Kurukshetra University, Kurukshetra
(Established by the State Legislature Act XII of 1956)
('A++' Grade, NAAC Accredited)

‖ योगस्थ: कुरु कर्माणि ‖
समबुद्धि व योग युक्त होकर कर्म करो
(Perform Actions while Stead fasting in the State of Yoga)

Scheme of Examination(1st and 2nd Semester) for Under-Graduate Programmes
Bachelor of Computer Applications (Data Science)
BCA (DS): **SCHEME D**
according to
Curriculum Framework for Under-Graduate Programmes
As per NEP-2020 (Multiple Entry-Exit, Internships and Choice Based Credit System)
DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS
(For the Batches Admitted From 2023-2024)

Kurukshetra University Kurukshetra
Scheme of Examination for Undergraduate programmes
Subject: BCA (Data Science)
According to
Curriculum Framework for Undergraduate Programmes
as per NEP 2020 (Multiple Entry-Exit, Internships, and Choice Based Credit System)

Sem	Course Type	Course Code	Nomenclature of paper	Credits	Contact hours	Internal marks	End term Marks	Total Marks	Duration of exam (Hrs) T + P
1	CC-A1	B23-CDS-101	Problem Solving through C	3	3	20	50	70	3
			Practical	1	2	10	20	30	3
	CC-B1	B23-CDS-102	Foundations of Computer Science	3	3	20	50	70	3
			Practical	1	2	10	20	30	3
	CC-C1	B23-CDS-103	Logical Organization of Computer	3	3	20	50	70	3
			Practical	1	2	10	20	30	3
	CC-M1	B23-CDS-104	Mathematical Foundations for Computer Science-I	1	1	10	20	30	3
			Practical	1	2	5	15	20	3
	MDC1	To be taken from other department							
	SEC1	To be taken from SEC Pool							
	VAC1	To be taken from VAC Pool							
	AEC1	To be taken from AEC Pool							

2	CC-A2	B23-CDS-201	Object Oriented Programming using C++	3	3	20	50	70	3
			Practical	1	2	10	20	30	3
	CC-B2	B23-CDS-202	Introduction to Web Technologies	3	3	20	50	70	3
			Practical	1	2	10	20	30	3
	CC-C2	B23-CDS-203	Concepts of Operating Systems	3	3	20	50	70	3
			Practical	1	2	10	20	30	3
	CC-M2	B23-CDS-204	Mathematical Foundations for Computer Science-II	1	1	10	20	30	3
			Practical	1	2	5	15	20	3
	MDC-2	To be taken from other department							
	SEC-2	To be taken from SEC Pool							
	VAC-2	To be taken from VAC Pool							
	AEC-2	To be taken from AEC Pool							

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Syllabus of Examination (1ˢᵗ Semester) for Under-Graduate Programmes
Bachelor of Computer Applications
(Data Science)
BCA (DS)
according to
Curriculum Framework for Under-Graduate Programmes
As per NEP-2020 (Multiple Entry-Exit, Internships and Choice Based Credit System)
DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS
(For the Batches Admitted From 2023-2024)

DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS
KURUKSHETRA UNIVERSITY, KURUKSHETRA

Scheme: 2023-24, Syllabus: 2023-24			
Part A - Introduction			
Subject	BCA (DS)		
Semester	I		
Name of the Course	Problem Solving through C		
Course Code	B23-CDS-101		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-A1		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	None		

Course Learning Outcomes(CLO):	After completing this course, the learner will be able to:
	  1. learn the basics of C program, data types, andinput/output statements.
	  2. understand different types of operators, their hierarchies, and also control statements of C.
	  3. implement programs using arrays and strings.
	  4. get familiar with advanced concepts like structures, union, etc. in C language.
	  _____
	  5*. to implement the programs based on various concepts of C.		

Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100(70(T)+30(P)) **Internal Assessment Marks:30(20(T)+10(P))** **End Term Exam Marks: 70(50(T)+20(P))**		**Time: 3 Hrs.(T), 3Hrs.(P)**	
Part B- Contents of the Course			

Unit	Topics	Contact Hours
I	Overview of C: History, Importance, Structure of C Program, Character Set, Constants and Variables, Identifiers and Keywords, Data Types, Assignment Statement, Symbolic Constant. Input/output: Formatted I/O Function-, Input Functions viz. scanf(), getch(), getche(), getchar(), gets(), output functions viz. printf(), putch(), putchar(), puts().	11
II	Operators & Expression: Arithmetic, Relational, Logical, Bitwise, Unary, Assignment, Conditional Operators and Special Operators Operator Hierarchy; Arithmetic Expressions, Evaluation of Arithmetic Expression, Type Casting and Conversion. Decision making with if statement, if-else statement, nested if statement, else-if ladder, switch, break and continue statements, goto statement, Looping Statements: for, while, and do- while loop, jumps in loops.	11
III	Arrays: One-dimensional arrays - Declaration, Initialization, and Memory representation; Two-Dimensional arrays -Declaration, Initialization and Memory representation. Functions: definition, prototype, function call, passing arguments to a function: call by value; call by reference, recursive functions. Strings: Declaration and Initialization, String I/O, Array of Strings, String Manipulation Functions: String Length, Copy, Compare, Concatenate, etc., Search for a Substring.	12
IV	Pointers in C: Declaring and initializing pointers, accessing address and value of variables using pointers; Pointers, and Arrays. User-defined data types: Structures - Definition, Advantages of Structure, declaring structure variables, accessing structure members, Structure members initialization, Array of Structures; Unions - Union definition; the difference between Structure and Union.	11
V*	Practicum: Students are advised to do laboratory/practical practice not limited	30

	to, but including the following types of problems:	
	- To read the radius of a circle and to find the area and circumference - To read three numbers and find the biggest of three - To check whether the number is prime or not - To read a number, find the sum of the digits, reverse the number, and check it for palindrome - To read numbers from the keyboard continuously till the userpresses 999 and to find the sum of only positive numbers - To read the percentage of marks and to display appropriate message (Demonstration of else-if ladder) - To find the roots of the quadratic equation - To read marks scored by n students and find the average of marks (Demonstration of single dimensional array) - To remove Duplicate Elements in a single dimensional Array - To perform addition and subtraction of Matrices - To find the factorial of a number - To generate Fibonacci series - To remove Duplicate Elements in a single dimensional Array - To find the length of a string without using the built-in function - To demonstrate string functions - To read, display, and add two m x n matrices using functions - To read a string and to find the number of alphabets, digits, vowels, consonants, spaces, and special characters - To Swap Two Numbers using Pointers - To demonstrate student structure to read & display records of n students - To demonstrate the difference between structure & union.	

