
2. Cyber Laws – J.P. Sharma, Sunaina Kanojia
3. Cyber Laws and IT Protection – Harish Chander
4. Cyber Laws – Justice Yatindra Singh
5. An Introduction to cyber crime and cyber law – Prof. R.K. Chaubey
6. Understanding Laws – Garima Tiwari
7. Computers Internet and New Technology Laws – Karnika Seth, Justice Altamas Kabir


**Course Code** **CST.555**
**Course Name** **Software Matrics**
**Credits** **4**



**Course Objectives:**

Understand the underlying concepts, principles and practices in Software Measurements. Designing of Metrics model for software quality prediction and reliability.

**Course Outcomes:**

Upon completion of this course, the students will be able to:

- Able to learn role software Metrics in Industry size software
- Empirical investigation of software for a quality measurement.
- Understand and identify software reliability and problem solving by designing and selecting software reliability models.

**CONTENTS**

**Unit-I** **14 hours**

**Overview of Software Metrics:** Measurement in Software Engineering, Scope of Software Metrics, Measurement and Models Meaningfulness in measurement, Measurement quality, Measurement process, Scale, Measurement validation, Object-oriented measurements,

**Goal based framework for software measurement:** Software measure classification, Goal-Question-Metrics(GQM) and Goal-Question-Indicator-Metrics (GQIM),Applications of GQM and GQIM.

**Unit-II** **15 hours**

**Empirical Investigation:** Software engineering investigation, Investigation principles, Investigation techniques, Planning Formal experiments, Case

Studies for Empirical investigations

**Object–oriented metrics:** Object-Oriented measurement concepts, Basic metrics for OO systems, OO analysis and design metrics, Metrics for productivity measurement, Metrics for OO software quality.

**Unit-III** **16 hours**

**Measuring Internal Product attributes:** Software Size, Length, reuse, Functionality, Complexity, Software structural measurement, Control flow structure, Cyclomatic Complexity, Data flow and data structure attributes Architectural measurement.

**Measuring External Product attributes:** Software Quality Measurements, Aspectes of Quality Measurements, Maintainability Measurements, Usability and Security Measurements.

**Unit-IV** **13 hours**

**Measuring software Reliability:** Concepts and definitions, Software reliability models and metrics, Fundamentals of software reliability engineering (SRE), Reliability management model.

**Suggested Readings**


1. Norman E. Fenton, S. L. P fleeger, "Software Metrics: A Rigorous and Practical Approach", published by International Thomson Computer Press, 2/e, 1998.
2. Stephen H. Kan, "Metrics and Models in Software Quality Engineering", Addison-Wesley Professional, 2/e, 2002.
3. Basu Anirban, "Software Quality Assurance, Testing and Metrics", Prentice Hall India Learning Private Limited, 2015
4. Robert B. Grady, "Practical Software Metrics for Project Management And Process Improvement", Prentice Hall, 1992.
5. Maxwell Katrina D., "Applied Statistics for Software Managers", Prentice Hall PTR, 2002

**Course Code** **CST. 600**
**Course Name** **Dissertation**
**Credits**
**Objectives:**

1.The student shall have to write his/ her synopsis including an extensive review of literature with simultaneous identification of scientifically sound (and achievable) objectives backed by a comprehensive and detailed methodology. The students shall also present their synopsis to the synopsis approval committee.

2.The second objective of Dissertation would be to ensure that the student learns the nuances of the scientific research. Herein the student shall have to carry out the activities/experiments to be completed during Dissertation (as mentioned in the synopsis).

