# DEPARTMENT OF DATA SCIENCE

## Scheme and Syllabus for B.Tech. In Data Science –V SEM according to NEP

| Course Code | Name of Course | Course Category | Teaching Scheme | | | | Credits | Evaluation Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Theory | | | Practical | | |
| | | | L | T | P | **Total Hours** | | **TAE** | L | T | P | **EXT** | **Total Marks** |
| SEMESTER-V | | | | | | | | | | | | | |
| 23BTDSL301/ 23BTDSP301 | Introduction to Data and Machine Learning | PCC6 | 3 | - | 2 | 5 | 4 | 10 | 15 | 50 | 25 | 25 | 125 |
| 23BTDSL302 | Operating Systems Fundamentals | PCC7 | 3 | - | - | 3 | 3 | 10 | 15 | 50 | - | - | 75 |
| 23BTDSL303 | Big Data Computing | PCC8 | 2 | - | 2 | 4 | 3 | 10 | 15 | 50 | 25 | - | 100 |
| 23BTDSL311<br>23BTDSL312<br>23BTDSL313 | PEC-I<br>• Principles of Object-Oriented Programming<br>• Next Generation Databases<br>• Augmented Reality Virtual Reality (ARVR) | PEC1 | 3 | - | 2 | 5 | 4 | 10 | 15 | 50 | 25 | - | 100 |
| 23BTDSL304 | MD –III<br>Data Visualization through POWERBI | MD3 | 3 | - | 2 | 5 | 4 | 10 | 15 | 50 | 25 | - | 100 |
| 23BTDSL305<br>23BTDSL306 | Open elective –III<br>• Soft Computing Techniques<br>• Machine Learning with Tensor flow | OE3 | 2 | - | - | 2 | 2 | 10 | 15 | 50 | - | - | 75 |
| 23BTSHP301 | Research Methodology | RM | - | - | 4 | 4 | 2 | - | - | - | 25 | | 25 |
| **TOTAL** | | | 16 | | 8 | 24 | 22 | 60 | 90 | 300 | 125 | 25 | 600 |

| Course Title: Introduction to Data and Machine Learning | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Semester | V | Teaching Scheme | | | | Evaluation Scheme | | | | |
| | | | | | | Theory | | | Practical | |
| Term | ODD | Th | Tu | Pr | Credits | TAE | CAE | ESE | INT | EXT |
| Course Category | PCC6 | 3 | -- | 2 | 4 | 10 | 15 | 50 | 25 | 25 |
| Course Code | 23BTDS L301 23BTDS P301 | | | | | | | | | |
| Duration of ESE | 3 | 5HRS | | | Total | 75 | | | 50 | |
| | | | | | | 125 | | | | |

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| **Course Objectives** | 1. To introduce the basic concepts of data and techniques of machine learning.<br>2. To understand major machine learning algorithms.<br>3. To identify machine learning techniques suitable for a given problem. |
| | **Upon successful completion of this course, student will be able to:** |
| **Course Outcomes** | On successful completion of the course, students will be able to:<br>1. Understand basic necessary data fundamentals for machine learning.<br>2. Apply supervised machine learning model to solve a specific problem.<br>3. Demonstrate Instance based learning for a given application.<br>4. Design unsupervised machine learning model to solve a specific problem.<br>5. Create machine learning model to solve a specific real world problem. |
| | |

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

| CourseOutcomes | Program Outcomes and Program Specific Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | 3 | 3 | 3 | 3 | 3 | 2 | | | | | | 2 | 2 | 1 |
| CO2 | 2 | 3 | 3 | 2 | 2 | 2 | | | | | | | 2 | 1 |
| CO3 | 2 | 3 | 3 | 1 | 2 | 3 | | | | | | | 2 | 1 |
| CO4 | 2 | 3 | 3 | 3 | 2 | 2 | | | | | | 2 | 2 | 1 |
| CO5 | 2 | 3 | 3 | 3 | 2 | 3 | | | | | | 3 | 2 | 1 |

| Unit | Contents | Hours |
|---|---|---|
| I | Data Types and Sources: Structured vs. Unstructured data, Data collection methods, Data Preprocessing: Data cleaning, handling missing and duplicate values, Data transformation and scaling, Feature engineering and selection, Data visualization techniques | 9 |
| II | Introduction to Machine Learning, types process and Applications, Evaluation of model, under fitting, over fitting, Bias variance Trade off, Concept of loss functions, Limitations of Machine Learning. Regression: Linear Regression, Logistic Regression. | 9 |
| III | Instance-Based Learning: k-Nearest neighbour algorithm, Case-based learning. Decision tree algorithm, Random forest Algorithm, Basics of ANN, Activation functions, learning process in ANN, Implementation of ANN. | 9 |
| IV | Clustering and Unsupervised Learning: K-means, Hierarchical Clustering using single linkage, complete linkage and average linkage methods. Naive Bayes classifier, Bayes optimal classifiers, Support Vector Machine | 9 |
| V | Ensemble Learning, Bagging and Boosting concepts, Ethics in Machine Learning, Capstone projects based upon real world applications and domains and case studies in machine learning. | 9 |

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| **Text Books** | Machine Learning- an Artificial Intelligence Approach, Volume-II, Tom Mitchell, Morgan Kaufmann, 1986. |
| | Machine Learning- Saikat Dutt, Subramanian Chandramouli, Pearson Education 2022 |
| **Reference Books** | Deep Learning- Amit Kumar das, Saptarsi Goswami, Pearson Education 2021 |
| | A. K. Jain and R. C. Dubes; Algorithms for Clustering Data; Prentice Hall PTR, 1988. |
| **Online TL Material** | https://unicornplatform.com/blog/top-5-best-websites-to-learn-machine-learning-for-free/ |
| | https://www.udemy.com/course/complete-machine-learning-and-data-science-zero-to-mastery |
| | https://www.coursera.org/collections/machine-learning |

## LIST OF PRACTICAL

| Name of Subject: MACHINE LEARNING ALGORITHMS | | Sem: V |
|---|---|---|
| **COURSE OUTCOME** | | |
| CO1 | Understand complexity of data and Machine Learning algorithms and their limitations | |
| CO2 | Understand supervised machine learning paradigms for real problems. | |
| CO3 | Understand un-supervised machine learning paradigms for real problems. | |
| CO4 | Create Machine Learning models using real-world data | |

| Sr. No | Practical List | Mapping with CO | Mapping with PO & PSO |
|---|---|---|---|
| 1. | **Comparative Analysis of Structured vs Unstructured Data with Pre-processing**<br>**Data Collection:**<br>• Download a **structured dataset** (e.g., CSV file from UCI Repository like Iris or Titanic).<br>• Collect an **unstructured dataset** (e.g., text data from news articles or product reviews using web scraping or pre-saved JSON/text files).<br>• **Data Inspection:** Display basic statistics and structure (`.info()`, `.head()`, `.shape()`)., Identify missing values and duplicates in both datasets.<br>• **Data Cleaning:**Handle missing values using imputation (mean/median/mode),Remove or fill duplicate records, Clean unstructured text (remove stopwords, punctuation, etc.).<br>• **Data Transformation:**Normalize or scale numeric columns using MinMaxScaler or StandardScaler.,Encode categorical values using OneHotEncoding or Label Encoding.<br>• **Output:**Compare before and after preprocessing.,Document preprocessing decisions and rationale. | **CO1** | PO1,PO2,PO3 and PSO1,PSO2 |
| 2 | **Feature Engineering, Selection & Data Visualization**<br>**Data Source:**<br>• Use a structured dataset like the **Titanic Dataset** or **California Housing Dataset**.<br>• **Feature Engineering:**<br>• Create new features (e.g., "FamilySize" = "SibSp" + "Parch" in Titanic).<br>• Extract datetime parts if applicable (e.g., year, month from timestamp). | **CO1** | PO1,PO2,PO3 and PSO1,PSO2 |

