Indira Gandhi University Meerpur, Rewari
SCHEME OF STUDIES AND EXAMINATION

B. Tech (Computer Science and Engineering-Data Science)
3rd Year

Semester 5th & 6th
Scheme Effective From 2025-26

COURSE CODE AND DEFINITIONS

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional Core Courses
PEC	Professional Elective Courses
LC	Laboratory Courses
MC	Mandatory Courses
PT	Practical Training
S	Seminar

Indira Gandhi University Meerpur, Rewari
B. Tech. (Computer Science and Engineering- Data Science)
Scheme of Studies/Examination w.e.f. 2025-26
Semester-5

Sr. No.	Course Code	Course Title	Hours per week			Total Contact Hrs. per week	Credit	Examination Schedule (Marks)				Duration of Exam (Hours)
			L	T	P			Class work Marks	Theory	Practical	Total	
1	PCC-DS-301	Data Science Fundamentals using R	3	0	0	3	3	25	75	-	100	3
2	PCC-DS-303	Data Mining and Analytics	3	0	0	3	3	25	75	-	100	3
3	PCC-DS-305	Automata Theory & Compiler Design	3	0	0	3	3	25	75	-	100	3
4	PCC-CSE-307 (Common with CSE)	Design and Analysis of Algorithms	3	0	0	3	3	25	75	-	100	3
5	PCC-DS-307	Artificial & Computational Intelligence	3	0	0	3	3	25	75	-	100	3
6	Refer to Annexure-I	Professional Elective-I	3	0	0	3	3	25	75	-	100	3
7	LC-DS-341	Data Science Lab	0	0	2	2	1	25	-	25	50	3
8	LC-DS-343	Advanced Programming Lab-I	0	0	2	2	1	25	-	25	50	3
9	LC-DS-345	Algorithms Design using C++ Lab	0	0	2	2	1	25	-	25	50	3
10	LC-DS-347	Artificial & Computational Intelligence Lab	0	0	2	2	1	25	-	25	50	3
11.	MC-317*	Constitution of India	2	0	0	2	0	-	-	-	-	-
12.	PT-CSE-329 (Common with CSE)	Practical Training -I				1						
Total			20	0	8	29	22				800	

*__MC-317__ is a mandatory non –credit course in which the students will be required passing marks in theory.

1. Practical Training I: The evaluation of Practical Training-I will be based on seminar, viva-voce, report submitted by the students. According to performance, the students will be awarded grades A, B, C, F. A student who is awarded 'F' grade is required to repeat Practical Training.

Grades: Excellent: A, Good: B, Satisfactory: C, Not Satisfactory: F

Indira Gandhi University Meerpur, Rewari
B.Tech. (Computer Science and Engineering- Data Science)
Scheme of Studies/Examination w.e.f. 2025-26
Semester-6

Sr. No	Course Code	Course Title	Hours per week			Total Contact Hrs. per week	Credit	Examination Schedule (Marks)				Duration of Exam (Hours)
			L	T	P			Class work Marks	Theory	Practical	Total	
1	PCC-DS-302	Machine Learning Essentials	3	0	0	3	3	25	75		100	3
2	PCC-DS-304	Computer Networks & Communication	3	0	0	3	3	25	75		100	3
3	PCC-DS-306	Big Data & Analytics	3	0	0	3	3	25	75		100	3
4	PCC-DS-308	Software Engineering & Practices	3	0	0	3	3	25	75		100	3
5	Refer to Annexure-I	Professional Elective-II	3	0	0	3	3	25	75	-	100	3
6	Refer to Annexure-I	Professional Elective-III	3	0	0	3	3	25	75	-	100	3
7	LC-DS-342	Project-I	0	0	4	4	2	25	-	25	50	3
8	LC-DS-344	Machine Learning using Python Lab	0	0	2	2	1	25	-	25	50	3
9.	LC-DS-346	Data Analytics Lab	0	0	2	2	1	25	-	25	50	3
10	LC-DS-348	Advanced Programming Lab-II	0	0	2	2	1	25	-	25	50	3
11.	MC-318*	Essence of Indian Traditional Knowledge	2	0	0	2	0	-	-	-	-	-
Total			20		10	30	23				800	

*__MC-318__ is a mandatory non –credit course in which the students will be required passing marks in theory.

NOTE: At the end of 6th semester, each student has to undergo Practical Industrial Training of 4/6 weeks in an Industry/ Institute/ Professional Organization/ Research Laboratory/ training center etc. and submit training report (Hard Copy) along with a certificate from the organization & its evaluation shall be carried out in the 5th Semester.

Annexure-I
Professional Electives Courses

Professional Electives		
	Course Code	**Course title**
Professional Elective -I	PEC-DS-309	DevOps Overviews
	PEC-DS-311	Advance Java Programming
	PEC-DS-313	Data Analytics Basics
Professional Elective – II & III	PEC-DS-310	Advanced Programming Practice
	PEC-DS-312	Business Intelligence & Analytics
	PEC-DS-314	NoSQL Database
	PEC-AI-308	Nature Inspired Computing Techniques
	PEC-DS-315	Predictive Analytics Essentials
	PEC-DS-316	UI/UX Design

Data Science Fundamentals				
Course code	PCC-DS-301			
Category	Professional Core Course			
Course title	Data Science Fundamentals using R			
Scheme and Credits	L	T	P	Credits
	3	0		3
Class work	25 Marks			
Exam	75 Marks			
Total	100 Marks			
Duration of Exam	03 Hours			

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

1. Able to apply fundamental algorithmic ideas to process data
2. Understand the Data Analytics lifecycle
3. Able to construct predictive models to classify new data set
4. Learn to apply hypotheses and data into actionable predictions
5. Document and communicate the results effectively to different stakeholders
6. Effectively communicate the findings using visualization techniques

Unit-I

Data Science Process: Data science role and different stages in project, Working with data files: Structured, unstructured and other formats and Transforming data in R, Working with relational and NoSQL databases, Staging and Curating the data, Exploring data, Managing data, Cleaning data, Sampling for modeling and validation : Training and test set split, Sample group column, Record grouping, Data provenance, Data Structures- Structured, Semi-structured, Quasi-structured and Unstructured data, Drivers of big data, Devices – Mobile, smart devices

Unit-II

Approaching Analytics Problems: Key roles for successful Analytics project, Discovery: Business domain, Resources, Problem framing, Key stakeholders, Analytics sponsors, Initial hypotheses, Data sources. Data Preparation: Learning about the data, conditioning, Model Planning: Data exploration, Model selection. Model Building: Common tools for model building. Communicate Results: Analysis over the different models, Operationalize, Moving the model to deployment, environment Analytics Plan , Key deliverables of analytics project , Presentation: Project sponsors, Analysts, Code, Technical specifications

Unit-III

Introduction to R, R Graphical user interfaces , Data Import and Export, Attributes and Data Types, Vectors, Arrays and Matrices, Data Frames, Lists, Factors, Contingency Tables, Descriptive statistics, Model building, Evaluation a Deployment, Hypotheses Testing, Null hypotheses and Alternative hypotheses, Difference of means Student t-test, Welch's t-test, Wilcoxon Rank-Sum test, Type I and II errors, Choosing and evaluating models, Schematic model construction and evaluation, Mapping problems to machine

learning, Evaluating classification models, Solving classification problems, working without known targets Accuracy, precision, Recall, sensitivity and specificity, Evaluating clustering models Intracluster distance, cross cluster distance

Unit-IV)

Validating models: Overfitting, Quantifying model soundness, Ensuring model quality Memorization methods using single variable and multi variable, Linear regression, Building a linear regression model and predicting, Logistic regression , Building a logistic regression model and predicting, Unsupervised methods, Cluster analysis.

Documentation, Deploying models, Knitr package, Deploying R HTTP services and exporting, Presenting your results to the project sponsor , Summarizing the project goals and stating the results , Presenting your model to end user, Presenting your work to other data scientist, Introduction to data analysis, Dirty data , Visualization before Analysis , Visualizing a single variable, Examining multiple variables, Box and Whisker plot, Scatterplot matrix, Dotchart and Barplot , Hexbinplot for large datasets, Analyzing a variable over time

Reference Books:

1. David Dietrich, Barry Heller, Beibei Yang, “Data Science and Big Data Analytics” , EMC Education Services,2015
2. Nina Zumel, John Mount,“Practical Data Science with R”,Manning Publications,2014
3. Jure Leskovec, Anand Rajaraman, Jeffrey D.Ullman,“Mining of Massive Datasets”, Cambridge University Press,2014
4. Mark Gardener,“Beginning R- The Statistical Programming Language”, John Wiley & Sons, Inc,2012
5. W.N.Venables, D.M.Smithandthe R Core Team,“An Introduction to R”, 2013
6. Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, Abhijit Dasgupta, “Practical Data Science Cookbook”, Packt Publishing Ltd.,2014

Course Outcomes

The students will learn

1. Able to comprehend basic methods of processing data from real world problems
2. Able to convert data into actionable insights
3. Build clustering and classification models using R environment
4. Apply statistical techniques for evaluation
5. Analyze and validate the models using appropriate performance metrics
6. Present the results using effective visualization techniques

Data Mining and Analytics				
Course code	PCC-DS-303			
Category	Professional Core Course			
Course title	Data Mining and Analytics			
Scheme and Credits	L	T	P	Credits
	3	0	0	3
Class work	25 Marks			
Exam	75 Marks			
Total	100 Marks			
Duration of Exam	03 Hours			

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

1. Understand the concepts of Data Mining
2. Familiarize with Association Rule Mining
3. Familiarize with various Classification algorithms
4. Understand the concepts of Cluster Analysis
5. Familiarize with Outlier Analysis techniques
6. Familiarize with applications of Data mining in different domains

Unit 1

Introduction to Data Mining, Types of Data for mining , Kinds of patterns that can be mined, Applications suitable for data mining, Issues in Data mining, Data objects and Attribute types, Statistical descriptions of data, Need for data preprocessing and data quality, Data cleaning, Data integration, Data reduction, Data transformation, Data cube and its usage

Unit 2

Mining frequent patterns: Basic concepts , Market Basket Analysis, Frequent itemsets, Closed itemsets, Association rules-Introduction, Apriori algorithm, Generating Association rules from frequent itemsets, FP Growth algorithm, Mining frequent itemsets using Vertical data format, Strong rules vs. weak rules, Association analysis to Correlation, Comparison of pattern evaluation measures.

