Bachelor of Technology (Computer Science & Engineering)										
Credit-Based Scheme of Studies/Examination										
Semester VII (w.e.f. session 2021-2022)										
S. No.	**Course Code**	**Subject**	**L:T:P**	**Hours/Week**	**Credits**	**Examination Schedule (Marks)**				**Duration of Exam (Hrs)**
						Major Test	**Minor Test**	**Practical**	**Total**	
1	PE	Elective-IV	3:0:0	3	3	75	25	0	100	3
2	PE	Elective-V	3:0:0	3	3	75	25	0	100	3
3	OE	Open Elective-II	3:0:0	3	3	75	25	0	100	3
4	PROJ-CS-401A	Project-II	0:0:12	12	6	0	40	60	100	3
5	PE- LA	Elective-IV Lab	0:0:2	2	1	0	40	60	100	3
6	PE- LA	Elective-V Lab	0:0:2	2	1	0	40	60	100	3
Total				**21**	**17**	**225**	**115**	**60**	**400**	
7	SIM-401*	Seminar on Summer Internship	2:0:0	2	0	0	50	0	50	

PE Elective-IV	**PE Elective-V**
Data Mining: PE-CS-D401A	**Soft Computing: PE-CS-D409A**
Software Verification and Validation and Testing:: PE-CS-D403A	Neural Networks and Deep Learning: PE-CS-D411A
Information Retrieval: PE-CS-D405A	Object Oriented Software Engineering: PE-CS-D413A
Speech and Natural Processing : PE-CS-D407A	Expert Systems: PE-CS-D415A

OE Elective-II
Cyber Law and Ethics: OE-CS-401A
Bioinformatics: OE-CS-403A
Fiber Optic Communications: OE-CS-405A
Industrial Electrical Systems: OE-CS-407A

The course of both PE & OE will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.

***Note:** SIM-401* is a mandatory credit-less course in which the students will be evaluated for Summer Internship undergone after 6th semester and students will be required to get passing marks to qualify.

PE-CS-D401A	Data Mining						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	**To provide the knowledge of data mining and its techniques.**						
Course Outcomes (CO)							
CO1	To learn data mining concepts in details.						
CO2	Expose the criteria for data generalization.						
CO3	To explore knowledge of mining associations, correlations and classification.						
CO4	To evaluate various types of data mining.						

Unit I: Basics of Data Mining

Need for data mining, data mining as the evolution of Information technology, data mining as a step in the process of knowledge discovery, Transactional database, Major issues in data mining, data preprocessing, data cleaning, data integration, data reduction, data transformation, data warehousing and Online Analytical Processing (OLAP).

Unit II: Mining Frequent Itemsets with Associations and Correlations

Data cube technology, multidimensional data mining, multi-dimensional data analysis, Mining Frequent Patterns, Associations and Correlations: Basic concepts and methods, market basket analysis example with rule of support and confidence, frequent itemsets, closed itemsets, and association rules, frequent itemset mining methods-Apriori algorithm.

Unit III: Mining Associations and Correlations

Advanced pattern mining, mining multilevel patterns, multi-dimensional patterns, classification: basic concepts, decision tree induction, naive bayesian classification methods, rule based classification, cluster analysis: basic concepts and methods, partitioning methods, hierarchical methods, density based methods, grid based methods.

Unit IV: Data Mining Trends

Mining spatial data, mining spatiotemporal data, mining multimedia data, mining text data, mining web data, stastical data mining, data mining applications-data mining for financial data analysis, intrusion detection and prevention, retail and telecommunication industries, science and engineering, privacy, security and social impacts of data mining, data mining trends.

Suggested Books

- J.Han, M.Kamber, Data Mining: Concepts and Techniques, Academic Press, Morgan Kanfman Publishers, 2015.
- Pieter Adrians, DolfZantinge, Data Mining, Addison Wesley 2013.
- C.S.R. Prabhu, Data Ware housing: Concepts, Techniques, Products and Applications, Prentice Hall of India, 2014.
- Berry and Lin off, Mastering Data Mining: The Art and Science of Customer Relationship Management, John Wiley and Sons, 2012.
- Seidman, Data Mining with Microsoft SQL Server, Prentice Hall of India, 2016.

PE-CS-D403A	Speech and Natural Language Processing						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	To provide the understanding of the mathematical and linguistic foundations underlying approaches to the various areas in NLP.						
Course Outcomes (CO)							
CO1	Be familiar with syntax and semantics in NLP.						
CO2	To implement various concepts of knowledge representation using Prolog.						
CO3	To classify different parsing techniques and understand semantic networks.						
CO4	To identify/explain various applications of NLP.						

Unit-I

Speech recognitionand speech synthesis: concept overview, key algorithms in the noisy channel paradigm. Fundamental components of Natural Language Processing: Lexicography, syntax, semantics, prosody, phonology, pragmatic analysis, world knowledge.Knowledge Representation schemes: Semantic net, Frames, Conceptual Dependency, Scripts.

Unit-II

Representing knowledge using rules: Logic Programming, Introduction to LISP and Prolog, Rules based deduction systems, General concepts in knowledge acquisition.**Syntax Analysis:** Formal Languages and grammars, Chomsky Hierarchy, Left- Associative Grammars, ambiguous grammars, resolution of ambiguities.

Unit-III

Computation Linguistics: Recognition and parsing of natural language structures- ATN and RTN, General Techniques of parsing- CKY, Earley and Tomitas algorithm.Semantics: Knowledge representation, semantics networks logic and inference pragmatics, graph models and optimization.

Unit-IV

Applications of NLP: Intelligent work processor, Machine translation, user interfaces, Man-Machine interfaces, natural language querying, tutoring and authoring systems, speech recognition, commercial use of NLP.

Suggested Books:

- Daniel Jurafsky, James H. Martin, "Speech *and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition"*, 2nd edition, Pearson Edu., 2013.
- James Allen, "Natural Language Understanding", Pearson Education, Second Edition, 2003.
- Ivan Bratko, "Prolog: Programming for Artificial Intelligence", 3rd Edition, Pearson Education, Fifth Impression 2009.
- G. Gazder, "Natural Language processing in prolog", Addison Wesley, 1989.

PE-CS-D405A	Information Retrieval						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	To provide an overview of Information Retrieval and comprehensive details about various Evaluation methods.						
Course Outcomes (CO)							
CO1	To provide an overview of Information Retrieval process and models.						
CO2	To understand the experimental evaluation of performance metrics.						
CO3	To gain knowledge about various web search engines.						
CO4	To understand the application of appropriate text classification and clustering.						

Unit I

Introduction: Goals and history of IR. The impact of the web on IR. The role of artificial intelligence (AI) in IR. Basic IR models: boolean and vector-space retrieval models; ranked retrieval; text similarity metrices; TF-IDF (term frequency/ inverse document frequency) weighting; cosine similarity.

Basic Tokenizing Indexing, and Implementation of Vector space Retrieval: Simple tokenizing, stop word removal, and stemming, inverted indices, efficient processing with sparse vectors, python implementation.

Unit II

Experimental evaluation of IR: performance metrics: recall, precision, and F-measure, evaluations on benchmark text collections.

Query Operations and Languages: Relevance feedback; query expansion; query languages.

Unit III

Text Representation: Word statistics; Zipf's law; porter stemmer; morphology; index term selection; using thesauri, metadata and markup languages (SGML, HTML, XML).

Web Search: search engines; spidering; metacrawlers; directed spidering; link analysis (e.g. hubs and authorities, google pagerank); shopping agents.

Unit IV

Text Categorization and Clustering: Categorization algorithms: naïve bayes; decision trees; and nearest neighbour. Clustering algorithms: agglomerative clustering; k-means; expectation maximization (EM). Applications to information filtering; organization; and relevance feedback.

Recommender System: collaborative filtering and content based recommnadation of documents and products.

Suggested Books:

- Introduction to Information Retrieval Manning, Raghavan and Schutze, Cambridge University Press, 2008.
- Ricardo Baeza-Yates and Berthier Ribeiro-Neto, Modern Information Retrieval: The Concepts and Technology behind Search, Second Edition, ACM Press Books, 2011.
- Ricci, F, Rokach, L. Shapira, B.Kantor, Recommender Systems Handbook, First Edition, 2011.
- Stefan Buettcher, Charles L. A. Clarke and Gordon V. Cormack, Information Retrieval: Implementing and Evaluating Search Engines, The MIT Press, 2010.

PE-CS-D407A	Software Verification and Validation and Testing						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	To provide an understanding of concepts and techniques for testing software and assuring its quality.						
Course Outcomes							
CO 1	Expose the criteria and parameters for the generation of test cases.						
CO 2	Learn the design of test cases and generating test cases.						
CO 3	Be familiar with test management and software testing activities and V&V activities.						
CO 4	Be exposed to the significance of software testing in web and Object orient techniques.						

Unit-I

Introduction: Overview of software evolution, SDLC, Testing Process, Terminologies in Testing: Error, Fault, Failure, Verification, Validation, Difference between Verification and Validation, Definition of software testing, test cases, test oracles, testing process, limitations of testing.

Unit-II

Functional Testing: Boundary Value Analysis, Equivalence Class Testing, Decision Table Based Testing, Cause Effect Graphing Technique.

