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UNIVERSITY OF MYSORE

Estd.1916

Vishwavidyanilaya Karyasoudha
Crawford Hall, Mysuru- 570 005

(Re-accredited by NAAC at 'A')

(NIRF-2022 Ranked 33 in University Category & 54 in Overall Category)

No.: PMEB-1/Spl./28(6)/2021-22 **Date: 03-11-2022**

NOTIFICATION

Sub.: Syllabus and Examination pattern of **B.Sc. (Hons.)(Data Science & Artificial Intelligence)** course under Specialized Programmes from the academic year 2022-23-reg.

Ref.: 1. Decision of the BOS Meeting held on 10-06-2022.
2. Decision of the Faculty of Science & Technology meeting held on 15-09-2022.
3. Decision of the Academic Council meeting held on 23-09-2022.

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The Board of Studies in **B.Sc. (Hons.)(Data Science & Artificial Intelligence) (UG)** at its meeting held on 10-06-2022 has recommended approve the 1st year Syllabus of **B.Sc. (Hons.)(Data Science & Artificial Intelligence)** course in University of Mysore under specialized/specified programs from the academic year 2022-23 as per NEP-2020.

The Faculty of Science & Technology and the Academic Council at their meetings held on 15-09-2022 and 23-09-2022 respectively, have also approved the above said proposal and the same is hereby notified.

The 1st year syllabus of **B.Sc. (Hons.)(Data Science & Artificial Intelligence)** course may be downloaded from the University website **https://uni-mysore.ac.in/PMEB/.**

REGISTRAR

REGISTRAR
University of Mysore
MYSURU - 570 005

To;

1. The Registrar (Evaluation), University of Mysore, Mysuru.
2. The Dean, Faculty of Science & Technology, DoS in Earth Science, Manasagangothri, Mysuru.
3. Prof. Suresha, DoS in Computer Science, Manasagangothri, Mysuru.
4. The Principal, Sarada Vilas College, Krishnamurthypuram, Mysuru.
5. The Deputy Registrar/ Asst. Registrar/ Superintendent, Examination Branch, UOM, Mysuru.
6. The PA to Vice-Chancellor/Registrar/Registrar (Evaluation), University of Mysore, Mysuru.
7. Office Copy.

o/c

SARADA VILAS EDUCATIONAL INSTITUTION

Krisanamurthypuram, Mysore-570008

Proceedings of the meeting of the members of the Board of Studies in B.Sc. (Hon's) (Data Science and Artificial Intelligence) (UG)held on 10-06-2022 at 12.00 PM at the Sarada Vilas College, Mysuru.

Ref: 1. UA2/379/2016-2017, DATED : 17-05-2022

With references to the above cited, a meeting of the members of the Board of Studies in B.Sc (Hon's) (Data Science and Artificial Intelligence) has been conducted at the Sarada Vilas College on Friday the 10-06-2022 at 12.00 PM. The following members have attended the meeting.

1. Dr. Vasuki K. R — Member
2. Prof.H.S. Nagendraswamy — Member
3. Prof.Satyanarayana — Member
4. Prof. Suresha — Chairman

The following member were absent for the meeting.

1. Sri.B.K. SrinivasRaghavan — Member
2. Sri.Biswajit Chatterjee — Member

The meeting was initiated with a welcome speech by Prof. Suresha, Chairman of the board. The importance of the meeting was presented along with the agenda of framing the syllabus as per NEP 2020 Regulations for various courses to be offered as part of the proposed B.Sc. (Hon's) (Data Science and Artificial Intelligence) UG program. The draft of the proposed scheme, titles of the courses and the respective syllabi are placed before the members of the board for discussion and suggestions were sought.

After detailed presentation and discussion among the members, the following were resolved to be recommended.

1. The proposed B.Sc. (Hon's) (Data Science and Artificial Intelligence) should be offered under the common NEP 2020 regulations being followed by the University from time to time for the existing general (conventional) B.Sc. (Hon's) (Data Science and Artificial Intelligence) program. The only difference is in the titles of various courses and their respective syllabi offered under DSC, DSE and SEC.

2. The overall number of credits to be earned by the students and distributions of credits in each semester are exactly on par with the existing B.Sc. (Hon's) (Data Science and Artificial Intelligence) program of the University.

3. The scheme and titles of the various courses along with the credit patterns and the respective syllabi for the proposed program are given in ANNEXURE B.Sc. (Hon's) (Data Science and Artificial Intelligence)

Prof.
Suresha
CHAIRMAN

Dr. SURESHA
Professor
Department of Studies in Computer Science
University of Mysore
Manasagangotri, Mysore - 570 006
Karnataka, INDIA

ANNEXURE

Bachelor of Honour's
Data Science and Artificial Intelligence

As per NEP Regulations

To be implemented from the Academic year 2022-23

Proposed Scheme & syllabus for BSc Hon's (Data Science and Artificial Intelligence)
As per NEP 2020 regulations

I.OBJECTIVES:

1. To develop skills required to be an expert in fundamental computer application subjects including both software and hardware.
2. To provide competent and technical skills personnel to the industry in the area of Data Science and Artificial Intelligence.
3. To enhance the employability skills.
4. To encourage entrepreneurship among student pursuing the education.
5. To ensure holistic development of students.