Unit 3

Classification: Basic concepts , General approach to Classification, Decision tree induction, Algorithms and numerical examples for Decision tree induction, Attribute selection measure, Tree pruning, Bayes' Theorem Naïve Bayesian Classification , IF-THEN rules for classification, Rule extraction from a decision tree, Metrics for evaluating classifier performance, Cross validation, Bootstrap, Ensemble methods-Introduction, Bagging and Boosting

Unit 4

Cluster Analysis: Introduction, Types of Clustering approaches, Partitioning method: k-means, k-medoids, Hierarchical method: Agglomerative vs. Divisive method, Distance measures in algorithmic methods, BIRCH technique, DBSCAN technique, STING technique, CLIQUE technique, Evaluation of clustering techniques;
Outliers: Introduction, Challenges of outlier detection, Outlier detection methods: Supervised and Semi-supervised methods, Unsupervised methods, Statistical approaches

Suggested books:

1. Jiawei Han and Micheline Kamber, " Data Mining: Concepts and Techniques", 3rd Ed, Morgan Kauffman Publishers, 2011.
2. L. Bing *Web Data Mining* Springer-Verlag,2017.
3. P. Ponniah, *Data Warehousing*, (2e), Wiley India Pvt. Ltd., 2011
4. A.K. Pujari, *Data Mining Techniques* (4e), Orient Black Swan/ Universities Press 2016.
5. N.T. Pang, M. Steinbach, K. Anuj and V. Kumar., *Introduction to Data Mining*, Pearson Education 2nd Ed, Pearson 2018

Course outcomes

1. Gain knowledge about the concepts of Data Mining
2. Understand and Apply Association rule mining techniques
3. Understand and Apply various Classification algorithms
4. Gain knowledge on the concepts of Cluster Analysis
5. Gain knowledge on Outlier analysis techniques
6. Understand the importance of applying Data mining concepts in different domains

Automata Theory & Compiler Design					
Course code	PEC-DS-305				
Category	Professional Core Course				
Course title	Automata Theory & Compiler Design				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

1. To get familiar with regular expressions to describe a language using automata.
2. Usage of context free grammars to describe the syntax of a language.
3. To learn different parsing techniques.
4. To provide techniques for syntactic, semantic language analysis, intermediate code Generation and optimization.

Unit: 1

Formal Language And Regular Expressions : Languages, Operations On Languages, Regular Expressions, Identity Rules For Regular Expressions, Finite Automata – DFA, NFA, Conversion of Regular Expression to NFA, NFA To DFA.
Introduction to Compilers: Phases of the Compiler.
Syntax Analysis: Chomsky hierarchy of languages, Context Free Grammars, CNF, GNF, Top-Down Parsing, Recursive Descent Parsers: LL (K) Parsers. Bottom-Up Parsing: Shift Reduces Parser, LR Parsers: SLR, CLR, LALR.

UNIT- 2

Syntax Directed Translation: Syntax Directed Definition, Construction of Syntax Trees, L-Attributed Definitions. Intermediate Code Generation: Intermediate Languages, Translation of Assignment Statements and Boolean Expressions;
Push Down Automata**:** Introduction to PDA, Deterministic and Non-Deterministic PDA, Design of PDA: Transition table, Transition diagram and acceptability of strings by designed PDA; Turing Machine- basic model, Design, Transition table and diagram, Halting problem

UNIT- 3

Type Checking: Specification of Simple Type Checker, Equivalence of Type Expressions, Type Conversions Runtime Environments: Storage Organization, Storage Allocation Strategies, Access to Non Local Names, Parameter Passing, Symbol Table, Dynamics Storage Allocation Techniques.

UNIT- 4

Code Optimization: Principal Sources of Optimization, Optimization of Basic Blocks, Loops in Flow Graphs, Global Data Flow Analysis, Peephole Optimization.
Code Generation: Issues in Design of Code Generator, Simple Code Generator, Register Allocation and Assignment, DAG Representation of Basic Block, Generating Code from DAGs.

Suggested books:

1. Compilers Principle, Techniques & Tools – Alfread V. AHO, Ravi Sethi & J.D. Ullman; 1998 Addison Wesley.
2. Introduction to Automata Theory Languages & Computation, 3rd Edition, Hopcroft, Ullman, PEA

Suggested reference books

1. Theory and practice of compiler writing, Tremblay & Sorenson, 1985, Mc. Graw Hill.
2. System software by Dhamdhere, 1986, MGH.
3. Principles of compiler Design, Narosa Publication
4. Elements compiler Design, Dr. M. Joseph, University Science Press

Course Outcomes

1. Read and write finite automata and grammars for programming language constructs.
2. Understand the functionality of parsing mechanisms.
3. Construct syntax trees and generate intermediate code.
4. Understand the concepts of storage administration for different programming environments.
5. Understand the concepts of optimization and generate the machine code.

Design and Analysis of Algorithms					
Course code	PCC-CSE-307				
Category	Professional Core Course				
Course title	Design and Analysis of Algorithms				
Scheme and Credits	L	T	P	Credits	Remarks: Common With CSE
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

1. Analyze the asymptotic performance of algorithms.
2. Write rigorous correctness proofs for algorithms.
3. Demonstrate a familiarity with major algorithms and data structures.
4. Apply important algorithmic design paradigms and methods of analysis.
5. Synthesize efficient algorithms in common engineering design situations.

Unit 1

Introduction to Algorithms: Algorithm, Performance Analysis (Time and Space complexity), Asymptotic Notation (Big OH, Omega and Theta)-best, average and worst-case behavior. Elementary Data Structures (Basic terminology of Stacks and Queues, Tree, Graph), Sets and Disjoint Set, Union.

Divide and Conquer: General method, Binary Search, Merge Sort, Quick Sort, and other sorting algorithms with divide and conquer strategy, Strassen's Matrix Multiplication algorithms and analysis of these problems.

Unit 2

Greedy Method: General method, Fractional Knapsack problem, Job Sequencing with Deadlines, Minimum Cost Spanning Trees, Single source shortest paths.
Dynamic Programming: General method, Optimal Binary Search Trees, 0/1 knapsack, The Traveling Salesperson problem.

Unit 3

Back Tracking: General method, The 8-Queen's problem, Sum of subsets, Graph Colouring, Hamiltonian Cycles.
Branch and Bound: The method, 0/1 knapsack problem, Traveling Salesperson problem, Efficiency considerations.

Unit 4

NP Hard and NP Complete Problems: Basic concepts, Cook's theorem, NP hard graph problems, NP hard scheduling problems, NP hard code generation problems, and Some simplified NP hard problems.

Suggested books:

1. Fundamental of Computer algorithms, Ellis Horowitz and Sartaj Sahni, 1978, Galgotia Publication
2. Introduction to Algorithms, Thomas H Cormen, Charles E Leiserson and Ronald Lrivest: 1990, TMH

Suggested reference books:

1. The Design and Analysis of Computer Algorithm, Aho A.V. Hopcroft J.E., 1974, Addison Wesley.
2. Algorithms-The Construction, Proof and Analysis of Programs, Berlion, P.Bizard, P., 1986. Johan Wiley & Sons,
3. Writing Efficient Programs, Bentley, J.L., PHI 4. Introduction to Design and Analysis of Algorithm, Goodman, S.E. &Hedetnieni, 1997, MGH.
5. Introduction to Computers Science- An algorithms approach, Jean Paul Trembley, Richard B.Bunt, 2002, T.M.H.
6. Fundamentals of Algorithms: The Art of Computer Programming Vol Knuth, D.E.: 1985, Naresh Publication.

Course outcomes

1. To identify and justify correctness of algorithms and to analyse running time of algorithms based on asymptotic analysis.
2. To understand when an algorithmic design situation calls for the divide-and-conquer paradigm. Synthesize divide-and-conquer algorithms.
3. Describe the greedy paradigm and dynamic-programming paradigm. Explain when an algorithmic design situation calls for it.
4. Developing greedy algorithms/dynamic programming algorithms, and analyze it to determine its computational complexity.
5. To write the algorithm using Backtracking and Branch and Bound strategy to solve the problems for any given model engineering problem.

