Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Program / Semester: **B.Tech (V Sem)**	Branch: **Data Sciences**
Subject: **Artificial Intelligence**	Course Code: **C109511(022)**
Total / Minimum-Pass Marks (End Semester Exam): **100/35**	L: 3 T: 1 P: 0 Credits: **4**
Class Tests & Assignments to be conducted: **2 each**	Duration (End Semester Exam): **03 Hours**

Course Objective:

- To impart knowledge about Artificial Intelligence.
- To give understanding of the main abstractions and reasoning for intelligent systems.
- To enable the students to understand the basic principles of Artificial Intelligence in various applications.

UNIT-I: Introduction: Overview of AI problems, AI problems as NP, Artificial Intelligence and its applications, Artificial Intelligence Techniques, Level of models, criteria of success, Intelligent Agents, Nature of Agents, Learning Agents. AI Techniques, advantages, and limitations of AI, Impact and Examples of AI, Application domains of AI. The AI Ladder - The Journey for Adopting AI Successfully, Advice for a career in AI, Hotbeds of AI Innovation.

UNIT-II: Problem Solving Techniques: State space search, control strategies, heuristic search, problem characteristics, production system characteristics., Generate and test, Hill climbing, best first search, A* search, Constraint satisfaction problem, Mean-end analysis, Min-Max Search, Alpha-Beta Pruning, Additional refinements, Iterative Deepening.

UNIT-III: Logic: Propositional logic, predicate logic, Resolution, Resolution in proportional logic and predicate logic, Clause form, unification algorithm.

UNIT-IV: Knowledge Representation Schemes and Reasoning: Mapping between facts and representations, Approaches to knowledge representation, procedural vs declarative knowledge, Forward vs. Backward reasoning, Matching, conflict resolution, Non-monotonic reasoning, Default reasoning, statistical reasoning, fuzzy logic Weak and Strong filler structures, semantic nets, frame, conceptual dependency, scripts.

UNIT-V: Planning: The Planning problem, planning with state space search, partial order planning, planning graphs, planning with propositional logic, Analysis of planning approaches, Hierarchical planning, conditional planning, Continuous and Multi Agent planning.

Text Books:

1. A Classical Approach to Artificial Intelligence, M.C. Trivedi, Khanna Book Publishing, 2019.
2. Artificial Intelligence: A modern approach by Stuart Russel, Pearson Education, 2010.
3. Artificial Intelligence by Rich and Knight, The McGraw Hill, 2017.
4. Artificial Intelligence: A new synthesis by Nils and Nilson, Elsevier, 1997.
5. Artificial Intelligence by Luger, Pearson Education, 2002.
6. Artificial Intelligence by Padhy, Oxford Press, 2005.
7. https://www.edx.org/course/artificial-intelligence-ai
8. https://www.udemy.com/course/artificial-intelligence-az/

Reference Books:

1. Title Introduction to Artificial Intelligence and Expert Systems Author Dan W. Patterson Publisher Pearson Education Edition 1st Edition, 2015.
2. 2Title Artificial Intelligence: A Modern Approach Author S. Russell and P. Norvig. Publisher Prentice Hall Edition 3rd Edition 2009.

Course Outcome: At the end of this course students will:

- Apply AI algorithms for solving practical problems.
- Describe human intelligence and AI.
- Explain how intelligent system works.
- Apply basics of Fuzzy logic and neural networks.
- Learn About Application and Analysis of planning approaches.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Program / Semester: **B.Tech (V Sem)**	Branch: **Data Sciences**
Subject: **Statistical Analysis for Data Science**	Course Code: **C110512(022)**
Total / Minimum-Pass Marks(End Semester Exam):**100/35**	**L: 3 T: 1 P: 0** Credits: **4**
Class Tests & Assignments to be conducted: **2 each**	Duration (End Semester Exam): **03 Hours**

Course Objective:

- To learn Data Science concepts
- To learn Statistics concepts and analysis
- To correlate statistical analysis in data sciences

UNIT-I: Introduction to Data Science, Mathematical & Statistical SkillsMachine Learning, Algorithms used in Machine Learning, Model selection and evaluation, Artificial Intelligence, Data Warehousing, Data Mining, Data Visualisation, Cloud Computing, Scientific Computing

UNIT-II: Data Structures & Algorithms, Data Visualization, Business Intelligence, Scientific Computing, Optimization Techniques, Exploratory Data Analysis

UNIT-III: Matrix Computations, Scholastic Models, Experimentation, Evaluation and Project Deployment Tools, Predictive Analytics and Segmentation using Clustering, Applied Mathematics and Informatics

UNIT-IV: Statistical Analysis, Meaning, Types, Importance, Benefits, Process, Methods