| | | | |
|---|---|---|---|
| | • **Feature Selection:**<br>  • Use correlation matrix and `SelectKBest` or `RFE` (Recursive Feature Elimination) to select top 5 features.<br>• **Data Visualization:**<br>  • Plot histograms for continuous features.<br>  • Create bar plots for categorical features.<br>  • Generate a heatmap for correlation.<br>  • Use scatter plots or pairplots to observe feature interactions. | | |
| 3 | a)Linear Regression<br>To predict per capita income for 2020, 2022, and 2024 (Refer Dataset of Canada_per_capita_income.csv from kaggle)<br>b) Multiple Linear Regression<br>To predict price of home depending upon area, bedroom, age | CO2 | PO1,PO2,PO3 and PSO1,PSO2 |
| 4 | Logistic Regression<br>To predict fraud from available details of card data (Refer Dataset card_transdata.csv from kaggle) | CO2 | PO1,PO2,PO3,PO4,PO5,PO11,PO12 and PSO1,PSO2 |
| 5 | Implement the concept of K-Nearest neighborhood Algorithm | CO2 | PO1,PO2,PO3,PO4,PO5,PO11,PO12 and PSO1,PSO2 |
| 6 | Implement a program for Decision Tree (Dataset will be provided) | CO2 | PO1,PO2,PO3,PO4,PO5,PO11,PO12 and PSO1,PSO2 |
| 7 | Demonstrate use of Clustering: using k-means algorithm through python program (Dataset will be provided) | CO3 | PO1,PO2,PO3,PO4,PO5,PO11,PO12 and PSO1,PSO2 |
| 8 | Implement the concept of Naïve Bayes Algorithm (Dataset will be provided) | CO2 | PO1,PO2,PO3,PO4,PO5,PO11,PO12 and PSO1,PSO2 |
| 9 | Implemetation og Bagging and Boosting concept: Random forest algo, AdaBoost, XGBoost etc. (Dataset will be provided) | CO4 | PO1,PO2,PO3,PO4,PO5,PO11,PO12 and PSO1,PSO2 |
| 10 | Miniproject based upon above contents (Dataset will be provided) | CO4 | PO1,PO2,PO3,PO4,PO5,PO11,PO12 and PSO1,PSO2 |
| **Practical Beyond Syllabus** | | | |
| | Exploring Virtual Lab | CO1, CO3, CO4 | PO1,PO2,PO3,PO4,PO5,PO6,PO7 , PO11,PO12 and PSO2 |

| Course Title: Operating Systems Fundamentals | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Semester | V | Teaching Scheme | | | | Evaluation Scheme | | | | |
| | | | | | | Theory | | | Practical | |
| Term | ODD | Th | Tu | Pr | Credits | TAE | CAE | ESE | INT | EXT |
| Course Category | PCC7 | 3 | - | - | 3 | 10 | 15 | 50 | - | - |
| Course Code | 23BTDSL302 | | | | | | | | | |
| Duration of ESE | 3 | 3 | | | Total | 75 | | | - | |
| | | | | | | 75 | | | | |

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| **Course Objectives** | Introducing the core concepts, structure, and fundamental functions of an operating system. |
| | Providing insights into basic mechanisms for managing processes, memory, storage devices, and files. |
| | Highlighting recent advancements and emerging trends in operating system technologies. |
| | **Upon successful completion of this course, student will be able to:** |
| **Course Outcomes** | CO1. Understand the fundamental structure and primary purposes of an operating system. |
| | CO2. Understand process concepts and demonstrate various CPU scheduling algorithms. |
| | CO3. Explore the principles of inter-process communication and their applications. |
| | CO4. Analyze deadlock scenarios and outline security mechanisms in operating systems. |
| | CO5. Evaluate different memory management techniques, highlighting their pros and cons. |

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

| Course Outcome | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 1 | 2 | 1 | | | | | | | | | 1 | 1 | 1 |
| **CO2** | 1 | 2 | 2 | 1 | 2 | | | | | | | 1 | 2 | 2 |
| **CO3** | 2 | 2 | 1 | | | | | | | | | 1 | 3 | 2 |
| **CO4** | 2 | 3 | 2 | 1 | | | 1 | | | | | 1 | 3 | 2 |
| **CO5** | 2 | 3 | | | | | | | | | | 1 | 3 | 2 |

| Unit | Contents | Hours |
|---|---|---|
| I | **Introduction**<br>Overview of the development of OS over time, Examining various types such as batch, time-sharing, distributed, and real-time OS, Key hardware requirements to support modern operating systems. Overview of services provided by the OS, including system programs and system calls, Exploring methods for designing and implementing operating systems. Basics of Input/Output systems and their management. | **10** |
| II | **Processes and Scheduling**<br>Understanding the process control block (PCB), context switching, and types of schedulers, Exploring the multithreading model and its applications, Analyzing various CPU scheduling goals and algorithms. | **7** |
| III | **Process Management and Synchronization**<br>Addressing concurrency issues, critical section problems, and their solutions, Using semaphores, conditional critical regions, and monitors, Solving inter-process communication problems like producer-consumer, readers-writers, and dining philosophers. | **8** |
| IV | **Deadlock Management**<br>Definitions, conditions, and characteristics of deadlocks, Techniques for prevention, avoidance, detection, and recovery, Understanding protection mechanisms and access matrix implementation. | **8** |
| V | **Memory Management and File Systems**<br>Exploring contiguous allocation, relocation, paging, and segmentation.<br>Virtual Memory: Concepts like demand paging, page faults, instruction restart, and page replacement algorithms.<br>Performance Optimization: Concepts of working sets, locality of reference, thrashing, and garbage collection.<br>File Systems: File concepts, access methods, space allocation strategies, and disk arm scheduling techniques. Case Study based on above Syllabus | **12** |

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|---|---|---|
| Text Books | 1. | Operating System concepts – Silberchatz; Galvin, Addison Wesley, 6th Edn. |
| | 2. | Modern Operating Systems – Tanenbaum, Pearson Edn. 2ndedn |
| | 3. | Operating Systems: Internals and Design Principles -- WilliamStallings |
| ReferenceBooks | 1. | Operating Systems – S R Sathe, Macmillan Publishers, India,2008 |
| | 2. | Operating System –Milan Milenkovik, McGraw-Hill,1987 |
| | 3. | Operating Systems - 3 rd Edition by Gary Nutt, PearsonEducation. |
| On-line TL | 1. | https://nptel.ac.in/courses/106/108/106108101/ |

| Course Title: Big Data Computing | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Semester | V | Teaching Scheme | | | | Evaluation Scheme | | | | |
| | | | | | | Theory | | | Practical | |
| Term | Odd | Th | Tu | Pr | Credits | TAE | CAE | ESE | INT | EXT |
| Course Category | PCC8 | 2 | -- | 2 | 3 Credits | 10 | 15 | 50 | 25 | - |
| Course Code | 23BTDSL303 23BTDSP303 | | | | | | | | | |
| Duration of ESE | 3 Hrs | 4 | | | Total | 75 | | | 25 | |
| | | | | | | 100 | | | | |