Artificial & Computational Intelligence					
Course code	PCC-DS-307				
Category	Professional Core Course				
Course title	Artificial & Computational Intelligence				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE OBJECTIVES:

1. Understand the fundamentals of intelligent agents and Artificial Intelligence Methods to solve real life problems
2. Understand the principles and fundamentals of Computational Intelligence.
3. Learn the fundamentals & various topologies and learning algorithms of ANN
4. Understand the Fuzzy Logic and Fuzzy Rule based systems
5. Understand the basic concepts and techniques of Genetic Algorithms
6. Utilize the Neural, Fuzzy and Genetic Algorithms for real-time application development

Unit-I

Introduction and Intelligent Agents: AI introduction, Foundations History of Artificial Intelligence; State of the Art Intelligent Agents: Agents and Environments; Good Behavior: Concept of Rationality, Nature of Environments, and Structure of Agents; Case Studies of Intelligent agents in autonomous systems.
Problem-solving: Solving Problems by Searching: Problem-Solving Agents, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions, Beyond Classical Search Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces, Searching with Nondeterministic Actions, Searching with Partial Observations, Online Search Agents and Unknown Environments; Case Studies(any) of Search techniques for a sliding tile problem.

Unit-II

Knowledge, reasoning, and planning: Knowledge based Agents, Types of knowledge, Knowledge acquisition and its techniques; Knowledge representation: Level of representation; First-Order Logic and Its Inference;
Reasoning and Uncertain knowledge: Types of reasoning, Quantifying Uncertainty, Probabilistic Reasoning, Probabilistic Reasoning over Time, Bayes Theorem in reasoning, Bayesian Belief Network, Making Simple Decisions, Making Complex Decisions.
Planning: Components of a Planning system, Classical Planning, Planning and Acting in the Real World; Case Studies (any) of Application of planning to a production system

Unit-III

Computational Intelligence: Introduction to Computational Intelligence, Biological and Artificial Neural **N**etwork (ANN), artificial neural network models/architectures and Simulation of Biological Neurons to

Problem Solving; learning/training in artificial neural networks; neural network and its applications to solve some real life problems, Machine Learning, Deep Learning, Practice of Neural Network tools. **Evolutionary Computing & Optimization:** Fundamentals of evolutionary computation, Design and Analysis of Genetic Algorithms, Evolutionary Strategies, comparison of GA and traditional search methods. Genetic Operators and Parameters, Genetic Algorithms in Problem Solving; Optimization with case studies: Particle Swarm Optimization, Ant Colony Optimization, Artificial Immune Systems; Other Algorithms with case studies: Harmony Search, Honey-Bee Optimization, Memetic Algorithms, Co-Evolution, Multi-Objective Optimization, Tabu Search, Constraint Handling. Genetic Algorithms tools

Unit-IV

Fuzzy Systems: Crisp sets, Fuzzy sets: Basic types and concepts, characteristics and significance of paradigm shift, Representation of fuzzy sets, Operations, membership functions, Classical relations and fuzzy relations, fuzzyfication, defuzzyfication, fuzzy reasoning, fuzzy decision making and inference systems, fuzzy control system, fuzzy clustering, applications of fuzzy systems; Introduction to Neuro-fuzzy systems, neuro-fuzzy modeling; Adaptive Neuro-Fuzzy Inference Systems, neuro-fuzzy control;

Recent applications / Case Studies of AI: Credit card Fraud Analysis, Sentiment Analysis, Recommendation Systems and Collaborative filtering, Uber Alternative Routing, autonomous Education systems, Health /disease analysis and prediction.

Suggested References Books:

1. F. Martin et al., *Fuzzy Logic: A Practical approach*, (1e), AP Professional, 2014.
2. T J. Ross, *Fuzzy Logic with Engineering Applications*, (4e), Willey India, 2016.
3. S. Rajasekaran and G.A.V Pai, *Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis, and Applications*, (1e), Prentice Hall India, 2011
4. S. Haykin, *Neural Networks and Learning Machines*, (3e), PHI Learning, 2011
5. Samir Roy, Udit Chakraborty, "Introduction to Soft Computing: Neuro-Fuzzy and Genetic Algorithms", Pearson Education, 2013.
6. Russell S. and Norvig P.: Artificial Intelligence: A Modern Approach, Prentice-Hall.
7. Elaine Rich, Kevin Knight and Nair: Artificial Intelligence, TMH.
8. Luger G. F. and Stubblefield W. A.: Artificial Intelligence: Structures and strategies for Compile Problem Solving, Addison Wesley.
9. Nilsson Nils J.: Artificial Intelligence: A New Synthesis, Morgan Kaufmann Publishers Inc.
10. Patrick Henry Winston: Artificial Intelligence, Addison-Wesley Publishing Company.
11. M. Mitchell: An Introduction to Genetic Algorithms, Prentice-Hall.
12. J.S.R. Jang, C.T. Sun and E. Mizutani: Neuro-Fuzzy and Soft Computing, PHI, Pearson Education.
13. Davis E. Goldberg: Genetic Algorithms: Search, Optimization and Machine Learning, Addison Wesley.
14. Konar A., "Computational Intelligence: Principles, Techniques and Applications", Springer Verlag, 2005
15. Russell C. Eberhart and Yuhui Shi, Computational Intelligence: Concepts to Implementations, Morgan Kaufmann Publishers.
16. Andries P. Engelbrecht, Computational Intelligence: An Introduction, Wiley Publishing.

Course outcomes:

1. Acquire the knowledge on intelligent agents and Artificial Intelligence Methods to solve real life problems
2. Acquire the knowledge on the principles and fundamentals of Computational Intelligence.

3. Acquire the knowledge on constructing a neural network , Identify the basic Neural net and learning algorithm to apply for a real time problem
4. Acquire the ability to use Fuzzy operators, membership functions, Fuzzification and Defuzzification Techniques
5. Gain Knowledge on applying the Fuzzy rules to different applications
6. Acquire the knowledge of fitness functions and Genetic operators and apply the Genetic Algorithm to real-time applications

Constitution of India					
Course code	MC-317				
Category	Mandatory Course				
Course title	Constitution of India				
Scheme and Credits	L	T	P	Credits	
	2	0	0	0	
Class work	-				
Exam	-				
Total	-				
Duration of Exam	-				

Course Objectives:

Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Unit-I

Philosophy of Indian Constitution: Salient features of Indian Constitution, Preamble, and Nature of Indian Constitution, Procedure for amendment of the Constitution.

Unit-II

Federal structure and distribution of legislative and financial powers between the Union and the States

Unit-III

Organs of Governance: President – Qualification and Powers of the President, Governor-Qualification and Powers, Parliament: Composition, Qualifications and Disqualifications, Judiciary: Appointment, Tenure and Removal of Judges.

Unit-IV

Fundamental Rights: Origin and development of Fundamental rights, Need for fundamental rights. Introduction to Right to equality , Right to freedom, Right against exploitation, Right to freedom of religion, Cultural and Education rights and Fundamental duties.

References Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S.N. Busi, Dr. B.R. Ambedkar framing of Indian Constitution, latest Edition
3. M.P. Jain, Indian Constitution Law, Lexis Nexis, latest edition
4. D.D. Basu, Introduction to Constitution of India, Lexis Nexis, latest edition.

Data Science Lab					
Course code	LC-DS-341				
Category	Laboratory Course				
Course title	Data Science Lab				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

- **Firstly, give a basic installation, insight of R and its various libraries, R as a Data Importing Tool, Simulation and Hypothesis testing, Simulation, Model building, Evaluation and Deployment, Bayesian computation, Fitting a line with Bayesian techniques, Plotting and more which requires as per content of Data Science.**

- **Secondly, Experiments/Programs in R Programming related to the course contents of Data Science Fundamentals can be designed and developed by the subject faculty.**

Advanced Programming Lab-I					
Course code	LC-DS-343				
Category	Laboratory Course				
Course title	Advanced Programming Lab-I				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

NOTE: Minimum 15 Hands-on Lab activities related to the course contents of Professional Elective-I can be designed and developed by the subject faculty using suitable Open Source tools/ software..

Algorithms Design using C++ Lab					
Course code	LC-DS-345				
Category	Laboratory Course				
Course title	Algorithms Design using C++ Lab				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Branches (B. Tech.)	Computer Science and Engineering				
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Course Objectives:

1. Implementation of various algorithms and to analyze the performance of algorithms.
2. Demonstrate a familiarity with major algorithms and data structures.
3. Apply important algorithmic design paradigms and methods of analysis.
4. Synthesize efficient algorithms in common engineering design situations.

List of programs:

1. Write a Program for iterative and recursive Binary Search.
2. Write a Program to sort a given set of elements using the Quick Sort/Merge Sort/Selection Sort method and determine the time required to sort the elements.
3. Write a Program for implementation of Fractional Knapsack problem using Greedy Method and 0/1 Knapsack problem using Dynamic Programming.
4. Write a Program to find the shortest path from a given vertex to other vertices in a weighted connected graph using Dijkstra's algorithm.
5. Write a Program to find the minimum cost spanning tree (MST) of a given undirected graph using Kruskal's algorithm/Prim's Algorithms.
6. Write a Program to implement N-Queens problem using back tracking.
7. Write a Program to check whether a given graph is connected or not using DFS method.
8. Write a program to implement the Travelling Salesman Problem (TSP).

Note: At least 5 to 10 more exercises to be given by the faculty concerned.

Course Outcomes:

1. The course will help in improving the programming skills of the students.
2. The design of algorithms for any problem will inculcate structured thinking process in the students and improve the analytical power.

Artificial & Computational Intelligence Lab					
Course code	LC-DS-347				
Category	Laboratory Course				
Course title	Artificial & Computational Intelligence Lab				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Branches (B. Tech.)	Computer Science and Engineering				
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

NOTE: Minimum 15 Lab activities / programs related to the course contents of Artificial & Computational Intelligence can be designed and developed by the subject faculty using MATLab/Python / any suitable Open Source tools/ software.

