Course Curriculum for

B Tech in Artificial Intelligence and Data Science

2023-2024 onwards

Computer Science and Engineering Department

NATIONAL INSTITUTE OF TECHNOLOGY DELHI

(An autonomous Institute under the aegis of Ministry of Education, Govt. of India.)

Department of Computer Science and Engineering
National Institute of Technology Delhi

1.1 About the Department

The Computer Science and Engineering Department was started in 2010 along with the foundation of NIT Delhi. Initially, only the Bachelor of Technology Programme was offered with the intake 30 which presently has been increased to 60. Now, apart from B. Tech., the department also offers Master of Technology (CSE & Analytics), and Ph.D. program which cover a number of important areas of Computer Science and Engineering. The department provides the students with a broad undergraduate and graduate curriculum, based on the application and theoretical foundations of computer science. The departmental faculties and students participate in interdisciplinary research. The department envisions producing quality graduates, capable of leading the world in the technical realm. The department is equipped with the latest configuration and high computing system with hi-speed Internet facilities. The Computer Science Program at this institute are dedicated to educate students and to advance research in computer and information technology. The department has all the facilities to carry out the related teaching and research work.

1.2 Vision

- To communicate quality Computer Science education for producing globally identifiable technocrats and entrepreneurs upholding sound ethics, profound knowledge, and innovative ideas to meet industrial and societal expectations.

1.3 Mission

- To impart value-based technical knowledge and skill relevant to Computer Science and Engineering through effective pedagogies and hands-on experience on the latest tools and technologies to maximize employability.
- To strengthen multifaceted competence in allied areas of Computer Science in order to nurture creativity and innovations to adapt the ever-changing technological scenario requiring communally cognizant solutions.
- To create an appetite for research that leads to pursuing a research career or higher education in contemporary and emerging areas of computer science.
- To inculcate the moral, ethical, and social ideals essential for prosperous nation building.

2. B. Tech Artificial Intelligence and Data Science

2.1 Program Outcomes (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.\
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

2.2 Program Educational Objectives (PEOs)

PEO-1	Graduates will be capable of applying advanced tools and techniques to innovate ideas and create intelligent systems for a wide range of real-world problems while maintaining strong ethical standards.
PEO-2	Graduates will be prepared to pursue higher studies and continue to develop their professional knowledge.
PEO-3	Graduates will recognize the importance of research and professional development in the rapidly evolving fields of AI and Data Science. .
PEO-4	Graduates will be prepared with an entrepreneurial mindset, enabling them to identify business opportunities, create startups, exhibit leadership qualities with demonstrable attributes in lifelong learning

2.3 Program Specific Outcomes (PSOs)

PSO-1	Ability to analyze, build, and design new techniques and tools to produce innovative industrial solutions using mathematical and theoretical concepts of Artificial Intelligence and Data Science.
PSO-2	Ability to carry out research and education in trans-disciplinary fields to solve real world problems using state-of-art algorithms and techniques of Artificial Intelligence and Data Science.

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(An autonomous Institute under the aegis of Ministry of Education (Shiksha Mantralaya), Govt. of India)
Plot No. FA7, Zone P1, GT Karnal Road, Delhi-110036, INDIA
दूरभाष/Tele: +9111-33861000, 1001, 1005 फैक्स/ Fax: +9111-27787503,
वेबसाइट/Website: www.nitdelhi.ac.in

Course Scheme for B. Tech (AI&DS) AY 2023-24

Year	First Semester						Second Semester					
	Sub. Code	**Subject Name**	**L**	**T**	**P**	**C**	**Sub. Code**	**Subject Name**	**L**	**T**	**P**	**C**
I	ADLB 101	Mathematical Foundations for Data Science	3	0	0	3	ADLB 151	Probability and Statistics	3	0	0	3
	ADLB 102	Discrete Mathematics	3	1	0	4	ADBB 152	Computer Organization and Architecture	3	0	2	4
	ADBB 103	Computer Programming-I	3	0	2	4	ADBB 153	Data Structures and Algorithms	3	0	2	4
	ADBB 104	Computer Fundamentals	2	0	2	3	ADBB 154	Programming using Python	1	0	2	2
	PHLB 112	Quantum Physics	3	1	0	4	ADLB 155	System Programming	3	0	0	3
	HMLB 102	Theory and Practices of Human Ethics	1	0	0	1	CELB 101	Environmental Sciences	2	0	0	2
	HSPB 150	Holistic Health & Sports	0	0	2	1	ADPB 156	Project I	0	0	4	2
		Total	**16**	**2**	**4**	**20**	**Total**		**13**	**1**	**12**	**20**
	Third Semester						**Fourth Semester**					
II	ADBB 201	Artificial Intelligence	3	0	2	4	ADBB 251	Data Science	3	0	2	4
	ADBB 202	Database Management Systems	3	0	2	4	ADBB 252	Data Warehousing and Mining	3	0	2	4
	ADLB 203	Optimization Techniques	3	1	0	4	ADBB 253	Big Data Management	2	0	2	3
	ADBB 204	Operating Systems	3	0	2	4	ADBB 254	Machine Learning	3	0	2	4
	ADBB 205	Computer Graphics	3	0	2	4	ADLB 255	Theory of Computation	3	0	0	3
							ADPB 200	Project II	0	0	4	2
		Total	**15**	**1**	**8**	**20**		**Total**	**14**	**0**	**12**	**20**

Year	Fifth Semester						Sixth Semester					
	Sub. Code	**Subject Name**	**L**	**T**	**P**	**C**	**Sub. Code**	**Subject Name**	**L**	**T**	**P**	**C**
III	ADBB 301	Deep Learning	3	0	2	4	ADLB 351	Social Network Analysis	3	1	0	4
	ADLB 302	Natural Language Processing	3	1	0	4	ADBB 352	Big Data Analytics	3	0	2	4
	ADBB 303	Cloud Computing	3	0	2	4	ADBB 353	Soft Computing	3	0	2	4
	ADBB 304	Image Processing and Computer Vision	3	0	2	4	ADLB XXX	Program Elective-I	3	0	0	3
	ADLB 305	Internet of Things	3	1	0	4	ADLB XXX	Program Elective -I	3	0	0	3
		Total	**15**	**2**	**6**	**20**	ADPB 300	Project - III	0	0	4	2
							ADPB 354	**Internship (during summer break)**	**Credit will be given to the next Semester**			
								Total	**15**	**1**	**8**	**20**
IV	**Seventh Semester**						**Eighth Semester**					
	ADLB 401	Cyber Security	3	0	0	3	ADPB 400	B. Tech Project (Internship inside NIT Delhi / Outside NIT Delhi)	-	-	-	16
	ADLBXXX	Program Elective-II	3	1	0	4	ADLB 451	Independent Study/ MOOC Course	3	0	0	3
	ADLBXXX	Program Elective-II	3	1	0	4	ADPB 452	Seminar	0	0	2	1
	ADBBXXX	Program Elective-III	3	0	2	4						
	ADBBXXX	Program Elective-III	3	0	2	4		**Total**	3	0	2	20
	ADPB 354	Internship	0	0	2	1						
		Total	**12**	**2**	**6**	**20**						

Year	Program Elective-I										
III	**Sub. Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Sub. Code**	**Subject Name**	**L**	**T**	**P**	**C**
	ADLB 355	Human Computer Interface	3	0	0	3	ADLB 356	Nature Inspired Algorithms	3	0	0	3
	ADLB 357	Cognitive Networks	3	0	0	3	ADLB 358	Blockchain Technology	3	0	0	3
	ADLB 359	Fundamentals of Robotics	3	0	0	3	ADLB 360	Sensor Networks	3	0	0	3
	ADLB 361	Biometrics Systems	3	0	0	3	ADLB 362	Sentiment Analysis	3	0	0	3
	ADLB 363	Statistical Methods for Data Science	3	0	0	3	ADLB 364	Reinforcement learning	3	0	0	3
	ADLB 365	Multimedia Databases	3	0	0	3	ADLB 366	Information Storage and Retrieval	3	0	0	3
	Program Elective-II											
IV	ADLB 402	Fuzzy Logic and Applications	3	1	0	4	ADLB 403	Quantum Computing	3	1	0	4
	ADLB 404	Foundations of Cryptography	3	1	0	4	ADLB 405	Digital Forensics	3	1	0	4
	ADLB 406	Drone Applications	3	1	0	4	ADLB 407	GIS Applications	3	1	0	4
	ADLB 408	High performance Parallel Computing Architecture	3	1	0	4	ADLB 409	Multi Agent Applications	3	1	0	4
	ADLB 410	Game Theory	3	1	0	4	ADLB 411	Graph Mining	3	1	0	4
	ADLB 412	Biometric Security	3	1	0	4	ADLB 413	IoT and Multimedia Technology	3	1	0	4
	Program Elective-III											
IV	ADBB 414	Augmented and Virtual reality	3	0	2	4	ADBB 415	Social Computing	3	0	2	4
	ADBB 416	Performance Modelling	3	0	2	4	ADBB 417	Spatio – Temporal Data Analysis	3	0	2	4
	ADBB 418	Motion Planning for Robotics	3	0	2	4	ADBB 419	Convex Optimization	3	0	2	4
	ADBB 420	Compiler Design	3	0	2	4	ADBB 421	Computational Biology	3	0	2	4
	ADBB 422	Intelligent Data Management	3	0	2	4	ADBB 423	Speech Recognition	3	0	2	4
	ADBB 424	Forensics Biometric Analysis	3	0	2	4	ADBB 425	Time Series Analysis	3	0	2	4

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Degree Requirements

Category of Courses	Category of Courses
Basic Science Core (BSC)	4
Engineering Science Core (ESC)	2
Humanities and Social Sciences Core (HSC)	1
Programme Core (PC)	104
Programme Electives (PE)	22
Internship, Independent Study, Seminar Project, and Major Project (MP)	27
Total	**160**

COURSE CONTENT

Department: Computer Science and Engineering

Course no: ADLB 101	**Open course (Y/N)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO	NO	YES	NO
Type of course	**Core**			
Course Title	**MATHEMATICAL FOUNDATION OF DATA SCIENCE**			
Course objectives:	The purpose of this course is to introduce the concepts of mathematics as the basic building blocks for data science; extend the concept of linear systems of equations, matrices and determinants, and vector spaces for data science; gain insights about probability and optimization theory for modern day computing applications; and promote research activities to uphold in the theory and practice.			
POs				

Semester	**Autumn: Yes**		**Spring:**		
III	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1	Title	Introduction to linear algebra
	Author	Gilbert Strang
	Publisher	Wellesley-Cambridge Press
	Edition	Sixth edition 2023
2	Title	Optimization by vector space methods
	Author	David Luenberger
	Publisher	John Wiley and Sons
	Edition	1969 th edition (January 23, 1997)
Reference Book:		
1	Title	Linear Algebra
	Author	Kenneth Hoffman and Ray Kunze
	Publisher	Pearson

		Edition	Second Edition 2018
Content	**Unit** – 1 (5 Hours) Introduction; Typology of problems; Importance of linear algebra, statistics and optimization from a data science perspective; Structured thinking for solving data science problems. **Unit**-2 (8 Hours) Vectors; Matrices and their properties (determinants, traces, rank, nullity, etc.); Addition and Multiplication; Eigenvalues and eigenvectors; Matrix factorizations; Distances and Nearest Neighbors; Similarities; Projections; Notion of hyperplanes; half-planes. **Unit** – 3 (9 Hours) Probability theory and axioms; Random variables; Probability distributions and density functions (univariate and multivariate); Conditional Probability, Bayes' Theorem, Continuous and discrete distributions, Transformation of random variables, estimating mean, variance, covariance, Expectations and moments; Covariance and correlation; Statistics and sampling distributions; Hypothesis testing; Confidence (statistical) intervals; Correlation functions; White-noise process; Exponential family of distributions (Bernoulli, Beta, Binomial, Dirichlet, Gamma, & Gaussian) **Unit** – 4 (8 Hours) Unconstrained optimization; Necessary and sufficiency conditions for optima; Gradient descent methods; Constrained optimization, KKT conditions; Introduction to non-gradient techniques; Introduction to least squares optimization; Optimization view of machine learning. **Unit** – 5 (6 Hours) Linear regression as an exemplar function approximation problem; Linear classification problems.		
Course Outcomes	● Represents the rudiments of Data Science (L2) ● Extend the use of linear systems of equations, matrices and determinants, and vector spaces in the science of data (L2) ● Demonstrate the rules of probability and statistics for understanding the nature of data (L3) ● Articulate the use of different optimization techniques for data analysis (L3) ● Illustrate analytical models for real-word scenarios (L4)		
Course Assessment	Continuous Evaluation 25%		
	Mid Semester 25%		
	End Semester 50%		

Course no: ADLB 102	**Open course (Y/N)**		**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO		NO	YES	NO
Type of course	**Core**				
Course Title	**DISCRETE MATHEMATICS**				
Course objectives:	The purpose of this course is to understand and use discrete mathematics which is the backbone of computer science. In this course the students will learn various ways for describing sets, i.e., logic and proofs, identify induction hypotheses and prove elementary properties of modular arithmetic, and apply graph theory models of data structures to solve problems of connectivity and constraint satisfaction.				
POs					

Semester	**Autumn: Yes**		**Spring:**		
III	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	1	0	4	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1	Title	Discrete Mathematics and applications
	Author	K.H.Rosen
	Publisher	TataMcGraw Hill
	Edition	fifth edition 2003
Reference Book:		
1	Title	Elements of Discrete Mathematics
	Author	C.L.Liu
	Publisher	McGraw-Hill Book Company.
	Edition	Second edition 1985
2	Title	Discrete Mathematics for Computer Scientists and Mathematicians
	Author	1. J .L.Mott, A.Kandel, T.P .Baker
	Publisher	Prentice Hall of India
	Edition	Second edition 1986

3		Title	Logic and Discrete Mathematics
		Author	W.K.Grassmann and J.P.Tremblay
		Publisher	Pearson
		Edition	1995
Content	**Unit** – 1 (5 Hours) Mathematical reasoning; propositions; negation disjunction and conjunction; implication and equivalence; truth tables; predicates; quantifiers; natural deduction; rules of Inference; methods of proofs; use in program proving; resolution principle. **Unit**-2 (10 Hours) Set theory; Paradoxes in set theory; inductive definition of sets and proof by induction; Peono postulates; Relations; representation of relations by graphs; properties of relations;equivalence relations and partitions; Partial orderings; Posets; Linear and well-ordered sets **Unit** – 3 (7 Hours) Graph Theory; elements of graph theory, Euler graph, Hamiltonian path, trees, tree traversals, spanning trees. **Unit** – 4 (7 Hours) Functions; mappings; injection and surjections; composition of functions; inverse functions;special functions; Peono postulates; pigeonhole principle; recursive function theory. **Unit** – 5 (7 Hours) Definition and elementary properties of groups, semigroups, monoids, rings, fields, vector spaces and lattices. Elementary combinatorics; counting techniques; recurrence relation; generating functions.		
Course Outcomes	• Illustrate the basics of discrete mathematics and predicate calculus (L2). • Explain set theory and relations (L2). • Demonstrate the concepts of graph theory and experiment with trees to solve problems like minimum spanning tree and tree traversals (L3). • Develop the concept of functions and recursive function theory (L3). • Illustrate different algebraic structures (L2).		
Course Assessment	Continuous Evaluation 25%		
	Mid Semester 25%		
	End Semester 50%		

