MULTIDISCIPLINARY COURSES COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE) [OFFERED TO OTHER DEPARTMENTS]											
Semester	**Category**	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**No. of Credits**
				L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
III	MD	BTDS25MD304A	Java Programming	3	0	0	20	20	60	100	3
	MD	BTDS25MD304B	Introduction to Data Science	3	0	0	20	20	60	100	3
IV	MD	BTDS25MD404A	Analysis and Design of Algorithms	3	0	0	20	20	60	100	3
	MD	BTDS25MD404B	Computer Organization and Architecture	3	0	0	20	20	60	100	3
V	MD	BTDS25MD505A	Machine Learning	3	0	0	20	20	60	100	3
		BTDS25MD509AL	Machine Learning Laboratory	0	0	2	50	0	50	100	1
	MD	BTDS25MD505B	Cyber Security	3	0	0	20	20	60	100	3
		BTDS25MD509BL	Cyber Security Laboratory	0	0	2	50	0	50	100	1
VI	MD	BTDS25MD606A	Database Management System	2	0	0	20	20	60	100	2
	MD	BTDS25MD606B	Human Computer Interaction	2	0	0	20	20	60	100	2
VII	MD	BTDS25MD705A	Deep Learning	2	0	0	20	20	60	100	2
	MD	BTDS25MD705B	IOT and implementation in Industry	2	0	0	20	20	60	100	2

LIST OF COURSES B.Tech Honors - COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE) [Swayam / NPTEL]										
Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**No. of Credits**
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
HO	BTDS25HO333	Statistical Learning for Reliability Analysis https://onlinecourses.nptel.ac.in/noc22_cs120/preview	3	0	0	20	20	60	100	3
HO	BTDS25HO444	Artificial Intelligence: Search Methods for Problem Solving https://onlinecourses.nptel.ac.in/noc20_cs81/preview	3	0	0	20	20	60	100	3
HO	BTDS25HO555	Cloud Computing for Data Science https://onlinecourses.nptel.ac.in/noc21_cs14/preview	3	0	0	20	20	60	100	3
HO	BTDS25HO666	Algorithmic Graph Theory and Data Structures https://onlinecourses.nptel.ac.in/noc26_cs08/preview	3	0	0	20	20	60	100	3
HO	BTDS25HO777	Business Intelligence & Analytics https://onlinecourses.nptel.ac.in/noc24_cs65/preview	3	0	0	20	20	60	100	3
HO	BTDS25HO888	Software Project Management https://onlinecourses.nptel.ac.in/noc19_cs70/preview	3	0	0	20	20	60	100	3

ADDITIONAL CRITERIA FOR DOUBLE MINOR (SPECIALIZATION)										
Category under NEP	Course Code	Course Title	Teaching Scheme			Evaluation Scheme			No. of Credits	
			L	T	P	CA	MSE	ESE	Total	
DMS	BTDS25DMS333	Data Structure and Algorithms	3	0	0	20	20	60	100	3
DMS	BTDS25DMS444	Analysis and Design of Algorithms	3	0	0	20	20	60	100	3
DMS	BTDS25DMS555	Software Testing and Quality Assurance	3	0	0	20	20	60	100	3
DMS	BTDS25DMS666	Data Analytics and Visualizations	3	0	0	20	20	60	100	3
DMS	BTDS25DMS777	Natural Language Processing	3	0	0	20	20	60	100	3
DMS	BTDS25DMS888	Big Data Analytics	3	0	0	20	20	60	100	3

ADDITIONAL CRITERIA FOR HONORS WITH RESEARCH										
Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				No. of Credits
			L	T	P	CA	MSE	ESE	Total	
HR	BTME25HR777	Research Project Stage 1	--	--	18	--	--	100	100	9
HR	BTME25HR888	Research Project Stage 2	--	--	18	--	--	100	100	9

GUIDELINES FOR THE HONOUR WITH RESEARCH PROJECT

- The purpose of this course is to introduce students to the process of conducting research projects/work.
- The students will be helped to conceptualize, design and execute a research project by a guide/supervisor.

