

Course Structure for Second Year
B. Tech in Artificial Intelligence & Data Science

Semester III (Term 3)										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
BSC7	BTBS301	Engineering Mathematics-III	3	1	-	20	20	60	100	4
PCC1	BTAIC302	An Introduction to Artificial Intelligence	3	1	-	20	20	60	100	4
PCC2	BTAIC303	Data Structure and Algorithm using Python	3	1	-	20	20	60	100	4
ESC11	BTAIES304	Computer Architecture & Operating Systems	3	-	-	20	20	60	100	3
ESC12	BTAIES305	Digital Logic & Signal Processing	3	-	-	20	20	60	100	3
LC1	BTAIL306	Artificial Intelligence Lab & Data Structure and Algorithm using Python Lab	-	-	4	60	-	40	100	2
Seminar	BTAIS307	Seminar-I	-	-	4	60	-	40	100	2
Internship	BTES211P	Internship –I (Evaluation)	-	-	-	-	-	-	-	Audit
			15	3	8	220	100	380	700	22

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course HSSMC = Humanities and Social Science including Management Courses

Course Structure for Second Year
B. Tech in Artificial Intelligence & Data Science

Semester IV (Term 4)										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC3	BTAIC401	Data Analysis	3	1	-	20	20	60	100	4
PCC4	BTAIC402	Database ManagementSystem	3	1	-	20	20	60	100	4
HSSM C3	BTHM403	Basic Human Rights	3	-	-	20	20	60	100	3
BSC8	BTBS404	Probability Theory and Random Processes	3	-	-	20	20	60	100	3
PEC-1	BTAIPE405	Professional ElectiveCourses –I	3	1	-	20	20	60	100	4
	BTAIPE405A	1. Numerical Methods andComputer Programming								
	BTAIPE405B	2. Image Processing &Computer Vision								
	BTAIPE405C	3. Internet of Things &Embedded System								
	BTAIPE405D	4. Programming in JAVA								
LC2	BTAIL406	Data Analysis Lab and Database ManagementSystem Lab	-	-	4	60	-	40	100	2
Seminar	BTAIS407	Seminar - II	-	-	4	60	-	40	100	2
Internship	BTAIP408	Field Training / Internship / Industrial Training - II	-	-	-	-	-	-	-	Audit to be evaluate in V semester
			15	3	8	220	100	380	700	22

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course HSSMC = Humanities and Social Science including Management Courses

Second Year (Semester –III)
Engineering Mathematics-III

BTBS301	Engineering Mathematics-III	BSC7	3L- 1T -0P	4 Credits
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Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam:20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. To study the concepts of transformations, used in various field of artificial intelligence and data science.
2. To study partial differential equations to apply it in computer and electronics engineering.
3. To use complex variables.

Course Outcomes:

On completion of the course, students will be able to:

CO1	Understand the concept of LT & ILT.
CO2	Solve problems related to Fourier transform to Deep Learning, Signal & Image processing.
CO3	Understand the concepts of linear algebra and apply Linear Programming, Computer Graphics and Cryptography.
CO4	Understand the concepts of PDE and apply it in data analysis.
CO5	Analyze function of complex variables.

Course Contents:

Unit 1: Laplace Transform

[07 Hours]

Definition – conditions for existence ; Transforms of elementary functions ; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n , scale change property, transforms of functions divided by t , transforms of integral of functions, transforms of derivatives ; Evaluation of integrals by using Laplace transform; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.

Unit 2: Inverse Laplace Transform**[07 Hours]**

Introductory remarks ; Inverse transforms of some elementary functions ; General methods of finding inverse transforms ; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms ; Applications to find the solutions of linear differential equations and simultaneous linear differential equations with constant coefficients.

Unit 3: Fourier Transform**[07 Hours]**

Definitions – integral transforms ; Fourier integral theorem (without proof) ; Fourier sine and cosine integrals ; Complex form of Fourier integrals ; Fourier sine and cosine transforms; Properties of Fourier transforms ; Parseval's identity for Fourier Transforms.

Unit 4: Partial Differential Equations and Their Applications**[09 Hours]**

Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations solvable by direct integration; Linear equations of first order (Lagrange's linear equations); Method of separation of variables – applications to find solutions of one dimensional heat flow equation $\frac{\partial^2 u}{\partial x^2} = \frac{\partial^2 u}{\partial t^2}$ and one dimensional wave equation (i.e. $\frac{\partial^2 u}{\partial x^2} = \frac{\partial^2 u}{\partial t^2}$).

