TULSIRAMJI GAIKWAD-PATIL College of Engineering & Technology

Mohgaon, Wardha Road, Nagpur - 441 108

An Autonomous Institute

DEPARTMENT OF DATA SCIENCE

Teaching Scheme & Syllabus

From

Academic Year 2023-24

Vision of Institute

To emerge as a learning Center of Excellence in the National Ethos in domains of Science, Technology and Management.

Mission of Institute

- To strive for rearing standard and stature of the students by practicing high standards of professional ethics, transparency and accountability.
- To provide facilities and services to meet the challenges of Industry and Society.
- To facilitate socially responsive research, innovation and entrepreneurship.
- To ascertain holistic development of the students and staff members by inculcating knowledge and profession as work practices.

Vision of the Department

To achieve excellent standards of quality-education by creating Data Science Engineers who are empowered with latest tools and technologies to provide customer-oriented innovations to industry towards serving the greater cause of society.

Mission of the Department

- To develop professionals who are skilled in the area of Data Science
- To undertake industry academic collaboration to enhance competency in graduates.
- To foster innovative ideas amongst students for becoming leaders.
- To create an environment of research culture.
- To impart social and ethical values for inculcating the culture of lifelong learning.

Program Education Objectives (PEO)

- Acquire fundamental knowledge of mathematics, science and engineering to analyze, design and implement solutions to the Data Science problems
- Understand emerging concepts and trends in Data Science.
- Apply Data Science tools to develop innovative computational systems.
- The students are encouraged to develop the habit of lifelong learning to face the challenges.
- The students will be embedded as a responsible individual having ethical and social values to lead the society and to nurture team spirit.

Program Outcomes (PO)

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and software tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Lifelong learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Program Specific Outcomes (PSO)

PSO-1: Visualize, curate, and prepare data for use with a variety of statistical/AI methods and models and recognize how the quality of the data and the means of data collection may affect conclusions.

PSO-2: Ability to use modern software packages and scalable computing infrastructure to formulate problems, identify and gather relevant existing data, and analyze the data to provide insights

PSO-3: Utilize contemporary computing technologies, such as machine learning, AI, parallel and distributed computing, to solve practical problems characterized by large-scale data.

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SCHEME OF INSTRUCTION & SYLLABI

Programme: Data Science

Scheme of Instructions: Second Year B. Tech. in Data Science

Semester – III

Sr. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME				
									CT-1	CT-2	TA/CA	ESE	TOTAL
1	BSC	BDS2301	Applied Mathematics-III	3	-	-	3	3	15	15	10	60	100
2	PCC	BDS2302	Internet of Things	3	_	-	3	3	15	15	10	60	100
3	PCC	BDS2303	Introduction To Data Science	3	-	-	3	3	15	15	10	60	100
4	PCC	BDS 2304	Data Structures and Algorithms	3	-	-	3	3	15	15	10	60	100
5	PCC	BDS2305	Internet of Things Lab	-	-	2	2	2	-	-	25	25	50
6	PCC	BDS 2306	Object Oriented Programming with C++ Lab	-	-	2	4	2	-	-	25	25	50
7	PCC	BDS 2307	Data Structures and Algorithms Lab	-	-	2	2	1	-	-	25	25	50
8	PCC	BDS 2308	Introduction To Data Science Lab	-	-	2	4	1	-	-	25	25	50
9	HSMC	BSH2301	Human Values for Professional Society	3	-	-	3	3	15	15	10	60	100
10	PCC	BDS2309	Data Preprocessing lab	-	-	2	4	2	-	-	25	25	50
11	MCC	BAU2303	Environmental Science	2	-	-	2	Audit	-	-	-	-	-
			Total	**17**	**0**	**10**	**33**	**23**	**75**	**75**	**175**	**425**	**750**

L- Lecture T-Tutorial P-Practical CT1- Class Test 1 CT2- Class Test 2 TA/CA- Teacher Assessment/Continuous Assessment
ESE- End Semester Examination (For Laboratory End Semester performance)

Course Category	HSMC (Hum., Soc. Sc, Mgmt.)	BSC (Basic Sc.)	ESC (Engg. Sc.)	PCC (Programme Core Courses)	PEC (Programme Elective Courses)	OEC (Open Elective coursesfrom other discipline)	Project /Seminar / Industrial Training	MCC (Mandatory Courses)
Credits	3	03	00	17	--	--	--	--
Cumulative Sum	6	21	14	17	--	--	--	--

PROGRESSIVE TOTAL CREDITS :35+23=58

27/09/2023
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SCHEME OF INSTRUCTION & SYLLABI