II. ELIGIBILITY FOR ADMISSION:

Candidates who have passed two years Pre-University course of Karnataka State in any discipline or its equivalent (Viz., 10 + 2 of other states, ITI, Diploma etc) are eligible for admission into this program.

III. DURATION OF THE PROGRAM:

The program of study is 4 years of 8 semester a candidate shell completes his or her degree within 8 academic years from the date of his or her admission to the first semester. The NEP 2020 provides multiple exit options first students as specified below.

EXIT OPTIONS:

The students who successfully complete one year or two semesters and leave the program will be awarded certificate in BSC honours (Data Science and Artificial Intelligence)

The students who successfully complete 2 years or 4 semesters and leave the program will be awarded diploma in honours (Data Science and Artificial Intelligence)

Students who successfully complete 3 years or 6 semesters and leave the program will be awarded Bachelors degree in honours (Data Science and Artificial Intelligence)

An option is given to the students to continue their education to the fourth year and those who successfully complete 4 years or 8 semesters will be awarded Bachelor's degree in honours (Data Science and Artificial Intelligence)

IV. MEDIUM OF INSTRUCTION

The medium of instruction shall be English

V. ATTENDANCE.

a. For the purpose of calculating attendance each semester shall be taken as a Unit.

b. A student shall be conserved to have satisfied the requirement of attendance for the semester, if he/she has attended not less than 75% in aggregate of the number of working periods in each of the subjects compulsorily.

c. A student who fails to complete the course in the manner stated should not be permitted to take the University examination.

VI. TEACHING AND EVALUATION

As basic degree from recognised University are only eligible to teach and to evaluate all the honours courses except languages constitution of India and environmental studies health wellness social and emotional learning/ sports/ NCC/ NSS others.

VII.SKILL DEVELOPMENT RECORD MAINTENANCE

a. Every college is required to establish a dedicated data science lab for the purpose of conducting practical Assignments to be written in the record.

b. In every semester the students should maintain a record book in which a minimum of 5 exercise or activities for course are to be recorded.

VIII. SCHEME OF EXAMINATION

a. There shall be a University examination at the end of each semester the maximum marks of the universities examination in each people shall be 60 marks for DSC /DSE /Vocational / SEC and OEC.

b. Internal assessment 40 marks for DSC /DSE /Vocational / SEC and OEC.

Guidelines for continuous internal evaluation and semester and examination

The CIE and SEE will carry 40% and 60% weightage each to enable the course to be a valuated for a total of 100 marks it is respective of its credits. The evaluation system of the course is comprehensive and continuous during the entire period of the semester. For a course the CIE and SEE evaluation will be on the following parameters.

Sl.No	Parameters for the evaluation	Marks
	Continuous Internal Evaluation (CIE)	
1	Continuous and comprehensive Evaluation (CCE)-(A)	20
2	Internal Assessment Test (IAT) (B)	20
	Total of CIE(A+B)	40
3	Semester End Examinations (SEE)-(C)	60
	Total of CIE and SEE (A+B+C)	100 Marks

Continuous Internal evaluation:

a. Continuous and comprehensive evaluation (CCE):

The CCE will carry a maximum of 20% weight age (20 Marks) of total marks of a course before the start of academic session in each semester, a faculty member should choose for his/ her course.

Minimum for 4 of the following assessment methods with 5 marks each (4X5=20)

i. Individual assignment
ii. Seminars classroom presentations quizzes
iii. Group discussion class discussion group assignments
iv. Case studies / Caselets
v. Participatory and Industry Integrated Learning/ Industrial Visits
vi. Practical activities / Problem solving exercises
vii. Participation in seminars / Academic events/ Symposia.
viii. Mini projects/Capstone projects

a. **Internal Assessment Test (IAT)**

The IAT will carry a maximum of 20% weightage (20 Marks) of total marks of a course. Under this component, two test will have to be conducted in semester for 40 marks each and the same is to be scaled down to 10 marks each

Internal Assessment Test

Course Code: Name of the Course:
Duration: 1 Hour Total Marks: 40

Part A

Answer any one of the following questions. (10 Marks) (1X10=10)
1.....
2. .....

Part B

Answer any one of the following questions. (10 Marks) (1X10=10)
3. .....
4. .....

Part C

Answer any two of the following questions. (10 Marks) (2X10=20)
5. .....
6. .....
7……

Semester End Examination (SEE):

The semester and examination for the courses for which students who get richest during the semester shall we conducted. SEE of the course shall be conducted after full filing them in minimum attendance requirement as per the university norms. The BOS constituted by the University has prepared the seep framework and the question paper for SEE is presented below for 60 marks.

PATTERN OF QUESTION PAPER

Time: 3 Hours Marks: 60

Answer the following questions. (15 Marks) (15X4=60)

1.....

2.....

OR

3. . .....

4. . . ..

5. . .....