Unit 5: Functions of Complex Variables**[08 Hours]**

Analytic functions; Cauchy- Riemann equations in Cartesian and polar forms; Harmonic functions in Cartesian form; Cauchy's integral theorem; Cauchy's integral formula; Residues; Cauchy's residue theorem (All theorems without proofs)

Text Books

1. Linear Algebra, Seymour Lipschutz, Schaums outlines, 4th Edition, McGraw-Hill Publication.

Reference Books

1. Introduction to Linear Algebra, Gilbert Strang, 5th Edition, Wellesley-Cambridge Press.
2. K. Hoffman and R. Kunze, Linear Algebra, 2nd Edition, Prentice-Hall of India, 2005.
3. M. Artin, Algebra, Prentice-Hall of India, 2005.

Second Year (Semester –III)
An Introduction to Artificial Intelligence

BTAIC302	An Introduction to Artificial Intelligence	PCC1	3L- 1T - 0P	4 Credits
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Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. To provide a strong foundation of fundamental basics of Artificial Intelligence.
2. Demonstrate awareness and fundamental understanding of various applications of AI techniques.
3. Apply Artificial Intelligence techniques for problem solving.

Course Outcomes:

On completion of the course, students will be able to:

CO1	Discuss Meaning, Scope and Stages of Artificial Intelligence
CO2	Understand and Implement Problem Space and Search Strategies for Solving problems.
CO3	Discuss the Search Techniques and Knowledge Representation.
CO4	Apply search for solving Constraint Satisfaction Problems and Game-playing.
CO5	Discover the Application of Artificial Intelligence and Analyze Impact of AI on Society

Course Contents:

Unit No 1: Introduction:

[7 Hours]

What Is AI? The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art. Introduction: Philosophy of AI, Definitions, AI Future. Stages of AI. (ANI, AGI ASI with examples).

Intelligent Agents: Agents and Environments Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

Unit No 2: Search Methods

[8 Hours]

State Space Search

Generate and test, simple search, Depth first search (DFS), Breadth First search (BFS), Comparison, Quality of Solution, Depth Bounded DFS, Depth First Iterative Deepening.

Heuristic Search:

Heuristic Functions, Search Techniques: Best-first search, Hill climbing, Local Maxima, Solution Space Search, Variable Neighbourhood Descent, Beam Search, Tabu Search, Peak to peak method.

Unit No 3: Randomized Search:**[7 Hours]**

Population Based Methods: Escaping Local Optima, Iterated Hill Climbing, Simulated Annealing, Genetic Algorithms, Neural Network, Emergent Systems, Ant Colony Optimization.

Unit No 4: Optimal Path Finding**[7 Hours]**

Brute Force, Branch & Bound, Refinement Search, Dijkstra Algorithm, Algorithm A*, Admissible A*, Iterative Deepening A*, Recursive Best First Search, Pruning the CLOSED List, Pruning the OPEN List, Conquer Beam Stack Search.

Unit No 5: Constraint Satisfaction**[7 Hours]**

N Queens, Constraint Propagation, Scene labelling, Higher order consistency, Algorithm backtracking, Look-head strategies, Strategic retreat.

Text Books

1. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw-Hill Education, 2013.
2. Eugene, Charniak, Drew Mcdermott, "Introduction to artificial intelligence", Addison Wesley, 1985.
3. Elaine Rich, Kevin Knight, Shivashankar B Nair: Artificial Intelligence, Tata CGraw Hill 3rd edition. 2013.
4. Stuart Russel, Peter Norvig: Artificial Intelligence A Modern Approach, Pearson 3rd edition 2013.

