The Curriculum Book

Bachelor of Science (Hons. / Hons. with Research)

in

Computer Science (Artificial Intelligence and Data Science)

4 YEAR-PROGRAMME

Choice Based Credit System and NEP-2020

w. e. f. July 2023

DEPARTMENT OF DATA SCIENCE

GURU JAMBHESHWAR UNIVERSITY OF SCIENCE & TECHNOLOGY

HISAR-125001, HARYANA

SEMESTER I

S. No.	Course Code	Nomenclature	Course Type	Hours / Week			Credit(s)	Int.	Ext.	Total
				L	T	P				
Discipline Specific Courses (DSC)										
1	BDS-DSC-111T	Computer Fundamentals and C Programming	DSC-A1	3	0	0	3	25	50	75
2	BDS-DSC-111P	C Programming Lab.	DSC-A1	0	0	2	1	10	15	25
3	BDS-DSC-112T	Introduction to Data Science	DSC-A2	3	0	0	3	25	50	75
4	BDS-DSC-112P	Data Analysis using Excel Lab.	DSC-A2	0	0	2	1	10	15	25
Minor (MIC)										
5	BDS-MIC-111T	Digital Logic Design	MIC1	4	0	0	4	30	70	100
Multidisciplinary (MDC)										
6	BDS-MDC-111T	Mathematics I	MDC1	3	0	0	3	25	50	75
Ability Enhancement (AEC)										
7		Hindi	AEC1	2	0	0	2	15	35	50
Skill Enhancement (SEC)										
8	BDS-SEC-111T	Data Analysis using R	SEC1	2	0	0	2	15	35	50
9	BDS-SEC-111P	Data Analysis using R Lab.	SEC1	0	0	2	1	10	15	25
Value Added Course (VAC)										
10		Yoga and Meditation	VAC1	2	0	0	2	15	35	50
		TOTAL		**19**		**06**	**22**			**550**

SEMESTER II

S. No.	Course Code	Nomenclature	CourseType	Hours / Week			Credit(s)	Int.	Ext.	Total
				L	T	P				
Discipline Specific Courses (DSC)										
1	BDS-DSC-123T	Data Structures	DSC-A3	3	0	0	3	25	50	75
2	BDS-DSC-123P	Data Structures Lab.	DSC-A3	0	0	2	1	10	15	25
3	BDS-DSC-124T	Introduction to Artificial Intelligence	DSC-A4	4	0	0	4	30	70	100
Minor (MIC)										
4	BDS-MIC-122T	Internet and Web Technology	MIC2	3	0	0	3	25	50	75
5	BDS-MIC-122P	Internet and Web Technology Lab.	MIC2	0	0	2	1	10	15	25
Multidisciplinary (MDC)										
6	BDS-MDC-122T	Statistics I	MDC2	3	0	0	3	25	50	75
Ability Enhancement (AEC)										
7		English	AEC2	2	0	0	2	15	35	50
Skill Enhancement (SEC)										
8	BDS-SEC-122T	Python Programming	SEC2	2	0	0	2	15	35	50
9	BDS-SEC-122P	Python Programming Lab.	SEC2	0	0	2	1	10	15	25
Value Added Course (VAC)										
10		Environment Studies	VAC2	2	0	0	2	15	35	50
		TOTAL		**19**		**06**	**22**			**550**

Note: Students exiting the programme after second semester and securing 48 credits including 4 credits of summer internship will be awarded UG Certificate in the relevant Discipline/Subject.

CURRICULUM AND CREDIT FRAMEWORK FOR B.Sc. COMPUTER SCIENCE (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE)

(SINGLE MAJOR)

Semester	Discipline Specific Courses(DSC)			Minor(MIC)/ Vocational(VOC)			Multidisciplinary (MDC)			Ability Enhancement (AEC)			Skill Enhancement (SEC)			Value Added Course (VAC)			Total Credits
	Courses	Credits	Hours /Week	Courses	Credits	Hours /Week	Courses	Credits	Hours /Week	Courses	Credits	Hours /Week	Courses	Credits	Hours /Week	Courses	Credits	Hours /Week	
I	2TH+ 2P	8	10	1TH	4	4	1TH	3	3	1TH	2	2	1TH+ 1P	3	4	1TH	2	2	22
II	2TH+ 1P	8	9	1TH+ 1P	4	5	1TH	3	3	ITH	2	2	1TH+ 1P	3	4	1TH	2	2	22

Computer Fundamentals and C Programming

General Course Information

Course Code: BDS-DSC-111T **Credits:** 3 **Hours/Week:** 3 **Course Type:** DSC-A1 **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 3 Hours	**Course Assessment Methods:** **Max. Marks: 75 (Internal: 25; External: 50)** Three minor tests, each of 15 marks, will be conducted. The third minor will be conducted by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the highest marks obtained by a student in any of the minor examinations will be considered. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 50 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain short answers type questions. The remaining eight questions are to be given by setting two questions units of the syllabus. A candidate is required to attempt five questions from each of the four in all, one compulsory and any other four questions by selecting one from each unit.