Suggested Evaluation Methods

Internal Assessment:	End Term Examination:

➢ **Theory**
  • Class Participation: 5
  • Seminar/presentation/assignment/quiz/class test etc.: 5
  • Mid-Term Exam: 10
 	
➢ **Practicum**
  • Class Participation: NA
  • Seminar/Demonstration/Viva-voce/Lab records etc.: 10
  • Mid-Term Exam: NA
	A three hour exam for both theory and practicum.

Part C-Learning Resources

Recommended Books/e-resources/LMS:
- Gottfried, Byron S., Programming with C, Tata McGraw Hill.
- Balagurusamy, E., Programming in ANSI C, Tata McGraw-Hill.
- Jeri R. Hanly & Elliot P. Koffman, Problem Solving and Program Design in C, Addison Wesley.
- Yashwant Kanetker, Let us C, BPB.
- Rajaraman, V., Computer Programming in C, PHI.
- Yashwant Kanetker, Working with C, BPB.

*Applicable for courses having practical component.

Scheme: 2023-24, Syllabus: 2023-24			
Part A - Introduction			
Subject	BCA(DS)		
Semester	I		
Name of the Course	Foundations of Computer Science		
Course Code	B23-CDS-102		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/ VAC)	CC-B1		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	None		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. understand the basics of computer 2. learn about I/O devices and operating systems 3. understand the Internet and its services 4. learn about the threats and security concepts on computers <hr> 5*. to understand the working of the operating system, internet, and security-related concepts.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100(70(T)+30(P)) **Internal Assessment Marks:30(20(T)+10(P))** **End Term Exam Marks: 70(50(T)+20(P))**	**Time: 3 Hrs.(T), 3Hrs.(P)**		
Part B- Contents of the Course			
Instructions for Paper- Setter Examiner will set a total of nine questions. Out of which first question will be compulsory.			

Remaining eight questions will be set from four unit selecting two questions from each unit. Examination will be of three-hour duration. All questions will carry equal marks. First question will comprise of short answer type questions covering entire syllabus.

Candidate will have to attempt five questions in all, selecting one question from each unit. First question will be compulsory.

Practicum will be evaluated by an external and an internal examiner. Examination will be of three-hour duration.

Unit	Topics	Contact Hours
I	Computer Fundamentals: Evolution of Computers through generations, Characteristics of Computers, Strengths and Limitations of Computers, Classification of Computers, Functional Components of a Computer System, Applications of computers in Various Fields. Types of Software: System software, Application software, Utility Software, Shareware, Freeware, Firmware, Free Software. Memory Systems: Concept of bit, byte, word, nibble, storage locations and addresses, measuring units of storage capacity, access time, concept of memory hierarchy. Primary Memory - RAM, ROM, PROM, EPROM. Secondary Memory - Types of storage devices, Magnetic Tape, Hard Disk, Optical Disk, Flash Memory.	11
II	I/O Devices: I/O Ports of a Desk Top Computer, Device Controller, Device Driver. Input Devices: classification and use, keyboard, pointing devices - mouse, touch pad and track ball, joystick, magnetic stripes, scanner, digital camera, and microphone Output Devices: speaker, monitor, printers: classification, laser, ink jet, dot-matrix. Plotter. Introduction to Operating System: Definition, Functions, Features of Operating System, Icon, Folder, File, Start Button, Task Bar, Status Buttons, Folders, Shortcuts, Recycle Bin, Desktop, My Computer, My Documents, Windows Explorer, Control Panel.	12
III	The Internet: Introduction to networks and internet, history, Internet, Intranet & Extranet, Working of Internet, Modes of Connecting to Internet. Electronic Mail: Introduction, advantages and disadvantages, User Ids, Passwords, e-mail addresses, message components, message composition, mailer features. Browsers and search engines.	11
IV	Threats: Physical & non-physical threats, Virus, Worm, Trojan, Spyware, Keylogers, Rootkits, Adware, Cookies, Phishing, Hacking, Cracking. Computer Security Fundamentals: Confidentiality, Integrity, Authentication, Non-Repudiation, Security Mechanisms, Security Awareness, Security Policy, anti-virus software & Firewalls, backup	11

	& recovery.	
V*	Practicum: Students are advised to do laboratory/practical practice not limited to, but including the following types of problems: Operating System: • Starting with basics of Operating Systems and its functionalities Computer Basics: • Identify the various computer hardware • Understanding the working of computer • Understanding various types of software Internet and E-mail: • Using Internet for various tasks • Creating and using e-mail. Security: • Understanding various threats • How to be safe from virus threats • Various software to get safe from virus attacks.	30

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	**End Term Examination:** A three-hour exam for both theory and practicum.

Part C-Learning Resources

Recommended Books/e-resources/LMS:
- Sinha, P.K. & Sinha, Priti, Computer Fundamentals, BPB.
- Dromey, R.G., How to Solve it By Computer, PHI.
- Norton, Peter, Introduction to Computer, McGraw-Hill.
- Leon, Alexis & Leon, Mathews, Introduction to Computers, Leon Tech World.
- Rajaraman, V., Fundamentals of Computers, PHI.

*Applicable for courses having practical component.

DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS
KURUKSHETRA UNIVERSITY, KURUKSHETRA

Scheme: 2023-24, Syllabus: 2023-24			
Part A - Introduction			
Subject	BCA(DS)		
Semester	I		
Name of the Course	Logical Organization of Computer		
Course Code	B23-CDS-103		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-C1		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)	Basic Knowledge of Mathematics (10th Level)		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. understand number systems, error detecting correcting code and representations of numbers in a computer system. 2. understand computer arithmetic and Boolean algebra and simplification of Boolean expressions. 3. understand working of logic gates and design various combinational circuits using these logic gates. 4. understand working of different types of flip-flops and design different types of registers. ──────────────────────────────── 5*. to understand the practical aspects of logical organization of computer.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100(70(T)+30(P)) **Internal Assessment Marks:30(20(T)+10(P))** **End Term Exam Marks: 70(50(T)+20(P))**	**Time: 3 Hrs.(T), 3Hrs.(P)**		

Part B- Contents of the Course

Instructions for Paper-Setter

The examiner will set a total of nine questions. Out of which first question will be compulsory. The remaining eight questions will be set from four units, selecting two questions from each. The examination will be of three-hour duration. All questions will carry equal marks. The first question will comprise short answer-type questions covering the entire syllabus.

The candidate will have to attempt five questions, selecting one from each unit. The first question will be compulsory.

The practicum will be evaluated by an external and an internal examiner. The examination will be of three-hour duration.