Course no: ADBB 103	**Open course (Y/N)**		**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO		NO	YES	NO
Type of course	**Core**				
Course Title	**COMPUTER PROGRAMMING-I**				
Course objectives:	This course aims to provide the students with a foundation in computer programming. The goals of the course are to develop the basic programming skills in students, and to improve their proficiency in applying the basic knowledge of programming to solve problems related to their field of engineering.				
POs					

Semester	**Autumn: Yes**		**Spring:**		
I	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	2	4	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:

1	Title	Programming in ANSI C
	Author	E. Balagurusamy
	Publisher	TATA McGraw Hill
	Edition	6th edition, 2012

Reference Book:

1	Title	Let Us C
	Author	Yashavant Kanetkar
	Publisher	Infinity Science Press
	Edition	13th edition, 2012
2	Title	The C Programming Language
	Author	Brian Kernighan & Dennis Ritchie
	Publisher	Prentice Hall
	Edition	2nd Edition, 1988
3	Title	Schaum's Outline of Programming with C
	Author	Byron S Gottfried
	Publisher	TATA Mc Graw Hill

	Edition	2nd edition, 1996

Content	**Unit – 1** (5 Hours) Introduction to Computers: Hardware and Software. Basic Model of Computation, Notion of Algorithms, Flowcharts, Top down design, Bottom up approaches of problem solving, Number system **Unit – 2** (9 Hours) Introduction to programming language, Basics of C, Basic Data types – int, float, double, char, Bool, Void. Arithmetic and logical operators: precedence and associativity. Flow of Control- Conditional statements- If-else, Switch-case constructs, Loops- While, do-while, for. **Unit – 3** (7 Hours) Function – User defined functions, library functions, Parameter passing – call by value, call by reference, recursion. **Unit – 4** (7 Hours) Arrays- Advantages and drawbacks, One dimensional, Multi-Dimensional Arrays and strings: Declaration, Initialization, Accessing, Passing arrays and strings as parameters to functions. Pointers, Dynamic memory allocation, Dynamic arrays – One dimensional, Multidimensional dynamic arrays. **Unit – 5** (8 Hours) Structure: Declaration, Initialisation, passing structure to function, Use of pointers in structure. Preprocessors, Macros, File management in C I/O – Opening, closing and editing files. Correctness & Efficiency Issues in Programming, Time & Space measures.
Course Outcomes:	● Illustrate the steps involved in compiling, linking, and debugging any code written in a specific language (L2). ● Explain the basic concepts such as keyword, identifiers, header files, and the methods of iteration or looping and branching, etc (L2). ● Apply the concepts of functions to understand modular programming (L3). ● Utilise the concept of pointers and arrays to structure data in a computer program (L3). ● Develop the basic applications in C programming using structures, union and file handling (L6).
Course Assessment	Continuous Evaluation 25%
	Mid Semester 25%
	End Semester 50%

Lab Experiments:

Exp. No.	Experiments
1.	Installation of C Development Environment.
2.	Introduction to Programming Logic Building.

3.	Basic Concepts of a Computer Programming Language.
4.	Implementation of sequential constructs.
5.	Implementation of selection constructs.
6.	Implementation of Iterative constructs and their nested variants.
7.	Implementation of arrays (One dimensional and multi-dimensional along with operations performed on arrays).
8.	Implementation of functions (normal functions, recursive functions and parameter passing methods).
9.	Implementation of Pointers with arrays, strings and functions.
10.	Implementation of structures and Union.
11.	Implementation of file handling in C.

<table>
<tr><td rowspan="2">Course no: ADBB 104</td><td colspan="2">Open course (Y/N)</td><td>HM Course (Y/N)</td><td>DC (Y/N)</td><td colspan="2">DE (Y/N)</td></tr>
<tr><td colspan="2">NO</td><td>NO</td><td>YES</td><td colspan="2">NO</td></tr>
<tr><td>Type of course</td><td colspan="6">Core</td></tr>
<tr><td>Course Title</td><td colspan="6">COMPUTER FUNDAMENTALS</td></tr>
<tr><td>Course objectives:</td><td colspan="6">This course aims to provide knowledge of computer hardware and other peripherals to the students. They will become familiar with different types of softwares, networking devices and concepts.</td></tr>
<tr><td>POs</td><td colspan="6"></td></tr>
<tr><td>Semester</td><td colspan="2">Autumn: Yes</td><td colspan="4">Spring:</td></tr>
<tr><td>I</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Credits</td><td colspan="2">Total teaching hours</td></tr>
<tr><td>Contact Hours</td><td>2</td><td>0</td><td>2</td><td>3</td><td colspan="2">24</td></tr>
<tr><td>Prerequisite course code as per proposed course numbers</td><td>NIL</td><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Prerequisite credits</td><td>NIL</td><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Equivalent course codes as per proposed course and old course</td><td>NIL</td><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Overlap course codes as per proposed course numbers</td><td>NIL</td><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td colspan="7">Text Books:</td></tr>
<tr><td rowspan="4">1</td><td>Title</td><td colspan="5">Computer Fundamentals</td></tr>
<tr><td>Author</td><td colspan="5">Peter Nortan</td></tr>
<tr><td>Publisher</td><td colspan="5">TATA McGraw Hill</td></tr>
<tr><td>Edition</td><td colspan="5">5th edition, 2003</td></tr>
<tr><td colspan="7">Reference Book:</td></tr>
<tr><td rowspan="4">1</td><td>Title</td><td colspan="5">Computer Science Handbook</td></tr>
<tr><td>Author</td><td colspan="5">Allen B. Tucker</td></tr>
<tr><td>Publisher</td><td colspan="5">CRC Press</td></tr>
<tr><td>Edition</td><td colspan="5">2nd edition, 2004</td></tr>
<tr><td rowspan="4">2</td><td>Title</td><td colspan="5">Introduction to Computer Science</td></tr>
<tr><td>Author</td><td colspan="5">I. T. L. Education Solutions Limited, Itl Esl</td></tr>
<tr><td>Publisher</td><td colspan="5">Pearson Education</td></tr>
<tr><td>Edition</td><td colspan="5">4th impression, 2009</td></tr>
<tr><td>Content</td><td colspan="6">Unit – 1 (3 Hours)
Computer hardware: Evolution of Computer Hardware, Moore’s Law, Classification of Computers, Fundamental Units of Computer, Communication between various units, Processor speed, Multiprocessor system Input Output devices, Storage Devices.
Unit – 2 (5 Hours)</td></tr>
</table>

	Number System: Introduction and type of Number system, Conversion between number system, complements Arithmetic operations on number system, Signed and unsigned number system, Fixed and floating point numbers. **Unit – 3** (5 Hours) Logic development and algorithms: Various techniques to solve a problem, Ways to specify an algorithm, Flow charting techniques, Types of Computer Languages. **Unit – 4** (6 Hours) Operating Systems and System Software: What is Operating System–Evolution of OS, Types of Operating System batch system, multiprogramming, multiprocessing, multi user, time sharing, personal system, parallel system, real time system, Single User System, Multi User Systems, Booting, Approaches to OS design and implementation: Microkernel, Layered, Kernel Approach, Introduction to Development tools: Editors, Translators, Compiler, Debugger, Assembler. **Unit – 5** (5 Hours) Data communication, Computer network and Internet Basics: Concepts and Terminology, Analog and Digital Data Transmission, Transmission Impairments, Guided Transmission Media, Wireless Transmission, Introduction to Computer Network, Types of Networks: Broadcast and Point-to-point- LAN-MAN-WAN- Wireless networks.
Course Outcomes	• To illustrate the binary system and its importance in computer architecture (L2) • To identify where, when and how enhancements of computer hardware and software have taken place (L3) • To develop skills for problem solving approaches (L3) • To analyse different types of operating systems, network types and topologies (L4)
Course Assessment	Continuous Evaluation 25%
	Mid Semester 25%
	End Semester 50%

Lab Experiments:

Exp. No.	Experiments
1.	Basic Unix commands
2.	Familiarisation with operating system along with file management commands like create, copy, move, delete and rename files and folders.
3.	Prepare and print Bio-data with a covering letter using Latex.
4.	Calculation of Total mark, grade based on boundary conditions for n number of students using Spread sheet.
5.	Preparation of presentation (with transition and animations , insertion of scanned images and internet contents)

6.	Figure creation using Draw.io
7.	Basic of programming
8.	Programs to calculate average of 3 numbers, area of triangle, volume of cylinder, Temperature conversion.
9.	Largest of 3 numbers, Check whether even or odd, Roots of quadratic equation, Character name of the day.
10.	Print natural numbers, Factorial value, Multiplication table, Sum of digits, Sum of a set of numbers, calculation of grade based on boundary conditions
11.	Programs to convert from one number system to another.

Course no: PHLB 112	Open course (Y/N)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)
Type of course				
Course Title	QUANTUM PHYSICS			
Course Objectives:	• This course develops concepts in quantum mechanics such that the behaviour of the physical universe can be understood from a fundamental point of view. It provides a basis for further study of quantum mechanics. • To provide the exposure of non-relativistic quantum mechanics, the time-dependent and time-independent Schrödinger equation for simple potentials. • The student will achieve the physical description through the mathematics of a problem. And to give the explanation of the physical meaning of the mathematical formulation and their solution to the quantum mechanics problem. • To provide the exposure for sketching the physical parameters of a problem (e.g., wave function, potential, probability distribution, the role of operators and their connection with observables, and uncertainty, transformations), as appropriate for a particular problem and composite systems.			

Semester	Autumn: Yes		Spring:		
I	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	1	0	4	48
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Reference Book:

1	Title	Concepts of Modern Physics
	Author	Arthur Beiser
	Publisher	Tata McGraw Hill
	Edition	6th Edition (2003)
2	Title	The Feynman Lectures on Physics
	Author	Richard P. Feynman, Robert Leighton, Mathew Sands
	Publisher	Pearson Education India
	Edition	The New Millennium Edition (2012)
3	Title	Principles of Quantum Mechanics
	Author	R. Shankar
	Publisher	Plenum Press
	Edition	2nd Edition 1994
4	Title	Introduction to Quantum Mechanics

	Author	D. Griffiths
	Publisher	Prentice-Hall
	Edition	IInd Edition (2005)
Content	**Unit I – Introduction to Quantum Mechanics 4 Lectures** Planck’s radiation law, Photoelectric effect, Compton’s experiment, The Bohr model, de Broglie’s hypothesis, **Unit II - The Mathematical Structure of Quantum Mechanics 10 Lectures** Probability Amplitudes and Quantum States, Operators and Observables, Position and Momentum Representations, Time Evolution in Quantum Mechanics **Unit III - Wave Mechanics and Oscillators 10 Lectures** Wave mechanics: Free particle in one dimension, Infinite square well, Finite square well, Split infinite square well, Scattering of free particles, Resonant Scattering; Harmonic Oscillators: Ground state of the Quantum Harmonic Oscillator, Excited states of the Quantum Harmonic Oscillator, What oscillates in the quantum harmonic oscillator?, Quantum vs classical harmonic oscillator **Unit IV - Transformations 10 Lectures** Transformations and Symmetries, Translations: Expectation values, Wave functions, Translational Invariance and momentum as a “good quantum number"; Reflections (Parity); Rotations; Heisenberg picture and Heisenberg equation of motion **Unit V – Angular Momentum 7 Lectures** Rotational invariance and angular momentum as a good quantum number, Eigenstates of L^2 and $\hat{\square}_{\square}$. **Unit V - Composite Systems 7 Lectures** Operators, Position representation, Independent particles, Measurements; Product States vs entangled states; Entanglement Growth; EPR experiment and Bell inequalities	
Course Outcomes	• Basic understanding of key concepts and the principle of Quantum Physics and its applications, Understanding the role of uncertainty in quantum physics (L1, L2). • Interpretation of the wave function and apply operators to it to obtain information about a particle's physical properties such as position, momentum and energy (L1-L5). • Solve the Schrödinger equation to obtain wave functions for some basic, physically important types of potential in one dimension, and estimate the shape of the wavefunction based on the shape of the potential (L3, L4). • Analysis and evaluation of the quantum physics with key questions and problems independently (L4, L5).	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: HHPB 150	**Open course (Y/N)**		**HM Course (Y/N)**		**DC (Y/N)**	**DE (Y/N)**
Type of course						
Course Title	**Holistic Heath & Sports**					
Course objectives:	To create awareness about Physical Fitness & Health among students					
POs						
Semester	**Autumn: Yes**		**Spring:**			
I	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**	
Contact Hours	0	0	2	1	24	
Prerequisite course code as per proposed course numbers	NIL					
Prerequisite credits	NIL					
Equivalent course codes as per proposed course and old course	NIL					
Overlap course codes as per proposed course numbers	NIL					

Content	**Unit 1: Physical Fitness & Health** Physical fitness, components of physical fitness, methods to improve components of physical fitness, health, components of health, health related fitness components, factors affecting overall health. Respiratory rate, Breathing rate, Body Mass Index. Physical Fitness Testing : Cooper's test, Push-up test, Squat test, Sit & Reach Test, Isometric Back strength test, Standing Broad jump test, Shuttle run test, 100 metre sprint test, one minute Sit-up test. **Unit 2: Yoga & its Elements** Yoga, elements of Yoga, Asanas, Pranayama, Surya Namaskar **Unit 3: First Aid & Sports Injuries** First aid, aim of first aid, techniques of first aid, CPR technique, Recovery position, introduction to sports injuries. **Unit 4: Nutrition & Balanced Diet** Nutrition, component of Nutrition, Balanced diet. **Unit 5: Sports & Psychology** Psychology, Sports Psychology, Motivation, Anxiety, Leadership, The Big 5 personality Test.
Course Outcomes:	• Students will be more aware about their overall health. • Students will learn methods to keep them physically fit and to access their physical fitness.
	Continuous Evaluation 50%
	End Semester 50%

Course no: ADLB 151	Open course (Y/N)		HM Course (Y/N)	DC (Y/N)	DE (Y/N)	
Type of course						
Course Title	PROBABILITY AND STATISTICS					
Course objectives:	The purpose of this course is to introduce the fundamental rules of Probability, discrete and continuous distributions, and statistical methods that are most commonly used in Computer Science and Engineering. Students will be introduced to stochastic processes, Markov chains and statistical inference methods and will apply the theory and methods to the evaluation of queuing systems and computation of their vital characteristics.					
POs						
Semester	Autumn:		Spring: Yes			
II	Lecture	Tutorial	Practical	Credits	Total teaching hours	
Contact Hours	3	0	0	3	36	
Prerequisite course code as per proposed course numbers	NIL					
Prerequisite credits	NIL					
Equivalent course codes as per proposed course and old course	NIL					
Overlap course codes as per proposed course numbers	NIL					
Text Books:						
1	Title	Introduction to Probability and Statistics for Engineers and Scientists				
	Author	Sheldon M Ross				
	Publisher	Elsevier				
	Edition	Fifth Edition				
Reference Book:						
1	Title	Probability and Statistics with Reliability, Queuing, and Computer Science Applications				
	Author	K. Trivedi				
	Publisher	Wiley				
	Edition	Second edition (2002)				
2	Title	Probability, random variables, and stochastic processes.				
	Author	Papoulis, Athanasios, and S. Unnikrishna Pillai				
	Publisher	Tata McGraw-Hill Education				
	Edition	2002				
3	Title	Introduction to Mathematical Statistics				
	Author	Robert V Hogg, Joseph McKean, Allen T Craig				