UNIT-V: Statistical Analysis in Data Science: Statistical Foundations for Data Science,Applications, Case Study & Discussion

Text Books:

1. Introducing Data Science by Davy Cielen, Anro DB Meysman, Mohamed Ali Davy Cielen
2. Data Science Job: How to Become a Data Scientist by Przemek Chojecki
3. Data Science from Scratch by Joel Grus
4. Think Stats By Allen B. Downey

Course Outcomes: The student will learn

- To familiar with Data Sciences
- To know Statistical Analysis
- To understand how Statistical Analysis is useful for Data Science

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Program / Semester: **B.Tech (V Sem)**	Branch: **Data Sciences**
Subject: **Theory of Computation**	Course Code: **C109513(022)**
Total / Minimum-Pass Marks (End Semester Exam):**100/35**	L: 3 T: 1 P: Credits: **4**
Class Tests & Assignments to be conducted: **2 each**	Duration (End Semester Exam): **03 Hours**

Course Objective:

- Students will learn about a variety of issues in the mathematical development of computer science theory, particularly finite representations for languages and machines.
- Students will gain a more formal understanding of algorithms and procedures
- To illustrate finite state machines to solve problems in computing.
- To explain the hierarchy of problems arising in the computer sciences.
- To familiarize Regular grammars, context frees grammar.
- To solve various problems of applying normal form techniques, push down automata and Turing Machines.

UNIT-I: The Theory of Automata: Introduction to automata theory, Examples of automata machine, Finite automata as a language acceptor and translator. Deterministic finite automata. Non deterministic finite automata, finite automata with output (Mealy Machine. Moore machine). Finite automata with? moves, Conversion of NFA to DFA by Arden's method, Minimizing number of states of a DFA. My hill Nerode theorem, Properties and limitation of FSM. Two way finite automata. Application of finite automata.

UNIT-II: Regular Expressions: Regular expression, Properties of Regular Expression. Finite automata and Regular expressions. Regular Expression to DFA conversion & vice versa. Pumping lemma for regular sets. Application of pumping lemma, Regular sets and Regular grammar. Closure properties of regular sets. Decision algorithm for regular sets and regular grammar.

UNIT-III: Grammars: Definition and types of grammar. Chomsky hierarchy of grammar. Relation between types of grammars. Role and application areas of grammars. Context free grammar. Left most linear &right most derivation trees. Ambiguity in grammar. Simplification of context free grammar. Chomsky normal from. Greibach normal form, properties of context free language. Pumping lemma fro context free language. Decision algorithm for context tree language.

UNIT-IV: Push Down Automata and Turing Machine: Basic definitions. Deterministic pushdown automata and non deterministic push down automata. Acceptance of push down automata. Push down automata and context free language. Turing machine model. Representation of Turing Machine Construction of Turing Machine for simple problem's. Universal Turing machine and other modifications. Church's Hypothesis. Post correspondence problem. Halting problem of Turing Machine.

UNIT-V: Computability: Introduction and Basic concepts. Recursive function. Partial recursive function. Partial recursive function. Initial functions, computability, A Turing model for computation. Turing computable functions, Construction of Turing machine for computation. Space and time complexity. Recursive enumerable language and sets.

Text Books :

1. Theory of Computer Science (Automata Language & Computation), K.L.P. Mishra and N. Chandrasekran, PHI.
2. Introduction to Automata theory. Language and Computation, John E. Hopcropt& Jeffery D. Ullman, NarosaPublishing House.

Reference Books :

1. Theory of Automata and Formal Language, R.B. Patel & P. Nath, Umesh Publication
2. An Introduction and finite automata theory, Adesh K. Pandey, TMH.
3. Theory of Computation, AM Natrajan. Tamilarasi, Bilasubramani, New Age International Publishers.
4. Finite Automata and Formal Languages: A Simple Approach, A.M. Padma Reddy, Pearson Education, India.

Course Outcome:

At the end of this course students will:

- Design finite automata to accept a set of strings of a language.
- Determine whether the given language is regular or not.
- Design context free grammars to generate strings of context free language.
- Design push down automata and the equivalent context free grammars and Design Turing machine.
- Distinguish between computability and no computability, Decidability and un-decidability.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Program / Semester: **B.Tech (V Sem)**	Branch: **Data Sciences**
Subject: **Introduction to Data Analytics and Visualization**	Course Code: **C110514(022)**
Total / Minimum-Pass Marks (End Semester Exam): **100/35**	**L: 2 T: 1 P: Credits: 3**
Class Tests & Assignments to be conducted: **2 each**	Duration (End Semester Exam): **03 Hours**

Course Objective:

- To introduce the fundamental concepts of data Analysis and pre-processing.
- To introduce different types of data mining techniques.
- To introduce effective visualizations using appropriate chart types, color schemes, and labeling techniques.
- To introduce the utilization of visualization tools and libraries to create interactive and static visualizations.
- To introduce the use of data visualization in high-dimension data handling and in Machine learning.