Programme: Data Science

Scheme of Instructions: Second Year B. Tech. in Data Science

Semester – IV

Sr. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME				
									CT-1	CT-2	TA/CA	ESE	TOTAL
1	BSC	BDS 2401	Mathematics in Data Science	3	1	-	4	4	15	15	10	60	100
2	PCC	BDS2402	Operating System Concepts	3	-	-	3	3	15	15	10	60	100
3	PCC	BDS 2403	Formal Languages and Automata	3	-	-	3	3	15	15	10	60	100
4	PCC	BDS2404	Database Management Systems	3	-	-	2	2	15	15	10	60	100
5	PCC	BDS2405	Design & Analysis of Algorithms	3	-	-	3	3	15	15	10	60	100
6	PCC	BDS2406	Machine Leaning Algorithms	3	-	-	3	3	15	15	10	60	100
7	PCC	BDS2407	Machine Leaning Algorithms Lab	-	-	2	2	1	-	-	25	25	50
8	PCC	BDS408	Database Management Systems Lab	-	-	2	2	1	-	-	25	25	50
9	PCC	BDS2409	Mini Project	-	-	2	2	1	-	-	25	25	50
10	PCC	BAU2404	Data Analysis Using R	-	-	2	2	Audit	-	-	-	-	-
11	MCC	BAU2405	Group Reading of Classics	2	-	-	2	Audit	-	-	-	-	-
			Total	**20**	**01**	**08**	**28**	**21**	**90**	**90**	**135**	**435**	**750**

L- Lecture T-Tutorial P-Practical CT1- Class Test 1 CT2- Class Test 2 TA/CA- Teacher Assessment/Continuous Assessment

ESE- End Semester Examination (For Laboratory End Semester performance)

Course Category	HSMC (Hum., Soc. Sc, Mgmt.)	BSC (Basic Sc.)	ESC (Engg. Sc.)	PCC (Programme Core courses)	PEC (Programme Elective courses)	OEC (Open Elective courses from other discipline)	Project / Seminar / Industrial Training	MCC (Mandatory Courses)
Credits	--	04	-	17	--	--	--	
Cumulative Sum	9	25	14	34	--	--	--	--

PROGRESSIVE TOTAL CREDITS :58+21

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Semester	Course Code	Name of Course
III	BDS2301	Applied Mathematics-III

Pre-Requisites: Mathematics – I, Mathematics – II

Teaching Scheme	
Lectures	4Hrs/week
Tutorial	1Hrs/week
Total Credit	5

Examination Scheme	
CT-1	15 Marks
CT-2	15 Marks
TA	10 Marks
ESE	60 Marks
Total	100 Marks
Duration of ESE: 03Hrs 00Min.	

Course Objective:

1	To make the students aware of the numerical methods for the solution of scientific problems which cannot be solved analytically.
2	To introduce Fourier Transform, Z Transform and its applications in the field of Engineering.
3	Equipping students with essential tools for statistical analyses at the graduate level
4	To improve the student's skills in numerical methods by using the numerical analysis software and computer facilities.

Course Contents

Unit I	**Laplace Transform**: Definition, Properties, Laplace Transform of Derivatives and Integrals, Evaluation of integrals by Laplace Transform, Inverse Laplace Transform and its Properties, Convolution theorem (Statement only), Applications of Laplace Transform to solve Ordinary Differential Equations, Simultaneous Differential Equations, Integral Equations & Integro-Differential Equations.
Unit II	**Probability and Probability Distributions**: Probability, Theorems on Probability, Bayes theorem, Random variables, Mathematical Expectation, Probability density function, Probability distributions: Binomial, Poisson, Normal and Hyper geometric, Sampling distributions, Test of Hypothesis: Chi-Square test, t-test.
Unit III	**Numerical Methods:** Numerical Solution of Algebraic and Transcendental equations: Bisection, Secant, Regula-Falsi, Newton–Raphson and Successive Approximation Methods, Convergence and Stability. Numerical Solutions of System of linear equations: Gauss elimination, LU Decomposition, Cholesky, Jacobi and Gauss-Seidel Methods.
Unit IV	**Interpolation**: Bound of truncation error. Solution of Ordinary differential equations: Euler's, Modified Euler's, Runge-Kutta 4th order methods and Predictor-Corrector methods **Statistics**: Measures of central tendency, Measures of dispersion, Coefficient of variation, Moments, Skewness and Kurtosis, Curve fitting: fitting of straight line, parabola and related curves, Correlation and Regression, Reliability of Regression Estimates.
Unit V	**Fourier Transform (FT):** Fourier transform, Fourier Sine & Cosine transforms and their inverses, Discrete Fourier Transform Convergence of Z-transform and Properties, Inverse Z-transform by Partial Fraction Method, Residue Method (Inversion Integral Method) and Power Series Expansion, Convolution of two sequences. Solution of Difference Equation with Constant Coefficients by Z-transform method.