Unit	Topics	Contact Hours
I	Number Systems: Binary, Octal, Hexadecimal, etc. Conversions from one number system to another, BCD Number System. BCD Codes: Natural Binary Code, Weighted Code, Self-Complimenting Code, Cyclic Code. Error Detecting and Correcting Codes. Character representations: ASCII, EBCDIC, and Unicode. Number Representations: Integer numbers - sign-magnitude, 1's & 2's complement representation. Real Numbers normalized floating point representations.	11
II	Binary Arithmetic: Binary Addition, Binary Subtraction, Binary Multiplication, Binary Division using 1's and 2's Compliment representations, Addition and subtraction with BCD representations. Boolean Algebra: Boolean Algebra Postulates, basic Boolean Theorems, Boolean Expressions, Boolean Functions, Truth Tables, Canonical Representation of Boolean Expressions: SOP and POS, Simplification of Boolean Expressions using Boolean Postulates & Theorems, Kaurnaugh-Maps (up to four variables), HandlingDon't Care conditions.	11
III	Logic Gates: Basic Logic Gates – AND, OR, NOT, Universal Gates – NAND, NOR, Other Gates – XOR, XNOR, etc. Their symbols, truth tables, and Boolean expressions. Combinational Circuits: Design Procedures, Half Adder, Full Adder, Half Subtractor, Full Subtractor, Multiplexers, Demultiplexers, Decoder, Encoder, Comparators, Code Converters.	11
IV	Sequential Circuits: Basic Flip-Flops and their working. Synchronous and Asynchronous Flip –Flops, Triggering of Flip-Flops, Clocked RS, D Type, JK, T type, and Master-Slave Flip-Flops.State Table, State Diagram, and State Equations. Flip-flops characteristics & Excitation Tables.	12

	Sequential Circuits: Designing registers –Serial-In Serial-Out (SISO), Serial-In Parallel-Out (SIPO), Parallel-In Serial-Out (PISO) Parallel-In Parallel-Out (PIPO) and shift registers.	
V*	Practicum: Students are advised to do laboratory/practical practice not limited to but including the following types of problems: Number System: • Problems based on the Number System and their conversion. • Programs based on Number System conversion. Binary Arithmetic • Programs based on Binary Arithmetic. • Problems based on Boolean Expression and their simplification Logic Gates • Understanding the working of logic Gates.Combinatorial Circuits: • Designing and understanding various combinational circuits. Sequential Circuits: • Designing and understanding various sequential circuits.	30

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	**End-Term Examination:** A three-hour exam for both theory and practicum.

Part C-Learning Resources

Recommended Books/e-resources/LMS:
- M. Morris Mano, Digital Logic and Computer Design, Prentice Hall of India Pvt. Ltd.
- V. Rajaraman, T. Radhakrishnan, An Introduction to Digital Computer Design, Prentice Hall.
- Andrew S. Tanenbaum, Structured Computer Organization, Prentice Hall of India Pvt. Ltd.
- Nicholas Carter, Schaum's Outlines Computer Architecture, Tata McGraw-Hill.

*Applicable for courses having practical component.

DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS
KURUKSHETRA UNIVERSITY, KURUKSHETRA

Scheme: 2023-24, Syllabus: 2023-24	
Part A - Introduction	
Subject	BCA(DS)
Semester	I
Name of the Course	Mathematical Foundations for Computer Science-I
Course Code	B23-CDS-104
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-M1
Level of the course (As per Annexure-I	100-199
Pre-requisite for the course (if any)	None
Course Learning Outcomes (CLO):	After learning this course student will be able to: 1. Gain knowledge of set theory, types of sets, and operations on sets. Understand various concepts of matrices and determinants, and acquire the cognitive skills to apply different operations on matrices and determinants. 2. Know the basic concepts of complex numbers and acquire skills to solve linear quadratic equations. 3. Gain knowledge of the concepts of Arithmetic progression, Geometric progression, and Harmonic progression, and find A.M., G.M., and H.M. of given numbers. 4. Understand the concept of differentiation 5. * Attain the skills to make use of the learned concepts of Introductory Mathematics in multidisciplinary learning contexts and to know their applications

Credits	Theory	Practical	Total
	1	1	2
Contact Hours	1	2	3

Max. Marks:50(30(T)+20(P))
Internal Assessment Marks:15(10(T)+5(P))
End Term Exam Marks:35(20(T)+15(P))

Time: 3 Hrs.(T), 3Hrs.(P)

Part B-Contents of the Course

Instructions for Paper-Setter

The examiner will set a total of nine questions. Out of which first question will be compulsory. The remaining eight questions will be set from four units selecting two questions from each unit. The examination will be of three-hour duration. All questions will carry equal marks. The first question will comprise short answer-type questions covering the entire syllabus.

Candidate will have to attempt five questions in all, selecting one question from each unit. The first question will be compulsory.

The practicum will be evaluated by an external and an internal examiner. The examination will be of three-hour duration.

Unit	Topics	Contact Hours
I	Sets and their representations, Empty sets, Finite and infinite sets, Subsets, Equal sets, Power sets, Universal sets, Union and intersection of sets, Difference of two sets, Complement of a set, Venn diagram, De-Morgan's laws, and their applications.	4
II	An introduction to matrices and their types, Operations on matrices, Symmetric and skew-symmetric matrices, Minors, and Co-factors. Determinant of a square matrix, Adjoint and inverse of a square matrix, Solutions of a system of linear equations up to order 3.	4
III	Quadratic equations, Solution of quadratic equations. Arithmetic progression, Geometric progression, Harmonic progression, Arithmetic mean (A.M.), Geometric mean (G.M.), Harmonic mean (H.M.), Relation between A.M., G.M. and H.M.	3
IV	The concept of differentiation, differentiation of simple functions, and Use of differentiation for solving problems related to real-life situations. Differentiation of simple algebraic, trigonometric, and exponential functions.	4

| V* | Practicum:
Students are advised to do laboratory/practical practice not limited to but including the following types of problems:
Problem Solving- Questions related to the practical problems based on the following topics will be worked out and a record of those will be maintained in the Practical Note Book:

• Problems related to union, intersection, difference and complement of sets.
• Problems based on De Morgan's Laws.
• Problems related to Venn diagrams.
• Problems to find inverse of a matrix.
• Problems to find determinant of a square matrix of order 3.
• Problems to find nth term of A.P., G.P. and H.P.
• Problems to find sum of n terms of A.P., G.P. and H.P.
• Problems to find A.M., G.M. and H.M. of given numbers.
• Problems involving formulation and solution of quadratic equations in one variable.
• Problems to find the first derivatives of functions. | 30 |

Suggested Evaluation Methods

| Internal Assessment:
➢ **Theory**
• Class Participation: 4
• Seminar/presentation/assignment/quiz/class test etc.: NA
• Mid-Term Exam: 6