Research Project Stage-1:

- Learners will be encouraged to read books and research journals related to his/her research topic to do a literature review and identification of the problem.
- Research design/Methodology
- Data collection
- Data processing and analysis
- Publish a review paper in a journal
- At the end evaluated by two members of the department

Research Project Stage-2:

- Actual implementation
- Data Analysis and Interpretation
- Report writing & Presentation
- Publish a paper in a journal.
- The faculty supervisor will assess the findings.

At the end evaluated by two members of the department.

SUBJECT CODE	SUBJECT	CREDITS
BTDS25PC303 / BTDS2SMD304A	**Java Programming**	2

Teaching Scheme	Examination Scheme
Theory: 2 Hrs. / Week Tutorial : Practical:	Continuous Assessment: 20 Marks Mid-Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:-

1	Understand object-oriented programming concepts.
2	Learn Java syntax and programming constructs.
3	Develop programs using classes and objects.
4	Understand exception handling and multithreading.
5	Implement file handling and event-driven programming.

Course Outcomes:-

CO1	An understanding of the principles and practice of object oriented analysis and design in the construction of robust, maintainable programs which satisfy their requirements;
CO2	A competence to design, write, compile, test and execute straightforward programs using a high level language;
CO3	An appreciation of the principles of object oriented programming;
CO4	An awareness of the need for a professional approach to design and the importance of good documentation to the finished programs
CO5	Be able to implement, compile, test and run Java programs comprising more than one class, to address a particular software problem.

Mapping of Course Outcome with Program Outcomes

Course Outcome	Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	--	--	--	--	--	--	--	--	--	--
CO2	--	--	3	1	3	--	1	--	--	--	--	--
CO3	3	--	2	--	--	1	--	--	--	--	1	--
CO4	--	--	--	1	--	1	--	2	--	3	--	--
CO5	--	--	3	--	3	--	--	--	2	--	--	1

COURSE CONTENTS

UNIT-I **[06 Hours]**

Java Programming- History of Java, comments, Data types, Variables, Constants, Scope and Lifetime of variables, Operators, Operator Hierarchy, Expressions, Type conversion and

casting, Enumerated types.

OOP Concepts:-Data abstraction, encapsulation, inheritance, Benefits of Inheritance, Polymorphism, classes and objects, Procedural and object oriented programming paradigms.

UNIT – II **[07 Hours]**

Inheritance – Inheritance hierarchies super and sub classes, Member access rules, super keyword, preventing inheritance: final classes and methods.

Polymorphism – dynamic binding, method overriding, abstract classes and methods.

Interfaces- Interfaces Vs Abstract classes, defining an interface, implement interfaces, accessing implementations through interface references.

UNIT-III **[06 Hours]**

Exception handling- Dealing with errors, benefits of exception handling, the classification of exceptions- exception hierarchy, checked exceptions and unchecked exceptions, usage of try, catch, throw.

Multithreading – Differences between multiple processes and multiple threads, thread states, creating threads, interrupting threads.

UNIT-IV **[05 Hours]**

Applets – Concepts of Applets, differences between applets and applications, life cycle of an applet, types of applets, creating applets, passing parameters to applets.

UNIT-V **[05 Hours]**

Files- Streams- Byte streams, Character streams. Files- Streams- Byte streams, Character streams, random access file operations, File management using File class.

TEXT BOOK:

1. Java Fundamentals **–** A Comprehensive Introduction, Herbert Schildt and Dale Skrien, TMH.

REFERENCE BOOKS:

1. Java for Programmers, P.J.Deitel and H.M.Deitel, PEA (or) Java: How to Program , P.J.Deitel and H.M.Deitel,PHI
2. Object Oriented Programming through Java, P. Radha Krishna, Universities Press. Thinking in Java, Bruce Eckel,PE
3. Programming in Java, S. Malhotra and S. Choudhary, Oxford Universities Press

SUBJECT CODE	SUBJECT	CREDITS
BTDS25OE305(D) / BTDS2SMD304B	**Introduction to Data Science**	**3**

Teaching Scheme	Examination Scheme
Theory: 3 Hrs. / Week	Continuous Assessment: 20 Marks
Tutorial :	Mid-Semester Exam: 20 Marks
Practical:	End Semester Exam: 60 Marks

Course Objectives:-

1	Understand data science concepts and tools.
2	Learn data preprocessing and visualization.
3	Study statistical analysis methods.
4	Understand machine learning basics.
5	Explore data-driven decision making.