Text Books

1	Higher Engineering Mathematics by B.S. Grewal, 40th Edition, Khanna Publication
2	Advanced Engineering Mathematics by Erwin Kreysizig, 8th Edition, Wiley India

3	Applied Mathematics for Engineers & Physicist by L.R. Pipes and Harville.
Reference Books	
1	A Text Book of applied Mathematics, Volume II , by P.N. Wartikar& J.N. Wartikar, Poona Vidyarthi Griha Prakashan
2	Introductory methods of Numerical Analysis, by S.S. Sastry, PHI
Useful Links	
1	https://nptel.ac.in/courses/117/106/117106034/
2	https://nptel.ac.in/courses/108108076/
3	https://nptel.ac.in/courses/108105062/

Course Outcomes		**CL**	**Class Session**
After the completion of this course, students will be able to-			
BDS2301.1	**Understands** concept Laplace transformation	2	9
BDS2301.2	**Describe** Random Variables & Probability Distributions, mathematical Expectation and its different methods and probability distributions	2	9
BDS2301.3	**Examine** the error and evaluate the solution of different type of equations.	1	9
BDS2301.4	**Analyze** the co-relation between variables and find analytical solution of different equations.	4	9
BDS2301.5	**Understand** the function & expansions of Fourier and Z transform	2	9

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Semester	Course Code	Name of Course
III	BDS2302	Internet of Things

Teaching Scheme		Examination Scheme	
Lectures	3Hrs/week	**CT-1**	15 Marks
Tutorial	1Hrs/week	**CT-2**	15 Marks
Total Credit	3	**TA**	10 Marks
		ESE	60 Marks
		Total	100 Marks
		Duration of ESE: 03Hrs 00Min.	

Course Objective:

1.	To enable students to understand scope of Internet of things in Industry.
2.	To introduce the concept of Internet of things.
3.	To develop and apply Advance method for implementation of Internet of Things.

Course Contents

Unit I	**Architecture of IoT:** Introduction of IoT, Introduction Industry 4.0, Need of IoT for Industry 4.0, Block Diagrams of IoT System, Virtual Private server and IoT Cloud, Application Programming Interface (API)
Unit II	**Development of Things using Arduino Platform:** Introduction of IoT Node with Sensor and Actuator, Interface sensors &devices, Node MCU and ESP 32 Wi-Fi Microcontroller, Network: LORA, NRF, Xbee, IoT Gateway.
Unit III	**Communication protocol:** Introduction of Internet Protocol, Internet Layer: IP Transport layer-TCP, UDP , Application Layer- HTTP, MQTT, FTP, CoAP, SPDY.
Unit IV	**IoT Platform and Application:** Customized IoT Platform using Virtual Private Server, Amazon Alexa, Google API, Blynk, Cayenne, Things board, Things speak
Unit V	**IoT Clouds and data analytics:** RESTful web API, Amazon web services for IoT, Apache Hadoop, Batch data analysis. **IoT Application:** Case studies: smart cities, smart homes, connected vehicles, Industrial IoT

Text Books

1	Samuel Greengard ,The Internet of Things" by Samuel Greengard
2	Klaus Schwab ,The Fourth Industrial Revolution" by Klaus Schwab Author
3	CunoPfister Author: CunoPfister ,Getting started with Internet of Things

Reference Books

1	CunoPfister, Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud (Make: Projects) 2018
2	Adrian McEwen , Designing the Internet of Things Kindle Edition

Useful Links

1	NPTEL :: Computer Science and Engineering - NOC:Introduction to internet of things
2	https://www.youtube.com/watch?v=tb5SEdgmz4g
3	Lecture 1.2: IoT Devices - What Is the Internet of Things (IoT)? | Coursera

Course Outcomes		CL	Class Session
After the completion of this course, students will be able to-			
BDS2302.1	**Analyze** various IoT devices and its technology.	4	9
BDS2302.2	**Select** and use of appropriate IoT technologies & Gateways protocols for application development.	5	9
BDS2302.3	**Design** and development of IoT application with the use of different cloud technology.	6	9
BDS2302.4	**Design** and study of IoT application on the IoT platforms.	6	9
BDS2302.5	**Design** and apply IoT in application with the use of different cloud technology.	6	9

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Semester	Course Code	Name of Course
III	BDS2303	Introduction to Data Science

Teaching Scheme		Examination Scheme	
Lectures	3Hrs/week	**CT-1**	15 Marks
Tutorial	1Hrs/week	**CT-2**	15 Marks
Total Credit	3	**TA**	10 Marks
		ESE	60 Marks
		Total	100 Marks
		Duration of ESE:03Hrs 00Min.	

Course Objective:

1	An understanding of problems solvable with data science and an ability to understand them from a statistical perspective.
2	The ability to create data analytical pipelines and applications in Python.

