ADAMAS UNIVERSITY

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

POSTGRADUATE PROGRAM

Course Structure and Syllabus

M. Tech (Computer Science and Engineering)

W.e.f. AY 2022-23

ADAMAS UNIVERSITY, KOLKATA
SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

VISION OF THE UNIVERSITY

To be an internationally recognized university through excellence in inter-disciplinary education, research and innovation, preparing socially responsible well-grounded individuals contributing to nation building.

MISSION STATEMENTS OF THE UNIVERSITY

M.S 01: Improve employability through futuristic curriculum and progressive pedagogy with cutting-edge technology

M.S 02: Foster outcomes based education system for continuous improvement in education, research and all allied activities

M.S 03: Instill the notion of lifelong learning through culture of research and innovation

M.S 04: Collaborate with industries, research centres and professional bodies to stay relevant and up-to-date

M.S 05: Inculcate ethical principles and develop understanding of environmental and social realities

CHANCELLOR / VICE CHANCELLOR

ADAMAS UNIVERSITY, KOLKATA
SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

VISION OF THE SCHOOL

To develop well-grounded, socially responsible engineers and technocrats in a way to create a transformative impact on Indian society through continual innovation in education, research, creativity and entrepreneurship.

MISSION STATEMENTS OF THE SCHOOL

M.S. 01: Build a transformative educational experience through disciplinary and inter-disciplinary knowledge, problem solving, and communication and leadership skills.

M.S. 02: Develop a collaborative environment open to the free exchange of ideas, where research, creativity, innovation and entrepreneurship can flourish among individual students.

M.S. 03: Impact society in a transformative way – regionally and nationally - by engaging with partners outside the borders of the university campus.

M.S. 04: Promote outreach programs which strives to inculcate ethical standards and good character in the minds of young professionals.

DEAN / SCHOOL CONCERNED

ADAMAS UNIVERSITY, KOLKATA
SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

VISION OF THE DEPARTMENT

Graduates of the Department of Computer Science and Engineering will be recognized as innovative leaders in the fields of computer science and software engineering. This recognition will come from their work in software development in a myriad of application areas, as well as through their work in advanced study and research. The faculty is, and will continue to be, known for their passion for teaching and for their knowledge, expertise, and innovation in advancing the frontiers of knowledge in computer science and software engineering.

MISSION STATEMENTS OF THE DEPARTMENT

M.S 01: Our mission is to teach and prepare liberally educated, articulate, and skilled computer scientists and software engineers for leadership and professional careers and for advanced study.

M.S 02: A central objective of our program is to contribute to society by advancing the fields of computer science and software engineering through innovations in teaching and research, thus enhancing student knowledge through interactive instruction, global engagement, and experiential learning.

M.S 03: The program will serve as a resource to inform society about innovations related to the production and uses of computers and software.

M.S 04: To impart moral and ethical values, and interpersonal skills to the students.

HEAD OF THE DEPARTMENT **DEAN / SCHOOL CONCERNED**

ADAMAS UNIVERSITY, KOLKATA
SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Name of the Programme: M.Tech (Computer Science and Engineering)

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO 01: To prepare professionals who will have successful career in industries, academia, research and entrepreneurial endeavors.

PEO 02: To prepare graduates who will demonstrate analytical, research, design and implementation skills offering techno-commercially feasible and socially acceptable solutions to real life problems.

PEO 03: To prepare graduates who will thrive to pursue life-long learning and contribute to society as an ethical and responsible citizen.

HEAD OF THE DEPARTMENT	**DEAN / SCHOOL CONCERNED**

ADAMAS UNIVERSITY, KOLKATA
SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Name of the Programme: M.Tech (Computer Science and Engineering)

GRADUATE ATTRIBUTES/PROGRAMME OUTCOMES

GA 01 / PO 01: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

GA 02 / PO 02: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching sustained conclusions using first principles of mathematics, natural sciences, and engineering sciences.

GA 03 / PO 03: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

GA 04 / PO 04: Conduct Investigations of Complex Computing Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.

GA 05 / PO 05: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

GA 06 / PO 06: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

GA 07 / PO 07: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

GA 08 / PO 08: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

GA 09 / PO 09:Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

GA 10 / PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

GA 11 / PO 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

GA 12 / PO 12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

HEAD OF THE DEPARTMENT **DEAN / SCHOOL CONCERNED**

ADAMAS UNIVERSITY

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

PG Program: M.Tech (Computer Science and Engineering)

COURSE STRUCTURE

FIRST YEAR

SEMESTER I							
S.No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**H**	**C**
1	CSE21841	Advanced Database Management systems	3	0	0	3	3
2	CSE21842	Soft Computing	3	0	0	3	3
3	CSE21843	Advanced Graph Theory	3	0	0	3	3
4	CSE21844	Foundation of Computer Science	3	1	0	3	4
5	CSE22845	Applied Computing Lab -I	3	0	2	3	2
Total			**12**	**1**	**2**	**15**	**15**

SEMESTER II							
S.No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**H**	**C**
1		Elective – I	3	0	0	0	3
	CSE21846	Blockchain and Cryptocurrency					
	CSE21847	Software Process Management					
	CSE21848	Natural Language Processing					
2		Elective – II	3	0	0	0	3
	CSE21849	Computer Forensics					
	CSE21850	Software Architecture					
	CSE21851	Computer Vision					
3		Elective – III	3	0	0	0	3
	CSE21852	Introduction to Information Security Management					
	CSE21853	Software Security					
	CSE21854	Social Network Analysis					
4	CSE21855	Research Methodologies	2	0	0	2	2
5	CSE21856	Parallel and Distributed Computing	3	0	0	3	3
6	CSE22857	Applied Computing Lab-II	0	0	2	2	3
Total			**14**	**0**	**2**	**16**	**17**

1st Year Credits = 32

SECOND YEAR

SEMESTER III							
S.No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**H**	**C**
1		Elective – IV	3	0	0	3	3
	CSE21858	Advanced Network Security					
	CSE21859	Data Mining					
	CSE21860	Computational Biology					
2	CSE25861	Thesis – I	0	0	24	24	16
3	CSE25862	Seminar – I	0	0	6	6	4
Total			**3**	**0**	**30**	**33**	**23**

SEMESTER IV							
S.No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**H**	**C**
1	CSE25863	Thesis-II	0	0	27	27	18
2	CSE25864	Seminar-II	0	0	6	6	3
3	CSE25865	Grand Viva	0	0	0	0	4
Total			**0**	**0**	**33**	**33**	**26**

2nd Year Credits Total : 49

CREDIT DISTRIBUTION (SEMESTER-WISE)

SEM I	SEM II	SEM III	SEM IV	TOTAL
15	**17**	**23**	**26**	**81**

CREDIT DISTRIBUTION (YEAR-WISE)

YEAR I	YEAR II	Total
32	**49**	**81**

Year- I
Semester-I

CSE21841	**Advanced Database Management systems**	**L**	**T**	**P**	**C**
Version 1.0	**Contact Hours – 45 Hours**	**3**	**0**	**0**	**3**
Pre-requisite/Exposure	**Database Management systems**				
Co-requisite	**NA**				

Course Objectives:

1. To learn different types of databases.
2. To be exposed to query languages.
3. To be familiar with the indexing techniques.

Course Outcomes:

On the completion of this course the student will be able to

CO1: **Understand** the different types of databases.
CO2: **Illustrate** the concepts of Use query languages.
CO3: **Apply** indexing techniques.
CO4: **Examine** case studies on design database.

Course Description:

Database management systems are at the core of computer applications that need to store, manipulate, and query data. This course takes a deep dive into how modern database systems function internally, from studying their high-level design to understanding the underlying data structures and algorithms used for efficient data processing. The course covers a range of data management techniques from both commercial systems and cutting-edge research literature, enabling students to apply these techniques to other fields of computer science.

The covered topics include database architecture, storage manager, data models (row, columnar), indexing (tree-based, hash tables), transaction processing (ACID, concurrency control), crash recovery, parallel architectures (multi-core, distributed), cloud databases, and ML in databases. These topics will be valuable to students who plan to work in the data science industry but also to students who want to do research in the area of data management. The programming component of this course will allow students to develop first-hand experience working with database systems that goes beyond writing SQL queries.

Course Content:

Unit-I	**9 Lecture Hours**
PARALLEL AND DISTRIBUTED DATABASES Inter and Intra Query Parallelism – Architecture – Query evaluation – Optimization – Distributed Architecture – Storage – Catalog Management – Query Processing - Transactions – Recovery - Large-scale Data Analytics in the Internet Context – Map Reduce Paradigm - run-time system for supporting scalable and fault-tolerant execution - paradigms: Pig Latin and Hive and parallel databases versus Map Reduce.	
Unit-II	**9 Lecture Hours**
ACTIVE DATABASES Syntax and Sematics (Starburst, Oracle, DB2) – Taxonomy – Applications – Integrity Management – Workflow Management – Business Rules – Design Principles – Properties – Rule Modularization – Rule Debugging – IDEA methodology – Open Problems.	
Unit-III	**9 Lecture Hours**
TEMPORAL AND OBJECT DATABASES Overview – Data types – Associating Facts – Temporal Query Language – TSQL2 – Time Ontology – Language Constructs – Architecture – Temporal Support – Object Database and Change Management – Change of Schema – Implementing Database Updates in O2 – Benchmark Database Updates – Performance Evaluation.	
Unit-IV	**9 Lecture Hours**
COMPLEX QUERIES AND REASONING Logic of Query Languages – Relational Calculi – Recursive rules – Syntax and semantics of Data log – Fix point semantics – Implementation Rules and Recursion – Rule rewriting methods – Compilation and Optimization – Recursive Queries in SQL – Open issues.	
Unit-V	**9 Lecture Hours**
SPATIAL, TEXT AND MULTIMEDIA DATABASES Traditional Indexing Methods (Secondary Keys, Spatial Access Methods) – Text Retrieval – Multimedia Indexing – 1D Time Series – 2d Color images – Sub pattern Matching – Open Issues – Uncertainties.	
Text Books: 1. Raghu Ramakrishnan "Database Management System", Mc Graw Hill Publications, 2000. **Reference Books:** 1. 1. Carlo Zaniolo, Stefano Ceri "Advanced Database Systems", Morgan Kauffmann Publishers.VLDB Journal, 1997 2. 2. Abraham Silberschatz, Henry F. Korth and S. Sudharshan, "Database System Concepts", Sixth Edition, Tata McGraw Hill, 2011	

Modes of Evaluation: Quiz/Assignment/Presentation/Extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
Course Outcomes (COs)		**Mapped Program Outcomes**
CO1	**Understand** the different types of databases.	PO1, PO2, PO3, PO4
CO2	**Illustrate** the concepts of Use query languages.	PO1, PO2, PO3, PO5, PO7
CO3	**Apply** indexing techniques.	PO1, PO2, PO3, PO4
CO4	**Examine** case studies on design database.	PO1, PO2, PO3,

		Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
Course Code	**Course Title**	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CSE21841	**Advanced Database Management systems**	3	3	3	2	1	-	1	-	-	-	-	-

1 = Weakly Mapped
2 = Moderately Mapped
3 = Strongly Mapped

CSE21842	Soft Computing	L	T	P	C
Version 1.0	Contact Hours – 45 Hours	3	0	0	3
Pre-requisite/Exposure	Artificial Intelligence				
Co-requisite	High School Mathematics				

Course Objectives:

1. To understand theoretical foundations and basics of soft computing.
2. To introduce the ideas of fuzzy sets, fuzzy logic and fuzzy inference system.
3. To impart knowledge on theory and applications of Neural Networks.
4. To introduce basics of genetic algorithms and their applications in optimization and planning.

Course Outcomes:

On the completion of this course the student will be able to

CO1: **Understand** the fundamentals of computing techniques.
CO2: **Illustrate** the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic
CO3: **Study** on various artificial neural network architecture.
CO4: **Apply** genetic algorithm and its types for solving optimization problem.
CO5: **Examine** case studies on soft computing techniques on emerging fields.

Course Description:

The main objective of the course is to expose the students to soft computing, various types of soft computing techniques, and applications of soft computing. This course introduces soft computing methods which, unlike hard computing, are tolerant of imprecision, uncertainty and partial truth. This tolerance is exploited to achieve tractability, robustness and low solution cost. The principal constituents of soft computing are fuzzy logic, neural network theory, and probabilistic reasoning. The course studies the methods and explores how they are employed in associated techniques such as Case-Based Reasoning and expert systems for pattern recognition, clustering, diagnosis, and control both individually and in hybrid arrangement. The basics of each technique will be discussed, and industrial applications will illustrate the strengths of each approach.