		Publisher	Pearson
		Edition	Seventh Edition
4.		Title	Probability and Computing: Randomized Algorithms and Probabilistic Analysis
		Author	Michael Mitzenmacher, Eli Upfal
		Publisher	Cambridge University Press
		Edition	
Content	**Unit – 1** (7 Hours) Events and outcomes. Probability rules Sample space and events, The axioms of probability. Conditional probability, Independence, Bayes' Rule, Law of Total Probability Elementary theorems of probability **Unit – 2** (7 Hours) Random variables, Joint and marginal distributions. Expectation and variance. Discrete distributions: Bernoulli, Binomial, Geometric, and Poisson. **Unit – 3** (7 Hours) Continuous distributions and densities: Uniform, Exponential, Gamma, Normal Central Limit Theorem and Normal approximations, Law of Large Numbers. **Unit – 4** (7 Hours) Statistical Inference: Introduction of sampling, Sampling distributions of mean and variance, Point and interval estimation. **Unit – 5** (8 Hours) Stochastic processes: concepts and classifications. Bernoulli process. Poisson process. Markov chains. Transition probabilities. Steady-state distribution		
Course Outcomes	• Illustrate the principal concepts about probability (K2). • Explain the concept of a random variable and the discrete probability distributions (K2). • Explain continuous distributions and solve the distribution-related problems (K3). • Apply the fundamentals of statistics to experiment with statistical inferences (K3). • Utilise stochastic processes and Markov chains to solve real life problems (K3).		
Course Assessment	Continuous Evaluation 25%		
	Mid Semester 25%		
	End Semester 50%		

Course no: ADBB 152	**Open course (Y/N)**	**HM Course (Y/N)**	**DC (Y/N)**		**DE (Y/N)**
	NO	NO	YES		NO
Type of course	Core				
Course Title	**COMPUTER ORGANIZATION and ARCHITECTURE**				
Course objectives:	The purpose of this course is to have a thorough understanding of the basic structure and operation of a digital computer. Students will learn the basic operations involved in the execution of an instruction, interrupts and their usage to implement I/O control and data transfers and identify the different architectural design issues that can affect the performance of a computer such as RISC architecture, instruction set design, and addressing modes.				
POs					
Semester	**Autumn:**		**Spring: Yes**		
V	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	2	4	36
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					
Text Books:					
1	Title	Computer Organization and Design - The Hardware/Software Interface			
	Author	D. A. Patterson and J. L. Hennessy			
	Publisher	Morgan Kaufmann			
	Edition	2014			
Reference Book:					
1	Title	Computer System Architecture			
	Author	M. Morris Mano			
	Publisher	Prentice Hall of India Pvt Ltd			
	Edition	Third edition, 2002			
2	Title	Computer Organization and Architecture - Designing for Performance			
	Author	W. Stallings			
	Publisher	Prentice Hall of India			
	Edition	2002			
3	Title	Computer Organization			
	Author	C. Hamacher, Z. Vranesic and S. Zaky			
	Publisher	McGrawHill			

		Edition	2002
4.		Title	Computer Architecture and Organization
		Author	J .P. Hayes
		Publisher	McGraw-Hill
		Edition	1998
Content	**Unit - 1** (5 Hours) Introduction: Function and structure of a computer Functional components of a : Function and structure of a computer, Functional components of a computer, Interconnection of components, Performance of a computer. **Unit -2** (7 Hours) Representation of Instructions Representation of Instructions: Machine instructions, Operands, Addressing : Machine instructions, Operands, Addressing modes, Instruction formats, Instruction sets, Instruction set architectures - CISC and RISC architectures. **Unit - 3** (7 Hours) Processing Unit: Organization of a processor - Registers, ALU and Control unit, Data path in a CPU, Instruction cycle, Organization of a control unit - Operations of a control unit, Hardwired control unit, Microprogrammed control unit. **Unit – 4** (9 Hours) Memory Subsystem: Semiconductor memories, Memory cells - SRAM and DRAM cells, Internal Organization of a memory chip, Organization of a memory unit, Error correction memories, Interleaved memories, Cache memory unit - Concept of cache memory, Mapping methods, Organization of a cache memory unit, Fetch and write mechanisms, Memory management unit - Concept of virtual memory, Hardware support for memory management. **Unit – 5** (8 Hours) Input/Output Subsystem: Access of I/O devices, I/O ports, I/O control mechanisms - Program controlled I/O Interrupt controlled I/O and DMA controlled I/O I/O interfaces Program controlled I/O, Interrupt controlled I/O, and DMA controlled I/O, I/O interfaces - Serial port, Parallel port, PCI bus, SCSI bus, USB bus, I/O peripherals - Input devices, Output devices, Secondary storage devices.		
Course Outcomes:	• Understand the fundamentals of computer organization and its relevance to classical and modern problems of computer design (K2). • Apply knowledge of combinational and sequential logic circuits to mimic simple computer architecture to solve the given problem (K3). • Analyze performance of various instruction set architecture, control unit, memories and various processor architectures (K4). • Explain the basic concept of interrupts and their usage to implement I/O control and data transfers (K2).		
Course Assessment	Continuous Evaluation 25%		
	Mid Semester 25%		
	End Semester 50%		

Course no: ADBB 153	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)	Open course (YES/NO)
	NO	NO	YES	NO	NO
Type of course	**Core**				
Course Title	**DATA STRUCTURES AND ALGORITHMS**				
Course objectives:	This course aims to develop students' knowledge in data structures, its associated algorithms and applications in problem solving. Students will be introduced to common sorting and searching algorithms along with their complexities.				
POs					

Semester	**Autumn:**		**Spring: Yes**		
II	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	2	4	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1	Title	Introduction to Algorithms
	Author	Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein
	Publisher	MIT Press
	Edition	Fourth Edition, 2022
Reference Book:		
1	Title	Fundamentals of Data Structures
	Author	E. Horowitz, S. Sahni
	Publisher	Computer Science Press
	Edition	2nd Edition, 2008
2	Title	Data Structures Using C
	Author	E. Balagurusamy
	Publisher	TATA McGraw Hill
	Edition	2013
3	Title	Data Structure and Program Design
	Author	R.L. Kruse
	Publisher	Prentice Hall

	Edition	2nd Edition, 1996
4	Title	Data Structures Using C
	Author	A. M. Tanenbaum, Y. Langsam, M. J. Augenstein
	Publisher	Pearson Education
	Edition	1990
Content	**Unit – 1** (5 Hours) Introduction: Dynamic aspects of operations on data, Characteristics of data structures, Creation and manipulation of data structures, Operations on data structures, Types of data structures – linear and nonlinear. Introduction to algorithm: Asymptotic notations, Analysis of algorithms: Time and Space complexity. **Unit – 2** (7 Hours) Arrays: Dynamic memory allocation, one-dimensional arrays, multidimensional arrays, operations on arrays, storage – Row major order, Column major order. Linked lists: types of linked lists – singly, doubly and circularly linked lists, operations on linked lists. **Unit – 3** (8 Hours) Stacks: Implementation of stacks– array and linked list, operations on stacks, Applications of Stacks, Notations – infix, prefix and postfix, Conversion and evaluation of arithmetic expressions using Stacks. Queues: Implementation of queues– array and linked list, operations on queues, Types of queues – queue, double ended queue and priority queue. **Unit – 4** (8 Hours) Trees: Binary tree, Binary search tree, Threaded binary tree, Height balanced trees, Tries, Heaps, Hash tables. Graph traversals: Breadth First Search, Depth First Search, Shortest path: Depth first search in directed and undirected graphs. Union-find data structure and applications. Directed acyclic graphs; topological sort. **Unit – 5** (8 Hours) Searching: Linear search, Binary search and Hashing. Algorithms and data structures for sorting: Insertion Sort, Bubble sort, Selection Sort, Merge sort, Quick Sort, Heap sort, Radix sort, Bucket sort. Algorithm design techniques: Divide and conquer, Greedy approach, dynamic programming.	
Course Outcomes:	• Recognize the need of different data structures and understand its characteristics (K2). • Demonstrate the operations for maintaining common data structures and recognize the associated algorithms' complexity (K2). • Apply different data structures including stacks, queues, hash tables, binary and general tree structures, search trees, and graphs for given problems (K3). • Design, analyse and compare different algorithms for sorting and searching techniques (K5).	
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%	

Course no: ADBB 154	Open course (YES/NO)	HM Course (Y/N)	DC (Y/N)	DE (Y/N)	Open course (YES/NO)
	NO	NO	YES	NO	NO
Type of course	**Core**				
Course Title	**PROGRAMMING USING PYTHON**				
Course objectives:	The objective of this course is to develop problem solving skills using algorithms and procedures. Moreover, the students will learn different Python data structures and their use in Data Science applications.				
POs					

Semester	**Autumn:**		**Spring: Yes**		
II	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	1	0	2	2	
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:

1	Title	Fundamentals of Python: First Programs
	Author	Kenneth A. Lambert
	Publisher	Cengage Learning, Inc.
	Edition	2nd Edition, 2018

Reference Book:

1.	Title	Python Programming using Problem Solving Approach
	Author	Reema Thareja
	Publisher	Oxford University Press
	Edition	2nd Edition, 2023
2.	Title	Think Python: How to Think Like a Computer Scientist
	Author	Allen B. Downey
	Publisher	O’reilly
	Edition	2nd edition, Updated for Python 3, Shroff/O‘Reilly Publishers, 2016
3.	Title	Introduction to Computation and Programming Using Python
	Author	John V Guttag
	Publisher	MIT Press

	Edition	Revised and expanded Edition, 2013

Content	**Unit – 1** (5 Hours) Introduction to computers – Computer Organization – Characteristics – Hardware and Software – Modes of operation – Types of programming languages – Developing a program. Algorithms – Characteristics – Flowcharts. **Unit – 2** (7 Hours) Data types; variables, assignments; immutable variables; numerical types; arithmetic operators and expressions; comments; understanding error messages; Conditions, Boolean logic, logical operators; ranges; Control statements: if-else, loops (for, while); short-circuit (lazy) evaluation **Unit – 3** (8 Hours) Strings and text files; manipulating files and directories, OS and SYS modules; text files: reading/writing text and numbers from/to a file; creating and reading a formatted file (csv or tab-separated). String manipulations: subscript operator, indexing, slicing a string; strings and number system: converting strings to numbers and vice versa. Binary, octal, hexadecimal numbers **Unit – 4** (8 Hours) Lists, tuples, and dictionaries; basic list operators, replacing, inserting, removing an element; searching and sorting lists; dictionary literals, adding and removing keys, accessing and replacing values; traversing dictionaries. **Unit – 5** (8 Hours) Design with functions: hiding redundancy, complexity; arguments and return values; formal vs actual arguments, named arguments- Program structure and design- Recursive functions – Introduction to classes and OOP. Applications: Sample problems in engineering, data pre- processing, and plotting tools.
Course Outcomes	● Explain the problem solving fundamentals (K2) ● Illustrate the syntax and semantics and looping structures in Python programming language (K2) ● Utilise string handling mechanisms for data handling (K3) ● Make use of lists, tuples and dictionaries in Python programming language (K3) ● Develop applications using file handling mechanisms, modules and packages of python language (K6)
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

Course no: ADLB 155	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**		**DE (Y/N)**
	NO	NO	YES		NO
Type of course	**Core**				
Course Title	**SYSTEM PROGRAMMING**				
Course objectives:	The purpose of this course is to provide the students with the knowledge of system-level programming. It aims to enable the students to understand the design of various system-level programs related to assembler, loader, macro, compiler and operating system.				
POs					
Semester	**Autumn:**		**Spring: Yes**		
III	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1	Title	Systems Programming
	Author	John J. Donovan
	Publisher	Tata McGraw Hill
	Edition	2014
Reference Book:		
1	Title	System Software-An Introduction to Systems Programming
	Author	L.L. Beck
	Publisher	Addition Wesley
	Edition	3rd Edition, 1996.

Content	**Unit – 1** (5 Hours) Introduction: Evolution of the Components of a Programming System, Evolution of Operating systems. Machine Structure, Machine Language, and Assembly Language. **Unit – 2** (7 Hours) Assemblers: Design of Assembler. Table Processing: searching and sorting. Macro Language and the Macro Processor : Macro Instructions, Features of Macro facility, Implementation. **Unit – 3** (8 Hours)

	Loaders: Loader Schemes, Design of an Absolute Loader, Design of a Direct-Linking Loader. **Unit – 4** (8 Hours) Compilers: Statement of problem, Phases of the compiler, Data Structures, Recursion, Call and Return statements, Storage Classes – Use, Implementation, Block Structure, Nonlocal Go To's, Interrupts, Pointers. **Unit – 5** (8 Hours) Operating Systems: I/O Programming, Memory Management, Processor Management, Device Management, Information Management.
Course outcomes	• Apply the knowledge of assembler and macro processors to convert assembly language into machine code. • Analyse working phases of Compiler to undertake meaningful language translation. • Evaluate Linkers, Loaders, interpreters and debugging methods to manages system memory and provide a portable runtime environment. • Analyze the working of an operating system and its components.
Course Assessment	Continuous Evaluation 25%
	Mid Semester 25%
	End Semester 50%

Course Code: ADBB 201	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**	
	NO	NO	Yes	NO	
Type of course	Core				
Course Title	**ARTIFICIAL INTELLIGENCE**				
Course Objectives:	Gain a comprehensive understanding of Artificial Intelligence, covering its historical development, problem-solving techniques, search strategies, logical reasoning, and planning methods, with a focus on practical applications, particularly in the field of robotics. Develop essential skills to tackle complex AI challenges effectively.				
Course Outcomes	**CO1:** Understand the basic concepts of AI.				**L1, L2**
	CO2: Apply search strategies to solve AI problems.				**L3**
	CO3: Apply knowledge representation and reasoning to solve real world AI Problems.				**L3**
	CO4: Explore machine learning concepts and algorithms for real world applications.				**L4**
Semester	**Autumn:**		**Spring: YES**		
III	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	2	4	60
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					
Text Books:					
1	Title	Artificial intelligence : A Modern Approach,			
	Author	Stuart Russell, Peter Norvig			
	Publisher	Prentice Hall			
	Edition	Fourth edition, 2020.			

Reference Book:		
2.	Title	Artificial Intelligence: A New Synthesis
	Author	Nils J. Nilsson
	Publisher	Morgan-Kaufmann, 1998.
	Edition	
3.	Title	Heuristics: Intelligent Search Strategies for Computer Problem Solving
	Author	Judea Pearl
	Publisher	Addison-Wesley Publishing Company
	Edition	1984
Content	**UNIT 1** Introduction, History, Possible Approaches in AI, Automated Problem Solving Agent: Intelligent Agent & Environment, Complex Problems and AI, Shannon number, Problem Representation in AI **UNIT 2** Search Strategies: Search introduction, Uninformed Search, Informed/Heuristic Search, Beyond Classical Search, Local Search, Problem Reduction, Adversarial Search, Constraint Satisfaction Problems **UNIT 3** Logic and Deduction: Logical Agents, Propositional logic and Predicate Logic, First Order Logic, inference in First order Logic, Inferencing By Resolution Refutation, Classical Planning, **UNIT 4** Quantifying Uncertainty, Introduction of Probability, Probabilistic Reasoning, Bayes Net, Bayesian Network, Fuzzy Logic, Decisions Theory, Utility Function, Decision Network, Markov Decision Process, Probabilistic Reasoning over time, Hidden Markov Model, Kalman filter, Markov Chain Monte Carlo **UNIT 5** Learning Agent, Introduction to Machine Learning, Types of Machine Learning, Learning from experience: Reinforcement Learning, Background, Model based and Model free learning, TD and Q Learning, RL Applications, Learning from Example, Supervised learning : Introduction, Naive Bayes, Decision Tree, Perceptrons, Neural Network, Introduction to Deep Learning. AI Applications and Ethics, Ethics of AI	
Course Assessment	Continuous Evaluation 25%	
	Mid Semester 25%	
	End Semester 50%	

Lab Experiments:

Exp. No.	List of Experiments
1	Introduction to Prolog programming
2	Python Frameworks Tutorial (with Jupyter and Colab) and it's Data Structures
3	Searching in graph based problem space, exploring Uninformed search Techniques
4	Exploring Informed search Techniques (Vacuum world and Maze Problem)
5	Exploring Uninformed and Informed search Techniques (PACMAN Search Space)
6	Multi agent in a search space
7	Introduction Logical Agent and Knowledge representation using Prolog
8	Reasoning Under Uncertainty using Bayesian Learning
9	Reinforcement Learning using Q-Learning
10	Introduction to Machine Learning and Python libraries for Data Analysis (Pandas, NumPy, Matplotlib)

Course Code: ADBB 202	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	Yes	NO
Type of course	Core			
Course Title	**Database Management Systems**			

Course Objectives:	1. To understand the role and functions of a database management system and its impact on the overall performance of a computer system. 2. To understand the concepts and techniques involved in ER modeling. 3. To understand the SQL commands and relational algebraic expressions for query processing. 4. To gain hands-on experience designing and implementing database management systems through programming projects and case studies.