About the Course:

This subject deals with the computer fundamentals and the concepts of C programming language.

Course Content

Unit I

Introduction to Computers: Introduction, Characteristics and limitations of computers, block diagram of computer, types of computers, uses of computers, computer generations. Input and output devices: Keyboard and mouse, inputting data in other ways, Types of Software: system software, Application software, commercial, open source, domain and freeware software, Memories: primary, secondary and cache memory. Windows basics: desktop, start menu, icons, Programming Languages: Machine language, assembly language, high level language, Flow charts.

Unit II

Introduction to C: Introduction, Structure of C Program, Writing the first C Program, File used in C Program, Compiling and Executing C Programs, Using Comments, Keywords, Identifiers, Basic Data Types in C, Variables, Constants, I/O Statements in C, Operators in C, Programming Examples, Type Conversion and Type Casting.

Decision Control and Looping Statements: Introduction to Decision Control Statements, Conditional Branching Statements, Iterative Statements, Nested Loops, Break and Continue Statement, Goto Statement.

Unit III

Functions: Introduction, using functions, Function declaration/ prototype, Function definition, function call, return statement, Passing parameters, Scope of variables, Storage Classes, Recursive function

Arrays: Introduction, Declaration of Arrays, Accessing elements of the Array, Storing Values in Array, Calculating the length of the Array, Operations on Array, one dimensional array for inter-function communication, Two dimensional Arrays, Operations on Two Dimensional Arrays.

Strings: Introduction String and Character functions

Unit IV

Pointers: Understanding Computer Memory, Introduction to Pointers, declaring Pointer Variables, Pointer Expressions and Pointer Arithmetic, Null Pointers, Generic Pointers, Passing Arguments to Functions using Pointer, Pointer and Arrays, Passing Array to Function

Structure, Union, and Enumerated Data Types: Introduction, Nested Structures, Arrays of Structures, Structures and Functions, Unions, Enumerated Data Types

Files: Introduction to Files, Using Files in C, Reading Data from Files, Writing Data from Files, Detecting the End-of-file, Close a file, Random Access Files, Binary Files, Command line arguments

Text and Reference Books:

1. E Balagurusamy, *Computing Fundamentals & C Programming*, TataMcGrawHill, Second Reprint, 2008.
2. P. K. Sinha and P. Sinha, *Foundations of Computing*, BPB publication, 6th edition, 2004.
3. Brian Kernighan and Dennis Ritchie, *The C Programming Language*, PHI, 1988.
4. Byron C Gottfried*, Theory and problem of programming with C,* TMH, 1996.
5. E Balaguruswamy, *Programming in ANSI C*, Tata McGraw-Hill, 2011.

Introduction to Data Science

General Course Information

Course Code: BDS-DSC-112T **Credits:** 3 **Hours/Week:** 3 **Course Type:** DSC-A2 **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 3 Hours	**Course Assessment Methods:** **Max. Marks: 75 (Internal: 25; External: 50)** Three minor tests, each of 15 marks, will be conducted. The third minor will be conducted by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the highest marks obtained by a student in any of the minor examinations will be considered. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 50 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain short answers type questions. The remaining eight questions are to be given by setting two questions units of the syllabus. A candidate is required to attempt five questions from each of the four in all, one compulsory and any other four questions by selecting one from each unit.

About the Course:

This course introduces the basic terminology used in the life cycle of Data science project and Applications.

Course Content

Unit I

Data science definition. Data science benefit our society, Data science relation to other domains, Data science applications area, Data science challenges, Data Science Classification, Data science tools and programming platforms for developing data science applications, Role of data scientist, Data science growing market.

Unit II

Various type of Data, Various types of databases and datasets such as structured, unstructured, graph, etc., Data related challenges. Multimedia data, social media data, biological data, sensor data, etc. Different dataset with different challenges. Data science Ethics: Concept of Informed Consent, Data Ownership, Privacy, Anonymity, Data Validity, Algorithmic Fairness, Societal Consequences.

Unit III

Identifying Potential Data Sources, Data Wrangling, Data Munging, Data science Process: Prior Knowledge, Data Preparation, Modelling: Training and Testing Data set, Learning algorithms, Evaluation of model, Ensemble Modelling and Applications.

Unit IV

Exploratory Data Analysis, Data Exploration: Objectives of Data Exploration, Datasets, Descriptive Statistics, Data visualization, Roadmap for Data Exploration, Supervised and Unsupervised learning, Introduction to Machine learning,

Text and Reference Books:

1. Vijay Kotu, *Bala Deshpande, Data Science: Concepts and Practice*, Morgan Kaufmann 2nd edition, 2018.
2. Roger Peng, Elizabeth Matsui, *The Art of Data Science*, Lulu.com, 2016.
3. John D. Kelleher and Brendan Tierney, *Data Science*. The MIT Press, 2018.
4. Murtaza Haider, *Getting Started with Data Science: Making Sense of data with analytics*, IBM Press, 2015.
5. Field Cady, *The Data Science Handbook*, John Wiley & Sons, 2017.
6. Laura Igual and Santi Seguí, *Introduction to Data Science*, Springer International Publishing, 2017.
7. Cathy O'Neil and Rachel Schutt, *Doing Data Science*, O'Reilly Media, Inc. 2014.
8. Jure Leskovek, Anand Rajaraman and Jefrey Ullman., *Mining of Massive Datasets*, Cambridge University Press, 2019.

