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UNIVERSITY OF MYSORE

Estd.1916

Vishwavidyanilaya Karyasoudha
Crawford Hall, Mysuru- 570 005

(Re-accredited by NAAC at 'A')
(NIRF-2023 Ranked 44 in University Category & 71 in Overall Category)

No.: PMEB-1/Spl./10(2)/2023-24 **Date: 18-07-2024**

NOTIFICATION

Sub.: Revised Syllabus of **B.Sc. (Hons.)(Data Science & Artificial intelligence) course** under Specialized Programmes from the academic year 2024-25-reg.

Ref.: 1. Decision of the BOS Meetings held on 11-06-2024.
2. Decision of the Faculty of Science & Technology meeting held on 19-06-2024.
3. Decision of the Academic Council meeting held on 28-06-2024.

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The Board of Studies in **B.Sc. (Hons.)(Data Science & Artificial intelligence) (UG)** at its meeting held on 11-06-2024 has recommended the approval of the revised Syllabus of **B.Sc. (Hons.)(Data Science & Artificial intelligence)** course in University of Mysore under specialized/specified programs from the academic year 2024-25 as per NEP-2020.

The Faculty of Science & Technology and the Academic Council at their meetings held on 19-06-2024 and 28-06-2024 respectively, have also approved the above proposal and the same is hereby notified.

The revised 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 Mathematics, Manasagangotri, Mysuru.
3. Prof. Suresha, DoS in Computer Science, Manasagangothri, Mysuru.
4. The Principal, Sarada Vilas Educational Institutions, Krishnamurthy puram, 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.

Sarada Vilas Education Institutions
Krishnamurthypuram, Mysuru-570008

Proceedings of the meeting of the members of the Board of studies in B.Sc(Hon's)(Data Science & Artificial Intelligence)(UG) held on 11-06-2024 at 2.00 PM at the Sarada Vilas College, Mysuru.

Ref: No. UA2/158/2017/18 dated: 22-05-2020
PMEB-5/31/Spl./2022-23

With reference to the above sited, a meeting of the member of the Board of Studies in B.Sc(Hon's) (Data Science & Artificial Intelligence) has been conducted at Board Room, Sarada Vilas Educational Institution, Krishnamurthy Puram, Mysuru on 11-06-2024 at 2.00 PM.

The following members have attended the meeting:

Sl.No	Name	Designation	Signature
1	Prof. Suresha	Chairman	
2	Dr. M. Devika	Member	
3	Sri. Mohan Krishna B.G	Member	
4.	Smt. Akshaya H L	Member	

The following member was absent for the meeting.

1. Dr. K.S.Manjunath 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 & 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 & 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 & 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 & Artificial Intelligence) program of the University.

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

Laboratory cycles are added to the syllabus of all the four years and Theory part of syllabus of third and fourth year is reframed

Chairman

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

ANNEXURE

B. Sc (Hon's)
Data Science & Artificial Intelligence

As per NEP Regulations

To be implemented from the Academic year 2024-25

Proposed Scheme & **SYLLABUS** for BSc Hon's (Data Science and Artificial Intelligence)

As perNEP 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 Scienceand 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 disciplineor 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 or 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 Hon's (Data Science and Artificial Intelligence)

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

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

An option is given to the students to continue their education to the fourth year andthose who successfully complete 4 years or 8 semesters will be awarded Bachelor's degree in Hon's (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, ifhe/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 takethe University examination.

VI. TEACHING AND EVALUATION

As basic degree from recognized University are only eligible to teach and to evaluate all the Hon's courses except languages constitution of India and environmental studies health wellnesssocial and emotional learning/ sports/ NCC/ NSS others.

Imp Note*

<u>As per NEP Regulations common subjects will follow the syllabus prescribed bythe University.</u>

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 ofthe 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 andSEE evaluation will be on the following parameters.

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

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 2 of the following assessment methods with 5 marks each (2x10=20)

i. Individual assignment
ii. Seminars classroom presentations quizzes
iii. Group discussion class discussion group assignments
iv. Case studies / Case lets
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 20 marks each and the same isto be scaled down to 10 marks each

Internal Assessment Test

Course Code: Name of the Course:
Duration: 1 Hour Total Marks: 20

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. .....

Semester End Examination (SEE):

The semester and examination for the courses for which students who get richest during the semester shall be 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 forSEE is presented below for 60 marks.

PATTERN OF QUESTION PAPER

Time: 3 Hours Marks: 60

Answer the following questions. (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. That is, 21 marks out of 60 marks of theory examination and 40% in aggregate i.e., total 40 marksout 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 & Artificial Intelligence)

Year 1 Semester I								
Sl.No	**Code**	**Title of Course**	**Category Of Courses**	**Teaching Hrs per Week (L+T+P)**	**SEE**	**CIE**	**Total Marks**	**Credits**
1	BH/101	Functional English 1	AECC - 1A	3+0+0	60	40	100	3
2	BH/102	Language 1	AECC - 2A	3+0+0	60	40	100	3
3	BH/103	Basics of Mathematics and Calculus	DSC 1	3+2+0	60	40	100	5
4	BH/104	Fundamentals of Computers	DSC 2	3+0+0	60	40	100	3
5	BH/105	Problem solving & Programming in C	DSC 3	3+0+0	60	40	100	3
6	BH/105L	Problem solving & Programming in C Lab	DSC 3 Lab	0+0+2	25	25	50	2
7	BH/106	Digital Fluency	SEC SB	1+0+2	25	25	50	2
8	BH/107	Open Elective-Business Organisation	OEC	3+0+0	60	40	100	3
9	BH/108	Yoga, Health and Wellness	SEC VB	0+0+2	25	25	50	2
		Total Credits			**435**	**315**	**750**	**26**

Year 1 Semester II								
Sl.No	**Code**	**Title of Course**	**Category Of Courses**	**Teaching Hrs per Week (L+T+P)**	**SEE**	**CIE**	**Total Marks**	**Credits**
1	BH/109	Functional English 2	AECC - 1B	3+0+0	60	40	100	3
2	BH/110	Language 2	AECC - 2B	3+0+0	60	40	100	3
3	BH/111	Algebra and Discrete Mathematics	DSC 4	3+2+0	60	40	100	5
4	BH/112	Operating System Concepts	DSC 5	3+0+0	60	40	100	3
5	BH/113	Data Structures using C	DSC 6	3+0+0	60	40	100	3
6	BH/113 L	Data Structures using C Lab	DSC 6 Lab	0+0+2	25	25	50	2
7	BH/114	Environmental Studies	SEC SB	1+2+0	25	25	50	2
8	BH/115	Open Elective- Retail Management	OEC	3+0+0	60	40	100	3
9	BH/116	Sports/NCC/NSS/R&R, (S&G)/ Cultural	SEC VB	0+0+2	25	25	50	2
		Total Credits			**435**	**315**	**750**	**26**

Year 2 Semester III								
Sl.No	**Code**	**Title of Course**	**Category Of Courses**	**Teaching Hrs per Week (L+T+P)**	**SEE**	**CIE**	**Total Marks**	**Credits**
1	BH/117	Functional English 3	AECC - 1C	3+0+0	60	40	100	3
2	BH/118	Language 3	AECC - 2C	3+0+0	60	40	100	3
3	BH/119	Linear Algebra	DSC 7	3+2+0	60	40	100	5
4	BH/120	Introduction to Big Data & Tools	DSC 8	3+0+0	60	40	100	3
5	BH/121	Design and Analysis of Algorithms	DSC 9	3+0+0	60	40	100	3
6	BH/121L	Design and Analysis of Algorithms Lab	DSC 9 Lab	0+0+2	25	25	50	2
7	BH/122	Artificial Intelligence	SEC SB	3+0+0	25	25	50	2
8	BH/123	Open Elective -Rural Marketing	OEC	3+0+0	60	40	100	3
9	BH/124	Sports/NCC/NSS/R&R (S&G)/ Cultural	SEC VB	0+0+2	25	25	50	2
		Total Credits			**435**	**315**	**750**	**26**

Year 2 Semester IV								
Sl.No	**Code**	**Title of Course**	**Category Of Courses**	**Teaching Hrs per Week (L+T+P)**	**SEE**	**CIE**	**Total Marks**	**Credits**
1	BH/125	Functional English 4	AECC - 1D	3+0+0	60	40	100	3
2	BH/126	Language 4	AECC - 2D	3+0+0	60	40	100	3
3	BH/127	Probabilities and Statistics	DSC 10	3+2+0	60	40	100	5
4	BH/128	Big Data Analytics and Visualization	DSC 11	3+0+0	60	40	100	3
5	BH/129	Introduction to Python Programming	DSC 12	3+0+0	60	40	100	3
6	BH/129 L	Introduction to Python Programming Lab	DSC 12 Lab	0+0+2	25	25	50	2
7	BH/130	Cyber Law	SEC SB	3+0+0	25	25	50	2
8	BH/131	Open Elective - Business and Leadership Skill	OEC	3+0+0	60	40	100	3
9	BH/132	Sports/NCC/NSS/R&R (S&G)/ Cultural	SEC VB	0+0+2	25	25	50	2
		Total Credits			**435**	**315**	**750**	**26**

Year 3 Semester V								
Sl.No	**Code**	**Title of Course**	**Category Of Courses**	**Teaching Hrs per Week (L+T+P)**	**SEE**	**CIE**	**Total Marks**	**Credits**
1	BH/133	Foundation of AI and Machine Learning	DSC 13	3+2+0	60	40	100	5
2	BH/134	Introduction to Neural Networks	DSC 14	3+0+0	60	40	100	3
3	BH/134 L	Introduction to Neural Networks Lab	DSC 14 Lab	0+0+2	25	25	50	2
4	BH/135	Database Management System	DSC 15	3+0+0	60	40	100	3
5	BH/135 L	Database Management System Lab	DSC 15 Lab	0+0+2	25	25	50	2
6	BH/136	Elective I - Software Engineering	DSE 1	5+0+0	60	40	100	5
7	BH/137	Elective I -Operational Research System						
8	BH/138	Skill Enhancement Course I - Introduction to Robotics	SEC SB - 5	3+0+0	25	25	50	3
		Total Credits			**315**	**235**	**550**	**23**

Year 3 Semester VI								
Sl.No	**Code**	**Title of Course**	**Category Of Courses**	**Teaching Hrs per Week (L+T+P)**	**SEE**	**CIE**	**Total Marks**	**Credits**
1	BH/139	Deep Learning	DSC 16	3+2+0	60	40	100	5
2	BH/140	Natural Language Processing	DSC 17	3+0+0	60	40	100	3
3	BH/140 L	Natural Language Processing Lab	DSC 17 Lab	0+0+2	25	25	50	2
4	BH/141	Big Data Management	DSC 18	3+0+0	60	40	100	3
5	BH/141 L	Big Data Management Lab	DSC 18 Lab	0+0+2	25	25	50	2
6	BH/142	ELECTIVE II- Data Mining	DSE 2	5+0+0	60	40	100	5
7	BH/143	ELECTIVE II-Fuzzy Logic and ANN						
8	BH/144	Skill Enhancement Course II- Autonomous Robots	SEC SB - 6	3+0+0	25	25	50	3
		Total Credits			**315**	**235**	**550**	**23**

Year 4 Semester VII								
Sl.No	**Code**	**Title of Course**	**Category Of Courses**	**Teaching Hrs per Week (L+T+P)**	**SEE**	**CIE**	**Total Marks**	**Credits**
1	BH/145	Image Processing	DSC 19	4+0+0	60	40	100	4
2	BH/145 L	Image Processing Lab	DSC 19 L	0+0+2	25	25	50	2
3	BH/146	ELECTIVE III- Introduction to Networks and Cloud Computing	DSE 3	5+0+0	60	40	100	5
4	BH/147	ELECTIVE III- Information Security System						
5	BH/148	Skill Enhancement Course 3 - Predictive Analytics	SEC SB - 7	3+0+0	25	25	50	3
6	BH/149	Mini Project		0+0+0	60	40	100	4
		Total Credits			**230**	**170**	**400**	**18**

Year 4 Semester VIII								
Sl.No	**Code**	**Title of Course**	**Category Of Courses**	**Teaching Hrs per Week (L+T+P)**	**SEE**	**CIE**	**Total Marks**	**Credits**
1	BH/150	Research Project Work/Internship with VIVA	DSE 4		120	80	200	10
2	BH/151	Skill Enhancement Course 4 - Swayam Online Courses	SEC SB - 8	3+0+0	25	25	50	3
		Total Credits			**145**	**105**	**250**	**13**

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 30students) of the number of students in each class/section. 2 hours of practical classis 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

Sl.No	**Acronym**	**Expansion**
1	AECC	Ability Enhancement Compulsory Course
2	DSC	Discipline Specific Course
3	SEC	Skill Enhancement Course
4	SB/ VB	Skill Based/ Value Based
5	OEC	Open Elective Course
6	DSE	Discipline Specific Elective
7	SEE	Semester End Examination
8	CIE	Continuous Internal Evaluation
9	L+T+P	Lecture + Tutorial + Practical

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
Year I Semester I

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

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

Course Outcome: **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 differentiation 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 differentiation 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	Hrs.
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 - Evaluation, 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 equations, 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, homogeneous 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 properties; 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 conditions, 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 remainder; Wilson's theorem without proof - Statement and problems on finding remainders; Miscellaneous problems related to congruence.	
TEXT BOOKS: Marvin L. Bittinger, Basic Mathematics, 9th Edition, Addison Wesley,2002. George B Thomas, Joel Hass, Christopher Heil and Maurice D Weir, ThomasCalculus, Person Education, 2018. Ron Larson and Bruce Edwards, Calculus, Cengage Learning, Inc,2012. Integral Calculus (Golden Series), Laxmi Publications, 2012. David M. Burton, Elementary Number Theory, McGraw Hill Education (7th Edition). M.D.Raisinghania, Ordinary and Partial Differential Equations, S. ChandPublications, 2013.	