Implementation & Developing of- toy problems, agent programs for real world problems, constraint satisfaction problems, Analysis of DFS and BFS for an application, Best first search and A* Algorithm for real world problems, minimax algorithm for an application, unification and resolution for real world problems, knowledge representation schemes - use cases, uncertain methods for an application, learning algorithms for an application , Applying deep learning methods to solve an application.

Practice of Neural Network tool for : Simple Logic functions , XOR problem, Delta rule, Pattern Classification, Pattern Clustering, Learning Algorithms.

Practice of Fuzzy Logic tool for : Fuzzy functions, Fuzzy operations, Fuzzy controller design and applications, Decision making etc

Practice of Optimization and Genetic algorithm tools

Practical Training-I					
Course code	PT-CSE-329				
Category	Laboratory Course				
Course title	Practical Training				
Scheme and Credits	L	T	P	Credits	Remarks: Common With CSE
	0	0	0	0	
Branches (B. Tech.)	Computer Science and Engineering				
Class work	-				
Exam	-				
Total	-				
Duration of Exam	-				

The evaluation of Practical Training-I will be based on seminar, viva-voce, report submitted by the students. According to performance, the students are awarded grades A, B, C, F. A student who is awarded 'F' grade is required to repeat Practical Training.

Grades :

Excellent: A, Good : B, Satisfactory: C, Not Satisfactory: F

Machine Learning Essentials					
Course code	PCC-DS-302				
Category	Professional Core Course				
Course title	Machine Learning Essentials				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE OBJECTIVES:

1. Understand the machine learning techniques.
2. Gain knowledge on linear regression models, Random Forests
3. KNN classifier Gain knowledge on the basics of probabilistic approaches like Naïve Bayes, Bayes Theorem
4. Acquire knowledge on Support Vector machines
5. Introduce the working principle of Artificial Neural networks
6. Understand the K-means clustering techniques, PCA and SVD

Unit-I

Machine Learning Basics: Types of Machine Learning, Supervised vs. Unsupervised Learning, Parametric vs. non-parametric models. Learning theory-bias/variance tradeoff, union and Chernoff bounds, VC dimensions, Underfitting, Overfitting, Model selection, Cost functions. Comparison between regression and machine learning models, Compensating factors in machine learning models
Curse of Dimensionality: Principal Component Analysis (PCA), Difference between PCAs and Latent Factors, Factor Analysis, Introduction to gradient descent.

Unit-II

Bayesian Models: Bayesian concept learning, Bayesian Decision Theory, Naïve Bayesian, Zero Probability & Laplacian Correction, Bayesian Belief Networks**. Tree Models:** information theory, decision tree construction, tuning tree size; **Support Vector Machines**: kernel functions, k Nearest Neighbours.

Unit-III

Regression Models: Linear Regression, Ridge and Lasso Regression, Logistic Regression, Methods of threshold determination and performance measures for classification score models**. Ensembling and Boosting Algorithms:** Concept of weak learners, bagging algorithm, Adaptive Boosting, Extreme Gradient Boosting (XGBoost), Random Forests;

Unit-IV

Artificial Neural Networks: Perceptron, activation functions, learning rate, forward propagation Algorithm, Back propagation Algorithm, Stochastic Gradient descent – SGD, Optimization of neural networks,.

Unsupervised learning: Partitioning, Hierarchical and Density based methods. Deep Learning - Introduction, Solving methodology, Deep learning software.

Suggested References Books:

1. E. Alpaydin, *Introduction to Machine Learning*, (3e), PHI Learning 2015.
2. S Marsland, *Chapman and Hall, Machine Learning: An Algorithmic Perspective,* (2e), CRC,2014.
3. M. Bishop, *Pattern Recognition and Machine Learning*, (2e), Springer, 2013.
4. T. Mitchell, *Machine Learning,* (1e), McGraw Hill Education, 2017.
5. L.E. Sucar, *Probabilistic Graphical Models: Principles and Applications (Advances in Computer Vision and Pattern Recognition),(1e),* Springer, 2016

Course outcomes:

1. Acquire the knowledge on machine learning techniques.
2. Acquire the ability to build model based on logistic regression and random forest techniques
3. Understand the basic ideas of probability and work on probabilistic approaches like Naïve Bayes, Bayes Theorem
4. Apply the knowledge of Kernel functions in practical applications
5. Apply the knowledge of K- means clustering on real world examples
6. Acquire the knowledge on using PCA and SVD with Scikit-learn

Computer Networks & Communications				
Course code	PEC-DS-304			
Category	Professional Core Course			
Course title	Computer Networks & Communications			
Scheme and Credits	L	T	P	Credits
	3	0	0	3
Class work	25 Marks			
Exam	75 Marks			
Total	100 Marks			
Duration of Exam	03 Hours			

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

1. To develop an understanding of modern network architectures from a design and Performance perspective.
2. To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
3. To provide an opportunity to do Network programming
4. To provide a WLAN measurement ideas.

Unit 1

Introduction: Data communication and models, Components, Data Representation, Simplex, Half Duplex and Full Duplex Transmission, Modulation and Multiplexing, Computer networks, distributed processing, Internet, Topologies, Packet and circuit switching, connectionless and connection oriented services; Network Models: OSI model and TCP/IP Model;
Physical Layer – LAN: Ethernet, Token Bus, Token Ring, MAN Architecture- DQDB, WAN Architectures- Frame Relay, ATM, SONET/SDH

Unit 2

Data Link Layer and Medium Access Sub Layer: MAC Addressing, Framing, Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window Protocol.
Medium Access Control: Random access, Controlled Access and channelization protocols.
Network Layer: Logical addressing, classful and classless addressing, subnetting, Network Address Translation, IPv4, ICMPv4, ARP, RARP and BOOTP, IPv6 , IPv6 addressing, DHCP.

Unit 3

Network Devices: Repeater, hub, switch, router and gateway.

Routing Algorithms: introduction to routing, Shortest Path Algorithm, Flooding, Hierarchical Routing, Link State and Distance Vector Routing, Performance Analysis, Packet Tracer.
Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), TCP connection management,

Unit 4

Congestion Control, Quality of Service, QoS Improving techniques.
Application Layer: Domain Name Space (DNS), EMAIL, File Transfer Protocol (FTP), HTTP, SNMP
Network Security: Firewalls, security goals, types of attack, symmetric and asymmetric key ciphers.
Recent Trends in Computer Network and Security.

Suggested books:
1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw-Hill.
2. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.

Suggested reference books:

1. Computer Networks, latest Edition, Andrew S. Tanenbaum, Pearson New International Edition.
2. Internetworking with TCP/IP, Volume 1, latest Edition Douglas Comer, Prentice Hall of India.
3. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America.

Course outcomes

1. Explain the functions of the different layer of the OSI Protocol.
2. Draw the functional block diagram of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) and describe the function of each.
3. Identify and connect various connecting components of a computer network.
4. Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.

Big Data & Analytics					
Course code	PCC-DS-306				
Category	Professional Core Course				
Course title	Big Data & Analytics				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Branches (B. Tech.)	Computer Science and Engineering				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

1. To provide an overview of an emerging field of big data analytics.
2. To make students familiar with the tools required to manage and analyze big data like Hadoop, No SQL, Map-Reduce.
3. To teach the fundamental techniques and principles in achieving analytics with scalability and streaming capability on both structured and unstructured data.
4. To enable students to have skills that will help them to solve complex real-world problems in for decision support.

UNIT -I

Introduction to Big Data: Types of Digital Data-Characteristics of Data, Evolution of Big Data, Definition of Big Data, Characteristics, Applications & Challenges with Big Data, 3Vs of Big Data, Non-Definitional traits of Big Data, Big Data workflow Management, Business Intelligence vs. Big Data, Data science process steps, Foundations for Big Data Systems and Programming, Distributed file systems, Data warehouse and Hadoop environment, Coexistence.

UNIT -II

Big Data Analytics: Classification of analytics, Data Science, Terminologies in Big Data, CAP Theorem, BASE Concept. **NoSQL:** Types of Databases, Advantages, NewSQL, SQL vs. NOSQL vs NewSQL.
Introduction to Hadoop: Features, Advantages, Versions, Overview of Hadoop Eco systems, Hadoop distributions, Hadoop vs. SQL, RDBMS vs. Hadoop, Hadoop Components, Architecture, HDFS.

UNIT -III

Map Reduce: Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression. **Hadoop 2 (YARN):** Architecture, Interacting with Hadoop Eco systems.
No SQL databases: Mongo DB: Introduction, Features, Data types, Mongo DB Query language, CRUD operations, Arrays. Functions: Count, Sort, t – Limit, Skip, Aggregate, Map Reduce. Cursors: Indexes, Mongo Import, Mongo Export.

UNIT -IV

Cassandra: Introduction, Features, Data types, CQLSH, Key spaces, CRUD operations, Collections, Counter, TTL, alter commands, Import and Export, Querying System tables. **Hadoop Eco systems:** Hive, Architecture, data type, File format, HQL, SerDe, User defined functions.

Suggested books:

1. T. Erl , W.Khattak and P. Buhler., *Big Data Fundamentals, Concepts, Drivers & Techniques* (1e), The Prentice Hall Service Technology Series, 2016.
2. S. Acharya, *Big Data and Analytics*, Wiley India Pvt. Ltd., 2015
3. V. Prajapati, *Big Data Analytics with R and Hadoop*, Packt Publishing Ltd., 2013.
4. A. Holmes, *Hadoop in Practice*, (2e), Manning Publications, 2015
5. S. Ryza, *Advanced Analytics with Spark: Patterns for Learning from Data at Scale*, (2e), O'Reilly, 2017

Course Outcomes:

1. Understand the key issues in big data management and its associated applications for business decisions and strategy.
2. Develop problem solving and critical thinking skills in fundamental enabling techniques like Hadoop, MapReduce and NoSQL in big data analytics.
3. Collect, manage, store, query and analyze various forms of Big Data.
4. Interpret business models and scientific computing paradigms and apply software tools for big data analytics.
5. Adapt adequate perspectives of big data analytics in various applications like recommender systems, social media applications etc.