6. . .....

OR

7. . .....

8. .....

9. .....

10. . .....

OR

11. . .....

12. .....

13. .....

14. . .....

OR

15. . .....

16……..

Minimum Marks for a Pass:

Candidates who have obtained a minimum of 35% marks in semester end examination i.e, 21 marks out of 60 marks of theory examination and 40% in aggregate i.e, total 40 marks out of 100 marks of semester End Exam marks and Continuous Internal Evaluation Marks.

Proposed Scheme of Teaching Evaluation for B.Sc Hon's (Data Science and Artificial Intelligence)

Year 1 Semester I

Sl.NO	Title of Course	Category Of Courses	Teaching Hrs per Week (L+T+P)	SEE	CIE	Total Marks	Credits
1	Functional English 1	AECC - 1A	3+0+0	60	40	100	3
2	Language 1	AECC - 2A	3+0+0	60	40	100	3
3	Basics of Mathematics and Calculus	DSC 1	3+2+0	60	40	100	5
4	Fundamentals of Computers	DSC 2	3+0+0	60	40	100	3
5	Problem solving & Programming in C	DSC 3	3+2+0	60	40	100	5
6	Digital Fluency	SEC SB	1+0+2	25	25	50	2
7	Open Elective	OEC	3+0+0	60	40	100	3
8	Yoga, Health and Wellness	SEC VB	0+0+2	25	25	50	2
	Total Credits			410	290	700	26

Year 1 Semester II

Sl. NO	Title of Course	Category Of Courses	Teaching Hrs per Week (L+T+P)	SEE	CIE	Total Marks	Credits
1	Functional English 2	AECC - 1B	3+0+0	60	40	100	3
2	Language 2	AECC - 2B	3+0+0	60	40	100	3
3	Algebra and Discrete Mathematics	DSC 4	3+2+0	60	40	100	5
4	Operating System Concepts	DSC 5	3+0+0	60	40	100	3
5	Data Structures using C	DSC 6	3+2+0	60	40	100	5
6	Environmental Studies	SEC SB	1+0+2	25	25	50	2
7	Open Elective	OEC	3+0+0	60	40	100	3
8	Sports/NCC/NSS/R&R (S&G)/ Cultural	SEC VB	0+0+2	25	25	50	2
	Total Credits			410	290	700	26

Year 2 Semester III							
Sl. NO	**Title of Course**	**Category Of Courses**	**Teaching Hrs per Week (L+T+P)**	**SEE**	**CIE**	**Total Marks**	**Credits**
1	Functional English 3	AECC - 1C	3+0+0	60	40	100	3
2	Language 3	AECC - 2C	3+0+0	60	40	100	3
3	Linear Algebra	DSC 7	3+2+0	60	40	100	5
4	Introduction to Big Data & Tools	DSC 8	3+0+0	60	40	100	3
5	Design and Analysis of Algorithms	DSC 9	3+2+0	60	40	100	5
6	Cyber Law	SEC SB	1+0+2	25	25	50	2
7	Open Elective	OEC	3+0+0	60	40	100	3
8	Sports/NCC/NSS/R&R (S&G)/ Cultural	SEC VB	0+0+2	25	25	50	2
	Total Credits			410	290	700	26

Year 2 Semester IV							
Sl. NO	**Title of Course**	**Category Of Courses**	**Teaching Hrs per Week (L+T+P)**	**SEE**	**CIE**	**Total Marks**	**Credits**
1	Functional English 4	AECC - 1D	3+0+0	60	40	100	3
2	Language 4	AECC - 2D	3+0+0	60	40	100	3
3	Probabilities and statistics	DSC 10	3+2+0	60	40	100	5
4	Big Data Analytics and Visualisation	DSC 11	3+0+0	60	40	100	3
5	Introduction to Python Programming	DSC 12	3+2+0	60	40	100	5
6	Basics of Artificial Intelligence	SEC SB	1+0+2	25	25	50	2
7	Open Elective	OEC	3+0+0	60	40	100	3
8	Sports/NCC/NSS/R&R (S&G)/ Cultural	SEC VB	0+0+2	25	25	50	2
	Total Credits			410	290	700	26

Year 3 Semester V							
Sl. NO	**Title of Course**	**Category Of Courses**	**Teaching Hrs per Week (L+T+P)**	**SEE**	**CIE**	**Total Marks**	**Credits**
1	Foundation of AI and Machine Learning	DSC 13	3+2+0	60	40	100	5
2	Introduction to Neural Networks	DSC 14	3+0+0	60	40	100	3
3	Database Management System	DSC 15	3+2+0	60	40	100	5
4	Elective I - Software Engineering / OPERATIONAL Research	DSE 1	3+2+0	60	40	100	5
5	Big Data Management	SEC VB	3+0+0	60	40	100	3
6	Sports/NCC/NSS/R&R (S&G)/ Cultural	SEC VB	0+0+2	25	25	50	2
	Total Credits			**325**	**225**	**550**	**23**

