Syllabus of
First Year for
Bachelor of Vocation
In
Data Science
W.E.F. - 2021-22

Dr. Babasaheb Ambedkar Technological University,
Vidyavihar, Lonere, Maharashtra 402103

Semester I (Syllabus 2021-22)

Sr. No.	Course Code	Name of the Course	Teaching scheme			Evaluation Scheme			Credits	Total Marks
			L	T	P	IA	MSE	ESE		
General Education										
Theory										
1	BVDSC101	IT Foundation and Programming Concepts	3	0	0	25	0	25	3	50
2	BVDSC102	Programming in C++	3	0	0	25	0	25	3	50
3	BVDSC103	Discrete Mathematical Structures	3	0	0	25	0	25	3	50
4	BVIMC304	Descriptive Statistics	3	0	0	25	0	25	3	50
		Total							**12**	**200**
Skill Components										
Lab/Practical										
5	BVDSL105	IT Foundation and Programming Concepts Lab	0	0	1	25	0	25	1.5	50
6	BVDSL106	Programming in C++ Lab	0	0	1	25	0	25	1.5	50
On-Job-Training (OJT) / Qualification Packs										
				IA			EA			
7	BVDSE117	Technical Writer(SSC/Q0505)		50			150		15	200
		Total							**18**	**300**

Semester II (Syllabus 2021-22)

Sr. No.	Course Code	Name of the Course	Teaching scheme			Evaluation Scheme			Credits	Total Marks
			L	T	P	IA	MSE	ESE		
General Education										
Theory										
1	BVDSC201	Object Oriented Programming with JAVA	3	0	0	25	0	25	3	50
2	BVDSC202	Introduction to Data Science	3	0	0	25	0	25	3	50
3	BVDSC203	Applied Probability and Statistics	3	0	0	25	0	25	3	50
4	BVDSC204	Data Structures	3	0	0	25	0	25	3	50
		Total							**12**	**200**
Skill Components										
Lab/Practical										
5	BVDSL205	Object Oriented Programming with JAVA Lab	0	0	1	25	0	25	1.5	50
6	BVDSL206	Data Structures Lab	0	0	1	25	0	25	1.5	50
On-Job-Training (OJT) / Qualification Packs										
			IA			EA				
7	BVDSE217	Junior Software Developer (SSC/Q0508)	50			150			15	200
		Total							**18**	**300**

Semester
I
Syllabus

Subject Name: IT Foundation and Programming Concepts	
Course Code: BVDSC101	Semester: I
Weekly Teaching Hours: TH: 03 TUT: 00	Scheme of Marking TH: 25 IA: 25, Total: 50
TH Exam Duration: 01 Hour	Scheme of Marking PR: -
Credits: 03	

Unit	Content	Hours
Unit 1	**Computer System Characteristics and Capability** Basic structure, ALU, memory, CPU, I/O devices. Development of computers. Classification of computers:(Micro, mini frame, supercomputer, pc, server, workstations)	06
Unit 2	**Data Representation Within Computer** BIT, BYTE, WORD, ASCII, EBCDIC, BCD Code. Introduction to Number system: Binary, Octal, Decimal and Hexadecimal. Conversation from one number system to another number system. Introduction to Basic Gates.	07
Unit 3	**Input Devices and Output Devices** Keyboard, Direct Entry: Card readers, scanning devices (BAR CODE, OMR, MICR), Voice input devices, Light pen, Mouse, Touch Screen, Digitizer, scanner. CRT, LCD/TFT, Dot matrix printer, Inkjet printer, Drum plotter, Flatbed plotter	06
Unit 4	**Memory Devices** RAM, ROM, PROM, EPROM, EEPROM. - Base memory, extended memory, expanded memory, Cache memory - Storage devices Tape, FDD, HDD, CDROM, Pen Drive.	07
Unit 5	**Algorithm& Flowcharts** Algorithm: Introduction, Properties, Benefits and Limitations Flow chart: Introduction, Symbols, Guidelines, Benefits and Limitations Converting algorithms to flowcharts	07
Unit 6	**Introduction To Programming Environment** History of languages, high-level, Low level, Assembly languages etc., Compilers, Interpreters, Assemblers, Linkers, Loaders	07