Course Outcomes	**CO1:** Learn the basic concepts of Database Systems	**L2**
	CO2: Model the real-world systems using Entity Relationship Diagrams and convert the ER model into a relational logical schema using various mapping algorithms	**L3**
	CO3: Make use of SQL commands and relational algebraic expressions for query processing	**L4**
	CO4: Simplify databases using normalization process based on identified keys and functional dependencies and solve the atomicity, consistency, isolation, durability, transaction, and concurrency-related issues of databases	**L5**

Semester	**Autumn: Yes**		**Spring:**		
V	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	2	4	60
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:

1	Title	Fundamentals of Database Systems
	Author	R. Elmasri and S.B. Navathe
	Publisher	Pearson
	Edition	2016

Reference Book:

1.	Title	Database Systems Concepts
	Author	H.f.Korth and Silberschatz
	Publisher	McGraw Hill
	Edition	
2.	Title	Data Base Design
	Author	C.J. Date
	Publisher	Addison Wesley
	Edition	
3.	Title	DBM and Design
	Author	Hansen and Hansen
	Publisher	PHI
	Edition	
4.	Title	Database System
	Author	Hector Garcia-Molina, Jeff Ullman, and Jennifer Widom
	Publisher	Pearson
	Edition	2nd Edition

Content	**Unit 1 (6 hours)** Introduction - General introduction to database systems; Database - DBMS distinction, approaches to building a database, data models, database management system, three-schema architecture of a database, challenges in building a DBMS, various components of a DBMS. **Unit 2 (8 hours)** Database design and ER Model:- Overview, ER-Model, Constraints, ER-Diagrams, ERD Issues, weak entity sets, Codd's rules, Relational Schemas, Introduction to UML Relational database model: Logical view of data, keys, integrity rules. Relational Database design: features of good relational database design, atomic domain, and Normalization (1NF, 2NF, 3NF, BCNF). **Unit 3 (6 hours)** Relational algebra: introduction, Selection and projection, set operations, renaming, Joins, Division, syntax, semantics. Operators, grouping and ungrouping, relational comparison. Calculus: Tuple relational calculus, Domain relational Calculus, calculus vs algebra, computational capabilities. **Unit 4 (8 hours)** SQL - Introduction, data definition in SQL, table, key and foreign key definitions, update behaviors. Querying in SQL - basic select-from-where block and its semantics, nested queries- correlated and uncorrelated, notion of aggregation, aggregation functions group by and having clauses, embedded SQL. Data Storage and Indexes - file organizations, primary, secondary index structures, various index structures - hash-based, dynamic hashing techniques, multi-level indexes, and B+ trees. **Unit 5 (8 hours)** Transaction management and Concurrency control: Transaction processing and Error recovery - concepts of transaction processing, ACID properties, and serializability concurrency control, Lock based concurrency control (2PL, Deadlocks), Time stamping methods, optimistic methods, and database recovery management. Error recovery and logging, undo, redo, undo-redo logging, and recovery methods.
Course Assessment	Continuous Evaluation 25%
	Mid Semester 25%
	End Semester 50%

Lab Experiments:

Exp. No.	List of Experiments
1	Library Management system (File Handling)
2	Introduction to SQL ● Installation of SQL-Server ● SQL data definition ● Constraints in SQL ● Schema change Statement
3	Basic SQL Queries
4	Complex SQL Queries-1 ● Nested Queries

	• Correlated Nested Queries • EXISTS Function in SQL • Aggregation Function
5	Complex SQL Queries-2 • Joined Tables • Aggregate Functions
6	Complex SQL Queries-3 • Grouping • EXISTS and UNIQUE functions • Aggregate Functions
7	Entity-Relationship Diagram from Case Study
8	Normalization of the Case Study
9	Webpage Connectivity with SQL Server Using XAMPP- 1
10	Webpage Connectivity with SQL Server Using XAMPP- 2
11	Mini DBMS Project
12	Mini DBMS Project

Course no: ADLB 203	**Open course (YES/ NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**	
	NO	NO	NO	NO	
Type of course	Elective				
Course Title	Optimization Techniques				
Course Coordinator					
Course objectives:	This course aims to cover the concepts of optimization methods and algorithms developed for solving various types of optimization Problems. To apply the mathematical results and numerical techniques of Optimization theory to various Engineering and Analytics problems. Explain the theoretical workings of the graphical, simplex and analytical methods for making effective decision on variables so as to optimize the objective function.				
Course Outcomes:	**CO1:** To understand the fundament of Linear Programming and Dynamic Programming.	**L1,L3**			
	CO2: Enumerate fundamentals of Integer programming technique and apply different techniques to solve various optimization problems arising from engineering areas.	**L1,L2**			
	CO3: Identify appropriate optimization method to solve complex problems involved in various industries.	**L1,L2,L4**			
	CO4: To understand the graphical, simplex and analytical methods for making effective decision.	**L2,L5**			
Semester	**Autumn: Yes**		**Spring: Yes**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	1	0	4	48
Prerequisite course code as per proposed course numbers	Linear algebra, Calculus				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				

Overlap course codes as per proposed course Numbers	NIL				
Text Books:					
1.	Title	An Introduction to Optimization			
	Author	Edwin K.P. Chong, Stanislaw H. Zak,			
	Publisher	Wiley			
	Edition	4^{th}			
Reference Book:					
1.	Title	Convex Optimization			
	Author	Stephen Boyd			
	Publisher	LievenVandenberghe			
	Edition	3^{rd}			
2.	Title	Modern Optimization with R (Use R)			
	Author	Paulo Cortez			
	Publisher	Springer			
	Edition	2014			

Content	**Unit** 1 Preliminaries: Proofs, Vector Spaces and Matrices, Linear Transformations, Eigenvalues and Eigenvectors, Orthogonal Projections, Quadratic Forms, Matrix Norms, Concepts from Geometry, Elements of Calculus **Unit** 2 Unconstrained Optimization: Basics of Set Constrained and Unconstrained Optimization, One Dimensional Search Methods, Golden Section Search, Fibonacci Search, Newton's Method, Secant Method, Solving Ax = b **Unit 3** Linear Programming: Introduction to Linear Programming, Simplex Method, Duality **Unit 4** Nonlinear Constrained Optimization: Problems with Equality Constraints, Problems with Inequality Constraints, Karush Kuhn Tucker Condition, Convex Optimization Problems, **Unit 5** Algorithms for Constrained Optimization: Projections, Project gradient methods, Penalty methods.
Course Assessment	**Continuous Evaluation 25%** **Mid Semester 25%** **End Semester 50%**

Course no: ADBB 204	**Open course (YES/NO)**		**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
Type of course	**Program Core**				
Course Title	**Operating Systems**				
Course objectives:	• To understand the role and functions of an operating system and its impact on the overall performance of a computer system. • To understand the concepts and techniques involved in process management, such as process creation, scheduling, interprocess communication, and synchronization. • To understand the concepts and techniques involved in memory management, such as virtual memory, swapping, paging, and segmentation. • To gain hands-on experience with the design and implementation of operating systems through programming projects and case studies.				
POs					
Semester	**Autumn: Yes**		**Spring:**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	2	4	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				
Text Books:					
1	Title	Operating System concepts			
	Author	Abraham Silberschatz, Peter B. Galvin, Greg Gagne			
	Publisher	Addison-Wesley			
	Edition	Eighth edition, 2017			
Reference Book:					
1	Title	Modern Operating Systems			
	Author	Andrew Tanenbaum			
	Publisher	Prentice Hall			
	Edition				
2	Title	Operating Systems			
	Author	William Stallings			
	Publisher	Prentice Hall			
	Edition				

<table>
<tr><td rowspan="4" colspan="2">3</td><td>Title</td><td>An introduction to operating systems</td></tr>
<tr><td>Author</td><td>Harvey M. Deitel</td></tr>
<tr><td>Publisher</td><td>Addison-Wesley</td></tr>
<tr><td>Edition</td><td></td></tr>
<tr><td>Content</td><td colspan="3">Unit – 1 (5 Hours)
Basics: Operating System Functionalities, Types of Operating Systems, Computer Architecture support to Operating Systems.

Unit – 2 (8 Hours)
Process Management: Threads, Process Scheduling - Uniprocessor scheduling algorithms, Multiprocessor and Real-time scheduling algorithms, Process Synchronization - Peterson's Solution, Bakery. Algorithm, Hardware Support to Process Synchronization, Semaphores, Critical Regions, Monitors - Deadlock prevention, deadlock avoidance, and Detection and Recovery - Bankers Algorithm.

Unit – 3 (7 Hours)
Memory Management: Segmentation and space allocation, Basics of linking and loading, Demand Paging, Page replacement algorithms, Analysis of page allocation policies, Thrashing- Working Set.

Unit – 4 (8 Hours)
File Systems: Contiguous, Sequential, and Indexed Allocation, File system interface, File System implementation; Case study of Unix File system, Mounting and Unmounting files systems; Network File systems.

Unit – 5 (8 Hours)
I/O System: Disk Scheduling, Device drivers - block and character devices, streams, Character and Block device switch tables. Protection and Security - Accessibility and Capability Lists.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="3">● CO1: Understanding of the fundamental concepts, design principles, and implementation techniques of modern operating systems
● CO2: Ability to design, implement, and evaluate process management, memory management, file system management, and input/output management algorithms
● CO3: Ability to understand and implement distributed systems, such as client-server systems, distributed file systems, and distributed operating systems.
● CO4: Hands-on experience designing and implementing operating systems through programming projects and case studies.</td></tr>
<tr><td rowspan="3">Course Assessment</td><td colspan="3">Continuous Evaluation 25%</td></tr>
<tr><td colspan="3">Mid Semester 25%</td></tr>
<tr><td colspan="3">End Semester 50%</td></tr>
</table>

Lab Experiments:

Exp. No.	Experiments
1.	Basics of Unix Commands
2.	Implementation of Process Related System Calls (Fork).
3.	Implementation of System Calls (Open, Read, Write, and Close) for File Management
4.	Implementation of Process Synchronization
5.	Implementation of Memory Management Using Address Translation
6.	Implementation of FIFO Page Replacement Algorithms
7.	Implementation of LRU Page Replacement Algorithms
8.	Implementation of First Come First Serve and Shortest Job First Scheduling Algorithm
9.	Implementation of Priority and Round Robin CPU Scheduling Algorithm
10.	Implementation of Banker’s Algorithm.
11.	Implementation of Sleeping Barbar Problem in Process Synchronization
12.	Implementation of Algorithm for Deadlock Detection

<table>
<tr><td rowspan="2">Course no: ADBB 205</td><td colspan="2">Open course (YES/NO)</td><td>HM Course (Y/N)</td><td>DC (Y/N)</td><td colspan="2">DE (Y/N)</td></tr>
<tr><td colspan="2"></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Type of course</td><td colspan="2">Program Core</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Course Title</td><td colspan="6">Computer Graphics</td></tr>
<tr><td>Course objectives:</td><td colspan="6">Emphasize basic principles needed to design, use, and understand computer graphics systems.
Discuss both hardware and software components of graphics systems.
Implementation of Graphics Algorithms</td></tr>
<tr><td>POs</td><td colspan="6"></td></tr>
<tr><td colspan="2">Semester</td><td colspan="2">Autumn: Yes</td><td colspan="3">Spring: No</td></tr>
<tr><td colspan="2"></td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Credits</td><td>Total teaching hours</td></tr>
<tr><td colspan="2">Contact Hours</td><td>3</td><td>0</td><td>2</td><td>4</td><td>36</td></tr>
<tr><td colspan="2">Prerequisite course code as per proposed course numbers</td><td>NIL</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Prerequisite credits</td><td>NIL</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Equivalent course codes as per proposed course and old course</td><td>NIL</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Overlap course codes as per proposed course numbers</td><td>NIL</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="7">Text Books:</td></tr>
<tr><td colspan="2" rowspan="4">1</td><td>Title</td><td colspan="4">Computer graphics C Version</td></tr>
<tr><td>Author</td><td colspan="4">Donald Hearn and M. Pauline Baker</td></tr>
<tr><td>Publisher</td><td colspan="4">Pearson</td></tr>
<tr><td>Edition</td><td colspan="4">2nd edition, 2014</td></tr>
<tr><td colspan="7">Reference Book:</td></tr>
<tr><td colspan="2" rowspan="4">1</td><td>Title</td><td colspan="4">Computer Graphics-Principles and Practice</td></tr>
<tr><td>Author</td><td colspan="4">J. D. Foley, A. Van Dam, S. K. Feiner and J. F. Hughes</td></tr>
<tr><td>Publisher</td><td colspan="4">Pearson</td></tr>
<tr><td>Edition</td><td colspan="4">2nd edition, 2003</td></tr>
<tr><td colspan="2" rowspan="4">2</td><td>Title</td><td colspan="4">Procedural Elements of Computer graphics</td></tr>
<tr><td>Author</td><td colspan="4">David F. Rogers</td></tr>
<tr><td>Publisher</td><td colspan="4">McGraw Hill</td></tr>
<tr><td>Edition</td><td colspan="4">2nd edition, 1998</td></tr>
</table>

<table>
<tr><td colspan="2" rowspan="4">3</td><td>Title</td><td>Computer Graphics: A programming approach</td></tr>
<tr><td>Author</td><td>Steven Harringtons</td></tr>
<tr><td>Publisher</td><td>McGraw Hill</td></tr>
<tr><td>Edition</td><td>2nd edition, 1987</td></tr>
<tr><td>Content</td><td colspan="3">Unit – 1 (5 Hours)
OVERVIEW OF GRAPHICS SYSTEM: Input devices, Output primitives, Video display devices, Raster and vector graphics, linecircle-ellipse generating algorithm, filled area primitives

Unit – 2 (8 Hours)
TRANSFORMATIONS AND PROJECTIONS: 2D Transformation, 3D transformation, Parallel projection, Perspective projection.

Unit – 3 (7 Hours)
LINE CLIPPING: Cohen-Sutherland, Liang Barsky, Polygon clipping: Sutherland Hodgeman &Weiler-Atherton polygon clipping.

Unit – 4 (8 Hours)
CURVES & SURFACES: Conics-Parametric forms for circle, ellipse, parabola; Bezier Curves, Bernstein polynomials, Convex Hull property, B-Spline Curves: Knot vectors uniform and open uniform curves, Periodic B-splines, Uniform B-splines, Non-uniform, rational B-splines, subdividing curves.