Reference Books

1. Peter Norvig, Artificial Intelligence: A Modern Approach, Third Edition.
2. Herbert A. Simon, "The Sciences of the Artificial ", MIT Press, 3rd Edition (2nd Printing), 1995. 3. Tim Jones, "Artificial Intelligence Application Programming", Dreamtech Publication.
3. George F. Luger, "Artificial Intelligence-Structures and Strategies For Complex Problem Solving", Pearson Education / PHI, 2002.
4. Prolog Programming for A.I. by Bratko, TMH

Semester –III

Data Structure and Algorithm Using Python

BTAIC303	Data Structure and Algorithm Using Python	PCC2	3L-1T-0P	4 Credits
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Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam:20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Introduce the fundamental concept of Python programming to the students
2. Understand various data structures in Python and write algorithms and programs using them
3. Compare alternative implementations of data structures with respect to performance
4. Discuss the computational efficiency of the principal algorithms for sorting, searching, and hashing

Course Outcomes:

On completion of the course, students will be able to:

CO1	Write programs using basic concepts of Python Programming
CO2	Implement algorithms for arrays, linked structures, stacks, queues, trees, and graphs
CO3	Write programs that use arrays, linked structures, stacks, queues, trees, and graphs
CO4	Compare and contrast the benefits of dynamic and static data structures implementation
CO5	Discuss the computational efficiency of the principal algorithms for sorting, searching, and hashing

Course Contents:

Unit 1: Introduction to Programming

[07 Hours]

Introduction to Programming, Why Programming, What is a Program? Problem Solving, Algorithms and Data Structure

Introduction to Programming, Variables, Data Types, Input-Output Statements, Indentation, Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations.

Control Flow- if, if-elif-else, for, while break, continue, pass

Collections- String, Lists, Tuples, Dictionaries, Sets, Map

Unit 2: Functions & Object Oriented Programming using Python [07 Hours]

Functions- Built-in and User defined functions, Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function- Global and Local Variables, Recursions

Need for OOP, Classes and Objects, OOP Concepts, Constructor, Class Diagram, Encapsulation, Statics, Relationship, Inheritance, and Abstract Classes, Exception Handling

Unit 3: Data Structures in Python [07 Hours]

ADT- Defining the ADT, Using the ADT, Pre conditions and post conditions

Introduction to Data Structures, Types of Data Structures, Arrays- Need for array, Array ADT, Implementing array, 2-D arrays,

Linked Structures- Singly Linked List & Operations with algorithms, Application- Polynomials, Doubly Linked Lists, Circular Linked List

Stacks- Stack ADT, Implementing the stack- using Python List and using a linked list, Stack Applications- Evaluating Postfix expressions

Queues- Queue ADT, Implementing the queue- using Python List and using a linked list, Priority Queue, Applications of Queues

Unit 4: Non-Linear Data Structures in Python [07 Hours]

Binary Trees- Tree Structure, Properties, Implementation, Tree Traversals, Heaps-Definition, Implementation, Heap Sort

Binary Search Trees- Operations and Algorithms (searching, insertion, deletion, min, max),

Hash Tables- Hashing techniques, Hash functions, Applications

Unit 5: Searching & Sorting Algorithms and Analysis [08 Hours]

Search Algorithms- Linear Search Algorithm, Binary Search Algorithm,

Comparison Sort Algorithms- Introduction, Selection Sort, Insertion Sort, Bubble Sort, Merge Sort, Quick Sort

Algorithmic Techniques- Algorithm Technique- Greedy Approach, Dynamic Programming, Complexity Analysis of Algorithms- Introduction, Analysis of Algorithms, Big-O Notation, Evaluating the Python List.

Text Books / Reference Books

1. Data Structures and Algorithms Using Python, Rance D. Necaise
2. Python for Everybody, Exploring Data Using Python 3, Dr. Charles R. Severance
3. Data Structures and Algorithms in Python, Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser.

Semester –III

Computer Architecture and Operation Systems

BTAIES304	Computer Architecture and Operation Systems	ESC11	3L-0T-0P	3 Credits
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Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam:20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. To understand the structure, function and characteristics of computer systems
2. To identify the elements of modern instructions sets and their impact on processor design
3. To understand the services provided by and the design of an operating system.
4. Understand the structure, organization memory management.

Course Outcomes:

On completion of the course, students will be able to:

CO1	Understand the theory and architecture of central processing unit & Analyze some of the design issues in terms of speed, technology, cost, performance
CO2	Use appropriate tools to design verify and test the CPU architecture & Learn the concepts of parallel processing, pipelining and inter processor communication.
CO3	Understand the architecture and functionality of central processing unit & Exemplify in a better way the I/O and memory organization, Memory management systems, Virtual Memory
CO4	Describe and explain the fundamental components of a computer operating system
CO5	Define, restate, discuss, and explain the policies for scheduling, deadlocks, memory management, synchronization, system calls, and file systems.