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

Course Credits	No. of Hours per Week	Total No. of Teaching Hrs.
3 Credits	3 Hrs.	52 Hrs.

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

Course Outcome: **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	Hrs.
UNIT-1	**13**
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	**13**
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	**13**
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	**13**
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.	
TEXT BOOKS: 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
Year I Semester I

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

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

Course Outcome: **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	Hrs.
UNIT-1	**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	**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	**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	**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	
TEXT BOOKS: 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/105 L
Name of the Course: Problem solving & Programming in C Lab
Year I Semester I

Lab Programs

Part-A

1. Program to pick out the biggest and smallest number among three given numbers.
2. Program to find sum of even and odd numbers separately in the given list.
3. Program to find largest and smallest of N numbers
4. Program to find the roots of the quadratic equation using nested if.
5. Given two numbers, program to perform arithmetic operations using switch statement.
6. Program to generate Fibonacci series up to N numbers using do – while loop.
7. Program to find the reverse of the given number. Also sum and count the number of digits and check whether the given number is palindrome or not using while – do loop.
8. Program to generate prime numbers using for loop.
9. Program to search an element using linear search technique.
10. Program to check whether the given number is factorial of a number or not.

Part-B

1. Program to insert a sub-string into a given string.
2. Program to add and subtract two M x N matrices.
3. Program to multiply two M x N matrices.
4. Program to find trace and norm of a square matrix and print its principle diagonal elements.
5. Program to exchange principle and secondary diagonal elements of a square matrix.
6. Program to find the factorial of a number using recursion.
7. Program to swap two number using functions.
8. Program to read and write information of an employee using structure.
9. Program to create simple marks card assuming appropriate conditions.
10. Program to read and write information of an employee using a file.

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/111
Name of the Course: Algebra and Discrete Mathematics
Year I Semester II

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

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

Course Outcome: 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	HRS.
UNIT-1	**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 A(∨ ∼ ⇒ ⇔)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	**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	**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	**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 dimension (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, minters, 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.	
TEXT BOOKS: 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-leyPublications, 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	

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

Course Credits	No. of Hours per Week	Total No. of Teaching Hrs.
3 Credits	3Hrs.	52 Hrs.

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

Course Outcome: 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.

Categorize the operating system's resource management techniques, dead lock management techniques, memory management.

SYLLABUS	HRS.
UNIT-1	**13**
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	**13**
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	**13**
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	**13**
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	

TEXT BOOKS:

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/113
Name of the Course: Data Structures using C
Year I Semester II

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

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

Course Outcome: **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 Describe the concepts of recursion, give examples of its use.

SYLLABUS	Hrs.
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 nCr, Towers of Hanoi; Comparison between iterative and recursive functions.	
UNIT-2	**20**
Arrays: Basic Concepts – Definition, Declaration, Initialization, 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 linked list, Header linked 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 post order traversal… Graph: Graph terminology-Representation of graph-path matrix-Graph Traversal-BFS(breadth first search)-DFS(depth first search).	

TEXT BOOKS:

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/113 L
Name of the Course: Data Structures using C Lab
Year I Semester II

Lab Programs	
Part A	
01	Write a C Program to find GCD using recursive function.
02	Write a C Program to generate n Fibonacci numbers using recursive function.
03	Write a C Program to implement dynamic array, find smallest and largest element f the array.
04	Write a C Program to display Pascal Triangle using binomial function
05	Write a C Program to implement Towers of Hanoi.
06	Write a C Program to create two files to store even and odd numbers.
07	Write a C Program to create a file to store student records.
08	Design, Develop and Implement a menu driven program in C for the following Array operations a. Creating Array of N Integer elements. b. Display of Array elements with suitable headings. c. Inserting an element (ELEM) at a given valid position (POS). d. Deleting an element at a given valid position (POS). e. Exit.
09	Design, Develop and Implement a menu driven program in C for the following operations on STACK a. Push an element on to stack b. Pop an element from stack. c. Demonstrate how stack can be used to check palindrome. d. Demonstrate Overflow and Underflow situations on stack. e. Display the status of stack. f. Exit.
10	Write a C Program to convert an infix expression to postfix.
Part B	
01.	Design, Develop and Implement a Programming C for the following Stack Application, evaluation of Suffix expression with single digit operands and operators: +, -, *, /, %, ^
02.	Write a program to implement Queue using array.
03.	Write a C Program to implement linear linked list.
04.	Write a C Program to sort the given list using selection sort technique.
05.	Write a C Program to sort the given list using bubble sort technique.
06.	Write a C Program to sort the given list using insertion sort technique.
07.	Write a C Program to search an element using linear search technique.
08.	Write a C Program to search an element using recursive binary search technique.
09.	Write a program to implement Prim's Algorithm.
10.	Write a C Program to display traversal of a tree.

Name of the Program: B.Sc. (Hon's)Data Science and Artificial IntelligenceCourse Code: BH/119

Name of the Course: Linear Algebra

Year II Semester III

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

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

Course Outcome: At the end of this course, students will be able to
C1: describe various algebraic structures such as vector spaces, sub- spaces, inner product spaces and so on.
C2: define various terminologies related to vector spaces such as dimension, Eigen values and vectors, minimal polynomials, linear trans- formations, quadratic forms and so on.
C3: construct and carry out algorithms in various contexts of vector spaces, such as to find Eigen values and Eigen spaces, to find minimal polynomials, to find orthonormal bases, to find matrices of linear transformation, to verify diagonalizability, to maximize given binary quadratic form and so on.
C4: to classify the mathematical objects such as binary quadratic forms.
C5: prove various statements in the context of vector spaces.
C6: visualize and prove equivalent conditions in the context of vector spaces.
C7: appreciate the interlinkages between concepts and also the relevance of the concepts.

SYLLABUS	Hrs.
UNIT-1 INTRODUCTION TO VECTOR SPACE	**20**
Matrices - Recalling, Reduction of square matrix to Echelon form, rank of matrix and familiarity with solutions to system of linear equations; **Mathematical structures - Groups, Rings and Fields** - Familiarity with these terms; **Vector spaces** - Definition, examples and various properties; **Subspaces** - Definition, examples and criteria for a subset to be subspace; **Linear combination** - Definition and problems in $V_n(R)$; **Linearly dependent and independent sets** - Definitions, Examples, properties, various ways of determining linearly independent sets; **Basis and dimensions** - Definition, examples (both finite and infinite dimensional) and problems on finding dimension of subspaces	
UNIT-2 INNER PRODUCT SPACES AND LINEAR TRANSFORMATIONS	**20**
Inner product spaces - Definition, Examples, triangular inequality (proof), parallelogram law (proof), Problems on Gram-Schmidt orthogonalization process; Linear transformations - Definition, examples, properties; Matrix of linear transformation - Definitions of linear transformation, isomorphism and automorphisms, problems on finding matrices with respect standard and non-standard bases and finding linear transformation for given matrix; Rank Nullity theorem - Statement, Definition of Kernel, Range space and problems on Rank-Nullity theorem.	
UNIT-3 EIGEN VALUES AND EIGEN VECTORS	**20**
Eigen values and Eigen vectors of linear transformations - Definition, problems on finding Eigen values and Eigen vectors, properties and algebraic multiplicity (through characteristic equation); Eigen spaces - Definition of Eigen space and geometric multiplicity (GM), problems on finding geometric multiplicity and relation between AM and GM (without proof); Caley-Hamilton theorem - Statement (without proof), problems on verification, finding inverses and powers of matrices; Minimal polynomial - Definition, Properties and problems on finding minimal polynomials; Similar matrices Definition and properties.	

UNIT-4 MATRIX DECOMPOSITION AND REAL QUADRATIC FORMS	20
Diagonalization - Definition, various ways to verify diagonalizability and problems on diagonalizinga matrix; Jordan canonical form - Definition, problems on finding Jordan canonical form and criteriafor a matrix to be decomposed in Jordan form; Hermitian and non-Hermitian matrices - Definition, examples and proof that the Eigen values of Hermitian matrices are real; Spectral Decomposition theorem - Statement, proof and related problems; Real Quadratic forms - Definition, symmetric matrix representation, classification of quadratic forms, signature, indexand rank of quadratic forms, reduction of quadratic form to normal form, problems on maximaand minima.	

TEXT BOOKS:

1.I. N. Herstein, Topics in algebra, 2nd Edition, Wiley.
2.F. M. Stewart, Introduction to Linear Algebra, Dover Publications.
3.S. Kumaresan, Linear Algebra, Prentice Hall India Learning Pvt. Ltd.
4.K. Hoffman and R. Kunze, Linear Algebra, end Edition, Prentice Hall India Learning Pvt. Ltd.
5.G. Strang, Linear Algebra and its applications, 4th Edition, Cengage Learning India.

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/120
Name of the Course: Introduction to Big Data & Tools
Year II Semester III

Course Credits	No. of Hours per Week	Total No. of Teaching Hrs.
3 Credits	3 Hrs.	52 Hrs.

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

Course Outcome: On successful completion of the course, the students will understand overview of Big Data, i.e. storage, retrieval and processing of big data. In addition, it also focuses on the "technologies", i.e., the tools/algorithms that are available for storage, processing of Big Data.
a) Understand Big Data and its analytics in the real world.
b) Analyze the Big Data framework like Hadoop and NOSQL to efficiently store and process Big Data to generate analyst.
c) Big Data Analysis with Machine Learning.

SYLLABUS	Hrs.
UNIT-1	**13**
Introduction to Big Data - Big data and its importance, Evolution, Datasets, Different Types of Data, Data Appliance, Challenges with Big Data, Big Data sources, Data Modelling. Business intelligence, KPI, Big data characteristics, Drivers for big data adoption. Big Data Analysis Techniques: Quantitative analysis, Qualitative analysis, Data mining, Statistical analysis, Machine learning, Semantic analysis, Visual analysis, Data Analytics, Types of Analytics Case studies.	
UNIT-2	**13**
Hadoop-Hadoop Architecture, Overview of Distributed database Systems, Hadoop eco-system, Hadoop core components, Hadoop distributions, developing enterprise applications with Hadoop, Moving data in and out of Hadoop, HDFS architecture, HDFS files, Hadoop specific file types, HDFS federation and high availability, working with HDFS Commands, Map Reduce Framework, Anatomy of a Map Reduce job Run, Job Scheduling, Shuffle and Sort, Task Execution, Fundamentals of HBASE, Zookeeper concepts and methods to build applications with Zookeeper.	
UNIT-3	**13**
Data Analysis with Spark, Downloading Spark and Getting Started, Programming with RDDs, Machine Learning with MLlib, HIVE: Architecture and installation, Comparison with traditional database, HIVQL querying data, Sorting and aggregating, Joins & sub queries, HIVE Vs PIG, PIG: Architecture and installation, Execution Mechanisms, load/store operator, Pig scripts, Case studies: Analyzing big data with twitter, Big data for Ecommerce, Big data for blogs.	
UNIT-4	**13**
Data Analytics with R Machine Learning: Introduction – Supervised Learning – Unsupervised Learning – Collaborative Filtering – Big Data Analytics with BigR – Intro to Oozie, NoSQL- Types of NoSQL databases, Advantages of NoSQL, Use of NoSQL in industry, SQL VS NoSQL, MongoDB: MongoDB, Support for dynamic queries, Replications, Shading, Create Database and Drop Database, Collections and Documents, MongoDB Query Language.	

TEXT BOOKS:

1. Seema Acharya, Subhasini Chellappan, "Big Data Analytics", Wiley, 2015
2. Frank J Ohlhorst, "Big Data and Analytics: Turning Big Data into Big Money", Wiley and SAS Business Series, 2012.
3. Tom White, " Hadoop: The Definitive Guide" Third Edition, O'reily Media, 2012.

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/121
Name of the Course: Design and Analysis of Algorithms
Year II Semester III

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

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

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

a) Demonstrate a familiarity with major algorithms and data structures.
b) Analyze worst-case running times of algorithms using asymptotic analysis
c) Apply important algorithmic design paradigms and methods of analysis.