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| **Course Objectives** | Introduce fundamental concepts and techniques of Big Data. |
| | Explore the Hadoop Distributed File System (HDFS) and its practical applications. |
| | Understand the principles of MapReduce, including advanced MapReduce concepts. |
| | Gain insights into various Big Data tools and frameworks. |
| | Develop familiarity with tools like Pig, Hive, and Spark. |
| | **Upon successful completion of this course, student will be able to:** |
| **Course Outcomes** | CO1: Understand foundational concepts and techniques in Hadoop and Big Data computing. |
| | CO2: Develop proficiency in implementing various components of the Hadoop ecosystem. |
| | CO3: Apply knowledge of the ecosystem to solve real-world problems of moderate complexity. |
| | CO4: Design and implement solutions using different Big Data frameworks. |
| | CO5: Utilize data science techniques and Big Data analysis across diverse applications. |

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

| Course Outcomes | Program Outcomes and Program Specific Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | 3 | 2 | 3 | 3 | 3 | - | - | - | - | 2 | 2 | - | - | 2 |
| CO2 | 3 | 2 | 3 | 3 | 3 | - | - | - | - | 2 | - | - | - | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 2 | 2 |
| CO4 | 3 | 3 | 3 | 2 | 3 | - | - | - | - | 3 | 2 | - | 2 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | - | 3 |

| Unit | Contents | Hours |
|---|---|---|
| I | **Big Data and Hadoop**<br>Introduction to Hadoop and Big Data, challenges in processing Big Data, technologies enabling Big Data, history and evolution of Hadoop, Hadoop use cases, comparison of RDBMS and Hadoop, when to use and when not to use Hadoop. | 6 |
| II | **HDFS**<br>Hadoop Distributed File System: significance and features of HDFS, data storage in HDFS (blocks, data replication), accessing HDFS via Command Line Interface (CLI), admin commands, and Java-based approaches, fault tolerance in HDFS. Setting up Hadoop: downloading, installation, and configuration, start-up and shutdown processes. | 6 |
| III | **MapReduce**<br>Introduction to MapReduce: its story and architecture; how MapReduce works; developing MapReduce applications; programming model of MapReduce; phases of the MapReduce algorithm; data types in MapReduce. | 6 |
| IV | **Pig and Hive**<br>Overview of Apache Pig: comparison with MapReduce, modes of execution, loading data, and Pig Latin commands.<br>Introduction to Hive: architecture, data types, schemas, partitions, and buckets. Overview of HBase: concepts and use cases. | 6 |
| V | **Spark and Recent Trends**<br>Introduction to Spark: Spark shell, Spark applications.<br>Introduction to Flume and Sqoop: applications and significance.<br>Discussion on recent trends in Big Data computing and emerging technologies. | 6 |

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| Text Books | 1. | Tom White, "Hadoop: The Definitive Guide", 3rd edition, O'Reilly Media. |
| | 2. | Big Data (Black Book), Wiley |
| E--Books | 1. | BigData Now current perspective from O'Reilly Media |
| | 2. | Data-Intensive Text Processing with MapReduce, Jimmy Lin and Chris Dyer |
| Reference Books | 1. | V. Ankam, Big Data Analytics, Packt Pub Ltd. |
| | 2. | N. Dasgupta, Practical Big Data Analytics, Packt Pub Ltd. |
| online TL Material | 1. | https://www.udemy.com/big-data-hadoop-the-complete-course/ |
| | 2. | https://www.cloudera.com/more/training/certification.html |
| | 3. | https://www.edureka.co/big-data-and-hadoop |
| | 4. | https://www.simplilearn.com/big-data-and-analytics/big-data-and-hadoop-training |

## LIST OF PRACTICAL

| **Name of Subject: Big Data Computing** | **Sem: V** |
|---|---|
| **COURSE OUTCOME** | |
| CO1 | Understand foundational concepts and techniques in Hadoop and Big Data computing. |
| CO2 | Develop the ability to implement and work with various components of the Hadoop ecosystem. |
| CO3 | Apply ecosystem knowledge to address real-world problems of moderate complexity. |
| CO4 | Leverage data science methods and Big Data analytics to solve problems across a range of real-world applications. |

| **Sr. no.** | **Practical List** | **Mapping with CO** | **Mapping with PO & PSO** |
|---|---|---|---|
| 1 | Install the Hadoop framework, configure it, and set up a single-node cluster. Utilize web-based tools to monitor the Hadoop setup. | CO1,CO2 | PO1,PO2,PO3 and PSO1,PSO2 |
| 2 | Perform file management tasks in Hadoop HDFS, such as adding, retrieving, and deleting files. | CO1,CO2 | PO1,PO2,PO3,PO4,PO5,PO11,PO12 and PSO1,PSO2 |
| 3 | Implement a Word Count application using the MapReduce API. | CO1,CO2 | PO1,PO2,PO3,PO4,PO5,PO11,PO12 and PSO1,PSO2 |
| 4 | Create HDFS tables and load them into Hive. Implement operations such as joining tables in Hive. | CO3,CO4 | PO1,PO2,PO3,PO4,PO5,PO11,PO12 and PSO1,PSO2 |
| 5 | Install, deploy, and configure an Apache Spark cluster. Use Spark SQL to select fields from a dataset and explore the Spark shell while reading data from HDFS. | CO1,CO2 | PO1,PO2,PO3,PO4,PO5,PO11,PO12 and PSO1,PSO2 |
| 6 | Install and run Apache Pig. Write Pig Latin scripts to perform data operations like sorting, grouping, joining, projecting, and filtering. | CO3 | PO1,PO2,PO3,PO4,PO5,PO11,PO12 and PSO1,PSO2 |
| 7 | Conduct graph analytics and visualization using Tableau for enhanced insights. | CO4,CO5 | PO1,PO2,PO3,PO4,PO5,PO11,PO12 and PSO1,PSO2 |
| 8 | Implement basic functions and commands in R programming for visualization tasks, providing better representation than traditional data tables | CO4,CO5 | PO1,PO2,PO3,PO4,PO5,PO11,PO12 and PSO1,PSO2 |
| 9 | Use the following platforms to solve a Big Data analytic problem of your choice:<br>Amazon Web Services (AWS)<br>Microsoft Azure<br>Google App Engine | CO5 | PO1,PO2,PO3,PO4,PO5,PO11,PO12 and PSO1,PSO2 |
| **Practical Beyond Syllabus** | | | |
| 10 | Run a Hadoop job on a cloud platform | CO3,CO4 | PO1,PO2,PO3,PO4,PO5,PO6,PO7 , PO11,PO12 and PSO2 |

| Course Title : Principles of Object-Oriented Programming | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Semester** | **V** | **Teaching Scheme** | | | | **Evaluation Scheme** | | | | |
| | | | | | | **Theory** | | | **Practical** | |
| Term | ODD | Th | Tu | Pr | Credits | TAE | CAE | ESE | INT | EXT |
| Course Category | PEC-1 | 3 | - | 2 | 4 | 10 | 15 | 50 | 25 | - |
| Course Code | 23BTDSL311<br>23BTDSP311 | | | | | | | | | |
| Teaching Mode | Offline | 5HRS | | | Total | 75 | | | 25 | |
| Duration of ESE | 3 hrs | | | | | 100 | | | | |

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| Course Objectives | The objective of this course is to familiarize the prospective engineers with: |
| | 1. Understand fundamentals of Object-Oriented Programming (OOP) Concept and OOP-based software development methodologies. |
| | 2. To implement object-oriented programming techniques in software development using Java. |
| | **Upon successful completion of this course, student will be able to:** |
| Course Outcomes | **CO1**: Understand, and differentiate the Object Oriented concepts and Java Programming concepts. |
| | **CO2**: Apply object-oriented concepts to real-time scenarios. |
| | **CO3**: Design Exception handling and multithreading mechanisms to create efficient software applications. |
| | **CO4**: Analyse modern tools and collection frameworks to create Java applications to solve real-world problems. |
| | **CO5**: Design and develop GUI-based applications using swings javafx for real life applications. |