Course Contents:

Unit 1: Introduction, Arithmetic and Instruction Sets

[07 Hours]

Introduction: Concept of computer organization and architecture, Fundamental unit, Computer function and interconnection, CPU structure and function.

Computer Arithmetic: The arithmetic and logic Unit, Integer representation, Integer arithmetic, Floating point representation, Floating point arithmetic, Introduction of arithmetic co-processor.

Instruction Sets: Characteristics, Types of operands, Types of operations, Assembly language, Addressing modes, Instruction format, Types of instruction, Instruction execution, Machine state and processor status, Structure of program, Introduction to RISC and CISC architecture.

Unit 2: Memory Organization and Management

[8 Hours]

Memory Organization: Internal Memory: Semiconductor main memory, Error correction, Advanced DRAM organization, Virtual memory systems and cache memory systems. External Memory: Organization and characteristics of magnetic disk, Magnetic tape, Optical memory, RAID, Memory controllers.

Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Continuous Memory Allocation, Fixed and variable partition, Internal and external fragmentation and

compaction, Paging: Principle of operation, Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging.

Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault, Working Set, Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).

Unit 3: Control Unit & Input/ Output Organization: [07 Hours]

Control Unit: Control unit operation: Micro-operations, Control of the processor, Hardwired implementation, Micro-programmed Control Unit, Basic concepts, Micro-instruction sequencing, Micro-instruction execution, Applications of micro-programming.

Input/ Output Organization: External devices, I/O module, Programmed I/O, Interrupt driven I/ O, Direct memory access, I/O channels and processors, External interface. Instruction pipe-lining: Concepts. Parallel processing: Multiple processor organization, Symmetric multiprocessor, Cache coherence and the MESI protocol.

Unit 4: Introduction OS & Processes and CPU Scheduling: [07 Hours]

Introduction and Operating system structures: Definition, Types of Operating system, Real Time operating system, System Components- System Services, Systems Calls, System Programs, System structure. Virtual Machines, System Design and Implementation, System Generations.

Processes and CPU Scheduling: Process Concept, Process Scheduling, Operation on process, Cooperating processes. Threads, Inter-process Communication, Scheduling criteria, scheduling Algorithms, Multiple-Processor Scheduling, Real-Time Scheduling, Scheduling Algorithms and performance evaluation.

Unit 5: Process Synchronization & Deadlocks [07 Hours]

Process Synchronization: The critical-section problem, Critical regions, Synchronization Hardware, Semaphores, Classical Problems of synchronization, and Monitors Synchronizations in Solaris.

Deadlocks: Systems Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock, Combined approach to deadlock Handling.

Text Books

1. William Stalling, Computer Organization and Architecture: Designing for Performance, Prentice Hall Publication, 8th Edition, 2009.
2. Hayes, Computer Architecture and Organization, McGraw-Hill Publication, 3rd Edition, 2012.
3. Zaky, Computer Organization, McGraw-Hill Publication, 5th Edition, 2011
4. Andrew S. Tanenbaum, Modern Operating System, PHI Publication, 4th Edition, 2015.

Reference Books

1. Hennessy and Patterson, Computer Architecture: A Quantitative Approach, Morgan and Kaufman Publication, 4th Edition, 2007.
2. Morris Mano, Computer System Architecture, Pearson Education India, 3rd Edition, 2007.
3. Mostafa Abd-El-Barr, Hesham El-Rewini, Fundamentals of Computer Organization and Architecture, Wiley Publication, 1st Edition, 2004.

Semester –III
Digital Logic & Signal Processing

BTAIES305	Digital Logic & Signal Processing	ESC12	3L-0T-0P	3 Credits
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Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam:20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. To acquaint the students with the fundamental principles of two-valued logic and various devices used to implement logical operations on variables.
2. To classify signals and systems into different categories.
3. To analyze Linear Time Invariant (LTI) systems in time and transform domains.
4. To build basics for understanding of courses such as signal and image processing, computer vision, Machine Learning and Deep Learning.