Structural Testing: Path testing, DD-Paths, Cyclomatic Complexity, Graph Metrics, Data Flow Testing, Mutation testing.

Unit-III

Reducing the number of test cases: Prioritization guidelines, Priority category, Scheme, Risk Analysis, Regression Testing and Slice based testing.

Testing Activities: Unit Testing, Levels of Testing, Integration Testing, System Testing, Debugging, Domain Testing.

Unit-IV

Overview of SQM: Concepts of Software Quality, quality attributes, software quality models: McCall, Boehm, ISO-9000, CMM.

Misellaneous Topics: Stress testing, Adhoc testing, Buddy testing, Exploratory testing, Agile and extreme testing.

Suggested Books:

- Naresh Chauhan, "Softearw Testing Principles and Practices" Oxford publications, 2012.
- William Perry, "Effective Methods for Software Testing", John Wiley & Sons, New York, 1995.
- Cem Kaner, Jack Falk, Nguyen Quoc, "Testing Computer Software", Second Edition, Van Nostrand Reinhold, New York, 1993.
- Boris Beizer, "Software Testing Techniques", Second Volume, Second Edition, Van Nostrand Reinhold, New York, 1990.
- Louise Tamres, "Software Testing", Pearson Education Asia, 2002
- Roger S. Pressman, "Software Engineering – A Practitioner's Approach", Fifth Edition, McGraw-Hill International Edition, New Delhi, 2001.

- Boris Beizer, “Black-Box Testing – Techniques for Functional Testing of Software and Systems”, John Wiley & Sons Inc., New York, 1995.
- K.K. Aggarwal & Yogesh Singh, “Software Engineering”, New Age International Publishers, New Delhi, 2003.
- Marc Roper, “Software Testing”, McGraw-Hill Book Co., London, 1994.

PE-CS-D409A	Soft Computing						
Lecture	**Tutorial**	**Practical**	**Credit**	**MajorTest**	**MinorTest**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hour**
Purpose	To familiarize the students with the concepts of soft computing						
Course Outcomes							
CO 1	Identify and describe soft computing techniques and their roles in building intelligent machines						
CO 2	Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.						
CO 3	To learn non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, genetic algorithms.						
CO 4	Apply genetic algorithms to combinatorial optimization problems.						

Unit I

Introduction: Soft Computing and Neural Networks: Evolution of Computing: Soft Computing Constituents, Soft Vs Hard Computing, From Conventional AI to Computational Intelligence: Machine Learning Basics

Unit II

Fuzzy Logic: Fuzzy Classical and Fuzzy Sets: Overview of Classical Sets, Membership Function, Fuzzy rule generation. Operations on Fuzzy Sets: Compliment, Intersections, Unions, Combinations of Operations, Aggregation Operations. Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.

Unit III

Neural Networks: Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks: Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks, Implementation using Python/ Matlab

Unit IV

Genetic Algorithm (GA): Evolutionary computing, conditions for evolution, Simple Genetic Algorithm (SGA), different types of operators: Selection, Crossover, mutation and replacement, optimization problems and traditional optimization methods, differences between GA & traditional methods, Applications of GA in Machine Learning: Machine Learning Approach to Knowledge Acquisition.

Suggested Books:

- S. N. Sivanandam & S. N. Deepa, Principles of Soft Computing, Wiley India Pvt. Ltd.
- Goldberg D. E., Genetic Algorithms in Search, Optimization, and Machine Learning, Pearson Education.
- Jang, Sun, Mizutani, Neuro-Fuzzy and Soft computing, Pearson Education.
- Haykin, Neural networks: a comprehensive foundation, Pearson Education.
- George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic: Theory and Applications", Prentice Hall, 1995.

PE-CS-D411A	Neural Networks and Deep Learning						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	To provide knowledge of various artificial neural networks and deep learning algorithms for optimization						
Course Outcomes							
CO 1	To learn the basics of artificial neural networks concepts, various neural networks architecture						
CO 2	To explore knowledge of special types of Artificial neural networks						
CO 3	To understand the basics of Deep learning and its applications						
CO 4	To imprise about the different deep learning algorithms						

Unit-I

Artificial Neural Networks: Human brain, Model of an artificial neuron, Basic concepts of neural networks, fundamentals of biological neural network and artificial neural network, evolution of neural networks, Characteristics of Neural Networks, learning methods-supervised, unsupervised and reinforcement, taxonomy of neural network architectures, terminologies-weights, bias, threshold, learning rate, applications of Neural Networks.

Unit-II

Supervised and Unsupervised Neural Networks: Hebb network theory and training algorithm, perceptron networks architecture and training algorithms, Back Propagation networks architecture and Training Algorithms, Associative Memory network architecture and Training Algorithms, Hopfield networks architecture and Training Algorithms, Counter Propagation networks architecture and Training Algorithms, adaptive resonance theory networks architecture and Training Algorithms.

Unit-III

Advanced neural networks: Kohonan self organising feature, maps architecture and training algorithm, learning vector quantization architecture and training algorithm, boltzman machine, cognitron network, neocognitron network, optical neural networks electro-optical multipliers and holographic correlators.

Unit-IV

Deep learning: Machine learning basics, simple machine learning algorithms-linear regression, underfitting and overfitting challenges in machine learning, supervised learning approach for support vector machine, Deep Forward Networks, Convolutional networks, deep recurrent networks, deep boltzmann machine, applications in speech recognition and natural language processing.

Suggested Books:

- Li Min Fu, "Neural Networks in Computer Intelligence", McGraw-Hill, Inc. 2012.
- S N Sivanandam, "Neural Networks using MATLAB 6.0", TMH, 4th. Reprint 2015.
- S N Sivanandam, "Principles of Soft Computing", 2nd. Edition, Wiley, Reprint 2014.
- Freeman J.A. & D.M. Skapura, "Neural Networks: Algorithms, Applications and Programming Techniques", Addison Wesley, Reading, Mass, 2014.
- Deep Learning (Ian J. Goodfellow, Yoshua Bengio and Aaron Courville), MIT Press, 2016.
- Deep Learning with Python: A Hands-On Introduction by Ketkar, Apress

PE-CS-D413A	Object Oriented Software Engineering						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hour**
Purpose	To provide the thorough knowledge to use the concepts and their design attributes for Object Oriented Software Engineering approaches and platforms to solve real time problems.						
Course Outcomes							
CO 1	To learn the basic concepts of object oriented systems and software engineering.						
CO 2	To get exposure of various object modeling methodologies, tools for analyzing and designing software based systems using UML.						
CO 3	To explore problems using Use Cases, analyzing relations, responsibilities and collaborations among classes and their behavior in problem domain.						
CO 4	To evaluate object oriented design processes using models, design patterns, interfaces designs and communication mechanisms for performing required tasks.						

Unit-I

An Overview of Object-Oriented system Development, Objects Basis, Class Hierarchy, Inheritance, Polymorphism, Object Relationships and Associations, Aggregations and Object Containment, Object Persistence, Meta-Classes, Object Oriented Systems Development Life Cycle: Software Development Process, Object Oriented Systems Development: A Use-Case Driven Approach.

Unit-II

Object Oriented Methodologies: Rumbaugh Methodology, Jacobson Methodology, BoochMethodology, Patterns, Frameworks, The Unified approach, Unified Modeling Language (UML)

Unit-III

Object Oriented Analysis Process, Use Case Driven Object Oriented Analysis, Use Case Model, Object Analysis: Classification, Classification Theory, Approaches for identifying classes, Responsibilities and Collaborators, Identifying Object Relationships, Attributes and Methods: Associations, Super-Sub Class relationships, A-Part-of-Relationships-Aggregation, Class Responsibilities, Object Responsibilities.

Unit-IV

Object Oriented Design process and Design Axioms, Corollaries, Design Patterns, Designing Classes: Object Oriented Design Philosophy, UML Object Constraint Language, Designing Classes: The Process, Class Visibility, Refining Attributes, Designing Methods and Protocols, Packages and Managing classes, View Layer: Designing Interface objects,Designing View layer Classes, Macro and Micro Level Interface Design Process.

Suggested Books:

- Ali Bahrami, Object Oriented Systems Development, McGraw Hill Publishing Company Limited, New Delhi, 2013.
- Rumbaugh *et al.*, Object Oriented Modeling and Design, PHI, 2006.
- Robert Laganière and Timothy C. Lethbridge, Object-Oriented Software Engineering: Practical Software Development, McGraw-Hill Publishing Company Limited, New Delhi, Sixth Print 2008.

- Ivar Jacobson, MagnosChristerson, Patrick Jonsson, Gunnar Overgaard, Object-oriented Software
- Engineering: A Use Case Driven Approach, Pearson Education, New Delhi, Seventh Edition Reprint, 2009.
- David C. Kung, Object-Oriented Software Engineering: An Agile Unified Methodology, McGraw-Hill Publishing Company Limited, New Delhi, 2013

PE-CS-D415A	Expert Systems						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	In this course the student will learn the methodologies used to transfer the knowledge of a human expert into an intelligent program that can be used to solve real-time problems.						
Course Outcomes(CO)							
CO1	Examining the fundamentals and terminologies of expert system.						
CO2	To facilitate students to implement various knowledge representation techniques for acquisition and validate various structures in experts system domain.						
CO3	Signifying AI techniques to solve social, industrial and environmental problems.						
CO4	Application of professional aspects in multi-disciplinary approach to meet global standards towards design, realizing and manufacturing.						