Year 3 Semester VI							
Sl. NO	**Title of Course**	**Category Of Courses**	**Teaching Hrs per Week (L+T+P)**	**SEE**	**CIE**	**Total Marks**	**Credits**
1	Deep Learning	DSC 16	3+2+0	60	40	100	5
2	Natural Language processing	DSC 17	3+2+0	60	40	100	5
3	Introduction to AR Processing	DSC 18	3+0+0	60	40	100	3
4	ELECTIVE II- Data Mining/ Fuzzy Logic and ANN	DSE 1	0+0+2	25	25	50	2
5	Skill Enhancement Course II- Human Robot Interaction Using Motion Capture	SEC SB	3+0+0	25	25	50	3
6	Open Elective	OEC	0+0+2	25	25	50	2
7	Sports/NCC/NSS/R&R (S&G)/ Cultural	SEC VB	0+0+2	25	25	50	2
8	Autonomous Robots	SEC VB	0+0+3	25	25	50	3
	Total Credits						25

Year 4 - Semester VII							
Sl. NO	**Title of Course**	**Category Of Courses**	**Teaching Hrs per Week (L+T+P)**	**SEE**	**CIE**	**Total Marks**	**Credits**
1	ELECTIVE III - Image Processing	DSC 19	3+2+0	60	40	100	5
2	AI Based VR Programming	DSC 20	3+2+0	60	40	100	5
3	Robots Navigation	DSC 21	3+0+0	60	40	100	3
4	ELECTIVE IV - Introduction to Networks and Cloud Computing	DSE 2	3+0+0	60	40	100	3
5	Research Methodology - Mini Project	DSE 6	3+0+0	60	40	100	3
6	Skill Enhancement Course 3 - Predictive Analytics	SEC VB	3+0+0	25	25	50	3
	Total Credits						22

Year 4 - Semester VIII							
Sl. NO	**Title of Course**	**Category Of Courses**	**Teaching Hrs per Week (L+T+P)**	**SEE**	**CIE**	**Total Marks**	**Credits**
1	Research Project Work/Internship with VIVA	DSE 7		100+20	80	200	6
2	Skill Enhancement Course 4 - Swayam Online Courses	SEC VB	3+0+0	25	25	50	3
3	Web Analytics	DSC 22	3+1+0	60	40	100	4
4	Autonomous Robots	DSC 23	3+1+0	60	40	100	4
5	Information and Security System	DSC 24	3+1+0	60	40	100	4
	Total Credits						21

BACHELOR DEGREE WITH HONOURS – Experience of workplace problem solving in the form of internship or research experience preparing for higher education or entrepreneurship experience.

Notes:

- One hour of lecture is equal to 1 Credit
- Two hours of tutorial is equal to 1 credit (Except Language)
- Two hours of tutorial is equal to 2 hours of teaching.
- Two hours of practical is equal to 1 credit
- Two hours of practical is equal to 1 hour of teaching

Practical class may be conducted in the Computer lab depending on the requirements. One batch of students should not exceed half (i.e, 30 or less than 30 students) of the number of students in each class/section. 2 hours of practical class is equal to 1 hour of teaching, however, whenever it is conducted for the entire class (i.e,) more than 30 students) 2 hours of Practical class is equal to two hours of teaching.

Acronyms Expanded

AECC : Ability Enhancement Compulsory Course
DSC : Discipline Specific Course
SEC : Skill Enhancement Course – Skill Based/ Value Based SB/VB
OEC : Open Elective Course
DSE : Discipline Specific Elective
SEE : Semester End Examination
CIE : Continuous Internal Evaluation
L+T+P : Lecture+Tutorial+Practical(s)

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/104
Name of the Course: Fundamentals of Computers

Course Credits	No. of Hours per Week	Total No. of Teaching Hours
3 Credits	**4 Hrs.**	**64 Hrs.**

Pedagogy: Classrooms lecture, tutorials, and problem solving.

Course Outcomes: On successful completion of the course, the students will demonstrate

a) Confidently operate computers to carry out computational tasks
b) Understand working of Hardware and Software and the importance of operating systems
c) Understand Programming languages, number systems, peripheral devices, and networking, multimedia and internet concepts.

Syllabus:	**Hours**
Unit -1 INTRODUCTION TO COMPUTERS	**16**
Computer Definition, Characteristics of Computers, Evolution of Computers, Types of Computers, The Digital Revolution. Anatomy of a Computer: Functions & Components of a Computer	
Unit -2 COMPUTER HARDWARE	**16**
Central Processing Unit - ALU, Control Unit, Registers, Memory Unit and Memory Hierarchy - Cache memory, Primary memory types and technologies, Secondary memory, storage devices, Input and output Devices. Interconnecting the components of a computer - Ports and Buses, How CPU and memory work. Instruction Fetch-Decode-Execute cycle, Instruction set, Program execution with illustrative examples. Microprocessors and Microcontrollers.	
Unit -3 DATA REPRESENTATION	**16**
Number Systems – Decimal, Binary, octal, hexadecimal, conversion from one number system to another; Integer, Floating-point and Character data encoding – BCD, Gray Code, ASCII and Unicode; Boolean Algebra – Boolean Operators with Truth Tables; Introduction to Software: Types of Software – System Software and Application Software; Operating Systems: Functions of an operating System, Classification of Operating Systems with examples; Computer Languages - Machine Level, Assembly Level & High-Level Languages, Translator Programs – Assembler, Interpreter and Compiler; Programming the computer; Storage and Retrieval of data - file systems and DBMS.	
Unit -4 Basics of NETWORKING, INTERNET AND SECURITY	**16**
LANs and WANs, Internet, Logical and physical addresses, N services, Internet Service Providers, Domain Name System. Client-server systems, Introduction to web technologies, web browsers, HTTP, HTML5, CSS3 and JavaScript; Securing access to the computer - authentication and access control, security threats and protection, data security.	