Course Content:

Unit-I	**9 Lecture Hours**
Introduction to data driven concepts: Introduction: What is soft computing? Differences between soft computing and hard computing, Soft Computing constituents, Methods in soft computing, Applications of Soft Computing **Introduction To Fuzzy systems** Introduction : Fuzzy logic, Crisp sets, Operations of Crisp set, Properties: Fuzzy set and Crisp set	
Unit-II	**9 Lecture Hours**
Introduction To Fuzzy relations and Classical relations Cartesian Product, Classical Relations: cardinality, operations, properties, Fuzzy relations, Membership Functions, Fuzzy Rules & Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making, Defuzzification: Alpha-cuts, lambda-cuts, methods	
Unit-III	**9 Lecture Hours**
Artificial Neural Network Concept, biological neural system, Evolution of neural network, McCulloch-Pitts neuron model, activation functions, feed-forward networks, feedback networks, learning rules – Hebbian, Delta, Perceptron learning, applications of neural networks to pattern recognition systems such as character recognition, face recognition, application of neural networks in image processing.	
Unit-IV	**9 Lecture Hours**
Genetic Algorithm Introduction to Genetic Algorithms: Introduction to Genetic Algorithms (GA), Representation, Operators in GA, Fitness function, population, building block hypothesis and schema theorem. Genetic algorithms operators: Methods of selection, crossover and mutation, Simple GA(SGA), other variant of GA, generation gap, steady state GA, Applications of GA.	
Unit-V	**9 Lecture Hours**
Applications of Soft Computing Optimization of Travelling Salesman Problem using Genetic Algorithm approach: Problem Representation, algorithms, mutation methods, Hybrid fuzzy controller: neuro-fuzzy system, directive drive motor, Bayesian belief networks, Rocket engine control, etc.	

Text Books:

1. Principle of soft computing, S.N. Shivanandam, Wiley. ISBN13: 9788126527410, 2011.
2. Neuro-Fuzzy and Soft Computing, Jyh-Shing Roger Jang, Chuen-Tsai Sun, EijiMizutani, Prentice Hall of India, 2003.
3. Fuzzy Sets and Fuzzy Logic-Theory and Applications, George J. Klir and Bo Yuan, Prentice Hall, 1995.

Reference Books:

1. Neural Networks Algorithms, Applications, and Programming Techniques", James A. Freeman and David M. Skapura, Pearson Education, 2003.
2. Genetic Algorithms in Search, Optimization & Machine Learning", David E. Goldberg, Addison Wesley, 1997.

3. An Introduction to Genetic Algorithm, Mitchell Melanie, Prentice Hall, 1998

Modes of Evaluation: Quiz/Assignment/Presentation/Extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
Course Outcomes (COs)		Mapped Program Outcomes
CO1	**Understand** the fundamentals of computing techniques.	PO1, PO2, PO3, PO4
CO2	**Illustrate** the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy	PO1, PO2, PO3, PO5, PO7
CO3	**Study** on various artificial neural network architecture.	PO1, PO2, PO3, PO4
CO4	**Apply** genetic algorithm and its types for solving optimization problem.	PO1, PO2, PO3,
CO5	**Examine** case studies on soft computing techniques on emerging fields.	PO11, PO12,

		Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
Course Code	**Course Title**	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CSE21842	Soft Computing	3	3	3	3	3	1	-	-	-	-	-	-

1 = Weakly Mapped
2 = Moderately Mapped
3 = Strongly Mapped

CSE21843	Advance Graph Theory	L	T	P	C
Version 1.0	Contact Hours – 45 Hours	3	0	0	3
Pre-requisite/Exposure	Data Structure				
Co-requisite					

Course Objectives:

1. To understand and apply the fundamental concepts in graph theory.
2. To apply graph theory-based tools in solving practical problems.
3. To improve the proof writing skills.
4. To state the theorems and prove formally using various techniques.
5. To understand various graphs algorithms and analyse them.

Course Outcomes:

On the completion of this course, the student will be able to

CO1: **Understand** the different distance measures in graphs. Define the special types of graphs- complete graph, regular graph, bipartite graph and their properties.

CO2: **Discuss** the properties of trees, Minimal Spanning Tree, Breadth First Search, Depth First Search, Hauffman Trees.

CO3: **Discuss** the properties of trees, Arboricity, vertex and edge connectivity, auto-morphism groups, reconstruction problem and Mengers theorem.

CO4: **Interpret** algorithms and methods for Graph Colouring and Connectivity.

CO5: **Discuss** the properties of Planner Graphs and Ramsey Graphs.

Course Description:

This course is aimed to cover a variety of different problems in Graph Theory with an emphasis on applications and modelling. Graph theory is a study of graphs, trees and networks. In this course students will come across a number of theorems and proofs. Theorems will be stated and proved formally using various techniques. Topics that will be discussed include Euler formula, Hamilton paths, planar graphs and coloring problem; the use of trees in sorting and prefix codes; useful algorithms on networks such as shortest path algorithm, minimal spanning tree algorithm and min-flow max-cut algorithm.

Course Content:

Unit-I: Introduction	**10 Lecture Hours**
Unit Heading: Graph – definition; Degree sequences, Different distance measures in graphs, Special types of graphs – complete graph, regular graph, bipartite graph and their properties. Havel-Hakimi theorem and Erdos-Gallai theorem (statement only), hypercube graph, Petersen graph, trees, forests and spanning subgraphs, distances, radius, diameter, center of a graph, the number of distinct spanning trees in a complete graph.	
Unit-II: Trees	**5 Lecture Hours**
Unit Heading: Kruskal and Prim algorithms with proofs of correctness, Dijkstra's a algorithm, Breadth first and Depth first search trees, rooted and binary trees, Huffman's algorithm.	
Unit-III: Structure and Symmetry	**8 Lecture Hours**
Unit Heading: Cut vertices, bridges and blocks, auto-morphism groups, reconstruction problem. Trees and Connectivity: Properties of trees, Arboricity, vertex and edge connectivity, Mengers theorem . augmenting path, Hall's matching theorem, vertex and edge cover, independence number and their connections, Tutte's theorem for the existence of a 1- factor in a graph	
Unit-IV: Connectivity and Graph Colouring	**12 Lecture Hours**
Unit Heading: Graph Connectivity: k-vertex and edge connectivity, blocks, characterizations of 2- connected graphs, Menger's theorem and applications, Network flows, Ford- Fulkerson algorithm, Supply-demand theorem and the Gale-Ryser theorem on degree sequences of bipartite graphs **Graph Colouring:** Chromatic number, Greedy algorithm, bounds on chromatic numbers, interval graphs and chordal graphs (with simplicial elimination ordering), Brook's theorem and graphs with no triangles but large chromatic number, chromatic polynomials.	
Unit-V: Planar graphs and Ramsey theory	**10 Lecture Hours**
Unit Heading: Planner Graph: Embedding a graph on plane, Euler's formula, non-planarity of K5 and K3,3, classification of regular polytopes, Kuratowski's theorem (no proof), 5-colour theorem. **Ramsey Theory**: Bounds on R(p, q), Bounds on Rk(3): colouring with k colours and with no monochromatic K3, application to Schur's theorem, Erdos and Szekeres theorem on points in general position avoiding a convex m-gon.	
Text Books: 2. D. B. West, Introduction to Graph Theory, Prentice Hall of India, 2001. 3. J. A. Bondy and U. S. R. Murty, Graph Theory with Applications, Springer-Verlag, 2008 **Reference Books:** 1. R. Diestel, Introduction to Graph Theory, Springer-Verlag, 2010.	

Modes of Evaluation: Quiz/Assignment/Presentation/Extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
Course Outcomes (COs)		Mapped Program Outcomes
CO1	Understand the different distance measures in graphs. Define the special types of graphs- complete graph, regular graph, bipartite graph and their properties	PO1, PO2
CO2	Discuss the properties of trees, Minimal Spanning Tree, Breadth First Search, Depth First Search, Hauffman Trees	PO1,PO2, PO3

CO3	Discuss the properties of trees, Arboricity, vertex and edge connectivity, auto-morphism groups, reconstruction problem and Mengers theorem	PO1,PO2
CO4	Interpret algorithms and methods for Graph Colouring and Connectivity	PO1, PO2, PO3
CO5	Discuss the properties of Planner Graphs and Ramsey Graphs.	PO1, PO2, PO3

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CSE21843	Advance Graph Theory	3	3	3	-	-	-	-	-	-	-	-	-

1 = Weakly Mapped
2 = Moderately Mapped
3 = Strongly Mapped

CSE21844	Foundation of Computing Science	L	T	P	C
Version 1.0	Contact Hours – 60 Hours	3	1	0	4
Pre-requisite/Exposure	Discrete Mathematics, Programming Concepts				
Co-requisite	NIL				

Course Objectives:

1. To develop an in-depth understanding of the Propositional Logic, Propositional Calculus and Predicate Calculus, Inference Rules, Boolean Algebra, Sets, Relation and Function, Algebraic Structures and Morphism,.
2. Students should be able to demonstrate application using the above mathematical tools in computer science engineering.
3. Design grammars and recognizers for different formal languages
4. Prove or disprove theorems in automata theory using its properties
5. Determine the decidability and intractability of computational problems

Course Outcomes:

On the completion of this course the student will be able to

CO1. Define the fundamental knowledge to state the mathematical skills in basic and advance algebraic structures.

CO2. **Define** the fundamental knowledge to state the mathematical skills in Discrete Structure & Logic and allied fields.

CO3. Define the basic concepts in formal language theory, grammars, automata theory, Computability Theory, and complexity theory.

CO4. **Demonstrate** abstract models of computing, including deterministic (DFA), non-Deterministic (NFA), Push Down Automata (PDA) and Turing (TM) machine models and their power to recognize the languages.

CO5. **Prove** and disprove theorems establishing key properties of formal languages and automata.

Course Description:

For any program related to Computer Science study of computational Mathematics is very much important. The purpose of this course is to understand and use (abstract) discrete structures and advance algebraic structure that are backbones of computer science. In particular, this course is meant to introduce logic, proofs, sets, relations, functions, counting, and recurrence relation, with an emphasis on applications in computer science.

Course Content:

Unit-I	**12 Lecture Hours**
Discrete Structures: Sets, Relations and Functions, Morphisms; Posets and Lattices, Boolean algebra, Proof Techniques: Inductive and Deductive Reasoning, Proof by Contradiction; Recurrence Relations, Algebraic Structures – Semigroup, Monoid, Group, Ring and Field.	
Unit-II	**12 Lecture Hours**
Logic: Statements and Symbolic Representation, Propositional Calculus and Predicate Calculus, Inference Rules, Satisfiability and Validity, Resolution Principle, Notions of Soundness and Completeness.	
Unit-III	**15 Lecture Hours**
Automata and Languages: Strings, Phrase Structured Grammar and Formal Languages: Finite Automata and Regular Expressions, Closure Properties of Regular Languages, Pumping Lemma and Non-Regular Languages. Context Free Languages (CFL) and Pushdown Automata (PDA), Normal Forms of Context Free Languages, Closure Properties of CFLs, Pumping Lemma and Non-Context Free Languages, Deterministic Pushdown Automata and DCFLs. Chomsky Hierarchy of Grammars and Corresponding Acceptors ; Turing Machines, and Type 0 Languages, Recursive and Recursively Enumerable Languages, Turing Computable Functions, Primitive and μ-recursive functions.	
Unit-IV	**13 Lecture Hours**
Computability: Church-Turing Thesis, Decision Problems, Decidability and Undecidability, Universal Turing Machine, Halting Problem of Turing Machines, Problem Reduction (Turing and Mapping Reduction).	
Unit-V	**8 Lecture Hours**
Computational Complexity: Time and Space Complexity Measures; Class P and Class NP and Co-NP problems NP-Completeness.	

Text Books:

1. T1. Kenneth H. Rosen,Discrete Mathematics and its Applications, Tata McGraw - Hill.
2. T2. V Somasundaram, Discrete Mathematics with Graph Theory and Combinatory, Tata McGraw-Hill.
3. T3. C L Liu and D P Mohapatra, Elements of Discrete Mathematics A Computer Oriented Approach, 3rd Edition by, Tata McGraw – Hill.

Reference Books:

1. Norman L. Biggs, Discrete Mathematics, 2nd Edition, Oxford University Press.
2. Discrete Mathematics for Computer Science", Illustrated Edition, Kenneth Bogart, Clifford Stein, Robert L. Drysdale, Key College Publishing.

Modes of Evaluation: Quiz/Assignment/Presentation/Extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
Course Outcomes (COs)		Mapped Program Outcomes
CO1	**Define** the fundamental knowledge to state the mathematical skills in basic and advance algebraic structures.	**PO1, PO2**
CO2	**Define** the fundamental knowledge to state the mathematical skills in Discrete Structure & Logic and allied fields.	**PO1, PO2**
CO3	**Define** the basic concepts in formal language theory, grammars, automata theory, Computability Theory, and complexity theory.	**PO1, PO2, PO4**
CO4	**Demonstrate** abstract models of computing, including deterministic (DFA), non- Deterministic (NFA), Push Down Automata (PDA) and Turing (TM) machine models and their power to recognize the languages.	**PO2, PO3, PO5**
CO5	**Prove** and disprove theorems establishing key properties of formal languages and automata.	**PO3, PO4**

		Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
Course Code	**Course Title**	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CSE21844	Foundation of Computing Science	3	3	2	2	1	-	-	-	-	-	-	-

1 = Weakly Mapped
2 = Moderately Mapped
3 = Strongly Mapped

CSE22845	Applied Computing Lab-I	L	T	P	C
Version 1.0	Contact Hours – 30 Hours	0	0	2	2
Pre-requisite/Exposure	C Programming				
Co-requisite	NIL				

Course Objectives:

1. To accumulate knowledge about Python programming basics.
2. To learn about designing and programming Python applications.
3. To learn how to apply lists, tuples and dictionaries in Python programs.
4. To understand about PLSQL connection in Python.