Digital Logic Design

General Course Information

Course Code: BDS-MIC-111T **Credits:** 4 **Hours/Week:** 4 **Course Type:** MIC1 **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 3 Hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the highest marks obtained by a student in any of the minor examinations will be considered. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

About the Course:

This course is about the detailed coverage of number system, combinational circuits and sequential logics. This course covers the various types of conversions in number system and designing different logic circuits.

Course Content

Unit I

Information Representation: Number Systems, Binary Arithmetic Operations, Fixed-point and Floating point representation of numbers, BCD Codes, Error detecting and correcting codes, Character Representation – ASCII, EBCDIC, Unicode, Binary Logic: Boolean Algebra, Boolean Theorems, Boolean Functions Truth Tables, Canonical and Standard forms of Boolean functions, Simplification of Boolean Functions - Venn Diagram, Karnaugh Maps

Unit II

Digital Logic: Basic Gates -AND, OR, NOT, Universal Gates - NAND, NOR, Other Gates - XOR, XNOR etc. NAND, NOR, AND-OR-INVERT and OR-AND-INVERT implementations of digital circuits, Combinational Logic – Characteristics, Design Procedures, analysis procedures, Multilevel NAND and NOR circuits.

Unit III

Combinational Circuits: Half-Adder, Full-Adder, Half-Subtractor, Full-Subtractor, Encoders, Decoders, Multiplexers, Demultiplexers, Comparators, Code Converters BCD to Seven Segment Decoder.

Unit IV

Latches: RS latch and JK latch, Flip-flops: RS, JK, D, T flip flops, characteristic Tables, excitation tables and equations, Conversion from one type of Flip-Flop to another, Master-slave flip flops, Shift Registers, Counters, Up-Down counter.

Text and Reference Books:

1. M. Morris Mano, *Digital Logic and Computer Design*, Prentice Hall of India Pvt. Ltd., 2004.
2. Jain, R P, *Modern Digital Electronics*, McGraw Hill Education, 2009.
3. Thomas L. Floyd, *Digital Fundamentals*, Pearson Education, 2017
4. V. Rajaraman and T. Radhakrishnan, *An Introduction to Digital Computer Design*, Prentice Hall of India Pvt. Ltd., 2004.
5. Andrew S. Tanenbaum, *Structured Computer Organization*, Prentice Hall of India Pvt. Ltd., 1984.
6. Nicholas Carter, Schaum's Outlines *Computer Architecture*, Tata McGraw-Hill., 2002.

Mathematics I

General Course Information

Course Code: BDS-MDC-111T **Credits:** 3 **Hours/Week:** 3 **Course Type:** MDC1 **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 3 Hours	**Course Assessment Methods:** **Max. Marks: 75 (Internal: 25; External: 50)** Three minor tests, each of 15 marks, will be conducted. The third minor will be conducted by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the highest marks obtained by a student in any of the minor examinations will be considered. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 50 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain short answers type questions. The remaining eight questions are to be given by setting two questions units of the syllabus. A candidate is required to attempt five questions from each of the four in all, one compulsory and any other four questions by selecting one from each unit.

About the Course:

This course provides the fundamental notions of vector spaces viz linear dependence, basis and dimension and linear transformations on these spaces.

Course Content

Unit I

Systems of Linear Equations: Introduction, Basic Definitions, Rank of Matrices, Cramer's Rule Equivalent Systems, Elementary Operations, Small Square Systems of Linear Equations, Systems in Triangular and Echelon Forms, Gaussian Elimination, Echelon Matrices, Equivalence Matrices, Canonical Form, Gaussian Elimination, Matrix Formulation, Homogeneous and Non Homogeneous system of linear equations.

Unit II

Vector Spaces: Introduction, Vector Spaces, Examples of Vector Spaces, Linear Combinations, Spanning Sets, Subspaces, Linear Spans, Row Space of a Matrix, Linear Dependence and Independence of Vectors, Basis and Dimension, Application to Matrices.

Linear Mappings: Introduction, Mappings, Linear Mappings (Linear Transformations), Kernel and Image of a Linear Mapping, Singular and Non-singular Linear Mappings, Operations with Linear Mappings, Algebra of Linear Operators, Linear Transformation to Matrices and Matrices to Linear transformation.