UNIT-I: Introduction to Data Analytics: Introduction to data analytics and its significance, Types of data: structured, unstructured, and semi-structured, Exploratory data analysis (EDA) and data profiling, Data pre-processing techniques: cleaning, transformation, and integration

UNIT-II: Statistical Analysis and Data Mining: Descriptive statistics: measures of central tendency and variability, Inferential statistics: hypothesis testing and confidence intervals, Correlation and regression analysis, Introduction to data mining concepts and algorithms

UNIT-III: Introduction to Data Visualization and Representation: Introduction to data visualization and its importance, Perception, and cognition in visualization, Types of data and visualization tasks, Data visualization pipeline, Tools and software for data visualization, Data types and structures for visualization, Graphs, and charts for categorical and numerical data, Bar charts, line charts, scatter plots, Pie charts, histograms, box plots, Heatmaps.

UNIT-IV: Principles of Visualization Design and Tools: Principles of visual perception and cognition, Color theory and color encoding, Layout and composition in visualization, Effective use of typography and labels, Visualization storytelling, and narrative techniques. Introduction to popular data visualization tools, Creating visualizations using Python libraries (Matplotlib, Seaborn, Plotly).

UNIT-V: Advanced Data Visualization: Visualizing large and high-dimensional datasets, Information visualization and network visualization, Visualization for machine learning and AI applications, Evaluation and critique of visualizations, and Ethical considerations in data visualization. Text analytics and sentiment analysis. Time series analysis and forecasting.

Textbooks:

1. "Interactive Data Visualization for the Web" by Scott Murray
2. "Data Science for Business" by Foster Provost and Tom Fawcett
3. "Data Mining: Concepts and Techniques" by Jiawei Han, Micheline Kamber, and Jian Pei
4. "Python for Data Analysis" by Wes McKinney

Reference Books:

1. "Information Visualization: Perception for Design" by Colin Ware
2. "The Wall Street Journal Guide to Information Graphics: The Dos and Don'ts of Presenting Data, Facts, and Figures" by Dona M. Wong
3. "Data Visualization: A Practical Introduction" by Kieran Healy
4. "Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst" by Dean Abbott

Course Outcome: By the end of this course, students will be able to:

- Understand the fundamental concepts of data analysis.
- Apply various visualization techniques to explore and analyze datasets.
- Design and create effective visualizations using appropriate tools and software.
- Critically evaluate and improve existing visualizations based on principles of perception and design.
- Apply data visualization techniques to real-world problems in AI and machine learning.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Program / Semester: **B.Tech (V Sem)**	Branch: **Data Sciences**
Subject: **Artificial Intelligence (Lab)**	Course Code: **C110521(022)**
Total / Minimum-Pass Marks (End Semester Exam): **40/20**	L: 0 T: 0 P: 2 Credits: **1**

Course Objectives:

- To provide skills for designing and analyzing AI based algorithms.
- To enable students to work on various AI tools.
- To provide skills to work towards solution of real life problems

List of Experiments: (Each student should perform, at least, 10 experiments.)

1. Write a prolog program to find the rules for parent, child, male, female, son, daughter, brother, sister, uncle, aunt, ancestor given the facts about father and wife only.
2. Write a program to find the length of a given list
3. Write a program to find the last element of a given list
4. Write a program to delete the first occurrence and also all occurrences of a particular element in a given list.
5. Write a program to find union and intersection of two given sets represented as lists.
6. Write a program to read a list at a time and write a list at a time using the well defined read & write functions.
7. Write a program given the knowledge base,
   If x is on the top of y, y supports x.
   If x is above y and they are touching each other, x is on top of y.
   A cup is above a book. The cup is touching that book. Convert the following into wff's, clausal form; Is it possible to deduce that `The book supports the cup'.
8. Write a program given the knowledge base,
   If Town x is connected to Town y by highway z and bikes are allowed on z, you can get to y from x by bike.
   If Town x is connected to y by z then y is also connected to x by z.
   If you can get to town q from p and also to town r from town q, you can get to town r from town p.
   Town A is connected to Town B by Road 1. Town B is connected to Town C by Road 2.
   Town A is connected to Town C by Road 3. Town D is connected to Town E by Road 4.
   Town D is connected to Town B by Road 5. Bikes are allowed on roads 3, 4, 5.
   Bikes are only either allowed on Road 1 or on Road 2 every day. Convert the following into wff's, clausal formand deduce that `One can get to town B from town D'.
9. Solve the classical problems for demonstrating AI search heuristics: (Water Jug problem, Monkey Banana problem, Missionary Cannibals problem, Travelling Salesman Problem and alike).
10. Solve the classical Crypt arithmetic problems in AI: (DONALD + GERALD = ROBERT, CROSS + ROADS = DANGER, SEND + MORE = MONEY and alike).
11. Solve the classical Blocks World Problem demonstrating Planning Problem-solving simulation in AI.
12. Write a program to search any goal given an input graph using AO* algorithm.