Software Engineering & Practices					
Course code	PEC-DS-308				
Category	Professional Core Course				
Course title	Software Engineering & Practices				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE OBJECTIVES:

1. Familiarize the software life cycle models and software development process
2. Understand the various techniques for requirements, planning and managing a technology project
3. Examine basic methodologies for software design, development, testing, closure and implementation
4. Understand manage users expectations and the software development team
5. Acquire the latest industry knowledge, tools and comply to the latest global standards for project management

Detailed Syllabus:

Unit-I

Introduction: Legacy software, Software Myths. Software Engineering: A Layered Technology, a Process Framework, the Capability Maturity Model Integration (CMMI), Specialized Process Models, and the Unified Process. Software Project Management – life cycle activities, Traditional – Waterfall, V Model, Prototype, Spiral, RAD, Conventional – Agile, XP, Scrum etc.

Unit-II

Agile Development: Agile Process Models Software Engineering Practice, Communication Practice, Planning Practices, Modeling Practices, Construction Practice, Deployment Computer–Based Systems, issues in Agile development.

Unit-III

The System Engineering Hierarchy, Business Process Engineering: An Overview. Product Engineering: An Overview, Data Modeling Concepts, Object Oriented Analysis, Flow-Oriented Modeling, Taxonomy of Quality Attributes, Perspectives of Quality, Quality System, Software Quality Assurance, Capability Maturity Model Observation on Estimation,

Unit-IV

The Project Planning Process, Software Scope and Feasibility, Human Resources, Empirical Estimation Model ,Introduction To DevOps, Cloud Computing And Virtualization, Migration to DevOps, DevOps Tools.

References:

1. R. Pressman, *Software Engineering: A Practitioners Approach*, (8e), McGrawHill Pubs, 2019.
2. M. Walls, *Building a Dev Ops Culture*, O'Reilly Publications, 2013.
3. J. Joyner*, Dev Ops for Beginners, Dev Ops Software Development Method guide for software developers and IT professionals,* Mihails Konoplovs, 2015.

Suggested Reference Books:

1. Ian Sommerville, Software Engineering, 8th ed., Pearson Education, 2010
2. Rajib Mall, Fundamentals of Software Engineering, 4th ed., PHI Learning Private Limited, 2014
3. Ramesh, Gopalaswamy, Managing Global Projects, Tata McGraw Hill, 2005
4. Ashfaque Ahmed, Software Project Management: a process-driven approach, Boca Raton, Fla: CRC Press, 2012
5. Walker Royce, Software Project Management, Pearson Education, 1999
6. Jim Smith Agile Project Management: Creating Innovative Products,Pearson 2008

COURSE OUTCOMES (Cos):

1. Identify the process of project life cycle model and process
2. Analyze and specify software requirements through a productive working Relationship with project stakeholders
3. Design the system based on Functional Oriented and Object Oriented Approach for Software Design.
4. Develop the correct and robust code for the software products using DevOps tools

Project-I					
Course code	LC-DS-342				
Category	Laboratory Courses				
Course title	Project-I				
Scheme and Credits	L	T	P	Credits	
	0	0	4	2	
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Course Objectives:

1. To prepare the student to gain major design and or research experience as applicable to the profession
2. Apply knowledge and skills acquired through earlier course work in the chosen project.
3. Make conversant with the codes, standards, application software and equipment
4. Carry out the projects within multiple design constraints
5. Incorporate multidisciplinary components
6. Acquire the skills of comprehensive report writing

Students will be assigned projects(Applications/Research based) individually or in a group of not more than 3 students depending on the efforts required for completion of project in the subject(s)/area/ skills delivered in this semester using current tools/technology(ies) .

The project will have 4 stages:
(*Marks for internal evaluation are given in brackets)

1. Synopsis submission (5 marks)
2. 1st mid-term progress evaluation (Literature Survey in case of research project) (5 marks)
3. 2nd mid-term progress evaluation (Paper Publishing/acceptance in a reputed Journal or Conference acceptance/ Presenting) (5 marks)
4. Final submission evaluation (10Marks)

The external examiner will evaluate the project on the basis of idea/quality of project, implementation of the project, project report and/or publication and viva.

Course Outcomes:

Design a system / process or gain research insight into a defined problem as would be encountered in engineering practice taking into consideration its impact on global, economic, environmental and social context.

Machine Learning using Python Lab				
Course code	LC-CSE-344			
Category	Laboratory Course			
Course title	Machine Learning using Python Lab			
Scheme and Credits	L	T	P	Credits
	0	0	2	1
Class work	25 Marks			
Exam	25 Marks			
Total	50 Marks			
Duration of Exam	03 Hours			

NOTE:

1. **Minimum 15 Lab programs/activities can be designed and developed by the subject faculty using Python, Python Library/suitable Open Source tools/ software.**
2. **Lab activities will be carried out from the offered course contents of Machine Learning Essentials in the semester.**

In this course, various experiments will be performed, covering various Machine Learning techniques. Experiments covering pre-processing of data, various classifiers such as Bayesian, Decision Trees, Support Vector Machines, k-nearest neighbour; Regression Models, and data sets will be described in the laboratory manual. Measures of classification precision, enhancement of classifier efficiency by the assembly, boosting, etc.

Data Analytics Lab					
Course code	LC-DS-346				
Category	Laboratory Course				
Course title	Data Analytics Lab				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Classwork	25Marks				
Exam	25Marks				
Total	50Marks				
Duration of Exam	03Hours				

NOTE: Minimum 15 Lab activities / programs related to the course contents of Big Data & Analytics can be designed and developed by the subject faculty using Hadoop Tools/Hadoop Eco System/Python / any suitable Open Source tools/ software.

Advanced Programming Lab-II				
Course code	LC-CSE-348			
Category	Laboratory Course			
Course title	Advanced Programming Lab-II			
Scheme and Credits	L	T	P	Credits
	0	0	2	1
Class work	25 Marks			
Exam	25 Marks			
Total	50 Marks			
Duration of Exam	03 Hours			

NOTE: Minimum 15 Lab activities/Programs related to the course contents of Professional Electives (PE-II and PE-III) opted can be designed and developed by the subject teachers using suitable Open Source tools/ software.

Essence of Indian Traditional Knowledge					
Course code	MC-318				
Category	Mandatory Course				
Course title	Essence of Indian Traditional Knowledge				
Scheme and Credits	L	T	P	Credits	
	2	0	0	0	
Class work	-				
Exam	-				
Total	-				
Duration of Exam	-				

Course Contents

- Basic structure of Indian knowledge System: **अष्टादशविद्या - वेद, उपवेद (आयुर्वेद, धनुर्वेद, गन्धर्ववेद, स्थाप्य आदि), वेदांग (शिक्षा, कल्प, निरूक्त, व्याकरण, ज्योतिष, छंद), उपांग (धर्मशास्त्र, मीमांसा, पुराण, तर्कशास्त्र)**
- Modern Science and Indian Knowledge System
- Yoga and Holistic Health care
- Case studies

References

1. V. Sivaramakrishnan (Ed.), *Cultural Heritage of India-course material*, Bharatiya Vidya Bhavan, Mumbai. 5th Edition, 2014
2. Swami Jitatmanand, *Modern Physics and Vedant*, Bharatiya Vidya Bhavan
3. Swami Jitatmanand, *Holistic Science and Vedant*, Bharatiya Vidya Bhavan
4. Fritzof Capra, *Tao of Physics*
5. Fritzof Capra, *The Wave of life*
6. VN Jha (Eng. Trans.), *Tarkasangraha of Annam Bhatta*, International Chinmay Foundation, Velliarnad, Arnakulam
7. *Yoga Sutra of Patanjali*, Ramakrishna Mission, Kolkata
8. GN Jha (Eng. Trans.), Ed. RN Jha, *Yoga-darshanam with Vyasa Bhashya*, Vidyanidhi Prakashan, Delhi 2016
9. RN Jha, *Science of Consciousness Psychotherapyand Yoga Practices*, Vidyanidhi Prakashan, Delhi 2016
10. P B Sharma (English translation), *Shodashang Hridayan*

Professional Electives
(PE-I, PE-II & PE-III)

DevOps Overview					
Course code	PEC-DS-309				
Category	Professional Elective Course				
Course title	DevOps Overview				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE OBJECTIVES:

1. Understand DevOps as a practice, methodology and process for fast collaboration, integration and communication between Development and Operations team.
2. Understand the principles and fundamentals Master Continuous Integration, Continuous Deployment, Continuous Delivery, Configuration Management and Continuous Monitoring
3. Learn the fundamentals & various technologies such as GIT. Maven, Chef, Puppet & more.
4. Understand the Automation and increase the speed of productivity with reliability

Unit-I

Traditional Software development Processes- The Advent of Software Engineering, Waterfall model and other development models, Developers vs IT Operations conflict

Unit-II

AGILE Methodologies- Agile movement in 2000 - Agile Vs Waterfall Method - Iterative Agile Software Development - Individual and team interactions over processes and tools - Working software over - comprehensive documentation - Customer collaboration over contract negotiation - Responding to change over following a plan