Course Outcomes:

On completion of the course, students will be able to:

CO1	Use the basic logic gates and various reduction techniques of digital logic circuit in detail
CO2	Understand mathematical description and representation of various signals and systems.
CO3	Develop input output relationship for linear shift invariant system and understand the convolution operator for discrete time system.
CO4	Understand use of different transforms and analyze the discrete time signals and systems.
CO5	Understand the concept of correlation, regression and spectral density.

Course Contents:

Unit 1: Number System and Boolean Algebra **[07 Hours]**

Digital Signal, Digital logic circuits: AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR.

Boolean algebra and theorems.

Number System: Binary, Octal, Decimal, and Hexadecimal. Binary Arithmetic (addition, subtraction, multiplication, division), 1's & 2's compliment.

Codes: Binary, Gray, BCD, Excess-3, Octal, Hexadecimal code.

Unit 2: Introduction to Signals and Systems **[8 Hours]**

Signals: Definition of signal and systems, Continuous time and discrete time signal,

Classification of signals as even, odd, periodic and non-periodic, deterministic and non-deterministic, energy and power, elementary signals used for testing: exponential, sine,

impulse, step and its properties, ramp, rectangular, triangular, signum, sinc.

Operations on signals: Amplitude scaling, addition, multiplication, differentiation, integration (Accumulator for DT), time scaling, time shifting and time folding. Sampling Process.

Systems: Definition, Classification: linear and non-linear, time variant and invariant, causal and non-causal, static and dynamic, stable and unstable, invertible.

Unit 3: Discrete Fourier Transform **[07 Hours]**

DTFT, Definition, Frequency domain sampling, DFT, Properties of DFT, Convolution: circular convolution, linear convolution, FFT, decimation in time and decimation in frequency using Radix-2 FFT algorithm.

Unit 4: Z transform **[07 Hours]**

Need for transform, relation between Laplace transform and Z transform, between Fourier transform and Z transform, Properties of ROC and properties of Z transform, Inverse Z transform, Power series method, partial fraction expansion method, Solution of difference equations.

Unit 5: Correlation and Spectral Density **[07 Hours]**

Introduction of correlation and correlogram, the correlation function: analogy between correlation and convolution, auto-correlation, properties of auto-correlation, Cross-correlation: properties of cross correlation

Introduction of Spectral density, ESD, Properties of ESD, PSD, Properties of PSD.

Text Books

1. Dr. S. L. Nalbalwar, A.M. Kulkarni and S.P. Sheth, "Signals and Systems", 2nd Edition, Synergy Knowledgeware, 2017
2. Nagoor Kanni "Signals and Systems", 2nd edition, McGrawHill.

Reference Books

1. R. P. Jain, Modern digital electronics. 3rd edition, 12th reprint Tata McGraw Hill Publication, 2007.
2. Alan V. Oppenheim, Alan S. Willsky and S. Hamid Nawab, "Signals and Systems", PHI
3. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
4. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall, 1997.
5. S.K.Mitra, Digital Signal Processing: A computer based approach. TMH
6. Shaila Apte, "Signals and Systems-principles and applications", Cambridge University press, 2016.

Semester –III

An Introduction to Artificial Intelligence Lab and Data Structure and Algorithm Using Python Lab

BTAIL306	Artificial Intelligence Lab and Data Structure and Algorithm Using Python Lab	LC1	0L-0T-4P	2 Credits
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Teaching Scheme	Examination Scheme
Practical: 04 hrs./week	Continuous Assessment 1: 30 Marks Continuous Assessment 2: 30 Marks End Semester Examination: 40 Marks

A) **Artificial Intelligence Lab**

List of Practical/Tutorial

Software Tools: Programming languages, namely Java, Python, C++, Lisp, and Prolog, is highly recommended for students to use when completing their assignments and/or practical's for this course.

1. Study of Java/Python/C++/ Lisp/ PROLOG.
2. Existing AI Application (e.g. Recommendation system, Carpooling, OTT channels etc.)
3. Solve any problem using depth first search.
4. Solve any problem using breadth first search.
5. Solve 8-puzzle problem using best first search.
6. Write a program to solve Tic-Tac-Toe using Min-Max search.
7. Solve traveling salesman problem.
8. Write a program for Alpha–Beta Pruning.
9. Write a program to solve 8 queens problem.
10. Write a program to solve map coloring problem using CSP.