The students would present their work to the Evaluation Committee (constituted as per the university rules). The evaluation criteria shall be as detailed below:

**Evaluation criteria for Synopsis:**

| **Evaluation Parameter** | **Marks** | **Evaluated by** |
|---|---|---|
| Review of literature | 50 | **Internal Evaluation by Dean of School, HOD/ HOD nominee, Two faculty member nominated by Dean/HOD, Supervisor.** |
| Identification of gaps in knowledge and Problem Statement, Objective formulation & Methodology | 50 | |
| **Total** | **100** | |



Student will be given final marks based the average marks by the Evaluation Committee

**Timeline Works for Synopsis and Mid-Term:**

| **Month** | **JULY** | **AUG** | **SEP** | **OCT** | **NOV** | **DEC** |
|---|---|---|---|---|---|---|
| **Synopsis** | Bi-Weekly report submitted to Supervisor | Submission of Synopsis and Presentation | | | | |
| **Mid- Term** | | | Bi-Weekly report | Report submission in 3rd week | Final Submission of Mid | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | submitted to Supervisor | Final Presentation in 4th week | Term Report | |

**Grading of Marks:**

| **Grades** | A | B | C | D | E |
|---|---|---|---|---|---|
| **Marks** | 85-100 | 84-75 | 74-65 | 64-40 | 0-40 |

**Grading Evaluation:**

| **Abbreviations of Grades** | **Grades** |
|---|---|
| Excellent | A |
| Very Good | B |
| Good | C |
| Average | D |
| Below Average/ Un-Satisfactory | E |



**Evaluation criteria for Mid-Term:**

| **Evaluation Parameter** | **Maximum Marks** | **Evaluated By** |
|---|---|---|
| Mid Term Review and Presentation | 50 | **Internal/External Evaluation by Dean of School, HOD/ HOD nominee, Two faculty member nominated by Dean/ HOD, Supervisor.** |
| Continuous evaluation | 50 | |
| **Total** | **100** | |

**Seminar with Minor Project Evaluation:**

In this, the student has to select an area and specify the objectives to be achieved.

Evaluation criteria will be based on objective stated and achieved

**Timeline Work of Seminar:**

| **Month** | **AUG** | **SEP** | **NOV** |
|---|---|---|---|

| | | | |
|---|---|---|---|
| **Seminar** | Submit area and Objectives to be achieved | Weekly report to faculty Incharge. | • 3rd week submit report<br>• 4th week Presentation |

**Evaluation Criteria:**

| Evaluation Parameter | Marks | Evaluated By |
|---|---|---|
| Area & Objectives | 5 | **Evaluation Committee** |
| Reports and Implementation | 10 | |
| Presentation and Viva-voce | 10 | |
| **Total** | **25** | |

Student will be given final marks based the average marks by the Evaluation Committee

**Semester IV**

**Course Code** **CST. 600**
**Course Name** **Dissertation/Industrial Project**
**Credits**

**Objective:**

In Dissertation the student shall have to carry out the activities/experiments to be completed during Dissertation (as mentioned in the synopsis). The students would present their work to the evaluation Committee (constituted as per the university rules). One research paper (either accepted or published) out of the dissertation research work is compulsory. The Evaluation criteria shall be as detailed below:

| Evaluation Parameter | Maximum Marks | Evaluated By |
|---|---|---|
| Parameters by External Expert (As per University Criteria) | 50 | **Internal/External Evaluation by Dean of School, DAA Nominee, HOD/ HOD nominee, Supervisor.** |
| Presentation and defence of research work | 50 | |
| **Total** | 100 | |

Student will be given final marks based the average marks by the Evaluation Committee

**Timeline Work of Dissertation:**

| Month | JAN | FEB | MAR | APR | MAY | JUN |
|---|---|---|---|---|---|---|
| **Dissertation** | Bi-Weekly report submitted to Supervisor | Bi-Weekly report submitted to Supervisor | Report submission in 1st week | Pre-Submission Presentation in 3st week Report submission in 4th week | Final Submission of Dissertation / Industrial Project and External Evaluation | |

**Grading of Marks:**

| Grades | A | B | C | D | E |
|---|---|---|---|---|---|
| **Marks** | 85-100 | 84-75 | 74-65 | 64-40 | 0-40 |



**Grading Evaluation:**

| Abbreviations of Grades | Grades |
|---|---|
| Excellent | A |
| Very Good | B |
| Good | C |
| Average | D |
| Below Average/ Un-Satisfactory | E |