References:

1. Anita Goel: Computer Fundamentals, 2010, Pearson
2. Peter Norton: Introduction to Computers, 7th Edition (or later), 2017, McGraw Hill

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence **Course Code: BH/105** Name of the Course: Problem solving & Programming in C		
Course Credits	**No. of Hours per Week**	**Total No. of Teaching Hours**
5 Credits	**5 Hrs.**	**80 Hrs.**
Pedagogy: Classrooms lecture, tutorials, Group discussion, Seminar, Case studies etc.		
Course Outcomes: On successful completion of the course, the students will demonstrate 1. Read, understand and trace the execution of program written in C language 2. Write the C code for a given problem 3. Preform input and output operations using program in c 4. Write programs that perform operations on arrays, strings, structures, unions and files		

Syllabus:	**Hours**
UNIT-1: Programming Concepts and Introduction to C language:	**20**
Program development life cycle: Problem definition, analysis, Design, Coding, Testing and debugging, Documentation and maintenance. Algorithm- Features, simple examples. Flowchart –Symbols used in a flowchart, suitable examples, Overview of C: Importance of C, basic structure of C program, executing a C program, sample C program, Constants, variables and data types. C character set, C tokens, identifiers, constants, variables, declaration of variables, assigning values to variables. Data type conversion. Operators in C: arithmetic operators, relational operators. Logical operators, assignment operators, increment and decrement operators, conditional operators, bitwise operators, special operators, precedence of operators in arithmetic, relational and logical expressions, Pointers: Pointer data type, Use of pointers, declaration of pointer variable, pointer expressions, pointer operators - & and *	
UNIT-2: Input and output operations:	**20**
Input and output statements, reading a character: getchar(), writing a character: putchar(), formatted and unformatted I/O statements. Control structures: Branching: if, if-else, nested if, else-if ladder, switch. Looping: while, do-while and for loop. Jump statements, nested loops.	
UNIT-3: Arrays, Strings and Functions:	**20**
Arrays: Introduction, single dimensional array, two-dimensional arrays, initializing 2-d arrays, multidimensional arrays. Operations on arrays: traversal, insertion and deletion. Pointers and arrays, array of pointers, pointer to pointer. Strings: Declaring and initializing string variables, reading string from terminal, writing string to screen, putting strings together. Comparison of two strings, length of a string, copying a string. Functions: Introduction, types of functions, need for user-defined functions, function call, types of arguments, nesting of functions, a multi-function program, recursion, storage classes. String operations using library functions & User defined functions. function call by value and call by reference. Searching: linear search & binary search. Sorting: bubble sort, selection sort and insertion Sort. Dynamic memory allocation - examples and uses	
UNIT-: 4 Structures, Unions and Files:	**20**
Definition and declaration of a structure, assigning and accessing the members of a structure, structure initialization, structure elements in memory, comparison of structure variables, structure within the structure, array within structures. Unions: Definition and declaration, accessing the members of a union. comparison of structure and union. Files: Definition, types of files. Creating a text file. Modes of opening a file, formatted and unformatted i/o operations, random files	

Textbooks and References:

1. Let Us C: Authentic guide to C programming language (18th Edition), by Yashavant Kanetkar
2. Programming in ANSI C, 8th Edition, 2019 by E Balagurusamy
3. ANSI C Programming" (PHI 2015) by Brain Kernighan & Dennis M. Ritchie
4. "C Complete Reference" by Herbert Schildt (4th Edition)

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence

Course Code: BH/103

Name of the Course: Basic Mathematics and Calculus for Science

Course Credits	No. of Hours per Week	Total No. of Teaching Hours
5 Credits	**5 Hrs.**	**80 Hrs.**

Pedagogy: Classrooms lecture, tutorials, Group discussion, Seminar, Case studies etc.

Course Outcomes: On successful completion of the course, the students will demonstrate.