Argue the correctness of algorithms using inductive proofs and invariants

SYLLABUS	Hrs.
UNIT-1	**20**
Introduction: What is an Algorithm-Algorithm Specification, Analysis Framework, Performance Analysis- Space complexity, Time complexity, Asymptotic Notations-Big-Oh notation, Omega notation, Theta notation, Little-oh notation, Mathematical analysis, Important Problem Types-Sorting, Searching, String processing, Graph Problems, Combinatorial Problems, Fundamental Data Structures-Linear Data Structures, Graphs, Trees, Sets and Dictionaries.	
UNIT-2	**20**
General method-Recurrence equation, Algorithm: Binary search, Algorithm: Finding the maximum and minimum, Algorithm: Merge sort, Algorithm: Quick sort, Algorithm: Strassen's matrix multiplication, Advantages and Disadvantages, Decrease and Conquer Approach, Algorithm: Topological Sort.	
UNIT-3	**20**
Greedy method-General method, Coin Change Problem, Knapsack Problem, Job sequencing, Minimum cost spanning trees- Prim's Algorithm, Kruskal's Algorithm,3. Single source shortest paths-Dijkstra's Algorithm, Optimal Tree problem-Huffman Trees and Codes, Transform and Conquer Approach- Heaps, Heap Sort.	
UNIT-4	**20**
Introduction to Dynamic Programming -General method with Examples, Multistage Graphs, Transitive Closure-Warshall's Algorithm, All Pairs Shortest Paths- Floyd's Algorithm, Optimal Binary Search Trees, Knapsack problem, Bellman-Ford Algorithm, Travelling Sales Person problem, Reliability design	

TEXT BOOKS:

1. Introduction to Algorithms, by Thomas H. Cormen
2. Design and Analysis of Algorithms, Parag Himanshu Dave, Himanshu Balachandran Dave.
3. Design & Analysis of Computer Algorithms. Alfred V.Aho,john E.Hopcroft, Jeffrey Ullman

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/121 L
Name of the Course: Design and Analysis of Algorithms
Year II Semester III

Lab Programs

Part-A

1 Write a C Program to search an element using recursive binary search.
2 Write a c program to find the maximum and minimum element from an array.
3 Write a C Program to Sort a given set of elements using merge sort method and determine the time required to sort the elements. Repeat the experiment for different of values of n.
4 Write a C Program to sort the given list using quick sort technique.
5 Write a program to implement Strassen's Matrix Multiplication Algorithm.
6 Write a program to obtain the topological ordering of vertices in a given digraph.
7 Write a C program to find minimum number of denominations.
8 Write a program for knapsack problem using greedy approach.
9 Find minimum cost spanning tree of a given undirected path using a Prim's algorithm.

Part-B

10 Write a program to Implement the knapsack problem (0/1).
11 From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm.
12 Compute the transitive closure of a given directed graph using Warshall's algorithm.
13 Write a program to implement insertion sort using decrease and conquer technique.
14 Check whether a given graph is connected or not using DFS method.
15 Write a Program to Implement travelling salesman problem.
16 Write a Program to Print all the nodes reachable from a given starting node in a digraph using BFS method.
17 Find the minimum cost spanning tree of a given undirected graph using Kruskal's algorithm
18 Find the binomial co-efficient using dynamic programming.

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/127
Name of the Course: Probabilities and Statistics
Year II Semester IV

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

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

Course Outcome: To familiarize the students with basic concepts of domain subject and its applications.

SYLLABUS	Hrs.
UNIT-1	**20**
Sample Spaces - events - probability axioms - conditional probability - independent events – Baye's formula. Random Variables: Discrete, Continuous and Joint probability Distribution, Expectation, Functions of Random Variables.	
UNIT-2	**20**
Discrete Probability distributions: Binomial, Poisson, geometric Distributions. Continuous Probability Distributions - uniform, normal, & exponential.	
UNIT-3	**20**
Random sampling, statistics, Sampling Distributions, Sampling Distribution of Means and Sampling Distributions: chi-squared distributions. t-Distribution, F-Distribution. Test of Significance: General Concepts, the Central Limit Theorem, Testing a Statistical Hypothesis, P- Values for Decision Making in Testing Hypotheses, Single and Two Sample tests concerning mean and variances, Analysis of variance – Definition purpose, assumptions, Analysis of variance for one way and two-way classified data.	
UNIT-4	**20**
Correlation - Regression - The Simple Linear Regression Model, Least Squares and the Fitted Model, Properties of the Least Squares Estimators, Inferences Concerning the Regression Coefficients, Prediction, Choice of a Regression Model, Analysis-of-Variance Approach, Test for Linearity of Regression, Correlation: Bivariate data, Scatter diagram. Karl Pearson's Product moment correlation coefficient and its properties. Coefficient of determination. Correlation ratio. Rank correlation - Spearman's measure.	

TEXT BOOKS:

1."Probability & Statistics for Engineers & Scientists" by Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers
2. "Probability and Statistics - Schaum's Outline+" 4th Edition by John Schiller, R. Alu Srinivasan, Murray Spiegel
3. "Probability, Statistics and Random Processes", by A L Garcia
4. "Intuitive Probability and Random Processes using MATLAB", by S M Kay

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Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/128
Name of the Course: Big Data Analytics and Visualization
Year II Semester IV

Course Credits	No. of Hours per Week	Total No. of Teaching Hrs.
3 Credits	3 Hrs.	52 Hrs.

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

Course Outcome: On successful completion of the course, the students will understand overview of Big Data, i.e. storage, retrieval and processing of big data. In addition, it also focuses on the "technologies", i.e., the tools/algorithms that are available for storage, processing of Big Data.

a) Understand Big Data and its analytics in the real world.
b) Analyze the Big Data framework like Hadoop and NOSQL to efficiently store and process Big Data to generate analyst.
c) Big Data Analysis with Machine Learning.

SYLLABUS	Hrs.
UNIT-1	**13**
Elements of Big Data, Data analytics project life cycle, Problems & challenges in understanding Data Analytics, Data Analytics Life Cycle, Big Data Real-Time Analytics Processing, Enterprise Data Warehouse, Web page categorization, computing the frequency of stock market change, Use of Big Data in Social Networking, Use of Big Data in preventing Fraudulent activities. Applications on Big Data using Pig and Hive: Data processing in Pig, Hive Services, HiveQL, Predictive Analytics, Simple Linear Regression, Multi-Linear Regression, Regression Coefficients, Visual Data Analysis, Interaction techniques, Systems and applications.	
UNIT-2	**13**
NoSQL Databases: Schema-less Models ,Flexibility for Data Manipulation ,Key Value Stores , Document Stores ,Tabular Stores ,Object Data Stores, Graph Databases, Hive, Sharding, Hbase ,Analyzing big data with twitter, Big data for E-Commerce Big data for blogs, Review of Basic Data Analytic Methods using R , Marketing Process: Strategic Challenge ,Strategy with Data, Text Analytics, Improving marketing strategy with data and analytics ,Brand Assets ,Snapple and Brand Value ,Brand Personality ,Developing Brand Architecture ,Brand Pyramid ,Measurement of Brand Values ,Revenue Premium, Calculation of Brand Value – Case Studies	
UNIT-3	**13**
Customer Life-time Value (CLV): Methodology for CLV ,CLV Formula and its application and its extension, Decisions based on CLV Case Studies ,Marketing Experiments: Spreadsheet with formulas ,Cause and Effects Study ,Designing experiments ,Analyzing experiments, Projecting Lift and its calculation, Pitfalls in experiments ,Measures for maximizing effectiveness Case Studies ,Regression Analysis: Regression Properties ,Multivariable Regressions ,Bias ,Price Elasticity , Marketing Mix Models ,Analytic in different fields: HR Analytics ,Web Analytics ,Healthcare Data Analytics ,Financial Risk Analytics ,Next Generation of Databases .	

UNIT-4	13
History of Visualization, Goals of Visualization, Types of Data Visualization: Scientific Visualization, Information Visualization, Visual Analytics, Impact of visualization, Big DataVisualization Tools: Tableau, Google Chart, Bar Charts, Histograms, Pie Charts, Scatter Plots, Line Plots, Fitting a Model: Characteristics of a good model, Evaluation Process , Plain Accuracy , Confusion Matrix Unbalanced Classes ,Frame Classifier Evaluation ,Performance ,Data Visualization using Tableaus ,Classroom Exercises	

TEXT BOOKS:

S.N Sivananadam, S N Deepa Wiley India, Principles of Soft Computing.
Big Data: Concepts, Technology, and Architecture - Nandhini Abirami R

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/129
Name of the Course: Introduction to Python Programming
Year II Semester IV

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

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

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

a) Demonstrate the concepts of control structures in Python.
b) Implement Python programs using functions and strings.
c) Implement methods to create and manipulate lists, tuples and dictionaries.

Apply the concepts of file handling.

SYLLABUS	Hrs.
UNIT-1	**20**
Introduction to Features and Applications of Python; Python Versions; Installation of Python; Python Command Line mode and Python IDEs; Simple Python Program. Python Basics: Identifiers; Keywords; Statements and Expressions; Variables; Operators; Precedence and Association; Data Types; Indentation; Comments; Built-in Functions- Console Input and Console Output, Type Conversions; Python Libraries; Importing Libraries with Examples. Python Control Flow: Types of Control Flow; Control Flow Statements- if, else, elif, while loop, break, continue statements, for loop Statement; range () and exit () functions. Exception Handling: Types of Errors; Exceptions; Exception Handling using try, except and finally. Python Functions: Types of Functions; Function Definition- Syntax, Function Calling, Passing Parameters/arguments, the return statement; Default Parameters; Command line Arguments; Key Word Arguments; Recursive Functions; Scope and Lifetime of Variables in Functions.	
UNIT-2	**20**
Strings: Creating and Storing Strings; Accessing Sting Characters; the str() function; Operations on Strings- Concatenation, Comparison, Slicing and Joining, Traversing; Format Specifiers; Escape Sequences; Raw and Unicode Strings; Python String Methods. Lists: Creating Lists; Operations on Lists; Built-in Functions on Lists; Implementation of Stacks and Queues using Lists; Nested Lists. Dictionaries: Creating Dictionaries; Operations on Dictionaries; Built-in Functions on Dictionaries; Dictionary Methods; Populating and Traversing Dictionaries. Tuples and Sets: Creating Tuples; Operations on Tuples; Built-in Functions on Tuples; Tuple Methods; Creating Sets; Operations on Sets; Built-in Functions on Sets; Set Methods, Modules: Importing modules, Tricks for importing modules, Packages, Creating a module.	
UNIT-3	**20**
Object Oriented Programming: Classes and Objects; Creating Classes and Objects; Constructor Method; Classes with Multiple Objects; Objects as Arguments; Objects as Return Values; Inheritance- Single	

and Multiple Inheritance, Multilevel and Multipath Inheritance; Encapsulation- Definition, Private Instance Variables; Polymorphism- Definition, Operator Overloading. GU Interface: The tkinter Module; Window and Widgets; Layout Management- pack, grid and place. Python SQLite: The SQLite3 module; SQLite Methods- connect, cursor, execute, close; Connect to Database; Create Table; Operations on Tables- Insert, Select, Update. Delete and Drop Records. Object Oriented Programming: Classes and Objects; Creating Classes and Objects; Constructor Method; Classes with Multiple Objects; Objects as Arguments; Objects as Return Values; Inheritance- Single and Multiple Inheritance, Multilevel and Multipath Inheritance; Encapsulation- Definition, Private Instance Variables; Polymorphism- Definition, Operator Overloading. GU Interface: The tkinter Module; Window and Widgets; Layout Management- pack, grid and place. Python SQLite: The SQLite3 module; SQLite Methods- connect, cursor, execute, close; Connect to Database; Create Table; Operations on Tables- Insert, Select, Update. Delete and Drop Records.	
UNIT-4	**20**
Data Analysis: NumPy- Introduction to NumPy, Array Creation using NumPy, Operations on Arrays; Pandas- Introduction to Pandas, Series and Data Frames, Creating Data Frames from Excel Sheet and .csv file, Dictionary and Tuples. Operations on Data Frames. Data Visualization: Introduction to Data Visualization; Matplotlib Library; Different Types of Charts using Pyplot- Line chart, Bar chart and Histogram and Pie chart. Files: File processing, controlling file I/O, getting file lists, File/Directory management, Access, and ownership, manipulating file paths. Data Management and storage: Managing internal structures, Object Persistence.	

TEXT BOOKS:

1. Think Python How to Think Like a Computer Scientist, Allen Downey et al., 2nd Edition, Green Tea Press.
2. Freely available online @ https://www.greenteapress.com/thinkpython/thinkCSpy.pdf, 2015.
3. 2. Introduction to Python Programming, Gowrishankar S et al., CRC Press, 2019.
4. 3. Python Data Analytics: Data Analysis and Science Using Pandas, matplotlib, and the Python Programming
5. Language, Fabio Nelli, Apress®, 2015

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/129 L
Name of the Course: Introduction to Python Programming Lab
Year II Semester IV

Programs

Part-A

1 Check if a number belongs to a Fibonacci sequence.
2 Solve the quadratic equation.
3 Find the sum of N natural numbers.
4 Display the multiplication table.
5 Check if a given number is prime number or not.
6 Create a calculator program.
7 Explain string function.
8 Implement Sequential search.
9 Implement Selection sort.
10 Implement the stack.
11 Read and write into the file.