Unit-III

DevOps Overview, Definition and Introduction to DevOps - DevOps and Agile ,
PURPOSE OF DEVOPS- Minimum Viable Product, Application Deployment, Continuous Integration, Continuous Delivery

Unit-IV

CAMS (CULTURE, AUTOMATION, MEASUREMENT AND SHARING) CAMS – Culture – CAMS, Automation - CAMS – Measurement - CAMS – Sharing Test-Driven Development - Configuration Management - Infrastructure Automation - Root Cause Analysis – Blamelessness - Organizational Learning, REST API, GraphQL, HTTP/2, Application Containerization, DevOps Tools, Monitoring Tools; Recent applications / Case Studies of DevOps

Suggested References Books:

1. The DevOps Handbook,Gene Kim, Jez Humble, Patrick Debois, and Willis Willis , O'Rielly Publishers
2. What is DevOps? - by Mike Loukides
3. Effective DevOps: Building a Culture of Collaboration, Affinity, and Tooling at Scale, Jennifer Davis and Ryn Daniels, O'Rielly Publishers
4. Practical DevOps, Joakim Verona, O'Rielly Publishers
5. M. Walls, *Building a Dev Ops Culture*, O'Reilly Publications, 2013.
6. J. Joyner*, Dev Ops for Beginners, Dev Ops Software Development Method guide for software developers and IT professionals,* Mihails Konoplovs, 2015.
7. Online Resources on DevOps

Course outcomes:

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

1. Get thru the traditional software development process.
2. Learn the Agile methodologies and its Developments.
3. Make a way to DevOps as a practice, methodology and process for fast collaboration, integration and communication between Development and Operations team.
4. Master in Continuous Integration, Continuous Deployment, Continuous Delivery, Configuration Management and Continuous Monitoring

Advance Java Programming					
Course code	PEC-DS-311				
Category	Professional Elective Course				
Course title	Advance Java Programming				
Scheme and Credits	L	T	P	Credits	
	3	0		3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

1. To demonstrate the use of Object Oriented Programming and threads concepts in Java.
2. To familiarize students with Graphical user interface, distributed application, web development using servlet and JSP.
3. To impart the core features of Spring and hibernate framework.

Unit-I

Core Java and Multithread: Class and object - Packages and sub packages– Abstract class and Interface. Multithreading: thread creation, thread priorities, synchronization and Inter thread communication.

Abstract Window Toolkit and Swing: Abstract Window Toolkit(AWT): AWT classes, Window fundamentals - Frame Windows - creating a frame window in applet, Creating a Windowed Program. Event Handling: Event Classes – Sources of Events – Event Listener Interfaces. Swing: Icons and Labels – Text Fields –Buttons – Combo Boxes – Tabbed Panes – Scroll Panes – Trees – Tables.

Unit-II

Applications in Distributed Environment: Java Remote Method Invocation – Invocation concept – Remote Interface – Passing Objects – Client Side and Server side RMI Process. Java Interface Definition Language and CORBA – The Concept of Object Request Brokerage – IDL and CORBA – Client side and Server side IDL Interface.

Servlets with Database Connectivity: Java Servlets – MVC Architecture – Container Architecture – Controller Components – Dynamic Forms – Servlet Context - The JDBC API: The API components, database operations like creating tables, CRUD(Create, Read, Update, Delete) operations using SQL – JDBC Drivers

Unit-III

Java Server Pages and Enterprise JavaBeans: JSP Scripting Elements – Tags - Variables and Objects – Methods – Control Statements – User Sessions – Cookies – Session Objects – JSTL and Servlets with

JSP. Enterprise JavaBeans: Deployment Descriptors – Session JavaBean – Entity JavaBean – Message and Driven Bean.

Unit-IV

Spring Framework : Introduction to Spring – Bean scope and lifecycle – Inversion of control – Dependency injection – Spring MVC: Building spring web Apps – Creating controllers and views – Request params and request mapping – Form tags and data binding.

Hibernate Framework: Introduction to Hibernate – Hibernate CURD features – Advanced mappings – Hibernate Query Languages and Transactions. Spring Hibernate Integrations: Hibernate DAO implementation using Spring Framework. Recent trends.

Reference Books:

1. Herbert Schildt, "Java: The Complete Reference", McGraw-Hill Publishers, 11th Edition, 2019.
2. Mahesh P. Matha "JSP and SERVLETS: A Comprehensive Study", PHI publication, 2015
3. D.T. Editorial Services "Java 8 Programming Black Book", Wiley, 2015
4. Santosh Kumar K "Spring and Hibernate", Mc.Graw Hill Education, 2013

Course Outcomes

After successfully completing the course the student should be able to

1. Choose the appropriate OOP technique for solving the given problem and use multithreads when required.
2. Design Graphical User Interface using AWT and Swing.
3. Build and Deploy distributed applications using RMI and CORBA.
4. Design, Develop and Deploy dynamic web applications using Servlets with JDBC.
5. Design and Develop applications using JSP and Enterprise Java Bean.
6. Recognize the capabilities of java framework to facilitate solving industrial applications using Spring framework.

Data Analytics Basics					
Course code	PEC-DS-313				
Category	Professional Elective Course				
Course title	Data Analytics Basics				
Scheme and Credits	L	T	P	Credits	
	3	0		3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

1. To understand the Data analytics tasks, methods and process
2. To understand the concepts of data exploratory analysis
3. To familiarize students with data interaction and visualization techniques .
4. To impart the major simulation and visualization trends of volumetric data.

Unit-I

Steps in Data Analytics Projects, Data Analytics tasks and methods, Data Gathering and Preparation: Data Formats, Parsing and Transformation, Scalability and Real-time Issues; Data Cleaning: Consistency Checking, Heterogeneous and Missing Data, Data Transformation and Segmentation;

Unit-II

Exploratory Analysis: Descriptive and comparative statistics, Hypothesis testing, Statistical Inference. Association rule mining, Clustering. Visualization: Visual Representation of Data, Gestalt Principles, Information Overloads; Creating Visual Representations: Visualization Reference Model, Visual Mapping, Visual Analytics, Design of Visualization Applications;

Unit-III

Classification of Visualization Systems: Interaction and Visualization Techniques, Visualization of One, Two and Multi-Dimensional Data, Text and Text Documents; Visualization of Groups: Trees, Graphs, Clusters, Networks, Software, Metaphorical Visualization;

Unit-IV

Visualization of Volumetric Data: Vector Fields, Processes and Simulations, Visualization of Maps, Geographic Information, GIS systems, Collaborative Visualizations, Evaluating Visualizations; Recent Trends in Various Perception Techniques: Various Visualization Techniques, Data Structures used in Data Visualization.

Reference Books:

1. Glenn J. Myatt, Wayne P. Johnson, Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining, 2nd Edition, John Wiley & Sons Publication, 2014.
2. Glenn J. Myatt, Wayne P. Johnson, Making Sense of Data II: A Practical Guide to Data Visualization, Advanced Data Mining Methods, and Applications, John Wiley & Sons Publication, 2009.
3. E. Tufte. The Visual Display of Quantitative Information, (2e), Graphics Press, 2007.
4. Jules J., Berman D., Principles of Big Data: Preparing, Sharing, and Analyzing Complex Information, (2e), 2013.
5. Matthew Ward and Georges Grinstein, Interactive Data Visualization: Foundations, Techniques, and Applications, (2e), A K Peters/CRC Press, 2015.
6. Jurgen Kai-Uwe Brock, Data Design: The Visual Display of Qualitative and Quantitative Information, (1e), Consulting Press, 2017.
7. Edward R. Tufte, The Visual Display of Quantitative Information, (2e), Graphics Press USA, 2001.
8. Cole Nussbaumer Knaflic, Storytelling With Data: A Data Visualization Guide for Business Professionals, (1e), John Wiley and Sons, 2015.

Course Outcomes

After successfully completing the course the student should be able to

1. Get through the Data analytics tasks, methods and process in real world
2. Well familiar brief concepts of data exploratory analytics
3. Design, Develop and Deploy the dashboard with data interaction and visualization techniques.
4. Choose the appropriate simulation and visualization trends for its volumetric data.

Advanced Programming Practice					
Course code	PEC-DS-310				
Category	Professional Elective Course				
Course title	Advanced Programming Practice				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE OBJECTIVES:

1. Create Real-time Application Programs using structured, procedural and object oriented programming paradigms
2. Create Real-time Application Programs using event driven, declarative and imperative programming paradigms
3. Create Real-time Application Programs using parallel, concurrent and functional programming paradigms.
4. Create Real-time Application Programs using logic, dependent type and network programming paradigms
5. Create Real-time Application Programs using symbolic, automata based and graphical user interface program paradigm
6. Create Real-time Application Programs using different programming paradigms using python language

Unit-I

Introduction to Programming Language, Characteristics, classifications, types, various programming paradigm, programs, sub-programs, function, sub function, function types, routine, co-routine, sub-routine, virtual machines, platform independency. Various Programming paradigms and their implementation in Python - Overview of Structured Programming Paradigm, Programming Language Theory, structured programming features and languages examples like C, C++, Java, C#, Ruby; Structured Programing in Python.

Overview of Procedural Programming Paradigm, features, various programming aspects and languages examples- Bliss, ChucK, Matlab ; creating routines and subroutines using functions in Python.

Overview of Object Oriented Programming Paradigm, features, various programming aspects and languages examples- BETA, Cecil, Lava; OOPs in Python

Unit-II

Overview of Event Driven Programming Paradigm, Concepts, features, various programming aspects and languages examples- Algol, Javascript, Elm; Event Driven Programming in Python.

Overview of Declarative Programming Paradigm, basic concepts, features, various programming aspects and languages examples; Declarative Programming in Python.