Course Contents

Unit I	**Introduction to Data Science** Evolution of Data Science, Data Science Roles, Stages in a Data Science Project, Applications of Data Science in various fields, Data Security Issues. Architecture of data, data acquisition.
Unit II	**Data Collection and Data Pre-Processing** Data Collection Strategies, Data Pre-Processing Overview, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization.
Unit III	**Exploratory Data Analytics** Descriptive Statistics, Mean, Standard Deviation, Skewness and Kurtosis, Box Plots, Pivot Table, Heat Map, Correlation Statistics, ANOVA
Unit IV	**Model Development** Simple and Multiple Regression, Model Evaluation using Visualization, Residual Plot, Distribution Plot, Polynomial Regression and Pipelines, Measures for In-sample Evaluation, Prediction and Decision Making, Feature Engineering
Unit V	**Model Evaluation** Generalization Error, Out-of-Sample Evaluation Metrics, Cross Validation, Overfitting, Under Fitting and Model Selection, Prediction by using Ridge Regression, Testing Multiple Parameters by using Grid Search

Text Books

1	JojoMoolayil, “Smarter Decisions : The Intersection of IoT and DataScience”, PACKT, 2016.
2	Cathy O’Neil and Rachel Schutt , “Doing Data Science”, O'Reilly, 2015
3	David Dietrich, Barry Heller, Beibei Yang, “Data Science and Big data Analytics”, EMC 2013
4	Raj, Pethuru, “Handbook of Research on Cloud Infrastructures for Big Data Analytics”, IGI Global.

Reference Books

1	“A Hands on Introduction to Data Science”, Chirag Shah, Cambridge University, Press
2	“Essential Math for Data Science”, Thomas Nield

Useful Links

1	https://www.youtube.com/watch?v=-ETQ97mXXF0
2	https://www.youtube.com/watch?v=KdgQvgE3ji4&list=PL9ooVrP1hQOFZ1W2m8zYMxUiQhHywHxYm
3	https://www.youtube.com/watch?v=5-h5er6SLlk

Course Outcomes		CL	Class Session
After the completion of this course, students will be able to-			
BDS2303.1	**Understand** basic concepts of data science and key issues.	2	9
BDS2303.2	**Understand** data collection and data pre-processing.	2	9
BDS2303.3	**Apply** statistical analytics on datasets.	3	9
BDS2303.4	**Implement** regression models on datasets.	5	9
BDS2303.5	**Implement** model evaluation and validation of datasets.	5	9

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Semester	Course Code	Name of Course
III	BDS2304	Data Structures and Algorithms

Pre-Requisites: Basics of C Programming

Teaching Scheme	
Lectures	3Hrs/week
Tutorial	1Hrs/week
Total Credit	3

Examination Scheme	
CT-1	15 Marks
CT-2	15 Marks
TA	10 Marks
ESE	60 Marks
Total	100 Marks
Duration of ESE:03Hrs 00Min.	

Course Objective:

1.	This course introduces basic idea of data structure while making aware of methods and structure used to organize large amount of data.
2.	It's also aimed at developing skill to implement methods to solve specific problems using basic data structures.
3.	The course also provides career opportunities in design of data, implementation of data, technique to sort and searching the data.

Course Contents

Unit I	Introduction –Common operations on data structures, Types of data structures, Data structures & Programming, Program Design, Complexities, Time Complexity, order of Growth, Asymptotic Notation. Sorting and Searching Introduction, Sorting, Insertion Sort, Selection Sort, Merging, Merge- Sort, Shell Sort, Radix Sort, Searching and Data Modification, Hashing
Unit II	Arrays :Introduction, Linear Arrays, Arrays as ADT, Representation of Linear array in Memory, Traversing Linear Arrays, Inserting and deleting, Sorting; Bubble Sort, Searching; Linear Search, Binary Search, : Linked List Introduction, Linked Lists, Representation of Linked Lists in Memory, Traversing a Linked List, Searching a Linked List, Memory Allocation; Garbage Collection, Insertion into a Linked List, Deletion from a Linked List, Header Linked List, Circularly Linked Lists, Two-Way Lists (or Doubly Linked Lists).
Unit III	Stacks, Queue and Recursion-Introduction, Stacks ,Array Representation of Stacks ,Linked Representation of Stacks, Stack as ADT, Arithmetic Expression; Polish Notation, Application of Stacks, Recursion, Towers of Hanoi, Implementation of Recursive Procedures by Stacks, Queue, Linked Representation of Queues, Queues as ADT, Circular Queues, Deques, Priority Queues, Applications of Queues
Unit IV	Trees and Binary Trees -Binary Trees • Representation, Operations: Insert, Delete, Traversal: Preorder, Inorder, Postorder, Traversal Algorithms Using Stacks, Header Nodes; Threads, Threaded Binary Trees, Binary Search Trees ,Searching and Inserting in Binary Search Trees, Deleting in a Binary Search Tree, Balanced Binary Trees, AVL Search Trees, Insertion in an AVL Search Tree, Deletion in an AVL Search Tree, B-way Search Trees ,Searching, Insertion and Deletion in an m-way Search tree, B-Trees ,Searching, Insertion and Deletion in a B-tree,B+-Trees Graph Algorithms
Unit V	Graphs and their Applications: Introduction, Graph Theory terminology, Sequential Representation of Graphs, Adjacency Matrix; Path Matrix, Linked Representation of a Graph, Operations on Graphs, Traversing a Graph, Posets; Topological Sorting, Spanning Trees