Unit III

Inner Product Spaces Orthogonality: Introduction, Inner Product Spaces, Examples of Inner Product Spaces, Orthogonality, Orthogonal Sets and Bases, Gram–Schmidt Orthogonalization Process, Complex Inner Product Spaces

Unit IV

Diagonalization: Types of Matrices, Eigen values and Eigenvectors, Polynomials of Matrices, Characteristic Polynomial, Cayley–Hamilton Theorem Minimal Polynomial, Quadratic Form of Matrices: Definite and Indefinite Matrices, Similar Matrices and Diagonalization.

Text and Reference Books:

1. Seymour Lipschutz, Marc Lars Lipson, *Linear Algebra*, Mc Graw Hill,2009.
2. Gilbert Strang, *Linear Algebra and Its Applications*, Cengage India Private Limited,2005.
3. I.N. Herstein, *Topics in Algebra*, Wiley Eastern Ltd., New Delhi, 1975
4. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal, *Basic Abstract Algebra*.
5. Vivek Sahai and Vikas Bist, *Algebra*, Narosa Publishing House,2008.
6. I.S. Luther and I.B.S. Passi, *Algebra, Vol.-II*, Narosa Publishing House,1997.

Hindi

General Course Information

Course Code: **Credits:** 2 **Hours/Week:** 2 **Course Type:** AEC1 **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 3 Hours	**Course Assessment Methods:** **Max. Marks:50 (Internal:15; External:35)**

Note: The syllabus of this course will be provided by Department of Hindi, GJUS&T, Hisar

Data Analysis using R

General Course Information

Course Code: BDS-SEC-111T **Credits:** 2 **Hours/Week:** 2 **Course Type:** SEC1 **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 3 Hours	**Course Assessment Methods:** **Max. Marks: 50 (Internal: 15; External: 35)** Three minor tests, each of 10 marks, will be conducted. The third minor will be conducted by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the highest marks obtained by a student in any of the minor examinations will be considered. Class Performance will be measured through percentage of lectures attended (2 marks) Assignments (2 marks) and class performance (1 mark). The end semester examination will be of 35 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

About the Course:

This course is to learn the fundamentals of R and covers how to use different functions in R for data analysis.

Course Content

Unit I

Introduction to R programming: Installing R and RStudio; R command Prompt, script file; Working in the Console; Getting Help in R and Quitting RStudio. **R packages and scripts:** Installing and loading packages; Downloading and importing data; R scripts; comments and documentation; Creating reports; Loading and handling Data in R: Getting and Setting the Working Directory. Exporting data. **R data types**: Numeric, Integer, Character, logical, complex**. R Data structures:** Vectors; Matrices; Array; List; Data Frames; Factors; **R Operators**: Arithmetic Operators, Relational Operators, Logical Operator, Assignment Operators, Miscellaneous Operators. **R Decision Making**: if statement, if – else statement, switch statement; **R Loops**: repeat loop, while loop, for loop; Loop control statement: break statement, next statement.

Unit II

Descriptive statistics in R: Population, sample, variable, Scales of measurements and their implementation in R. **Measures of central tendency**: Mean, Median, Quantiles, Quartiles, Percentiles, Mode; **Measures of Dispersion**: Range and Interquartile Range, Absolute Deviation, Variance, Standard Deviation, Coefficient of Variation; Skewness and Kurtosis; Summary functions and descriptive statistics by group; Covariance.

Programming Statistical graphics: Scatter plot, Bar charts and dot charts; Pie charts; Histograms; Quantile plot; Box Plots; QQ plots and Box -Whisker Plots.

Unit III

Probability Distributions in R: Discrete Uniform, Binomial, Poisson and Normal;
Correlation: Scatter plot in R; Correlation Coefficient: Product Moment correlation coefficient, Spearman's Rank Correlation Coefficient.
Regression: Simple linear regression modeling : Estimating the coefficients; Point estimation and Interval estimation. Building regression models in R.

Unit IV

Simulation: Generating Random Numbers, Setting the Random number seed, Simulating a Linear Model.

Classification Modelling: The process of classification, KNN, evaluating a classification model: confusion matrix, accuracy, sensitivity, specificity, f-measure, kappa statistics, ROC and area under curve. accuracy and interpretability of classification models.

Text and Reference Books:

1. Mark Gardener, *Beginning R - The Statistical Programming Language*, Wiley India Pvt Ltd ,2012.
2. Andrie de Vries and Joris Meys, *R Programming for Dummies*, Wiley India Pvt Ltd,2015.
3. Jared P. Lander, *R For Everyone - Advanced Analytics and Graphics*, Pearson \Education Inc, 2014.
4. Braun, W. J., & Murdoch, D. J., *A first course in statistical programming with R*, Cambridge University Press, 2016.
5. Bloomfield, V. A. *Using R for numerical analysis in science and engineering*, CRC Press,2018.
6. Everitt, B.S. and Hothorn T, *A Handbook of Statistical Analysis Using R*, CRC Press,2010.
7. Michael J. Crawley, The *R book*, John Wiley & Sons Ltd,2013.