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcome**

| Course Outcome | Program Outcomes and Program Specific Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 |
| CO1 | 2 | 2 | 1 | 3 | 2 | | | | | | | | 2 | 2 |
| CO2 | 2 | 3 | 2 | 2 | 2 | | | | 2 | | | | 2 | 1 |
| CO3 | 3 | 3 | 2 | 2 | 2 | | | | 2 | | | | 2 | 2 |
| CO4 | 3 | 2 | 2 | 2 | 2 | | | | | | 2 | | 2 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | | | | | | 2 | 3 | 3 | 3 |

| UNIT | CONTENTS | HOURS |
|---|---|---|
| I | Introduction to Java: Basics of Java programming, Data types, Variables, Operators, Control structures including selection, Looping, Java methods, Overloading, Math class, and Arrays in java.<br>CONCEPTS OF CLASSES AND OBJECTS: Introducing methods, Method overloading, Constructors, Constructor overloading, Usage of static with data and method, Access control, this key word, Garbage collection, String class, String Tokenizer. | 10 |
| II | Inheritance basics, Types of inheritance, Member access rules, Usage of super keyword, Method overriding, Usage of final, Abstract classes, Interfaces - differences between abstract classes and interfaces, defining an interface, implementing interface, applying interfaces, variables in interface and extending interfaces; Packages - defining, creating and accessing a package, importing packages, access control in packages. | 8 |
| III | Collection framework: Collections Overview, Collection Interfaces - List, Set, Map, List - ArrayList, Linked List, Vector, Set - HashSet, TreeSet, Map - HashTable, HashMap, Accessing a collection via an Iterator, comparator, comparable. | 8 |
| IV | Exception handling: Concepts of exception handling, Types of exceptions, Usage of try, catch, throw, throws and finally keywords, Built-in exceptions, Creating user defined exception;<br>MULTITHREADING: Concepts of multithreading, Differences between process and thread, Thread life cycle, Creating multiple threads using Thread class and Runnable interface, Synchronization, Thread priorities, Inter thread communication. | 10 |
| V | GUI programming with swing:<br>Exploring swing controls: JLabel and Image Icon, JText Field, JButton, JCheckBox, JRadioButton, JTabbed Pane, JList, JCombo Box, Javafx | 9 |

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|---|---|
| Text Books | Object-Oriented Programming in C++: by Robert Lafore |
| | Java: The Complete Reference: by Herbert Schildt |
| Reference Books | Java Programming for Problem Solving: Subrata Saha and Satish Jain<br>Head First Java: Kathy Sierra and Bert Bates |
| e-Books/Online resource | https://greenteapress.com/wp/think-java/<br>https://math.hws.edu/javanotes/ |

## LIST OF PRACTICAL

| Name of Subject: Pricipal of object oriented Programming | | Sem: V |
|---|---|---|
| **COURSE OUTCOME** | | |
| CO1 | Implement and differentiate fundamental object-oriented programming concepts in Java through coding exercises. | |
| CO2 | Develop Java programs applying object-oriented principles to solve real-time problems. | |
| CO3 | Implement exception handling and multithreading techniques to build robust and efficient Java applications. | |
| CO4 | Utilize modern tools, APIs, and collection frameworks to develop Java programs addressing real-world scenarios. | |
| CO5 | Design and build GUI-based Java applications using Swing and JavaFX for practical, real-life use cases. | |

| Sr. no. | Practical List | Mapping with CO | Mapping with PO & PSO |
|---|---|---|---|
| 1 | a) The moons gravity is about 17% that of earth. Write a program that compute effective weight on moon.<br>b) Write program to print first 20 squares i.e upto 400, one per line using for loop.<br>c) Modify 2nd part so that it finds and displays the average of first 20 squares.<br>d) Write program to print various patterns :<br>0<br>1 2<br>3 4 5<br>6 7 8 9 | CO1 | PO1, PO2, PO3 |
| 2 | a) Write program to overload different method in such a way that one of the methods should return square of integer value and other should return cube of double number value.<br>b) Write program with method overloading in such a way that method should find area of rectangle and area of triangle with super keyword.<br>c) Write program for binary search using command line arguments. | CO2 | PO1, PO2, PO3, PO5 |
| 3 | a. Create a user defined package that contains the method to calculate the area of a circle and import this in a program to calculate the area of a circle of any radius.<br>b. Create a user defined package name homebudget which contains home expenditure and Home income class. For both the classes find a suitable data member and its functionality. Define another class where you have to import home budget package and find | CO3 | PO1, PO2, PO3, PO5, PO11 |

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|---|---|---|---|
| | out the total savings of your family. | | |
| 4 | Write a program in JAVA to implement Simple queue using interface. Interface should have two variables Front and Rear, two methods for inserting and deleting the nos. | CO3 | PO1, PO2, PO3, PO5 |
| 5 | Exception Handling:<br>a) Checked, b) unchecked Exception | CO3 | PO1, PO2, PO3, PO5 |
| 6 | Assume that a bank maintains two kinds of account for its customers, one called savings account and the other current account. The current account provides cheque book facility but no interest. Current account holders should also maintain a minimum balance falls below this level; a service charge is imposed.<br>Create a class **Account** that stores customer name, account number and type of account. From this derive the classes **Curr-acct** and **Sav-acct** to make them more specific to their requirement. Include the necessary methods in order to achieve the following tasks:<br>a) Accept deposit from a customer and update the balance.<br>b) Display the balance.<br>c)Compute and deposit interest<br>d)Permit withdrawal and update the balance<br>e) Check for the minimum balance, impose penalty, if necessary, and update the balance.<br>Do not use any constructor. Use methods to initialize the class members | CO2 | PO1, PO2, PO3, PO5, PO9, PO10 |
| 7 | Write a program in java to merge the contents of two files & store it in 3rd file in sorted order. Hint: Use file i/p stream, o/p stream buffered i/p stream & buffered classes. | CO4 | PO1, PO2, PO3, PO5 |
| 8 | a) Write a program in java to demonstrate multithreading in java.<br>b) Write a program in java to print the cosine series using Runnable interface. | CO5 | PO1, PO2, PO3, PO5 |
| 9 | Write a program in java to create GUI application using javafx. | CO5 | PO1, PO2, PO3, PO5, PO10 |
| **Practical Beyond Syllabus** | | | |
| 10 | PROJECT | CO1,CO2,CO3,CO4,CO5 | PO1,PO2,PO3,PO4,PO5,PO6,PO7 , PO11,PO12 and PSO2 |

| Course Title: Next Generation Databases | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Semester | V | Teaching Scheme | | | | Evaluation Scheme | | | | |
| | | | | | | Theory | | | Practical | |
| Term | ODD | Th | Tu | Pr | Credits | TAE | CAE | ESE | INT | EXT |
| Course Category | PEC1 | 3Hrs | - | 2Hrs | 4 | 10 | 15 | 50 | 25 | --- |
| Course Code | 23BTDSL312<br>23BTDSP312 | | | | | | | | | |
| Teaching Mode | Offline | 5Hrs | | | Total | 75 | | | 25 | |
| Duration of ESE | 3 hrs | | | | | 100 | | | | |

| | |
|---|---|
| **Course Objectives** | 1. Learn about the most advanced Database Management Systems on the large volume of unstructured data generated through social media and many other platforms |
| | 2. To make candidates familiarize with No SQL Technology and give some hands-on on one of the most popular No SQL database Mongo DB. |
| **Course Outcomes** | **Upon successful completion of this course, student will be able to:** |
| | **CO1**: Understand the functionalities of No SQL-DB as a document database. |
| | **CO2**: Identify the different types of indexes in No SQL-DB for query execution. |
| | **CO3**: Analyze the different Aggregation commands in No SQL-DB |
| | **CO4**: Evaluate and manage Replication in No SQL-DB. |
| | **CO5**: Implement Backup and restore operations. |