Course Outcomes:

On the completion of this course the student will be able to

CO1: **Apply** the basic concept of python programming and to **construct** a real-life application.
CO2: **Examine** different library and tools associated with python.
CO3: **Apply** object oriented Python programming concepts to design solutions to problems.
CO4: **Construct** database connection with Python using PLSQL

Course Description:

This course offers an introduction to the fundamental concepts in Python programming. It covers the core concepts using sequential execution, conditional execution, loops, variables and functions. The students get to learn about designing user-defined functions and applying various data structures such as lists, tuples and dictionaries etc. The concepts of object oriented programming in Python is discussed in details. The students will also be enabled to learn about connecting database with Python application.

Course Content:

Unit-I	**6 Lecture Hours**
1. Python program to demonstrate basic data types. 2. Python program to demonstrate operators 3. Python program to illustrate sequential execution of statements for solving basic problems such as power of a number, factorial of a number.	
Unit-II	**6 Lecture Hours**
4. Python program to demonstrate loops. 5. Python program to demonstrate arrays. 6. Python program to demonstrate string handing methods.	
Unit-III	**6 Lecture Hours**
7. Introduction to Additional useful string methods 8. String formatting, running Python as a script 9. The basics of functions, functional programming	
Unit-IV	**6 Lecture Hours**
10. Python program to demonstrate list operations 11. Python program to demonstrate tuple operations 12. Python program to demonstrate dictionary operations	
Unit-V	**6 Lecture Hours**
13. Python program to demonstrate file handling operations 14. Python program to demonstrate various package usage such as numpy, matplotlib etc. 15. Python program to demonstrate database connection using PL/SQL	

Text Books:

1. ‘‘Python Cookbook: Recipes for Mastering Python 3” by Brian K. Jones and David M. Beazley.

Reference Books:

1. “Programming Python” by Mark Lutz.
2. “How to think like a computer scientist: Learning with Python” by Allen B. Downey.

Modes of Evaluation: Quiz/Assignment/Presentation/Extempore/ Written Examination

Examination Scheme:

Components	Internal	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
Course Outcomes (COs)		Mapped Program Outcomes
CO1	**Apply** the basic concept of python programming and to construct a real-life application.	**PO1, PO2, PO3**
CO2	**Examine** different library and tools associated with python.	**PO1, PO2, PO3**
CO3	**Apply** object oriented Python programming concepts to design solutions to problems.	**PO4,PO6**
CO4	**Construct** database connection with Python using PLSQL	**PO5**

		Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
Course Code	**Course Title**	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CSE22845	Applied Computing Lab –I	2	2	2	1	1	1	-	-	-	-	-	-

1 = Weakly Mapped
2 = Moderately Mapped
3 = Strongly Mapped

Year- I
Semester-II

Elective – I

CSE21846	Blockchain and Cryptocurrency	L	T	P	C
Version 1.0	Contact Hours – 45	3	0	0	3
Pre-requisites/Exposure	Fundamentals of Cryptography				
Co-requisites	Distributed Databases				

Course Objectives:

1. Understanding the technical underpinnings of blockchain technology at sufficient depth to perform analysis.
2. Performing analysis of the implications of certain decisions upon blockchain proposals.
3. Apply various blockchain concepts to analyze examples, proposals, case studies, and
4. preliminary blockchain system design discussions.
5. Make decisions about the use (or not) of blockchain technology in systems, and support decisions with relevant arguments.

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

CO1. **State** core Blockchain concepts, the benefits, and the limitations of blockchain technologies.
CO2. **Demonstrate** the key differentiators for blockchain from other technology systems.
CO3. **Apply** various blockchain concepts to analyze examples, case studies.
CO4. **Understand** relevant privacy issues related to blockchain technologies.

Course Description:

Blockchain and Cryptocurrency is vastly discussed now days in all research domains to bring the decentralization. This course is to understand Blockchain and its main application cryptocurrency. Students will learn how this system works and how can they utilize and what application can be built. After successful completion of this course, students will be familiar with blockchain and cryptocurrency concepts. Also, they can build their own application using the learned concepts.

Unit-I	**14 Lecture Hours**
Basics: Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.	
Unit-II	**12 Lecture Hours**
Blockchain: Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain. Distributed Consensus: Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.	
Unit-III	**12 Lecture Hours**
Cryptocurrency: History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin, Cryptocurrency Regulation: Stakeholders, Roots of Bitcoin, Legal Aspects – Cryptocurrency Exchange, Black Market and Global Economy.	
Unit-IV	**7 Lecture Hours**
Blockchain Applications: Internet of Things, Medical Record Management System, Domain Name Service and future of Blockchain.	
Text Books: 1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press 2. Wattenhofer, The Science of the Blockchain **Reference Books:** 1. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies	

Modes of Examination: Assignment/Quiz/Project/Presentation/Written Exam

Examination Scheme:

Components	Mid term	Continuous Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Mapping between COs, POs and PSOs

Course Outcomes (COs)		Mapped POs and PSOs
CO1	**State** core Blockchain concepts, the benefits, and the limitations of blockchain technologies.	**PO1, PO2**
CO2	**Demonstrate** the key differentiators for blockchain from other technology systems.	**PO1, PO2, PO5**
CO3	**Apply** various blockchain concepts to analyze examples, case studies.	**PO1, PO5**
CO4	**Understand** relevant privacy issues related to blockchain technologies.	**PO1, PO2, PO5**

		Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CSE21846	Blockchain and Cryptocurrency	3	3	-	-	3	-	-	-	-	-	-	-

1=weakly mapped
2= moderately mapped
3=strongly mapped

CSE21847	Software Process Management	L	T	P	C
Unit-I		9 Lecture Hours			

Version 1.0	Contact Hours – 45 Hours	3	0	0	3
Pre-requisite/Exposure	Software Engineering				
Co-requisite	NA				

Course Objectives:

1. To acquire knowledge on software process management
2. To acquire managerial skills for software project development.
3. To understand software economics

Course Outcomes:

On completion of this course students will be able to:

CO1. Gain knowledge of software economics, phases in the life cycle of software development, project organization, project control and process instrumentation

CO2. Analyze the major and minor milestones, artifacts and metrics from management and technical perspective

CO3. Design and develop software product using conventional and modern principles of software project management.

Course Description:

This course provides an introduction to the study of software engineering by closely examining the software development process. Several popular software development process models are examined, along with topics on the software lifecycle, quality management, and software configuration management.

Course Content:

Software Process Maturity Software maturity Framework, Principles of Software Process Change, Software Process Assessment, The Initial Process, The Repeatable Process, The Defined Process, The Managed Process, The Optimizing Process. Process Reference Models Capability Maturity Model (CMM), CMMI, PCMM, PSP, TSP).

Unit-II	**9 Lecture Hours**

Software Project Management Renaissance Conventional Software Management, Evolution of Software Economics, Improving Software Economics, The old way and the new way. Life-Cycle Phases and Process artifacts Engineering and Production stages, inception phase, elaboration phase, construction phase, transition phase, artifact sets, management artifacts, engineering artifacts and pragmatic artifacts, model-based software architectures.

Unit-III	**9 Lecture Hours**

Workflows and Checkpoints of process Software process workflows, Iteration workflows, Major milestones, minor milestones, periodic status assessments. Process Planning Work breakdown structures, Planning guidelines, cost and schedule estimating process, iteration planning process, Pragmatic planning.

Unit-IV	**9 Lecture Hours**

Project Organizations Line-of- business organizations, project organizations, evolution of organizations, process automation. Project Control and process instrumentation The seven-core metrics, management indicators, quality indicators, life-cycle expectations, Pragmatic software metrics, metrics automation.

Unit-V	**9 Lecture Hours**

CCPDS-R Case Study and Future Software Project Management Practices Modern Project Profiles, Next-Generation software Economics, Modern Process Transitions.

Text Books:

1. Managing the Software Process, Watts S. Humphrey, Pearson Education

2. Software Project Management, Walker Royce, Pearson Education

Reference Books:

1. An Introduction to the Team Software Process, Watts S. Humphrey, Pearson Education, 2000 Process Improvement essentials, James R. Persse, O'Reilly, 2006
2. Software Project Management, Bob Hughes & Mike Cotterell, fourth edition, TMH, 2006
3. Applied Software Project Management, Andrew Stellman & Jennifer Greene, O'Reilly, 2006.
4. Head First PMP, Jennifer Greene & Andrew Stellman, O'Reilly, 2007
5. Software Engineering Project Management, Richard H. Thayer & Edward Yourdon, 2 nd edition, Wiley India, 2004.
6. Agile Project Management, Jim Highsmith, Pearson education, 2004.

Modes of Evaluation: Quiz/Assignment/Presentation/Extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Gain knowledge of software economics, phases in the life cycle of software development, project organization, project control and process instrumentation	**PO1,PO2,PO7**
CO2	Analyze the major and minor milestones, artifacts and metrics from management and technical perspective	**PO1,PO2,PO3**
CO3	Design and develop software product using conventional and modern principles of software project management.	**PO1,PO5**

		Computational Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex computing problems	Modern tool usage	Professional Ethics	Life-long Learning	Project Management and Finance:	Communication Efficacy	Societal & Environmental Concern:	Individual & Team Work	Innovation and Entrepreneurship
Course Code	Course Title	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO 11	PO 12
CSE21847	**Software Process Management**	3	3	1	-	1	-	1	-	-	-	-	-

1=weakly mapped 2= moderately mapped 3=strongly mapped

CSE21848	Natural Language Processing	L	T	P	C
Version 1.0	Contact Hours – 45 Hours	3	0	0	3
Pre-requisite/Exposure	Introduction to probability theory, statistics				
Co-requisite	Python, prior knowledge of some machine learning algorithms and data structures is very useful				

Course Objectives:

1. To understand key concepts from NLP are used to describe and analyze language
2. To understand semantics and pragmatics of language for processing
3. To apply structured semantic models on information retrieval and natural language applications

Course Outcomes:

On the completion of this course the student will be able to

CO1: **Recall** linguistic phenomena and an ability to model them with formal grammars.

CO2: **Illustrate** proper experimental methodology for training and evaluating empirical NLP systems

CO3. **Apply** natural language processing techniques to process speech and analyse text.

CO4**. Examine** algorithms of natural language processing

CO5. **Evaluate** different language modeling Techniques

Course Description:

The main objective of the course is to enable the fundamental concepts and techniques of natural language processing(NLP). However, extracting useful information has proven extremely challenging. This course introduces natural language processing techniques with sophisticated algorithms for processing large volumes of unstructured data such as textual data. It has also opened up exciting opportunities for exploring and analysing new types of data and for analysing old types of data in new ways. Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information. The course examines NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.

Course Content:

Unit-I	**9 Lecture Hours**
Introduction: Context - Classical Toolkit - Text Pre-processing – Tokenization – Sentence Segmentation Lexical Analysis: Finite State Morphonology Paradigm based Lexical Analysis - Syntactic Parsing – Deductive Parsing – LR Parsing – Constraint based Grammars –Issues in Parsing Semantic Analysis: Theories and approaches to Semantic Representation – Fine Grained Lexical Case studies - Natural Language Generation – Components of a Generator – Approaches to Text Planning – Linguistic Component	
Unit-II	**9 Lecture Hours**
Introduction to Corpus Corpus Size, Representation, Sampling – Data Capture – Corpus Markup and Annotation – Multilingual Corpora – Multimodal Corpora -Corpus Annotation Type Part-of-Speech Tagging: General Framework – POS Tagging Approaches – Other Statistical and Machine Learning Approaches. Statistical Parsing: Basics - Probabilistic Context-Free Grammars - Generative Models Discriminative Models - Beyond Supervised Parsing	
Unit-III	**9 Lecture Hours**
Methods of Word Similarity – Normalized Web Distance Method – Kolmogorov Complexity – Information Distance – Normalized Web Distance – Applications –Word Sense Inventories and Problem Characteristics – Applications of Word Sense Disambiguation –Approaches to Sense Disambiguation: Supervised, Lightly Supervised and Unsupervised.	
Unit-IV	**9 Lecture Hours**
Modern Speech Recognition: Hidden Markov Model, Architectural Components – Historical Developments – Speech Recognition Applications – Technical Challenges and Future Research Directions	
Unit-V	**9 Lecture Hours**
Case Studies : Natural Language Processing and Information Retrieval – Question Answering – Generic Question Answering System – Evaluation of Question Answering system – Multilingualism in Question Answering System Recent trends and Related Works – Information Extraction	
Text Books: 1. Daniel Jurafsky and James H. Martin Speech and Language Processing (2nd Edition), Prentice Hall; edition, 2008 2. Foundations of Statistical Natural Language Processing by Christopher D. Manning and Hinrich Schuetze, MIT Press, 1999 **Reference Books:** 1.James Allen, Natural Language Understanding, Addison Wesley; 2 edition 1994 2.Steven Bird, Ewan Klein and Edward Loper Natural Language Processing with Python, O'Reilly Media; 1 edition, 2009	

Modes of Evaluation: Quiz/Assignment/Presentation/Extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
Course Outcomes (COs)		Mapped Program Outcomes
CO1	**Recall** linguistic phenomena and an ability to model them with formal grammars.	PO1, PO2, PO3, PO4, PO5,PO6
CO2	**Illustrate** proper experimental methodology for training and evaluating empirical NLP systems	PO1, PO2, PO3, PO4, PO6
CO3	**Apply** natural language processing techniques to process speech and analyse text.	PO1, PO2, PO3, PO4, PO5
CO4	**Examine** algorithms of natural language processing	PO1, PO2, PO3,
CO5	**Evaluate** different language modeling Techniques	PO1, PO2,

		Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
Course Code	**Course Title**	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CSE21848	Natural Language Processing	3	3	3	3	3	-	-	-	-	-	-	-

1 = Weakly Mapped
2 = Moderately Mapped
3 = Strongly Mapped

Elective- II

CSE21849	Computer Forensics	L	T	P	C
Version 1.0	Contact Hours – 45 Hours	3	0	0	3
Pre-requisite/Exposure	Object Oriented Programming and HTML				
Co-requisite	NA				

Course Objectives:

1. To study the fundamentals of Computer Forensics
2. To learn, analyze and validate Forensics Data
3. To study the tools and tactics associated with Cyber Forensics.