Yoga and Meditation

General Course Information

Course Code: **Credits:** 2 **Hours/Week:** 2 **Course Type:** VAC1 **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 3 Hours	**Course Assessment Methods:** **Max. Marks:50 (Internal:15;External:35)**

Note: The syllabus of this course will be provided by Department of Physiotherapy GJUS&T, Hisar

C Programming Lab.

General Course Information

Course Code: BDS-DSC-111P **Credit:** 1 **Hours/Week:** 2 **Course Type:** DSC-A1 **Category:** Practical **Mode:** Lab Practice and Assignments	**Course Assessment Methods:** **Total Marks: 25 (internal: 10; external: 15)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA VOCE, the quality of lab. file and ethical practices followed. The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

About the Course:

This course is to make the student to understand and implement the C programming language for problem solving techniques.

Practical Lab based on subject BDS-DSC-111T

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

Data Analysis using Excel Lab.

General Course Information

Course Code: BDS-DSC-112P **Credit:** 1 **Hours/Week:** 2 **Course Type:** DSC-A2 **Category:** Practical **Mode:** Lab Practice and Assignments	**Course Assessment Methods:** **Total Marks: 25 (internal: 10; external: 15)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA VOCE, the quality of lab. file and ethical practices followed. The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

About the Course:

This course is about to familiarize oneself with Excel's Basic features and to gain skills on data visualization, data analysis and financial modelling using MS Excel.

Practical Lab based on subject BDS-DSC-112T

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

Data Analysis using R Lab.

General Course Information

Course Code: BDS-SEC-111P **Credit:** 1 **Hours/Week:** 2 **Course Type:** SEC1 **Category:** Practical **Mode:** Lab Practice and Assignments	**Course Assessment Methods:** **Total Marks: 25 (internal: 10; external: 15)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA VOCE, the quality of lab. file and ethical practices followed. The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

About the Course:

This course provides a solid foundation in both probability theory and mathematical statistics and also provides an indication of the relevance and importance of the theory in solving practical problems in the real world.

Practical Lab based on subject BDS-SEC-111T

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

Data Structures

General Course Information

Course Code: BDS-DSC-123T **Credits:** 3 **Hours/Week:** 3 **Course Type:** DSC-A3 **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 3 Hours	**Course Assessment Methods:** **Max. Marks: 75 (Internal: 25; External: 50)** Three minor tests, each of 15 marks, will be conducted. The third minor will be conducted by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the highest marks obtained by a student in any of the minor examinations will be considered. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 50 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain short answers type questions. The remaining eight questions are to be given by setting two questions units of the syllabus. A candidate is required to attempt five questions from each of the four in all, one compulsory and any other four questions by selecting one from each unit.

About the Course:

Data Structure is a core and an essential course for every graduate in Computer Science. This course introduces data structures like arrays, linked lists, trees and graphs etc. and various operations to be implemented on these data structures for solving real world problems. It includes various sorting and searching algorithms as well.

Course Content

Unit I

Introduction to data structures and their types, Abstract data types, Linear lists: Arrays and linked lists: memory representations, implementing operations like traversing, searching, inserting and deleting etc. Applications of arrays and linked lists. Representing sets and polynomials using linked lists.

Unit II

Stack and Queue: Static and linked implementations, Operations and Applications. Circular queues, Tress, Binary trees and related terminology, Tree traversals (Recursive), Threaded Binary Trees, Binary Search Trees implementation and operations, Priority queues.

Unit III

Height Balanced or AVL trees and B trees. Graph definitions and related terminology, memory representations and related operations (traversal, insertion, deletion, search), Single source shortest path, Hashing, Hash tables, hash function and collision resolution.

Unit IV

Sequential and binary search, Sorting algorithms: Bubble sort, Selection sort, Insertion sort, Quick sort, Merge sort, Comparison of searching and sorting techniques based on their complexity analysis, Time and space complexity of algorithms: Asymptotic analysis, Big O, Omega, Theta notations.

Text and Reference Books:

1. G.S. Baluja, *Data Structures Through C (a Practical Approach)*, Dhanpat Rai & Co.,2016.
2. Seymour Lipschutz, *Data Structures with C (Schaum's Outline Series)*, McGraw Hill Education,2017.
3. Ujjwal Mishra, *Data Structure Design*, Arihant Books,2023.
4. Aho, A. V., Ullman, J. D., and Hopcroft, J. E., *Data Structures and Algorithms*, Addison-Wesley, 1983.
5. Langsam Yedidyah, Augenstein J Moshe, Tenenbaum M Aaron, *Data Structures using C* and *C++,* PHI, 2009.
6. Cormen, T. H., Leiserson, C. E., Rivest, R. L. and Stein, C., *Introduction to Algorithms*, MIT Press, 2009.
7. Robert L. Kruse, *Data Structure and Program Design in C*, Pearson Education India, 2007.