Unit – 5 (8 Hours)
HIDDEN SURFACE REMOVAL: Hidden Surface Removal: Back face removal, Floating Horizon method for curved objects, Z-Buffer or depth buffer algorithm, Painter’s algorithm(Depth sorting method), Binary space partitioning trees, Scan line algorithm, Warnock’s algorithm (Area subdivision method).</td></tr>
<tr><td>Course Outcomes:</td><td colspan="3">CO1: Demonstrate understanding of the basics of Computer Graphics (L2).
CO2: Develop understanding and underlying techniques and algorithms of Graphics Primitives, Display Methods and Visible surface detection concepts (L3).
CO3: Develop understanding of frequency domain processing techniques. (L3)
CO4: Develop understanding of modelling techniques used to restore images (L3)
CO5: Develop understanding of color image processing and compressing techniques (L3)</td></tr>
<tr><td rowspan="3">Course Assessment</td><td colspan="3">Continuous Evaluation 25%</td></tr>
<tr><td colspan="3">Mid Semester 25%</td></tr>
<tr><td colspan="3">End Semester 50%</td></tr>
</table>

Lab Experiments:

Exp. No.	Experiments
1.	Digital Differential Analyzer Algorithm
2.	Bresenham’s Line Drawing Algorithm
3.	Midpoint Circle Generation Algorithm
4.	Ellipse Generation Algorithm
5.	Creating various types of texts and fonts
6.	Creating two dimensional objects
7.	Two Dimensional Transformations
8.	Coloring the Pictures
9.	Three Dimensional Transformations
10.	Curve Generation
11.	Simple Animations using transformations
12.	Key Frame Animation

Course no: ADBB 251	BSC (YES/ NO)	ESC (YES/ NO)	HSC (YES/ NO)	PC (YES/ NO)	PE (YES/ NO)	IN-IS-SP-MP (YES/ NO)
	NO	NO	NO	YES	NO	NO

Type of course	**Program Core**
Course Title	**DATA SCIENCE**
Course objectives:	The purpose of this course is to understand the foundations of Data Science and its applications. This course will equip students with the skills to preprocess, analyze, and interpret data, and further will introduce machine learning techniques for predictive analytics. The main aim would be to provide hands-on experience in working with real-world datasets.
POs	

Semester	**Autumn:**		**Spring: Yes**		
IV	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	1	4	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1	Title	Introducing Data Science
	Author	Davy Cielen, Arno D. B. Meysman, Mohamed Ali
	Publisher	Ebury Press
	Edition	First edition, 2023
Reference Book:		
1	Title	Introduction to Data Science: Practical Approach with R and Python
	Author	B. Uma Maheswari, R. Sujatha
	Publisher	Wiley
	Edition	First edition, 2021
2	Title	The Elements of Statistical Learning
	Author	Trevor Hastie, Robert Tibshirani, Jerome Friedman
	Publisher	Springer
	Edition	Second edition, 2009

3		Title	Python for Data Analysis
		Author	Wes McKinney
		Publisher	Shroff/O'Reilly
		Edition	Third edition, 2022
Content	**Unit -1: Foundational Mathematics for Data Science** (6 Hours) Linear algebra; vectors; matrices; product of matrix & vector; rank; null space; solution of over-determined set of equations and pseudo-inverse; distance; projections; eigenvalue decomposition; statistical modeling/descriptive statistics, notion of probability (random variables), distributions, mean, variance, covariance, covariance matrix, introduction to hypothesis testing, One-Tailed and Two-Tailed Test, Type 1 and Type 2 errors, Test Statistic. **Unit-**2: **Python Programming for Data Science** (8 Hours) Introduction to python; variables and datatypes; operators; sequence data; control structures and functions; reading data; most widely used library for python: Pandas, NumPy, SciPy, Matplotlib **Unit** –3: **Data Cleaning and Exploration** (8 Hours) Data analysis: types of data (Structured, unstructured, and semi-structured); Data preprocessing: Missing values, outliers, normalization, and standardization; Feature engineering: Encoding, scaling, and transformation, Singular value decomposition (SVD,)Principal component analysis(PCA) **Unit** –4**: Data modeling** (7 Hours) Predictive modeling; Linear regression, multiple linear regression; cross-validation; classification using logistic regression; classification using kNN and k-means clustering. **Unit** –5: **Model optimization** (7 Hours) Typology of data science problems and a solution framework; optimization techniques like multivariate optimization – unconstraint, equality constraint, unequality constraint; Gradient descent and cost functions.		

Course Outcomes	● Understand and apply data preprocessing techniques. ● Implement machine learning algorithms. ● Utilize statistical methods for data interpretation. ● Design visualizations to effectively communicate findings.
Course Assessment	Continuous Evaluation 25%
	Mid Semester 25%
	End Semester 50%

Lab Experiments:

Exp. No.	List of Experiments
1	Learn to install and use of various libraries used for data handling in python a. Install Anaconda and Jupyter Notebook b. Install Numpy, Pandas, SciPy, Matplotlib packages and learn basis operations on datasets using these packages c. Load data from file stored in local computer and visualize it

2	Implement eigenvalue decomposition on provided data sets: a. Using Numpy library b. Using SciPy library
3	Implement Singular Value Decomposition (SVD) on given datasets.
4	Analyze the relationship between the given data series by calculating their Covariance and Correlation. Create scatter plots to visualize the data and include a title displaying the Covariance and Correlation values.
5	Verify if given dataset is normally distributed or not by following methods: a. Visual method: create Histogram, Create a Q-Q plot b. Shapiro-Wilk Test c. Kalmogorov-Smirnov Test
6	State hypothesis and Perform following T statistics tests on given datasets a. One sample T-test b. Independent sample T-test c. Paired sample T-test
7	State hypothesis and Perform following F statistics tests on given datasets a. One way ANOVA test b. Two way ANOVA test
8	Perform following data preprocessing techniques on the given dataset. a. Handling missing data, non-relevant, noisy and outlier data b. Handling Categorical variables in data c. Scaling and normalization d. Handling Unbalanced data
9	Perform Principal Component Analysis (PCA) on given dataset.
10	Model the given datasets using linear regression, logistic regression, log-linear regression, and multiple regressions.
11	Implement the Decision Tree Algorithm on the provided dataset.
12	Apply the KNN algorithm to a given dataset.

Course no: ADBB 252	BSC (YES/ NO)	ESC (YES/ NO)	HSC (YES/ NO)	PC (YES/ NO)	PE (YES/ NO)	IN-IS-SP-MP (YES/ NO)
	NO	NO	NO	YES	NO	NO

Type of course	**Program Core**
Course Title	**Data Mining and Warehousing**
Course objectives:	The purpose of this course is to know the fundamental concepts of Data Mining and Warehousing, explore tools and practices for working with Data and apply analytics on structured and sunstructured data.
POs	

Semester	**Autumn:**		**Spring: Yes**		
IV	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	2	4	36 + 22
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:

1	Title	Data Mining Concepts and Techniques
	Author	Jiawei Han and Micheline Kamber
	Publisher	Morgan Kaufmann
	Edition	2011
2	Title	Data Mining: Practical Machine Learning Tools and Techniques
	Author	Eibe Frank and lan H. Witten
	Publisher	Morgan Kaufmann
	Edition	Third Edition, 2011
3	Title	Introduction to Data Mining
	Author	Pang-Ning Tan Michael Steinbach Vipin Kumar
	Publisher	Pearson
	Edition	Global edition, 2019

Reference Books:

1	Title	Database Concepts

<table>
<tr><td rowspan="3" colspan="2"></td><td>Author</td><td>Abraham Sibertschatz, Henry F. Korth and S. Sudarshan</td></tr>
<tr><td>Publisher</td><td>McGraw Hill</td></tr>
<tr><td>Edition</td><td>Seventh Edition, 2019</td></tr>
<tr><td>Content</td><td colspan="3">Unit -1: Introduction to Data Mining and Data Warehouse (8 Hours)

Design Guidelines for Data Warehouse Implementation, Multidimensional Models, OLAP - Introduction, Characteristics, Architecture, Multidimensional view, Efficient Processing of OLAP Queries, OLAP Server Architecture, ROLAP versus MOLAP Versus HOLAP and Data Cube, Data Cube Operations, Data Cube Computation. Motivation for data mining, Introduction to data mining system, Data mining functionalities, KDD, Data object and attribute types, Statistical description of data, Issues and Applications.

Unit-2: Machine Learning Concepts and Approaches (6 Hours)

Supervised Learning Framework, Concepts & Hypothesis, Training & Learning, Boolean Functions and Formulae, Monomials, Disjunctive Normal Form & Conjunctive Normal Form, A Learning Algorithm for Monomials.

Unit –3: Data Preparation and Minning Association Rules (8 Hours)

Data cleaning, Data integration and transformation, Data reduction, Data discretization and Concept Hierhy Generation, Data mining primitives Frequent patterns, Market basket analysis, Frequent itemsets, closed itemsets, association rules, Types of association rule (Single dimensional, multidimensional, multilevel, quantitative), Finding frequent itemset (Apriori algorithm, FP growth), Generating association rules from frequent itemset, Limitation and improving Apriori, From Association Mining to Correlation Analysis, Lift.

Unit –4: Classification and Prediction and Cluster Analysis (8 Hours)

Issues regarding Classification & Prediction, Classification by Decision Tree Induction, Bayesian Classification, Classification by Back Propagation,
k-Nearest Neighbour Classifiers, Genetic Algorithms, Rough
Set & Fuzzy Set Approaches.

Unit –5: Cluster Analysis (6 Hours)
Types of Data in Clustering Analysis, Categorization of Major Clustering Methods, Hierarchical Methods, Density-based methods, Grid-based methods, Grid-based methods, Model-based Clustering Method.</td></tr>
<tr><td>Course Outcomes</td><td colspan="3">● Explain the concept and significance of Data Mining (L2).
● Explore Recent Trends in Data Mining such as Web Mining, Spatial-Temporal Mining (L2).
● Analyze different mining algorithms and clustering techniques for Data Analytics (L3).
● Design and Develop a Data Warehouse for an organization (L6).</td></tr>
<tr><td rowspan="3">Course Assessment</td><td colspan="3">Continuous Evaluation 25%</td></tr>
<tr><td colspan="3">Mid Semester 25%</td></tr>
<tr><td colspan="3">End Semester 50%</td></tr>
</table>

Lab Experiments:

Exp. No.	List of Experiments
1	Load Data from heterogenous sources including text files into a predefined warehouse schema.
2	Design a data mart for a bank to store the credit history of customers in a bank, Use this credit profiling to process future loan applications.
3	Feature Selection and Variable Filtering (For very large data sets).
4	Association Mining in large data sets
5	Interactive Drill-Down, Roll up, Slice and Dice Operations.
6	Generalized EM and k-Means Cluster Analysis
7	Generalized Additive Models (GAM).
8	General Classification Regression Tress (GTrees)
9	General CHAID (Chi-square Automatic Interaction Detection) Models
10	Interactive Classification and Regression Trees.
11	Goodness of Fit Computations

Course Code: ADBB 253	BSC (YES/ NO)	ESC (YES/ NO)	HSC (YES/ NO)	PC (YES/ NO)	PE (YES/ NO)	IN-IS-SP-MP (YES/ NO)
	NO	NO	NO	YES	NO	NO
Type of course	**Program Core**					
Course Title	**BIGDATA MANAGEMENT**					
Course objectives:	This course introduces the fundamentals of Big Data, its applications, and challenges and provides a comprehensive understanding of data storage, processing, and management techniques. Main aim for the course is to understand the tools and frameworks for Big Data analytics, data streaming, batch processing, and visualization technique and to integrate Big Data management concepts with real-world applications and case studies.					
POs						

Semester	**Autumn:**		**Spring: Yes**		
IV	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	2	0	1	3	30
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:

1	Title	Big Data and Analytics
	Author	Seema Acharya, Subhashini Chellappan
	Publisher	Wiley
	Edition	Second edition, 2019

Reference Book:

1	Title	Hadoop: The Definitive Guide
	Author	Tom White
	Publisher	O'Reilly
	Edition	First edition, 2012
2	Title	Big Data: Principle and best practices of scalable real-time data systems
	Author	James Warren, Nathan Marz
	Publisher	Manning Publications
	Edition	First edition, 2015
3	Title	MongoDB: The Definitive Guide
	Author	S. Bradshaw, E. Brazil, K. Chodorow

	Publisher	Shroff/O'Reilly
	Edition	Third edition, 2020

Content	**Unit** –1 (6 Hours) Introducing to Big Data – Characteristics and evolution of Big Data (3Vs: Volume, Velocity, Variety); Applications of Big Data: Challenges in managing Big Data; Big Data vs Traditional data. **Unit**-2 (8 Hours) Big Data storage; Distributed File Systems: Introduction to HDFS (Hadoop Distributed File System); Key-value storage systems: NoSQL Databases (MongoDB); Comparison: SQL vs NoSQL; Data Models: Document, Columnar, Graph-Based Systems. **Unit** –3 (4 Hours) Big Data processing; Batch Processing: Introduction to Hadoop and MapReduce; working mechanism of MapReduce, YARN; real-time processing: introduction to Apache Spark: RDDs (Resilient Distributed Datasets), SparkSQL and DataFrames; Data Stream Processing: Kafka, Apache Flink (Overview). **Unit** –4 (4 Hours) Big Data Analytics; basics of Big Data Analytics: data preprocessing for Big Data, visualization tools (Tableau, PowerBI, Python Libraries). **Unit** –5 (4 Hours) Big Data security and privacy: Data Security in Distributed Systems; Privacy Challenges in Big Data; Data Governance and Compliance (GDPR, HIPAA, etc.); case studies and applications in Big Data applications (IoT, E-Commerce, etc.).
Course Outcomes	● Analyze and differentiate between traditional and Big Data technologies. ● Implement data processing pipelines using Big Data tools. ● Apply advanced storage and retrieval techniques for Big Data. ● Work with distributed systems and Big Data frameworks like Hadoop and Spark. ● Design and optimize Big Data solutions for real-world applications.
Course Assessment	Continuous Evaluation 25%
	Mid Semester 25%
	End Semester 50%

Lab Experiments:

Exp. No.	List of Experiments
1	To install and configure Hadoop (HDFS, MapReduce, YARN) on a local machine, VM or cluster, and understand the basic setup of the Hadoop ecosystem.
2	To perform basic HDFS operations such as uploading, retrieving, and managing large files stored in a distributed file system after the Hadoop installation.
3	To install Apache Hive on top of the Hadoop ecosystem and configure it for SQL-like query execution on big data.
4	To write and execute a basic MapReduce job that processes a large dataset on the Hadoop cluster, showcasing parallel processing.
5	To install and configure Apache Spark for distributed data processing, and integrate it with Hadoop.
6	To perform data processing tasks using Apache Spark, such as RDD operations, transformations, and aggregations on large datasets.
7	To install and configure Apache HBase, a NoSQL database, for handling large-scale real- time data storage and retrieval.
8	To perform data storage and retrieval operations in HBase, and analyze the use of HBase for real-time, large-scale data processing.
9	To install and configure Apache Impala for fast SQL querying on large datasets stored in Hadoop.
10	To execute complex SQL queries on large datasets using Apache Impala, and apply query optimization techniques for improved performance.