➢ **Practicum**
• Class Participation: NA
• Seminar/Demonstration/Viva-voce/Lab records etc.: 5
• Mid-Term Exam: NA | **End Term Examination:**
A three-hour exam for both theory and practicum. |

Part C-Learning Resources

Text /Reference Books:
- C. Y. Young (2021). *Algebra and Trigonometry*. Wiley.
- S.L. Loney (2016). *The Elements of Coordinate Geometry (Cartesian Coordinates)* (2nd Edition). G.K. Publication Private Limited.
- Seymour Lipschutz and Marc Lars Lipson (2013). *Linear Algebra.* (4th Edition) Schaum's Outline Series, McGraw-Hill.
- C.C. Pinter (2014). *A Book of Set Theory*. Dover Publications.
- J. V. Dyke, J. Rogers and H. Adams (2011). *Fundamentals of Mathematics* (10th Edition), Brooks/Cole.
- A.Tussy, R. Gustafson and D. Koenig (2010). *Basic Mathematics for College Students* (4th Edition). Brooks Cole

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Scheme of Examination (3rd & 4th Semester) for Under-Graduate Programmes
Bachelor of Computer Applications (Data Science)
BCA (DS): SCHEME D
according to
Curriculum Framework for Under-Graduate Programmes
As per NEP-2020 (Multiple Entry-Exit, Internships and Choice Based Credit System)
DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS
(For the Batches Admitted From 2023-2024)

Kurukshetra University Kurukshetra
Scheme of Examination for Undergraduate Programmes
Subject: BCA (Data Science)
According to
Curriculum Framework for Undergraduate Programmes
as per NEP 2020 (Multiple Entry-Exit, Internships, and Choice-Based Credit System)

Sem	Course Type	Course Code	Nomenclature of paper	Credits	Contact hours	Internal marks	End term Marks	Total Marks	Duration of exam (Hrs) T + P
3	CC-A3	B23-CDS-301	Java OOP Foundations	3	3	20	50	70	3
			Practical	1	2	10	20	30	3
	CC-B3	B23-CDS-302	Data Science Essentials with Python	3	3	20	50	70	3
			Practical	1	2	10	20	30	3
	CC-C3	B23-CDS-303	Data Base Technologies	3	3	20	50	70	3
			Practical	1	2	10	20	30	3
	CC-M3	B23-CDS-304	Linux and Shell programming	3	3	20	50	70	3
			Practical	1	2	10	20	30	3
	MDC-3	To be taken from another department							
	SEC-3	To be taken from SEC Pool							
	AEC-3	To be taken from AEC Pool							
4	CC-A4	B23-CDS-401	Data Structures and Applications	3	3	20	50	70	3
			Practical	1	2	10	20	30	3

CC-B4	B23-CDS-402	Introduction to Big Data	3	3	20	50	70	3
		Practical	1	2	10	20	30	3
CC-C4	B23-CDS-403	Artificial Intelligence and Expert Systems	3	3	20	50	70	3
		Practical	1	2	10	20	30	3
AEC-4	To be taken from AEC Pool							
VAC-3	To be taken from VAC Pool							
CC-M4(V)	To be taken from VOC Pool							

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Syllabus of Examination (3rd and 4th Semester) for Under-Graduate Programmes
BCA (Data Science)
Scheme D
according to
Curriculum Framework for Under-Graduate Programmes
As per NEP-2020 (Multiple Entry-Exit, Internships and Choice Based Credit System)
DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS
(For the Batches Admitted From 2023-2024)

DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS
KURUKSHETRA UNIVERSITY, KURUKSHETRA

Scheme: 2024-25, Syllabus: 2024-25	
Part A - Introduction	
Subject	BCA (Data Science)
Semester	III
Name of the Course	Java OOP Foundations
Course Code	B23-CDS-301
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-A3
Level of the course (As per Annexure-I	200-299
Pre-requisite for the course (if any)	Knowledge of any Computer Programming Language
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Implement simple Java programs. 2. Implement multiple inheritance using Interfaces 3. Implement Exception Handling and File Handling. 4. Use AWT to design GUI applications. 5* develop the project using Java.

Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5

Max. Marks:100(70(T)+30(P)) Internal Assessment Marks:30(20(T)+10(P)) End Term Exam Marks: 70(50(T)+20(P))	Time: 3 Hrs.(T), 3Hrs.(P)
Part B- Contents of the Course	

Instructions for Paper-Setter

The examiner will set a total of nine questions. Out of which the first question will be compulsory. The remaining eight questions will be set from four units, selecting two questions from each. The examination will be of three-hour duration. All questions will carry equal marks. The first question will comprise short answer-type questions covering the entire syllabus.

The candidate must attempt five questions, selecting one from each unit. The first question will be compulsory.

The practicum will be evaluated by an external and an internal examiner. The examination will

Unit	Topics	Contact Hours
	be of three-hour duration.	
I	Object Oriented Programming and Java Fundamentals: Structure of Java programs, Classes and Objects, Data types, Type Casting, Looping Constructs.	11
II	Interfaces: Interface basics; Defining, implementing, and extending interfaces; Implementing multiple inheritance using interfaces Packages: Basics of packages, Creating and accessing packages, System packages, Creating user-defined packages	11
III	Exception handling using the main keywords of exception handling: try, catch, throw, throws, and finally; Nested try, multiple catch statements, creating user-defined exceptions. File Handling Byte Stream, Character Stream, File I/O Basics, File Operations	11
IV	AWT and Event Handling: The AWT class hierarchy, Events, Event sources, Event classes, Event Listeners, Relationship between Event sources and Listeners, Delegation event model, Creating GUI applications using AWT.	12
V*	Practicum: Students are advised to do laboratory/practical practice not limited to but including the following types of problems: - WAP to find the sum of 10 numbers, entered as command line arguments. - WAP to find the area of rectangle and circle using Interface. - WAP to implement multiple inheritance. - WAP to show the concept of packages. - WAP to handle the Exception using try and multiple catch blocks and a final block. - WAP for Implementing Calculator in an Applet, use appropriate Layout Manager. - Write Applet code to add two integers in the textbox and their sum should appear in the third textbox. - Write AWT program in Java to find the sum, Multiplication, and average of three numbers entered in three Text fields by clicking the corresponding Labeled Button. The result should appear in the fourth text field. - Write Applet code to show all the activities of Mouse using Mouselistener and MouseMotionlistener. - What are various stream classes in Java? Write Java code to read characters from a file and write into another file. - What are AWT Classes? Write a Java Program to generate Even numbers and Odd Numbers in TextField "T1 and T2 respectively" while pressing buttons "Even" and "Odd". - Write a program to Copy the text from one file to another using byte stream.	30

Suggested Evaluation Methods	

Internal Assessment:
➢ **Theory**
  • Class Participation: 5
  • Seminar/presentation/assignment/quiz/class test etc.: 5
  • Mid-Term Exam: 10
 	
➢ **Practicum**
  • Class Participation: NA
  • Seminar/Demonstration/Viva-voce/Lab records etc.: 10
  • Mid-Term Exam:　NA
	End Term Examination: A three-hour exam for both theory and practicum.