**Mapping of Course Outcomes with Program Outcomes:**

| Course Outcomes | Program Outcomes& Program Specific Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO 2 |
| CO1 | 2 | - | 2 | 3 | 3 | - | - | 2 | - | - | 3 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 2 | - | - | - | - | 3 | 2 | 2 | 2 |
| CO3 | 3 | 3 | 2 | 3 | 3 | 2 | - | - | - | - | 3 | 2 | 2 | 2 |
| CO4 | 3 | 3 | 2 | 3 | 3 | 2 | - | - | - | - | 3 | 2 | 2 | 2 |
| CO5 | 3 | 3 | 2 | 3 | 3 | 2 | - | 2 | - | - | 3 | 2 | 2 | 2 |

| Unit | Contents | Hours |
|---|---|---|
| I | **Introduction to No SQL and Mongo DB :** Introduction to NoSQL Databases, Need of a Database, NoSQL features, Different types of database , Different types of NoSQL, Relational vs. Nonrelational database.<br>Introduction to MongoDB: MongoDB architecture, Data modelling in MongoDB, Advantages of MongoDB over RDBMS, Mongo Shell, Configuration file in MongoDB. | 6 |
| II | **CRUD operation and Indexing**<br>JSON File format for storing documents Introduction to Documents, Collections, Database Commands in Mongodb , Inserting and Saving Documents, Inserting multiple documents<br>CRUD operation: Updating Documents, Removing Documents, Document Replacement, Operator and Modifiers.<br>Indexing in MongoDB, Single index, Finding index, Multikey index. | 8 |
| III | **Aggregation** : Aggregation Framework , Pipeline Operations-: $match, $sort , $group<br>**Pipeline operations**: Pipeline Operations- $project, $unwind, $limit, $skip, MapReduce, Aggregation commands<br>**Database operations**: Backup and restore, Export and import of data, Importing from JSON file, Choosing the right database , Database era, Taking decisions on database, Strengths and weakness of database, Free and open source database. | 10 |
| IV | **Replication:**<br>Replication, Advantages of replication, Implementation of replication, Managing Configuration File in MongoDB, Setting up replica set in MongoDB, Replication configuration, Checking the Configuration, Change replication configuration, Replication status, Remove members, Adding new port in replica set, Terminologies used in replication, Help on replication, Adding arbitrator , Stepping down a member. | 10 |
| V | **Advanced MongoDB :** MongoDB - Relationships, MongoDB - Covered Queries, MongoDB - Analyzing Queries, , MongoDB - Advanced Indexing, MongoDB-MapReduce MongoDB Text Search | 11 |

| | | |
|---|---|---|
| Text Books | 1. | NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Author: Sadalage, P. & Fowler, Publication: Pearson Education. |
| | 2. | PramodSadalage and Martin Fowler, NoSQL Distilled, Addison-Wesley Professional, 2012. |
| | 3 | Dan McCreary and Ann Kelly, Making Sense of NoSQL, Manning Publications, 2013. |
| Reference Books | 1. | Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement by Eric Redmond and Jim R. |

| | | |
|---|---|---|
| | 2. | ShashankTiwari, Professional NoSQL, Wrox Press, Wiley, 2011, ISBN: 978-0-470-94224-6 |
| | 3. | Gaurav Vaish, Getting Started with NoSQL, Packt Publishing, 2013. |
| | 4. | Kristina Chodorow, Shannon Bradshaw, MongoDB: The Definitive Guide, 3rd Ed, O'Reilly Media 2018. |
| Online TL Material | 1. | https://nptel.ac.in/courses/106104135 2 3 |
| | 2. | https://www.coursera.org/learn/nosql-databases |
| | 3 | https://www.edx.org/course/introduction-to-nosql-data-solutions |

## List of Practical:

| **Name of Subject: Next Generation Databases** | **Sem: V** |
|---|---|
| **COURSE OUTCOME** | |
| CO1 | Understand the MongoDB environment, its installation, configuration, and operational interface through Mongo Shell and configuration files. |
| CO2 | Demonstrate the ability to create and manage databases, collections, and documents in MongoDB, including performing CRUD operations and indexing strategies. |
| CO3 | Apply aggregation techniques and backup-restore operations using MongoDB commands such as unwind, skip, limit, and explore data recovery processes. |
| CO4 | |

| **Sr. No.** | **Name of Experiments /Mini Projects/Case Studies** | **CO Mapped** | **PO & PSO Mapped** |
|---|---|---|---|
| 1 | Downloading and Installation of MongoDB<br>Setting path in environment variable. | CO1 | PO1 , PO2, PO5, PSO1 |
| 2 | Identify MongoDB environment using Mongo Shell and Configuration file in MongoDB | CO1 | PO1 , PO2, PO5, PSO1 |
| 3 | Create a database and collection using the MongoDB environment. For example a document collection meant for analyzing Restaurant records can have fields like restaurant_id, restaurant_name, customer_name, locality, date, cuisine, grade, comments. etc | CO2 | PO1 , PO2, PO3, PO4, PO5, PSO1 |
| 4 | A. Create Database , document , collection and apply CRUD operations on it.<br>B. Create index on emp_id in collection emp_professional_details and Create multiple index on emp_id,emp_name in collection emp_professonal details | CO2 | PO1 , PO2, PO3, PO4, PO5, PSO1 |
| 5 | Demonstrate unwind command, skip command, limit command | CO3 | PO1 , PO2, PO3, PO4, PO5, PSO1 |

| | | | |
|---|---|---|---|
| 6 | Create backup of collections, delete some records and then restore them from backup. | CO3 | PO1 , PO2, PO3, PO4, PO5, PSO1 |
| 7 | Study implementation of replication in MongoDB | CO4 | PO1 , PO2, PO3, PO4, PO5, PSO1 |
| 8 | Implement the method to set up MongoDB Replica Set. | CO4 | PO1 , PO2, PO3, PO4, PO5, PSO1 |
| 9 | Implement MongoDB MapReduce | CO5 | PO1 , PO2, PO3, PO4, PO5, PSO1 |
| 10 | Implement MongoDB Text Search | CO5 | PO1 , PO2, PO3, PO4, PO5, PSO1, PSO2 |

| Course Title: Augmented Reality Virtual Reality (ARVR) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Semester | V | Teaching Scheme | | | | Evaluation Scheme | | | | |
| | | | | | | Theory | | | Practical | |
| Term | ODD | Th | Tu | Pr | Credits | TAE | CAE | ESE | INT | EXT |
| Course Category | PEC1 | 3 | - | 2 | 4 | 10 | 15 | 50 | 25 | - |
| Course Code | 23BTDSL313 23BTDSP313 | | | | | | | | | |
| Duration of ESE | 3 Hrs. | 5 Hrs | | | Total | 75 | | | 25 | |
| | | | | | | 100 | | | | |

| | |
|---|---|
| Course Objectives | 1. The objective of this course is to provide a foundation to the fast growing field of AR and AR devices |
| | 2.Introduction to principles of Virtual Reality and learn the concepts of Development of Application in Virtual Reality |
| Course Outcomes | Upon successful completion of this course, student will be able to: |
| | **CO1:** Understand the basic concepts and different applications of Augmented Reality. |
| | **CO2:** Analyze and understand of AR systems work and list the applications of AR |
| | **CO3:** Apply the concept of AR in unity game engine for various applications. |
| | **CO4:** Understand the basic concepts of virtual reality and learn about the technology and psychology of VR and differentiate between VR and AR systems. |
| | **CO5:** Analyze of the concepts of content creation, interaction, and iterative design. |