Unit-I

Introduction to Expert Systems: Introduction to Expert Systems, Representation and organization of knowledge, Basics characteristics, Architecture of expert system, types of problems handled by expert systems, case study of PROSPECTOR.

Unit-II

Expert System Tools: Techniques of knowledge representations in expert systems, knowledge engineering, System-building aids, support facilities, stages in the development of expert systems.

Unit-III

Building an Expert System: Expert system development, Selection of tool, Acquiring Knowledge, Building process.

Unit-IV

Problems with Expert Systems: Difficulties, common pitfalls in planning, dealing with domain expert, difficulties during development.

Suggested Books

- Waterman D.A., "A Guide to Expert Systems", Addison Wesley Longman, 1985.
- Hayes-Roth, Lenat and Waterman: Building Expert Systems, Addison Wesley, 1983.
- Weiss S.M. and Kulikowski C.A., "A Practical Guide to Designing Expert Systems", Rowman &Allanheld, New Jersey, 2011.

PE—CS-D401AL	Data Mining Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3hrs**
Purpose	Learning of data mining tools and extracting knowledge by applying various data mining techniques. Also explore the different validation techniques on the given training data set to get output metrics.						
Course Outcomes(CO)							
CO1	Learning of Data Mining tools.						
CO2	Understanding of various Data Mining Algorithms.						
CO3	Developing the application for association mining, classification and clustering.						
CO4	Providing solutions for real world problems using various data mining techniques.						

List of Practicals

1. Study of WEKA data mining tool.
2. Study of ORANGE and KNIME open source data mining tools.
3. Develop an application to identify underlying relations between different items by extracting
1. association rule mining.
4. Develop an application for distinguishing the data classes using classification technique.
5. Develop an application for partitioning a set of data objects using clustering technique.
6. Develop an application by implementing Naive Bayes Classifier.
7. Develop an application by implementing Association Mining Rule based Apriori Algorithm.
8. Develop an application for Decision Tree from class-labeled training tuples.
9. Develop a Decision Tree from a given training data set.
10. Develop a Decision Tree with cross validation training data set.
11. Develop a Decision Tree by using prune method and reduced error pruning. Also show the
2. accuracy for cross validation trained data set.

PE—CS-D403AL	Software Verification and Validation and Testing Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3hrs**
Purpose	To gain a broad understanding of the discipline of software engineering implementation.						
Course Outcomes(CO)							
CO1	To understand the basic concepts of Software Engineering.						
CO2	To understand the different design techniques.						
CO3	To understand different software development models.						
CO4	To understand different types of Testing.						

List of Practical

1. To identify the role of the software in today's world across a few significant domains related to day to day life.
2. To identify any scenario and identify suitable software development model for the given scenario.
3. To classify the requirement into functional and non-functional requirements and list four functional and non functional requirements for any scenario.
4. Do comparative study of various software development models.
5. Preparation of requirement document for standard application problems in standard format.(e.g Library Management System, Railway Reservation system, Hospital management System, University Admission system)
6. To identify the usage of Regression Testing.
7. To identify the usage of Agile Testing.
8. To understand the importance of SDLC and STLC process.

PE—CS-D405AL	Information Retrieval Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3hrs**
Purpose	To provide an overview of Information Retrieval and implementation insight about various evaluation methods.						
Course Outcomes(CO)							
CO1	Understanding about Information Retrieval models.						
CO2	Learn experimental evaluation of performance matrices.						
CO3	Learn implementation of web search engines.						
CO4	Learn the implementation of text clustering and classification algorithms.						

List of Practicals

1. Implementation of Simple tokenization and Stop-word removal on a document.
2. Write a program to compute similarity between two text documents.
3. Write a map reduce program to count the number of occurrence of each alphabetic character in a document. The count for each letter should be case-insensitive.
4. Write a program to parse XML text, generate web graph and compute topic specific page rank.
5. Write a program to implement Simple web crawler.
6. Implementation of Naïve Bayes algorithm.
7. Implementation of Decision tree algorithm.
8. Implementation of K-nearest neighbour algorithm.
9. Implementation of K- means algorithm.
10. Evaluate the performance matrix using any algorithm.

PE-CS-D407AL	Speech and Natural Processing						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3hrs**
Purpose	The objective of Natural Language Processing lab is to introduce the students with the basics of NLP which will empower them for developing advanced NLP tools and solving practical problems in the field.						
Course Outcomes(CO)							
CO1	To understand the basic concepts of Speech and Natural Processing.						
CO2	To understand the different word analysis techniques.						
CO3	To understand different Speech and Natural Processing models.						
CO4	To understand different types of chunking.						

List of Practical

1. Word Analysis
2. Word Generation
3. Morphology
4. N-Grams
5. N-Grams Smoothing
6. POS Tagging: Hidden Markov Model
7. POS Tagging: Viterbi Decoding
8. Building POS Tagger
9. Chunking
10. Building Chunker

PE--CS-D409AL	Soft Computing Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3hrs**
Purpose	Soft Computing achieves practicability, robustness, and low cost solution for complex problems in real world using neural network, fuzzy systems ,optimization approaches.						
Course Outcomes(CO)							
CO1	Understand Fuzzy Concepts.						
CO2	Learn Neural Network with back propagation and without back propagation.						
CO3	Learn the operators of Genetic algorithms.						
CO4	Learn the implementation of Optimization algorithms.						

List of Practicals

1. Write a program to implement artificial neural network with back propagation.
2. Write a program to implement artificial neural network without back propagation.
3. Implementation of operations on Fuzzy Sets.
3. Implement Travelling Sales man problem with genetic algorithm..
4. Implement Crisp partitions for real life iris dataset.
5. Write a program to implement Logic gates.
6. Implement SVM classification of Fuzzy Concepts.
7. Implement ABC (Artificial Bee Colony) optimization Technique.
8. Implement DE (Differential Evolution) algorithm.

PE—CS-D411AL	Neural Networks and Deep Learning Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3hrs**
Purpose	Demonstrate knowledge and apply engineering and management principles to manage projects and in multi-disciplinary environment and use research-based knowledge and research methods including design of experiments, analysis and interpretation of data for valid conclusions.						
Course Outcomes (CO)							
CO1	Apply learning algorithms on perceptron and apply back propagation learning on Neural Network.						
CO2	Apply Feedback NN and plot a Boltzmann machine and associative memory on various application.						
CO3	Apply different types of auto encoders with dimensionality reduction and regularization.						
CO4	Design Convolutional Neural Network and classification using Convolutional Neural Network.						

List of Practicals

1. To Write a program to implement Perceptron.
2. To write a program to implement AND OR gates using Perceptron.
3. To implement Crab Classification using pattern net Objective.
4. To write a program to implement Wine Classification using Back propagation.
5. Write a MatLab Script containing four functions Addition, Subtraction, Multiply and Divide functions.
6. Write a program to implement classification of linearly separable Data with a perceptron.
7. To study ImageNet, GoogleNet, ResNet convolutional Neural Networks.
8. To study Convolutional Neural Network and Recurrent Neural Network.

PE—CS-D413AL	Object Oriented Software Engineering Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3hrs**
Purpose	Object-Oriented Software Development is an approach/paradigm of developing software byidentifying and implementing a set of objects and their interactions to meet the desired objectives. The first step towards this kind of software development is to learn and master the various concepts, tools and techniques that are to be used design and implementation of such systems.						
Course Outcomes (CO)							
CO1	To learn and understand various O-O concepts along with their applicability contexts.						
CO2	To learn various modeling techniques to model different perspectives of object-oriented software design (UML)						
CO3	To learn software development life cycle for Object-Oriented solutions for Real-World Problems.						
CO4	Learn how to test and document software.						

List of Practicals

1. Choose any one project and Write the complete problem statement.
2. Write the software requirement specification document
3. Draw the entity relationship diagram
4. Draw the data flow diagrams at level 0 and level 1
5. Draw use case diagram
6. Draw activity diagram of all use cases.
7. Draw state chart diagram of all use cases
8. Draw sequence diagram of all use cases
9. Draw collaboration diagram of all use cases
10. Assign objects in sequence diagram to classes and make class diagram.

PE—CS-D415AL	Expert System Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3hrs**
Purpose	In this course the student will learn different techniques of AI and Expert system that can be used to solve real-time problems.						
Course Outcomes(CO)							
CO1	Examining the fundamentals and terminologies of expert system.						
CO2	Study of various trends and issues related to AI and expert system.						
CO3	Implement general problems using AI and expert system techniques.						
CO4	Student will capable to handle real time problems related to AI and expert system.						

List of Practicals

1. Study of Prolog.
2. Write simple fact for the statements using PROLOG.
3. Write predicates One converts centigrade temperatures to
4. Write predicates One converts centigrade temperatures to Fahrenheit, the other checks if a temperature is below freezing.
5. Write a program to solve the Monkey Banana problem.
6. WAP to implement factorial, Fibonacci of a given number.
7. Write a program to solve 4-Queen problem.
8. Write a program to solve traveling salesman problem.
9. Write a program to solve water jug problem using LISP
10. Solve any problem using depth first search and best first search.