Text Books

1	AVAho, J Hopcroft, JD Ullman, Data Structures and Algorithms, Addison- Wesley, 1983.
2	THCormen, CF Leiserson, RL Rivest, C Algorithms, 3rd Ed., MIT Press, 2009.

Reference Books	
1	Data Structures & Algorithms, 1e, Alfred V.Aho, Jeffery D. Ullman , Person.
2	MT Goodrich, R Tamassia, DM Mount, Data Structures and Algorithmsin Java, 5th Ed., Wiley, 2010. (Equivalent book in C also exists.)
3	Wirth, N., "Algorithms and Data Structures", Prentice-Hall of India.
Useful Links	
1	https://nptel.ac.in/courses/106/102/106102064/
2	http://cse01-iiith.vlabs.ac.in/
3	https://ds2-iiith.vlabs.ac.in/data-structures-2/

Course Outcomes		CL	Class Session
After the completion of this course, students will be able to-			
BDS2304.1	**Categorize** essential data structures and understand when it is appropriate to use.	4	9
BDS2304.2	**Analyze** use of Abstract data types & ways in which ADTs can be stored, accessed and manipulated	4	9
BDS2304.3	**Apply** linear data structures to solve various real-world computing problems using programming language**.**	3	9
BDS2304.4	**Analyze** standard algorithms for searching and sorting	4	9
BDS2304.5	**Implement** linear data structure to find solution for given Engineering applications.	5	9

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Semester	**Course Code**	**Name of Course**
III	BDS2305	Internet of thing Lab

Teaching Scheme		**Examination Scheme**	
Practical	2 Hrs/week	**CA**	25 Marks
Total Credit	1	**ESE**	25 Marks
		Total	50 Marks
		Duration of ESE: 02 Hrs 00 Min.	

Sr. No.	**List of Experiment**	**COs**
1	To perform programming for Interfacing Node MCU to Cloud Things board	CO1
2	To perform programming for sending DHT Temperature sensor data to cloud.	CO1
3	To perform programming for control home appliance using Node MCU controller and cloud.	CO2
4	Design and inter face Water level indicator using Node MCU controller	CO2
5	Perform Raspberry PI program to interface of network device [Wi-Fi, GSM, GPRS] for device communication	CO3
6	Design and Perform digital Notice Board Application Using Raspberry pi3MegaBoardusingNodeMCU.	CO4
7	Design and Perform smart Garbage indication system using Node MCU controller and GLCD.	CO4
8	Design and Perform IOT Based Agriculture monitoring system using WifiESP8266[Think speak Cloud]	CO5
9	Project Module 6: Perform Automatic Plant Irrigation controlling System using Node MCU and Cloud	CO5
10	Open Ended Experiment	CO5

Text Books	
1	Samuel Greengard, The Internet of Things" by Samuel Greengard
2	Klaus Schwab, The Fourth Industrial Revolution "by Author: Klaus Schwab
3	Cuno Pfister Author: Cuno Pfister , Getting started with Internet of Things
Reference Books	
1	Cuno Pfister, Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud(Make: Projects)2018
2	Adrian Mc Ewen, Designing the Internet of Things Kindle Edition
Useful Links	
1	https://www.youtube.com/watch?v=APH6Nrar27w
2	https://www.youtube.com/watch?v=tb5SEdgmz4g
3	https://www.youtube.com/watch?v=APH6Nrar27w

Course Outcomes		CL	Lab Sessions
After the completion of this course, students will be able to-			
BDS2305.1	**Analyze** various IoT devices and its technology.	4	4
BDS2305.2	**Select** and use of appropriate IoT technologies & Gateways protocols for application development.	5	4
BDS2305.3	**Design** and development of IoT application with the use of different cloud technology.	6	4
BDS2305.4	**Design** and study of IoT application on the IoT platforms.	6	4
BDS2305.5	**Design** and apply IoT in application with the use of different cloud technology.	6	4

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Semester	Course Code	Name of Course
III	BDS2306	Object Oriented Programming with C++ Lab

Pre-Requisites: C Language

Teaching Scheme		Examination Scheme	
Practical	2 Hrs/week	**CA**	25 Marks
Total Credit	1	**ESE**	25 Marks
		Total	50 Marks
		Duration of ESE: 02 Hrs 00 Min.	