Course Outcomes:

On the completion of this course the student will be able to

CO1: Analyze and evaluate the cyber security needs of an organization.
CO2: Determine and analyze software vulnerabilities and security solutions to reduce the risk of exploitation.
CO3: Implement cyber security solutions and use of cyber security, information assurance, and cyber/computer forensics software/tools.
CO4: Comprehend and execute risk management processes, risk treatment methods, and key risk and performance indicators

CO5: Measure the performance and troubleshoot cyber security systems.

Course Description:

Computer forensics is the application of investigation and analysis techniques to gather and preserve evidence from a particular computing device in a way that is suitable for presentation in a court of law. The goal of computer forensics is to perform a structured investigation and maintain a documented chain of evidence to find out exactly what happened on a computing device and who was responsible for it.

Computer forensics -- which is sometimes referred to as computer forensic science -- essentially is data recovery with legal compliance guidelines to make the information admissible in legal proceedings. The terms digital forensics and cyber forensics are often used as synonyms for computer forensics.

Digital forensics starts with the collection of information in a way that maintains its integrity. Investigators then analyze the data or system to determine if it was changed, how it was changed and who made the changes. The use of computer forensics isn't always tied to a crime. The forensic process is also used as part of data recovery processes to gather data from a crashed server, failed drive, reformatted operating system (OS) or other situation where a system has unexpectedly stopped working

Course Content:

Unit-I	**9 Lecture Hours**
Introduction: Computer Forensics Fundamentals – Types of Computer Forensics Technology – Types of Computer Forensics Systems – Vendor and Computer Forensics Services.	
Unit-II	**9 Lecture Hours**
Computer forensics evidence and capture: Data Recovery – Evidence Collection and Data Seizure-Duplication and Preservation of Digital Evidence-Computer Image Verification and Authentication.	
Unit-III	**9 Lecture Hours**
Computer forensic analysis: Discover of Electronic Evidence Identification of Data – Reconstructing Past Events – Fighting against Macro Threats – Information Warfare Arsenal – Tactics of the Military – Tactics of Terrorist and Rogues – Tactics of Private Companies	
Unit-IV	**9 Lecture Hours**
Information warfare: Arsenal – Surveillance Tools – Hackers and Theft of Components – Contemporary Computer Crime-Identity Theft and Identity Fraud – Organized Crime &Terrorism – Avenues Prosecution and Government Efforts – Applying the First Amendment to Computer Related Crime-The Fourth Amendment and other Legal Issues.	
Unit-V	**9 Lecture Hours**
Computer forensic cases: Developing Forensic Capabilities – Searching and Seizing Computer Related Evidence –Processing Evidence and Report Preparation – Future Issues.	

Text Books:

1. John R. Vacca, "Computer Forensics: Computer Crime Scene Investigation", Cengage Learning, 2nd Edition, 2005.
2. Marjie T Britz, "Computer Forensics and Cyber Crime: An Introduction", Pearson Education, 2nd Edition, 2008.

Reference Books:

1. MariE-Helen Maras, "Computer Forensics: Cybercriminals, Laws, and Evidence", Jones & Bartlett Learning; 2nd Edition, 2014.
2. Chad Steel, "Windows Forensics", Wiley, 1st Edition, 2006.
3. Majid Yar, "Cybercrime and Society", SAGE Publications Ltd, Hardcover, 2nd Edition, 2013.
4. Robert M Slade, "Software Forensics: Collecting Evidence from the Scene of a Digital Crime", Tata McGraw Hill, Paperback, 1st Edition, 2004.

Modes of Evaluation: Quiz/Assignment/Presentation/Extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
Course Outcomes (COs)		**Mapped Program Outcomes**
CO1	Analyze and evaluate the cyber security needs of an organization.	PO1, PO2, PO3, PO4
CO2	Determine and analyze software vulnerabilities and security solutions to reduce the risk of exploitation.	PO1, PO2, PO3, PO5, PO7
CO3	Implement cyber security solutions and use of cyber security, information assurance, and cyber/computer forensics software/tools.	PO1, PO2, PO3, PO4
CO4	Comprehend and execute risk management processes, risk treatment methods, and key risk and performance indicators	PO1, PO2, PO3,
CO5	Measure the performance and troubleshoot cyber security systems.	PO2, PO5, PO7

		Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
Course Code	**Course Title**	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CSE21849	**Computer Forensics**	3	3	3	2	2	-	2	-	-	-	-	-

1 = Weakly Mapped
2 = Moderately Mapped
3 = Strongly Mapped

CSE21850	**Software Architecture**	L	T	P	C
Version 1.0	**Course Duration: 45 Hrs.**	3	0	0	3
Pre-requisites/Exposure	Software Engineering				
Co-requisites					

Course Objectives

1. Understand and apply object-oriented design techniques.
2. Develop and evaluate software architectures
3. Select and use appropriate architectural styles
4. Select and use appropriate software design patterns
5. Express the specifications and design of an application using UML

Course Outcomes

On completion of this course, the students will be able to

CO1: **Describe** Software architecture for various software systems.

CO2: **Recognize** and derive Quality attributes for software architectures.

CO3: **Demonstrate** the use of different architectural styles and frameworks.

CO4: **Depict** systems requirement with the help of different UML diagrams.

CO5: **Demonstrate** documentation for architectural patterns.

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Catalog Description

Software architecture is, simply, the organization of a system. This organization includes all components, how they interact with each other, the environment in which they operate, and the principles used to design the software. In many cases, it can also include the evolution of the software into the future. Software architecture in software engineering helps to expose the structure of a system while hiding some implementation details. Architecture focuses on relationships and how the elements and components interact with each other, as does software engineering. In fact, software architecture and software engineering often overlap. They are combined because many of the same rules govern both practices. The different sometimes comes when decisions are focused on software engineering and the software architecture follows. It is important to note that all software architecture is engineering, but not all engineering is software architecture. The software architect is able to distinguish between the details in the software engineering and importance to the internal structure.

Unit-I	9 Lecture Hours
Introduction Introduction to Software architecture and requirements, Architecture diagrams: UML Class Diagram, UML Component Diagram, UML Package Diagram, UML Deployment Diagram, UML Activity Diagram,	

Course Content:

Architecture structure – ABC (Architecture Business Cycle)

Unit-II	**9 Lecture Hours**

Understanding Quality Attributes and Achieving Quality

Introduction to Quality Attributes, Need of quality attributes, Understanding quality attributes: architecture and quality attributes. Case study of quality attributes in software architecture templates, Deriving Quality Attributes for software architectures.

Unit-III	**12 Lecture Hours**

Architecture in the life cycle / Architectural Views

Introduction, Structures and views: Representing views, available notations, Standard views: 4+1 view of Rational Unified Process, Siemens 4 views, SEI's perspectives and views, Case studies Architecture in the agile projects: Architecture and requirements, Implementation and testing, Architecture reconstruction and conformance

Unit-IV	**8 Lecture Hours**

Architectural Styles

Introduction, Data flow styles, Call-return styles, Shared Information styles, Event styles, Case studies for each style. Architectural styles, Pipes and filters, Data abstraction and object oriented organization Event based, implicit invocation, Layered systems, Repositories, Other familiar architectures, Heterogeneous Architectures.

Unit-V	**7 Lecture Hours**

Documenting the architecture

Guidelines and practices, Documenting the Views using UML, Pros and cons of using visual languages, Need for formal languages, Architectural Description Languages, ACME–Designing and documentation, Case studies.

Text Books:

1. Software Architecture in Practice, Len Bass, Paul Clements, Rick Kazman, Second Edition, Pearson, ISBN 978-81-775-8996-2.
2. Managing and global Software Projects, Ramesh Gopalaswamy, Tata Mc Graw Hill. Tenth Reprint 2011.

Reference Materials

1. Software Engineering - A Practitioner's Approach, Roger S.Pressman, 7th Edition McGraw Hill, 2010
2. Managing the Software Process, Humphery Watts, Addision Wesley, 1989.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Internal Assessment	MTE	ETE
Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Describe** Software architecture for various software systems.	**PO1, PO2, PO12**
CO2	**Recognize** and derive Quality attributes for software architectures.	**PO1, PO2, PO3, PO12**
CO3	**Demonstrate** the use of different architectural styles and frameworks.	**PO1, PO2, PO4, PO12**
CO4	**Depict** systems requirement with the help of different UML diagrams.	**PO1, PO2, PO11, PO12**
CO4	**Demonstrate** documentation for architectural patterns.	**PO1, PO2, PO12**

		Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CSE21850	Software Architecture	3	3	1	1	-	-	-	-	-	-	1	3

1=weakly mapped
2= moderately mapped
3=strongly mapped

CSE21843	**Computer Vision**	**L**	**T**	**P**	**C**
Version 1.0	**Contact Hours – 45 Hours**	**3**	**0**	**0**	**3**
Pre-requisite/Exposure	**Discrete Mathematics, Python Programing**				
Co-requisite					

Course Objectives:

1. To allow students to have a fundamental concepts of machine vision
2. To provide the platform to build computer vision applications from scratch
3. To expose students to state of the art applications in computer vision

Course Outcomes:

CO1 : Understand the cognitive concepts of organic vision
CO2 : Explain fundamental concepts of digital image processing
CO3 : Apply advance image feature extraction techniques
CO4 : Analyse deep learning based image processing approaches
CO5 : Validate modern computer applications

Course Description:

Computer vision is fundamental concept for the current world IT professionals to master. It has huge applications in the field of data science and image processing. The course has been designed to allow the student to explore fundamental concepts behind human vision and map it to digital image processing techniques. They can learn advanced techniques, deep learning based approaches and dissect modern computer vision applications.

Course Content:

Unit-I	**9 Lecture Hours**
Introduction : Biological Image Sensing: From Retina to Visual Cortex. Cognitive aspect of image understanding. Visual knowledge representation. Digital Image Sensing : CCD vs CMOS sensors, Lenses, Focal Lengths, Aperture, Field of View, Depth of Field, Color spaces – RGB, CMYK, LAB Challenges of Computer Vision. Applications of Computer Vision.	
Unit-II	**12 Lecture Hours**
Digital Image Processing : Digital image representation, grayscale vs color image, alpha channels, multispectral images, 3d images. **Grayscale image processing :** Thresholding, Contrast enhancement, Histogram equalization, Edge Detection, Gradient detection, Texture Analysis, Shape based Analysis. Image features: shape-based features, texture-based features, intensity histograms, marginal intensity histograms. **Spatial filter based approaches:** Sobel, Prewitt, Gabor, Gaussian, Laplacian. Noise removal, Sharpening Morphological transformations: structuring element dilation, erosion, opening, closing	
Unit-III	**9 Lecture Hours**
Region based Approaches: Region Growing, Normalized Cuts, Watershed Algorithm. **Gradient based feature extraction:** HOG, SIFT, SURF.	
Unit-IV	**8 Lecture Hours**
Neural Network based approaches: Multi-layered perceptron, backpropagation, Convolutional neural networks(CNN). **Applications of CNN:** Image classification, localization, segmentation, enhancement.	
Unit-V	**7 Lecture Hours**
Realtime image processing: Video analysis, optical flow, depth estimation. **Case Studies:** Fingerprint verification, Digit recognition, Face Recognition, Aerial Imaging, Microscopic Image analysis, Autonomous driving	
Text Books: **1. Digital Image Processing, 4th Edition Rafael C. Gonzalez, University of Tennessee** **2. Deep Learning – Goodfellow, Bengio, Courville**	

Modes of Evaluation: Quiz/Assignment/Presentation/Extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
Course Outcomes (COs)		Mapped Program Outcomes
CO1	Understand the cognitive concepts of organic vision	PO1, PO2
CO2	Explain fundamental concepts of digital image processing	PO1, PO2, PO3, PO4
CO3	Apply advance image feature extraction techniques	PO2, PO3, PO4, PO5
CO4	Analyse deep learning based image processing approaches	PO2, PO3, PO4, PO5
CO5	Validate modern computer applications	PO2, PO3, PO4, PO5

		Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
Course Code	**Course Title**	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CSE21843	Computer Vision	2	3	3	3	3	-	-	-	-	-	-	-

1 = Weakly Mapped, 2 = Moderately Mapped, 3= Strongly Mapped

Elective -III

CSE21852	Introduction to Information Security Management	L	T	P	C
Version 1.0	Contact Hours – 45 Hours	3	0	0	3
Pre-requisite/Exposure	Computer Forensics				
Co-requisite	NA				

Course Objectives:

- To understand of information assurance as practiced in computer operating systems, distributed systems, networks and representative applications.
- To demonstrate the familiarity with prevalent network and distributed system attacks, defences against them, and forensics to investigate the aftermath.
- Appraise a basic understanding of cryptography, how it has evolved, and some key encryption techniques used today.
- To learn how to conduct security audit.