Course Outcomes:-

CO1	Describe what Data Science is and the skill sets needed to be a data scientist
CO2	Explain the significance of exploratory data analysis (EDA) in data science
CO3	Ability to learn the supervised learning, SVM
CO4	Apply basic machine learning algorithms (Linear Regression)
CO5	Explore the Networks, PageRank

Mapping of Course Outcome with Program Outcomes

Course Outcome	Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	--	--	2	--	--	--	--	--	--	1
CO2	--	3	--	3	3	--	--	--	--	--	--	1
CO3	--	--	3	--	3	--	--	--	--	--	--	1
C04	--	--	--	3	3	--	--	--	--	2	--	1
C05	--	--	--	--	2	--	--	--	--	--	--	3

COURSE CONTENTS

Unit 1 **[09 Hours]**

Introduction to Data Science

The Data Science Lifecycle, Evolution of Data Science: Growth & Innovation, Roles in Data Science, Stages in a data science project, Applications of data science in various fields, Data security issues, Data Security Vs Data Privacy, Data Security Risks, Common Data Security Solutions and Techniques.

Unit 2 **[08 Hours]**

Data Collection and Preprocessing

DATA COLLECTION: Primary Data Collection Methods, Secondary Data Collection Methods, Data

preprocessing, key steps in data preprocessing, Data Preprocessing in Data Mining, Major Tasks in Data Preprocessing, Data Preprocessing in machine learning, Data cleaning, Steps of Data Cleaning, Methods of Data Cleaning, Process of Data Cleaning, Tools for Data Cleaning in Data Mining.

Unit 3 **[08 Hours]**

Descriptive Statistics

Types of Descriptive Statistics, Distribution (also called Frequency Distribution), Measures of Central Tendency, Variability (also called Dispersion), Skewness: Types of Skewness, Calculate the skewness coefficient of the sample, Kurtosis: Excess Kurtosis, Types of excess kurtosis, Box plot, Range: Interquartile Range(IQR). Pivot table, Wide vs. Long Data, Aggregation Functions, Missing Data.

Unit 4 **[09 Hours]**

Model Development

Regression Analysis, Simple Linear Regression, Multiple Linear Regression, Multiple regression in machine learning, MLR equation, Model evaluation using visualization, Residual Plot and its Analysis, Characteristics of Good Residual Plots, Polynomial Regression, Types of Polynomial Regression, Assumption of Polynomial Regression, Linear Regression Vs Polynomial Regression, Non-linear data in Polynomial Regression.

Unit 5 **[08 Hours]**

Model Evaluation

Generalization Error, Evaluation Metrics, Confusion Matrix, Type I Error: - equivalent to False Positives(FP), Type II Error: - equivalent to False Negatives(FN)., CROSS VALIDATION: K-Fold Cross Validation, Overfitting and Underfitting: What is Overfitting? Ways to Tackle Overfitting, What is Underfitting? Ways to Tackle Underfitting.

Texts/References:

1. Chantal D. Larose, Daniel T. Larose, Fundamentals of Data Science Using Python and R, Wiley India Edition, 2014, ISBN: 9788126562159
2. Aviral Sharma, Chaitan Baru, Data Science for Dummies
3. CBSE Data Science Student Handbook, Central Board of Secondary Education (CBSE)
4. Authors: Shalini Harisukh, Anjna Virmani, V.K. Jain, Data Science, Orange Education Pvt Ltd, 2021
5. M.C. Srivastava, Rajiv Saxena, Data Science: Concepts and Practice (Second Edition)
6. B. Uma Maheswari, Introduction to Data Science: Practical Approach with R and Python

SUBJECT CODE	SUBJECT	CREDITS
BTDS25PC402/BTDS2SMD404A	**Analysis and Design of Algorithms**	3

Teaching Scheme	Examination Scheme
Theory: 3 Hrs. / Week	Continuous Assessment: 20 Marks
Tutorial :	Mid-Semester Exam: 20 Marks
Practical:	End Semester Exam: 60 Marks

Course Objectives:-

1	To understand fundamental concepts of algorithm design and analysis.
2	To learn various algorithm design techniques like divide and conquer.
3	To study greedy, dynamic programming, and backtracking methods.
4	To analyze time and space complexity of algorithms.
5	To explore optimization and problem-solving strategies.