Part-B

12 Demonstrate usage of basic regular expression.
13 Demonstrate use of advanced regular expression for data validation.
14 Demonstrate the use of list
15 Demonstrate the use of dictionaries
16 Create SQLite Database and perform operations on table.
17 Create a GUI using Tkinter module.
18 Demonstrate Exceptions in python.
19 Drawing line chart and bar chart using matplotlib.
20 Drawing histogram and pie chart using matplotlib.
21 Create array using NumPy and perform operations on array.
22 Create Data Frame from Excel sheet using pandas and perform operations on data frames.

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/130
Name of the Course: Cyber Law
Year II Semester IV

Course Credits	No. of Hours per Week	Total No. of Teaching Hrs.
2 Credits	2 Hrs.	32 Hrs.

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

Course Outcome: Upon completion of the course, students will be able to.
(a) Understand the cyber security threat landscape.
(b) Develop a understanding and familiarity with various types of cyber attacks , cyber crimes, vulnerabilities and remedies thereto.
(c) Analyse and evaluate existing legal framework and laws on cyber security.
(d) Analyze and evaluate the digital payment system security and remedial measures against digital payment frauds.

SYLLABUS	Hrs.
UNIT-1	**8**
Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Advent of internet, Internet infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security.	
UNIT-2	**8**
Classification of cyber-crimes, Common cyber crimes- cyber crime targeting computers and mobiles, cyber crime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, Cybercriminals modus-operandi , Reporting of cyber crimes, Remedial and mitigation measures, Legal perspective of cyber crime, IT Act 2000 and its amendments, Cyber crime and offences, Organizations dealing with Cyber crime and Cyber security in India, Case studies.	
UNIT-3	**8**
Introduction to Social networks. Types of social media, Social media platforms, Social media monitoring, Hashtag, Viral content, Social media marketing, Social media privacy, Challenges, opportunities and pitfalls in online social network, Security issues related to social media, Flagging and reporting of inappropriate content, Laws regarding posting of inappropriate content, Best practices for the use of Social media, Case studies.	
UNIT-4	**8**
Definition of E- Commerce, Main components of E-Commerce, Elements of E-Commerce security, E-Commerce threats, E-Commerce security best practices, Introduction to digital payments, Components of digital payment and stake holders, Modes of digital payments- Banking Cards, Unified Payment Interface (UPI), e-Wallets, Unstructured Supplementary Service Data (USSD), Aadhar enabled payments, Digital payments related common frauds and preventive measures. RBI guidelines on digital payments and customer protection in unauthorised banking transactions. Relevant provisions of Payment Settlement Act,2007	

TEXT BOOKS:

1. Cyber Crime Impact in the New Millennium, by R. C Mishra , Auther Press. Edition 2010.
2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd. (First Edition, 2011)

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/133
Name of the Course: Foundation of AI and Machine Learning
Year III Semester V

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

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

Course Outcome: To introduce to students AI and ML concepts and gain application of the principles in real-world scenario

SYLLABUS	Hrs.
UNIT-1	**20**
Artificial Intelligence, Foundations of AI, History of AI, Applications of AI. **AI Problems:** Problem Definitions, Problem Space, Problem Characteristics, Production system. **Intelligent Agents:** Agent Definition, Problem Formulation, Types of Agents, Agent Environments, PEAS representation for an Agent, Architecture of Intelligent agents. Reasoning and Logic, Prepositional logic, first order logic, Using First-order logic, reasoning under uncertainty, review of probability, Baye's probabilistic interferences.	
UNIT-2	**20**
AI Ethics: AI bias and fairness, AI safety, Privacy, Ethics of autonomous systems, social impact of AI, Regulation of AI, Values alignment, Ethical considerations in data use, AI and human rights. Future of AI: Emerging trends and future applications of AI.	
UNIT-3	**20**
Machine Learning: Definition, Types and Applications, Features and Performance Measures, Bias-Variance trade-off, Linear Regression: Simple Linear Regression, Multiple Linear Regression, Regularization and Ridge Regression, Logistic Regression: Binary and Multiclass Logistic Regression	
UNIT-4	**20**
Dimensionality Reduction: Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA) Support Vector Machines (SVM): Maximal Margin Classifier, Soft-Margin Classifier and Regularization, Non-Linear SVM and Kernels. Clustering: Partioning Clustering, Hierarchical Clustering. Evaluation Metrics: Accuracy, Precision, Recall, and F1-Score, ROC Curve and AUC, Confusion Matrix and Cross-Validation Ensemble Methods: Boosting (AdaBoost), Bagging Applications: Recommender Systems, Computer Vision, Natural Language Processing.	

TEXT BOOKS:

1. "Pattern Classification" by Richard O Duda, Hart Start (2nd edition)
2. "Artificial Intelligence A Modern Approach" by Stuart Rusell, Peter Norving (4th Edition)
3. "Pattern Recognition" by Srigois Theaodoridis, Konstantinos,Koutroumbas (4th Edition)
4. "Machine Learning using Python", by U Dinesh Kumar Manaranjan Pradhan

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/134
Name of the Course: Introduction to Neural Networks
Year III Semester V

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

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

Course Outcome:
On successful completion of the course, the students will understand
a) Basic neuron Models.
b) Network Models
c) Basic Learning Algorithms and Applications

SYLLABUS	Hrs.
UNIT-1	**20**
Structure of biological neurons relevant to ANNs., Models of ANNs; Feedforward & feedback networks; learning rules; Hebbian learning rule, perception learning rule, delta learning rule, Widrow-Hoff learning rule, correction learning rule, Winner –lake all learning rule, etc.	
UNIT-2	**20**
Classification model, Features & Decision regions; training & classification using discrete perceptron, algorithm, single layer continuous perceptron networks for linearly separable classifications, linearly non-separable pattern classification, Delta learning rule for multi-perceptron layer, Generalized delta learning rule, Error back-propagation training, learning factors, Examples.	
UNIT-3	**20**
Basic Concepts, Hopfield networks, Training & Examples. Associative memories: Linear Association, Basic Concepts of recurrent. Retrieval algorithm, storage algorithm; By directional associative memory, Architecture, Association encoding & decoding, Stability.	
UNIT-4	**20**
Retrieval algorithm, storage algorithm; By directional associative memory, Architecture, Association encoding & decoding, Stability. UN supervised learning of clusters, winner-take-all learning, recall mode, Initialization of weights, separability limitations.	

TEXT BOOKS:
Introduction to Artificial Neural systems – Jacek M. Zurada, 1994, Jaico Publ.House
REFERENCE BOOKS
1. Neural Networks :A Comprehensive formulation – Simon Haykin, 1998, AW
2. Neural Networks – Kosko, 1992, PHI.
3. Neural Network Fundamentals – N.K. Bose , P. Liang, 2002, M.H
4. Neural Network – T.N.Shankar, University Science Press

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/134 L
Name of the Course: Introduction to Neural Networks Lab
Year III Semester V

Programs

1. Implementation of different activation functions to train Neural Network.
2. Implementation of different Learning Rules.
3. Implementation of Perceptron Networks.
4. Implementation of Adeline network for system identification.
5. Implementation of Madeline network
6. Pattern matching using different rules.
7. Project related to application of machine learning in healthcare**.**
8. Project related to application of machine learning in business analysis.
9. Project related to application of machine learning in sports analytics
10. Project related to application of machine learning in Time Series Analysis & Forecasting.

Name of the Program: B.Sc. (Hon's)Data Science and Artificial IntelligenceCourse Code: BH/135
Name of the Course: Database Management System
Year III Semester V

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

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

Course Outcome:
On successful completion of the course, the students will understand a) Illustrate the concepts of Database Management System.
b) Apply Relational Model concepts, Constraints and Design
c)Illustrate the Transactional Database Concepts, Scheduled, Lock Management and Recovery. d) Illustrate transaction management system in DBMS

SYLLABUS	**Hrs.**
UNIT-1	**20**
DBMS ; Characteristics of Database approach; Actors on the screen; Workers behind the scene; Advantages of using DBMS approach; A brief history of database applications; Data models, schemas and instances; Three-schema architecture and data independence; Centralized and client-server architectures.	
UNIT-2	**20**
Using High-Level Conceptual Data Models for Database Design; An Example Database Application; Entity Types, Entity Sets, Attributes and Keys; Relationship types, Relationship Sets, Roles and Structural Constraints; Weak Entity Types; Refining the ER Design; ER Diagrams, Naming Conventions and Design Issues.	
UNIT-3	**20**
Relational Model Concepts, Constraints and database schemas, Update operations, transactions, and dealing with constraint violations. Informal Design Guidelines for Relation Schemas; Functional Dependencies; Normal Forms Based on Primary Keys; General Definitions of Second and Third Normal Forms	
UNIT-4	**20**
SQL Data Definition and Data Types; Specifying basic constraints in SQL; Schema change statements in SQL; Basic queries in SQL; More complex SQL Queries. Insert, Delete and Update statements in SQL; Specifying constraints as Assertion and Trigger; Views (Virtual Tables) in SQL; Additional features of SQL. The ACID Properties; Transactions and Schedules; Concurrent Execution of Transactions; Lock- Based Concurrency Control; Performance of locking; Transaction support in SQL; Introduction to crash recovery; 2PL, Serializability and Recoverability; Lock Management	

TEXT BOOKS: 1.Elmasri and Navathe: Fundamentals of Database Systems, 5th Edition, Pearson Education, 2007.
2. Raghu Ramakrishnan and Johannes Gehrke: Database Management Systems, 3rd Edition, McGraw-Hill, 2003.
Reference Books:
1. Silberschatz, Korth and Sudharshan: Data base System Concepts, 6th Edition, Mc-GrawHill, 2010.
2. C.J. Date, A. Kannan, S. Swamynatham: An Introduction to Database Systems, 8th Edition, Pearson Education, 2006.

Name of the Program: B.Sc. (Hon's)Data Science and Artificial IntelligenceCourse Code: BH/135 L
Name of the Course: Database Management System Lab
Year III Semester V

Programs

Exercise-1

Create the following tables:

1) SALESMEN
Table Structure:

Field	Type	Constraint
SID	VARCHAR2 (5)	Primary Key
SNAME	VARCHAR2 (20)	Not Null
CITY	VARCHAR2 (15)	Not Null
SALARY	NUMBER (5, 2)	
PRODUCT	VARCHAR2 (20)	
TGTTOGET	NUMBER (5,2)	
COMM	NUMBER (5,2)	

2) CUSTOMERS
Table Structure:

Field	Type	Constraint
CID	VARCHAR2 (5)	Primary Key
CNAME	VARCHAR2 (20)	Not Null
CITY	VARCHAR2 (15)	Not Null
STATE	VARCHAR2 (15)	
PINCODE	NUMBER (8)	
PRODUCT	VARCHAR2 (20)	
CLASS	CHAR (1)	Default value 'A'

3) ORDERS
Table Structure:

Field Type Constraint		
OID	VARCHAR2 (5)	Primary Key
CID	VARCHAR2 (5)	Foreign Key (CUSTOMERS)
SID	VARCHAR2 (5)	Foreign Key (SALESMEN)
PRODUCT	VARCHAR2 (20)	
QTY	NUMBER (5)	
ODATE DATE	Not Null	
O_AMT	NUMBER (8, 2)	Minimum zero

Exercise 2

Insert the following records: (Enter required data in empty columns)

Table 1→ SALESMEN

SID	SNAME	CITY	SALARY	PRODUCT	TGTTOGET	COMM
S101	Ajay Patel	Ahmedabad				1200
S102	Chintan Shah	Baroda				1500
S103	Vinay Mehra	Pune				1200
S104	Jay Pandey	Surat				800
S105	Jimit Dave	Mumbai				300
S106	Manan Gandhi	Ahmedabad				1200

Table 2 → CUSTOMERS

CID	CNAME	CITY	STATE	PINCODE	PRODUCT	CLASS
C301	Nirav Patel	Nadiad				B
C302	Kiran Dave	Delhi				A
C303	Sapan Shah	Bangalore				B
C304	Saurabh Mehta	Baroda				C
C305	Smriti Mishra	Ahmedabad				B
C306	Harshal Pandya	Mumbai				A
C307	Sunil Gandhi	Baroda				B
C308	Bimal Thakkar	Surat				C

Table 3 → ORDERS

OID	CID	SID	PRODUCT	QUANTITY	ODATE	O_AMT
O501	C302	S102			02-JAN-09	700000
O502	C301	S105			21-JAN-09	10000
O503	C308	S103			10-FEB-09	250000
O504	C306	S104			14-FEB-09	400000
O505	C306	S102			29-MAR-09	100000
O506	C303	S101			15-APR-09	90000.50
O507	C304	S105			24-JUN-09	7500.75
O508	C306	S101			27-SEP-09	900000
O509	C302	S102			21-DEC-09	205000
O510	C307	S102			30-DEC-09	27800
O511	C303	S104			31-DEC-09	15000

Exercise 3

Solve the following queries:

- Display all the information about each salesman with appropriate headings.
- List all the salesmen that live outside the Gujarat.
- Displays class 'A' customers with their id and name.
- Add a new field as country in salesmen and customers table.
- Change the name of the city whose name is Sunil Gandhi from customers table.
- List the information of all the customers who are located in Baroda.
- List the name of all the salesmen whose salary is greater than 2000.
- Change the order amount for the order id O501.
- Display order id and order date from orders table whose sales id is S102.