Course Outcomes:

On completion of this course students will be able to:

CO1**. Define** the basics of OSI security model and Classical Encryption Technique.

CO2**. Understand** and identify the application of Public Key Encryption Techniques and practices.

CO3**. Demonstrate** the application of Data Authentication and Authorization.

CO4**. Examine** the basics concept of Network Security and Web Security.

CO5**. Understand** the process of identifying vulnerability in software and hardware devices.

Course Description:

This course is designed to teach the fundamentals of security management. The course is not technical in nature, but relies on the student's previous understanding of security systems. The course instead looks at security from a managerial perspective with regards to design, implementation, maintenance, and disaster recovery.

Unit-I	9 Lecture Hours

Course Content:

Information Security and its necessity: Basics Principles of Confidentiality, Integrity Availability Concepts Policies, procedures, Guidelines, Standards, Administrative Measures and Technical Measures. Basics of Cloud Computing, Application of Cloud. Information Security issues in Cloud Computing: Benefits and major issues related to information Security.	
Unit-II	**9 Lecture Hours**
Standards available for Information Securities : A brief overview on Cobit, Cadbury, ISO 27001, Open Web Application Security Project (OWASP), Open Source Security Testing Methodology Manual (OSSTMM) etc. , Certifiable Standards. Vulnerability, Threat and Remedies: Introduction to BCP / DRP / Incident management, Segregation and Separation of Duties & Roles and responsibilities, IT ACT 2000. **Information Security Assessments :** Vulnerability Assessment and Penetration Testing (VAPT), Web Application Audits, IT assessments or audits, Assessment of Network Equipment, Assessment of Security Devices (Web Filtering, Firewalls, IDS / IPS, Routers etc.), Data Centre Assessment, Business Continuity and Disaster Recovery Plans (BCP/DRP) assessments	
Unit-III	**9 Lecture Hours**
Security of Application Software: SAP Security, Desktop Security, RDBMS Security. Inbuilt Securities Provided in Windows and Linux : Types of audits in Windows environment, Server Security, Security for active directories (Group Policy), AntiVirus, Malware, End point protection, Shadow Passwords, SUDO (Super-user do) users etc.	
Unit-IV	**9 Lecture Hours**
Security issues in Web Application: Open Web Application Security Project (OWASP), Cross-site scripting (XSS), SQL injection, Cross-Site Request Forgery (CSRF), Password Vulnerabilities, Password Vulnerabilities, Completely Automated Public Turing test to tell Computers and Humans Apart (CAPTCHA), Session Hijacking, Local and Remote File Inclusion, Audit Trails, Web Server Issues, etc	
Unit-V	**9 Lecture Hours**
Technological Proficiency and Hardware/Software Required Hardware Backdoor, Semiconductor Doping, Hardware Side-Channel Attacks, Products Affected, Attack Motivation, Hardware Lifecycle Trust, Classification of Hardware Trojans.	
Text Books: **1. " The Web Application Hacker's Handbook: Discovering and Exploiting Security Flaws", Dafydd Stuttard, Marcus Pinto, Wiley** **2. " Hacking: The Art of Exploitation", Jon Erickson, 2nd edition, No Starch Press** **Reference Books:** **1. "Exploiting Software - How to Break Code", Greg Hoglund and Gary McGraw, Addison Wesley**	

Modes of Evaluation: Quiz/Assignment/Presentation/Extempore/ Written Examination
Examination Scheme:

Components	Mid Term	Class Assessment	End Term

Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Define** the basics of OSI security model and Classical Encryption Technique.	**PO1,PO2**
CO2	**Understand** and identify the application of Public Key Encryption Techniques and practices.	**PO1,PO2**
CO3	**Demonstrate** the application of Data Authentication and Authorization.	**PO1,PO5**
CO4	**Examine** the basics concept of Network Security and Web Security.	**PO2, PO3**
CO5	**Understand** the process of identifying vulnerability in software and hardware devices.	**PO5,PO7**

		Computational Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex computing problems	Modern tool usage	Professional Ethics	Life-long Learning	Project Management and Finance:	Communication Efficacy	Societal & Environmental Concern:	Individual & Team Work	Innovation and Entrepreneurship
Course Code	Course Title	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO 11	PO 12

CSE21853	Software Security	L	T	P	C
Version 1.0	Contact Hours - 45	3	0	0	3
Pre-requisites/Exposure	Undergraduate in Computer Science				
Co-requisites	Programming skill				

CSE21852	**Introduction to Information Security Management**	3	3	1	-	2	-	1	-	-	-	-	-

1=weakly mapped 2= moderately mapped 3=strongly mapped

Course Objectives:

1. Comprehend the basic terminologies in computer security including Confidentiality, Integrity and Availability (CIA).
2. Identify and describe different types of widely used encryption algorithms such as DES, AES and RSA and their applications in the real life.
3. Master the use the proper authentication methods based on the Application's domain and its security requirements.
4. Know how to implement and employ the proper access control mechanism.
5. Differentiate between the various types of malwares and implement the proper techniques to protect against them.
6. Understands the causes and consequences of the buffer over flow attack and the various ways to prevent, detect, and mitigate the system from this attack.

Course Outcomes:

On completion of this course, the students will be able to

CO1. **Define** basic terminologies in computer security including Confidentiality, Integrity and Availability (CIA).

Unit-I	**8 Lecture Hours**

CO2. **Implement** and employ the proper access control mechanism.
CO3. **Demonstrate** the causes and consequences of the buffer over flow attack and the various ways to prevent, detect, and mitigate the system from the attack.
CO4. **Differentiate** between the various types of malwares.

Course Description:

This course includes theory and practice of software security, focusing in particular on some common software security risks, including buffer overflows, race conditions and random number generation, and on identification of potential threats and vulnerabilities early in design cycle. Emphasizes methodologies and tools for identifying and eliminating security vulnerabilities, techniques to prove absence of vulnerabilities, ways to avoid security holes in new software, and essential guidelines for building secure software: how to design software with security in mind from the ground up and to integrate analysis and risk management throughout the software life cycle.

Course Content:

Security fundamentals: CIA triad, Policies, Threats, Role of Trust, Operational Issues, Security life cycle, Standard notions of security, Software Security Problems.	
Unit-II	**12 Lecture Hours**
Principles of Cryptography: Basic Terminology, Symmetric and Asymmetric encryption, Block and Stream Ciphers, Cryptanalysis Scheme, Substitution Ciphers, Digital Signatures, Public-Key Cryptosystems, Hash Functions, Digital Envelopes**.**	
Unit-III	**14 Lecture Hours**
Authentication Protocols: Authentication Using Symmetric Keys, Mutual Authentication Attack, Reflection Attack, Authentication Using Public Keys, Session Key, Public Key Authentication with Timestamp, Zero Knowledge Proof (ZKP), TCP-based Authentication, Naïve Session Key Protocol Access Control: Authentication vs. Authorization, Access Control Principles, Lampson's Access Control Matrix, Discretionary Access Control (DAC), Mandatory Access Control (MAC), Role-Based Access Control (RBAC), Attribute-Based Access Control (ABAC).	
Unit-IV	**11 Lecture Hours**
Malware: Malware Terminology, Classification of Malware, Virus Phases and Structure, Virus Classifications, Worms, Morris Worm, Malicious Mobile Code, Social Engineering, Payload – Attack Agents Bots, Stealthing Rootkit, Rootkit Classification Characteristics, Generic Decryption (GD) Host-Based Behaviour-Blocking Software Security Issues: Defensive Programming, Security by Design, Injection Attacks, Cross Site Scripting (XSS) Attacks, Validating Input Syntax, Input Fuzzing, Correct Algorithm Implementation, Preventing Race Conditions.	
Text Books: 1. William Stallings, Lawrie Brown, Computer Security: Principles and Practice, 4th Edition, Pearson, Dec 12, 2017. ISBN-13: 978-1292220611 • ISBN-10: 1292220619 2. Charles P. Pfleeger, Shari Lawrence Pfleeger, Jonathan Margulies, Security in Computing, 5th Edition, Prentice Hall, Jan 14, 2015.ISBN-13: 978-0134085043 • ISBN-10: 9780134085043 **Reference Books:** 1. Gary McGraw, Software Security: Building Security, 1st Edition, Addison-Wesley.	

Modes of Examination: Assignment/Quiz/Project/Presentation/Written Exam

Examination Scheme:

Components	Mid term	Continious Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Mapping between COs, POs and PSOs

Course Outcomes (COs)	Mapped POs and PSOs

CO1	**Define** basic terminologies in computer security including Confidentiality, Integrity and Availability (CIA).	**PO1, PO2**
CO2	**Implement** and employ the proper access control mechanism.	**PO1, PO2, PO3**
CO3	**Demonstrate** the causes and consequences of the buffer over flow attack and the various ways to prevent, detect, and mitigate the system from the attack.	**PO1, PO5**
CO4	**Differentiate** between the various types of malwares.	**PO1, PO2, PO3**

		Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CSE21853	Software Security	3	3	2	-	1	-	-	-	-	-	-	-

1=weakly mapped
2= moderately mapped
3=strongly mapped

CSE21854	**Social Network Analysis**	L	T	P	C

Version 1.0	**Course Duration: 45 Hrs.**	3	0	0	3
Pre-requisites/Exposure	Fundamental of computer network, Graph Theory				
Co-requisites					

Course Objectives

1. Understand the concept of semantic web and related applications.
2. Learn knowledge representation using ontology.
3. Understand human behaviour in social web and related communities.
4. Learn visualization of social networks.

Course Outcomes

On completion of this course, the students will be able to

CO1: **Develop** semantic web related applications.
CO2: **Represent** knowledge using ontology.
CO3: **Description** of Web community

CO4: **Predict** human behaviour in social web and related communities.
CO5: **Visualize** social networks.

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Catalog Description

Social network analysis (SNA) is the process of investigating social structures through the use of networks and graph theory. It characterizes networked structures in terms of *nodes* (individual actors, people, or things within the network) and the *ties*, *edges*, or *links* (relationships or interactions) that connect them. Social networks provide and limit opportunities for individual choices, whereas at the same time individuals initiate, construct, maintain, and break up relationships and by doing so determine the global structure of the network. Which network structures and positions create strong opportunities or, on the contrary, a strong constraint depends on the instrumental value of the relationships under study.

Unit-I	9 Lecture Hours

Introduction

Introduction to Semantic Web: Limitations of current Web - Semantic Web Development- Emergence of the Social Web - Social Network analysis: Development of Social Network Analysis - Key concepts and measures in network analysis - Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities - Web-based networks - Applications of Social Network Analysis.

Unit-II	9 Lecture Hours

Ontology: Modelling, Aggregating and Knowledge Representation

Ontology and their role in the Semantic Web: Ontology-based knowledge Representation - Ontology languages for the Semantic Web: Resource Description Framework - Web Ontology Language - Modelling and aggregating social network data: State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data - Advanced representations.

Unit-III	9 Lecture Hours

Extraction and Mining Communities in Web Social Networks

Extracting evolution of Web Community from a Series of Web Archive - Detecting communities in social networks - Definition of community - Evaluating communities - Methods for community detection and mining - Applications of community mining algorithms - Tools for detecting communities social network infrastructures and communities - Decentralized online social networks - Multi-Relational characterization of dynamic social network communities.

Unit-IV	9 Lecture Hours

Predicting Human Behavior and Privacy Issues

Understanding and predicting human behaviour for social communities - User data management - Inference and Distribution - Enabling new human experiences - Reality mining - Context - Awareness - Privacy in online social networks - Trust in online environment - Trust models based on subjective logic - Trust network analysis - Trust transitivity analysis - Combining trust and reputation - Trust derivation based on trust comparisons - Attack spectrum and countermeasures.

Unit-V	9 Lecture Hours

Visualization and Applications of Social Networks

Graph theory - Centrality - Clustering - Node-Edge Diagrams - Matrix representation - Visualizing online social networks, Visualizing social networks with matrix-based representations - Matrix and Node-Link Diagrams - Hybrid representations - Applications - Cover networks - Community welfare - Collaboration networks - Co-Citation networks.