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

| Course Outcomes | Program Outcomes and Program Specific Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1 | 3 | 3 | | | 2 | | | 2 | | | | | 3 | 3 |
| CO2 | 3 | 3 | 2 | 2 | | | | 2 | | | | | 3 | 3 |
| CO3 | 3 | | 3 | 3 | | 2 | 2 | 2 | | 2 | 2 | 2 | 3 | 3 |
| CO4 | 3 | | 3 | | 2 | | | | | | | 2 | 2 | |
| CO5 | 2 | 3 | 3 | 2 | 2 | | | | | | | 2 | 2 | 3 |

| Unit | Contents | Hours |
|---|---|---|
| I | **Basics of Augmented Reality:** What Is Augmented Reality, Applications, Components, History, Concept of Displays and Tracking (Tracking, Calibration and Registration), AR architecture, Reality Work, Trends, Mobile Augmented Reality | 9 |
| II | **Augmented Reality Hardware:** Hardware – Displays – Audio Displays, Haptic Displays, Visual Displays, Visual Perception, Requirements and Characteristics, Spatial Display Model, Tracking & Sensors - Tracking, Calibration, and Registration, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors, Optical Tracking | 9 |
| III | **Augmented Reality in Unity :** Game Loops and Functions, Simple Movement, and Input: Simple Movement, Simple Rotation and Scaling, Easy Input Handling in Unity,2D and 3D Physics Concepts: Rigid body Components, Unity Colliders, Physics Materials, Scripting Collision Events, Organizing Game Objects, Parent-Child Objects, Sorting Layers, Tagging Game Objects, Collision Layers | 9 |
| IV | **Introduction to virtual reality:** Introduction, Types of head-mounted displays, Difference VR and AR, Applications versus games, VR working, Types of VR experiences, technical skills that are important to VR**.** | 8 |
| V | **Virtual Reality System :** High-Level Concepts of Content Creation, Environmental Design, Affecting Behavior, Transitioning to VR Content Creation, Content Creation: Design Guidelines, Human-Centered Interaction, VR Interaction Concepts, Input Devices, Interaction Patterns and Techniques, Interaction: Design Guidelines | 10 |

| | | |
|---|---|---|
| **Text Books** | 1 | Augmented Reality for Developers by Jonathan Linowes, Krystian Babilinski, Released October 2017 Publisher(s): Packt Publishing,ISBN: 9781787286436 |
| | 2. | Jason Jerald- The VR Book: Human- Centered Design for Virtual Reality, Association for Computing Machinery and Morgan & Claypool Publishers (Aug. 5 2016), ISBNB01JV1LAZW |
| | 3. | Jonathan Linowes – Unity Virtual Reality Projects: Explore the world of virtual reality by building immersive and fun VR projects using Unity 3D Paperback‖, 1st Edition, Packt Publications, 2015, ISBN 978- 1783988556 |
| **Other Books** | 1. | Augmented Reality with Unity AR Foundation: A practical guide to cross-platform AR development with Unity 2020 and later versions, by Jonathan Linowes |
| | 2. | Tony Parsi, Learning Virtual Reality Developing Immersive Experiences and Applications for Desktop, Web and Mobile |
| on line TL Material | 1. | IIT Delhi: https://iitvirtualrealitycourse.com/iit-delhi-executive-programme-in-virtual-and-augmented-reality |
| | 2 | NPTEL-Foundation Course on Virtual Reality and Augmented Reality; IIT Madras Duration: 7 weeks https://elearn.nptel.ac.in/shop/iit-workshops/completed/foundation-course-on-virtual-reality-and-augmented-reality |

## LIST OF PRACTICAL

| Name of Subject: Augmented Reality Virtual Reality (ARVR) | Sem: V |
|---|---|
| | |

**The list of practicals will align with the syllabus mentioned above.**

| Course Title: Data Visualization through POWERBI | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Semester** | | **Teaching Scheme** | | | | **Evaluation Scheme** | | | | |
| | | | | | | **Theory** | | | **Practical** | |
| Term | ODD | Th | Tu | Pr | Credits | TAE | CAE | ESE | INT | EXT |
| Course Category | MD3 | 3 | -- | 2 | 4 | 10 | 15 | 50 | 25 | - |
| Course Code | 23BTDSL304<br>23BTDSP304 | | | | | | | | | |
| ESE exam | 3 hrs. | 5 hrs. | | | TOTAL | 75 | | | 25 | |
| | | | | | | 100 | | | | |

| | |
|---|---|
| **Course Objectives** | Understanding the Power BI interface and navigation and Connecting to various data sources |
| | Creating and formatting visualizations, such as charts, tables, and maps. |
| | Creating interactive dashboards and reports. |
| | Understand Best practices for data modeling and data visualization. |
| | **Upon successful completion of this course, student will be able to:** |
| **Course Outcomes** | CO1: Understand key components of Power BI, including its interface, data connectors, and visualization tools. |
| | CO2: Understand the process of importing, transforming, and preparing data for visualization in Power BI. |
| | CO3: Apply Power BI tools to create interactive dashboards and reports by applying data visualization techniques. |
| | CO4: Analyze complex datasets using Power BI's DAX (Data Analysis Expressions) and query editor to derive insights. |
| | CO5: Design and publish customized Power BI dashboards to effectively communicate data-driven stories tailored to specific business needs. |

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

| **Course Outcomes** | **Program Outcomes and Program Specific Outcomes** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| **CO1** | 3 | 3 | 3 | 2 | 2 | | | | | | | | 3 | |
| **CO2** | 3 | | | 3 | 3 | | | | | | | | | 3 |
| **CO3** | 2 | 3 | 2 | | 3 | | | | | | | | | 3 |
| **CO4** | 3 | | 3 | | 2 | 3 | | | | | | | 3 | 3 |
| **CO5** | 3 | 2 | 3 | 3 | 3 | 1 | 3 | | | | | 3 | 2 | 3 |

| Unit | Contents | Hours |
|---|---|---|
| I | **Introduction:**<br>Introduction to Business intelligence concept. Various tools and techniques in BI. Why we Need BI? Components and stages in Power BI. Overview of Power Bi Desktop Understanding the Power BI interface and navigation. | 9 |
| II | **Power BI Desktop (Power Query)**<br>Loading and transforming the data, combine, append, merge the data, Column operations add column, Transform, Custom Function split, trim operations, Group By concept. Custom column, conditional column. Text function, Number Function and Date Function | 9 |
| III | **Basic Visuals in Power BI**<br>Introduction to Basic Charts, Creating Column Chart, Bar chart, stacked chart, Pie Chart, Donut Chart, Funnel Chart, Ribbon Chart, Line Chart, Area Chart, Scatter Plot, Waterfall chart, Tree Map, Gauge Chart, Tables and Matrix, Number Card, Text card, Date card. Formatting the chart.<br>Creation and doing basic setting for map, creating filled map, shape map, Formatting of Map in Power BI | 9 |
| IV | **Advance Charts and visuals in Power BI**<br>Introduction to Slicers a filter in Power BI. Insert toolbar for image, text box, shapes and buttons. Creating AI visuals.<br>Introduction to advanced visuals and power BI service.<br>Introduction to DAX function. | 10 |
| V | **Capstone project: - Creating report page or dashboard.** | 8 |

| | |
|---|---|
| **Text Books** | Mastering Microsoft Power BI: Expert techniques for effective data analytics and business intelligence by Brett Powell |
| | The Definitive Guide to DAX: Business Intelligence for Microsoft Power BI by Marco Russo, Alberto Ferrari Alberto Ferrari |
| **Reference Books** | Microsoft Power BI Quick Start Guide, Devin Knight |
| | Microsoft Power BI Dashboards Step by Step 1st Edition by Errin O'Connor |
| **OnlineTL Material** | Training - Microsoft Learn- Power BI - Power BI for business users - Power BI \| Microsoft Learn |