OE-CS-401A	Cyber Law and Ethics						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	To provide an overview of Cyber Law and also explores technical, legal, and social issues related to cybercrimes, Laws Cyber Ethics						
Course Outcomes (CO)							
CO1	Understand Cyber laws, Cyber space.						
CO2	Describe Information Technology act and Related Legislation.						
CO3	Demonstrate Electronic business and legal issues.						
CO4	Interpret Cyber Ethics, significance and its need.						

Unit I

Cyber Law: Emergence of cyber space, Cyber Jurisprudence, Jurisprudence and law, Doctrinal approach, Consensual approach, Real Approach, Cyber Ethics, Cyber Jurisdiction, Hierarchy of courts, Civil and criminal jurisdictions, CyberspaceWeb space, Web hosting and web Development agreement, Legal and Technological Significance of domain Names, Internet as a tool for global access.

Unit II

Information Technology Act: Overview of IT Act 2000, Amendments and Limitations of IT Act, Digital Signatures, Cryptographic Algorithm, Public and Private Cryptography, Electronic Governance, Legal Recognition of Electronic Records, Legal Recognition of Digital Signature, Certifying Authorities, Cyber Crime and Offences, Network Service Providers Liability, Cyber Regulations Appellate Tribunal, Penalties and Adjudication.

Unit III

Cyber law and Related Legislation: Patent Law, Trademark Law, Copyright, Software – Copyright or Patented, Domain Names and Copyright disputes, Electronic Data Base and its Protection, IT Act and Civil Procedure Code, IT Act and Criminal Procedural Code, Relevant Sections of Indian Evidence Act, Relevant Sections of Bankers Book Evidence Act, Relevant Sections of Indian Penal Code.

Unit IV

Cyber Ethics: The Importance of Cyber Law, Significance of cyber Ethics, Need for Cyber regulations and Ethics. Ethics in Information society, Introduction to Artificial Intelligence Ethics: Ethical Issues in AI and core Principles, Introduction to Block-Chain Ethics.

Suggested Books:

- Cyber Laws: Intellectual property & E Commerce, Security- Kumar K, dominant Publisher
- Cyber Ethics 4.0, Christoph Stuckelberger, Pavan Duggal, by Globethic
- Information Security policy & Implementation Issues, NIIT, PHI
- Legal Dimensions of Cyber Space, Verma S, K, Mittal Raman, Indian Law Institute, New Delhi
- Cyber Crimes and Law Enforcement, Vasu Deva, Commonwealth Publishers, New Delhi, (2003).

OE-CS-403A	Bioinformatics						
Lecture	**Tutorial**	**Practical**	**Credit**	**MajorTest**	**MinorTest**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hour**
Purpose	To familiarize the students with the concepts of bioinformatics.						
Course Outcomes							
CO 1	Explain concepts of bioinformatics and its significance in biological data analysis.						
CO 2	Apply various bioinformatics tools to manage different type of biological data.						
CO 3	Explain computational method and algorithms for biological data interpretation.						
CO 4	Classify different types of biological databases.						

Unit-I

Introduction to Bioinformatics: Introduction, outline of proteins, primary structure: the 20 amino acids – chemical structure & properties; polypeptide geometry: the folding chain, nomenclature, molecular graphics, Structure evolution and mutation genetic information- the triplet code; DNA structure Synthesis of proteins: cell biology background; transcription; RNA polymerase, introns, exons, splicing translation: ribosomes, strat/stop codons, post-translational processing

Unit-II

Computing evolution: Phylogenetic Analysis Sequence- based taxonomy: overview and assumptions, from Multiple Alignment to phylogeny Neighbor, Joining Maximum Likelyhood Vs. Parsimony, The molecular Clock, Computer Tools for patterns, mapping and phylogenetic analysis, Mathematical tools of proteins and nucleic acids, sequence- Function Relationships Sequence Homology and Conserved Regions , Conserved DNA Sequences.

Unit-III

Bioinformatics tools: Networks- WWW, CERN EMBnet; EMBL Database, SEQNET, GenBank, NLM , etc., Sequence Databases and Sequence Analysis: Genomic , CDNA EMBL database GenBank Protein sequence, Pattern recognition tools Similarity searching, secondary sources, genome databases, Molecular graphics software and other packages, To find sequences based on keywords & phrases, to grab individual sequences or whole groups of Sequences from a database

Unit-IV

Genomics: Introduction , genome scale sequencing , comparative and evolutionary genomics, microarrays, proteomics, pharmacogenomics, Development using computer tools for sequencing projects, PCR and restriction mapping practical and theoretical problems in sequencing. The challenges of whole genome sequencing, web based tools for restriction mapping, new technologies and new bioinformatics tools.

Suggested Books:

- Teresa K. Attwood, David J. Parry-Smith: Introduction to Bioinformatics, 1999, Longman Higher Education.
- S. eddy, a. Krogh, G. Mitchison, Richard Durbin: Biological sequence analysis: probabilistic models of proteins and nucleic acids, 1999, Cambridge University Press.
- Andreas Baxevanis , B.F. Francis Ouellete: Bioinformatics : a practical guide to the analysis of genes and proteins,1998,john Wiley & sons, inc
- James D. Tisdall: Beginning perl for Bioinformatics. 2001. O`reilly & Associates.
- Michael S. Wterman: Mathematical methods for DNA sequences, 1989, CRC Press.

OE-CS-405A	FIBRE OPTIC COMMUNICATIONS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	To familiarize the students with the concepts of Optical communication covering the contents of optical fibers, losses in fibers, optical sources, detectors etc.						
Course Outcomes							
CO1	Students will be able to understand the structure of fiber and the mechanism of light travelling in the fiber.						
CO2	Students will be able to analyze various losses associated with fibers.						
CO3	Students will learn about the optical sources and optical detecters.						
CO4	Students will be able to understand the various components needed in optical networks						

Unit I

Introduction: Optical Fibers: Structure, Propagation within the fiber, Numerical aperture of fiber, step index and graded index fiber, Modes of propagation in the fiber, Single mode and multi mode fibers. Splices and connectors. Optical Power Launching and Coupling. Fiber-to-fiber joints.

Unit II

Losses in Optical Fiber: Rayleigh Scattering Losses, Absorption Losses, Leaky modes, Mode coupling losses, Bending Losses, Combined Losses in the fiber.

Dispersion Effect: Effect of dispersion on the pulse transmission Intermodal dispersion, Material dispersion, Wave guide dispersion, Polarization Mode Dispersion Total dispersion, Transmission rate. Dispersion Shifted Fibers, Dispersion Compensating Fibers.

Unit III

Light Sources: LEDS, Laser Action in semiconductor Lasers, Semiconductor Lasers for optical communication – Laser modes, Spectral Characteristics, Power Voltage Characteristics, Frequency response.

Detectors: P-I-N Photodiode, APD, Noise Analysis in detectors, Coherent and non-coherent detection, Infrared sensors. Bit error rate.

Unit IV

The Fiber-Optic Communication System: Design considerations of fiber optic systems: Analog and digital modulation. Optical Devices: Optical coupler, space switches, linear divider-combiners, wavelength division multiplexer and demultiplexer, optical amplifier

Optical Networks: Elements and Architecture of Fiber-Optic Network, Optical link network-single hop, multihop, hybrid and photonic networks.

Suggested Books:

- John Power, An Introduction to Fiber optic systems, McGraw Hill International.
- John Gowar, Optical communication Systems.
- R. Ramaswamy, Optical Networks, Narosa Publication
- John M. Senior,Optical Fiber Communication
- Gerd Keiser, Optical Fiber Communication

OE-CS-407A	Industrial Electrical Systems						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	To provide the conceptual knowledge of various Industrial Electrical Systems.						
Course Outcomes							
CO1	To study various fundamental concepts of Electrical components.						
CO2	To study and understand the residential and commercial electrical system.						
CO3	To study functions and selection of Industrial Electrical components.						
CO4	To study the basics and role of PLC & SCADA in automation.						

Unit I

Electrical System Components: LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, relays, MPCB, electric shock and electrical safety practices.

Unit II

Residential and Commercial Electrical Systems: types of residential and commercial wiring system, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, protection devices, requirements of commercial installation, earthing of commercial installation, selection and sizing of components.

Unit III

Industrial Electrical Systems: HT connection, industrial substation, transformer selection, power factor correction-kVAR calculation, type of compensation, Introduction to PCC, MCC panels. Specifications of LT breakers.

DG systems, UPS system, battery banks, sizing the DG, UPS and battery banks, selection of UPS and battery banks.

Unit IV

Industrial Electrical System Automation: Study of basic PLC, role of automation, advantages of process automation, PLC based control system design, Panel metering and Introduction to SCADA system for distribution automation.

Suggested Books:

- S.L. Uppal and G.C. Garg, "Electrical Wiring, Estimating & Costing", Khanna publishers, 2008.
- K.B. Raina, "Electrical Design, Estimating & Costing", New Age International, 2007.
- S. Singh and R.D. Singh, "Electrical estimating & costing", Dhanpat Rai and Co., 1997. Website for IS standards.
- H. Joshi, " Residential Commercial and Industrial Systems", McGraw Hill Education, 2008.