Course Code: ADBB 254	**Open course (YES/NO)**		**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	NO		NO	Yes	NO
Type of course	Core				
Course Title	**MACHINE LEARNING**				
Course Objectives:	Gain a comprehensive understanding of Artificial Intelligence, covering its historical development, problem-solving techniques, search strategies, logical reasoning, and planning methods, with a focus on practical applications, particularly in the field of robotics. Develop essential skills to tackle complex AI challenges effectively.				
Course Outcomes	**CO1:** Understanding popular ML algorithms with their associated mathematical foundations.				**L1, L2**
	CO2: Explore role of data in the future of computing, and also in solving real-world problems using machine learning algorithms.				**L3**
	CO3: Apply knowledge representation and reasoning to solve real world Machine Learning Problems.				**L3**
	CO4: Explore machine learning concepts and algorithms for real world applications.				**L4**
Semester	**Autumn:**		**Spring: YES**		
IV	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	2	4	36
Prerequisite course code as per proposed course numbers					
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					
Text Books:					
1	Title	Machine Learning			
	Author	Tom M. Mitchell			
	Publisher	Prentice Hall			
	Edition	Fourth edition, 2020.			
Reference Book:					
2.	Title	Machine Learning			
	Author	Saikat Dutt, S. Chjandramouli, Das			
	Publisher	Pearson			
	Edition				
3.	Title	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow			
	Author	Aurélien Géron			
	Publisher	O'Reilly Media			

		Edition	2nd
Content	**UNIT 1: Introduction to Machine Learning (8 Hours)** What is machine learning? Types of machine learning– supervised, unsupervised, semi-supervised and reinforcement learning, machine learning activities, applications of machine learning. **UNIT 2: Model Preparation, Evaluation and feature engineering (8 Hours)** Types of data in machine learning, Exploring structure of data, Data pre-processing, Model selection and training, Evaluating machine learning algorithms and performance enhancement of models. What is feature engineering?, Feature transformation, Feature subset selection. Principal component analysis. **UNIT 3: Supervised Learning (8 Hours)** Introduction of regression, Regression algorithms: Simple linear regression, Multiple linear regression, Polynomial regression model, Logistic regression, Maximum likelihood estimation. Introduction of supervised learning, Classification model and learning steps, Classification algorithms: Naïve Bayes classifier, k-Nearest Neighbour (kNN), Decision tree, Support vector machines, Random Forest. **UNIT 4: Unsupervised Learning (8 Hours)** Unsupervised Learning: Introduction of unsupervised learning, Unsupervised vs supervised learning, Application of unsupervised learning, Clustering and its types, Partitioning method: k-Means and K-Medoids, Hierarchical clustering, Density-based methods – DBSCAN. **UNIT 5: Advance topics in Machine Learning (6 Hours)** Introduction to deep learning, overview of reinforcement learning, Case-study of ML applications: Image recognition, speech recognition, Email spam filtering, Online fraud detection and other.		
Course Assessment	Continuous Evaluation 25%		
	Mid Semester 25%		
	End Semester 50%		

Lab Experiments:

Exp. No.	List of Experiments
1	Write a python program to import and export data using Pandas library functions.
2	Demonstrate various data pre-processing techniques for a given dataset.
3	Write a Python program to demonstrate various Data Visualization Techniques.
4	Implement Simple and Multiple Linear Regression Models.
5	Develop Logistic Regression Model for a given dataset.
6	Develop Decision Tree Classification model for a given dataset and use it to classify a new sample.
7	Implement Naïve Bayes Classification in Python.
8	Build KNN Classification model for a given dataset.
9	Write a python program to implement K-Means clustering Algorithm.
10	Implement Random forest ensemble method on a given dataset.

Couse No: ADLB 255	**Open Course (Yes/No)**	**HM Course (Y/M)**	**DC (Y/N)**	**DE (Y/N)**	
Type of Course	**Core**				
Course Title	**THEORY OF COMPUTATION**				
Course Objectives:	1. To give an overview of the theoretical foundations of computer science from the perspective of formal languages				
	2. To illustrate finite state machines to solve problems in computing				
	3. To explain the hierarchy of problems arising in the computer sciences.				
	4. To familiarize Regular grammars, context frees grammar.				
POs	1. To use basic concepts of formal languages of finite automata techniques				
	2. To Design Finite Automata's for different Regular Expressions and Languages				
	3. To Construct context free grammar for various languages				
	4. To solve various problems of applying normal form techniques, push down automata and Turing Machines				
Semester	**Autumn:**		**Spring:Yes**		
IV	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total Teaching Hours**
Contact Hours	3	0	0	3	36
Text Books:					
1.	Title	Introduction to Automata Theory, Languages and Computation			
	Author	J. E. Hopcroft R. Motwani and J. D. Ullman			
	Publisher	Addison Wesley			
	Edition	3rd Edition, 2006			
Reference Books					
1.	Title	Introduction to the Theory of Computation			
	Author	M. Sipser			
	Publisher	Thomson			
	Edition	2001			
2.	Title	Elements of Theory of Computation			
	Author	C. H. Papadimitriou, H. Lewis			
	Publisher	Prentice Hall			
	Edition	1981			

Content	**Unit-1: Regular Languages (10 Hours)** Introduction to Computing, Mathematical model of computing, decision problems, set membership problems, Notion of a formal language, DFAs and notion for their acceptance, informal and then formal definitions, Class of regular languages, Closure of the class under complementation, union and intersection, Strategy for designing DFAs, Pumping lemma for regular languages, NFAs, conversion of equivalent DFAs of NFAs. NFAs with epsilon transitions, Regular expressions, Closure properties of and decision problems for regular languages, Mealy Machine and Moore Machines. **Unit – 2: Context free languages (6 Hours)** Notion of grammars and languages generated by grammars. Equivalence of regular grammars and finite automata. Context free grammars and their parse trees. Pushdown automata (PDAs): deterministic and nondeterministic. Language acceptance by final states and by empty stack. PDAs and CFGs, epsilon productions, unit productions from CFGs. Chomsky hierarchy. Pumping lemma for CFLs and its use. Closure properties of CFLs. Decision problems for CFLs. **Unit – 3: Turing machines, Regular Expression languages (8 Hours)** Turing machines (TMs), their instantaneous descriptions. Language acceptance by TMs. Hennie convention for TM transition diagrams. Church-Turing hypothesis and its foundational implications. recursive languages. non-recursive enumerable languages. **Unit – 4: Undecidability (6 Hours)** Notion of undecidable problems. Universal language and universal TM. Separation of recursive and r.e. classes. Notion of reduction. Some undecidable problems of TMs. Rice's theorem. Undecidability of Post's correspondence problem (PCP), some simple applications of undecidability of PCP **Unit – 5: Intractability (6 Hours)** Notion of tractability/feasibility. The classes NP and co-NP, their importance. Polynomial time many-one reduction. Completeness under this reduction. Cook-Levin theorem: NP-completeness of propositional satisfiability, other variants of satisfiability. NP-complete problems from other domains.
Course Assessment	Continuous Evaluation 25%
	Mid Semester 25%
	End Semester 50%

Syllabus for B. Tech AI &DS (3rd Year – V and VI Semesters)

<table>
<tr><td rowspan="2">Course Code:
ADBB 301</td><td>PC (YES/ NO)</td><td>PE (YES/ NO)</td><td>OE (YES/ NO)</td><td>AS (YES/ NO)</td><td>HM (YES/ NO)</td><td>ST-IS-PR (YES/ NO)</td><td>AE (YES / NO)</td></tr>
<tr><td>YES</td><td>NO</td><td>NO</td><td>NO</td><td>NO</td><td>NO</td><td>NO</td></tr>
<tr><td>Type of course</td><td colspan="7">Program Core</td></tr>
<tr><td>Course Title</td><td colspan="7">DEEP LEARNING</td></tr>
<tr><td>Course Objectives</td><td colspan="7">To introduce the fundamentals and advanced concepts of deep learning, enabling students to design and apply neural network models including CNNs, RNNs, transformers, and generative models for solving real-world problems in vision, language, and time series domains using frameworks like TensorFlow and PyTorch.</td></tr>
<tr><td rowspan="4">Course Outcomes</td><td colspan="5">CO1: Understand the fundamental concepts of deep learning, including artificial neural networks, activation functions, loss functions, and optimization techniques.</td><td colspan="2">L1, L2, L3</td></tr>
<tr><td colspan="5">CO2: Apply convolutional and recurrent neural network architectures to solve real-world tasks such as image classification, object detection, and natural language processing.</td><td colspan="2">L4, L5, L6</td></tr>
<tr><td colspan="5">CO3: Analyze the working of advanced models like Transformers, Vision Transformers (ViT), and Swin Transformers for both vision and language-related applications.</td><td colspan="2">L4, L5, L6</td></tr>
<tr><td colspan="5">CO4: Design generative and time series models using autoencoders, GANs, diffusion models, and deep learning-based forecasting techniques for domain-specific applications.</td><td colspan="2">L4, L5, L6</td></tr>
<tr><td>Semester</td><td colspan="2">Autumn: Yes</td><td colspan="5">Spring: No</td></tr>
<tr><td></td><td>Lecture</td><td>Tutorial</td><td colspan="2">Practical</td><td>Credits</td><td colspan="2">Total teaching hours</td></tr>
<tr><td>Contact Hours</td><td>3</td><td>0</td><td colspan="2">2</td><td>4</td><td colspan="2">60</td></tr>
<tr><td>Prerequisite course code as per proposed course numbers</td><td>Machine Learning Course</td><td></td><td colspan="2"></td><td></td><td colspan="2"></td></tr>
<tr><td>Prerequisite credits</td><td>NIL</td><td></td><td colspan="2"></td><td></td><td colspan="2"></td></tr>
<tr><td>Equivalent course codes as</td><td>NIL</td><td></td><td colspan="2"></td><td></td><td colspan="2"></td></tr>
</table>

per proposed course and old course					
Overlap course codes as per proposed course numbers	NIL				

TextBooks		
1	Title	Deep Learning: Foundations and Concepts
	Author	Christopher M. Bishop & Hugh Bishop
	Publisher	Springer
	Edition	2023
2	Title	Deep Learning
	Author	Ian Goodfellow and Yoshua Bengio and Aaron Courville
	Publisher	MIT Press
	Edition	2016

Reference Books		
1	Title	Machine Learning: An Algorithmic Perspective, Second Edition
	Author	Stephen Marsland
	Publisher	Chapman and Hall/CRC
	Edition	2nd
2	Title	Introduction to Probability For Data Science
	Author	Stanley H. Chan
	Publisher	Michigan Publishing
	Edition	May 2021

Content	**Unit 1: Introduction to Deep Learning (10 Hours)** Overview of Deep Learning and its comparison with Machine Learning, Artificial Neural Networks (ANNs): Structure, perceptrons, limitations, forward propagation, backpropagation, activation functions (e.g., ReLU, Softmax), loss functions, optimization techniques (e.g., SGD, Adam), Regularization techniques: L1/L2 regularization, Dropout, Batch Normalization, Hyperparameter tuning, Commonly used frameworks (e.g., TensorFlow, PyTorch). **Unit 2: Convolutional Neural Networks (CNNs) (9 Hours)** Key concepts: convolution, padding, pooling, CNN layers, Architectures: AlexNet, VGG, ResNet, MobileNet, and others, Applications: Image classification, transfer learning, object detection (e.g., YOLO, R-CNN),

	encoder-decoder models, Image segmentation: semantic, instance, and panoptic segmentation using U-Net and its variants, Regularization methods, Data augmentation techniques. **Unit 3: Recurrent Neural Networks (RNNs) (6 Hours)** RNN architecture and working principles, Variants: LSTM, GRU, Advantages in handling sequential data, Challenges: vanishing and exploding gradients, Applications: NLP tasks such as sentiment analysis, text generation, sequence prediction. **Unit 4: Transformers (6 Hours)** Transformer architecture: encoder-decoder model, self-attention, multi-head attention, Applications: NLP tasks such as translation, summarization, sentiment analysis, Vision Transformers (ViTs), Swin Transformer and its hierarchical representation learning, Large Language Models (LLMs): BERT, GPT and their applications. **Unit 5: Advanced Topics (5 Hours)** Autoencoders and Variational Autoencoders (VAEs), Generative Adversarial Networks (GANs): architecture and applications, Diffusion models in generative AI, Time Series Forecasting: ARIMA, SARIMA, deep learning approaches (LSTM, GRU), Federated Learning: privacy-preserving distributed training, Real-world implementations in speech and gesture recognition.
Course Assessment	Continuous Evaluation 25%
	Mid Semester 25%
	End Semester 50%

Course Matrix (CO-PO-PSO Mapping)

COs	POs s & PSOs													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2			2							1	3	2
CO2	3	3	3	2	3							1	3	3
CO3	3	3	3	2	3							1	3	3
CO4	3	3	3	3	3							2	3	3

1=addressed to small extent
2= addressed significantly
3= addressed strongly (major part of course)

Lab Experiments

Exp No.	List of Experiments
1	**MNIST Digit Classification:** Train a simple feedforward neural network on the MNIST dataset using forward and backpropagation.
2	**Image Classification with CNN:** Develop and evaluate a CNN model on datasets like CIFAR-10 or Fashion-MNIST.
3	**Transfer Learning with Pre-trained CNN:** Fine-tune models like VGG16, ResNet, or MobileNet on a custom image dataset.
4	**Object Detection using YOLO:** Implement YOLOv5 or YOLOv8 for real-time object detection on images or video frames.
5	**Semantic Segmentation with U-Net:** Use the U-Net architecture for medical or satellite image segmentation.
6	**Instance Segmentation with Mask R-CNN:** Apply Mask R-CNN for pixel-wise object segmentation on COCO or similar datasets.
7	**Image Classification using ViT and Swin Transformer:** Train Vision Transformer (ViT) and Swin Transformer models, and compare their performance with CNNs on image classification tasks.
8	**Diffusion Model for Image Generation:** Use a pretrained or simplified diffusion model (e.g., Stable Diffusion) to generate high-quality synthetic images.
9	**Autoencoder and Variational Autoencoder (VAE)**: Build autoencoders for image denoising and extend to VAEs for generative modeling.
10	**Generative Adversarial Networks (GANs):** Implement a basic GAN or DCGAN to generate synthetic image data.
11	**Time Series Forecasting with LSTM and SARIMA:** Compare LSTM-based forecasting with classical SARIMA for time series prediction tasks.
12	**Sentiment Analysis using LSTM and BERT:** Perform sentiment classification using LSTM and fine-tuned BERT on datasets like IMDB or Twitter.