Text Books:

1. Social Networks and the Semantic Web‖, Peter Mika, First Edition, Springer 2007.
2. Handbook of Social Network Technologies and Applications‖, Borko Furht , 1st Edition, Springer, 2010.

Reference Books:

1. Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively, Dion Goh and Schubert Foo, IGI Global Snippet, 2008.
2. Web Mining and Social Networking – Techniques and applications, Guandong Xu ,Yanchun Zhang and Lin Li, First Edition, Springer, 2011.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Internal Assessment	MTE	ETE
Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	**Develop** semantic web related applications.	PO2, PO3, PO4
CO2	**Represent** knowledge using ontology.	PO2, PO3, PO4, PO12
CO3	**Description** of Web community	PO2, PO3, PO4, PO12
CO4	**Predict** human behavior in social web and related communities.	PO2, PO3, PO4, PO6
CO4	**Visualize** social networks.	PO2, PO3, PO5

		Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CSE21854	Social Network Analysis	-	3	3	3	1	1	-	-	-	-	-	2

1=weakly mapped
2= moderately mapped
3=strongly mapped

CSE21855	Research Methodologies	L	T	P	C
Version 1.0	Contact Hours – 30 Hours	2	0	0	2
Pre-requisite/Exposure	Knowledge on Data Acquisition and Visualization				
Co-requisite	NA				

Course Objectives:

1. To identify and discuss the role and importance of research in the social sciences.
2. To identify and discuss the issues and concepts salient to the research process.
3. To identify and discuss the complex issues inherent in selecting a research problem, selecting an appropriate research design, and implementing a research project.

Course Outcomes:

On the completion of this course the student will be able to

CO1: Discuss different methodologies and techniques used in research work.
CO2: Explain basic computer skills necessary for the conduct of research.
CO3: Assess the basic function and working of analytical instruments used in research.

Course Description:

Computer forensics is the application of investigation and analysis techniques to gather and preserve evidence from a particular computing device in a way that is suitable for presentation in a court of law. The goal of computer forensics is to perform a structured investigation and maintain a documented chain of evidence to find out exactly what happened on a computing device and who was responsible for it.

Computer forensics -- which is sometimes referred to as computer forensic science -- essentially is data recovery with legal compliance guidelines to make the information admissible in legal proceedings. The terms digital forensics and cyber forensics are often used as synonyms for computer forensics.

Digital forensics starts with the collection of information in a way that maintains its integrity. Investigators then analyze the data or system to determine if it was changed, how it was changed and who made the changes. The use of computer forensics isn't always tied to a crime. The forensic process is also used as part of data recovery processes to gather data from a crashed server, failed drive, reformatted operating system (OS) or other situation where a system has unexpectedly stopped working

Course Content:

Unit-I	**10 Lecture Hours**
Motivation and objectives – Research methods vs. Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, concept of applied and basic research process, criteria of good research. Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review-primary and secondary sources, reviews, monograph, patents, research databases, web as a source, searching the web, critical literature review, identifying gap areas from literature and research database, development of working hypothesis.	
Unit-II	**10 Lecture Hours**
Accepts of method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools, data analysis with statically package (Sigma STAT,SPSS for student t-test, ANOVA, etc.), hypothesis testing.	
Unit-III	**10 Lecture Hours**
Computer and its role in research, Use of statistical software SPSS, GRETL etcin research. Introduction to evolutionary algorithms - Fundamentals of Genetic algorithms, Simulated Annealing, Neural Network based optimization, Optimization of fuzzy systems.	
Text Books: 1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition. 2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press . **Reference Books:** 1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers. 2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International.	

Modes of Evaluation: Quiz/Assignment/Presentation/Extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
Course Outcomes (COs)		Mapped Program Outcomes
CO1	Discuss different methodologies and techniques used in research work.	PO1, PO2, PO3, PO4
CO2	Explain basic computer skills necessary for the conduct of research.	PO1, PO2, PO3, PO5, PO7
CO3	Assess the basic function and working of analytical instruments used in research.	PO1, PO2, PO3, PO4

		Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
Course Code	**Course Title**	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CSE21855	**Research Methodologies**	3	3	3	2	1	-	1	-	-	-	-	-

1 = Weakly Mapped
2 = Moderately Mapped
3 = Strongly Mapped

CSE21856	Parallel and Distributed Computing	L	T	P	C
Version 1.0	Contact Hours -45	3	0	0	3
Pre-requisites/Exposure	Java, Computer Networking, Operating systems				
Co-requisites	---				

Course Objectives:

1. To formulate and evaluate a hypothesis by proposing, implementing and testing a project.

2. To relate one project to prior research via a review of related literature.

3. To understand the fundamental questions in parallel and distributed computing and analyze different solutions to these questions.

4. To understand different parallel and distributed programming paradigms and algorithms, and gain practice in implementing and testing solutions using these.

Course Outcomes:

On completion of this course, the students will be able to

CO1. **Apply** the fundamentals of parallel and distributed computing including parallel architectures and paradigms.

CO2. **Apply** parallel algorithms and key technologies.

CO3. **Develop** and execute basic parallel and distributed applications using basic programming models and tools.

CO4. **Analyze** the performance issues in parallel computing and trade-offs.

Catalog Description:

This course covers the architecture and enabling technologies of parallel and distributed computing systems and their innovative applications. We will cover scalable multiprocessors,

distributed clusters, P2P networks, computational Grids, virtual machines, and Internet Clouds. Case studies include IBM BlueGene/L, Google search-engine, TeraGrid, e-Science, DataGrid, Gnuttela, BitTorrent, content-delivery networks, VM Monitors, IBM BlueCloud, Amazon Elastic Clouds, Google Clouds, etc. The course aims to acquaint Master and Ph.D. students in computer science, electrical and computer engineering with state-of-the-art supercomputers and distributed computing systems for high-performance computing, e-commerce, and web-scale Internet applications.

Unit-I	7 Lecture Hours

Introduction

Characterization of Distributed Systems- Introduction, Examples of distributed systems, Resource sharing and the Web Challenges, System Models- Architectural models, Fundamental Models Theoretical Foundation for Distributed System: Limitation of Distributed system, absence of global clock, shared memory, Logical clocks, Lamport's& vectors logical clocks, Causal ordering of messages, global state, termination detection.

Unit-II	8 Lecture Hours

Distributed Mutual Exclusion: Classification of distributed mutual exclusion, requirement of mutual exclusion theorem, Token based and non token based algorithms, performance metric for distributed mutual exclusion algorithms. Distributed Deadlock Detection: system model, resource Vs communication deadlocks, deadlock prevention, avoidance, detection & resolution, centralized dead lock detection, distributed dead lock detection, path pushing algorithms, edge chasing algorithms

Unit-III	8 Lecture Hours

Agreement Protocols- Introduction, System models, classification of Agreement Problem, Byzantine agreement problem, Consensus problem, Interactive consistency Problem, Solution to Byzantine Agreement problem, Application of Agreement problem, Atomic Commit in Distributed Database system. Distributed Objects and Remote Invocation- Communication between distributed objects, Remote procedure call, Events and notifications, Java RMI case study. Distributed Shared Memory-Architecture and motivations. Algorithms for implementing DSM. Memory Coherence.

Unit-IV	10 Lecture Hours

Security- Overview of security techniques, Cryptographic algorithms, Digital signatures Cryptography pragmatics, Case studies- Needham Schroeder, Kerberos, SSL and Millicent. Distributed File Systems: File service architecture, Sun Network File System, The Andrew File System, Recent advances, Transactions and Concurrency Control: Transactions, Nested transactions, Locks, Optimistic Concurrency control, Timestamp ordering, Comparison of methods for concurrency control. Distributed Transactions: Flat and nested distributed transactions, Atomic Commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery. Replication: System model and group communication, Fault - tolerant services, highly available services, Transactions with replicated data.

Unit-V	12 Lecture Hours

Distributed Algorithms- Introduction to communication protocols, Balanced sliding window protocol, Routing algorithms, Destination based routing, APP problem, Deadlock free Packet switching, Introduction to Wave and traversal algorithms, Election algorithm CORBA Case Study- CORBA RMI, CORBA services.

Introduction to Big Data: Big Data Definition, Characteristic Features, Structure, Applications - Big Data vs Traditional Data - Risks of Big Data - Challenges of Conventional Systems - Web Data – Evolution of Analytic Scalability - Evolution of Analytic Processes, Tools and methods - Analysis vs Reporting - Modern Data Analytic Tools.

Introduction definition and evolution of Cloud Computing; Enabling Technologies, Service and Deployment Models Popular Cloud Stacks and Use Cases; Benefits, Risks, and Challenges of Cloud Computing Economic Models and SLAs. Topics in Cloud Security; Common cloud providers and their associated cloud stacks and popular cloud use case scenarios.

Text Books:

1. "Distributed System: Concepts and Design", Coulouris, Dollimore, Kindberg, Pearson Education.

Reference Books:

1. "Advanced Concept in Operating Systems", Singhal&Shivaratri, McGraw Hill
2. "Distributed Algorithms", Gerald Tel, Cambridge University

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Continuous Class Assessment	MTE	ETE
Weightage (%)	**30**	**20**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and PPOs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Apply** the fundamentals of parallel and distributed computing including parallel architectures and paradigms.	**PO1,PO2,PO6**
CO2	**Apply** parallel algorithms and key technologies.	**PO1, PO2,PO3,PO5**
CO3	**Develop** and execute basic parallel and distributed applications using basic programming models and tools.	**PO1, PO4,PO5,PO6**
CO4	**Analyze** the performance issues in parallel computing and trade-offs.	**PO4,PO2,PO6**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning
Course Code	Course Title	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CSE21856	Parallel and Distributed Computing	3	2	2	2	2	2	-	-	-	-	-	-

1=weakly mapped 2= moderately mapped 3=strongly mapped

CSE22857	Applied Computing Lab-II	L	T	P	C
Version 1.0	Contact Hours- 45	0	0	2	3
Pre-requisites/Exposure	C Programming				
Co-requisites	--				

Course Objectives:

1. To formulate and evaluate a hypothesis by proposing, implementing and testing a project.
2. To relate one project to prior research via a review of related literature.
3. To understand the fundamental questions in parallel and distributed computing and analyze different solutions to these questions.
4. To understand different parallel and distributed programming paradigms and algorithms, and gain practice in implementing and testing solutions using these.

Course Outcomes:

On completion of this course, the students will be able to

CO1. **Build** a communication between two sockets over a network.

CO2. **Apply** the basic concept of python programming and to **construct** a real-life application.

CO3. **Develop** a client server communication between multiple computing systems.

CO4. **Examine** different library and tools associated with python.

Catalog Description:

This course covers the architecture and enabling technologies of parallel and distributed computing systems and their innovative applications. We will cover scalable multiprocessors,

distributed clusters, P2P networks, computational Grids, virtual machines, and Internet Clouds. Case studies include IBM BlueGene/L, Google search-engine, TeraGrid, e-Science, DataGrid, Gnuttela, BitTorrent, content-delivery networks, VM Monitors, IBM BlueCloud, Amazon Elastic Clouds, Google Clouds, etc. The course aims to acquaint Master and Ph.D. students in computer science, electrical and computer engineering with state-of-the-art supercomputers and distributed computing systems for high-performance computing, e-commerce, and web-scale Internet applications.

Course Content:

Experiment 1:
Familiar Socket programming.
Experiment 2:

Database creation and update.

Experiment 3:
Building large client server applications.

Experiment 4:
Basics of compiler writing using lex and yacc.

Experiment 5:
Introduction to python Object, varibles and data types.

Experiment 6:
Introduction to duck typing, equality vs. identity testing.

Experiment 7:
Introduction to Additional useful string methods

Experiment 8:
String formatting, running Python as a script

Experiment 9:
The basics of imports, Data Structures, Functions, Functional Programming

Experiment 10:
Object-Oriented Python, Standard Library, Third-Party Tools.

Text Books:

1."Python Cookbook: Recipes for Mastering Python 3" by Brian K. Jones and David M. Beazley.

Reference Books:

1. "Programming Python" by Mark Lutz.
2. "How to think like a computer scientist: Learning with Python" by Allen B. Downey.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Continuous Class Assessment	ETE
Weightage (%)	**50**	**50**

Relationship between the Course Outcomes (Cos) and Program Outcomes (Pos)

Mapping between COs and Pos		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Build** a communication between two sockets over a network.	**PO2,PO3,PO4**
CO2	**Apply** the basic concept of python programming and to **construct** a real-life application.	**PO1,PO3,PO4,PO5**
CO3	**Develop** a client server communication between multiple computing systems.	**PO1, PO2,PO3,PO4,PO6**
CO4	**Examine** different library and tools associated with python.	**PO1, PO2,PO5, PO6**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CSE22857	Applied Computing Lab-II	3	3	3	2	2	2	-	-	-	-	-	-

1=weakly mapped 2= moderately mapped 3=strongly mapped

Unit-I	11 Lecture Hours
Introduction Application Security: Introduction – Overview of Attacks Against Applications, Attacking SUID Programs, Environment Attacks, Input Argument Attacks, File Access Attacks, Smashing the Stack for Fun and Profit, Format String Attacks, Assembly Primer, ELF File Format, PLT and GOT, Data and BSS Overflow, Array	

CSE21858	Advanced	L	T	P	C
Version 1.0	Contact Hours – 45	3	0	0	3
Pre-requisites/Exposure	Computer Networks				
Co-requisites					

Year- II
Semester-III
Elective – IV

Course Objectives:

The objective of this course is to expose students to advanced topics in network security. Topics covered will include network security issues like authentication, anonymity, traceback, denial of service, encryption, forensics etc. in both wired and wireless networks. At the conclusion of the course, students will be expected to get a clear and in-depth understanding of state of the art in network security attacks and defences.