## List of Practical:

| Sr. No. | Name of Experiments | PO | PSO |
|---|---|---|---|
| 1 | Introduction to interface of Power BI with various data file import and creating basic charts. | PO1,PO2,PO3,PO4 ,PO5,PO6 | PSO1,PSO2 |
| 2 | To transform, clean dataset using power query editor. | PO1,PO2,PO3,PO4 ,PO5,PO6 | PSO1,PSO2 |
| 3 | To create basic visuals of Power BI – (at least 6 visuals) | PO1,PO2,PO3,PO4 ,PO5,PO6 | PSO1,PSO2 |
| 4 | To create and set up the map visuals in Power BI | PO1,PO2,PO3,PO4 ,PO5,PO6 | PSO1,PSO2 |
| 5 | To use slicers and filters in report page. | PO1,PO2,PO3,PO4 ,PO5,PO6 | PSO1,PSO2 |
| 6 | To use DAX function | PO1,PO2,PO3,PO4 ,PO5,PO6 | PSO1,PSO2 |
| 7 | To use insert features in visualization | PO1,PO2,PO3,PO4 ,PO5,PO6 | PSO1,PSO2 |
| 8 | To create report page for specific dataset (dashboard creation) | PO1,PO2,PO3,PO4 ,PO5,PO6,PO7, PO12 | PSO1,PSO2 |
| **Open Ended Experiments** | | | |
| 1 | Case study-real data | PO7, PO12 | PSO1,PSO 2 |
| 2 | Case study-real data-KAGGLE ETC | PO7, PO12 | PSO1,PSO2 |
| **Details of on line Laboratory Resource Material Instruction / Operating Manuals** | | | |
| 1. | https://learn.microsoft.com/en-gb/training/modules/get-started-with-power-bi/ | | |

| **Course Title: Soft Computing Techniques** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Semester | V | Teaching Scheme | | | | Evaluation Scheme | | | | |
| | | | | | | Theory | | | Practical | |
| Term | ODD | TH | TU | PR | Credits | TAE | CAE | ESE | INT | EXT |
| Course Category | OE3 | 2 | - | - | 2 | 10 | 15 | 50 | - | - |
| Course Code | 23BTDSL305 | | | | | | | | | |
| Duration of ESE | 3 | 2 hrs. | | | Total | 75 | | | -- | |
| | | | | | | 75 | | | | |

| | |
|---|---|
| Course Objectives | 1. To give fundamentals of non-traditional technologies and approaches for solving artificial neural networks, fuzzy sets and fuzzy logic. |
| | 2. To introduce Soft computing application areas particularly to intelligent systems. |
| | 3. To introduce soft computing techniques and promote their abilities in designing and implementing soft computing based solutions for real-world problems. |
| | 4. To introduce the concept of Training for verification and recognition applications |
| Course Outcomes | **Upon successful completion of this course, student will be able to:** |
| | CO1: Understand the basics of hard and soft computing applications. |
| | CO2: Uunderstand of the McCulloch-Pitts model, perceptron, and their learning procedures. |
| | CO3: Understand and apply the principles of fuzzy logic. |
| | CO4: Apply Genetic algorithm based applications for real world world applications. |
| | CO5: Design the real world applications using hybrid models |

| Course Outcomes | Program Outcomes and Program Specific Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | 2 | 2 | 1 | 1 | 1 | | | | | | | | 1 | 2 |
| CO2 | 3 | 3 | 2 | 2 | 3 | | | | | | | | 1 | 2 |
| CO3 | 2 | 2 | 3 | 3 | 3 | | | | | | | 1 | 1 | 1 |
| CO4 | 2 | 2 | 3 | 3 | 3 | | | | | | | 2 | 2 | 3 |
| CO5 | 2 | 2 | 3 | 3 | 3 | | | | | | | 2 | 2 | 3 |

| Unit | Contents | Hours |
|---|---|---|
| I | Definition and need for soft computing, Hard computing vs. soft computing, Applications of soft computing in various domains, Introduction to Neural Networks: Biological vs. artificial neural networks, Activation functions. Basics of artificial neural networks, Characteristics of neural networks,<br>Model of neuron, McCulloch Pitts model | 5 |
| II | Basic learning laws, Learning in ANN: Supervised learning, Unsupervised learning, Reinforced learning, Competitive learning, The delta rule, Gradient descent rule, unsupervised learning: Hebbian learning, Supervised learning: Perceptron learning, Delta Rule, Backpropagation learning algorithm - mathematical analysis, Application and criticism. | 7 |
| III | **Fuzzy Logic Fundamentals:** Fuzzy sets and operations, Membership functions, Fuzzy relations and composition, Fuzzy rule-based systems, Fuzzy inference systems (Mamdani and Sugeno approaches), Fuzzification and defuzzification methods, **Applications of Fuzzy Logic** | 6 |
| IV | Basics of GA: Chromosome, population, fitness function, selection, crossover, mutation, GA workflow and operators, Advantages and limitations of GA, Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), Differential Evolution (DE) | 6 |
| V | Hybrid Soft Computing Techniques, Neuro-fuzzy systems, Genetic-neural systems, Fuzzy-genetic systems, Applications of Hybrid Systems, Robotics, medical diagnosis, and financial forecasting | 6 |

| | | |
|---|---|---|
| **Text Books** | 1. | Introduction to Artificial Neural Networks: M. Zurada, 3rd Edition, Jaico Publishers. |
| | 2. | Understanding Neural Networks and Fuzzy Logic, Basic Concepts and Applications: Stamatios V. Kartalopoulos, PHI . |
| | 3. | Fuzzy Sets Uncertainty and Information : George Klir, PHI . |
| **Reference Books** | 1. | Neural Networks and Fuzzy System : B.Kosko, PHI |
| | 2. | Neural Networks, Algorithms, Application and Programming Techniques : J.P.Freeman & David M. Skapura, Pearson. |
| | 3. | Fuzzy Neural Control, Principles, Algorithms and Applications : Junhong Nie & Derek Linkens, PHI. |

| Course Title : Machine learning Using TensorFlow | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Semester** | **V** | Teaching Scheme | | | | Evaluation Scheme | | | | |
| | | | | | | Theory | | | Practical | |
| Term | ODD | Th | Tu | Pr | Credits | TAE | CAE | ESE | INT | EXT |
| Course Category | OE3 | 2 | - | - | 2 | 10 | 15 | 50 | - | - |
| Course Code | 23BTDSL306 | | | | | | | | | |
| Teaching Mode | Offline | 2 | | | Total | 75 | | | - | |
| Duration of ESE | 3 hrs | | | | | 75 | | | | |

| | |
|---|---|
| Course Objectives | The objective of this course is to familiarize the prospective engineers with: |
| | 1. Establish and cultivate a broad and comprehensive understanding of Important library used for Machine Learning Algorithms. |
| | 3. Summarize the aspects for betterment of existing technology using machine learning |
| Course Outcomes | CO1: Understand fundamental of Machine learning and learning methods. . |
| | CO2: Apply the machine learning concept using Tensor. |
| | CO3: Apply the pre-processing steps to make data usable using TensorFlow. . |
| | CO4: Apply encoding techniques on time series data. |
| | CO5: Use prediction feature with TensorFlow. |