Course Code: ADBB 302	**PC (YES/ NO)**	**PE (YES/ NO)**	**OE (YES/ NO)**	**AS (YES/ NO)**	**HM (YES / NO)**	**ST-IS-PR (YES/ NO)**	**AE (YES / NO)**	
	YES	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	
Type of course	**Program Core**							
Course Title	**NATURAL LANGUAGE PROCESSING**							
Course Objectives	To provide a broad introduction to NLP with a particular emphasis on core algorithms, data structures, and machine learning for NLP, text classification, sentiment analysis and other applications of NLP.							
Course Outcomes	**CO1:** Understand the fundamental concepts of natural language processing, including models, ambiguity, processing paradigms, and phases of NLP along with text representation in computers.					L1, L2, L3		
	CO2: Apply linguistic resources and tools such as corpus, WordNet, TreeBank, and Finite State Automata to analyze morphology and word recognition using probabilistic models like N-grams and HMM.					L4, L5, L6		
	CO3: Demonstrate the ability to perform Part-of-Speech tagging, statistical and probabilistic parsing, and handle challenges like unknown words and multi-word expressions.					L4, L5, L6		
	CO4: Design semantic analysis techniques, Word Sense Disambiguation methods, and NLP applications such as sentiment analysis, summarization, and machine translation.					L4, L5, L6		
Semester	**Autumn: Yes**			**Spring: No**				
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**			
Contact Hours	3	1	0	4	48			
Prerequisite course code as	Machine Learning							

per proposed course numbers	Course				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

TextBooks		
1	Title	Speech and Language Processing
	Author	Daniel Jurafsky and James H Martin
	Publisher	Pearson Education
	Edition	2009
2	Title	Natural language processing and Information retrieval
	Author	Siddiqui T., Tiwary U. S.
	Publisher	OUP
	Edition	2008
Reference Books		
1	Title	Natural language Understanding
	Author	James A
	Publisher	Pearson Education
	Edition	1994
2	Title	Natural language processing: a Paninian perspective
	Author	Bharati A., Sangal R., Chaitanya V.
	Publisher	PHI
	Edition	2000

Content	**Unit 1: Introduction to Natural Language Processing (8 Hours)** Human and Natural Language, Features of Language, Ambiguity in Language, NLP Applications, Rule-Based NLP, Statistical NLP, Machine Learning Approaches, Morphological Analysis, Syntactic Analysis, Semantic Analysis, Text Representation in Computers, ASCII, Unicode, Bag of Words, TF-IDF, Word Embeddings, NLP Tools and Libraries (NLTK, SpaCy). **Unit 2: Linguistic Resources and Statistical Foundations (9 Hours)** Corpus, Balanced Corpus, TreeBank, PropBank, FrameNet, WordNet, VerbNet, Regular Expressions, Finite State Automata, Tokenization, Lexical Analysis, Morphology, Inflection, Derivation, Finite State Transducer, n-gram Language Models, Smoothing Techniques, Entropy, Perplexity, Hidden Markov Models (HMM), Maximum Entropy Models. **Unit 3: POS Tagging and Parsing Techniques (9 Hours)** Part-of-Speech Tagging, Rule-Based Tagging, Stochastic Tagging, HMM Tagging, Transformation-Based Learning (TBL), Unknown Words, Named Entities, Multiword Expressions, Syntax Trees, Dependency Parsing, CYK Algorithm, Earley Parser, CKY Parser, Transition-Based Parsing, Statistical Parsing, Probabilistic Parsing. **Unit 4: Semantics and Text Analysis (5 Hours)** Lexical Semantics, Synonymy, Polysemy, WordNet, Word Sense Disambiguation, Dictionary-Based WSD, Supervised WSD, Unsupervised WSD, Predicate Logic, Semantic Role Labelling, Text Classification, Text Clustering, Sentiment Analysis, Subjectivity Detection. **Unit 5: NLP Applications (5 Hours)** Spell Checking, Text Normalization, Text Summarization, Extractive Summarization, Abstractive Summarization, Machine Translation, Rule-Based MT, Statistical MT, Neural MT, Chatbots, Dialogue Systems, Question Answering, Information Retrieval, Text Generation, Named Entity Recognition, Speech Recognition, Text-to-Speech (TTS), Topic Modelling, Latent Dirichlet Allocation (LDA).
Course Assessment	Continuous Evaluation 25%
	Mid Semester 25%
	End Semester 50%

Course Matrix (CO-PO-PSO Mapping)

COs	POs s & PSOs													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2

CO1	3	2			2							1	3	2
CO2	3	3	2	2	3							1	3	2
CO3	3	3	2	2	3							1	3	3
CO4	3	3	2	3	3							2	3	3

1=addressed to small extent
2= addressed significantly
3= addressed strongly (major part of course)

Course Code: ADBB 303	**PC (YES/ NO)**	**PE (YES/ NO)**	**OE (YES/ NO)**	**AS (YES/ NO)**	**HM (YES / NO)**	**ST-IS-PR (YES/ NO)**	**AE (YES / NO)**
	YES	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Type of course	**Program Core**						
Course Title	**CLOUD COMPUTING**						
Course Objectives	The course aims to introduce the fundamentals of cloud computing, including its architecture, service models (IaaS, PaaS, SaaS), and deployment models. It equips students with knowledge of virtualization and cloud storage along with hands-on experience using leading cloud platforms.						
Course Outcomes	**CO1**: Understand the fundamental concepts, service models, and deployment strategies of cloud computing and evaluate its benefits and challenges in real-world applications.	**L2**					
	CO2: Analyze the architecture of cloud systems and apply knowledge of virtualization and data center technologies to design scalable and efficient cloud solutions.	**L4**					
	CO3: Implement and evaluate basic cloud-based programs using distributed programming frameworks.	**L5**					
	CO4: Develop and demonstrate the ability to use modern cloud platforms and services for application development and deployment.	**L6**					
Semester	**Autumn: Yes**		**Spring:**				
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**		
Contact Hours	3	0	2	4	60		
Prerequisite course code as per proposed course numbers	NIL						
Prerequisite credits	NIL						

Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

TextBooks

1	Title	Cloud Computing, Principal and Paradigms
	Author	Edited By Raj Kumar Buyya, James Broberg, A.Goscinski
	Publisher	Wiley
	Edition	2011
2	Title	Cloud Computing: A Practical Approach
	Author	Anthony Velte and Robert C. Elsenpete
	Publisher	McGraw Hill
	Edition	2018
3	Title	Cloud Computing: Bible
	Author	Barrie Sosinsky
	Publisher	Wiley Publication
	Edition	2018

Reference Books

1	Title	Cloud Computing: Web Based Applications That Change the Way You Work and Collaborate Online
	Author	Robert Gibbons
	Publisher	Que Publishing
	Edition	August 2008
2	Title	Cloud Computing – Insights into New Era Infrastructure
	Author	Kumar Saurabh
	Publisher	Wiley Indian
	Edition	2011
3	Title	Cloud Computing Best Practices for Managing and Measuring Processes for On demand Computing
	Author	Haley Beard

Course Matrix (CO-PO-PSO Mapping)

COs	POs s & PSOs													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2											2	3
CO2	3	3	2										3	2

CO3	2	2	3		2								3	2
CO4	2	2	3	1	3								3	1

1=addressed to small extent
2= addressed significantly
3= addressed strongly (major part of course)

Lab Experiments

Exp No.	List of Experiments
1	Install hypervisor with linux or windows OS on top of host OS.
2	Install a C compiler in the virtual machine created using virtual box and execute Simple Programs.
3	Install Google App Engine (GAE). Create hello world app and other simple web applications using python/java.
4	Use Google App Engine (GAE) launcher to launch the web applications.
5	Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
6	Implement a procedure to transfer the files from one virtual machine to another virtual machine.
7	Install Hadoop node cluster and run basic applications.

Course Code: ADLB 304	**PC (YES/ NO)**	**PE (YES/ NO)**	**OE (YES/ NO)**	**AS (YES/ NO)**	**HM (YES / NO)**	**ST-IS-PR (YES/ NO)**	**AE (YES / NO)**
	YES	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Type of course	**Program core**						
Course Title	**IMAGE PROCESSING AND COMPUTER VISION**						
Course Objectives	To provide students with a comprehensive understanding of digital image processing techniques, including spatial and frequency domain transformations, image segmentation, and color image processing. The course aims to enable students to develop image processing tools from scratch and gain hands-on experience using OpenCV and MATLAB.						
Course Outcomes	**CO1**: Learn the basics and mathematical background of Image Processing	L1, L3					
	CO2: Analysis and study of methods used for image sampling and quantization, image transforms, image enhancement and restoration, image encoding, image analysis and pattern recognition.	L2, L4					
	CO3: Utility of image compression techniques for storage and transmission purpose	L3, L5					
	CO4: To learn about color imaging, color models, and color image processing.	L4					
Semester	**Autumn: Yes**	**Spring:**					
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**		
Contact Hours	3	0	2	4	60		
Prerequisite course code as per proposed course numbers	NIL						
Prerequisite	NIL						

credits					
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

TextBooks		
1	Title	Digital Image Processing
	Author	R.C. Gonzalez, R.E Woods
	Publisher	Pearson Education
	Edition	2008
Reference Books		
1	Title	Digital Image Processing Using MATLAB
	Author	R.C. Gonzalez, R.E Woods, S. L. Eddins
	Publisher	PHI
	Edition	2003
2	Title	Image Processing, Analysis, and Machine Vision
	Author	M. Sonka, V. Hlavac, R. Boyle
	Publisher	Brooks/Cole
	Edition	2007
3	Title	Digital Image Processing
	Author	W.K. Pratt
	Publisher	Wiley-Interscience
	Edition	2007
Content	**Unit 1: Digital Image Fundamentals (9 Hours)** Introduction: Digital image representation, Fundamental steps in image processing, Components of Digital Image processing systems, Elements of visual perception, Image Formation model, Image Sampling and quantization, Relationship between pixels-neighbourhood, adjacency connectivity, regions, boundaries and distance measures. **Unit 2: Image Enhancement Techniques (9 Hours)** Image Enhancement: Enhancement by point processing, Sample intensity	

	transformation, Histogram processing, Image subtraction, Image averaging, Spatial Filtering-Smoothing Spatial filters, Sharpening Spatial filters, Frequency domain-Fourier Transform, Low-Pass, High-Pass, Laplacian, Homomorphic filtering. **Unit 3: Image Segmentation Methods (9 Hours)** Image Segmentation: Detection of discontinuities – point, line and edge detection, Edge linking and boundary detection, Thresholding, Region-based segmentation – region growing, region splitting and merging, Use of motion in segmentation- Spatial techniques and Frequency domain techniques. **Unit 4: Image Compression Principles (5 Hours)** Image Compression: Coding redundancy, Interpixel redundancy, fidelity criteria, Image compression models, Error-free compression, Variable length coding, Bit-plane coding, Lossless predictive coding, Lossy compression, Image compression standards, Real-Time image transmission, JPEG and MPEG. **Unit 5: Color Image Processing (4 Hours)** Color Image Processing: Color Models, Pseudo color Image Processing, Color Transformations, Smoothing and sharpening, Image Segmentation based on color.
Course Assessment	Continuous Evaluation 25%
	Mid Semester 25%
	End Semester 50%

Course Matrix (CO-PO-PSO Mapping)

COs	POs s & PSOs												
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2			2							1	3	2
CO2	3	3	3	2	3							1	3	3
CO3	3	2	3	2	3							2	3	3
CO4	2	2	2	2	2							1	2	2

1=addressed to small extent
2= addressed significantly
3= addressed strongly (major part of course)

Lab Experiments

Exp No.	List of Experiments
1	Image Acquisition and Display: Read and display grayscale and color images using MATLAB or Python.
2	Gray-Level Transformations: Apply negative, log, and gamma correction transformations.
3	Histogram Equalization: Enhance contrast using histogram equalization.
4	Noise Removal Using Filters: Apply mean and median filters to remove salt-and-pepper noise.
5	Edge Detection: Detects edges using Sobel, Canny, and Laplacian operators.
6	Fourier Transform and Filtering: Perform FFT, apply low-pass and high-pass filtering, and reconstruct the image.
7	Image Restoration: Simulate degradation and restore using Wiener filtering.
8	Color Image Processing: Convert RGB to HSI and display individual components.
9	Morphological Operations: Perform dilation, erosion, opening, and closing on binary images.
10	Image Segmentation: Apply thresholding, edge-based, and watershed segmentation.

<table>
<tr><td rowspan="2">Course Code:
ADBB 305</td><td>PC (YES/ NO)</td><td>PE (YES/ NO)</td><td>OE (YES/ NO)</td><td>AS (YES/ NO)</td><td>HM (YES / NO)</td><td>ST-IS-PR (YES/ NO)</td><td>AE (YES / NO)</td></tr>
<tr><td>YES</td><td>NO</td><td>NO</td><td>NO</td><td>NO</td><td>NO</td><td>NO</td></tr>
<tr><td>Type of course</td><td colspan="7">Program core</td></tr>
<tr><td>Course Title</td><td colspan="7">INTERNET OF THINGS</td></tr>
<tr><td>Course Objectives</td><td colspan="7">To provide a broad introduction to the Internet of Things (IoT), focusing on its enabling technologies, hardware components, and practical applications. The course aims to help students understand the evolution, definition, and scope of IoT, and its role in modern technology. It also covers the study of sensors, actuators, microcontrollers (such as Arduino and Raspberry Pi), and embedded systems used in IoT development.</td></tr>
<tr><td rowspan="4">Course Outcomes</td><td colspan="5">CO1: Understand the fundamentals of the Internet of Things, including its architecture, characteristics, enabling technologies, and real-world applications such as smart homes, healthcare, and smart cities.</td><td colspan="2">L1, L2</td></tr>
<tr><td colspan="5">CO2: Identify and utilize appropriate IoT hardware components, microcontrollers, and communication protocols to design basic IoT systems.</td><td colspan="2">L3</td></tr>
<tr><td colspan="5">CO3: Analyze the integration of IoT systems with cloud platforms and apply concepts of cloud storage, edge, and fog computing for IoT data processing and analytics.</td><td colspan="2">L4</td></tr>
<tr><td colspan="5">CO4: Evaluate and implement basic security and privacy measures in IoT systems and develop small-scale IoT applications using Python and open-source platforms like Arduino or Raspberry Pi.</td><td colspan="2">L5, l6</td></tr>
<tr><td>Semester</td><td colspan="3">Autumn: Yes</td><td colspan="4">Spring:</td></tr>
<tr><td></td><td colspan="2">Lecture</td><td>Tutorial</td><td colspan="2">Practical</td><td>Credits</td><td>Total teaching hours</td></tr>
<tr><td>Contact Hours</td><td colspan="2">3</td><td>0</td><td colspan="2">2</td><td>4</td><td>60</td></tr>
<tr><td>Prerequisite course code as</td><td colspan="2">NIL</td><td></td><td colspan="2"></td><td></td><td></td></tr>
</table>

per proposed course numbers					
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

TextBooks

1	Title	Introducing Internet of Things
	Author	Arshdeep Bahga, Vijay Madisetti
	Publisher	Pearson
	Edition	1st Edition, 2015

Reference Books

1	Title	Introducing Internet of Things
	Author	Raj Kamal
	Publisher	McGraw Hill Education
	Edition	1st Edition, 2017
2	Title	Designing the Internet of Things
	Author	Adrian McEwen, Hakim Cassimally
	Publisher	Wiley
	Edition	1st Edition, 2014
3	Title	Internet of Things: a Modern Approach
	Author	Olivier Hersent, David Boswarthick, Omar Elloumi
	Publisher	Wiley
	Edition	2nd Edition, 2016

Content	**Unit 1: Introduction to IoT (6 Hours)** Definition, Characteristics, and Evolution of IoT, IoT Ecosystem & Architecture, Physical design and Logical design of IoT, Enabling Technologies: RFID, Bluetooth, Zigbee, GPS, Wi-Fi, 4G/5G, Challenges and Applications of IoT (Smart Home, Smart City, Healthcare, etc). **Unit 2: IoT Hardware and Communication (8 Hours)** IoT Devices: Sensors, Actuators, Microcontrollers (e.g., Arduino, Raspberry Pi), Embedded systems overview, Communication Models and APIs, IoT Communication Protocols: MQTT, CoAP, AMQP, HTTP, XMPP, M2M Communication. **Unit 3: IoT Platforms and Cloud Integration (7 Hours)** IoT and Cloud Computing, Introduction to IoT Platforms: Google Cloud IoT, AWS IoT, Azure IoT, Cloud Storage Models for IoT Data, Data Analytics in IoT, Edge and Fog Computing in IoT. **Unit 4: Security and Privacy in IoT (7 Hours)** IoT Security Challenges, Authentication and Authorization in IoT, IoT Security Architecture, Common Attacks in IoT and their Mitigation, Privacy Preservation in IoT. **Unit 5: IoT Application Development (8 Hours)** IoT System Design Methodology, Developing IoT Applications using Python, Hands-on with Arduino/Raspberry Pi, Case Studies: Smart Agriculture, Smart Healthcare, Smart Energy, etc, Mini Project / Lab Implementation.
Course Assessment	Continuous Evaluation 25%
	Mid Semester 25%
	End Semester 50%