1. **C1:** will be able to define mathematical structures related to set the- ory, differential and integral calculus, differential equations and number theory (like sets, relations, function and graphs, limits derivatives and continuity of functions, multi variable functions, greatest common di- visors of integers, prime and composite numbers and so on).
2. **C2:** will be able to describe the properties of mathematical structures (like that of relations - symmetric, transitive, reflexive and so on and that of functions like one-one and onto etc.)
3. **C3:** will demonstrate the understanding of different techniques of dif- ferentiation and integration.
4. **C4:** will be able to verify the statements of the theorems (like that of Rolle's theorem, mean value theorem, Leibniz theorem for differentia- tion of product of functions).
5. **C5:** will be able to visualize properly by sketching the regions (like that of region of integration in double integration)
6. **C6:** will be able to apply the various rules learned (like that in solving differential equations, multiple integrals and also the algorithm learned to find GCD of numbers)
7. **C7:** will be able to prove certain statements in number theory (like that of fundamental theorem of algebra)
8. **C8:** will be able to apply the statements learned in solving problems(like that of Wilson's and Fermat's theorem in Number theory).

Syllabus:	**Hours**
UNIT-1: Set theory, Differential and Integral Calculus	**20**
Sets - Operations on sets (Union, Intersection, Complement, Symmetric difference; Relations - Definition, types of relations; Functions and graphs- Definition, types of functions, Visualization of functions through graphs (illustrations); Limits of functions- Definitions and problems; Continu- ity -Definition, Problems based on definition and related standard problems; Differentiation- Differentiation through first principles, Rules and techniques of differentiation, Finding the equation of tangent, Finding maxima and minima of functions (related real life problems); Integration - Some standard integrals, Techniques of integration - Integration by substitution, by parts, Integration of rational and irrational functions, Definite integrals. Multivariable functions - Definitions and examples.	
UNIT-2: Fundamentals of Analysis and Multiple integrals	**20**

Leibniz product rule of differentiation without proof - nth derivative of some standard functions, statement of Leibniz theorem, problems related; Mean Value Theorem without proof - Statement, problems related to it; Rolle's theorem without proof - Statement, problems related to it; Lagrange's Mean Value theorem without proof - Statement, problems related to it; Increasing and decreasing functions - Definition, equivalent condition through derivatives, related problems; Double integral - Evalu- ation, interchanging the order, sketching the region, Finding the Area and Volume; Triple Integral - Definition, evaluation, finding the volume; Vector calculus - Definition of vector valued functions, Definition and Problems related to Gradient, Curl and Divergence.

UNIT-3: Differential equations	**20**

Differential Equation - Definition, degree and order of differential equa- tions, formation of differential equations, verifying the solutions; Solutions of first order first degree differential equations - Problems related to variable separable and reducible to variable separable method, homoge- neous equations, reducible to homogeneous, differential equations of the form dy/dx+Py = Q (linear form), reducible to the linear form; Solutions of differential equations of Higher order equations - Definition of D-operator,

Problems related to equations of the form$(a_nD^n + a_{n-1}D^{n-1} + \cdots + a_0)y = 0$;

Partial Differential equations - PDEs - Definition and examples of partial derivatives and related problems, formation of PDEs.

UNIT-: 4 Theory of numbers	**20**

Division algorithm without proof - Statement, examples and simple problems. Divisibility - Definition and properties; Greatest Common Divisor - GCD - Definition, Euclidean algorithm to find GCD along with proof, expressing GCD as linear combination, co-prime numbers and prop- erties; Prime and composite numbers - Definition, properties of primes numbers, Fundamental theorem of Arithmetic with proof, finding GCD and Least Common Multiple (LCM) through prime factorization, Miscellaneous problems related to all these; Congruence - Definition, equivalent condi- tions, definition of residue class, algebra of congruence, problems on finding remainders and last digits, divisibility tests for 3, 4, 8, 9, and 11; Fermat's theorem without proof - Statement and related problems on finding re- mainder; Wilson's theorem without proof - Statement and problems on finding remainders; Miscellaneous problems related to congruence.

Textbooks and References:

1. Marvin L. Bittinger, *Basic Mathematic*s, 9th Edition, Addison Wesley,2002.
2. George B Thomas, Joel Hass, Christopher Heil andMaurice D Weir, *Thomas Calculus*, Person Education, 2018.
3. Ron Larson and Bruce Edwards, *Calculus*, Cengage Learning, Inc,2012.
4. *Integral Calculus (Golden Series)*, Laxmi Publications, 2012.
5. David M. Burton, *Elementary Number Theory*, McGraw Hill Education(7th Edition).
6. M.D.Raisinghania, *Ordinary and Partial Differential Equations*, S. Chand Publications, 2013.

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence

Course Code: BH/113

Name of the Course: Data Structures using c

Course Credits	No. of Hours per Week	Total No. of Teaching Hours
5 Credits	**5 Hrs.**	**80 Hrs.**

Pedagogy: Classrooms lecture, tutorials, Group discussion, Seminar, Case studies etc.,

Course Outcomes: On successful completion of the course, the students will demonstrate

1. Describe how arrays, records, linked structures, stacks, queues, trees and graphs are represented in memory and used by algorithms.
2. Describe common applications for arrays, records, linked structures, stacks, queues, trees and graphs
3. Write programs that use arrays, records, linked structures, stacks, queues, trees and graphs
4. Demonstrate different methods for traversing trees
5. Describe the concepts of recursion, give examples of its use.