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

CO1. **Describe** network security services and mechanisms.
CO2. **Demonstrate** the concept of Data integrity, Authentication, Digital Signatures.
CO3. **Define** the terms vulnerability, threat and attack
CO4. **Understand** Various network security applications, IPSec, Firewall, IDS, Web security, Email security, and Malicious software etc.

Course Description:

This course is about the realisation of IT Security on the level of network infrastructure. Usually, security is implemented at single points of a network (e.g. at firewalls or on important servers). The perspective from a network infrastructure often is not taken care of. The growing complexity of Network structures brings along many risks for secure traffic and high availability. You will learn what kind of dangers there are on a network level and how efficient security measures can be implemented.

Overflow, Non-terminated String Overflow, Heap Overflow, Tools and Defences.	
Unit-II	**11 Lecture Hours**
Network Security: Introduction – Overview of Network Attacks, Network Protection -IDS, Types of IDS's, Issues in Intrusion Detection, Challenges in Intrusion Detection, Taint Analysis, Network Based IDS, Problems in NIDS, Impact Analysis, TCP Overview – Connection Setup/Teardown, Packet Sniffing, Detecting Sniffers on your network, IP Spoofing, ARP Poisoning, UDP Hijacking, Fragmentation Attack- Ping of Death, Evasion & Denial of Service, UDP Hijacking, TCP Spoofing, TCP Hijacking – Mitnick attack, Joncheray attack, SYN Flood Attack, Denial of Service Attack, Port Scanning Techniques, ICMP, ICMP Attacks – ICMP Echo Attacks, Smurf Attacks, ICMP Redirect Attacks, WLAN, 802.11	
Unit-III	**12 Lecture Hours**
Wireless Security Overview, Attacks Against Wireless Networks – Eavesdropping, WEP Attacks, Injection Attacks -, WEP Encryption, WEP Attacks, FMS Attack, Denial of Service, Man-in-the-Middle Attack, Protection Mechanisms and Tools, War Driving, Vulnerabilities in Internet Applications(SMTP, FTP, DNS, Remote Access), SPAM, DNS Zones, Zone Transfer, BIND, DNS Spoofing, DNS Cache Poisoning, IPSec – Introduction, Tunnel & Transfer Modes, IPSec Authentication Header, Encapsulating Security Header and Payload, IPSec Key Exchange, VPNs, FTP Protocol, Exploiting FTP, FTP Bounce	
Unit-IV	**10 Lecture Hours**
Web Security: HTTP Challenge Response Protocol, Web-based Authentication, Man-in-the-Middle Attacks, Cookies, Sessions, CGI, Active Server Pages (ASP), Servlets, Java Server Pages, PHP, Web Framework, Client-side Scripting , DOM and BOM, Javascript Security, Browser Security, AJAX, Web Attacks, SQL Injection, XSS, Authentication Attacks, Authorization Attacks, Command Injection Attacks, Server-Side Includes(SSI)	
Text Books: 1. Charlie Kaufman, Radia Perlman and Mike Speciner, "Network Security: PRIVATE Communication in a PUBLIC world", Second Edition, Prentice Hall, 2002 2. Jonathan Katz, Yahuda Lindell, Introduction to Modern Cryptography, CRC Press **Reference Books:** 1. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach	

Modes of Examination: Assignment/Quiz/Project/Presentation/Written Exam

Examination Scheme:

Components	Mid term	Continuous Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Mapping between COs, POs and PSOs

Course Outcomes (COs)		Mapped POs and PSOs
CO-1	**Describe** network security services and mechanisms.	**PO1, PO2**
CO-2	**Demonstrate** the concept of Data integrity, Authentication, Digital Signatures.	**PO1, PO2, PO5**
CO-3	**Define** the terms vulnerability, threat and attack	**PO1, PO5**
CO-4	**Understand** Various network security applications, IPSec, Firewall, IDS, Web security, Email security, and Malicious software etc.	**PO1, PO2, PO5**

		Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CSE21858	Advanced Network Security	3	3	-	-	3	-	-	-	-	-	-	-

1=weakly mapped
2= moderately mapped
3=strongly mapped

CSE21859	**Data Mining**	**L**	**T**	**P**	**C**

Version 1.0	**Contact Hours – 45 Hours**	**3**	**0**	**0**	**3**
Pre-requisite/Exposure	**Data Warehouses, Data Analysis**				
Co-requisite	**High School Mathematics**				

Course Objectives:

1. To understand major principles and techniques in data mining.
2. To introduce the ideas of develop better understanding of how data mining technology can be applied to various kind of data.
3. To impart knowledge on data analysis.
4. To introduce basics algorithms and concepts to analyze data.

Course Outcomes:

On the completion of this course the student will be able to

CO1: **Understand** the fundamentals of data mining concepts.
CO2: **Illustrate** basic types of data, data quality, pre-processing techniques, measure of similarity and dissimilarity.
CO3: **Study** on data exploration, summary statistics, visualization techniques
CO4: **Apply** various algorithms to classify data.
CO5: **Examine** some basics of anomaly detection.

Course Description:

The main objective of the course is to enable organizations to accumulate vast amounts of data. However, extracting useful information has proven extremely challenging. This course introduces data mining methods with sophisticated algorithms for processing large volumes of data. It has also opened up exciting opportunities for exploring and analysing new types of data and for analysing old types of data in new ways. Data mining techniques can be used to support a wide range business intelligence application such as customer profiling, targeted marketing, workflow management and fraud detection. The course studies the methods and explores how they are employed mining techniques such as market expert systems for pattern recognition, clustering, diagnosis, and control both individually and in hybrid arrangement. The basics of each technique will be discussed, and industrial applications will illustrate the strengths of each approach.

Course Content:

Unit-I	**9 Lecture Hours**
Introduction to data driven concepts: Introduction: What is data mining? Origin of data mining, Data mining tasks, Types of data, Data pre-processing: Sampling, Dimensionality reduction, feature creation, variable transformation, knowledge discovery process.	
Unit-II	**9 Lecture Hours**
Introduction to KDD Importance of data mining, drawbacks of traditional data analysis, processing, data mining architecture. **Introduction To Classification** Basic concepts, Approach to solve classification problem, Decision Tree: working, building, measures for selecting best split, overfitting, evaluating, Rule-based classifier, Nearest neighbour classifiers, etc	
Unit-III	**9 Lecture Hours**
Association Rule Learning Problem definition, Frequent Itemset generation: Apriori algorithm, Pruning, rule generation, FP-Growth, Evaluation of association patterns, Handling categorical data, sequential patterns, etc.	
Unit-IV	**9 Lecture Hours**
Cluster Analysis K-Means, Agglomerative Hierarchical clustering, DBSCAN, clustering evaluation, Prototype-based clustering, Density-based clustering, Graph-based clustering,	
Unit-V	**9 Lecture Hours**
Anomaly Detection Basics concepts, statistical approaches, detecting outliers, proximity-based outlier detection, density-based outlier detection. **Applications of Data Mining and Case Studies** Different case studies from industries on data ming,etc	
Text Books: 1. Introduction to data mining, Pang-Ningtan, Michael Steinbach, Vipin Kumar, Pearson 2. Data mining: Concepts and Techniques, by Jiawei Han and Micheline Kamber, Morgan Kaufmann, ISBN 1-55860-489-8. 3. Principles of Data Mining, by David Hand, Heikki Mannila, Padhraic Smyth, The MIT Press, ISBN 0-262-08290-X **Reference Books:** 1. Reference books include "Data Mining: Concepts and Techniques" by Jiawei Han and Micheline Kamber, Elsevier, 2006.	

Modes of Evaluation: Quiz/Assignment/Presentation/Extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
Course Outcomes (COs)		Mapped Program Outcomes
CO1	**Understand** the fundamentals of data mining concepts.	PO1, PO2, PO3, PO4, PO5
CO2	**Illustrate** basic types of data, data quality, pre-processing techniques, measure of similarity and dissimilarity.	PO1, PO2, PO3, PO4
CO3	**Study** on data exploration, summary statistics, visualization techniques	PO1, PO2, PO3, PO4, PO5
CO4	**Apply** various algorithms to classify data.	PO1, PO2, PO3,
CO5	**Examine** some basics of anomaly detection.	PO1, PO2, PSO1,

		Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
Course Code	**Course Title**	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CSE21859	Data Mining	3	3	3	3	3	-	-	-	-	-	-	-

1 = Weakly Mapped
2 = Moderately Mapped
3 = Strongly Mapped

CSE21860	Computational Biology	L	T	P	C
Version 1.0	Contact Hours – 45 Hours	3	0	0	3
Pre-requisite/Exposure	C Programing				
Co-requisite	NIL				

Course Objectives:

1. To understand the fundamental concepts in Biology
2. To understand the algorithms used for Biological problems
3. To introduce the basic concepts and techniques of Machine Learning.
4. To understand and apply the fundamental concepts in graph theory.
5. To computationally formulate and apply different biological problems

Course Outcomes:

On the completion of this course, the student will be able to

CO1: **Understand** the basic concepts of biology and bioinformatics
CO2: **Discuss** the bioinformatics algorithm used for biological problems.
CO3: **Analyze** fundamental issues and challenges of machine learning
CO4: **Discuss** the different distance measures in graphs. Define the special types of graphs- complete graph, regular graph, bipartite graph and their properties.
CO5: **Apply** the concept of computation for biological problems

Course Description:

The objective of the course is to introduce students to the rapidly evolving field of biology and bioinformatics. The term "bioinformatics" often means different things to different scientists, and our goal is not to cover all those things. Rather, we will aim to cover in the lectures the most fundamental topics, such as sequence alignment and pattern finding, and then explore some of the frontier areas. We will also learn to solve different biological problems on the basis of Machine learning and Graph Theoretic Approach. After completing this course, the students will gain an understanding of the computational in the analysis of large biological data set. They will understand how some of the commonly used bioinformatics tools work, how to use these tools effectively, and how to read and evaluate research articles in the field.

Course Content:

Unit-I: Introduction	**5 Lecture Hours**
Unit Heading: Basic Biology: What is life? The unity and the diversity of living things. Prokaryotes and Eukaryotes, Yeast and People, Evolutionary time and relatedness, Living parts: Tissues, cells, compartments and organelles, Central dogma of molecular biology, Concept of DNA, RNA, Protein and metabolic pathway. What is Bioinformatics? Recent challenges in Bioinformatics. Biological databases: Their needs and challenges. Example of different biological databases – sequence, structure, function, microarrray, pathway, etc.	
Unit-II: Bioinformatics Algorithm	**10 Lecture Hours**
Unit Heading: Simple Alignment, Needleman Wunsch Algorithm, Global and local Alignment, Smith-waterman Algorithm, Divide and Conquer, Dynamic Programming, Substitution patterns, Variation of blast search, Multiple alignment - computational approach. Hidden Markov Model: Alignment and Predictor, Greedy algorithm in Bioinformatics, Biological content search on Biological database, Exhaustive Search.	
Unit-III: Concept of Machine Learning	**10 Lecture Hours**
Unit Heading: Why Machine learning, Types of Machine Learning - Supervised Learning - Unsupervised Learning – reinforcement, The Curse of dimensionality, Over fitting and linear regression, Bias and Variance, Linear Regression, Polynomial Regression, Features, Scaling, Cost Function, Gradient Descent, Learning Rate, Supervised Learning, Linear classifier, Logistic Regression, Multi-class Classification, Bias and Variance. Unsupervised Learning, Clustering, K-Means, Optimization Using Evolutionary Techniques, Number of Clusters, Expectation Maximization, Dimensionality Reduction	
Unit-IV: Concept of Graph Theory	**10 Lecture Hours**
Unit Heading: Graph – definition; Degree sequences, Different distance measures in graphs, Special types of graphs – complete graph, regular graph, bipartite graph and their properties. Havel-Hakimi theorem and Erdos-Gallai theorem (statement only), hypercube graph, Petersen graph, trees, forests and spanning subgraphs, distances, radius, diameter, center of a graph, the number of distinct spanning trees in a complete graph.	
Unit-IV: Computational Biology	**10 Lecture Hours**
Genomics and Proteomics: Interaction, Structure, Functional Clustering: GraphTheoretic approach, Machine Learning algorithm.	