List of Equipments/Machine required: PC with Wndows XP Operating System, Visual prolog compiler

Recommended Books :

1. Ivan Bratko : Logic & prolog programming.
2. Carl Townsend : Introduction to Turbo Prolog, BPB, Publication.
3. W.F. Clocksin &Mellish : Programming in PRLOG, Narosa Publication House

Laboratory Outcomes [After undergoing the course, students will be able to:]

- Acquire an overview of logic constructs for performing inferencing techniques. (First Order Predicate Calculus) in toy problems /classical problems using PROLOG / LISP syntax.
- Gain confidence in drafting production rules (iterative / recursive) for an AI simulating code, given a story domain.
- Under stand,on how to use different data structures (lists, trees, stacks and queues) for solving routing problems and implementing heuristic searches.
- Gain exposure to deal with situations that crop up syntax / compile-time / run-time errors.
- Simulate game playing / puzzle problems using general solution in PROLOG / LISP syntax.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Program / Semester: **B.Tech (V Sem)**	Branch: **Data Sciences**
Subject: **Data Analytics and Visualization (Lab)**	Course Code: **C110522(022)**
Total / Minimum-Pass Marks (End Semester Exam): **40/20**	L: 0 T: 0 P: 2 Credits: **1**

Course Objectives:

- Understand and implement data cleaning techniques in Python to handle missing values in a dataset and perform data normalization.
- Develop the ability to compute and interpret descriptive statistics measures such as mean, median, mode, and variance using Python.
- Gain proficiency in creating various types of plots and visualizations, including line charts, bar plots, scatter plots, histograms, and multiple graphs in a single figure.
- Acquire knowledge and skills to perform hypothesis testing using t-tests, ANOVA, and chi-square tests through programming in Python.
- Learn and apply regression analysis techniques, including fitting a linear model and making predictions, using Python programming.

Syllabus:

1. write a program in Python for Cleaning and handling missing values in a dataset and data normalization.
2. Write a program to perform descriptive statistics: mean, median, mode, variance, etc.
3. Write a program for Creating line charts, bar plots, scatter plots, and histograms, Plotting multiple graphs in a single figure.
4. Write a program for Hypothesis testing using t-tests, ANOVA, and chi-square tests.
5. Write a program for Regression Analysis, fitting a linear model and making predictions.
6. Write a program for binary Classification using Machine Learning Algorithms
7. Write a program for Model evaluation using accuracy, precision, recall, and F1-score.
8. Write a program to use the K-means clustering algorithm.
9. Write a program for Text preprocessing using tokenization, stop word removal, and stemming.
10. Write a program to work with time-series data in Python.

Recommended Books:

1. Python Data Analytics– Fabio Nelli, APress.
2. Python for Data Analysis, Wes McKinney, O'Reilly.
3. "Python for Data Science for Dummies" by John Paul Mueller and Luca Massaron

Course Outcomes [After undergoing the course, students will be able to:]

- Proficiency in Python programming for data analytics.
- Understanding of essential data cleaning, preprocessing, and visualization techniques.
- Ability to apply statistical analysis and machine learning algorithms to real-world datasets.
- Skills in interpreting and visualizing data insights effectively.
- Knowledge of advanced topics such as text analytics, time series analysis, and recommender systems.
- Proficiency in using popular data analytics libraries, such as Matplotlib, Seaborn, Pandas, and Scikit-learn.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Program / Semester: **B.Tech (V Sem)**	Branch: **Data Sciences**
Subject: **R-Programming (Lab)**	Course Code: **C110523(022)**
Total / Minimum-Pass Marks (End Semester Exam): **40/20**	L: 0 T: 0 P: 2 Credits: **1**

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

- Install and configure R and RStudio
- Write basic R code
- Import and clean data in R
- Manipulate data in R
- Create plots in R
- Perform descriptive and inferential statistics in R
- Build linear and logistic regression models in R
- Create different types of data visualizations in R
- Use data visualizations to communicate the results of data analysis
- Install and use R packages
- Write R packages

List of Experiments: Do the project work based on given task

Experiment 1: Installing and Configuring R and RStudio: In this experiment, students will install R and RStudio on their computers. They will then configure RStudio to their liking.