Part C-Learning Resources	

Recommended Books/e-resources/LMS:
  • Schildt, H. (2018). Java: The Complete Reference. 10th edition. McGraw-Hill Education.
  • Balaguruswamy E. (2014). Programming with JAVA: A Primer. 5th edition. India: McGraw Hill Education
  • Horstmann, C. S. (2017). Core Java - Vol. I – Fundamentals (Vol. 10). Pearson Education
  • Schildt, H., & Skrien, D. (2012). Java Fundamentals - A Comprehensive Introduction. India: McGraw Hill Education.	

*Applicable for courses having practical components.

Scheme: 2024-25, Syllabus: 2024-25			
Part A - Introduction			
Subject	BCA (Data Science)		
Semester	III		
Name of the Course	Data Science Essentials with Python		
Course Code	B23-CDS-302		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-B3		
Level of the course (As per Annexure-I	200-299		
Pre-requisite for the course (if any)	Basic knowledge of mathematics and computer		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Understand the basics of Python and its control structures. 2. Learn to work with various data structures. 3. Ability to apply various Modules and Packages 4. Utilize NumPy for array operations, statistical analysis, and employ Matplotlib and Pandas for data visualization and handling data frames. 5*. To apply the concepts of python programming for data visualizations.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100(70(T)+30(P)) **Internal Assessment Marks:30(20(T)+10(P))** **End Term Exam Marks: 70(50(T)+20(P))**	**Time: 3 Hrs.(T), 3Hrs.(P)**		
Part B- Contents of the Course			

Instructions for Paper-Setter

The examiner will set a total of nine questions. Out of which the first question will be compulsory. The remaining eight questions will be set from four units selecting two questions from each unit. The examination will be of three-hour duration. All questions will carry equal marks. The first question will comprise short answer-type questions covering the entire syllabus. The candidate will have to attempt five questions in all, selecting one question from each unit.

The first question will be compulsory.

The practicum will be evaluated by an external and an internal examiner. The examination will be of three-hour duration.

Unit	Topics	Contact Hours
I	**Introduction to Data Science:** Overview of Data Science and its Significance, The History and Evolution of Data Science Fundamental Framework and Architecture, Growth of Data Science, Roles within Data Science, Core Components of Data Science, Users and the Hierarchical Model of Data Science**.**	11
II	**Statistical Modeling:** Overview of Statistical Modeling for Data Science **Key Statistical Concepts in Data Science:** Descriptive Statistics – Mean, Median, Mode, Range, Variance, and Standard Deviation, Inferential Statistics – Probability distributions - Binomial Distribution, Poisson Probability, Sampling methods – Probability Sampling, Random Sampling, Stratified Sampling, Systematic Sampling, Cluster Sampling. Normal Distribution, Hypothesis Testing	11
III	**Python Basics:** History and need of Python, Advantages and Disadvantages of Python, installing Python, Input and output in Python, variables and data types, Numbers, Strings, Lists, Tuples, Dictionary, Set. **Control Structures:** Conditional Statements (if, else, elif), Python Indentations, Looping Constructs (for, while), Control Statements (break, continue), Range function: introduction to range (), types of range () functions, use of range () function.	11
IV	**Python Collections:** Introduction to Python Collections, List - Creation, Access, Operations, and Comprehensions, Tuples - Creation, Access, Immutability, and Operations, Sets - Introduction, Set Operations, and Methods, Dictionaries - Key-Value Pairs, Access, and Comprehensions **File Handling:** Introduction, Data Loading, Creating Files, and Operations on Files.	12
V*	Practicum: 1. Write a program in Python to display the following information: a. Your Name, Full Address, Mobile Number, College Name, Subjects. 2. Implement a program to input two numbers and perform basic arithmetic operations (addition, subtraction, multiplication, division). 3. Implement a program that demonstrates the use of the range function with different types of ranges. 4. Implement a program that uses conditional statements	30

(if, else, elif) to determine the largest of three numbers.
5. To print the factorial of a positive integer
6. To print the sum of N prime numbers
7. Program to count the number of occurrences of a character in a given string.
8. Write a program that combines two lists in a dictionary.
9. Program to find duplicates in a list.
10. Demonstrate the immutability of tuples by attempting to modify them.
11. Write a program to find the union, intersection, difference, and symmetric difference of given two sets.
12. Write a Python program that generates and prints the first 10 numbers of the Fibonacci sequence using a loop. The Fibonacci sequence starts with 0 and 1; each subsequent number is the sum of the previous two.
13. Write a list comprehension to generate a list of squares of numbers from 1 to 10.
14. Write a Python program to create a new file and write some text to it.
15. You have been provided with a list of exam scores for a class of students. The scores are as follows: 85, 90, 78, 92, 85, 85, 88, 90, 100, 78, 92, 85. Your task is to perform a statistical analysis of this data using Python. i.e. you need to calculate Mean, Median, Mode, Standard Deviation, Variance

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	**End Term Examination:** **A three-hour exam for both theory and practicum.**

Part C-Learning Resources
Recommended Books/e-resources/LMS: • Data Science from Scratch, Joel Grus, O'REILLY, 2nd Edition • Data Analytics using Python,Bharti Motwani,Wiley • "Statistics for Data Science" by James D. Miller • Introduction to Python Programming, Gowrishankar S et al., CRC Press, 2019. • Core PYTHON Applications Programming, Wesley J. Chun, 3rd Edition, Prentice Hall, 2012

*Applicable for courses having practical components.

DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS
KURUKSHETRA UNIVERSITY, KURUKSHETRA

Scheme: 2024-25, Syllabus: 2024-25	
Part A - Introduction	
Subject	BCA (Data Science)
Semester	III
Name of the Course	Data Base Technologies
Course Code	B23-CDS-303
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/ VAC)	CC-C3
Level of the course (As per Annexure-I	200-299
Pre-requisite for the course (if any)	Basic Knowledge of computer
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. understand the basic concepts and structure of database technologies 2. understand the various models used in the database 3. understand various ways to manipulate the data in the database 4. understand the relational model and data representation in a structured manner. 5*. to perform various operations on databases.

Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5

Max. Marks:100(70(T)+30(P)) **Internal Assessment Marks:30(20(T)+10(P))** **End Term Exam Marks: 70(50(T)+20(P))**	**Time: 3 Hrs.(T), 3Hrs.(P)**
Part B- Contents of the Course	

Instructions for Paper-Setter

The examiner will set a total of nine questions. Out of which the first question will be compulsory. The remaining eight questions will be set from four units selecting two questions from each unit. The examination will be of three-hour duration. All questions will carry equal marks. The first question will comprise short answer-type questions covering the entire syllabus. The candidate will have to attempt five questions in all, selecting one question from each unit.

	The first question will be compulsory. The practicum will be evaluated by an external and an internal examiner. The examination will be of three-hour duration.	

Unit	Topics	Contact Hours
I	Basic Concepts – Data, Information, Records, Files, Schema and Instance etc. Limitations of File-Based Approach, Characteristics of Database Approach, Database Management System (DBMS), Components of DBMS Environment, DBMS Functions and Components, Database Interfaces, Advantages and Disadvantages of DBMS. Database Users: Data and Database Administrator, Role and Responsibilities of Database Administrator, Database Designers, Application Developers etc. Database System Architecture – 1-Tier, 2-Tier & Three Levels of Architecture, External, Conceptual, and Internal Levels, Schemas, Mappings and Instances, Data Independence – Logical and Physical Data Independence.	11
II	Data Models: Hierarchical, Network, and Relational Data Models. Entity-Relationship Model: Entity, Entity Sets, Entity Type, Attributes: Type of Attributes, Keys, Integrity Constraints, Designing of ER Diagram, Symbolic Notations for Designing ER Diagram,	11
III	SQL: Meaning, Purpose and Need of SQL, Data Types, SQL Components: DDL, DML, DCL and DQL, Basic Queries, Joint Operations and Sub-queries. Constraints and its Implementation in SQL. Relational Algebra: Basic Operations: Select, Project, Join, Union, Intersection, Difference, and Cartesian Product, etc. Relational Calculus: Tuple Relational and Domain Relational Calculus.	12
IV	Relational Model: Functional Dependency, Characteristics, Inference Rules for Functional Dependency, Types of Functional Dependency, Normalization: Benefits and Need of Normalization, Normal Forms Based on Primary Keys- (1NF, 2NF, 3NF, BCNF), Multi-valued Dependencies, 4 NF, Join dependencies, 5 NF, Domain Key Normal Form.	11
V*	The following activities be carried out/ discussed in the lab during the period of the semester. Programming Lab: • Performing various SQL statements. Creating various tables and performing all possible queries based on the syllabus. • Creating and populating a simple database, performing basic CRUD operations.	30

9

	• Writing complex queries involving joins subqueries, and using indexes. • Understanding relational model concepts • Understanding normalization • Designing a database schema for a given problem, and normalization of the schema.	
Suggested Evaluation Methods		
Internal Assessment: ➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	**End Term Examination:** **A three-hour exam for both theory and practicum.**	
Part C-Learning Resources		
Recommended Books/e-resources/LMS: • Elmasri & Navathe, Fundamentals of Database Systems, Pearson Education. • A Silberschatz, H Korth, S Sudarshan, Database System and Concepts, McGraw-Hill. • Thomas Connolly Carolyn Begg, Database Systems, Pearson Education. • C. J. Date, An Introduction to Database Systems, Addison Wesley.		

*Applicable for courses having practical components.

DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS
KURUKSHETRA UNIVERSITY, KURUKSHETRA

Scheme: 2024-25, Syllabus: 2024-25			
Part A - Introduction			
Subject	BCA (Data Science)		
Semester	III		
Name of the Course	Linux and Shell Programming		
Course Code	B23-CDS-304		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-M3		
Level of the course (As per Annexure-I	200-299		
Pre-requisite for the course (if any)	Must have basic knowledge of computer		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. understand Linux architecture. 2 use various Linux commands that are used to manipulate system operations. 3 acquire knowledge of Linux File System. 4 understand and make effective use of I/O and shell scripting language to solve problems. 5*. to implement the programs based on various shell commands and programs in Linux.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100(70(T)+30(P)) **Internal Assessment Marks:30(20(T)+10(P))** **End Term Exam Marks: 70(50(T)+20(P))**	**Time: 3 Hrs.(T), 3Hrs.(P)**		
Part B- Contents of the Course			
Instructions for Paper-Setter			
The examiner will set a total of nine questions. Out of which the first question will be compulsory. The remaining eight questions will be set from four units selecting two questions from each unit. The examination will be of three-hour duration. All questions will carry equal marks. The first question will comprise short answer-type questions covering the entire syllabus.			

The candidate will have to attempt five questions in all, selecting one question from each unit. The first question will be compulsory.

The practicum will be evaluated by an external and an internal examiner. The examination will be of three-hour duration.

Unit	Topics	Contact Hours
I	Introduction to Linux: Linux distributions, Overview of Linux operating system, Linux architecture, Features of Linux, Accessing Linux system, Starting and shutting down system, Logging in and Logging out, Comparison of Linux with other operating systems.	11
II	Commands in Linux: General-purpose commands, File oriented commands, directory-oriented commands, Communication-oriented commands, process-oriented commands, etc. Regular expressions & Filters in Linux: Simple filters viz. more, wc, diff, sort, uniq, grep; Introducing regular expressions.	11
III	Linux file system: Linux files, inodes and structure and file system, file system components, standard file system, file system types. Processes in Linux: Starting and Stopping Processes, Initialization Processes, Mechanism of process creation, and Job control in Linux using at, batch, cron & time.	11
IV	Shell Programming: vi editor, shell variables, I/O in shell, control structures, loops, subprograms, creating & executing shell scripts in Linux.	12
V*	Practicum: Students are advised to do laboratory/practical practice not limited to but including the following types of problems: • Basic Linux command • Basic Shell Programming (Fibonacci Series generation, Factorial of a given number, Checking for Armstrong number) • Designing an Arithmetic calculator • Generation of Multiplication table • Base Conversion (Decimal to Binary, Binary to Decimal) • Finding the information about the Login name and File name. • Write a shell script to exchange the contents of two variables. • Write a shell script, which accepts three subject marks scored by a student and declares the result. • Write a shell script program to find the area of a square, rectangle, circle, and triangle. • Write a shell script to print integer numbers from 1 to 20.	30
Suggested Evaluation Methods		
Internal Assessment: ➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5		**End Term Examination:** A three-hour exam for both

	theory and practicum.