Exercise 4(Constraints)

- Add primary key and Foreign Key to the existing tables using alter tablecommand.
- Create cust table which contains cno having pk, cname and occupation where data
- Values inserted for cno must start with the capital letter C and cname should be inupper case.
- Insert the correct values as well as display the error message for incorrect values.
- Find out the name of all the salesmen having ‘a’ as the second letter in theirnames.
- List all the information of customers whose state contains null value.
- List all the information of customers in descending order according to their name.

Exercise 5(Joins)

- Display customer no, name, city and order amount.
- Display salesman details with their order details.
- Display customer info of salesman S102 and S105.
- List the salesmen details along with customers names associated with them.

Exercise 5 (Group functions)

- Display order info with salesman name which has given on date before 10of any month.
- Display minimum order amount of each sales man.
- Display total order amount for each salesman.
- Find the customer city of customer which order amount is minimum.

Exercise 6 (aggregate, math and string functions)

- Count the total number of orders.
- Count the number of salesmen whose commission is greater than 500.
- Find average order amount of each salesman.
- Find out the orders whose order amount is more than 12000 and also find the neworder amount as original order amount * 5.
- Determine the minimum and maximum salary of the salesman and rename thetitle as “min_sal” and “max_sal” respectively.
- Show the use of right and left justify string function.
- Show use of floor and ceiling function.

Exercise 7(Sub queries)

- Display customer name which customer no is highest.
- Display customer name whose salesman staying in Ahmadabad.
- Display order info for which order taken earliest.

Exercise 8

1. Insurance database.

1. SQL> create table person(driver_id varchar(10),name varchar(10),address varchar(10),primary key(driver_id));

SQL> create table car(regno varchar(10),model varchar(10),year int, primary key(regno));

SQL> create table accident(report_number int, accd_date date, locationvarchar(10),primary key(report_number));

SQL> create table owns(driver_id varchar(10),regno varchar(10),primary key(driver_id, regno),foreign key(driver_id) references person(driver_id),foreignkey(regno) references car(regno));

SQL> create table participated(driver_id varchar(10),regno varchar(10),report_numberint,damage_amount int, primary key(driver_id,regno,report_number),foreign key(driver_id) references person(driver_id),foreign key(regno) references car(regno),foreign key(report_number) references accident(report_number));

2. SQL> insert into person values('&driver_id','&name','&address');SQL> insert into

car values('&regno','&model',&year);

SQL> insert into accident values(&report_number,'&accd_date','&location');SQL> insert into

owns values('&driver_id','&regno');

SQL> insert into participated values('&driver_id','&regno',&report_number,&damage_amount);

3a. SQL> update participated set damage_amount=25000 where report_number=12 andregno='5';

3b. SQL> insert into accident values(&report_number,'&accd_date','&location');

SQL> insert into participated values('&driver_id','&regno',&report_number,&damage_amount);

4.SQL> select count(distinct o.driver_id) as People from owns o,participated p,accidenta where a.accd_date like '%08' and o.regno=p.regno and p.report_number=a.report_number;

5. SQL> select count(*) as Totalcars from car c, participated p where c.regno=p.regno and c.model='Alto';

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/136
Name of the Course: Software Engineering
Year III Semester V

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

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

Course Outcome: On successful completion of the course, the students will understand
a) Define software engineering process and translate a requirements specification into high level and low-level designs.
b) Explain software development techniques to develop applications
c)Apply verification and validation techniques and estimate software cost.

SYLLABUS	Hrs.
UNIT-1	**20**
The role of software engineering in system design, software products, emergence of software engineering, notable changes in software development practices, the changing nature of software, the software engineering challenges, Software processes, desired characteristics of software process, the software life cycle, software development process models, comparison of process models. Requirement analysis and specification, need for SRS, characteristics of SRS, organization of SRS document. Techniques for representing complex logic, functional specification with Use Cases, formal system development techniques. System models: Data-flow models, semantic data models, object models, data dictionaries.	
UNIT-2	**20**
Main objectives of SPM, responsibility of software project managers, project planning, structure of software project management document. Project size estimation metrics, project estimation techniques (empirical, heuristic, analytical), Halstead's software science. Project scheduling and staffing, work break down structure, Gantt charts, PERT charts, organization and team structures, attributes of a good software engineer. Risk management plan and configuration management plan.	
UNIT-3	**20**
Introduction, cohesion and coupling, software design approaches, design principles, module level concepts.Function-oriented software design: Overview of the structured analysis and structured design methodology, data flow diagrams, extending DFD to real time systems, structured design. Object-oriented software design concepts: Overview, UML, object-oriented design methodology, OOD metrics and goodness criteria. User-interface design: Characteristics, basic concepts, command language based interface, menu-based interface, direct manipulation interfaces, windowing systems, types of widgets, overview of X window.	
UNIT-4	**20**
Coding standards, guidelines, code walkthroughs, code inspections, software documentation, unit testing, black box testing, white box testing. Debugging, approaches and guidelines, program analysis tools, integration testing, system testing, general issues associated with testing. Software quality factors, quality metrics, software quality management system, the maintenance process, software reverse engineering, software maintenance process models, estimation of maintenance costs, maintainability measurement. CASE and its scope, CASE support in software life cycle, characteristics of CASE tools, architecture of CASE environment.	

TEXT BOOKS:

Ian Sommerville – Software Engineering, Fifth Edition, Addison-Wesley.
Pankaj Jalote – An Integrated Approach to Software Engineering, Third Edition.
Rajib Mall – Fundamentals of Software Engineering, PHI.
Roger S. Pressman – Software Engineering, Sixth Edition, Mc Graw Hill

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/137
Name of the Course: Operational Research
Year III Semester V

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

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

Course Outcome: To equip the students with the capabilities for formulating and solving problems; construct linear programming models and discuss solution techniques; set-up decision models and propose best strategy using decision-making methods under uncertainty and game theory.

SYLLABUS	Hrs.
UNIT-1	**20**
Operation Research – Nature, Management Application, Modelling, Principles of modelling, features, Different Phases, scope, Advantages and Limitations of O.R. General method for solving O.R models and Role of O.R in decision making. Some important definitions – Solutions to LPP, Feasible solution, Basic solutions, Basic feasible solution, Optimum basic feasible solution, Unbounded solution. Assumptions in LPP, Limitations of LPP, Applications of LPP and advantages of LPP Standard Linear Programming – Formulation of a Linear Programming Solving L.P.P. by Graphical Method Problem and Simplex Method.	
UNIT-2	**20**
Artificial Variable Technique – two phase method and Big M method, Duality – Meaning, definitions of primal problem, General rules for converting any primal problem into its dual. Characteristics of Dual problem – Advantages of Duality – Dual formulation procedure and Problems to obtain the dual of LPP. Fundamental Duality theorems – Primal and Dual correspondence	
UNIT-3	**20**
Transportation Problems – Method of finding initial basic feasible solution to Transportation Problem-North West Corner, Least Cost Method and Vogel 's Method – Method of finding initial basic feasible solution to Assignment Problem using Hungarian Method	
UNIT-4	**20**
Sequencing Problems – Definitions, terminology and notations, Principal assumptions, Processing _n 'jobs through two machines Travelling Salesman (Routing) Problems - Formulations of TSP as an assignment problem	
TEXT BOOKS: 1. "Introduction to Operations Research", by Prem Kumar Gupta 2 "Operations Research", by S D Sharma 3 "Operations Research", by P Shankar Iyer 4 "Essentials of Operations Management", by Nigel Slack 5 "Operations Management: Theory and Practice", by B Mahadevan "Operations Research: Applications and Algorithms", by W L Winston	

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/138
Name of the Course: - Introduction to Robotics
Year III Semester V

Course Credits	No. of Hours per Week	Total No. of Teaching Hrs.
3 Credits	2 Hrs.	32 Hrs.

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

Course Outcome:
On successful completion of the course, the students will demonstrate.
The field of Robotics is a multi-disciplinary as robots are amazingly complex system comprising mechanical, electrical, electronic H/W and S/W and issues germane to all these.

SYLLABUS	Hrs.
UNIT-1	**16**
Robot anatomy-Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robotics-Simple problems- Specifications of Robot-Speed of Robot-Robot joints and links-Robot Classifications-Architecture of robotic systems-Robot Drive systems- Hydraulic, Pneumatic and Electric system.	
UNIT-2	**16**
Robot Kinematics: Position Analysis, Dynamic Analysis and Forces, Robot Programming languages & systems: Introduction, the three levels of robot programming, requirements of a robot programming language, problems peculiar to robot programming languages.	

TEXT BOOKS:

1. John J. Craig, "Introduction to Robotics", Addison Wesley publication
2. Tsuneo Yoshikawa, "Foundations of Robotics", PHI Publication
3. Craig. J. J. "Introduction to Robotics mechanics and control", Addison- Wesley,1999

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/139
Name of the Course: Deep Learning
Year III Semester VI

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

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

Course Outcome: After completing this course, students should be able to
1.Explain the basic concepts in the design of deep neural networks
2. Apply the concepts of deep neural networks in formulating solutions to complex machine learning problems.
3. Illustrate parameter tuning for deep learning architecture

SYLLABUS	**Hrs.**
UNIT-1	**16**
Neural Networks, Training Neural Networks, Activation Functions, Loss Functions, Hyper parameters. Deep Learning, Common Architectural Principles of Deep Networks, Building Blocks of Deep Networks.	
UNIT-2	**16**
Unsupervised Pretrained Networks, Convolutional Neural Networks (CNNs), Recurrent Neural Networks, Recursive Neural Networks.	
UNIT-3	**24**
Matching Deep Networks to the Right Problem, The DL4J Suite of Tools, Basic Concepts of the DL4J API, Modelling CSV Data with Multilayer Perceptron Networks, Modelling Handwritten Images Using CNNs, Modelling Sequence Data by Using Recurrent Neural Networks, Using Autoencoders for Anomaly Detection, Using Variational Autoencoders to Reconstruct MNIST Digits, Applications of Deep Learning in Natural Language Processing	
UNIT-4	**24**
Basic Concepts in Tuning Deep Networks, Matching Input Data and Network Architectures, Relating Model Goal and Output Layers, Working with Layer Count, Parameter Count, and Memory, Weight Initialization Strategies, Using Activation Function, Applying Loss Functions, Understanding Learning Rates, How Sparsity Affects Learning Applying Methods of Optimization, Using Parallelization and GPUs for Faster Training, Controlling Epochs and Mini-Batch Size, How to Use Regularization, Working with Class Imbalance, Dealing with Overfitting	

TEXT BOOKS:

1. Josh Patterson and Adam Gibson, Deep Learning A Practitioner's Approach, Oreilly,2017.

Reference Books:

1. Nikhil Buduma, "Fundamentals of Deep Learning", Oreilly,2017
2. Ian Goodfellow, YoshuaBengio, Aaron Courville., "Deep Learning", The MIT Press, Cambridge, Massachusetts, London,2016.