Learning Resources			
Sr. No.	Title of Book	Author	Publication
1	Computers And Commonsense	R. Hunt and Shell Y.	BPB Publications
2	Computer Fundamentals	V.Rajaraman	PHI Learning
3	Computer Fundamentals and Applications	Ashok Arora	Vikas Publishing House
4	Foundations of Computing	Pradeep K. Sinha, Priti Sinha	BPB Publications

Subject Name: Programming in C++	
Course Code: BVDSC102	Semester: I
Weekly Teaching Hours: TH: 03 Tut: 00	Scheme of Marking TH: 25, IA: 25 Total: 50
TH Exam Duration: 01 Hour	Scheme of Marking PR: -
Credits: 03	

Unit	Content	Hours
Unit 1	**Introduction to C++** C++: history, uses, applications, structure of C++ program. Header files. Keywords, variable, variable scope - local and global; constants - character, integer, float, string; escape sequences, data types - built-in and user defined	08
Unit 2	**Operators and I/O in C++** Operators - arithmetic, relational, logical, assignment, bitwise, conditional, operator precedence and associativity. Simple programs using cout and cin. Manipulator: definition, endl, setw and setfill	08
Unit 3	**Control Structures and Looping** Decision making constructs - If, If-Else, Nested If-Else and Switch. Looping constructs - While, For, do-while and nested looping. Infinite loop, loop control statements - break, continue, go to and Exit statements	08
Unit 4	**Array and Function** Array - definition, advantages, array declaration, initialisation, accessing element of array. Two-dimensional array - declaration, initialisation, accessing element of two-dimensional array, character array, pointer. Function, advantages of function, defining function - return type, function name and parameters; declaring function, function arguments - pass by value and pass by reference, function recursion	08
Unit 5	**Exception Handling and File** Exception, handling exception in C++: Throw, Try, Catch. Stream, C++ stream classes, unformatted I/O operation, formatted I/O operation. File: introduction, file stream classes, opening & closing file, writing to file, reading from file, file position pointers	08

Learning Resources			
Sr. No.	Title of Book	Author	Publication
1	Let us C++	Yashavant Kanetkar	BPB Publication
2	Programming with C++, 2nd Edition	John R. Hubbard	Tata McGraw Hill
3	Mastering C++, 2nd	K.R. Venugopal	Tata McGraw Hill
4	Object-Oriented Programming with C++	M. P. Bhave	Pearson Education India

Learning Platform	
Sr. No.	Particulars
1	https://www.javatpoint.com/cpp-tutorial
2	https://www.programiz.com/cpp-programming
3	http://nptel.ac.in/courses/106/105/106105225
4	http://www.cprogramming.com/tutorial/c-tutorial.html
5	https://www.cplusplus.com/doc/tutorial/

Subject Name: Discrete Mathematical Structures	
Course Code: BVDSC103	Semester: I
Weekly Teaching Hours: TH: 03 Tut: 00	Scheme of Marking TH: 25, IA: 25 Total: 50
TH Exam Duration: 01 Hour	Scheme of Marking PR: --
Credits: 03	

Unit	Content	Hours
Unit 1	**Introduction to Sets** Introduction: Sets - finite and Infinite sets, un-countable Infinite Sets; functions, relations, Properties of Binary Relations, Closure, Partial Ordering Relations; counting - Pigeonhole Principle, Permutation and Combination; Mathematical Induction, Principle of Inclusion and Exclusion.	15
Unit 2	**Growth of Functions and Recurrences** Growth of Functions: Asymptotic Notations, Summation formulas and properties, Bounding Summations, approximation by Integrals Recurrences: Recurrence Relations, generating functions, Linear Recurrence Relations with constant coefficients and their solution, Substitution Method, Recurrence Trees, Master Theorem	10
Unit 3	**Graph Theory** Graph Theory: Basic Terminology, Models and Types, multigraphs and weighted graphs, Graph Representation, Graph Isomorphism, Connectivity, Euler and Hamiltonian Paths and Circuits, Planar Graphs, Graph Coloring, Trees, Basic Terminology and properties of Trees, Introduction to Spanning Trees	10
Unit 4	**Proportional Logic** Prepositional Logic: Logical Connectives, Well-formed Formulas, Tautologies, Equivalences, Inference Theory	10