Text Books:

1. Dan E.Krane, Michael L. Raymer. Fundamental Concepts of Bioinformatics. Pearson Education, 2006
2. Jones, Neil C., and Pavel Pevzner. An introduction to bioinformatics algorithms. MIT press, 2004.
3. D. Gusfield, Algorithms on Strings, Trees, and Sequences: Computer Science and Computational Biology, Cambridge University Press, 1997.

Reference Books:

1. D. W. Mont, Bio-Informatics: Sequence and Genome Analysis, CSHL Press.
2. Forsdyke, Donald R. Evolutionary bioinformatics. Springer Science & Business Media, 2010.

Modes of Evaluation: Quiz/Assignment/Presentation/Extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
Course Outcomes (COs)		Mapped Program Outcomes
CO1	Understand the different distance measures in graphs. Define the special types of graphs- complete graph, regular graph, bipartite graph and their properties	PO1, PO2
CO2	Discuss the properties of trees, Minimal Spanning Tree, Breadth First Search, Depth First Search, Hauffman Trees	PO1,PO2, PO3
CO3	Discuss the properties of trees, Arboricity, vertex and edge connectivity, auto-morphism groups, reconstruction problem and Mengers theorem	PO1,PO2
CO4	Interpret algorithms and methods for Graph Colouring and Connectivity	PO1, PO2, PO3
CO5	Discuss the properties of Planner Graphs and Ramsey Graphs.	PO1, PO2, PO3

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CSE21860	Computational Biology	3	3	3	-	-	-	-	-	-	-	-	-

1 = Weakly Mapped
2 = Moderately Mapped
3 = Strongly Mapped

CSE25861	**Thesis (Part – I)**	**L**	**T**	**P**	**C**
Version 1.0	**Contact Hours-240**	**0**	**0**	**24**	**16**
Pre-requisites/Exposure	**Basic idea of the required subjects**				
Co-requisites					

Course Objectives:

- To be able to design, develop, document, and test software using current techniques.
- To understand the fundamentals of computer architecture and computing theory.
- To be able to solve problems working in group settings.
- To demonstrate the ability to give presentations and write technical reports.
- To demonstrate understanding of the importance of social and ethical issues related to the profession.

Course Outcomes:

On completion of this course, the students will be able to

CO1**. Identify** a real world problem

CO2. **Utilize** the modern tools to solve the problems

CO3. **Discuss** in a group to promote team spirit and leadership quality among the students

CO4. **Plan** a projects involving both technological aspects and finance

CO5. **Identify** newer areas of in depth study and research and lifelong learning

Catalog Description:

The course encourages students to take thesis works that are based on current trends and technologies in various subjects, which will augment the theory subjects. The students will form a group to do their thesis work. This teaming is to encourage team spirit and to insist the importance of team work. The students typically undergo group formation, finalization of area of work, testing, generation and verification of results, and possible research publication procedure.

Course Content:

The Evaluation of the thesis work are to be carried out in the following way:
1. In-depth study of a topic proposed by the supervisor
2. Continuous Evaluation through guide.
3. An open pre-submission seminar by the student.
4. End-semester University Examination (An open seminar followed by a Viva voce)

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	-	-	100

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Investigate** a real world problem	**PO2, PO3**
CO2	**Utilize** the modern tools to solve the problems	**PO2, PO3**
CO3	**Discuss** in a group to promote team spirit and leadership quality among the students	**PO1, PO9, PO11**
CO4	**Plan** a projects involving both technological aspects and finance	**PO3, PO7, PO9, PO10, PO11**
CO5	**Identify** newer areas of in depth study and research and lifelong learning	**PO7, PO9, PO11, PO12**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long Learning
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CSE25861	Thesis (Part – I)	1	2	3	-	-	-	2	-	1	1	3	1

1=weakly mapped

2= moderately mapped

3=strongly mapped

CSE25862	Seminar -I	L	T	P	C
Version 1.0	Contact hour-90	0	0	6	4
Pre-requisites/Exposure	Knowledge on Computer domain				
Co-requisites	--				

Course Objectives:

- To
  o **develop** skills in doing literature survey, technical presentation and report preparation.
- To **enable** project identification and execution of preliminary works on final semester project

Course Outcomes:

On completion of this course, the students will be able to

CO1. **Identify** the advanced technologies and globalization

CO2. **Develop** communication and representation skills towards becoming a good team leader and manager

CO3. **Plan** for lifelong learning towards industry readiness

CO4. **Build** the ability to identify an engineering problem, analyze it and propose a work plan to solve it.

Catalog Description:

The course involves presentation and report submission by every student. Reference search and technical writing skills along with effective presentation skills are focused. The course strengthens the research attributes including literature survey.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	**Identify** the advanced technologies and globalization	PO1, PO2,

		PO3
CO2	**Develop** communication and representation skills towards becoming a good team leader and manager	**PO9, PO10**
CO3	**Plan** for lifelong learning towards industry readiness	**PO1, PO12**
CO4	**Build** the ability to identify an engineering problem, analyze it and propose a work plan to solve it.	**PO1, PO2, PO3, PO4, PO5, PO6**

CSE25863	**Thesis (Part – II)**	**L**	**T**	**P**	**C**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CSE25862	Seminar-I	3	2	2	1	1	1	-	-	1	1	-	1

1=weakly mapped

2= moderately mapped

3=strongly mapped

Version 1.0	**Contact Hours -270**	**0**	**0**	**27**	**18**
Pre-requisites/Exposure	**Basic idea of the required subjects**				
Co-requisites					

Course Objectives:

1. To be able to design, develop, document, and test software using current techniques.
2. To understand the fundamentals of computer architecture and computing theory.
3. To be able to solve problems working in group settings.
4. To demonstrate the ability to give presentations and write technical reports.
5. To demonstrate understanding of the importance of social and ethical issues related to the profession.

Course Outcomes:

On completion of this course, the students will be able to

CO1**. Identify** a real world problem

CO2. **Utilize** the modern tools to solve the problems

CO3. **Discuss** in a group to promote team spirit and leadership quality among the students

CO4. **Plan** a projects involving both technological aspects and finance

CO5. **Identify** newer areas of in depth study and research and lifelong learning

Catalog Description:

The course encourages students to take thesis works that are based on current trends and technologies in various subjects, which will augment the theory subjects. The students will form a group to do their thesis work. This teaming is to encourage team spirit and to insist the importance of team work. The students typically undergo group formation, finalization of area of work, testing, generation and verification of results, and possible research publication procedure.

Course Content:

The Evaluation of the thesis work are to be carried out in the following way:
1. In-depth study of a topic proposed by the supervisor
2. Continuous Evaluation through guide.
3. An open pre-submission seminar by the student.
4. End-semester University Examination (An open seminar followed by a Viva voce)

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	**-**	**-**	**100**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Investigate** a real world problem	**PO2,PO3**
CO2	**Utilize** the modern tools to solve the problems	**PO2,PO3, PO11**
CO3	**Discuss** in a group to promote team spirit and leadership quality among the students	**PO1, PO9**
CO4	**Plan** a projects involving both technological aspects and finance	**PO3,PO7, PO9,PO10, PO11**
CO5	**Identify** newer areas of in depth study and research and lifelong learning	**PO7, PO9, PO11,PO12**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long Learning
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CSE25863	Thesis (Part – II)	1	2	3	-	-	-	2	-	3	1	3	

													1

CSE25864	**Seminar –II**	**L**	**T**	**P**	**C**
Version 1.0	**Contact Hour - 60**	**0**	**0**	**6**	**4**
Pre-requisites/Exposure	**Knowledge on Computer Domain**				
Co-requisites	**--**				

1=weakly mapped 2= moderately mapped 3=strongly mapped

Course Objectives:

- To **develop** skills in doing literature survey, technical presentation and report preparation.
- To **enable** project identification and execution of preliminary works on final semester project

Course Outcomes:

On completion of this course, the students will be able to

CO1. **Identify** the advanced technologies and globalization

CO2. **Develop** communication and representation skills towards becoming a good team leader and manager

CO3. **Plan** for lifelong learning towards industry readiness

CO4. **Build** the ability to identify an engineering problem, analyze it and propose a work plan to

solve it.

Catalog Description:

The course involves presentation and report submission by every student. Reference search and technical writing skills along with effective presentation skills are focused. The course strengthens the research attributes including literature survey.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Identify** the advanced technologies and globalization	**PO1, PO2, PO3**
CO2	**Develop** communication and representation skills towards becoming a good team leader and manager	**PO9, PO10**
CO3	**Plan** for lifelong learning towards industry readiness	**PO1, PO12**
CO4	**Build** the ability to identify an engineering problem, analyze it and propose a work plan to solve it.	**PO1, PO2, PO3, PO4, PO5, PO6**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CSE25864	Seminar -II	3	2	2	1	1	1	-	-	1	1	-	1

1=weakly mapped

2= moderately mapped

3=strongly mapped

Course Objectives:

CSE25865	Grand Viva	L	T	P	C
Version 1.0		0	0	0	4
Pre-requisites/Exposure	Willing to knowledge acquisition				
Co-requisites	--				

1. To Give an overview of emerging technology and relate to subject.
2. To enable students to improve their reasoning ability.
3. To give the students a outline of technical question.
4. To expound Idea dissemination for a new technology by assessment of pupil's knowledge.

Course Outcomes:

On completion of this course, the students will be able to

CO1**. Understand** importance of knowledge acquisition.

CO2**. Conceptualize** the real-life scenario, based on viva question.

CO3. **Formalize** and practical implementation with emerging application.

CO4**. Expound** understanding in technology up gradation.

Catalog Description:

The course tests the technical knowledge acquired during the study, spoken skills, and the ability to think logically under time pressure. The course proves extremely useful for placement interviews

Course Content:

Scientific approach to resolve open end question, Theoretical Vs Practical exploration, in research paradigms, epistemology and ontology in management research, positivism vs. interpretivism, subjectivism vs. objectivism.
Foundations of confidence building in answering question, Categories of theory, theory building vs. theory testing, conceptualization and hypothesis testing. Analyze the conformity of the system to the functional requirements Appreciate importance of fundamental knowledge and its application.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Understand** importance of knowledge acquisition.	**PO4,PO10,**
CO2	**Conceptualize** the real-life scenario, based on viva question	**PO10 PO3,PO5,PO6, PO8,PO9,PO2,**
CO3	**Formalize** and practical implementation with emerging application.	**PO1, PO12, PO2, PO3,PO5,PO6**
CO4	**Expound** understanding in technology up gradation.	**PO2, PO3,PO5,PO6,PO7,P09,PO11**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12
CSE25865	Grand Viva	2	3	3	1	3	3	1	1	2	3	1	1

CONSOLIDATED CO-PO MAPPING TABLE													
Code	**Course Title**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CSE21841	Advanced Database Management systems	3	3	3	2	1	-	1	-	-	-	-	-
CSE21842	Soft Computing	3	3	3	3	3	1	-	-	-	-	-	-
CSE21843	Advance Graph Theory	3	3	3	-	-	-	-	-	-	-	-	-
CSE21844	Foundation of Computing Science	3	3	2	2	1	-	-	-	-	-	-	-
CSE22845	Applied Computing Lab –I	2	2	2	1	1	1	-	-	-	-	-	-
CSE21846	Blockchain and Cryptocurrency	3	3	-	-	3	-	-	-	-	-	-	-
CSE21847	Software Process Management	3	3	1	-	1	-	1	-	-	-	-	-
CSE21848	Natural Language Processing	3	3	3	3	3	-	-	-	-	-	-	-
CSE21849	Computer Forensics	3	3	3	2	2	-	2	-	-	-	-	-
CSE21850	Software Architecture	3	3	1	1	-	-	-	-	-	-	1	3
CSE21843	Computer Vision	2	3	3	3	3	-	-	-	-	-	-	-
CSE21852	Introduction to Information Security Management	3	3	1	-	2	-	1	-	-	-	-	-
CSE21853	Software Security	3	3	2	-	1	-	-	-	-	-	-	-
CSE21854	Social Network Analysis	-	3	3	3	1	1	-	-	-	-	-	2
CSE21855	Research Methodologies	3	3	3	2	1	-	1	-	-	-	-	-
CSE21856	Parallel and Distributed Computing	3	2	2	2	2	2	-	-	-	-	-	-
CSE22857	Applied Computing Lab-II	3	3	3	2	2	2	-	-	-	-	-	-
CSE21858	Advanced Network Security	3	3	-	-	3	-	-	-	-	-	-	-
CSE21859	Data Mining	3	3	3	3	3	-	-	-	-	-	-	-
CSE21860	Computational Biology	3	3	3	-	-	-	-	-	-	-	-	-

CSE25861	Thesis (Part – I)	1	2	3	-	-	-	2	-	1	1	3	1
CSE25862	Seminar -I	3	2	2	1	1	1	-	-	1	1	-	1
CSE25863	Thesis (Part – II)	1	2	3	-	-	-	2	-	3	1	3	1
CSE25864	Seminar -II	3	2	2	1	1	1	-	-	1	1	-	1
CSE25865	GrandViva	2	3	3	1	3	3	1	1	2	3	1	1
	AVERAGE	2.7	2.8	2.5	2	2	1.5	1.4	1	1.6	1.4	2	1.5