Introduction to Artificial Intelligence

General Course Information

Course Code: BDS-DSC-124T **Credits:** 4 **Hours/Week:** 4 **Course Type:** DSC-A4 **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 3 Hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the highest marks obtained by a student in any of the minor examinations will be considered. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

About the Course:

Artificial Intelligence is a core and an essential course for every graduate in Computer Science. This course introduces the concepts of Artificial Intelligence and challenges inherent in building intelligent systems. It includes the role of knowledge representation in problem solving and how these are used in making intelligent machine.

Course Content

Unit I

Overview of Artificial Intelligence: Introduction to AI, Importance of AI, AI and its related field, AI techniques, Problems, Problem Space and search: Defining the problem as a state space search, Production system and its characteristics, Issue in the design of search problem.

Unit II

Depth first search, Breadth First Search Heuristic Search Technique: Generate and test, hill climbing, Best first search technique, A* algorithm, Game Playing: introduction to game playing, min-max and alpha-beta pruning algorithms.

Unit III

Knowledge representation: Definition and importance of knowledge, Knowledge representation, various approaches used in knowledge representation, Issues in knowledge representation, Using Predicate Logic: Representing simple facts in logic.

Unit IV

Learning: Introduction learning, Rote learning, learning by taking advice, learning in problem solving, learning from example-induction, Explanation based learning.
Expert system: Introduction, Representing using domain specific knowledge, Expert system shells.

Text and Reference Books:

1. Elaine Rich, Kevin Knight and Shivashankar B Nair, *Artificial intelligence*, McGraw Hill Education, 2009.
2. Rajiv Chopra, *Artificial Intelligence (A Practical Approach)*, S Chand Publishing, 2012.
3. Stuart Russel and Peter Norvig, *Artificial intelligence: A modern Approach*, Pearson Education, 2015.
4. Dan W. Patterson, *Introduction to Artificial Intelligence and Expert System*, Pearson Education.1st edition, 2007.
5. Deepak Khemani*, A first course in Artificial Intelligence,* McGraw Hill Education. 3rd edition, 1st edition, 2013.
6. George F. Luger, *Artificial Intelligence: Structures and Strategies for Complex Problem Solving*, Pearson Education, 5th edition, 2009

Internet and Web Technology

General Course Information

Course Code: BDS-MIC-122T **Credits:** 3 **Hours/Week:** 3 **Course Type:** MIC2 **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 3 Hours	**Course Assessment Methods:** **Max. Marks: 75 (Internal: 25; External: 50)** Three minor tests, each of 15 marks, will be conducted. The third minor will be conducted by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the highest marks obtained by a student in any of the minor examinations will be considered. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 50 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain short answers type questions. The remaining eight questions are to be given by setting two questions units of the syllabus. A candidate is required to attempt five questions from each of the four in all, one compulsory and any other four questions by selecting one from each unit.

About the Course:

Web development is a management of information. This course introduces web designing tools like HTML, XML, Java Script.

Course Content

Unit I

Introduction to Internet and World Wide Web; Evolution and History of World Wide Web; Basic features; Web Browsers; Web Servers; Hypertext Transfer Protocol, Overview of TCP/IP and its services; URLs; Searching and Web-Casting Techniques; Search Engines and Search Tools;

Unit II

Web Development: Introduction to HTML; Hypertext and HTML; HTML Document Features; HTML command Tags; Creating Links; Headers; Text styles; Text Structuring; Text colors and Background; Formatting text; Page layouts , Images and Multimedia, Links and webs.

Unit III

Cascading Style Sheet: Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, XML: Introduction of XML- Some current applications of XML,

Features of XML, Anatomy of XML document, The XML Declaration, Element Tags: Nesting and structure, XML text and text formatting element

Unit IV

Introduction to JavaScript, Variable Naming Rules and JavaScript Data Types, Expressions and Operators, Flow Control, Objects and Arrays, Defining Functions and Methods, The Document Object Model (DOM), How to Get Input and Output, JavaScript in Browsers, Handling Web Page Events

Text and Reference Books:

1. Raj Kamal Satinder Bal Gupta & Brij Mohan Goel, *Internet and Web Technologies,* Tata McGraw-Hill,2017.
2. Kogent, *Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, ASP.NET, XML and Ajax, Black Book*, Wiley India Ltd ,2009.
3. Thomas Powell , Fritz Schneider , *JavaScript: The Complete Reference* ,McGraw Hill Education, 2017.
4. Thomas A Powell, *HTML-The Complete Reference*, Tata McGraw Hill, 2003.
5. Scott Guelich, Shishir Gundavaram, Gunther Birzniek*, CGI Programming with Perl*, O'Reilly, 2000.
6. Doug Tidwell, James Snell, Pavel Kulchenko, *Programming Web Services with SOAP*, O'Reilly, 2009.
7. Paul J. Deitel, Harvey M. Deitel, Abbey Deitel, *Internet & World Wide Web How to Program,* 2008.