Learning Resources			
Sr. No.	Title of Book	Author	Publication
1	Elements of Discrete mathematics, 2nd Edition	C.L. Liu, D.P. Mahopatra	Tata McGraw Hill, 2017
2	Discrete Mathematics and Its Applications, Sixth Edition	Kenneth Rosen	McGraw Hill 2006
3	Discrete Structures, Logic, and Computability, 3rd Edition	J. L. Hein	Jones and Bartlett Publishers

Subject Name: Descriptive Statistics	
Course Code: BVDSC104	Semester: I
Weekly Teaching Hours: TH: 03 Tut: 00	Scheme of Marking TH: 25 IA: 25 Total: 50
TH Exam Duration: 01 Hour	Scheme of Marking PR: --
Credits: 03	

Unit	Content	Hours
Unit 1	**Introduction to Statistics** Introduction to Statistics : Introduction to Statistics – Primary and Secondary data – Nominal, Ordinal, Ratio, and Interval scale (with examples)- Graphical Representation of data – Bar-charts, Pie-diagrams, Histograms, Frequency polygon, Ogives	08
Unit 2	**Measures of Central Tendency and Dispersion** Measures of central tendency: – properties – merits and demerits – weighted means– graphical location of median, quartiles, deciles, percentiles, and mode – relation between arithmetic mean, geometric mean and harmonic mean. Measures of dispersion: – characteristics – Coefficient of dispersion – Coefficient of variation – Moments – Relation between moments about mean in terms of moments about point – Pearson's coefficients	08
Unit 3	**Skewness, Kurtosis and Curve Fitting** Skewness and Kurtosis – Pearson's coefficient of Skewness – Bowley's coefficient of Skewness – coefficient of Skewness based upon moments. Curve fitting – Principle of least squares – Fitting of straight line, parabola, exponential and power curve.	08
Unit 4	**Correlation, Regression and Hypothesis Testing** Correlation and Regression: Simple correlation – Karl Pearson's coefficient. Of correlation – Rank correlation –Simple Regression – lines of regression – properties of regression coefficient –Multiple and Partial correlation coefficient in three variables. Hypothesis Testing: Estimation and Hypothesis testing, t-test, chi-square test, ANOVA	08

Learning Resources			
Sr. No.	Title of Book	Author	Publication
1	Basic Statistics, 3/e	B. L. Agarwal	New Age International (P) Ltd
2	Statistical Methods	S. P. Gupta	Sultan Chand & sons
3	Fundamentals of Mathematical Statistics, 10/e	S. C. Gupta and V. K. Kapoor	Sultan Chand & sons

	Subject Name: IT Foundation and Programming Concepts Lab	
Course Code: BVDSL105	Semester: I	
Weekly Practical Hours: PR: 02 Tut: 00	Scheme of Marking TH: --	
TH Exam Duration: --	Scheme of Marking PR: 25, IA: 25, Total: 50	
Credits: 1.5		

Sr. No.	List of Practical
1	Identify the internal and external hardware/peripheral components
2	Familiarization with operating system along with file management commands like create, copy, move, delete and rename files and folders.
3	Prepare and print Bio-data with a covering letter using word processor.
4	Calculation of Total mark, grade based on boundary conditions for n number of students using Spread sheet.
5	Experiments for burning the contents into optical disks.
6	Preparation of presentation (with transition and animations, insertion of scanned images and internet contents)
7	Email id creation, sending and receiving of email with attachments.
8	Algorithm to calculate average of 3 numbers, area of triangle, volume of cylinder, Temperature conversion.
9	Algorithm to calculate Largest of 3 numbers, Check whether even or odd, Roots of quadratic equation, Character name of the day.
10	Algorithm to Print natural numbers, Factorial value, Multiplication table, Sum of digits, Sum of a set of numbers, calculation of grade based on boundary conditions