Syllabus:	**Hours**
UNIT-1:	**20**

Introduction to data structures: Definition; Types of data structures - Primitive & Non-primitive, Linear and Non-linear; Operations on data structures. Dynamic memory allocation: Static & Dynamic memory allocation; Memory allocation and de-allocation functions - *malloc*, *calloc*, *realloc* and *free*. Algorithm Specification, Performance Analysis, Performance Measurement Recursion: Definition; Types of recursions; Recursion Technique Examples - GCD, Binomial coefficient ${}^{n}C_{r}$, Towers of Hanoi; Comparison between iterative and recursive functions.

UNIT-2:	**20**

Arrays: Basic Concepts – Definition, Declaration, Initialisation, Operations on arrays; Types of arrays; Arrays as abstract data types (ADT); Representation of Linear Arrays in memory.

Traversing linear arrays; Inserting and deleting elements; Sorting – Selection sort, Bubble sort, Quick sort, Selection sort, Insertion sort; Searching - Sequential Search, Binary search; Iterative and Recursive searching; Multidimensional arrays; Representation of multidimensional arrays; Sparse matrices.

Stacks: Basic Concepts – Definition and Representation of stacks; Operations on stacks; Applications of stacks; Infix, postfix and prefix notations; Conversion from infix to postfix using stack; Evaluation of postfix expression using stack; Application of stack in function calls.

UNIT-3:	**20**

Queues: Basic Concepts – Definition and Representation of queues; Types of queues - Simple queues, Circular queues, Double ended queues, Priority queues; Operations on Simple queues.

Linked list: Basic Concepts – Definition and Representation of linked list, Types of linked lists - Singly linked list, Doubly liked list, Header liked list, Circular linked list; Representation of Linked list in Memory

Operations on Singly linked lists – Traversing, Searching, Insertion, Deletion; Memory allocation; Garbage collection

UNIT-4:	**20**

Trees: Definition; Tree terminologies –node, root node, parent node, ancestors of a node, siblings, terminal & non-terminal nodes, degree of a node, level, edge, path, depth;
Binary tree: Type of binary trees - strict binary tree, complete binary tree, binary search tree and heap tree; Array representation of binary tree. Traversal of binary tree; preorder, inorder and postorder traversal…
Graph: Graph terminology-Representation of graph-path matrix-Graph Traversal-BFS(breadth first search)-DFS(depth first search).

Textbooks and References:

1. Data Structures and Algorithms using C by R. S. Salaria, 2018
2. Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles, Fifth Edition by Narasimha Karumanchi (2011)
3. Data Structures and Algorithm Analysis in C by Mark Allen Weiss, 2nd Edition, Pearson Education
4. Data Structures (Revised First Edition) | Schaum's Outline Series Paperback by Seymour Lipschutz, 2014

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code:BH/112
Name of the Course: Operating System Concepts

Course Credits	No. of Hours per Week	Total No. of Teaching Hours
3 Credits	**3 Hrs.**	**48 Hrs.**

Pedagogy: Classrooms lecture, tutorials, Group discussion, Seminar, Case studies etc..

Course Outcomes: On successful completion of the course, the students will demonstrate

a) Understand fundamental operating system abstractions such as processes, threads, files.
b) Analyze important algorithms eg. Process scheduling and memory management algorithms.
c) Categorize the operating system's resource management techniques, dead lock management techniques, memory management.

Syllabus:	**Hours**
Unit 1	**12**
Definition of Operating System, Need, Early systems, Simple monitors, Batch Systems, Multiprogramming, Time Sharing, Real time, Parallel and Distributed systems. Computing Environments – Traditional, Client Server, Peer-to-Peer and Web based. Process Management: Process concept – meaning of process, sequential and concurrent processes, process state, process control block, threads, Process scheduling – scheduling queues, schedulers, context switch.	
Unit 2	**12**
Processor – CPU I/O burst cycle, CPU Scheduler, Preemptive scheduling, dispatcher. Scheduling criteria, Scheduling algorithms: First-Come-First-Served (FCFS), Shortest Job First (SJF), Priority Scheduling, Round Robin. Real time scheduling with pre-emption and Non-preemption. Deadlocks: Definition with example, System model, Deal lock characterization – Necessary Conditions Resource Allocation Graph, Dead lock prevention, Avoidance and detection, Recovery from dead lock.	
Unit 3	**12**
Introduction to memory management, functions of memory management, partitioned memory – single partition, multiple partition (MFT & MVT), fragmentation, memory management technique – paging, segmentation, Demand paging, page replacement, page replacement algorithms – FIFO, LRU, Optional page replacement.	
Unit 4	**12**

File System: File concept; Access methods; Directory structure; File system mounting; File sharing; Protection. File system structure; File system implementation; Directory implementation; Allocation methods; Free space management

Textbooks and References:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne: Operating System Principles, 9th edition, Wiley India, 2009.
2. D.M Dhamdhere: Operating systems - A concept-based Approach, 2nd Edition, Tata McGraw-Hill, 2002.
3. P.C.P. Bhatt: Introduction to Operating Systems: Concepts and Practice, 2nd Edition, PHI, 2008

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code:BH/112
Name of the Course: Algebra and Discrete Mathematics

Course Credits	No. of Hours per Week	Total No. of Teaching Hours
5 Credits	**5 Hrs.**	**80 Hrs.**

Pedagogy: Classrooms lecture, tutorials, Group discussion, Seminar, Case studies etc..