Experiment 2: Writing Basic R Code: In this experiment, students will learn how to write basic R code. They will learn how to create variables, assign values to variables, and perform basic mathematical operations.

Experiment 3: Importing and Cleaning Data in R: In this experiment, students will learn how to import data into R from different sources. They will also learn how to clean data in R to remove errors and inconsistencies.

Experiment 4: Manipulating Data in R: In this experiment, students will learn how to manipulate data in R. They will learn how to select rows and columns of data, how to sort data, and how to group data.

Experiment 5: Creating Plots in R: In this experiment, students will learn how to create plots in R. They will learn how to create different types of plots, such as bar charts, line charts, and scatter plots.

Experiment 6: Performing Descriptive and Inferential Statistics in R: In this experiment, students will learn how to perform descriptive and inferential statistics in R. They will learn how to calculate descriptive statistics, such as the mean, median, and standard deviation. They will also learn how to perform hypothesis testing in R.

Experiment 7: Building Linear and Logistic Regression Models in R: In this experiment, students will learn how to build linear and logistic regression models in R. They will learn how to fit a linear regression model to data and how to interpret the results of the model. They will also learn how to fit a logistic regression model to data and how to interpret the results of the model.

Experiment 8: Creating Different Types of Data Visualizations in R: In this experiment, students will learn how to create different types of data visualizations in R. They will learn how to create bar charts, line charts, scatter plots, and other types of visualizations.

Experiment 9: Using Data Visualizations to Communicate the Results of Data Analysis: In this experiment, students will learn how to use data visualizations to communicate the results of data analysis. They will learn how to choose the right type of visualization for the data and how to create effective visualizations.

Experiment 10: Installing and Using R Packages: In this experiment, students will learn how to install and use R packages. They will learn how to find R packages, how to install R packages, and how to use R packages.

Experiment 11: Writing R Packages: In this experiment, students will learn how to write R packages. They will learn how to create R packages, how to install R packages, and how to use R packages.

Text Book :

1. R for Data Science by Hadley Wickham and Garrett Grolemund.
2. R for Data Analysis by Garrett Grolemund and Hadley Wickham.
3. Introduction to Statistical Learning by Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani
4. Data Visualization: The Language of Graphics by Edward Tufte.
5. R Packages by Hadley Wickham.

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

- Demonstrate proficiency in the use of R for data science
- Apply R to solve real-world data science problems
- Communicate the results of data analysis using data visualizations
- Write R packages to share their code with others

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Program / Semester: **B.Tech (V)**	Branch: **Data Sciences**
Subject: **Minor Project Phase-I**	Course Code: **C110524(022)**
Total / Minimum-Pass Marks (End Semester Exam): **40/20**	L: 0 T: 0 P: 2 Credits: **1**

Pre-requisite: Knowledge of Minimum 2 Subjects & Laboratory

Course Objectives:

- Acquire the knowledge of Computer Engineering and apply this knowledge to develop a Project Model.
- Understand and analyse the Engineering Problem.
- Prepare a well-organized Documentation for the Project Developed.

Guidelines for Project:

Project work: Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary project can be assigned to an individual student or to a group having not more than 4 students.

In extraordinary cases, like the funded projects requiring students from different disciplines, the project student strength can be 5 or 6.

Project Work Phase - 1:

A committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide, shall award the Sessional marks.

The sessional marks awarded for the project work phase -1, shall be based on the evaluation of the project work phase -1 Report (covering Literature Survey, Problem identification, Objectives and Methodology), project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the Project report shall be the same for all the batch mates.

- Student has to Identify and formulate problem
- Students has to survey minimum 5 Research Papers of Reputed Publication
- Proposed Methodology and Objectives of the Project should be defined
- Adopt appropriate method to design selected problem
- Concerned guide and Review Committee will conduct timely evaluation of the project for SESSIONAL assessment.
- At the end of the semester students has to prepare and submit a well-organized project report.

Course Outcomes: [After undergoing the course, students will be able to:]

- Demonstrate skill to identify and formulate the given problems.
- Apply basic engineering knowledge learnt in developing system individually or in-group
- Evaluate current research status by conducting literature survey.
- Design and develop real time applications
- Apply the programming language for the implementation of the project and prepare well-organized report.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Program / Semester: **B. Tech (V)**	Branch: **Data Sciences**
Subject: **Internet of Things (IoT)(Professional Elective - I)**	Course Code: **C110531(022)**
Total / Minimum-Pass Marks(End Semester Exam):**100 / 35**	L: 2 T: 0 P: 0 Credits: **2**
Class Tests & Assignments to be conducted: 2 each	Duration (End Semester Exam): **03 Hours**

Course Objectives:

- To study the fundamentals about IoT.
- To study about the functional blocks and IoT Access technologies.
- To study the design methodology and different IoT hardware platforms.
- To study the basics of IoT Data Analytics and supporting services.
- To study about various IoT case studies.