Name of the Program: B.Sc. (Hon's)Data Science and Artificial IntelligenceCourse Code: BH/140

Name of the Course: Natural Language ProcessingYear III

Semester VI

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

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

Course Outcome**:** After completing this course, students should be able to:Illustrate the various aspects of natural language generation
Develop applications for NLP using machine learning algorithms.Design finite state transducers for Language Processing

SYLLABUS	Hrs.
UNIT-1	**16**
Introduction to NLP: Definition, Knowledge in speech and speech language processing, Word Classes: Review of Regular Expressions, Morphology: Inflectional, derivational, parsing and parsing with FST, Combining FST lexicon and rules, human morphological processing	
UNIT-2	**16**
Speech sounds, phonetic transcription, phoneme and phonological rules, optimality theory, machine learning of phonological rules, phonological aspects of prosody and speech synthesis. Pronunciation, Spelling and N-grams: Spelling errors, detection and elimination using probabilistic models, pronunciation variation (lexical, allophonic, dialect), decision tree model, counting words in Corpora, simple N-grams, smoothing (Add One, Written-Bell, Good-Turing), N-grams for spelling and pronunciation.	
UNIT-3	**16**
Tag sets, concept of HMM tagger, rule based and stochastic POST, algorithm for HMM tagging, transformation-based tagging, Sentence level construction & unification: Noun phrase, co-ordination, sub-categorization, concept of feature structure and unification. Semantics: Representing Meaning: Unambiguous representation, canonical form, expressiveness, meaning structure of language, basics of FOPC, semantics of FIPC.	
UNIT-4	**16**
Semantic Analysis: Syntax driven, attachment & integration, robustness. Lexemes (homonymy, polysemy, synonymy, hyponymy), WordNet, internal structure of words, creativity and the lexicon: metaphor and metonymy and their computational approaches. Word Sense Disambiguation: Selection restriction-based, machine learning based and dictionary-based approaches. Discourse: Reference resolution and phenomena, syntactic and semantic constraints on Co reference, pronoun resolution algorithm, text coherence, discourse structure. Dialogues: Turns and utterances, grounding, dialogue acts and structures. Natural Language Generation: Introduction to language generation, architecture, discourse planning, text schemata, rhetorical relations	

TEXT BOOKS:

1. D. Jurafsky& J. H. Martin – "Speech and Language Processing – An introduction to Language processing, Computational Linguistics, and Speech Recognition", Pearson Education

REFERENCE BOOKS:

1. Allen, James. 1995. – Natural Language Understanding. Benjamin/Cummings, 2ed.Bharathi, A Vineet Chaitanya and Rajeev Sangal. 1995.
2. Natural Language Processing-A Pananian Perspective.Prentice HllIndia, Eastern Economy Edition. EugeneCherniak:

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/141 L
Name of the Course: Natural Language Processing Lab
Year III Semester VI

Programs

1. Installation and exploring features of NLTK and spaCy tools. Download Word Cloud and few corpora.
2. Write a program to implement both user-defined and pre-defined functions to generate.
3. Write a program to identify the word collocations
4. Write a program to print all words beginning with a given sequence of letters.
5. Write a program to print all words longer than four characters.
6. Write a program to identify different components of an email address.
7. Write a program to identify all antonyms and synonyms of a word.
8. Write a function that finds the 50 most frequently occurring words of a text that are not stop words.
9. Define a conditional frequency distribution over the names corpus that allows you to see which initial letters are more frequent for males versus females.
10. Write a program to implement Part-of-Speech (PoS) tagging for any corpus.
11. Classification using Naïve Bayes.
12. Write a program to implement chunking.
13. Write a program to implement Identifying Dialogue Act Types.
14. Write a program to find all the mis-spelled words in a paragraph.
15. Write a program to implement Named Entity Recognition (NER).
16. Write a program to perform Auto-Correction of spellings for any text.
17. Parsing using recursive descent parser.

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/141
Name of the Course: Big Data Management
Year III Semester VI

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

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

Course Outcome: On successful completion of the course, the students will understand overview of Big Data, i.e. storage, retrieval and processing of big data. In addition, it also focuses on the "technologies", i.e., the tools/algorithms that are available for storage, processing of Big Data.
a) Understand Big Data and its analytics in the real world.
b) Analyze the Big Data framework like Hadoop and NOSQL to efficiently store and process Big Data to generate analyst.
c) Big Data Analysis with Machine Learning

SYLLABUS	Hrs.
UNIT-1	**20**
Distributed and Parallel Data Management Framework - Data Management in Cloud – Programming Models and Declarative languages, managing high velocity data streams, Distributed data management: Using Specialized Processors – Big Data Cleaning – Data Science in the current Century – Application of Big Data Management principles in real-world, Web Data: The Original Big Data -Web Data Overview -What Web Data Reveals -Web Data In Action. A Cross-Section of Big Data Sources and The Value They Hold	
UNIT-2	**20**
Introduction To Streams Concepts, Stream Data Model and Architecture, Stream Computing, Sampling Data in A Stream, Filtering Streams, Counting Distinct Elements In A Stream, Estimating Moments, Counting Oneness In A Window, Decaying Window, Realtime Analytics Platform (RTAP) Applications. The Stream Data Model, A Data-Stream-Management System.	
UNIT-3	**20**
Big Data Tools: SAS Cloud-source Proprietary software, Statistical modelling, Statistical Libraries, Usages, Apache Spark: Batch Processing and Stream Processing, Comparison with MapReduce, Spark for real-time data, Conjunction with Scala, Speed in Spark.	
UNIT-4	**20**
Walmart: How Big Data Is Used to Drive Supermarket Performance, CERN: Unravelling The Secrets Of The Universe With Big Data, Netflix: How Netflix Used Big Data To Give Us the Programs We Want, Rolls-Royce: How Big Data Is Used To Drive Success In Manufacturing, Shell: How Big Oil Uses Big Data, Apixio: How Big Data Is Transforming Healthcare, Lotus F1 Team: How Big Data Is Essential To The Success Of Motorsport Teams, Pendleton & Son Butchers: Big Data For Small Business, US Olympic Women's Cycling Team: How Big Data Analytics Is Used To Optimize Athletes' Performance, ZSL: Big Data In The Zoo And To Protect Animals, Facebook: How Facebook Use Big Data To Understand Customers.	

TEXT BOOKS:

1. Bill Franks Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with advanced analytics John Wiley & sons, 2017
2. Anand Rajaraman and Jeffrey David Ullman Mining of Massive Datasets Cambridge University Press,2016

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/141 L
Name of the Course: Big Data Management Lab
Year III Semester VI

	Programs
1	Write a Program to Visualize the Iris Data and also Compute Mean and Standard Deviation. Identify the best Features.
2	Write a Program to Visualize the Tips Data and also Compute Mean and Standard Deviation. Identify the best Feature.
3	Write a Program analyze the Data using K-Means Clustering.
4	Write a Program analyze and reduce Data using PCA.
5	Write a Program analyze and the Data using Hierarchical Clustering.
6	Write a Program analyze and the Data using Single Linkage.
7	Write a Program analyze and the Data using complete Linkage.
8	Write a Mapping and Reducer Programs for Analyzing Large Data. (Airline).
9	Read and Analyze MAT-File with Key-Value Data.
10	Write a Program to represent the data using Data Store.

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/142
Name of the Course: Data Mining
Year III Semester VI

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

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

Course Outcome: To build data mining applications using statistical analysis techniques.
Explain the basic concepts and techniques of Data Mining.
Analyse Associate rules to solve the problem.
Apply statistical analysis techniques.
Evaluate advanced data mining techniques

SYLLABUS	Hrs.
UNIT-1	**20**
Data Mining, KDD, Challenges, Data Mining Tasks. Data Preprocessing: An Overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation, and Data Discretization and Binarization, Data Transformation; Measures of Similarity and Dissimilarity- Basics.	
UNIT-2	**20**
Problem Definition, Frequent Item Set Generation, The APRIORI Principle, Support and Confidence Measures. Association Rule Generation: APRIOIRI Algorithm, The Partition Algorithms, FP-Growth Algorithms, Compact Representation of Frequent Item Sets- Maximal Frequent Item Set, Closed Frequent Item Set. Evaluation of association patterns, Effect of skewed support distribution.	
UNIT-3	**20**
Classification techniques: Decision Trees , Induction: Construction, Methods for Expressing attribute test conditions, Measures for Selecting the Best Split, Algorithm for Decision tree Induction; KNN Classifier, Bayesian Classifiers, Bayesian Belief Networks - Algorithm and Characteristics.	
UNIT-4	**20**
Problem Definition, Clustering Overview, K-means Algorithm, K-means: Additional issues. Hierarchical clustering – Agglomerative and divisive methods, specific techniques, key issues in Hierarchical Clustering, Strengths, and Weakness; DBSCAN- Algorithm, strength, and Weaknesses; Cluster Evaluation.	

TEXT BOOKS:

1. Introduction to Data Mining – Pang-Ning Tan, Michael Steinbach & Vipin Kumar, 4th Impression, 2009 by Pearson.
2. Data Mining Introductory and Advanced topics – Margaret H Dunham, PEA.
Reference Books:
1. Data Mining – Concepts and Techniques – Jiawei Han & Micheline Kamber, 3rd Edition Elsevier.

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/143
Name of the Course: Fuzzy Logic and ANN
Year III Semester VI

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

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

Course Outcome: To inculcate in students the knowledge of principals of fuzzy logic models of Artificial neural networks and their application to design and manufacturing sectors.

SYLLABUS	Hrs.
UNIT-1	**20**
Introduction: The Case for Imprecision, An Historical Perspective ,The Utility of Fuzzy Systems ,Limitations of Fuzzy Systems ,The Allusion: Statistics and Random Processes ,Uncertainty and Information ,Fuzzy Sets and Membership, Chance versus Fuzziness ,Sets as Points in Hypercubes, Classical Sets -Operations on Classical Sets ,Properties of Classical (Crisp) Sets, Mapping of Classical Sets to Functions ,Fuzzy Sets-Fuzzy Set Operations, Properties of Fuzzy Sets ,Noninteractive Fuzzy Sets , Alternative Fuzzy Set Operations.	
UNIT-2	**20**
Classical Relations and Fuzzy Relations -Cartesian Product ,Crisp Relations ,Cardinality of Crisp Relations ,Operations on Crisp Relations ,Properties of Crisp Relations ,Composition ,Fuzzy Relations-Cardinality of Fuzzy Relations ,Operations on Fuzzy Relations ,Properties of Fuzzy Relations ,Fuzzy Cartesian Product and Composition ,Tolerance and Equivalence Relations ,Crisp Equivalence Relation ,Crisp Tolerance Relation ,Fuzzy Tolerance and Equivalence Relations, Value Assignments -Cosine Amplitude ,Max–Min Method ,Other Similarity Methods ,Other Forms of the Composition Operation.	
UNIT-3	**20**
Properties of Membership Functions, Fuzzification, and Defuzzification- Features of the Membership Function, Various Forms, Fuzzification, Defuzzification to Crisp Sets, λ-cuts for Fuzzy Relations, Defuzzification to Scalars. Logic and Fuzzy Systems- Logic- Classical Logic, Tautologies, Contradictions, Equivalence, CONTENTS ix Exclusive Or and Exclusive Nor, Logical Proofs, Deductive Inferences. Fuzzy Systems -Natural Language, Linguistic Hedges, Fuzzy (Rule-Based) Systems, Graphical Techniques of Inference.	
UNIT-4	**20**
Development of Membership Functions: Membership Value Assignments - Intuition , Inference ,Rank Ordering ,Neural Networks ,Genetic Algorithms ,Inductive Reasoning, Automated Methods for Fuzzy Systems- Batch Least Squares Algorithm , Recursive Least Squares Algorithm ,Gradient Method ,Clustering Method , Learning From Example ,Modified Learning From Example, Fuzzy Systems Simulation- Fuzzy Relational Equations , Nonlinear Simulation Using Fuzzy Systems , Fuzzy Associative Memories (FAMs).	

TEXT BOOKS:
FUZZY LOGIC WITH ENGINEERING APPLICATIONS (Second Edition)- Timothy J. Ross University of New Mexico, USA

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/144
Name of the Course: - Autonomous Robots
Year III Semester VI

Course Credits	No. of Hours per Week	Total No. of Teaching Hrs.
3 Credits	2 Hrs.	32 Hrs.

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

Course Outcome:

To introduce students into the world of Robotics and apply modern software development and deployment strategies.

SYLLABUS	Hrs.
UNIT-1	**16**
Path Planning – Map Representations, Path-planning algorithms – Robot Embodiment, Dijkstra's, A* Algorithm, Sampling based planning path. Robotic Sensors, sensors using light, sound, Inertia based sensors, Beacon based sensors.	
UNIT-2	**16**
Feature detection, line fitting using least square, RANSAC algorithm, scale invariant feature transforms, RGBD- SLAM: converting range data into point cloud data, ICP algorithm, RGB-D mapping.	

TEXT BOOKS:

1. Introduction to Autonomous Robots: Kinematics, Perception, Localization and Planning" by Nikolaus Correll
2."Engineering Autonomous Vehicles and Robots" by Shaoshan Liu

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/145
Name of the Course: - Image Processing
Year IV Semester VII

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

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

Course Outcome: After completing this course, students should be able to:
Explain basic concepts and techniques of image processing.
Develop skills of using image processing for solving practical problems
Analyze various image segmentation and feature extraction techniques

SYLLABUS	Hrs.
UNIT -1:	**20**
Image processing systems and its applications. Basic image file formats. Image formation: Geometric and photometric models; Digitization - sampling, quantization; Image definition and its representation, neighborhood metrics.	
UNIT-2	**20**
Enhancement, contrast stretching, histogram specification, local contrast enhancement; Smoothing, linear and order statistic filtering, sharpening, spatial convolution, Gaussian smoothing, DoG, LoG**.**	
UNIT-3	**20**
Pixel classification; Grey level thresholding, global/local thresholding; Optimum thresholding - Bayes analysis, Otsu method; Derivative based edge detection operators, edge detection/linking, Canny edge detector; Region growing, split/merge techniques, line detection, Hough transform. Textural features - gray level co-occurrence matrix; Moments; Connected component analysis; Convex hull; Distance transform, medial axis transform, skeletonization/thinning, shape properties.	
UNIT-4	**20**
Registration: Mono-modal/multimodal image registration; Global/local registration; Transform and similarity measures for registration; Intensity/pixel interpolation. Fundamentals of different colour models - RGB, CMY, HSI, YCbCr, Lab False colour; Pseudo colour; Enhancement; Segmentation. Morphological Filtering Basics: Dilation and Erosion Operators, Top Hat Filters	

TEXT BOOKS:

1. Digital Image Processing. R. C. Gonzalez and R. E. Woods, 4th edition,Prentice Hall, 2017.
Reference Books:
1. Image Processing: The Fundamentals. Maria Petrou and Panagiota Bosdogianni, John Wiley & Sons, Ltd.
2. Digital Image Processing. K. R. Castleman:, Prentice Hall, Englewood Cliffs.
3. Visual Reconstruction. A. Blake and A. Zisserman, MIT Press, Cambridge.
4. Digital Pictures. A. N. Netravali and B. G. Haskell, Plenum Press.
5. Digital Images and Human Vision. A. B. Watson:, MIT Press, Cambridge.