Sr. No.	List of Experiment	COs
1	Derive a program to sort a list of numbers in ascending order.	CO1
2	Write C++ programs that illustrate how the following forms of inheritance are supported: a)Single inheritance b)Multiple inheritance c)Multi level inheritance d)Hierarchical inheritance	CO1
3	Write a program Illustrating Class Declarations, Definition, and Accessing Class Members.	CO1
4	Implement a C++ program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.	CO2
5	Design a C++ program to find the sum of individual digits of a positive integer.	CO2
6	Program to illustrate default constructor, parameterized constructor and copy constructors	CO3
7	Write a Program to Demonstrate the i) Operator Overloading. ii) Function Overloading.	CO4
8	Write a Program to Demonstrate Friend Function and Friend Class.	CO4
9	Write a Program Containing a Possible Exception. Use a Try Block to Throw it and a Catch Block to Handle it Properly.	CO5
10	Write a C++ program to implement the matrix ADT using a class. The operations supported by this ADT are: a) Reading a matrix. b) Addition of matrices. c) Printing a matrix. d) Subtraction of matrices. e) Multiplication of matrices	CO5

Text Books

1	Object Oriented Programming with C++ by Balagurusamy
2	C++, the Complete Reference, 4th Edition, Herbert Schildt, TMH.
3	Matt Weisfeld, “The Object-Oriented Thought Process”, Pearson

Reference Books

1	C++ Primer, 3rd Edition, S.B.Lippman and J.Lajoie, Pearson Education.
2	The C++ Programming Language, 3rd Edition, B.Stroutstrup, Pearson Education.

Useful Links

1	https://nptel.ac.in/courses/106/102/106102064/
2	http://cse01-iiith.vlabs.ac.in/
3	https://ds2-iiith.vlabs.ac.in/data-structures-2/

Course Outcomes		CL	Lab Sessions
After the completion of this course, students will be able to-			
BDS2306.1	**Understand** how to apply the major object-oriented concepts to implement object-oriented programs in C++.	2	4
BDS2306.2	**Summarize** the relative merits of C++ as an object-oriented programming language.	2	4
BDS2306.3	**Develop** how to apply the major object-oriented concepts to implement object.	6	4
BDS2306.4	**Apply** how to produce object-oriented software using C++.	3	4
BDS2306.5	**Analyze** advanced features of C++ specifically stream I/O, templates and operator overloading.	4	4

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Semester	Course Code	Name of Course
III	BDS2307	Data Structures and Algorithms Lab

Pre-Requisites: Basics of C Programming

Teaching Scheme		Examination Scheme	
Practical	2 Hrs/week	**CA**	25 Marks
Total Credit	1	**ESE**	25 Marks
		Total	50 Marks
		Duration of ESE: 02 Hrs 00 Min.	

Sr. No.	List of Experiment	COs
1	Write a program that uses functions to perform the following operations on singly linked list i)Creation ii)Insertion iii)Deletion iv)Traversal.	CO1
2	Write a program that uses functions to perform the following operations on doubly linked list i)Creation ii)Insertion iii) Deletion iv)Traversal.	CO1
3	Write a program that uses functions to perform the following operations on circular linked List i)Creation ii)Insertion iii)Deletion iv)Traversal.	CO2
4	Write a program that implement stack (its operations) using i)Arrays ii)Linked list(Pointers).	CO2
5	Write a program that implement Queue(its operations)using i)Arrays ii)Linked list(Pointers).	CO3
6	Write a program that implement Circular Queue using arrays. Write a program that uses both recursive and non recursive functions to perform the following searching operations for a Key value in a given list of integers: a)Linear search b)Binary search.	CO3
7	Write a program that implements the following sorting i)Bubble sort ii)Selection sort iii)Quick sort.	CO4
8	Write a program that implements the following i)Insertion sort ii)Merge sort iii)Heap sort.	CO4
9	Write a program to implement all the functions of a dictionary(ADT)using Linked List.	CO5
10	Write a program to perform the following operations: Insert an element in to a binary search tree. Delete an element from a binary search tree. Search for a key element in a binary search tree.	CO5

Text Books

1	Data Structures with C by SEYMOUR LIPSCHUTZ [TMH].
2	Data Structure using C by ISRD Group [TMH].
3	Introduction to Data Structure in C by Ashok N. Kamthane [Pearson].