Subject Name: Programming in C++ Lab	
Course Code: BVDSL106	Semester: I
Weekly Practical Hours: PR: 02 Tut: 00	Scheme of Marking TH: --
TH Exam Duration: --	Scheme of Marking PR: 25, IA: 25, Total: 50
Credits: 1.5	

Sr. No.	List of Practical
1	Programs based on input output statements
2	Programs based on various operators
3	Programs based on control statement (if, switch)
4	Programs based on various loops (for, while, do-while)
5	Programs based on One Dimensional Array
6	Programs based on Two-Dimensional Array
7	Programs based on Function (Library functions and User Defined Function, Recursion)
8	Programs based on Pointer
9	Programs based on Structure and Union
10	Programs based on Files and Command Line Arguments (File handling functions)

Qualification Pack

Subject Name: Technical Writer(SSC/Q0505)	
Course Code: BVDSE117	Semester: I
Weekly Skilling Hours: PR: 24 Tut: 00	Scheme of Marking TH: --
PR Exam Duration: 06 Hours	Scheme of Marking PR: 150, IA: 50, Total: 200
Credits: 15	

Syllabus for this qualifier pack is available on http://www.sscnasscom.com/qualification-pack/SSC/Q0505/

Semester
II
Syllabus

Subject Name: Object Oriented Programming with JAVA	
Course Code:BVDSC201	Semester: II
Weekly Teaching Hours: TH: 03 Tut: 00	Scheme of Marking TH: 25 IA: 25 Total: 50
TH Exam Duration: 01 Hours	Scheme of Marking PR: --
Credits: 03	

Unit	Content	Hours
Unit 1	**Basics of Java** History of Java, JVM, Java Environment Setup, Programming Structure and naming conventions, Variables and Data types, Operators, Decision and Control Statements, Arrays and Strings	08
Unit 2	**Object Oriented Programming with Java** Object Oriented Programming, Features of OOPS, Class and Object, Static variables and static methods, Overloading methods, Passing and returning object as argument, Constructors and Overloading constructors	08
Unit 3	**Inheritance** Use of inheritance, IS-A,HAS-A,USES-A relationship, Method overriding, Super keyword and Final keyword, Abstract classes and methods, Packages, Interfaces	08
Unit 4	**Exception handling and Multithreading** Exceptions and their types, Handling exceptions, Use of Multithread programming, Thread class and Runnable interface, Thread priority	08
Unit 5	**File handling and JDBC** Stream classes, Class hierarchy, Creation of text file, Reading and writing text files, JDBC Architecture, JDBC Drivers, Java Database Connectivity using JDBC	04
Unit 6	**GUI Applications** Applets and its life cycle, Graphics Class, AWT, Layout managers, Event handling classes and interfaces, SWING, and Its Components	04

Learning Resources			
Sr. No.	Title of Book	Author	Publication
1	The Java Programming Language	Ken Arnold, James Gosling, David Homes	Addison-Wesley
2	Head First Java	Kathy Sierra, Bert Bates	Shroff
3	Java The Complete Reference	Herbert Schildt	McGraw Hill Education

Subject Name: Introduction to Data Science	
Course Code: BVDSC202	**Semester: II**
Weekly Teaching Hours: TH: 03 Tut: 00	**Scheme of Marking TH: 25, IA: 25 Total: 50**
TH Exam Duration: 01 Hour	**Scheme of Marking PR: -**
Credits: 03	