Course Matrix (CO-PO-PSO Mapping)

COs	POs s & PSOs													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2			2							1	2	2
CO2	3	2	3		3							1	3	3
CO3	3	3	3	3	3							2	3	3
CO4	3	3	3	3	3							2	3	3

1=addressed to small extent
2= addressed significantly

3= addressed strongly (major part of course)

Lab Experiments

Exp No.	List of Experiments
1	Introduction to Arduino and Raspberry Pi: LED Blinking using GPIO
2	Sensor Data Acquisition: Reading Temperature and Humidity Using Sensor
3	Actuator Control: Automating Fan/LED based on Sensor Input
4	IoT Communication: Publishing Sensor Data using MQTT Protocol
5	Remote Monitoring: Sending Sensor Data using HTTP Requests
6	Cloud Integration: Real-time Data Logging on IoT Platforms (ThingSpeak/AWS IoT)
7	IoT Security: User Authentication and Data Encryption in IoT Applications
8	Smart Home Simulation: Controlling Devices via Smartphone App
9	Smart Agriculture System: Automated Irrigation using Soil Moisture Sensor

Course Code: ADLB 351	**PC (YES/ NO)**	**PE (YES/ NO)**	**OE (YES/ NO)**	**AS (YES/ NO)**	**HM (YES / NO)**	**ST-IS-PR (YES/ NO)**	**AE (YES / NO)**
	YES	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Type of course	**Program core**						
Course Title	**SOCIAL NETWORK ANALYTICS**						
Course Objectives	To introduce the fundamentals and graph-based representation of social networks, study key models and measures for analysis, explore techniques for community detection and link prediction, understand diffusion and influence models in social media, and develop skills for mining and visualizing social media data, with attention to ethical considerations.						
Course Outcomes	**CO1**: Understand the basic structure of social networks, their types, graph-based representations, and foundational graph theory concepts.	L1, L2					
	CO2: Analyze and apply network models and centrality/structural measures to characterize and evaluate social networks.	L3, L4					
	CO3: Apply and evaluate community detection and link prediction algorithms in social networks, using appropriate evaluation metrics.	L4, L5					
	CO4: Design and implement solutions for analyzing influence propagation, mining and visualizing social media data, while addressing privacy and ethical concerns.	L5, l6					

Semester	**Autumn:**		**Spring: Yes**		
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	1	0	4	48
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				

Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				
TextBooks					
1	Title	Introducing Social Network Analytics			
	Author	Matthew A. Russell			
	Publisher	O'Reilly Media			
	Edition	3rd Edition, 2018			
Reference Books					
1	Title	Introducing Social Network Analysis			
	Author	Stanley Wasserman & Katherine Faust			
	Publisher	Cambridge University Press			
	Edition	1st Edition, 1994			
2	Title	Networks, Crowds, and Markets			
	Author	David Easley & Jon Kleinberg			
	Publisher	Cambridge University Press			
	Edition	1st Edition, 2010			
3	Title	Social Network Analysis for Startups			
	Author	Maksim Tsvetovat & Alexander Kouznetsov			
	Publisher	O'Reilly Media			
	Edition	1st Edition, 2011			

Content	**Unit 1: Introduction to Social Networks Analytics (6 Hours)** Definition and types of social networks (online, offline, ego networks), Real-life applications: Facebook, Twitter, LinkedIn, citation networks, Structure of social networks: Nodes, edges, adjacency matrices, Basic concepts in graph theory: Paths, connectivity, degree, clustering coefficient. **Unit 2: Social Network Analytics Models and Measures (8 Hours)** Random network models: Erdős–Rényi model, Small-world networks: Watts-Strogatz model, Scale-free networks: Barabási–Albert model, Centrality measures: Degree, Closeness, Betweenness, Eigenvector, Network density, Diameter, Reciprocity, Assortativity. **Unit 3: Social Network Community Detection and Link Prediction (8 Hours)** Communities and modularity, Algorithms: Girvan-Newman, Louvain Method, Label Propagation, Link prediction methods: Similarity-based, probabilistic models, Evaluation metrics: Precision, recall, AUC. **Unit 4: Social Network Information Diffusion and Influence Analysis (7 Hours)** Diffusion models: Independent Cascade Model, Linear Threshold Model, Influence maximization: Greedy algorithms, Contagion models: Viral marketing, epidemic modeling, Case study: Twitter hashtag propagation. **Unit 5: Mining and Visualization of Social Media Data (7 Hours)** Text mining from social networks, Sentiment analysis and opinion mining, Social media APIs (Twitter, Facebook Graph API), Visualization tools: Gephi, NetworkX, Cytoscape, Ethics, privacy, and challenges in social media analytics.
Course Assessment	Continuous Evaluation 25%
	Mid Semester 25%
	End Semester 50%

Course Matrix (CO-PO-PSO Mapping)

COs	POs s & PSOs												
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2			2							1	2	2
CO2	3	3	3	2	3							1	3	3
CO3	3	3	3	3	3							2	3	3
CO4	3	3	3	3	3							2	3	3

1=addressed to small extent
2= addressed significantly
3= addressed strongly (major part of course)

Course Code: ADBB 352	**PC (YES/ NO)**	**PE (YES/ NO)**	**OE (YES/ NO)**	**AS (YES/ NO)**	**HM (YES / NO)**	**ST-IS-PR (YES/ NO)**	**AE (YES / NO)**
	YES	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Type of course	**Program Core**						
Course Title	**BIG DATA ANALYTICS**						
Course Objectives	This course aims to provide the fundamental concepts of Big Data and Analytics; explore tools and practices for working with Big Data and stream computing; understand the Big Data use cases; apply analytics on structured and unstructured data with R; and provide comprehensive knowledge on developing and applying Machine Learning algorithms for massive real-world datasets in distributed frameworks.						
Course Outcomes	**CO1**: Explain the concept and significance of Big Data and its analysis.	L2					
	CO2: Apply and Analyze regression and classification algorithms for Big Data analytics.	L4					
	CO3: Analyze different mining algorithms and clustering techniques for Big Data Analytics.	L4					
	CO4: Design and develop big data-based analytics for real-word ubiquitous computing scenarios.	L6					
Semester	**Autumn:**	**Spring: Yes**					
	Lecture	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**		
Contact Hours	3	0	2	4	60		
Prerequisite course code as per proposed course numbers	NIL						
Prerequisite credits	NIL						
Equivalent course	NIL						

codes as per proposed course and old course					
Overlap course codes as per proposed course numbers	NIL				

TextBooks		
1	Title	Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph
	Author	David Loshin
	Publisher	Morgan Kaufmann/Elsevier Publishers
	Edition	2013
2	Title	Mining of Massive Datasets
	Author	Anand Rajaraman and Jeffrey David Ullman
	Publisher	Cambridge University Press
	Edition	2012
Reference Books		
1	Title	Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data
	Author	EMC Education Services
	Publisher	Wiley
	Edition	2015
2	Title	Analytics in a Big Data World: The Essential Guide to Data Science and its Applications
	Author	Beasan Bart
	Publisher	Wiley
	Edition	2015
Content	**Unit 1: Introduction to Big Data (7 Hours)** Evolution of big data, best practices for big data analytics, big data characteristics; Validating, Promotion of the value of big data, big data use cases. Characteristics of big data applications, Perception and quantification of value. Big Data Tools and Techniques: Understanding big data storage, General overview of high-performance architecture, HDFS, Map Reduce and YARN; Map Reduce programming model; Review of basic data analytic methods using R.	

	Unit 2: Regression and Classification (7 Hours) Advanced analytical theory and methods, Regression: Linear regression, Logistic regression; Classification: Decision trees, Overview of a decision tree, Decision tree algorithms, Evaluating a decision tree, Decision trees in R, Naïve Bayes, Bayes ‘theorem, Naïve Bayes classifier in R. **Unit 3: Data Stream Analysis (7 Hours)** 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; Real Time Analytics Platform (RTAP) applications, Case studies: Real time sentiment analysis, Stock market predictions. **Unit 4: Frequent Itemset and Clustering (7 Hours)** Mining frequent itemset: Market based model, Apriori algorithm, handling large datasets in main memory, Limited Pass algorithm, counting frequent itemset in a stream, Clustering techniques: Hierarchical, k-Means, Clustering high dimensional data. **Unit 5: NoSQL Data Management for Big Data (8 Hours)** NoSQL databases: Schema-less models, increasing flexibility for data manipulation, Key value stores, Document stores, Tabular stores, Object data stores, Graph databases; Hive; Sharding; HBase; Case Study: Analyzing big data with twitter, big data for E-Commerce Big data for blogs.
Course Assessment	Continuous Evaluation 25%
	Mid Semester 25%
	End Semester 50%

Course Matrix (CO-PO-PSO Mapping)

COs	POs s & PSOs												
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	3	1	1			3					1	2
CO2	2	3	3	3	1							3	3	2
CO3	2	3	3	3	1							3	3	2
CO4	2	2	3	3	1			3				3	3	3

1=addressed to small extent
2= addressed significantly
3= addressed strongly (major part of course)

Lab Experiments

Exp No.	List of Experiments
1	Study and Configuration Hadoop-based distributed architecture for Big Data Analytics.
2	Map Reduce Programming Examples Word Count. Union, Intersection and Difference. Matrix Multiplication.
3	Installation and Creation of MongoDB for Schema-less database.
4	Study and Implementation of Regression-based algorithms for Big Data Analytics.
5	Study and Implementation of Clustering-based algorithms for Big Data Analytics.
6	Implement and Perform Streaming Data Analysis for X data (formerly twitter), chat data, weblog analysis.
7	Implementation of Visualization techniques for Interpreting Big Data and its Analytics.

<table>
<tr><td rowspan="2">Course Code:
ADBB 353</td><td>PC (YES/ NO)</td><td>PE (YES/ NO)</td><td>OE (YES/ NO)</td><td>AS (YES/ NO)</td><td>HM (YES / NO)</td><td>ST-IS-PR (YES/ NO)</td><td>AE (YES / NO)</td></tr>
<tr><td>YES</td><td>NO</td><td>NO</td><td>NO</td><td>NO</td><td>NO</td><td>NO</td></tr>
<tr><td>Type of course</td><td colspan="7">Program Core</td></tr>
<tr><td>Course Title</td><td colspan="7">SOFT COMPUTING</td></tr>
<tr><td>Course Objectives</td><td colspan="7">To provide an understanding of the fundamental concepts of neural networks, fuzzy logic, and genetic algorithms, along with their applications in soft computing.</td></tr>
<tr><td rowspan="4">Course Outcomes</td><td colspan="5">CO1: Understand the fundamentals of artificial neural networks, including early models like ADALINE and MADALINE, and different neural network architectures such as feedforward and recurrent networks.</td><td colspan="2">L2</td></tr>
<tr><td colspan="5">CO2: Apply supervised and unsupervised learning techniques to build and analyze different neural network models, including associative memory networks and Hopfield networks.</td><td colspan="2">L4</td></tr>
<tr><td colspan="5">CO3: Analyze fuzzy logic concepts such as fuzzy sets, fuzzy arithmetic, fuzzy rule-based systems, and defuzzification techniques to develop fuzzy inference systems.</td><td colspan="2">L4</td></tr>
<tr><td colspan="5">CO4: Evaluate the role of genetic algorithms and hybrid intelligent systems (e.g., neuro-fuzzy, genetic-fuzzy, and genetic-neural hybrids) in solving optimization and learning problems.</td><td colspan="2">L6</td></tr>
<tr><td>Semester</td><td colspan="3">Autumn:</td><td colspan="4">Spring: Yes</td></tr>
<tr><td></td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Credits</td><td>Total teaching hours</td></tr>
<tr><td>Contact Hours</td><td>3</td><td>0</td><td>2</td><td>4</td><td>60</td></tr>
<tr><td>Prerequisite course code as per proposed course numbers</td><td>NIL</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Prerequisite</td><td>NIL</td><td></td><td></td><td></td><td></td></tr>
</table>

credits					
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

TextBooks		
1	Title	A comprehensive foundation. Neural Networks
	Author	Simon Haykin
	Publisher	Pearson Education
	Edition	2nd Edition, 2001.
Reference Books		
1	Title	Fuzzy logic with engineering applications
	Author	Timothy J. Ross
	Publisher	John Wiley & Sons
	Edition	3rd Edition,2009
2	Title	An Introduction to Genetic Algorithms
	Author	Melanie Mitchell
	Publisher	Prentice-Hall
	Edition	1998
3	Title	Genetic Algorithms in Search, Optimization, and Machine Learning
	Author	D. E. Goldberg
	Publisher	Addison-Wesley
	Edition	1989

Content	**Unit 1: Introduction to Artificial Neural Networks (7 Hours)** Artificial Neural Networks: Basic concepts of artificial neural networks, earlier neural networks: ADALINE, MADALINE. Neural Network Architectures: Single layer feedforward network, Multi-layer feedforward network, Recurrent network. **Unit 2: Learning Networks and Associative Memory (11 Hours)** Supervised Learning Network: Perceptron network, Back propagation network,

	Radial basis function network. Unsupervised Learning Network: Fixed weight competitive nets, Kohonen self-organizing feature maps, Counter propagation network, Adaptive reasoning theory. Associative memory: Auto-associative memory network, Hetero Associative memory network, Bidirectional associative memory, Hopfield networks. **Unit 3: Fuzzy Logic and Fuzzy Systems (10 Hours)** Fuzzy Logic: Crisp set and Fuzzy set, Basic concepts of fuzzy sets, Fuzzy set operations, Fuzzy Arithmetic-fuzzy numbers, Fuzzy ordering, Fuzzy vectors. Fuzzy measures-belief and plausibility measure. Probability measure: Measure of fuzziness, Fuzzy integrals. Membership functions: Features of membership function, Fuzzification. Fuzzy Rule Based Systems: Fuzzy proposition, Formation and decomposition of rules, Fuzzy reasoning, Fuzzy inference systems, Fuzzy expert system. Defuzzification: Max-membership, Centroid method, Weighted average, Mean max. **Unit 4: Genetic Algorithms and Search Techniques (8 Hours)** Genetic Algorithms: Traditional optimization and search techniques, Genetic algorithms. Operators: Encoding, Selection, Crossover, Mutation. Classification: Adaptive genetic algorithms, Hybrid genetic algorithms, Parallel genetic algorithms, Real coded genetic algorithms.
Course Assessment	Continuous Evaluation 25%
	Mid Semester 25%
	End Semester 50%

Course Matrix (CO-PO-PSO Mapping)

COs	POs s & PSOs												
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2			2							1	3	2
CO2	3	3	3	2	3							1	3	3
CO3	3	3	3	2	3							1	3	3
CO4	3	3	3	3	3							2	3	3

1=addressed to small extent
2= addressed significantly
3= addressed strongly (major part of course)

Lab Experiments

Exp No.	List of Experiments
1	Train a single-layer perceptron to classify linearly separable data.
2	Demonstrate learning and convergence for simple classification tasks.
3	Train a neural network for XOR or digit classification problems using backpropagation.
4	Design and test an RBF network on a small dataset.
5	Implement SOM for clustering or dimensionality reduction.
6	Use a Hopfield network to store and recall binary patterns.
7	Perform fuzzy union, intersection, and complement operations.
8	Create a Mamdani-type or Sugeno-type FIS for a real-world problem (e.g., temperature control).
9	Compare different defuzzification methods (centroid, mean of maxima, etc.) for a fuzzy output.
10	Solve a mathematical optimization problem using a basic GA with crossover and mutation.