Course Outcomes: On successful completion of the course, the students will demonstrate

1. **C1:** will be able to define various mathematical structures like logical statements, tautologies, contradictions, matrices and determinants, graphs (varieties of graphs and), groups (variety of groups), Homeomorphisms, boolean algebra.
2. **C2:** will be able to describe and deduce various properties of mathematical structures like that of determinants, groups, boolean algebra, graphs (like distance, radius, diameter), straight lines.
3. **C3:** will be able to apply the rules of logic in arriving at inferences(like that of Modus ponens, Modus Tollens and so on).
4. **C4:** will be able to apply the rules and algorithms in solving problems like that of solving recurrence relations, minimizing the boolean expression through Karnaugh Map method
5. **C5:** will be able prove the mathematical statements related to group theory, boolean algebra, mathematical logic.

Syllabus:	Hours
Unit 1: Sets, Matrices, Mathematical Logic and Counting	**20**
Sets - Posets; Matrices and determinants - Definitions of matrix and determinant, types of matrices, operations on matrices, definition of ad- joint, relation between matrix and its adjoint (with proof), finding inverses of lower order matrices through the adjoints; Mathematical Structure - Introduction to propositional logic: Definition of statements (propositions), Logical operators ($\wedge \vee \sim \Rightarrow \Leftrightarrow$)and truth tables, Tautology and Contra- diction, Theory of inferences; Predicate Calculus: Definitions of predicates, quantifiers, rules of inferences, Methods of mathematical proofs (Axioms and propositions, Direct proof, contra-positive proof and proof through contra- diction) and related problems; Counting - problems related to pigeonhole principle, definition and problems related to permutation and combination; Recurrence relations - Examples and problems on solving recurrence relations.	
Unit 2: Introduction to Graph Theory	**20**
Graphs - Definition and examples; Finite and null graphs - Definition and examples; Classes of graphs - Complete graph, Complete Bi-partite graph Paths and Cycles - walk, path, trail, cycle; sub-graphs - Definition and examples of sub-graphs and spanning graphs; Degree of a vertex - Definition and examples, minimum and maximum degrees of a graph, hand-shaking lemma, problems based on hand shaking lemma, some simple properties related to degree; Distance between vertices - Definitions and calculations of radius, diameter, eccentricity of graphs; Connected and Disconnected graphs - Definition and examples; Matrix representation of graphs - Incidence and adjacency matrices (definition and examples); Eulerian and Hamiltonian graphs - Definition, examples, listing of applications of these graphs; Isomorphism of graphs - Definition and some simple problems; Various applications of graph theory.	
Unit 3: Algebra	**20**
Binary Operation - Definition, Associative, Commutative operations, Identity elements and inverse elements with respect to Binary operation (Definition and problems); Groups - Definition and examples for groups and semi-groups, some general properties of groups; Subgroups - Definition and examples, characterization of subgroups, left and right cosets of a subgroup, Lagrange's theorem for finite group (with proof); Normal subgroups - Definition and examples, Equivalent conditions; Quotient groups - Formation of quotient groups, examples; Homomorphisms - Definition and examples of homomorphism, isomorphism and automorphism, properties on homomorphism, fundamental theorem of homomorphism.	
Unit 4 : Boolean Algebra and Analytical Geometry	**20**
Analytical geometry - Co-ordinates, distance formula in plane and space (derivation and problems), section formula in plane and space (derivation and problems), area of a triangle in a plane in plane (Derivation and problems), different forms of straight lines in plane, angle between straight lines in plane (derivations), equation of plane and straight lines in three dimen- sion (No derivation); Hyperplanes Definition and visualization; Boolean Algebra - Definition and Examples, some properties related to Boolean algebra (For example: idempotent law), Miscellaneous problems; Boolean forms - Definition of atoms, literals, minterms, maxterms and examples to each; Boolean forms - Definition and problems on Disjunctive Boolean forms, Minimal forms, Normal Disjunctive Boolean forms, The Karnaugh Map method and applications to circuits.	

Textbooks and References:

1. Kenneth H. Rosen, *Discrete Mathematics and its Applications*, Mc-Graw Hill (8th Edition), 2021
2. W. D. Wallis, *A beginner's guide to Discrete Mathematics*, Springer (Birkhauser), 2002.
3. DavidLiben-Nowell, *Discrete Mathematics for Computer Science*, Wi-ley Publications, 2017.
4. Joseph A. Gallian, *Contemporary abstract Algebra*, Cengage LearningIndia Pvt. Ltd., 2019.
5. Douglas B West, *Introduction to graph theory*, Person, 2000.
6. Howard Pospesel, *Introduction to Logic: Predicate Logic*, Person, 2003.