Unit	Content	Hours
Unit 1	**Introduction to Data Science** Introduction to Data Science: Foundation of Data science, Area and Scope of Data Science, Steps of Data Science Process: Data collection, Pre- processing, training, and testing. Use cases in various domain such Image, Natural Language, Audio and Video.	**10**
Unit 2	**Introduction to Artificial Intelligence** Introduction to Artificial Intelligence: Introduction Artificial Intelligence, The Foundations of AI, AI Technique, Production system characteristics, Production systems: 8-puzzle problem. Searching: Uniformed search strategies – Breadth first search, depth first search.	**10**
Unit 3	**Searching Algorithms and Learning** Searching Algorithms and Learning: Local Search Algorithms: Generate and Test, Hill climbing, simulated annealing search, Constraint satisfaction problems, Greedy best first search, A* search, AO* search. Self-Learning: Propositional logic - syntax &semantics, Game Playing: Overview, Minimax algorithm, Alpha-Beta pruning, Additional Refinements	**15**
Unit 4	**Introduction to Data Mining and Machine Learning** Introduction to Data Mining and Machine Learning: Introduction to Data Mining and Machine Learning, Supervised, Unsupervised and Reinforcement learning. Prediction vs Classification v/s Clustering. Association Rule Mining, classification and regression techniques, clustering, Scalability and data management issues in data mining algorithms, measures of interestingness	**10**

Learning Resources			
Sr. No.	**Title of Book**	**Author**	**Publication**
1	Doing Data Science: Straight Talk from the Frontline	Rachel Schutt, Cathy O'Neil	O'Reilly
2	Artificial Intelligence A Modern Approach	S. Russell and P. Norvig	Pearson Education
3	Data Smart: Using data Science to Transform Information into Insight	John W. Foreman	John Wiley& Sons

Subject Name: Applied Probability and Statistics	
Course Code: BVDSC203	Semester: II
Weekly Teaching Hours: TH: 03 Tut: 00	Scheme of Marking TH: 25, IA: 25 Total: 50
TH Exam Duration: 01 Hour	Scheme of Marking PR: -
Credit: 03	

Unit	Content	Hours
Unit 1	**Basic Probability** Basic Probability - Random Experiments - Sample Spaces Events - The Concept of Probability -The Axioms of Probability - Some Important Theorems on Probability - Assignment of Probabilities -Conditional Probability -Theorems on Conditional Probability - Independent Events -Bayes' Theorem or Rule Combinatorial Analysis - Fundamental Principle of Counting - Tree Diagrams -Permutations	10
Unit 2	**Random Variables and Probability Distributions** Random Variables and Probability Distributions - Random Variables - Discrete Probability Distributions–Distribution Functions for Random Variables - Distribution Functions for Discrete Random Variables - Continuous Random Variables – Graphical Interpretations Joint Distributions Independent Random Variables - Change of Variables - Probability Distributions of Functions of Random Variables – Convolutions – Conditional Distributions Applications to Geometric Probability.	10
Unit 3	**Mathematical Expectation** Mathematical Expectation - Definition of Mathematical Expectation - Functions of Random Variables - Theorems on Expectation - Variance & Standard Deviation - Theorems on Variance - Standardized Random Variables - Special Probability Distributions - Binomial Distribution - Normal Distribution - Poisson Distribution	10
Unit 4	**Sampling Theory** Sampling Theory - Population and Sample - Statistical Inference- Sampling With and Without Replacement Random Samples - Random Numbers - Population Parameters - Sample Statistics -Sampling Distributions - Sample Mean - Sampling Distribution of Means - Sampling Distribution of Proportions - Sampling Distribution of Differences and Sums – Sample Variance - Sampling Distribution of Variances - Computation of Mean, Variance, and Moments for Grouped Data - The Least- Squares Parabola - Multiple Regression Standard Error of Estimate The Linear Correlation Coefficient Generalized Correlation Coefficient Rank Correlation	15

Learning Resources			
Sr. No.	Title of Book	Author	Publication
1	Probability and Statistics	Murray R. Spiegel, John J. Schiller & R. Alu Srinivasan	McGrawHill
2	Statistical Methods	S. P. Gupta	S. Chand and Sons
3	Fundamentals of Mathematical Statistics	S. C Gupta and V. K. Kapoor	S.Chand and Sons

Subject Name: Data Structures	
Course Code: BVDSC204	Semester: II
Weekly Teaching Hours: TH: 03 Tut: 00	Scheme of Marking TH: 25, IA: 25 Total: 50
TH Exam Duration: 01 Hour	Scheme of Marking PR: --
Credits: 03	