UNIT-I: Fundamentals of IoT: Evolution of Internet of Things, Enabling Technologies, M2M Communication, IoT World Forum (IoTWF) standardized architecture, Simplified IoT Architecture, Core IoT Functional Stack, Fog, Edge and Cloud in IoT.

UNIT-II: Functional Block and IoT Protocols: Sensors, Actuators, Smart Objects, Connecting Smart Objects. **Access Technology:** Physical layer, MAC layers, Topology and Security of IEEE 802.15.4, 802.11ah and Lora WAN. **IP as the IoT Network Layer:** IP versions, Constrained Nodes and Constrained Networks, 6LoWPAN, IoT Application Transport Methods: SCADA, **IoT Application Layer Protocols:** CoAP and MQTT.

UNIT-III: Design and Development: Design Methodology, Embedded computing logic, Microcontroller, System on Chips, IoT system building blocks IoT Platform overview: Overview of IoT supported Hardware platforms such as: Raspberry pi, Arduino Board details

UNIT-IV: Data Analytics and Supporting Services: Data Analytics: Introduction, Structured Versus Unstructured Data, Data in Motion versus Data at Rest, IoT Data Analytics Challenges, Data Acquiring and storage, organizing the data. **Supporting Services:** Cloud computing paradigm for data collection, storage and computing, everything as a service and Cloud Service Models.

UNIT-V: IoT Case Studies: IoT/IIOT Applications in the Premises, Supply-Chain and Customer Monitoring, IoT applications for smart homes, cities, Environment Monitoring and Agriculture. **CASE STUDY:** Smart City Streetlights Control and Monitoring.

Text Books:

1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017
2. Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015 3. Internet of Things: Architecture, Design Principles and Applications, Rajkamal, McGraw Hill Higher Education

Reference Books:

1. The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012.
2. "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Jan Ho¨ ller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014.
3. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer, 2011.

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

- Understand the basics of IoT.
- Implement the state of the Architecture of an IoT.
- Understand design methodology and hardware platforms involved in IoT.
- Understand how to analyze and organize the data.
- Compare IOT Applications in real world.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Program / Semester: **B.Tech (V Sem)**	Branch: **Data Sciences**
Subject: **Introduction to Toolkits for Machine Learning (Professional Elective - I)**	Course Code: **C110532(022)**
Total / Minimum-Pass Marks (End Semester Exam): **100 / 35**	L: 2 T: 0 P: 0 Credits: **2**
Class Tests & Assignments to be conducted: **2 Each**	Duration (End Semester Exam): **03 Hours**

Course Objectives:

- To introduce the use of various Machine Learning Toolkits.
- To introduce the use of Exploratory Data Analysis for performing various data processing activities.
- To introduce the use of the Seaborn library for data visualization activities.
- To introduce the concept of Ensemble Learning techniques.
- To introduce the use of Scikit-Learn Library for data analysis.

UNIT-I: Introduction to Machine Learning Toolkits

Definition and purpose of machine learning toolkits, simplification process of toolkits, Overview of different types of machine learning toolkits such as models and techniques; Data Pre-processing and Feature Engineering-Exploring various pre-processing techniques, data scaling, handling missing values, and one-hot encoding, Feature selection and extraction methods, Model Evaluation and Performance Metrics.

UNIT-II: Exploratory Data Analysis

Exploratory Analysis: Descriptive and comparative statistics, EDA explained using sample Data set; Exploratory Graphs: 3D scatter plot, Pair plot, and limitations, Histogram and introduction to PDF, Univariate analysis using PDF, Mean, variance, standard deviation, Box-plot with whiskers.

UNIT-III: Data Visualization using Seaborn

Visualization: various plots viz multiple, categorical, distribution, Regression; Seaborn-Statistical Estimation; Time Series, Geo-location Data, Correlations and Connections, Hierarchies, Networks, Interactivit.

UNIT-IV: Ensembles Methods

Introduction to Ensembles Methods, Types of ensemble methods viz stacking, blending, bagging, boosting and its impact on bias and variance, C5.0 boosting, Random Forest, Gradient Boosting Algorithm (GBM), AdaBoost: Adaptive Boosting, Extreme Gradient Boosting (XGBoost), LightGBM.