Bachelor of Technology (Computer Science & Engineering)										
Credit-Based Scheme of Studies/Examination										
Semester VIII (w.e.f. session 2021-2022)										
S. No.	**Course Code**	**Subject**	**L:T:P**	**Hours/Week**	**Credits**	**Examination Schedule (Marks)**				**Duration of Exam (Hrs)**
						Major Test	**Minor Test**	**Practical**	**Total**	
1	PE	Elective-VI	3:0:0	3	3	75	25	0	100	3
2	OE	Open Elective-III	2:0:0	2	2	75	25	0	100	3
3	OE	Open Elective-IV	2:0:0	2	2	75	25	0	100	3
4	PROJ-CS-402A	Project-III	0:0:12	12	6	0	40	60	100	3
5	PE-LA	Elective-VI Lab	0:0:4	4	2	0	40	60	100	3
		Total		**23**	**15**	**225**	**155**	**120**	**500**	

The course of both PE & OE will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.

PE Elective-VI
Cloud Computing: PE-CS-A402A
Computer Graphics: PE-CS-A404A
Software Reliability: PE-CS-A406A
Mobile Apps Development: PE-CS-A408A

OE Elective-III	**OE Elective-IV**
Cyber Security: OE-CS-402A	Web and Internet Technology: OE-CS-410A
Satellite Communication: OE-CS-404A	Automation in Manufacturing: OE-CS-412A
Social Networks Analysis & Mining: OE-CS-406A	IPR, Bioethics and Biosafety: OE-CS-414A
Agile Software Engineering: OE-CS-408A	Signal & Systems: OE-CS-416A

PE-CS-A402A	Cloud Computing						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	To familiar the concepts of cloud services and storage to deploy various resources and arbitrary software.						
Course Outcomes (CO)							
CO1	Summarize main concepts, key technologies, strengths and limitations of Cloud Computing.						
CO2	Explore various cloud service and deployment models to utilize different cloud services.						
CO3	Interpret various data, scalability & cloud services in order to get efficient database for cloud storage.						
CO4	To deal with various security threats and their controlling mechanism for accessing safe cloud services.						

Unit-I

Overview of Computing Paradigm: Recent trends in Computing, Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing, evolution of cloud computing, Business driver for adopting cloud computing. Cloud Computing (NIST Model): History of Cloud Computing, Cloud service providers, Properties, Characteristics & Disadvantages, Pros and Cons of Cloud Computing, Benefits of Cloud Computing, Cloud computing vs. Cluster computing vs. Grid computing, Role of Open Standards.

Unit-II

Cloud Computing Architecture: Cloud computing stack, Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used, Role of Web services, Service Models (XaaS) - Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), Deployment Models- Public cloud, Private cloud, Hybrid cloud, Community cloud, Cloud Architecture and open source.

Unit-III

Service Management in Cloud Computing: Service Level Agreements (SLAs), Billing & Accounting, comparing Scaling Hardware: Traditional vs. Cloud, Economics of scaling: Benefitting enormously, Managing Data- Looking at Data, Scalability & Cloud Services, Database & Data Stores in Cloud, Large Scale Data Processing, Cloud management with Puppet.
Case study: Eucalyptus, Microsoft Azure, Amazon EC2.

Unit-IV

Cloud Security: Infrastructure Security, Network level security, Host level security, Application level security, Data security and Storage, Data privacy and security Issues, Jurisdictional issues raised by Data location, Identity & Access Management, Access Control, Trust, Reputation, Risk, Authentication in cloud computing, Client access in cloud, Cloud contracting Model, Commercial and business considerations, DROPS: Division and Replication of data in Cloud for Optimal Performance and Security.

Suggested Books:

- Barrie Sosinsky, Cloud Computing Bible, Wiley-India, 2010.
- Rajkumar Buyya, James Broberg, Andrzej M. Goscinski,Cloud Computing: Principles and Paradigms, Wiley, 2011.
- Nikos Antonopoulos, Lee Gillam, Cloud Computing: Principles, Systems and Applications, Springer, 2012.
- Ronald L. Krutz, Russell Dean Vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Wiley-India, 2010.

PE-CS-A404A	Computer Graphics						
Lecture	**Tutorial**	**Practical**	**Credit**	**MajorTest**	**MinorTest**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hour**
Purpose	**Introduces Computer Graphics that help in designing different kinds of static and movable objects.**						
Course Outcomes							
CO 1	Explore the background and standard line and circle drawing algorithms.						
CO 2	Exposure of various transformation approaches and its comparative analysis.						
CO 3	Illustrate Projection and clipping with explore different techniques.						
CO 4	Apply design principles to create different curves and explore hidden lines and surface techniques.						

Unit-I

Computer Graphics applications, Display Devices, Point & Positioning Devices, Plotting Techniques for point and Line, Line drawing algorithms: DDA, Bresenhams's Circle drawing algorithms, Filled area algorithms: Scan line, Polygon filling algorithms, Boundary filled algorithms.

Unit-II

Window to view port transformation, Window to view port mapping, Two Dimensional transformation: translation, scaling, rotation, reflection and Shear, Homogeneous Coordinate system. 3-D transformation: Rotation, Shear, translation, Numerical Problems of transformation viewing pipeline.

Unit-III

Clipping: Point & Line clipping algorithm, 4-bit code algorithm, Cohen-Sutherland Line clipping algorithms, Liang-Barsky line clipping algorithms. Polygon clipping: Sutherland-Hodgeman Polygon clipping algorithm. Curve clipping, Text clipping. Projection: Parallel, Perspective, Vanishing Points.

Unit-IV

Representation of 3-D Curves and Surfaces: interpolation and approximation alpines, parametric conditions, Geometric continuity conditions, Beizer curves and surfaces: properties of beizer curves, beizer surfaces.

Hidden Surfaces removal: Hidden surface elimination, depth buffer algorithm, scan line coherence and area coherence algorithm, painter's algorithm

Suggested Books:

- Donald Hearn & M.Pauline Baker, Computer Graphics, 2nd Edition, Pearson Education.
- William M. Newmann & Robert F. Sproull, Principles of Interactive Computer Graphics, Tata McGraw-Hill Second Edition, New Delhi, India.
- Zhigang Xiang & Roy A Plastock , Computer Graphics, Second Edition, Schaum's Outline, Tata McGraw Hill Education Private Limited, New Delhi, India.
- Foley, van Dam, Feiner, and Hughes. Computer Graphics: Principles and Practice, 3rd edition in C.
- Hearn, D. Basker, Computer Graphics, Prentice Hall

PE-CS-A406A	Web and Internet Technology						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	To gain a broad understanding of the discipline of Web engineering and its application to the development and management of Web Applications.						
Course Outcomes (CO)							
CO1	Learn the basic concepts of internet and its conncetivity.						
CO2	Learn about the services of internet, designing and its architecture.						
CO3	Understand the basic concepts of Python and its applications as per information industry standards.						
CO4	Acquaint the latest programming language for the implementation of object based and procedure based applications using Python.						

Unit I

Intenet, growth of internet, owners of the internet, anatomy of internet, ARPANET and internet history of the worls wide web, basic internt terminology, internet applications-commerce on the internet, governance on the internet, impact of internet on society- crime on/through the internet, the role of information architect, collaboration and communication. Organizing information, Organizing web sites and Intranets, Creating cohesive organization systems, designing navigation systems, types of navigation systems, Integrated navigation elements, designing navigation systems, Searching systems, Searching your web site, designing the search interface.

Unit II

Setting up a connection: Hardware requirement, selection of a modem, software requirement, modem configuration, common terminologies: Node, Host, Workstation, bandwidth, interoperability, network administrator, netwotk security, network components: servers, clients, communication medis, service options- email, News firewall etc.

Introduction to XHTML and HTML5: Origins and Evolution of HTML and XHTML, Basic Syntax, Standard XHTML Document Structure, Basic Text Markup, Images, Hypertext Links, Lists, Tables, Forms, HTML5, Syntactic Differences between HTML and XHTML.

Cascading Style Sheets: Introduction, Levels of Style Sheets, Style Specification Formats, Selector Forms, Property Value Forms, Font Properties, List Properties, Color, Alignment of Text, Box Model, Background Images

Unit III

Introduction to Python: Applications of python in information industry, Introduction to Python, Data Types, branching programs, control structures, array and input, iteration.

Functions and scoping: Functions and scoping, recursion and global variables. Creation, insertion and deletion of items: strings, tuples, lists and dictionaries.

Unit IV

Classes and objects-oriented programming: Abstract data types and classes, inheritance, encapsulation and information hiding. File handling, exception handling, database (MySQLdb) operation: file check, table creation, insertion and deletion of data, regular expressions-Res in Python and plotting.

Suggested Books:

- By Peter Morville, Louis Rosenfeld, “Information Architecture on the World Wide Web”,

O'Reilly Media, 2006.

- Robert W. Sebesta, “Programming The World Wide Web”, Eight Edition, Pearson India, 2015.
- Kenneth A. Lambert, “The Fundamentals of Python: First Programs”, 2011, Cengage Learning.
- Thomas A Powell, “HTML The Complete Reference”, Tata McGraw Hill Publications.

PE-CS-A408A	Mobile Apps Development						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	To introduce the concepts of developing the mobile applications.						
Course Outcomes (CO)							
CO1	Be exposed to technology and Mobile apps development aspects.						
CO2	Be competent with the characterization and architecture of mobile applications.						
CO3	Appreciation of nuances such as native hardware play, location awareness, graphics, and multimedia.						
CO4	Perform testing, signing, packaging and distribution of mobile apps.						