Course Outcomes:-

CO1	Be able to analyze algorithms and improve the efficiency of algorithms.
CO2	Apply different designing methods for development of algorithms to realistic problems, such as divide and conquer, greedy and etc.
CO3	Prerequisites (Subjects) Data structures, Mathematical foundations of computer science.
CO4	To solve problems using algorithm design methods such as the greedy method, divide and conquer, dynamic programming, backtracking and branch and bound.
CO5	Ability to understand and estimate the performance of algorithm.

Mapping of Course Outcome with Program Outcomes

Course Outcome	Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	--	--	2	--	--	--	--	--	--	1
CO2	--	3	--	2	--	--	--	--	--	--	--	1
CO3	3	--	3	--	3	--	--	--	--	--	--	1
C04	--	--	3	2	3	--	--	--	--	--	--	1
C05	--	3	--	3	--	--	--	--	--	--	--	1

COURSE CONTENTS

[Unit 1] Introduction to Algorithms **[09 Hours]**

Introduction: Definition, Properties of Algorithms, Expressing Algorithm, Flowchart, **Algorithm Design Techniques:** Performance Analysis of Algorithms, Types of Algorithm's Analysis, Order of Growth, Asymptotic Notations.

Recursion: Recurrences Relation, Substitution Method, Iterative Method, Recursion Tree, Master Theorem.

[Unit 2] Divide and Conquer [08 Hours]

Introduction, Binary Search, Merge Sort, Quick Sort, Strassen's Matrix Multiplication.

[Unit 3] Backtracking [08 Hours]

Backtracking: Concept, N–Queens Problem, Four–Queens Problem, Eight–Queen Problem, Hamiltonian Cycle, Sum of Subsets Problem, Graph Coloring Problem.

Branch and Bound: Introduction, Travelling Salesperson Problem, 15-Puzzle Problem, Comparisons between Backtracking and Branch and Bound.

[Unit 4] Greedy Algorithms [09 Hours]

Introduction to Greedy Technique, Greedy Method, Optimal Merge Patterns, Huffman Coding, Knapsack Problem, Activity Selection Problem, Job Sequencing with Deadline, Minimum Spanning Tree, Single-Source Shortest Path Algorithms.

[Unit 5] Dynamic Programming [09 Hours]

Introduction, Characteristics of Dynamic Programming, Component of Dynamic Programming, Comparison of Divide-and-Conquer and Dynamic Programming Techniques, Longest Common Sub-sequence.

Shortest Path: Bellman Ford, Floyd Warshall, Application of Dynamic Programming.

NP Completeness: Introduction, The Complexity Class P, The Complexity Class NP, Polynomial-Time Reduction, The Complexity Class NP-Complete.

TEXT BOOK:

1. T. Cormen, Introduction to Algorithms, PHI Publication, 2nd Edition, 2002.

REFERENCE BOOKS:

1. Aho, Ullman, Data Structure and Algorithms, Addison-Wesley Publication, 1st Edition, 1983.
2. Michel Goodrich, Roberto Tamassia, Algorithm Design – Foundation, Analysis & Internet Examples, Wiley Publication, 2nd Edition, 2006.
3. George T. Heineman, Gary Pollice, Stanley Selkow, Algorithms in a Nutshell, A Practical Guide, O'Reilly Media, 2nd Edition, 2016.
4. Ellise Horowitz, Sartaj Sahni, S. Rajasekaran, Fundamentals of Computer Algorithms, University Press (India) Private Ltd, 2nd Edition, 2008.
5. Sara Base, Computer algorithms: Introduction to Design and Analysis, Addison-Wesley Publication, 2nd Edition, 1988.