Reference Books

1	Data Structure through C by G. S. BALUJA [Dhanpat Rai & co.].
2	Data structures using C and C++ by Tenenbaum [Pearson].
3	Data structures Pseudocode with C by Gilberg/Foruzen, Cengage Learning

Useful Links

1	https://nptel.ac.in/courses/106/102/106102064/
2	https://nptel.ac.in/courses/106/106/106106127/
3	https://nptel.ac.in/courses/106/103/106103069/

Course Outcomes		CL	Class Session
After the completion of this course, students will be able to-			
BDS2307.1	**Categorize** essential data structures and understand when it is appropriate to use.	4	9
BDS2307.2	**Analyze** use of Abstract data types & ways in which ADTs can be stored, accessed and manipulated	4	9
BDS2307.3	**Apply** linear data structures to solve various real-world computing problems using programming language**.**	3	9
BDS2307.4	**Analyze** standard algorithms for searching and sorting	4	9
BDS2307.5	**Implement** linear data structure to find solution for given Engineering applications.	5	9

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Semester	Course Code	Name of Course
III	BDS2308	Introduction of Data Science Lab

Teaching Scheme		Examination Scheme	
Practical	2 Hrs/week	**CA**	25 Marks
Total Credit	1	**ESE**	25 Marks
		Total	50 Marks
		Duration of ESE: 02 Hrs 00 Min.	

Sr. No.	List of Experiment	COs
1	Perform and implement various control structures in Python	**CO1**
2	Apply the data frames in python for data reading, preparation and pre-processing.	**CO1**
3	Perform the analysis of various dataset and plot histogram on it.	**CO2**
4	Study and Implement various clustering models on data sets	**CO2**
5	Study and Implement Polynomial Regression with Python Implementation	**CO3**
6	To Implement Stock market prediction using python	**CO3**
7	Introduction of Num Pie.	**CO4**
8	Introduction of Panda	**CO4**
9	Case Study-1	**CO5**
10	Mini Project/ Case study	**CO5**

Text Books

1	CathyO 'Neiland Rachel Schutt,“ Doing Data Science”, O'Reilly,2015
2	Raj, Pethuru, “Handbook of Research on Cloud Infrastructures for Big Data Analytics”, IGIGlobal.

Reference Books

1	Jojo Moolayil, “Smarter Decisions: The Intersection of IoT and DataScience”,PACKT,2016.
2	David Dietrich, Barry Heller, Beibei Yang, “Data Science and Big data Analytics”, EMC 2013

Useful Links

1	https://www.youtube.com/watch?v=X3paOmcrTjQ
2	https://www.youtube.com/watch?v=-ETQ97mXXF0
3	https://www.youtube.com/watch?v=uswU1s3M2VE

Course Outcomes		CL	Lab Sessions
After the completion of this course, students will be able to-			
BDS2308.1	**Understand** basic concepts of data science and key issues	2	4
BDS2308.2	**Understand** data collection and pre-processing	2	4
BDS2308.3	**Apply** statistical analytics on datasets	3	4
BDS2308.4	**Implement** regression models on datasets.	5	4
BDS2308.5	**Implement** model evaluation and validation of datasets.	5	4

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Semester	Course Code	Name of Course
III	BSH2301	Human Values for Professional Society

Teaching Scheme		Examination Scheme	
Lectures	3Hrs/week	**CT-1**	15 Marks
Tutorial	1Hrs/week	**CT-2**	15 Marks
Total Credit	3	**TA**	10 Marks
		ESE	60 Marks
		Total	100 Marks
		Duration of ESE:03Hrs 00Min.	

Course Objective:

1.	Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence
2.	Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence

Course Contents

Unit I	**Course Introduction - Need, Basic Guidelines, Content and Process for Value Education:** Purpose and motivation for the course, Self-Exploration, Continuous Happiness and Prosperity, Right understanding relationship and physical facility, Understanding happiness and prosperity correctly, method to fulfil the above human aspiration.
Unit II	**Understanding Harmony in the Human Being - Harmony in Myself!** Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body', Understanding the Body as an instrument of 'I', Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body.
Unit III	**Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship** Understanding values in human-human relationship, Understanding the meaning of Trust, Understanding the meaning of Respect, Understanding the harmony in the society, Visualizing a universal harmonious order in society
Unit IV	**Understanding Harmony in the Nature and Existence - Whole existence as Coexistence** Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature, Understanding Existence as Co-existence, Holistic perception of harmony
Unit V	**Implications of the above Holistic Understanding of Harmony on Professional Ethics** Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in professional ethics, Strategy for transition from the present state to Universal Human Order: a) At the level of individual, b) At the level of society.