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/145 L
Name of the Course: - Image Processing Lab
Year IV Semester VII

Programs

Part-A

1. Generate the grey scale from 0 – 255 in steps of n.
2. Extract the all combinations of RGB colour components of an image and display all of them.

R	G	B	Colour component
0	0	0	nil
0	0	1	B
0	1	0	G
0	1	1	GB
1	0	0	R
1	0	1	RB
1	1	0	RG
1	1	1	RGB

3. Flip the Image in all possible directions
   a. Horizontal Left
   b. Horizontal Right
   c. Vertical UP
   d. Vertical Down
   e. Horizontal Right - Vertical UP
   f. Horizontal Right - Vertical Down
   g. Horizontal Left - Vertical UP
   h. Horizontal Left - Vertical Down
4. Extract bit-planes of a Gray Image and display the results.
5. Write a program to find the convex hull of an image.
6. Write a program to illustrate morphological operation dilate and erode
7. Write a program to find the edge of an image using Robert, sobel, prewitt and canny methods. Use library functions available in MATLAB image processing tool.
8. Write the program for line detection
   a. horizontal line
   b. vertical line
   c. diagonal45 line
   d. diagonal-45 line
9. Write a program to perform morphological operators Open and Close
10. Write a program to find the Distance transform of an image.

	Part-B
11	Consider the arbitrary region of interest as a mask and apply block averaging. Generate a series of block averaging images say 1 x 1 to 10 x 10 and animate them from 1 to 10 and from 10 to 1 with a suitable delay.
12	Apply contrast stretching on a given image by lookup table method. Design a proper transfer function by analysing the given image's histogram. Display histogram of the input given image as well as histogram of output image. Also display the transfer function applied to the input image. Compare input and output image by displaying them side by side.
13	Apply Histogram Equalization on a given image by lookup table method. Display histogram of the input given image as well as histogram of output image. Also display the transfer function applied to the input image. Compare input and output image by displaying them side by side.
14	Illustrate the image smoothing (Blur effect) by Box Filter or Averaging filter. Generate a series of smooth images say by applying kernel size from 3 x 3 to 27 X 27 and animate them from 3 to 27 and from 27 to 3 with a suitable delay.
15	Illustrate the image smoothing by Gaussian Filter. Generate a series of smooth images say by applying kernel size from 3 x 3 to 27 X 27 and animate them from 3 to 27 and from 27 to 3 with a suitable delay.
16	Generate the edge of an image using Robert's method. Use conv2 function. Input : colour image (file) Output: Gradient x, Gradient y and Robert's edge for each RGB component Save output as a separate bmp file. illustrate the program on i. Geometrical figures ii. Real picture
17	Also display Edge of colour image as well as converted gray image. Using Soble edge detection, generate the edge of an image. Do not use conv2 or standard edge function. Input : colour image (file) Output: Gradient x, Gradient y and soble's edge Save output as a separate bmp file.

18	illustrate the program on i. Geometrical figures ii. Real picture Also display Edge of colour image as well as converted gray image. Using Perwitt edge detection, generate the edge of an image. Do not use conv2 or standard edge function. Input : colour image (file) Output: Gradient x, Gradient y and Perwitt's edge Save output as a separate bmp file illustrate the program on i. Geometrical figures ii. Real picture Also display Edge of colour image as well as converted gray image.
19	Apply image segmentation by Region Growing method. Illustrate with suitable example. i. Geometrical figures ii. Real picture Assume suitable seeds and threshold.
20	Illustrate Hough Transformation to identify the linking lines of edges.

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/146
Name of the Course: - Introduction to Cloud Computing
Year IV Semester VII

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

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

Course Outcome:
Illustrate the various services and delivery models offered by the cloud.
Apply the various cloud services offered in application implementation.
Gathering the working knowledge of Cloud Micro Services.
Describe the concept of layering and virtualization in the cloud computing.
Illustrate various security issues in cloud computing.

SYLLABUS	Hrs.
UNIT-1	**20**
Cloud Fundamentals, Cloud Service Components - Deployment Models – Application of Cloud Computing	
UNIT-2	**20**
Cloud Services, Application Services - Deployment and Management Services - Amazon Web Services - Windows Azure, usage of kebernetes. Application Architectures, Monolithic and Distributed – Micro Service fundamentals – Design Approach – Cloud Native Application – Application Integration Process – API fundamental – API Management.	
UNIT-3	**20**
Virtualization: Cloud Resource Virtualization. Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and paravirtualization, Hardware support for virtualization.	
UNIT-4	**20**
Security: Cloud Security, Cloud Application Development. Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment, Trust, operating system security, Virtual machine Security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS, A trusted virtual machine monitor, Amazon web services: EC2 instances, connecting clients to cloud instances through firewalls.	

Text Books

1.Dan C Marinescu: Cloud Computing Theory and Practice. Second Edition, Elsevier(MK) 2017
2. RajkumarBuyya, James Broberg, Andrzej M. Goscinski, Cloud Computing Principles and Paradigms, 1 st Edition, Wiley, 2013.
3. Kumar Saurabh, Cloud Computing,Wiley India,2011
Reference Books:
1. Toby Velte, Anthony Velte, Robert Elsenpeter, Cloud Computing, A Practical Approach, McGraw Hill, 2010.
2. Judith Hurwitz, Robin Bloor, Marcia Kaufman, Fern Helper, Cloud Computing For Dummies, Wiley, 2010
3. Ronald Krutz and Russell Dean Vines, Cloud Security: A Comprehensive Guide to Secure Cloud

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/147
Name of the Course: - Information and Security System
Year IV Semester VII

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

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

Course Outcome: On successful completion of the course, the students will demonstrate.
To enable students, assess the security landscape, appraise the interrelationships among elements forming part of a modern current system and design information security system for an information-driven enterprise.

SYLLABUS	Hrs.
UNIT-1	**20**
Introduction – Concepts of information security – Terminologies used – Human aspects involved – information security for server systems: Types of attacks to web-servers - information security for client devices: Attacks for PCs and smart phones – Counter-measures – Malicious software intrusions and their effects – information security risk management: Processes involved – Information assets – Evaluation of security risk – Mitigation of risks – Classroom exercises	
UNIT-2	**20**
Security Risk Management: Information Security governance in an organization – Information Security Management Systems – Information Security Policy, Standards and Procedures – Information Security Evaluation – Security Incident Response: Overview – Computer Security incidents and responses	
UNIT-3	**20**
Information Security and Cryptography: Basic Concepts – Secure communication – Definitions – Types of Cryptography: Classic Cryptography – Modern Cryptography – Common Key Cryptography – Public Key Cryptography – Classroom exercises	
UNIT-4	**20**
Common Key Cryptography: Algorithms involved – DES – Triple DES – AES – Encryption modes – Key Distribution – Public Key Cryptography: RSA – Hybrid Encryption – Data Integrity – Hash Function- Digital Signature – Public Key Certificate – Public Key Infrastructure (PKI) – Certification Authority – Laws in India governing – Classroom exercises	

TEXT BOOKS:

1. "Introduction to Information Security and Cyber Laws", by Surya Prakash Tripathi & Ritendra
2. "Cyber Security for Beginners", by Raef Meeuwisse
3. "Cryptography and Information Security", by V K Pachghare
4. "Network Security: The Complete Reference", by Bragg
5. "Practical Malware Analysis", by Michael Sikorski
6. "Understanding Cryptography", by Christof Paar and Jan Pelzi

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/148
Name of the Course: - Predictive Analytics
Year IV Semester VII

Course Credits	No. of Hours per Week	Total No. of Teaching Hrs.
3 Credits	2 Hrs.	32 Hrs.

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

Course Outcome

To impart working knowledge to students on Predictive Analytics using Python, ML, Data Visualisation etc techniques whereby they learn to apply predictive analytics and business intelligence to tackle and solve business problems in real world applications.

SYLLABUS	Hrs.
UNIT-1	**16**
Predictive data analytics, The predictive data analytics, Project life cycle, Data Explorations - Data Quality Report, Getting to know the Data, Identifying Data Quality Issues, Handling Data Qualities Issues, Data Exploration and Preparations, Information Based Learning Fundamentals	
UNIT-2	**16**
Similarity Based Learning -Fundamentals Probability Based Learning, Fundamentals Error -based Learning – Fundamentals, Evaluation - Fundamentals the art of Machine Learning for Predictive Analysis - Different Perspectives on Prediction Models and Case Studies	

TEXT BOOKS:

1. "Fundamentals of machine learning for predictive data analytics" by John D Kelleher, Brain Mac Namee, Aoife D'Arcy
2. "Hands on predictive analytics with python" by Alvaro Fuentes

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/149
Name of the Course: -Mini Project
Year IV Semester VII

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

Objective: To advance the skills of students in chosen areas of interest at the same time test their current level of knowledge. During the duration of the course students are expected to work in collaborative groups. The students will form a group comprising not less than 5 persons in choosing any **one** of the following mini projects. (List is only inclusive liable to changes)

1. Color of Emotions
2. Ball Tracking Robot
3. Intelligent Robot Conversation (Alexa)
4. Global Pandemic Visualization
5. Predicting Cost Of Real Estate
6. Twitter Sentiment Analytics
7. Library Bot
8. Chat Bot
9. Security Bot
10. Swarm Robots

A brief on the topics:

1. Colour of Emotion embraces mainly three components- Evolutionary Connections, Cultural Connections and Personal Connections. For example, a good web design forges emotional connection between the end user and the product.

2. Ball tracking Robot is a mechanism of estimating the position of an object over a pattern of images. It plays important role in application such as video surveillance, human computer interface, auto navigation of vehicles and robot control.

3. Intelligent Robot Conversation (ALEXA) is an application of human computer interaction. With conversational AI Systems, Voice user interface voice services like Alexa can communicate with people in many ways.

4. Global Pandemic Visualization is a Data scientist project. Taking the recent case of Covid 19, it rose from being an epidemic to a global pandemic in a short time. The project involves using a mathematical model to stimulate how the pandemic spreads and its economic/demographic effect on humanity.

5. Predicting Cost of Real Estate is a machine language project in which the predictive power of a model trained and tested on data collected from Registration Authorities in say Mysore city are studied. In this project students will be able to predict real estate prices using Python, In this project students will be able to predict real estate prices using Python. The project helps both the buyers and the sellers to have and overview of the market conditions.

6. Twitter sentiment analytics involves python and usage of libraries such as Twitter. It is usage of advanced text mining techniques to analyze the sentiment of the tweet in the form of positive negative and neutral.

7. Library bot is a virtual agent offering self-service options in the context of information services to clients. Libraries offer a wide range of automation and testing capabilities for Robot framework.
The necessary components to run the project or on GitHub repository and other open source libraries.

8.Chat bot is intelligent software capable of communicating and perform tasks like a human being. Chat bots or widely employed for customer interaction, business marketing etc. Some of the python libraries for chat bots such as spaCy (For NLP in python language), Natural Language Tool Kit for building programs in python language etc are open-source libraries which can be employed for the project.

9. Security bot intends to replace human surveillance with a surveillance Robot. Being miniature in size these bots can move in different harsh and hazardous locations. Such robots can traverse both in vertical and horizontal direction with camera mounted on top of surveillance purpose. For the project the students can try night vision patrolling using Raspberry Pi technology.

10.Swarm Robots consists of many individual intelligent agents working with no Central controls but acting based on simple and local behaviour pattern. Swarm robots adopt to changes in operational environments. indivision robots exhibit behaviour ranging from simple reactive mapping between sensor inputs to elaborate swam algorithms. Industrial application of Swarm Robot still in its nascent stage and therefore other wide range of challenging opportunities to the students

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/150
Name of the Course: - Research Project
Year IV Semester VIII

Course Credits	No. of Hours per Week	Total No. of Teaching Hrs.
10 Credits		

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

Course Outcome

On successful completion of the course, the students will demonstrate
To expose students to industry-standard project practices, through a real-life project work under time and deliverable constraints, applying the knowledge acquired through various courses.
1. To provide an opportunity to apply the knowledge gained through various courses in solving a real-life problem
2. To provide an opportunity to practice different phases of software/system development life cycle
3. To introduce the student to a professional environment and/or style typical of a global IT industry
4. To provide an opportunity for structured team work and project management
5. To provide an opportunity for effective, real-life, technical documentation
6. To provide an opportunity to practice time, resource and person management.