SUBJECT CODE **BTDS25PC401/ BTDS2SMD404A**	SUBJECT **Computer Organization & Architecture**	CREDITS 3

Teaching Scheme	Examination Scheme
Theory: 3 Hrs. / Week Tutorial : Practical:	Continuous Assessment: 20 Marks Mid-Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:-

1	To introduce the basic structure and functional units of computer systems.
2	Interpret instruction set architectures, addressing modes, and execution flow, and compare RISC and CISC architectures
3	Apply principles of computer arithmetic to perform integer and floating-point operations, and analyse ALU design
4	Evaluate memory organisation techniques, including cache, virtual memory, and external storage systems, for performance and reliability
5	Analyse control unit design, I/O organisation, pipelining, and parallel processing techniques for improving system performance

Course Outcomes:-

CO1	Describe the basic structure and operation of a digital computer
CO2	Illustrate instruction formats, addressing modes, and execution of instructions.
CO3	Analyze arithmetic operations and design of ALU
CO4	Explain memory hierarchy, cache mapping techniques, and virtual memory concepts
CO5	Evaluate I/O organization and system buses

Mapping of Course Outcome with Program Outcomes

Course Outcome	Program Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	--	--	--	--	--	--	--	--	--	--	--
CO2	3	2	--	--	--	--	--	--	--	--	--	--
CO3	3	2	2	--	--	--	--	--	--	--	--	--
C04	3	2	2	2	--	--	--	--	--	--	--	--
C05	3	2	2	2	2	--	--	--	--	--	--	--

COURSE CONTENTS

UNIT 1 Introduction **[7 Hours]**

Introduction: Concept of computer organization and architecture, Fundamental unit, Computer function and interconnection, CPU structure and function.

UNIT 2 Instruction Sets **[7 Hours]**

Characteristics, Types of operands, Types of operations, Assembly language, Addressing

modes, Instruction format, Types of instruction, Instruction execution, Machine state and processor status, Structure of program, Introduction to RISC and CISC architecture.

UNIT 3 Computer Arithmetic [8 Hours]

The arithmetic and logic Unit, Integer representation, Integer arithmetic, Floating point representation, Floating point arithmetic, Introduction of arithmetic co-processor.

UNIT 4 Memory Organization [9 Hours]

Internal Memory: Semiconductor main memory, error correction, advanced DRAM organisation, virtual memory systems, and cache memory systems. External Memory: Organisation and characteristics of magnetic disks, magnetic tapes, optical memory, RAID, and memory controllers.

UNIT 5 Control Unit and Input / Output Organization [9 Hours]

Control Unit Operation: Micro-operations, Control of the processor, Hardwired implementation, Micro-programmed Control Unit, Basic concepts, Microinstruction sequencing, Microinstruction execution, Applications of micro-programming. Input /

Output Organization: External devices, I/O module, Programmed I/O, Interrupt driven I/O, Direct memory access, I/O channels and processors, External interface. Instruction Pipe-lining and Parallel processing: Multiple processor organization, Symmetric multiprocessor, Cache coherence and the MESI protocol. .

REFERENCE BOOKS:

1. William Stalling, Computer Organisation and Architecture: Designing for Performance, Prentice Hall Publication, 8th Edition, 2009.
2. Hayes, Computer Architecture and Organization, McGraw-Hill Publication, 3rd Edition, 2012.
3. Zaky, Computer Organization, McGraw-Hill Publication, 5th Edition, 2011.
4. Hennessy and Patterson, Computer Architecture: A Quantitative Approach, Morgan and Kaufmann Publication, 4th Edition, 2007.
5. Morris Mano, Computer System Architecture, Pearson Education India, 3rd Edition, 2007.
6. Mostafa Abd-El-Barr, Hesham El-Rewini, Fundamentals of Computer Organization and Architecture, Wiley Publication, 1st Edition, 2004.
7. Miles J. Murdocca, Vincent P. Heuring, Computer Architecture and Organization: An Integrated Approach, Wiley Publication, 1st Edition, 2007.
8. Sajjan G. Shiva, Computer Organization: Design, and Architecture, CRC Press, 5th Edition, 2013.