• Mid-Term Exam: 10
 	
➢ **Practicum**
  • Class Participation: NA
  • Seminar/Demonstration/Viva-voce/Lab records etc.: 10
  • Mid-Term Exam: NA	

Part C-Learning Resources

Recommended Books/e-resources/LMS:
  • Yashwant Kanetkar, Unix & Shell programming – BPB Publications.
  • Richard Petersen, The Complete Reference – Linux, McGraw-Hill.
  • M.G.Venkateshmurthy, Introduction to Unix & Shell Programming, Pearson Education.
  • Stephen Prata, Advanced UNIX-A Programmer's Guide, SAMS Publication.
  • Sumitabha Das, Your Unix - The Ultimate Guide, Tata McGraw-Hill.

*Applicable for courses having practical components.

Scheme: 2024-25, Syllabus: 2024-25	
Part A - Introduction	
Subject	BCA (Data Science)
Semester	IV
Name of the Course	Data Structures and Applications
Course Code	B23-CDS-401
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-A4
Level of the course (As per Annexure-I	200-299
Pre-requisite for the course (if any)	Knowledge of any Computer Programming Language
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. learn the basics of data structure and algorithm complexities. 2. acquire knowledge of arrays and strings. 3. understand the idea of implementation for linked lists and stacks. 4. learn various searching and sorting techniques along with the implementation of queues. 5* develop the project with data structures.

Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5

Max. Marks:100(70(T)+30(P)) Internal Assessment Marks:30(20(T)+10(P)) End Term Exam Marks: 70(50(T)+20(P))	Time: 3 Hrs.(T), 3Hrs.(P)

Part B- Contents of the Course
Instructions for Paper-Setter
The examiner will set a total of nine questions. Out of which first question will be compulsory. The remaining eight questions will be set from four units selecting two questions from each unit. The examination will be of three-hour duration. All questions will carry equal marks. The first question will comprise short answer-type questions covering the entire syllabus.   The candidate must attempt five questions, selecting one from each unit. The first question will be compulsory.   The practicum will be evaluated by an external and an internal examiner. The examination will be of three-hour duration.

Unit	Topics	Contact Hours
I	**Data Structure** Definition, Data Type vs. Data Structure, Classification of Data Structures, Data Structure Operations, Applications of Data Structures. **Algorithm Specifications**: Performance Analysis and Measurement (Time and Space Analysis of Algorithms- Average, Best and Worst Case Analysis). **Arrays**: Introduction, Linear Arrays, Representation of Linear Array in Memory, Two Dimensional and Multidimensional Arrays, Sparse Matrix and its Representation, Operations on Array: Algorithm for Traversal, Selection, Insertion, Deletion and its implementation.	11
II	**String Handling**: Storage of Strings, Operations on Strings viz., Length, Concatenation, Substring, Insertion, Deletion, Replacement, Pattern Matching **Linked List**: Introduction, Array vs. linked list, Representation of linked lists in Memory, Traversing a Linked List, Insertion, Deletion, Searching into a Linked list, Type of Linked List.	11
III	**Stack**: Array Representation of Stack, Linked List Representation of Stack, Algorithms for Push and Pop, Application of Stack: Polish Notation, Postfix Evaluation Algorithms, Infix to Postfix Conversion, Infix to Prefix Conversion, Recursion. **Introduction to Queues**: Simple Queue, Double Ended Queue, Circular Queue, Priority Queue, Representation of Queues as Linked List and Array, Applications of Queue. Algorithm on Insertion and Deletion in Simple Queue and Circular Queue. Priority Queues.	12
IV	**Tree:** Definitions and Concepts, Representation of Binary Tree, Binary Tree Traversal (Inorder, postorder, preorder), Binary Search Trees – Definition, Operations viz., searching, insertions and deletion; Searching and Sorting Techniques, Sorting Techniques: Bubble sort, Merge sort, Selection sort, Quick sort, Insertion Sort. Searching Techniques: Sequential Searching, Binary Searching.	11
V*	**Practicum**: Students are advised to do laboratory/practical practice not limited to but including the following types of problems: • Write a program that uses functions to perform the following operations on an array i) Creation ii) Insertion iii) Deletion iv) Traversal. • Write a program that uses functions to perform the following operations on strings i) Creation ii) Insertion iii) Deletion iv) Traversal. • Write a program that uses functions to perform the following operations on a singly linked list i) Creation ii) Insertion iii) Deletion iv) Traversal. • Write a program that uses functions to perform the following operations on a doubly linked list i) Creation ii) Insertion iii) Deletion iv) Traversal • Write a program that implement stack (its operations) using	30

	i) Arrays ii) Linked list(Pointers).	
	• Write a program that implements Queue (its operations) using i) Arrays and ii) Linked lists (Pointers).	
	• Write a program that implements the following sorting i) Bubble sort ii) Selection sort iii) Quick sort.	
	• Write programs for various types of tree traversals.	

Suggested Evaluation Methods

Internal Assessment:	End-Term
➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	**Examination:** A three-hour exam for both theory and practicum. **End Term Exam Marks: 70(50(T)+20(P))**

Part C-Learning Resources

Recommended Books/e-resources/LMS:
- Seymour Lipschutz, Data Structures, Tata McGraw- Hill Publishing Company Limited, Schaum's Outlines.
- Yedidyan Langsam, Moshe J. Augenstein, and Aaron M. Tenenbaum, Data Structures Using C, Pearson Education.
- Trembley, J.P. And Sorenson P.G., An Introduction to Data Structures with Applications, McGraw-Hill.
- Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Addison- Wesley.

* Applicable for courses having practical components.

1

DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS
KURUKSHETRA UNIVERSITY, KURUKSHETRA

Scheme: 2024-25, Syllabus: 2024-25			
Part A - Introduction			
Subject	BCA (Data Science)		
Semester	IV		
Name of the Course	Introduction to Big Data		
Course Code	B23-CDS-402		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/ VAC)	CC-B4		
Level of the course (As per Annexure-I	200-299		
Pre-requisite for the course (if any)	Basic Knowledge of Computers		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Understand the concept of Big Data and its significance in the modern world. 2. Learn about the tools and technologies used to manage and analyze Big Data. 3. Understand the architecture of Big Data systems and processing techniques. 4. Understand the concepts of security and privacy in big data. 5*. Gain practical experience in handling Big Data using relevant software and platforms.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100(70(T)+30(P)) **Internal Assessment Marks:30(20(T)+10(P))** **End Term Exam Marks: 70(50(T)+20(P))**	**Time: 3 Hrs.(T), 3Hrs.(P)**		
Part B- Contents of the Course			

Instructions for Paper-Setter

The examiner will set a total of nine questions. Out of which the first question will be compulsory. The remaining eight questions will be set from four units selecting two questions from each unit. The examination will be of three-hour duration. All questions will carry equal marks. The first question will comprise short answer-type questions covering the entire syllabus. The candidate will have to attempt five questions in all, selecting one question from each unit. The first question will be compulsory.