Guidelines and preparations for the project work:

a. Selection of Team: To meet the stated objectives, it is imperative that Major Project is done through a team effort. Though it would be ideal to select the team members at random (drawing lots) and this should be strongly recommended, due to practical considerations, students may also be given the choice of forming themselves into teams with maximum of 3 members. A gender mix should also be strongly suggested. A team leader shall be elected through drawing lots. Teams shall maintain team meeting minutes and ensure that every team member has tasks assigned in writing. Team meeting minutes shall form a part of the Project Report. Even if students are doing projects as groups, each one must independently take up different modules of the work and must submit the reports also independently
(though, in such cases, some common materials is permissible). Evaluation will also be done independently.

b. Selection of Tools: No restrictions shall be placed on the students in the choice of platforms/tools/languages to be utilized for their project work, though open source is strongly recommended, wherever possible. No value shall be placed on the use of tools in the evaluation of the project.

c. Selection of Organization & Guide: No restrictions shall be placed on the students in the choice of organization where project work may be done, in terms of locality, type of organization (public/private) etc. It is the duty of the Head of Institution or the Principal of College to ensure that the Aims, Objectives and full project guidelines are communicated to the external organization. The guide should ideally be a post-graduate with minimum 2 years of work experience.

d. Students may also choose to do project in the college/institute (or partially in the college and partially in an external organization), especially product-based work, but in such cases the supervisors must ensure that
(i) industry practices are followed
(ii) the students undertake a planned visit to an IT industry with international operations to make up for the

loss of experience and
(iii) the services of an external guide with industry experience is obtained.

e. Head of Institution or the Principal of College should publish a list of students, projects topics, internal guide and external organization (if any) and teams agreed, before the end of semester

VI. Changes in this list may be permitted for valid reasons and shall be considered favorably by Head of Institution or the Principal of College any time before commencement of the project. Any request for change after commencement should considered by a committee of 3 teachers and their recommendation shall be accepted by Head of Institution or the Principal of College.

f. Gantt-chart of proposed activities and a draft statement of project deliverables (which may subsequently be altered if justified) should be prepared before the commencement of the project. The actual completion of each phase should be noted on the chart in the course of the project work. Students should submit a fortnightly report of progress which could be indication of percentage of completion marked on the original Gantt-chart, with any notes attached. Students should ideally keep a daily activity log sheet. Team meetings should be documented in the format given at the end. Changes in the submitted documents are possible, as project development is essentially an evolutionary process. The Project Guide must ensure that changes are necessary due to the knowledge gained in succeeding phases of the project.
The date of completion of a phase should be brought forward if the changes made are deemed to be errors and not due to additional knowledge gained from a succeeding phase.

Project Guidelines (subject to alteration to suit different industries):-

1. Group size: Not over three members.

2. Number of records: One copy to each participant and one copy to the Department.

3. Certificate will contain the names of all participating member and of the Project Guide.

4. Minimal phases for the project work: Project search, finalization and allocation, Investigation of system requirements, Data and Process Modelling, System Design, Program design, Program coding and unit testing, System integration, System implementation and acceptance testing.

5. Planning the Project: The Major Project is an involved Exercise that has to be planned well in advance. The topic should be chosen in Semester IV itself and the case study of Course in
Semester IV should as far as possible, be based on the project topic, though on exceptional cases and for valid reasons, the Project Guide may waive this condition. Related reading,
training and discussions should start from Semester V itself.

6. Suggestive project work is three in nature:

a. Developing solution for a real-life problem: In this case, a requirement for developing a computer-based solution already exists and the different stages of system development life cycle is to be implemented successfully. Examples are Accounting Software Package for a particular organization, Computerization of administrative functions of an organization, Web- Based Commerce, etc. The scope for creativity and Exploration in such projects is limited, but if done meticulously, valuable Experience in the industrial context can be gained.

b. Innovative Product development: These are projects where a clear-cut requirement for developing a computer-based solution may not be existing but a possible utility for the same is conceived by the proposer. Example are: a Kannada Language Editor with Spell Checker, Computer Music Software for Indian Music, Heat Engines Simulation Software for e-Learning, Digital Water Marking Software.

c. Research level project: These are projects which involve research and development and may not be as structured and clear cut as in the above cases. Examples are Kannada Character Recognition, Neural Net Based Speech Recognizer, Biometric Systems, Machine Translation System etc. These projects provide more challenging opportunities to students, but at the student level I s a difficult choice. If any student identifies proper support in terms of guidance, technology and references from external organizations and also the supervisors are convinced of the ability of the student(s) to take up the project, it shall be permitted. The methodology and reporting of such projects could be markedly different from type (a) and is left to the proposer/external supervisor of the projects.

Documentation Guidelines:

1. The final outer dimensions of the report shall be 21cm X 30 cm. The color of the flap cover shall be light Blue. Only hard binding should be done, with title of the thesis and the words <BRIEF TITLE> BSC(HONS)(DS & AI) Project Report 20…." displayed on the spine in 20 point, Bold, Times New Roman, as in example below. In case the title is too long, a shorter version of it may be used (Like "Image Pro" instead of" Image Pro – An Interactive Image Processing package").
2. It is highly recommended that Latex be used for documentation.

3. The text of the report should be set in 12 pt, Times New Roman, Single Spaced.

4. Headings should be set as follows: CHAPTER HEADINGS 20 pt, Times New Roman, Bold, All Caps, and Centred. Example: "HUMANOID ROBOTS": BSC(HONS)(DS & AI) PROJECT 2023;

5. SECTION HEADINGS 12 pt, Times New Roman, Bold, All Caps, Left Adjusted.

6. Section Sub-headings 12 pt, Times New Roman, Bold, Left Adjusted.

7. Titles of Figures, Tables etc are done in 12 point, times New Roman, Italics, and Centred. <PROJECT TITLE> <STUDENT'S NAME> <SARADA VILAS COLLEGE> PROJECT REPORT :: Submitted in partial fulfilment of the requirements for the award of B.Sc.(Hon's)(DS & AI) degree of University of Mysore :: 2024

8. Some general guidelines on documentation stylistics are:

a. Double quotes and single quotes ("", ") should be used only when essential. In most cases words put in quotes are better highlighted by setting them in italics. This process is known as "morphing".

b. Page numbers shall be set at right hand top corner, paragraph indent shall be set as 3.

c. Only single space need be left above a section or sub-section heading and no space may be left after them.

d. Certificate should be in the format: "Certified that this report titled ..... is a bonafide record of the project work done by Sri/Kum .....under our supervision and guidance, towards partial fulfilment of the requirements for the award of the Degree of B.Sc.(Hon's)(DS& AI) of the University of Mysore" with dated signatures of Internal Guide, External Guide and also Head of Institution or the Principal of the College.

e. If the project is done in an external organization, another certificate on the letterhead of the organization is required: "Certified that this report titled .....is a bonafide record of the project work done by Sri/Kum..... under any supervision and guidance, at the ..... Department of..... (Organization) towards partial fulfilment of the requirements for the award of the Degree of B.Sc.(Hon's)(DS & AI) of the University of Mysore".

f. References shall be IEEE format (see any IEEE magazine or transaction). Take care in use of italics and punctuation. While doing the project, keep note of all books you refer, in the correct format, and include them in alphabetical order in your reference list. (Eg: A book is cited as: "Understanding Neural Networks and

Fuzzy Logic", Author: Kartalopoulos, S V Publishers: BPB Publishers, 1996 Edn., pp. 21-27. (pp.21-27 indicates that pages 21-27 have been referred.) If the whole book is being referred, this may be omitted. If a single page is referred, say page 47, it may be cited as p.47.

g. Report writing is NOT a hasty activity done after finishing the project. Students must try to develop the report along with the work, so as to give it flesh and blood. Drafts should be read, modified, spell checked and grammar checked at least thrice during the course of the project and before a final printout is taken, the same may be got approved from the internal guide. The students should send two interim reports to internal guides. This will also help the students in their report writing.

h. The Gantt chart, fortnightly progress reports, and team meeting minutes mentioned above should appear as appendix to the project report. Regarding the body of the report, as an indicative example, is as follows:-
– Organizational overview (of the client organization, where applicable)
– Description of the present system
– Limitations of the present system
– The Proposed system- Its advantages and features
– Context diagram of the proposed system.
– Top level DFD of the proposed system with at least one additional level of Expansion
– Structure Chart of the System
– System flowchart
– Menu Tree
– Program List
– Files or tables (for DBMS projects) list. Class names to be entered for each file in OO systems.
– List of fields or attributes (for DBMS projects) in each file or table.
– Program – File table that shows the files/tables used by each program and the files are read, written to, updated, queried or reports were produced from them.
– Reports List with column headings and summary information for each report.
– System Coding and variable/file/table naming conventions
– System controls and standards
– Screen layouts for each data entry screen.
– Report formats for each report.

Program documentation is suggested on the following lines:
– Program id
– Program level run chart
– Program function Explanation
– Data entry screen (reproduced from system documentation).
– Report layout (reproduced from system documentations)
– Program level pseudo code or flowchart.
– Decision tables, decision trees, with English Explanation where necessary.
– Program listing
– Test data
– Test results.

Project Methodology: Wherever applicable, object oriented approach should be used for software development. The project report should generally contain details of the following steps (though students should not attempt to fit every kind of project into this format):
(a) Analysis
– Study of existing systems and its drawbacks (general)
– Understanding the functionalities of the system (detailed)
– Preparation of requirement
– Conduct of Feasibility study
– Identification of relevant Objects
– Abstraction of each object (attributed and methods)

– Relationship between objects
(b) Design
– Design of each subsystems
– Design of each classes
– Design of communications between objects
– Design of Algorithms for problem solving
– User interface Design
– Any other steps if necessary

(c) Coding and Impletion

(d) Testing

(e) Security, Backup and Recovery Mechanisms

(f) On line help and User Manuals

(g) Upgradability Possibilities

Intellectual Property Rights: The intellectual property rights in all project work done by the students shall vest jointly with the University of Mysore and Sarada Vilas College, except in cases where some external organizations seek undertaking from students to concede IPR in all work done in their organization or under their guidance. Where possible, students should attempt to obtain at least a joint IPR for the College and the University. In cases where project works are of public utility, students shall be asked to publish their work including source code and documentation, in so far as their rights are clear.

Evaluation of Project

• Documentation – 30 marks

• Content & Methodology - 50 marks

• Viva Voce - 20 marks

Name of the Program: B.Sc. (Hon's)Data Science and Artificial Intelligence
Course Code: BH/151
Name of the Course: - Swayam Online Course
Year IV Semester VIII

Course Credits	No. of Hours per Week	Total No. of Teaching Hrs.
2 Credits		

SWAYAM is India's national Massive Online Open Courses (MOOC) platform. It offers over 2,150 courses taught by close to 1,300 instructors from over 135 Indian universities and IITs. It allows students in India to earn academic credit online. Since the platform was launched in 2017, over 10 million learners have taken courses on SWAYAM.
SWAYAM is a program initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., access, equity and quality. The objective of this effort is to take the best teaching learning resources to all, including the most disadvantaged. SWAYAM seeks to bridge the digital divide for students who have hitherto remained untouched by the digital revolution and have not been able to join the mainstream of the knowledge economy. This is done through an indigenous developed IT platform that facilitates hosting of all the courses, taught in classrooms from 9th class till post-graduation to be accessed by anyone, anywhere at any time.

SWAYAM offers:
- Best in class Instructors drawn from high-ranked Universities and IITs.
- Weekly Assignments to ensure students' progress in a timely manner.
- Easy Credit Transfer by complementing students' program
- Systematic Approach enabling students towards learning goals

Qualifying Certificates may, in turn, be used by students enrolled in India's higher education to earn academic credit for completing SWAYAM courses earmarked as credit-eligible by their universities. SWAYAM is supported by various industries such and as such the students undertaking the courses will have added advantage of ranking for placements. Laboratory facility will be allotted by the Course Coordinator depending on the available time-slots. For further information about how India is leveraging SWAYAM at the university level, please contact the Course Coordinator in the College and taking his guidance, register for the same.

Some of the suggested courses under SWAYAM for students to choose from are listed below:
1. Design and Analysis of Algorithms
2. Python for Data Science
3. Scalable Data Science
4. Cloud Computing
5. Big Data Computing
6. Predictive Analytics
7. Data Science for Engineers
8. Data Mining
9. Deep Learning
10. Deep Learning for Visual Computing
11. Deep Learning for Computer Vision
12. Artificial Intelligence: Search Methods for Problem Solving
13. Introduction to Internet of Things
14. Business Analytics & Data Mining Modeling Using R
15. Robotics
16. Practical Machine Learning with Tensorflow
17. Principles of Management