Statistics I

General Course Information

Course Code: BDS-MDC-122T **Credits:** 3 **Hours/Week:** 3 **Course Type:** MDC2 **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 3 Hours	**Course Assessment Methods:** **Max. Marks: 75 (Internal: 25; External: 50)** Three minor tests, each of 15 marks, will be conducted. The third minor will be conducted by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the highest marks obtained by a student in any of the minor examinations will be considered. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 50 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain short answers type questions. The remaining eight questions are to be given by setting two questions units of the syllabus. A candidate is required to attempt five questions from each of the four in all, one compulsory and any other four questions by selecting one from each unit.

About the Course:

This course is about to understand the basic concepts of statistics and demonstrate the discrete and continuous distributions. It also explains the Cramer-Rao inequality regarding lower bound to the variance of unbiased estimator.

Course Content

Unit I

Random variables: Discrete and continuous Random variables, properties of random variables, Probability mass function, Probability density function and cumulative distribution function, Distribution function and its properties. Two dimensional random variables: discrete and continuous type, joint, marginal and conditional Probability mass function, Probability density function and cumulative distribution function, Independence of random variables.

Mathematical Expectation and Generating Functions: Expectation of random variables and its properties, Raw and central moments, covariance, Sums of IID random variables, weak law of large numbers, central limit theorem, Moment generating function, cumulative generating function, probability generating function, Conditional expectations and conditional variance.

Unit II

Discrete and Continuous Probability distributions: Discrete Probability distributions: Bernoulli, Binomial, Poisson and uniform distributions with their properties.

Continuous probability distributions: Rectangular, exponential and normal probability distributions with their properties.

Unit III

Theory of Estimation: Concepts of point and interval estimation, Bias in estimators and MSE, unbiasedness, consistency, efficiency and sufficiency, Neyman's Factorization theorem, MVUE, Cramer-Rao lower bound for unbiased estimators. Maximum likelihood methods of estimation and its properties. Central and non–central chi-Square, t, z and F distributions with their properties.

Unit IV

Hypothesis testing and Confidence intervals: Statistical hypothesis: Simple and composite, Test of statistical Hypothesis: Null and alternative hypotheses, critical region, types of errors, randomized and non-randomized tests, level of significance, power function, most powerful tests, Uniformly most powerful test, Neyman-Pearson fundamental lemma.

Text and Reference Books:

1. S.C. Gupta and V.K. Kapoor, *Fundamentals of Mathematical Statistics*, Sultan Chand & Sons, 2002
2. Murray R. Spiegel, John J. Schiller and R. Alu Srinivasan, *Schaum's Outline of Probability and Statistics*, McGraw-Hill Education,2009
3. Trosset, M. W., *An introduction to statistical inference and its applications with R*, CRC Press,2012
4. Rao C. R*., Linear Statistical Inference and its Applications*, John Wiley, 1973
5. Lehmann, E. L., Romano, J. P., & Casella, Testing *Statistical Hypotheses*, Springer New York, 2005
6. Rohatgi VK & Saleh AK. Md. E., *An Introduction to Probability and Statistics*, John Wiley and sons,2015
7. Hogg and Craig*, Introduction to Mathematical statistics*, Pearson Education,2005

English

General Course Information

Course Code: **Credits:** 2 **Hours/Week:** 2 **Course Type:** AEC2 **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 3 Hours	**Course Assessment Methods:** **Max. Marks:50 (Internal:15 ; External:35)**

Note: The syllabus of this course will be provided by Department of English, GJUS&T, Hisar

Python Programming

General Course Information

Course Code: BDS-SEC-122T **Credits:** 2 **Hours/Week:** 2 **Course Type:** SEC2 **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 3 Hours	**Course Assessment Methods:** **Max. Marks: 50 (Internal: 15; External: 35)** Three minor tests, each of 10 marks, will be conducted. The third minor will be conducted by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the highest marks obtained by a student in any of the minor examinations will be considered. Class Performance will be measured through percentage of lectures attended (2 marks) Assignments (2 marks) and class performance (1 mark). The end semester examination will be of 35 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

About the Course:

Python is a popular open-source programming language used for both standalone programs and scripting applications in a wide variety of domains. It is free, portable, and powerful and is both relatively easy and remarkably fun to use. In today's era Python has found great applicability in machine learning, data analytics and many other data science applications. This is introductory course and covers most of the basic concepts required for basic python programming

Course Content

Unit I

Introduction to Python, History of Python, Features of Python, Python Identifiers, Python Character Set, Keywords and Indentation, Comments, Command Line Arguments, Assignment Operator, Operators and Expressions, print() Function, input() Function, eval() Function, Python Data Types: int, float, complex, Variables, Mutable vs Immutable variables, Namespaces, Decision Statements: Boolean Type, Boolean Operators, if statement, else statement, Nested Conditionals Statements, Multi-way Decision Statements (elif statement)

Unit II

Loop Control Statements: While loop, range() Function, For Loop, Nested Loops, Infinite Loop, Break Statement, Continue Statement, Pass Statement, Introduction to Strings, String Operations: Indexing and Slicing, Lists: Operations on List: Slicing, Inbuilt Functions for Lists, List Processing: Searching and Sorting,Tuples, Dictionaries: Need of Dictionary, Operations on Directories: Creation, Addition,

Retrieving Values, Deletion; Tuples, operations on Tuples, Inbuilt Functions for Tuples, Introduction to Sets, operations on sets.