The practicum will be evaluated by an external and an internal examiner. The examination will be of three-hour duration.

Unit	Topics	Contact Hours
I	**Introduction to Big Data:** Definition and characteristics of Big Data (Volume, Variety, Velocity, Veracity, and Value), Traditional Data vs. Big Data, Big Data Analytics and its importance, Applications of Big Data in different domains (e.g., healthcare, finance, retail) **Big Data Technologies and Tools:** Overview of Big Data technologies, Introduction to Hadoop Ecosystem, Hadoop Distributed File System (HDFS), MapReduce programming model	11
II	Introduction to NoSQL databases (MongoDB), Overview of Apache Spark **Big Data Architecture:** Architecture of Big Data systems, Data storage and processing in Big Data, Distributed computing and its role in Big Data, Data ingestion, and ETL processes	11
III	**Big Data Processing Techniques:** Batch processing vs. Stream processing, Real-time data processing, Introduction to Apache Kafka and Flume, Data preprocessing and cleaning techniques **Data Analytics and Visualization:** Introduction to data analytics techniques (descriptive, predictive, prescriptive), Data visualization tools for Big Data (Tableau)	12
IV	Case studies on Big Data analytics, Challenges in Big Data Analytics **Security and Privacy in Big Data:** Security challenges in Big Data, Data encryption techniques, Privacy concerns, and data protection laws, Best practices for securing Big Data	11
V*	Practicum: Students are advised to do laboratory/practical practice not limited to but including the following types of problems: **Introduction to the Hadoop Ecosystem** • Installation and configuration of Hadoop • Working with HDFS: Storing and retrieving data • Running a basic MapReduce job **Working with NoSQL Databases** • Introduction to MongoDB • Basic operations: CRUD (Create, Read, Update, Delete) • Handling large datasets with MongoDB **Data Processing with Apache Spark** • Introduction to Apache Spark • Setting up a Spark environment • Running basic Spark applications using RDDs and DataFrames **Practical 4: Real-time Data Processing** • Setting up a Kafka environment • Streaming data from Kafka to Spark • Real-time data processing with Spark Streaming **Data Analytics with Big Data** • Analyzing large datasets using Spark MLlib • Implementing machine learning algorithms on Big Data • Visualizing the results using Tableau/Power BI	30

	Security in Big Data	
	• Implementing data encryption techniques • Securing data in HDFS • Best practices for ensuring privacy in Big Data projects	
Suggested Evaluation Methods		
Internal Assessment: ➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	**End-Term Examination:** A three-hour exam for both theory and practicum. **End Term Exam Marks: 70(50(T)+20(P))**	
Part C-Learning Resources		
Recommended Books/e-resources/LMS: • "Big Data: Principles and Best Practices of Scalable Real-time Data Systems" by Nathan Marz and James Warren • "Hadoop: The Definitive Guide" by Tom White • "MongoDB: The Definitive Guide" by Kristina Chodorow • "Learning Spark: Lightning-Fast Data Analytics" by Holden Karau, Andy Konwinski, Patrick Wendell, and Matei Zaharia • "Real-Time Big Data Analytics: Emerging Architecture" by Mike Barlow		

*Applicable for courses having practical components.

DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS
KURUKSHETRA UNIVERSITY, KURUKSHETRA

Scheme: 2024-25, Syllabus: 2024-25	
Part A - Introduction	
Subject	BCA (Data Science)
Semester	IV
Name of the Course	Artificial Intelligence and Expert Systems
Course Code	B23-CDS-403
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-C4
Level of the course (As per Annexure-I	200-299
Pre-requisite for the course (if any)	Basic understanding of computer systems and programming.
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Understand core principles and techniques of AI and expert systems. 2. Learn and implement AI algorithms and expert system methodologies. 3. Develop practical skills in creating and evaluating expert systems. 4. Discuss ethical considerations and societal impacts of AI and expert systems. 5*. Apply AI techniques to solve real-world problems.

Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5

Max. Marks:100(70(T)+30(P)) Internal Assessment Marks:30(20(T)+10(P)) End Term Exam Marks: 70(50(T)+20(P))	Time: 3 Hrs.(T), 3Hrs.(P)
Part B- Contents of the Course	

Instructions for Paper-Setter

The examiner will set a total of nine questions. Out of which the first question will be compulsory. The remaining eight questions will be set from four units selecting two questions from each unit. The examination will be of three-hour duration. All questions will carry equal marks. The first question will comprise short answer-type questions covering the entire syllabus. The candidate will have to attempt five questions in all, selecting one question from each unit. The first question will be compulsory.

Unit	Topics	Contact Hours
continued	The practicum will be evaluated by an external and an internal examiner. The examination will be of three-hour duration.	
I	Introduction to Artificial Intelligence: Overview of AI; History; Applications; Terminology Problem-Solving and Search Algorithms: Problem-solving as search; Uninformed search strategies (BFS, DFS); Informed search strategies (A*)	11
II	Adversarial Search and Game Playing: Game theory basics; Minimax algorithm; Alpha-beta pruning Knowledge Representation and Reasoning: Logical agents; Propositional logic; First-order logic; Inference mechanisms	11
III	Expert Systems Fundamentals: Introduction to expert systems; Components; Knowledge representation; Inference engines Knowledge Acquisition and Management: Techniques for knowledge acquisition; Knowledge management; Ontologies	11
IV	Ethics and Social Impacts of AI and Expert Systems: Ethical considerations; Bias and fairness; Societal impact of AI and expert systems Case Studies in Expert Systems: Case studies of successful expert systems in various domains (e.g., medical diagnosis, financial forecasting)	12
V*	Practicum: Students are advised to do laboratory/practical practice not limited to but including the following types of problems: • Exercises on BFS, DFS, and A* algorithms • Implementing Minimax and Alpha-beta pruning algorithms • Exercises on propositional and first-order logic • Exercises on building and implementing rule-based expert systems • Using tools for knowledge management and acquisition • Analyzing case studies and extracting design principles • Group discussions and presentations on case studies • Analysis and discussion of ethical issues related to AI and expert systems	30

Suggested Evaluation Methods

Internal Assessment:	End-Term Examination:
➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	A three-hour exam for both theory and practicum. **End Term Exam Marks: 70(50(T)+20(P))**

Part C-Learning Resources
Recommended Books/e-resources/LMS: • "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig • "Expert Systems: Principles and Programming" by Joseph C. Giarratano and Gary D. Riley

*Applicable for courses having practical components.