Unit	Content	Hours
Unit 1	**Introduction** Introduction: Data Structure types, Importance of Data Structure, Abstract data Type. Algorithms: Complexity, Time-space Trade-offs, Arrays: Operation Performed on array, Dynamic Memory Allocation	06
Unit 2	**Searching Techniques** Searching Techniques: List Searches using Linear Search, Binary Search, Sorting Techniques: Basic concepts, Sorting by: Bubble, Insertion and selection. Hash Function: Address calculation techniques, Common hashing Functions, Collision resolution, Linear probing, quadratic probing	06
Unit 3	**Stack and Queue** Stack: LIFO structure, PUSH and POP operations, Polish Notation, Queue: FIFO structure, Operations on Queues,Circular Queue.	08
Unit 4	**Linked List** Introduction, single linked list, Operations on a Single linked list, Advantages and disadvantages of single linked list, circular linked list, Double linked list	08
Unit 5	**Tree** Tree: General tree terminology, Tree traversal, Operation on Binary Tree Heap: Heap Sort	06
Unit 6	**Graph** Graphs: Graph Storage structure (Adjacency Matrix, Adjacency List)Operations on graphs Traverse Graph (Depth-First, Breadth-First), Minimum Spanning Tree, Kruskal's algorithm, Prim's algorithm	08

Learning Resources			
Sr. No.	Title of Book	Author	Publication
1	Fundamentals Of Data Structures in C++	Sahni	Galgotia Publications
2	Data Structures	Lipschutz & Pai	Tata McGraw-Hill Education
3	Fundamentals of Data Structures	Anuradha A. Puntamberkar	Technical Publications

	Subject Name: Object Oriented Programming with JAVA Lab	
Course Code: BVDSL205	**Semester: II**	
Weekly Practical Hours: PR: 02 Tut: 00	**Scheme of Marking TH: --**	
TH Exam Duration: --	**Scheme of Marking PR: 25, IA: 25, Total: 50**	
Credits: 1.5		

Sr. No.	List of Practical
1	Design a simple Java class with appropriate programming structure and naming conventions
2	Sample programs on conditional statements and loop controls
3	Demonstrate class, object and methods with various access modifiers
4	Sample program on static variables and static methods
5	Sample program on passing and returning object as argument
6	Demonstrate constructors overloading
7	Demonstrate types of inheritance
8	Abstract classes and methods
9	Program on Packages and Interfaces
10	Demonstration of threads using Thread class and Runnable Interface

	Subject Name: Data Structures Lab	
Course Code: BVDSL206	Semester: II	
Weekly Practical Hours: PR: 02 Tut: 00	Scheme of Marking TH: --	
TH Exam Duration: --	Scheme of Marking PR: 25, IA: 25, Total: 50	
Credits: 1.5		

Sr. No.	List of Practical
1	Write a program to demonstrate insertion, deletion, search and displaying of an element in an array.
2	Write a program to demonstrate sorting algorithm. (using any one of these techniques: bubble, Insertion, selection).
3	Write a program to demonstrate operations performed on stack.
4	Write a program to convert infix expression to postfix and infix to postfix.
5	Write a program to demonstrate operations on queue.
6	Write a program to demonstrate operations on singly link list.
7	Write a program to implement operations on double link list.
8	Write a program to demonstrate creation, traversing and searching in Binary Search Tree.
9	Write a program to traverse a graph using DFS with an adjacency matrix.
10	Write a program to traverse a graph using BFS with an adjacency matrix.

Qualification Pack

Subject Name: Junior Software Developer(SSC/Q0508)	
Course Code: BVDSE217	Semester: II
Weekly Skilling Hours: PR: 24 Tut: 00	Scheme of Marking TH: --
PR Exam Duration: 06 Hours	Scheme of Marking PR: 150, IA: 50, Total: 200
Credit: 15	

Syllabus for this qualifier pack is available on https://www.sscnasscom.com/qualification-pack/SSC/Q0508/