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes**

| Course Outcome | Program Outcomes and Program Specific Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 |
| CO1 | 2 | 2 | 3 | 3 | 3 | | | | | | | | 2 | 2 |
| CO2 | 2 | 3 | 2 | 2 | 3 | | | | | | | | 2 | 1 |
| CO3 | 3 | 3 | 2 | 2 | 3 | | | | | | | | 2 | 2 |
| CO4 | 3 | 2 | 2 | 2 | 2 | | | | | | | | 2 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | | | | | | | | 3 | 3 |

| UNIT | CONTENTS | HOURS |
|---|---|---|
| I | **Getting started with machine learning:** Introduction to Machine learning, Fundamentals of Machine learning, Types of Machine Learning, Ensemble methods, technical classification of ensemble approach. | 6 |
| II | **Introduction to Tensor flow:** Tensor and its types, creating operators, executing operators with sessions, understanding code as a graph, setting session configurations, variables, Saving and loading variables, Visualizing data using Tensor Board. | 6 |
| III | **Loading and Pre-processing Data with Tensor Flow** The Data API, Chaining Transformation, Shuffling the data, Pre-processing the data, prefetching, using the data with TF. Keras, TF record format, compressed TF record files. | 6 |
| IV | **Data Encoding**: Types of encoding, Categorical Features, Crossed Categorical Features, Encoding Categorical Features Using One- Hot Vectors, Encoding Categorical Features Using Embedding, Using Feature Columns for Parsing, Using Feature Columns in Models. | 5 |
| V | **Prediction using time series Data:** Time Series data, type of time series data, Errors, types of errors, Train, tune and use time series, sequence and prediction models. Train models to predict values for both univariate and multivariate time series. | 7 |

| | |
|---|---|
| **Text Books** | 1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems |
| | 2. Deep Learning with TensorFlow 2 and Keras Regression, ConvNets, GANs, RNNs, NLP, and More with TensorFlow 2 and the Keras API, 2nd Edition |
| **Reference Books** | 1. TensorFlow Machine Learning Cookbook: Explore machine learning concepts using the latest numerical computing library - TensorFlow - with the help of this comprehensive cookbook<br>2. Python Machine Learning by Example - Third Edition: Build intelligent systems using Python, TensorFlow 2, PyTorch, and scikit-learn |
| **e-Books/Online resource** | 1. https://onlinecourses.nptel.ac.in/noc19_cs81/preview<br>2. www.tensorflow.org |

| **Course Title: Research Methodology** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Semester | V | Teaching Scheme | | | | Evaluation Scheme | | | | |
| | | | | | | Theory | | | Practical | |
| Term | Odd | Th | Tu | Pr | Credits | TAE | CAE | ESE | INT | EXT |
| Course Category | RM | -. | - | 4 Hrs | 2 | - | - | - | 25 | - |
| Course Code | 23BTSHP301 | | | | | | | | | |
| Teaching Mode | Offline | 4Hrs | | | Total | | | | 25 | |
| Duration of ESE | - | | | | | 25 | | | | |

| | |
|---|---|
| Course Objectives | 1. To understand the role of research methodology in Engineering. |
| | 2. To understand data collection methods and basic instrumentation. |
| | 3. To learn various statistical tools for data analysis. |
| | 4. To develop the ability to apply statistical tools and techniques. |
| | 5. To provide knowledge on sampling design. |
| Course Outcomes | CO1: Understand the role of research methodology in Engineering |
| | CO2: Apply appropriate techniques for data collection |
| | CO3: Analyze collected data using editing, classification, coding, and quantitative methods |
| | CO4: Apply statistical methods for data analysis |
| | CO5: Evaluate sampling designs and apply suitable sampling techniques |

**Mapping of Course Outcomes with Program Outcomes**

| Course Outcomes | Program Outcomes and Program Specific Outcomes | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | | 3 | | 3 | | | | | | | | | | | |
| CO2 | | 3 | | 3 | 1 | | | | | | | | | | |
| CO3 | | 3 | 3 | 3 | 2 | | | | | | | | | | |
| CO4 | | | | 3 | 1 | | | | | | | | | | |
| CO5 | | 3 | | 3 | | | | | | | 2 | | | | |

| Unit | Contents | Hours |
|---|---|---|
| I | **Introduction to Research**: Definition of research, Characteristics of research, Types of research- Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, Overview of research methodology in various areas, Introduction to problem solving, basic research terminology such as proof, hypothesis, lemma etc., Role of Information and Communication Technology(ICT) in research. | 6 |
| II | **Data Collection:** Primary Data: Meaning, Importance & limitations.,, Observation , Questionnaire, Interview, Interview Scheduled<br>Social Survey, Case Study Secondary Data: Meaning, Importance& limitations. Sources Secondary Data. | 6 |
| III | **Data Analysis And Use Of Quantitative Method**: Editing, Classification and Coding. Categorization, Tabulation, Tables, Graphs, Illustrations. Use of quantitative method in research. | 6 |
| IV | **Data Analysis And Use Of Statistical Method:** Statistical Techniques: Measures of Central tendency, Dispersion, Skewness, Kurtosis & Moments, Correlation, Regression. Theory of Attributes & Association, chi squareTest & Distribution. | 6 |
| V | **Sampling Design:** Census and sample survey, Characteristics of good sample design, Implications of sample design, Sampling Techniques, Probability or random sampling, Non-probability sampling | 6 |

| | | |
|---|---|---|
| Text Books | 1 | Ranjit Kumar, "Research Methodology: A Step by Step Guide for Beginners", SAGE Publications Ltd., 2011. |
| | 2 | C.R. Kothari ,"Research Methodology: Methods and Trends",<br>New Age International,2004 |
| | 3 | Gupta S.C, Fundamentals of Statistics, Himalaya Publication House, Bombay Rajaram V.<br>(1996), |
| E--Books | 1 | Wayoc C. Booth : The Craft of Research |
| | 2 | David Willinson : Research Tools Kits : A Complete Guide to Practitioner Research |
| Reference Books | 1 | Wayne Goddard, Stuart Melville, "Research Methodology: An Introduction" JUTA and Company Ltd, 2004. |
| on line TL Material | 1 | http:// www.shodhaganga.inflibnet.ac.in |
| | 2 | http:// www.inflibnet.ac.in. |
| | 3 | http:// www.zotero.org |

| Sr. No. | Name of Experiments / Mini Projects/ Case Studies (Any 8) |
|---|---|
| 1 | Report writing explaining importance of research.(CO1) |
| 2 | To collect data using two different methods. (CO2) |
| 3 | Performing literature review, identifying gaps (CO3) |
| 4 | Design simple sampling method for survey(CO3) |
| 5 | Raw data coding and classification(CO3) |
| 6 | Formulation of hypothesis based on collected data (CO3) |
| 7 | Using bar graphs, pie charts for interpreting findings(CO4) |
| 8 | Project proposal that includes problem identification.(CO5) |
| 9 | Ethical consideration in research methodology.(CO5) |

**Rubrics**
**For 25 internal marks**

| Attendance | Submission | Final Oral presentation/Viva Voce | Total Marks |
|---|---|---|---|
| **5** | **10** | **10** | **25** |