Overview of Imperative Programming Paradigm, basic concepts, features, various programming aspects and languages examples- PHP, Ruby, Perl, Swift; Imperative Programming in Python.
Parallel Programming Paradigm: Multi-threading, Multi-Processing, Serial Processing, Parallel Processing, Multiprocessing module in Python, Process class, Pool class; Parallel Programming in Python

Unit-III

Concurrent Programming Paradigm: Parallel Vs Concurrent Programming, threading, multiprocessing, concurrent. greenlets, celery, Other languages: ANI, Plaid; Concurrent Programming in Python
Functional Programming Paradigm: Sequence of Commands- map(), reduce(), filter(), lambda, partial, functools, Other languages: F#, Clojure, Haskell ; Functional Programming in Python.
Logic Programming Paradigm: First-class function, Higher-order function, Pure functions, Recursion, Packages: Kanren, SymPy , PySWIP, PyDatalog, Other languages: Prolog, ROOP, Janus; Logic Programming in Python.
Dependent Type Programming Paradigm: Logic Quantifier: for all, there exists, Dependent functions, dependent pairs

Unit-IV

Network Programming Paradigm: Socket Programming: TCP & UDP, Connection oriented, connectionless, Sock_Stream, Sock_Dgram, socket(), bind(), recvfrom(), sendto(), listen() , Server-Client; send(), recv(), connect(), accept(), read(), write(), close(), Other languages: PowerShell, Bash, TCL; Socket Programming in Python.
Symbolic Programming Paradigm : Symbolic Maths, algebraic manipulations, limits, differentiation, integration, series SymPy usage for symbolic maths Equation Solving, Matrices, Other languages: Aurora, LISP, Wolfram; Symbolic Programming in Python
GUI Programming Paradigm: Graphical User Interface (GUI) , Tkinter, WxPython, Jpython, WxWidgets, PyQT5, Other languages: GTK, java-gnome; GUI Programming in Python

Suggested References Books:

1. Elad Shalom, A Review of Programming Paradigms throughout the History: With a suggestion Toward a Future Approach, Kindle Edition, 2018
2. John Goerzen, Brandon Rhodes, Foundations of Python Network Programming: The comprehensive guide to building network applications with Python, 2nd ed., Kindle Edition, 2010
3. Elliot Forbes, Learning Concurrency in Python: Build highly efficient, robust and concurrent applications, Kindle Edition, 2017
4. Amit Saha, Doing Math with Python: Use Programming to Explore Algebra, Statistics, Calculus and More, Kindle Edition, 2015
5. Alan D Moore, Python GUI Programming with Tkinter: Develop responsive and powerful GUI applications with Tkinter, Kindle Edition, 2018
6. https://www.scipy-lectures.org/

Course outcomes:

1. Create Programs using structured, procedural and object oriented programming paradigms
2. Create Programs using event driven, declarative and imperative programming paradigms
3. Create Programs using parallel, concurrent and functional programming paradigms
4. Create Programs using logic, dependent type and network programming paradigms
5. Create Programs using symbolic, automata based and graphical user interface programming paradigms
6. Create Programs using different programming paradigms using python language

Business Intelligence & Analytics					
Course code	PEC-DS-312				
Category	Professional Electives Course				
Course title	Business Intelligence & Analytics				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

1. Introduce the Business intelligence concepts ,techniques and models
2. Understand the modeling process behind business analytics
3. To analyze different data analysis tools and techniques

Unit-I

Introduction: Introduction to Business Intelligence – Designing Business Intelligence Application- Requirements Gathering, Establishing the Technical Architecture, Designing a Business Intelligence Solution , Designing Dimensional Models , Designing the Physical Databases ;

Predictive Analytics: Data Mining Concepts- Definitions, Characteristics, and Benefits - How Data Mining Works - Data Mining Versus Statistics Data Mining Process - Data Mining Methods - Data Mining and Privacy Issues - Regression – Classification –Association Rules – clustering -Techniques for Predictive Modeling – ANN- SVM

Unit-II

Text Analytics, Text Mining, And Sentiment Analysis: Text Analytics, Text Mining, and Sentiment Analysis - Natural Language Processing - Text Mining Process- tools - Sentiment Analysis -Overview, Process, Applications - Speech Analytics – Rule based, Multi, Layer, Hybrid Sentimental analysis – Machine Learning in Sentimental analysis

Web Analytics and Web Mining : Web Mining Overview - Web Content and Web Structure Mining - Search Engines - Search Engine Optimization - Web Analytics Technologies, metrics - Web Analytics Maturity Model and Web Analytics Tools

Unit-III

Prescriptive Analytics: Decision Support Systems Modeling - Mathematical Models for Decision Support - Certainty, Uncertainty, and Risk- Decision Modeling with Spreadsheets - Mathematical

Programming Optimization, - Decision Analysis with Decision Tables and Decision Trees - Problem-Solving Search Methods - Problem-Solving Search Methods

Unit-IV

Knowledge Management and Big Data Analytics : Knowledge Management –Concepts, Definitions , Approaches, tools and techniques - Big Data and Analytics- Fundamentals of Big Data Analytics – Technologies - Data Scientist - Big Data and Data Warehousing - Automated Decision Systems and Expert Systems - Business Analytics: Emerging Trends and Future Impacts, Recent Trends and contemporary issues.

Reference Books:

1. Efraim Turban, Ramesh Sharda, Dursun Delen, "Business Intelligence and Analytics", 10th Edition, Pearson , 2015.
2. S. Christian Albright, Wayne L. Winston, Business Analytics: Data Analysis & Decision Making, 6th Edition, CENGAGE INDIA , 2017
3. Dinabandhu Bag, Business Analytics, Routledge, 1st edition, 2016
4. Rick Sherman, Business Intelligence Guidebook: From Data Integration to Analytics, Morgan Kaufmann, 1st edition 2014

Course Outcomes:

After successfully completing the course the student should be able to

1. Understand the fundamental of Business Intelligence and to design a customized solution.
2. Familiarize on the concepts, techniques and reporting methods of descriptive analytics and predictive analytics
3. Explore the methods used to analyze speech and text and implement optimized search engines
4. Design and implement Decision Support systems
5. Familiarize on the processes needed to develop, report, and analyze business data.

NOSQL Databases					
Course code	PEC-DS-314				
Category	Professional Elective Course				
Course title	NOSQL Databases				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

The objective of this course are:

1. Explore the origins of NoSQL databases and the characteristics that distinguish them from traditional relational database management systems.
2. Understand the architectures and common features of the main types of NoSQL databases (key-value stores, document databases, column-family stores, graph databases)
3. Discuss the criteria that decision makers should consider when choosing between relational and non-relational databases and techniques for selecting the NoSQL database that best addresses specific use cases.

Unit-I

INTRODUCTION TO NOSQL CONCEPTS: Database revolutions: First generation, second generation, third generation, Managing Trans- actions and Data Integrity, ACID and BASE for reliable database transactions, Speeding performance by strategic use of RAM, SSD, and disk, Achieving horizontal scalability with Database sharding, Brewers CAP theorem.

NOSQL DATA ARCHITECTURE PATTERNS : NoSQL Data model: Aggregate Models- Document Data Model- Key-Value Data Model- Columnar Data Model, Graph Based Data Model Graph Data Model, NoSQL system ways to handle big data problems, Moving Queries to data, not data to the query, hash rings to distribute the data on clusters, replication to scale reads, Database distributed queries to Data nodes.

Unit-II

KEY VALUE DATA STORES : From array to key value databases, Essential features of key value Databases, Properties of keys, Characteristics of Values, Key-Value Database Data Modeling Terms, Key-Value Architecture and implementation Terms, Designing Structured Values, Limitations of Key-Value Databases, Design Patterns for Key-Value Databases, Case Study: Key-Value Databases for Mobile Application Configuration.

DOCUMENT ORIENTED DATABASE: Document, Collection, Naming, CRUD operation, querying, indexing, Replication, Sharding Consistency Implementation: Distributed consistency, Eventual Consistency, Capped Collection, Case studies: document oriented database: Mongo DB and/or Cassandra

Unit-III

COLUMNAR DATA MODEL – I: Data warehousing schemas: Comparison of columnar and row-oriented storage, Column-store Architectures: C-Store and Vector-Wise, Column-store internals and, Inserts/updates/deletes, Indexing, Adaptive Indexing and Database Cracking.

COLUMNAR DATA MODEL – II : Advanced techniques: Vectorized Processing, Compression, Write penalty, Operating Directly on Compressed Data Late Materialization Joins , Group-by, Aggregation and Arithmetic Operations, Case Studies

Unit-IV

DATA MODELING WITH GRAPH : Comparison of Relational and Graph Modeling, Property Graph Model Graph Analytics: Link analysis algorithm- Web as a graph, Page Rank- Markov chain, page rank computation, Topic specific page rank (Page Ranking Computation techniques: iterative processing, Random walk distribution Querying Graphs: Introduction to Cypher, case study: Building a Graph Database Application- community detection. Recent trends in Databases/Next Generation Databases and Contemporary Issues.

References Books:

1. Christopher D.manning, Prabhakar Raghavan, Hinrich Schutze, An introduction to Information Retrieval, Cambridge University Press
2. Daniel Abadi, Peter Boncz and Stavros Harizopoulas, The Design and Implementation of Modern Column-Oriented Database Systems, Now Publishers.
3. Guy Harrison, Next Generation Database: NoSQL and big data, Apress.