Unit I

Introduction to Mobility: Mobility landscape, Mobile platforms, Mobile apps development, Overview of Android platform, setting up the Mobile App Development environment along with an Emulator.App User Interface Designing – Mobile UI resources (Layout, UI elements, Drawable, Menu).

Unit II

Building blocks of Mobile Apps: Activity- States and Life Cycle, Interaction amongst Activities. App functionality beyond user interface - Threads, Async task, Services – States and Life Cycle, Intents: concept, types, Use of Intents to transfer various type of data, Notifications, Broadcast receivers, Content provider.

Unit III

Sprucing up Mobile Apps: Fragments: Concept, Use of fragments in Android Apps, Nested Fragments, Graphics and animation – Custom views, Canvas, Animation APIs, Multimedia – Audio/Video playback and record, Location awareness. Native data handling–file I/O, shared preferences, mobile databases such as SQLite, and enterprise data access (via Internet/Intranet).

Unit IV

Testing Mobile Apps: Debugging mobile apps, White box testing, Black box testing, and test automation of Mobile apps, JUnit for Android, Testing tools. Loading data using loaders, permissions, performance & security, firebase and admob and publish.

Suggested Books:

- Dawn Griffiths, David Griffiths, Head First Android Development, 2nd Edition, O'Reilly Media, 2017.
- Barry Burd, Android Application Development All in one for Dummies, Wiley publications, 2nd Edition 2015.
- Android Developer Fundamentals Course– Concepts (Learn to develop Android applications) Concepts Reference Developed by Google Developer Training Team, 2016.
- Valentino Lee, Heather Schneider, and Robbie Schell, Mobile Applications: Architecture, Design, and Development, Prentice Hall, 2004.
- Brian Fling, Mobile Design and Development, O'Reilly Media, 2009.
- Maximiliano Firtman, Programming the Mobile Web, O'Reilly Media, 2010.

PE—CS-A402AL	Cloud Computing Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
-	**-**	**4**	**2**	**40**	**60**	**100**	**3hrs**
Purpose	Design and Implement various mobile applications using emulators and learn how to Deploy applications to hand-held devices.						
Course Outcomes(CO)							
CO1	Know the components and structure of mobile application development frameworks for Android based mobiles.						
CO2	Understand how to work with various mobile application development frameworks.						
CO3	Learn the basic and important design concepts and issues of development of mobile applications.						
CO4	Understand the capabilities of mobile devices.						

List of Practicals

1. Write a program to use the API's of Hadoop to interact with it.
2. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs
3. Install Google App Engine. Create hello world app and other simple web applications using python/java.
4. Use GAE launcher to launch the web applications.
5. Show the virtual machine migration based on the certain condition from one node to the other.
6. Write a word count program to demonstrate the use of Map and Reduce tasks.
7. Find procedure to set up the one node Hadoop cluster and run simple applications like word count.

PE—CS-A404AL	Computer Graphics Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
-	**-**	**4**	**2**	**40**	**60**	**100**	**3hrs**
Purpose	To Design and implement various Line and Circle Drawing Algorithms.						
Course Outcomes(CO)							
CO1	To Implement basic algorithms related to Line & Circle Drawing.						
CO2	Implement various Line & Circle Drawing Algorithms.						
CO3	Hands on experiments on 2-D transformations.						
CO4	Conceptual implementation of Clipping and other drawing algorithms.						

List of Practicals

1. Write a program to implement DDA line drawing algorithm.
2. Write a program to implement Bresenham's line drawing algorithm.
3. Implement the Bresenham's circle drawing algorithm.
4. Write a program to draw a decagon whose all vertices are connected with every other vertex using lines.
5. Write a program to move an object using the concepts of 2-D transformations.
6. Write a program to implement the midpoint circle drawing algorithm any Object Oriented Programming Language like Python, C++, Java.
7. Implement the line clipping algorithm using any Object Oriented Programming Language like Python, C++, Java.
8. Implement boundary fill algorithm using any Object Oriented Programming Language like Python, C++, Java.
9. Implement the depth buffer algorithm using any Object oriented language like Python, C++, Java.
10. Perform the Polygon Clipping Algorithm using any Object oriented language like Python, C++, Java.
11. Draw a Rectangle using Bresenham's and DDA Algorithm using any Object oriented language like Python, C++, Java.

PE—CS-A406AL	Software Reliability Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
-	**-**	**4**	**2**	**40**	**60**	**100**	**3hrs**
Purpose	In this course the student will understand the working of software reliability models and reliability prediction models, and able to design reliability models.						
Course Outcomes(CO)							
CO1	To study the computation method for evaluation of software reliability						
CO2	Understand the mechanisms for Evaluation Testing methods in Software Reliability						
CO3	Understand the working of Software Reliability Models						
CO4	To Study and understand procedure of software Reliability Prediction						

List of Practicals

1. To study the Computation of software reliability
2. To implement software Reliability Evaluation Testing methods
3. To understand the working of Functional and Operational Profiles
4. To understand the concept of Time Dependent Software Reliability Models
5. To understand the concept of Time Independent Software Reliability Models.
6. To study Software Reliability Modeling
7. To identify the role of various phases included in software Reliability Prediction
8. To study software Reliability Analyzing Predictive
9. To study software Reliability Recalibration

PE—CS-A408AL	Mobile Apps Development Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
-	**-**	**4**	**2**	**40**	**60**	**100**	**3hrs**
Purpose	To understand the components and structure of mobile application development frameworks for Android based mobiles						
Course Outcomes(CO)							
CO1	To understand the components and structure of mobile application Development frameworks for Android based mobiles.						
CO2	To understand how to work with various mobile application development frameworks.						
CO3	To learn the basic and important design concepts and issues of development of mobile applications.						
CO4	To understand the capabilities and limitations of mobile devices.						

List of Practicals

1. Develop an application that uses GUI components, Font and Colors
2. Develop an application that uses Layout Managers and event listeners.
3. Develop a native calculator application.
4. Write an application that draws basic graphical primitives on the screen.
5. Implement an application that implements Multi threading
6. Develop a native application that uses GPS location information.
7. Implement an application that writes data to the SD card.
8. Implement an application that creates an alert upon receiving a message.
9. Write a mobile application that creates alarm clock.
10. Develop a sign-in page with appropriate validation.
11. Develop a real life application that makes use of database.

OE-CS-402A	Cyber Security						
Lecture	**Tutorial**	**Practical**	**Credit**	**MajorTest**	**MinorTest**	**Total**	**Time**
2	**0**	**0**	**2**	**75**	**25**	**100**	**3 Hour**
Purpose	To gain a broad understanding in order to get predictive ways out related to cyber security.						
Course Outcomes							
CO 1	To facilitate the basic knowledge of cyber security.						
CO 2	To explore and sort issues related to different types of activities in cyber crime.						
CO 3	To get enable to fix the various cyber attacks.						
CO 4	To deal with the digital forensics and related scenarios of cyber crimes.						

Unit-I

Introduction: Fundamentals of Cyber Crime, Nature and Scope of Cyber Crime, Types of Cyber Crime: crime against individual, Crime against property, Cyber extortion, Drug trafficking, cyber terrorism.

Cryptanalysis-steganography, stream and block ciphers, modern block ciphers: Block cipher principles, Shannon's theory of confusion and diffusion, fiestal structure, Data Encryption Standard (DES), strength of DES, differential and linear crypt analysis of DES, block cipher modes of operations, triple DES-AES

Unit-II

Integrity checks and authentication algorithms MD5 message digest algorithm, Secure Hash Algorithm (SHA), Digital Signatures, authentication protocols, digital signature standards (DSS), proof of digital signature algorithm, authentication application, Kerberos and X.509, directory authentication service, electronic mail security, pretty good privacy (PGP), S/MIME.

Unit-III

Introduction to cyber attacks: passive attacks, active attacks, Cyber crime prevention methods, Application security (Database, E-mail and Internet), Data Security Considerations-Backups, Archival Storage and Disposal of Data, Security Technology-Firewall and VPNs, Intrusion Detection, Access Control,Hardware protection mechanisms, OS Security.

Web Security: Secure socket layer and transport layer security-secure electronic transaction (SET)-system security: Intruders-Viruses and related threats, firewall design principles, trusted systems.

Unit-IV

Digital Forensics: Introduction to Digital Forensics, historical background of digital forensics, Forensic Software and Hardware, need for computer forensics science, special tools and techniques digital forensic life cycle, challenges in digital forensic.

Law Perspective: Introduction to the Legal Perspectives of Cybercrimes and Cyber security, Cybercrime and the Legal Landscape around the World, Why Do We Need Cyber laws, The Indian IT Act, Cybercrime Scenario in India, Digital Signatures and the Indian IT Act, Cybercrime and Punishment.

IP Security: Architecture-Authentication header-Encapsulating security payloads, combining security associations, key management.

Suggested Books:

- Nelson Phillips and Enfinger Steuart, "Computer Forensics and Investigations", Cengage Learning, New Delhi, 2009.
- Robert M Slade," Software Forensics", Tata McGraw - Hill, New Delhi, 2005.
- Sunit Belapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India Pvt. Ltd.