Unit III

Python Functions, Inbuilt functions, Main function, User Defined functions, Defining and Calling Function, Parameter Passing, Actual and Formal Parameters, Default Parameters, Global and Local Variables, Recursion, Passing Functions as Data, Lamda Function, Modules, Importing Own Module, Packages. Python Object Oriented: Overview of OOP, Classes and objects, Accessing attributes, Built-In Class Attributes, Methods, Class and Instance Variables, Destroying Objects, Polymorphism, Overlapping and Overloading of Operators, Class Inheritance.

Unit IV

Operations on File: Reading text files, read functions, read(), readline() and readlines(), writing Text Files, write functions, write() and writelines().

NumPy: Creating arrays, using arrays and Scalars, Indexing Arrays, Array Transposition, Universal Array Function, Array Processing, Array Input and Output, Arithmetic operations with Array. Matplotlib: create different types of visualization reports like line plots, scatter plots, histograms, bar charts, pie charts, box plots.

Text and Reference Books:

1. Ashok Namdev Kamthane, *Programming and Problem Solving with Python*, Mc Graw Hill Education Publication, 2018.
2. Lutz, M., *Learning Python: Powerful Object-Oriented Programming,* O'Reilly Media, Inc., 2013.
3. Saroj Dahiya Ratnoo and Himmat Singh Ratnoo, *Essentials of R for Data Analytics*, Wiley, 2021.
4. John Guttag, *Introduction to Computation and Programming using Python,* Springer, Revised and Expanded version (Referred by MIT), 2013.
5. Michael T Goodrich and Robertto. Thamassia, Micheal S Goldwasser*, Data Structures and Algorithms in Python*, Wiley, 2016.
6. Y. Daniel Liang, *Introduction to Programming Using Python*, Pearson, 2013.
7. Reema Thareja, *Python Programming Using Problem Solving Approach*, Oxford Publications, 2017.
8. R. Nageswara Rao, *Core Python Programming,* dreamtech Press*,* 2019.
9. Allen B. Downey *Think Python*, O'Reilly Media,2012.
10. Kenneth A. Lambert, *The Fundamentals of Python: First Programs*, Cengage Learning, 2011.

Environment Studies

General Course Information

Course Code: **Credits:** 2 **Hours/Week:** 2 **Course Type:** VAC2 **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 3 Hours	**Course Assessment Methods:** **Max. Marks:50 (Internal:15 ; External:35)**

Note: The syllabus of this course will be provided by Department of Environmental Sciences, GJUS&T, Hisar

Data Structures Lab.

General Course Information

Course Code: BDS-DSC-123P **Credit:** 1 **Hours/Week:** 2 **Course Type:** DSC-A3 **Category:** Practical **Mode:** Lab Practice and Assignments	**Course Assessment Methods:** **Total Marks: 25 (internal: 10; external: 15)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA VOCE, the quality of lab. file and ethical practices followed. The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

About the Course:

This lab course involves implementation of basic and advance data structures and various operations on these data structures. The objective of the lab course is to train the students to solve the problems related to data structures and choose the appropriate data structure for solving computational problem efficiently.

Practical Lab based on subject BDS-DSC-123T

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

Internet and Web Technology Lab.

General Course Information

Course Code: BDS-MIC-122P **Credit:** 1 **Hours/Week:** 2 **Course Type:** MIC2 **Category:** Practical **Mode:** Lab Practice and Assignments	**Course Assessment Methods:** **Total Marks: 25 (internal: 10; external: 15)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA VOCE, the quality of lab. file and ethical practices followed. The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

About the Course:

This lab course on web development involves learning web-based programming languages. It incorporates the development of web pages by structuring information provided for the website design. The objective of the lab course is to equip the students to design web pages using modern web development tools.

Practical Lab based on subject BDS-MIC-122T

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

Python Programming Lab.

General Course Information

Course Code: BDS-SEC-122P **Credit:** 1 **Hours/Week:** 2 **Course Type:** SEC2 **Category:** Practical **Mode:** Lab Practice and Assignments	**Course Assessment Methods:** **Total Marks: 25 (internal: 10; external: 15)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA VOCE, the quality of lab. file and ethical practices followed. The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

About the Course:

Python is a scripting programming language known for both its simplicity and wide breadth of applications. For this reason, it is considered one of the best languages for beginners. Used for everything from web development to scientific computing Python is referred to as a general-purpose language by the greater programming community. The major objective of Python language is to make the students solve real word problem efficiently using python.

Practical Lab based on subject BDS-SEC-122T

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.