Course Outcomes:

After successfully completing the course the student should be able to

1. Explain the detailed architecture, Database properties and storage requirements
2. Differentiate and identify right database models for real time applicationsOutline Key value architecture and characteristics
3. Design Schema and implement CRUD operations, distributed data operations
4. Compare data ware housing schemas and implement various column store internals
5. Choose and implement Advanced columnar data model functions for the real time applications
6. Develop Application with Graph Data model

Nature Inspired Computing Techniques					
Course code	PEC-AI-308				
Category	Professional Elective Course				
Course title	Nature Inspired Computing Techniques				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

The objective of this course are:

1. To Understand the basics of Natural systems and its applications
2. To understand new basic Natural systems functions(operations)
3. To understand the fundamentals of nature inspired techniques which influence computing
4. To understand an Integration of Hardware and software in Natural applications.
5. To Understand practical implementation of Natural design considerations.

Unit-I

Introduction, Nature to Nature Computing , A Brief Overview of Three Branches, Individuals, Entities and agents, Parallelism and Distributivity Interactivity, Adaptation- Feedback, Self-Organization, Complexity, Emergence , Bottom-up Vs Top-Down Approach, Determination, Chaos and Fractals

Unit-II

Evolutionary Computing, Hill Climbing, Simulated Annealing, Simulated Annealing, Genetics Principles, Standard Evolutionary Algorithm, Genetic Algorithms, Reproduction, Crossover Mutation, Evolutionary Programming, Genetic Programming,

Unit-III

Swarm Intelligence – Introduction, Ant Colony Optimization, Ant Foraging Behavior, Ant Colony Optimization, SACO algorithm, Ant Colony Algorithm (ACA), Scope of ACO algorithms, Swarm Robotics, Social Adaptation of Knowledge, Particle Swarm Optimization.
Immune System-Introduction to Immune System, Physiology and main components, Pattern Recognition and Binding, Immune Network Theory, Danger Theory, Immune Algorithms, Genetic algorithms, Bone Marrow Models, Forest's Algorithm, Artificial Immune Networks

Unit-IV

DNA Computing, DNA Molecule, Adleman's experiment, PAM Model, Splicing Systems, From Classical to DNA Computing, Universal DNA Computers, Scope of DNA Computing, Lipton's Solution to SAT Problem

Recent Trends and real world applications

References Books:

1. Leandro Nunesde Castro," Fundamentals of Natural Computing, Basic Concepts, Algorithms And Applications",Chapman &Hall/CRC, Taylorand Francis Group,2007.
2. FloreanoD.and MattiussiC.,"Bio- Inspired Artificial Intelligence: Theories, Methods and Technologies", MIT Press, Cambridge, MA,2008.
3. AlbertY.Zomaya,"Handbook of Nature-Inspired and Innovative Computing",Springer,2006
4. Marco Dorrigo,Thomas Stutzle," Ant Colony Optimization", PHI,2005

Course Outcomes:

After successfully completing the course the student should be able to

1. Illustrate the basic concepts of Swarm Intelligence processes
2. Examine the principle of Immuno computing techniques
3. Skills for planning, estimating, and resourcing for Natural design considerations
4. Manage the scope changes of nature inspired techniques which influence computing
5. Ability to identify optimization Techniques as a means to provide functionality and value to apply context in specific case studies
6. Ability to understand the needs and familiarize the DNA Computing

Predictive Analytics Essentials					
Course code	PEC-DS-315				
Category	Professional Elective Course				
Course title	Predictive Analytics Essentials				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

The objective of this course are:

1. To provide the knowledge of various quantitative and classification predictive models based on various regression and decision tree methods.
2. To provide the knowledge to select the appropriate method for predictive analysis
3. To provide the understanding of how to search, identify, gather and pre-process data for the analysis.
4. To provide the understanding of how to formulate predictive analytics questions.

Unit-I

Introduction: The Analytics Life Cycle, Introduction to Predictive Analytics, Matrix Notation, Basic Foundations, Model, Method and Feature Selection.
Regression: Covariance, Correlation and ANOVA review; Simple Linear Regression, OLS Model Diagnostics, Dummy Variables, Multivariate Regression, OLS Assumptions ,Weighted Least Squares (WLS), Generalized Linear Models (GLM).

Unit-II

Classification Models: Introduction, Binomial Logistic Regression, Multinomial Logistic Regression, Linear Discriminant Analysis, Quadratic Discriminant Analysis.
Decision Trees: Introduction Regression Trees, Regression Tree Issues, Classification Trees, Pruning Trees, Bootstrap Aggregation (Bagging), Random Forest Models.

Unit-III

Data Pre-Processing: Overview, Variable Types, Introduction to Data Transformations, Data Transformations: Categorical to Dummy Variables, Polynomials, Box-Cox Transformation, Log & Elasticity Models, Logit Transformation, Count Data Models, Centering, Standardization, Rank Transformations, Lagging Data (Causal Models), Data Reduction.
Variable Selection: Dimensionality Issues, Multi-Collinearity, Variable Selection Methods, Step Methods.

Unit-IV

Dimensionality: Regularization (Penalized or Shrinkage Models, Ridge Regression, LASSO, Dimension Reduction Models, Principal Components Regression (PCR), Partial Least Squares(PLS).
Machine Learning: Machine Learning Overview, Bias vs. Variance Trade-off, Error Measures, Cross-Validation.
Deep Learning: Machine Learning Overview, architecture, techniques and applications.
Recent trends and contemporary issues.

References Books:

1. An Introduction to Statistical Learning: with Applications in R, James, Witten, Hastie and Tibshirani, Springer, 1st Edition, 2013.
2. The Elements of Statistical Learning-Data Mining, Inference, and Prediction, Trevor Hastie, Robert Tibshirani, Jerome Friedman , Second Edition , Springer Verlag, 2009.
3. Predictive & Advanced Analytics (IBM ICE Publication)

Course Outcomes:

After successfully completing the course the student should be able to

1. Ability to develop and use various quantitative and classification predictive models based on various regression and decision tree methods.
2. Ability to select the appropriate method for predictive analysis
3. Ability to search, identify, gather and pre-process data for the analysis.
4. Ability to formulate predictive analytics questions.

UI/UX Design					
Course code	PEC-CSE-316				
Category	Programme Elective Course				
Course title	UI/UX Design				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

The objective of this course are:

1. Understand the concepts of design; Utilize by learning various color models
2. Gain knowledge on the basics of various law in UX
3. Construct the task for requirement gathering
4. Gain knowledge on how to Design for various domains or applications
5. Introduce tools for designing various applications
6. Utilise different types of design for real-time programming applications

Unit-I

Typography: Types, properties, baseline, cap height, X-height, ascenders, Descenders and weight, Type classification-Serif**, sans** serif fonts, monospace, handwriting and Display, Readability, letter spacing, line height with an example, Paragraph spacing, power of alignment, Leading and Kerning, Fundamentals of color, Color Models Introduction, RGB, CMYK, Color harmony: monochromatic, analogous, Complementary, triadic, double-complementary, Meaning of colors, The power of Contrast

Unit-II

Laws of UX designing **,** Hicks law, example of hicks law with an application Jakob‘s law, example of jakob‘s law with an application, Fitts‘s Law, example of Fitts‘s law with an application, Ockham‘s Razor **,** example of Ockham‘s law with an application, Pareto Principle, example of Pareto principle with an application, Weber‘s law, example of Weber‘s law with an application, Tesler‘s law, example of Tesler‘s law with an application, Law of proximity, example of proximity, Law of similarity and human eye

Unit-III

Introduction to Interaction Design **,** Task analysis, Data collection for gathering user **,** Data for task requirements, Requirements gathering, Eliciting Qualitative data, analyzing qualitative data, Qualitative metrics, User narratives, Scenario implementation and its challenges, Wireframes, Example on wireframes. Prototypes **:** Introduction, Implementation of Prototypes, UX design for mobile application, Application design example , Responsive Design, Adaptive design and difference with Responsive design. Culture in

usability, Universal usability, Inclusive interaction, Importance of accessibility, principles of accessibility, Universal design, Accessibility design, Font weight, color, Contrast, Screen readers, Alt text using a tool

Unit-IV

Introduction to Multifaceted Users, Designing for Multifaceted Users, Design guidelines, Guidelines for helping adults, Application example, Virtual third eye simulator introduction, Web accessibility guide, Virtual third eye simulator web accessibility.

Importance of case studies and guidelines: Tracking APP Introduction, Tracking APP Design guidelines, Tracking APP demo, Designing UI, Redesigning Gmail and making it flash, Design principles, Redesigning Gmail and making it flash Demo.

Introduction of how to Design a new UX concept to reduce driver distraction, Designing concepts of Driver distraction Demo, Importance of User data in UX designing, Approach to design without user data, Designing concept **,** Implementation problems without data, Dynamic webpages, Demo, Perform UI Case study

Reference Books:

1. Jeff Johnson, Kate Finn, Designing user Interfaces for an aging population towards Universal design, Morgan Kauffman publishers, Elseiver-2017
2. Elvis Canziba, Hands-on UX Design for Developers, Packt Birminiham,mumbai-2018
3. Andrew Rogerson, User Experience Design, Smashin media 2012, Freiburg,Germany
4. Barbara Ballard, Designing the mobile user experience, Wiley publications, 2007
5. https://uxdesign.cc/tagged/case-study

Course Outcomes:

After successfully completing the course the student should be able to

1. Identify various color models for design
2. Create the design as per the design law
3. Construct the task for requirement gathering
4. Create wire frames and prototypes
5. Create the usability constraints and accessibility
6. Construct real-time applications using real -time programming applications