OE-CS-404A	Satellite Communication						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**75**	**25**	**100**	**3 Hrs.**
Purpose	To familiarize the students with the concepts of Satellite communication and various terms, laws and multiple access schemes used in its working**.**						
	Course Outcomes						
CO1	To understand the concept of basics of satellite communication and various basic laws and terms of satellite communication.						
CO2	To understand the concept and processes of various communication satellites used in satellite communication.						
CO3	To familiarize with the concept and design issues of satellite link design and satellite access.						
CO4	To familiarize with the concepts of Multiple access schemes used in satellite communication.						

Unit I

Satellite Orbits: Orbital Mechanics- Kepler's laws ,locating the satellite in the Orbit, locating the satellite with respect to the earth, Orbital elements, look angle determination, Sub satellite point, Azimuth and elevation angle calculation, Orbital perturbations, Longitudinal and Inclination changes; Launches and launch vehicles-ELV's, Placing the satellite into geostationary orbit, Doppler shift, range variations, solar eclipse, sun transit outage.

Unit II

Communication Satellites: Satellite Subsystems, Attitude and Orbit Control system(AOCS), Telemetry, Tracking, Command and Monitoring (TTC&M), Power System, Communication Subsystems-description, Transponders, satellite antennas-basic antenna types, basic antennas in practice.

Unit III

Satellite Link Design and Satellite Access: Basic transmission theory**,** system noise temperature and G/T ratio; Downlink design-link budget; Uplink design; design for specified C/N, uplink and downlink attenuation in rain, communication link design procedure; system design examples.

Unit IV

Multiple Access Schemes: FDMA, TDMA, CDMA, DAMA; VSAT systems-basic techniques, VSAT earth station engineering, system design; DBS systems-C-band and Ku band home TV, digital DBS; satellite mobile systems; GPS

Suggested Books:

- Timothy Pratt, Satellite Communications, Wiley India edition
- Anil K Maini, Satellite Communication, Wiley India edition

OE-CS-406A	Social Networks						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**75**	**25**	**100**	**3 Hour**
Purpose	To study the role of Social networks and how they make convenient to access information, provide information and communicate via social media by providing a platforms for the benefit of their						
Course Outcomes							
CO 1	To understand the concept of social networking						
CO 2	To know the various social networks and their working						
CO 3	To study the frameworks of social networks						
CO 4	To extract the information from social networks						

UNIT-I

Introduction to social networks, google page rank, link prediction, importance of acquaintances, web graph, introduction: emergence of connectedness, granovetter's strength of weak ties, triads, clustering coefficient and neighbourhood overlap, structure of weak ties, bridges, and local bridges, embeddedness, betweenness measures and graph partitioning, finding communities in a graph (Brute Force Method), community detection using Girvan Newmann algorithm, strong and weak relationship.

UNIT II

Introduction to homophily, selection and social influence, Foci closure and membership closure, Introduction to Fatman Evolutionary model, triadic closure, spatial segregation, an introduction, schelling model implementation, positive and negative relationships- introduction, structural balance, creating graph, displaying it and counting unstable triangles, equal coin distribution, random walk coin distribution

UNIT III

Matrices in social network analysis (Betweenness, centrality, equivalence relation, centralization, clustering Coefficient and structural cohesion), Diffusion in networks, Impact of communities on diffusion, cascade and clusters, introduction to hubs and authorities, hubs and authorities, page rank as a matrix operation, introduction to power law, rich get richer phenomena, implementing a random graph (Erdos Renyi Model)

UNIT IV

Rich Get Richer- The long tail, Epidemics- an introduction, simple branching process for modelling epidemics, basic reproductive number, SIR and SIS spreading models, percolation model, milgram's experiment, the generative model, decentralized search, basic of equivalence concepts in social networks.

Suggested Books

- David Easley and Jon Kleinberg, "Networks, crowd and Markets", Cambridge University Press.
- Matthew O. Jackson, "Social and Economic Networks", Princeton University Press
- Matthew A. Russeil, "Mining the Social web", O'Reilly and SPD Second Edition New Delhi
- Hanneman, R.A., & Riddle, M., "Introduction to social network methods, Riverside, California: University of California Riverside retrieved from http://faculty.ucr.edu/~hanneman/nettext/
- John scott, Peter J. Carrington,"social network analysis", sage publishing ltd.

OE-CS-408A	Agile Software Engineering						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**75**	**25**	**100**	**3 Hrs.**
Purpose	**Introduces the business value of adopting Agile approaches and provide complete understanding of the Agile development practices**						
Course Outcomes (CO)							
CO1	Understand the background and driving forces for taking an Agile approach to software development.						
CO2	Understand the business value of adopting Agile approaches.						
CO3	Drive development with unit tests using Test Driven Development.						
CO4	Apply design principles and refactoring to achieve Agility.						

Unit I

Fundamentals of Agile: The Genesis of Agile, Introduction and background, Agile Manifesto and Principles, Overview of Scrum, Extreme Programming, Feature Driven development, Lean Software Development, Agile project management, Design and development practices in Agile projects, Test Driven Development, Continuous Integration, Refactoring, Pair Programming, Simple Design, User Stories, Agile Testing, Agile Tools

Unit II

Agile Scrum Framework: Introduction to Scrum, Project phases, Agile Estimation, Planning game, Product backlog, Sprint backlog, Iteration planning, User story definition, Characteristics and content of user stories, Acceptance tests and Verifying stories, Project velocity, Burn down chart, Sprint planning and retrospective, Daily scrum, Scrum roles – Product Owner, Scrum Master, Scrum Team, Scrum case study, Tools for Agile project management.

Unit III

Agile Testing: The Agile lifecycle and its impact on testing, Test-Driven Development (TDD), xUnit framework and tools for TDD, Testing user stories - acceptance tests and scenarios, Planning and managing testing cycle, Exploratory testing, Risk based testing, Regression tests, Test Automation, Tools to support the Agile tester.

Unit IV

Agile Software Design and Development: Agile design practices, Role of design Principles including Single Responsibility Principle, Open Closed Principle, Liskov Substitution Principle, Interface Segregation Principles, Dependency Inversion Principle in Agile Design, Need and significance of Refactoring, Refactoring Techniques, Continuous Integration, Automated build tools, Version control.

Suggested Books:

- Ken Schawber, Mike Beedle, *Agile Software Development with Scrum*, Pearson publications.
- Robert C. Martin, *Agile Software Development, Principles, Patterns and Practices*, Prentice Hall.
- Lisa Crispin, Janet Gregory, *Agile Testing: A Practical Guide for Testers and Agile Teams*, Addison Wesley.
- Alistair Cockburn, *Agile Software Development: The Cooperative Game*, Addison Wesley.
- Mike Cohn, *User Stories Applied: For Agile Software*, Addison Wesley.

OE-CS-410A	Software Quality Models						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**75**	**25**	**100**	**3 Hour**
Purpose	To provide an understanding of various concepts related to software quality, reliability and maintenance.						
Course Outcomes							
CO 1	To understand the concept of software quality						
CO 2	To study the various quality models						
CO 3	To understand the testing and reliability concepts						
CO 4	Relation of maintenance and quality						

Unit-I

Software Quality: Meaning and scope, software quality factors, software quality metrics, relationship b/w quality factors and quality metrics, quality management system, software reviews, formal technical reviews, correctness proof, statistical quality assurance, clear room, software engineering, standards of software quality assurance.

Unit-II

Software Reliability: meaning and its relation with software quality, reliability modelingexponential failure time models (viz., Jelinski Moranda model, Schneidiwind's model, Musa's basic execution time model, hyberexponential model), Weibull and gamma failure time model (viz. Weibull model, S-shaped reliability growth model), and infinite failure category models (viz. Duane's model, geometric model, Muse-Okumto model). Types of failure, bath-tub Curve, Exponential law of reliability.

Unit-III

Software Testing: Meaning. Scope and its relationship with software quality, software testing techniques: white box testing, basis path testing, control structure testing and black box testing, etc. Software testing strategies: unit testing, integration testing, validation testing and system testing, etc.

Unit-IV

Software Maintenance: Concept of repair and maintenance, concept of availability and its relation with reliability and maintainability, preventive maintenance, Software maintenance, the management of reliable software, automatic error detection and error correction.

Suggested Books:

- Software Quality: Concepts and Plan, by Robert H Dunn Prentice Hall International 71
- Software Reliability: Measurement, Prediction and application by John D.Musa, McGraw Hill
- Software Reliability Engineering By Michele R Lyu , McGraw Hill
- Software Reliability By K.K. Aggarwal
- Software Reliability by H Koptez.
- C.R. Vick & C.V. Rama Moorthy: Handbook of Software Engineering CBS Publishers & Distributors, Delhi.
- Software Engineering, K K Aggarwal, New Age International Publication, New Delhi
- Mark Paulik, The capability Maturity Model-Guidelines for improving the software Process, Addison Wesley.
- Michael, Deutsch, Willis, Ronald r-Software Quality Engineering –A Total Techinical and Management approach, Prentice Hall.

OE-CS-412A	Automation in Manufacturing						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**75**	**25**	**100**	**3 Hour**
Purpose	The purpose of this course is to impart knowledge of production automation, Robotics, flexible manufacturing, CNC programming, material handling and automated storage systems.						
Course Outcomes							
CO 1	To explain the role of automation in manufacturing and Robotics in industry.						
CO 2	To describe the group technology and flexible manufacturing techniques in the automated production line and manufacturing system.						
CO 3	To explain computer aided process planning and shop floor manufacturing activities.						
CO 4	To develop CNC programs and understand the concept automated guided vehicle and automated storage system in material handling						

Unit l

Introduction: Production system, automation in production system, manual labour in production system, automation principle and strategies, manufacturing industries and products, manufacturing operations, product facilities, product/production relationship, basic elements of an automation system, advance automation function, level of automation.