UNIT-V: Scikit-Learn (Open Source Data Analysis Library)

Overview of scikit-learn, Supervised Learning Models with scikit-learn viz linear regression, logistic regression, decision trees, and support vector machines; Introduction to unsupervised learning algorithms using scikit-learn library viz k-means, Hierarchical clustering, DBSACN, and Principal Component Analysis; Measuring classification and Clustering Performance parameters.

Text Books:

1. Data Mining Concepts and Techniques. Jiawei Han, Micheline Kamber and Jian Pei. Morgan Kaufmann
2. Publisher is an imprint of Elsevier.
3. Machine Learning in Action. Peter Harrington, Manning Publications, 2012.
4. Introduction to Machine Learning (3e), Ethem Alpaydin, MIT Press.

Reference Books:

1. Python Data Analytics– Fabio Nelli, Apress.
2. Python for Data Analysis, Wes McKinney, O'Reilly.
3. Foundations of Machine Learning(2e), Mohri Mehryar, Afshin Rostamizadeh, and Ameet Talwalkar,MIT Press.

Course Outcomes [After undergoing the course, students will be able to:]

- Use various Machine Learning Toolkits available in Python.
- Apply the concept of Exploratory Data Analysis for performing various data processing activities.
- Apply the use of the Seaborn library for data visualization activities.
- Apply the Ensemble Learning techniques.
- Apply the Scikit-Learn Library for data analysis and data handling activities.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Program / Semester: B.Tech (V Sem)	Branch: **Data Sciences**
Subject: **Neural Network Architecture for Data Analysis (Professional Elective I)**	Course Code: **C110533(022)**
Total / Minimum-Pass Marks(End Semester Exam): **100 / 35**	L: 2 T: 0 P: 0 Credits: **2**
Class Tests & Assignments to be conducted: **2 Each**	Duration (End Semester Exam): **03 Hours**

Course Objectives:

- To introduce the use of various Data Acquisition Methods.
- To introduce the use of Data Pre-processing activities.
- To introduce the fundamental techniques and principles of Neural Networks.
- To explain the functioning of deep neural networks.
- To familiarize deep learning concepts with Convolutional Neural Network case studies.

UNIT-I: Data Acquisition: Data Acquisition Gather information from different sources, internal systems and External systems, Web APIs, Open Data Sources, Data APIs, Web Scrapping, and Relational Database access (queries) to process/access data.

UNIT-II: Data Pre-processing: Data Pre-processing Data Cleaning: Missing Values, Noisy Data, Data Cleaning as a Process; Data Integration: Redundancy and Correlation Analysis; Data Reduction: Overview of Data Reduction Strategies, Principal Components Analysis; Data Transformation and Data Discretization: Data Transformation Strategies Overview, Data Transformation by Normalization, and Discretization by Histogram Analysis.

UNIT-III: Fundamentals of Neural Networks: Introduction to Neural Networks, Model of Artificial Neuron, Learning rules, and various activation functions. Single-layer Feed-forward Networks. Multi-layer Feed-forward Networks. Recurrent Networks. Back Propagation Networks, Architecture of Back-propagation (BP) Networks, Back-propagation Learning, and Variation of Standard Back propagation algorithms.

UNIT-IV: Deep Neural Networks: Introduction to Deep Neural Networks, training deep models, Training Deep Neural Networks using Back Propagation-Setup and initialization issues, Gradient- Descent Strategies, vanishing and exploding Gradient problems, regularizations, and dropouts.

UNIT-V: Convolutional Neural Networks: The basic structure of Convolutional Network, Convolutions for Images, Padding, and Stride, Multiple Input and Multiple Output Channels, Pooling, FCNN Case study: Image classification using CNN.

Text Books:

1. S.Rajasekaran and G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI
2. Learning Pvt. Ltd., 2003, ISBN:978-81-203-2186-1.
3. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, "Dive into Deep Learning", Amazon
4. Science, 2021.
5. Hands-On Exploratory Data Analysis with Python, Suresh Kumar Mukhiya, Usman Ahmed, Packt Pub, 2020.

Reference Books:

1. Jacek M. Zurada,"Introduction to artificial neural systems", West Publishing Co., 1992, ISBN: 0-3 14-93391-3.
2. Goodfellow I., BengioY., and Courville A., "Deep Learning", MIT Press, 2016, ISBN: 978-0262035613.