Text Books

1	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books,New Delhi, 2010

Reference Books

1	JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
2	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3	The Story of Stuff (Book)
4	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.
5	Small is Beautiful - E. F Schumacher.
6	Slow is Beautiful - Cecile Andrews

7	Economy of Permanence - J C Kumarappa
8	Rediscovering India - by Dharampal
9	Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
10	India Wins Freedom - Maulana Abdul Kalam Azad
11	Vivekananda - Romain Rolland (English)

Course Outcomes		CL	Class Session
After the completion of this course, students will able to-			
BSH2301.1	**Understand** the contents and process for value education.	2	9
BSH2301.2	**Understand** harmony in the Human Being and harmony in Myself.	2	9
BSH2301.3	**Understand** harmony in the Family and Society- Harmony in Human-Human Relationship.	2	9
BSH2301.4	**Understand** harmony in the Nature and Existence - Whole existence as Coexistence.	2	9
BSH2301.5	**Apply** implications of the Holistic Understanding of Harmony on Professional Ethics.	3	9

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Semester	Course Code	Name of Course
III	BDS2309	Data Preprocessing Lab

Teaching Scheme		Examination Scheme	
Practical	2 Hrs/week	**CA**	25 Marks
Total Credit	1	**ESE**	25 Marks
		Total	50 Marks
		Duration of ESE: 02 Hrs 00 Min.	

Sr. No.	List of Experiment	COs
1	Implementation of Basic Python Libraries	CO1
2	Find out missing data in dataset	CO1
3	Perform the Categorization of dataset	CO2
4	Execute feature scaling on given dataset	CO2
5	Implement normalization on dataset	CO3
6	Perform proper data labeling operation on dataset	CO3
7	Implement principal component analysis algorithm	CO4
8	Perform Encoding categorical features on given dataset	CO4
9	Apply the appropriate Binarization methods on given dataset	CO5
10	Perform the Standardization operation on dataset	CO5

Text Books

1	Data pre-processing The Ultimate Step-By-Step Guide, Gerardus Blokdyk
2	M. Shron, O'Reilly, Thinking with Data: How to Turn Information into Insights, Publisher: O'Reilly Media, 2014
3	T. Fawcett and F. Provost , Data Science for Business: What you Need to Know about Data Mining and Data Analytic Thinking, Publisher: O'Reilly Media, 2013

Reference Books

1	Ralph Kimball, Margy Ross, The Data Warehouse Toolkit, 3rd edition, Publisher: Wiley, 2013
2	J. Han, M. Kamber and J.Pei, Morgan Kaufmann, Data Mining, Concepts and Techniques, Publisher: Elsevier, 2006

Useful Links

1	http://www.prolearninghub.com/courses/data-warehouse-concepts-designdata-integration/
2	https://www.youtube.com/watch?v=j0tqUBhs-Nc

Course Outcomes		CL	Lab Sessions
After the completion of this course, students will be able to-			
BDS2309.1	**Understand** data using Statistical tools and techniques.	2	4
BDS2309.2	**Apply** appropriate techniques for Data Cleaning.	3	4
BDS2309.3	**Apply** Feature Scaling , Data Labeling techniques.	3	4
BDS2309.4	**Analyze** data through graph plots.	4	4
BDS2309.5	**Apply** the data pre-processing techniques on real world datasets.	3	4

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Semester	Course Code	Name of Course
III	BAU2303	Environmental Studies

Teaching Scheme		Examination Scheme	
Lectures	2 Hrs/week	**CT-1**	-
Tutorial	1Hrs/week	**CT-2**	-
Total Credit	Audit	**TA**	-
		ESE	50 Marks
		Total	50 Marks
		Duration of ESE:03Hrs 00Min.	

Course Contents

Unit I	Natural Resources: Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Energy resources: Growing energy needs, use of alternate energy sources. Forest resources: Use and over-exploitation, deforestation, mining, dams and their effects on forest. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources.
Unit II	Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers. Energy flow in the ecosystem, Ecological succession. Food chains, food webs and ecological Pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems .
Unit III	Environmental Pollution: Definition, Cause, effects and control measures of: a. Air pollution, b. Water pollution, c. Noise pollution, d. nuclear hazards. E-Solid waste Management: Causes, effects and control measures of urban and industrial wastes

Text Books	
1	Ecology and Environmental Science, Rana S.V.S, PHI Learning Private Ltd
2	Environmental Science and Engineering, Anjali Bagad, PHI Learning Private Ltd.
3	Environmental Science, Fundamentals, Ethics & Laws, Shulka, Ashish &Others,I. K. International P. Ltd.
Reference Books	
1	Environmental Science and Demystified, William Linda, Tata MCgraw Hill
2	Essential of Ecology and Environmental Science, Rana SVs, Prentice Hall Of India
3	Environmental Pollution Control Engineering, C S Rap, New Age International Publishers
Useful Links	
1	https://youtu.be/NRoFvz8Ugeo
2	https://youtu.be/iMSwvJhlIA8
3	http://youtu.be/els4M2OGO

Course Outcomes		CL	Class Session
After the completion of this course, students will be able to-			
BAU2303.1	**Examine** natural resources and their importance.	1	8
BAU2303.2	**Illustrate** energy flow in the ecosystem	3	8
BAU2303.3	**Predict** the causes of environmental pollution and preventive measures.	5	8

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