Industrial Robotics: Robot anatomy and related attributes, joint and links, common robot configuration, joint drive system, sensors in Robotics, robot control system, end effectors, grippers and tools, applications of industrial robots, material handling, processing operation, assembly and inspection, robot programming.

Unit ll

Group technology and cellular manufacturing: Part families, part classifications and coding, production flow analysis, cellular manufacturing-composite part concept, machine cell design, applications of group technology, grouping parts and machines by rank order clustering technique, arranging machines in G.T. cell.

Flexible manufacturing: Introduction, FMS components, flexibility in manufacturing-machine, product, routing operation, types of FMS, FMS layouts, FMS planning and control issues, deadlock in FMS, FMS benefits and applications.

Unit lll

Process planning: Introduction, manual process planning, computer aided process planning- variant, generative, decision logic decision tables, decision trees, introduction to artificial intelligence.

Shop floor control: Introduction, shop floor control features, major displays, major reports, phases of SFC, order release, order scheduling, order progress, manufacturing control, methodology, applications, shop floor data collections, types of data collection system, data input techniques, automatic data, collection system.

Unit lV

CNC basic and part programming: Introduction, historical, background, basic components of an NC steps in NC, verification of numerical control machine tool programs, classification of NC machine tool, basics of motion control and feedback for NC M/C, NC part programming, part

programming methods, modern machining system, automatically programmed tools, DNC, adaptive control.

Automated Guided Vehicle and Storage System: Functions of AGV, types of AGV, safety consideration for AGV, design of AGV, Introduction to storage system, storage system performance, storage location strategies, conventional storage method and equipment, automated storage system, fixed aisle automated storage/retrieval system, carousel storage system, analysis of storage system, fixed aisle automated storage/retrieval systems, carousel storage system.

Suggested Books

- Automation, production system and computer integrated manufacturing- Mikell P. Groover, Pearson 4th edition.
- CAD/CAM: Computer Aided Design and manufacturing Groover- M.P. and Zimmers E. W., Prentice Hall International, New Delhi 1992
- CAD/CAM/CIM-P. Radhakrishnan, S. Subramanayan and V. Raju, New Age International (P) Ltd., New Delhi
- Computer Integrated Manufacturing- Alavudeen and Venkateswaran, Prentice Hall of India Pvt. Ltd. New Delhi.

OE-CS-414A	IPR, Bioethics and Biosafety						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**75**	**25**	**100**	**3 Hour**
Purpose	The course concentrates on technology, knowledge and business management aspect of intellectual property, including patenting aspect.						
Course Outcomes							
CO 1	To provide an understanding on biosafety and risk assessment of products, ethical issues in biological research						
CO 2	To introduce about the IPR and its role						
CO 3	To examine the role of Biosafety and bioethics						
CO 4	To know the procedure of applying IPR						

Unit I

Biotechnology and society: Introduction to science, technology and society, issues of access-Case studies/experiences from developing and developed countries. Ownership, monopoly, traditional knowledge, biodiversity, benefit sharing, environmental sustainability, public vs. private funding, biotechnology in international relations, globalization and development divide. Public acceptance issues for biotechnology: Biotechnology and hunger: Challenges for the Indian Biotechnological research and industries

Unit II

Bioethics & legal issues: Principles of bioethics: Legality, morality and ethics, autonomy, human rights, beneficence, privacy, justice, equity etc. Expanding scope of ethics from biomedical practice to biotechnology, bioethics vs. business ethics, ethical dimensions of IPR, technology transfer and other global biotech issues. Legal, institutional and socio-economic impacts of biotechnology; biotechnology and social responsibility, Public education to increase the awareness of bioethics with regard to generating new forms of life for informed decision making-with case studies.

Unit III

Biosafety: Good Lab Practices, Introduction to Biological Safety Cabinets, Primary Containment for Biohazards, Biosafety Levels GMOs and LMOs and their environmental impact, Roles of Institutional Biosafety Committee, RCGM, GEAC etc. For GMO applications in food and agriculture Risk analysis, assessment and management

Bioethics: Bioethical issues related to Healthcare & medicine Food & agriculture Genetic engineering, The Human Genome Project and Genetic Testing Environmental problems

Unit IV

IPR, Patents and Patents Laws: Intellectual property rights-TRIP- GATT International conventions patents, Requirement of patentable novelty Methods of application of patents Legal implications Biodiversity and farmer rights Objectives of the patent system, Basic principles and general requirements of patent law, Biotechnological inventions and patent law. Legal development: Patentable subjects and protection in biotechnology, Patenting of living organisms, procedure for applying for patent Patent Infringement and related case studies Biological Patentability.

IPR and Biotechnology: Biopiracy and Bioprospecting Farmers Rights and Plant breeders rights Biodiversity.

Suggested Books:

- Biosafety in Microbiological and Biomedical Laboratories, (2009) 5th Ed, www.cdc.gov/ od/ ohs/ biosfty/ bmbl5/ bmbl5toc.html.
- V. Shree Krishna, (2007), Bioethics and Biosafety in Biotechnology, New Age International Pvt. Ltd. Publishers.
- Deepa Goel, ShominiParashar, (2013), IPR, Biosafety and Bioethics, Pearson.
- R. Ian Freshney, Culture of Animal Cells: a Manual of Basic Technique and Specialized Applications, 6th Ed, John Wiley & Blackwell
- Biotechnology and Safety Assessment Thomas J.A., Fuch R.L Academic Press 3rd Edition 2002
- Biological safety Principles and practices Fleming D.A., Hunt D. ASM Press 3rd. ed. 2000
- Bioethics Ben Mepham Oxford University Press 2008
- Bioethics & Biosafety R Rallapalli&Geetha Bali APH Publication 2007

OE-CS-416A	Big Data and Analytics						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**75**	**25**	**100**	**3 Hrs.**
Purpose	**To provide knowledge of Big Data Analytics and Distributed File Systems.**						
Course Outcomes (CO)							
CO1	To learn in details the concepts of big data.						
CO2	Expose the criteria of big data analytics and big data storage.						
CO3	To explore knowledge of big data compression techniques.						
CO4	To explore learning of big data tools and state-of-the-art knowledge with implementation for big data.						

Unit I

Big Data Background: Big data definition and features of big data, big data value, development of big data, challenges of big data, NoSQL databases, technologies related to big data including cloud computing, Internet of Things, data center, Hadoop, relationship between IoT and big data, relationship between hadoop and big data, big data generation and acquisition includes data collection, data transmission, data pre-processing, big data applications.

Unit II

Big Data Analytics and Storage: Big data analysis, big data analytic methods and tools, Pig, Hive, Flume, Mahout, Big data storage, distributed storage system for massive data, storage mechanism for big data GFS, HDFS, HBase, MongoDB, Cassandra, big data storage deduplication techniques, fixed-size and variable-size blocks based deduplication, content defined chunking, frequency based chunking, byte and multi-byte indexing techniques, Cloud storage.

Unit III

Big Data Compression: Big data delta compression, Xdelta implementation, Message Digest (MD5), Secure Hash Algorithm (SHA-1/SHA-256), Gear Hash, Tiger Hash, Rabin and Incremental Secure Fingerprint based deduplication, lossless duplicate and similar data elimination approaches, Parallel deduplication and compression using PCOMPRESS, Scalable Decentralized Deduplication Store (SDDS) using Cassandra.

Unit IV

Big Data Processing: Installation procedure with system requirements for Apache Hadoop, Cassandra, Spark, Pig, Hive, HBase, MongoDB large scale distributed storage systems, Map Reduce programming model working, YARN architecture, Apache Pig and Hive architecture, Single node and Multi-nodes Hadoop Cluster Set up and running a Big Data example, NoSQL implementation.

Suggested Books:

- "Big Data" by Viktor Mayer-Schönberger, Kenneth Cukier, ISBN:978-0544002692, Eamon Dolan/Houghton Mifflin Harcourt 2013.
- "Big Data Now", by O'Reilly Media Inc., ASIN: B0097E4EBQ, O'Reilly 2012.
- "Hadoop Operation", by Eric Sammer, ISBN: 978-1449327057, O'Reilly 2012.
- "MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems", by Donald Miner, Adam Shook, ISBN:978-1449327170, O'Reilly 2012.
- "Programming Hive", by Edward Capriolo, ISBN: 978-1449319335,O'Reilly 2012.
- "HBase: the Definitive Guide", by Lars George, ISBN: 978-1449396107, O'Reilly 2011.

- "Mahout in Action", by Sean Owen, Robin Anil, Ted Dunning, Ellen Friedman, ISBN: 978-1935182689, Manning 2011.
- "Programming Pig", by Alan Gates, ISBN: 978-1449302641, O'Reilly 2011.
- "Cassandra, the Definitive Guide", by Eben Hewitt ISBN: 978-1449390419 O'Reilly 2011.

"MongoDB: The Definitive Guide" by Kristina Chodorow, Michael Dirolf,ISBN: 978-1449381561, O'Reilly, 2010.