Course Outcomes [After undergoing the course, students will be able to:]

- Implement the Web APIs and Data APIs.
- Able to understand the various steps of data cleaning.
- Design Feed Forward Neural Network architecture for real-world problems.
- Apply deep learning techniques to practical problems.
- Apply different types of Convolutional architectures for image datasets.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Program / Semester: **B. Tech (V Sem)**	Branch: **Data Sciences**
Subject: **Techniques of Data Mining (Professional Elective-I)**	Course Code: **C110534(022)**
Total / Minimum-Pass Marks(End Semester Exam): **100 / 35**	L: 2 T: 0 P: 0 Credits: **2**
Class Tests & Assignments to be conducted: **2 each**	Duration (End Semester Exam): **03 Hours**

Course Objectives:

- To provide students with a comprehensive understanding of the concepts and techniques of data mining.
- To enable students to apply data mining algorithms to extract knowledge from large datasets.
- To prepare students for careers in data mining and related fields.

UNIT-I: Introduction to Data Mining: What is Data Mining? History of Data Mining**,** Data Mining Process**,** Data Mining Algorithms**,** Data Mining Tools**,** Data Mining Applications

UNIT-II: Data Pre-processing: Data Cleaning, Data Integration, Data Reduction, Data Transformation, Data Discretization, Data Normalization

UNIT-III: Classification: Decision Trees**,** Naïve Bayes**,** Support Vector Machines**,** K-Nearest Neighbors**,** Random Forests**,** Ensemble Learning

UNIT-IV: Clustering: Hierarchical Clustering**,** K-Means Clustering**,** Density-Based Clustering**,** Spectral Clustering**,** Gaussian Mixture Models

UNIT-V: Association Rule Mining: Apriori Algorithm, Eclat Algorithm**,** FP-Growth Algorithm**,** Mining Frequent Itemsets**,** Mining Association Rules

Text Book:

1. Data Mining: Concepts and Techniques by Jiawei Han, Micheline Kamber, and Jian Pei
2. Introduction to Data Mining by Pang-Ning Tan, Michael Steinbach, and Vipin Kumar
3. Data Mining for Business Intelligence by Foster Provost and Tom Fawcett
4. Data Mining: A Tutorial by Ian H. Witten, Eibe Frank, and Christopher J. Hall

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

- Define data mining and explain its importance.
- Describe the different types of data mining problems.
- Apply data mining algorithms to real-world datasets.
- Evaluate the effectiveness of data mining models.
- Communicate the results of data mining projects.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Program / Semester: **B.Tech (V Sem)**	Branch: **Data Sciences**
Subject: **Environmental Science**	Course Code: **C110525(022)**
Total / Minimum-Pass Marks (End Semester Exam):**10**	L : 0 T: 0 P: 2 Credits: -

Course Objectives:

- Understanding the importance of ecological balance for sustainable development.
- Understanding the impacts of developmental activities and mitigation measures.
- Understanding the environmental policies and regulations

UNIT-I: Ecosystems: Definition, Scope, and Importance of ecosystem. Classification, structure, and function of an ecosystem, Food chains, food webs, and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Biomagnifications, ecosystem value, services and carrying capacity, Field visits.

UNIT-II: Natural Resources: Classification of Resources: Living and Non-Living resources, water resources: use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems. Mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, Land resources: Forest resources, Energy resources: growing energy needs, renewable and non-renewable energy sources, use of alternate energy source, case studies.

UNIT-III: Biodiversity and Biotic Resources: Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, Hot spots of biodiversity. Field visit. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-sit conservation. National Biodiversity act.

UNIT-IV: Environmental Pollution and Control Technologies: Environmental Pollution: Classification of pollution, Air Pollution: Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards. Water pollution: Sources and types of pollution, drinking water quality standards. Soil Pollution: Sources and types, Impacts of modern agriculture, degradation of soil. Noise Pollution: Sources and Health hazards, standards, Solid waste: Municipal Solid Waste management, composition and characteristics of e-Waste and its management. Pollution control technologies: Wastewater Treatment methods: Primary, secondary and Tertiary.

UNIT-V: Environmental Policy: Environmental Protection act, Legal aspects Air Act-1981, Water Act, Forest Act, Wildlife Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste management and handling rules.

Text Books:

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.
2. Environmental Studies by R. Rajagopalan, Oxford University Press.

Reference Books:

1. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela. 2008 PHI Learning Pvt. Ltd.
3. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.
4. Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers.

5. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications.
6. Introduction to Environmental Science by Y. Anjaneyulu, BS. Publications.

Course Outcomes:

On successful completion of the course, the student will be able to:

- Demonstrate an understanding of basic concept of ecosystem.
- Demonstrate an awareness of importance of natural resources.
- Demonstrate an awareness of biotic resources.
- Understand the pollution caused by different sources.
- Understand/evaluate/develop technologies on the basis of ecological principles and environmental regulations which in turn helps in sustainable development.