Note:

1. Open Source tools and technology use for programs
2. Lab should be in scope of hands of experience and practice related program must
3. Add case study and Live project experience if any related contents

Software Tools: Programming languages Python and Opens Source tools must and highly recommended for students to use when completing their assignments and/or practical's for this course.

B) Data Structure and Algorithm Using Python Lab

List of Practical

Downloading and installing Python gcc in Python as start of lab for hands on laboratory

- 1) Write code and understand the concept Variable, Data Type and Data Object in python.
- 2) Write code and understand the concept List, Tuple, and Array in python.
- 3) Write code and understand the concept Loop and Function in python.
- 4) Write code and understand the concept Classes and Objects in python.
- 5) Write code and understand the concept Constructor and Relationship
- 6) Write code and understand the concept Inheritance and Exception Handling in python.
- 7) Write code and understand the concept List in data Structure
- 8) Write code and understand the concept Queue in data Structure
- 9) Write code and understand the concept Array in data Structure
- 10) Write code and understand the concept Graphs, Trees in data Structure
- 11) Write code and understand the concept Hashing, Hash Tables in data Structure
- 12) Write code and understand the concept Search Algorithms (Any two)
- 13) Write code and understand the concept Sorting Algorithms (Any two)
- 14) Write code and understand the concept Algorithm Technique on Greedy Approach

Note:

1. Open Source tools and technology use for programs
2. Lab should be in scope of hands of experience and practice related program must
3. Add case study and Live project experience if any related contents

Semester –III
Seminar-I

BTAIS307	SEMINAR- I	Seminar	0L-0T-4P	2 Credits
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Guidelines for Seminar

The students shall study in group of two members (or individual) on some special topic beyond the scope of the syllabus under the subjects of Artificial Intelligence, Data Science, Electronics Engineering and Computer Science Engineering or inter discipline branch from current literature, by referring the current technical journal or reference books, under the guidance of the teacher. The students shall prepare his report and deliver talk on the topic for other students of his class in the presence of his guide and internal examiner. The student is permitted to use audio-visual aids or any other such teaching aids.

Continues Assessment:

The Continues Assessment for this head will consists of the report written in a technical reporting manner and presentation of the talk on the subject and will be assessed by the internal examiner appointed by the HOD of concern department of the institution.

Semester –III
Internship - I

BTES211P	Field Training / Internship / Industrial Training	Internship	Audit
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Guidelines for Internships

Guidelines for Field Training / Internship / Industrial Training Industrial Training:

1. To apply for a suitable Industrial Training, submit an application form to respective Organization concerned one semester before the Industrial Training Programmed commences.
2. Student can also apply through online platforms such as Internshala for industrial training.
3. Submit one copy of the offer letter for the Industrial Training to the Head of the department or Faculty coordinator (Industrial Training).
4. To complete the Industrial Training process within the specified time based on the Industrial Training Programme schedule.
5. Assessment within the Industrial Training context aims to evaluate the student's work quality and appropriateness to the field of study with reference to the learning outcomes of the Industrial Training Programme.
6. Evaluation of the students' performance should be done in the next upcoming semester.
7. Those students who fails, they can also complete online certification courses which are available at free of cost on various MOOC platforms.

Semester –IV

Data Analysis

BTAIC401	Data Analysis	PCC3	3L - 1T - 0P	4 Credits
Teaching Scheme		Examination Scheme		
Lecture: 3 hrs./week Tutorial : 1 hr./week		Continuous Assessment : 20 Marks Mid Semester Exam:20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)		

Pre-Requisites: Basics of Linear Algebra, Introduction, Probability and Statistics.

Course Objectives:

After completion of the course, students will learn:-

1. To obtain a Comprehensive knowledge of various tools and techniques for Data transformation and visualization
2. To learn the probability and probabilistic models of data science
3. To learn the basic statistics and testing hypothesis for specific problems
4. To learn about the prediction models
5. To give a hands-on experience with real-world data analysis

Course Outcomes:

On completion of this course, the student should be able to

CO1	Apply preprocessing techniques to convert raw data so as to enable further analysis
CO2	Apply exploratory data analysis and create insightful visualizations to identify patterns
CO3	Understand how to derive the probability density function of transformations of random variables and use these techniques to generate data from various distributions
CO4	Understand the statistical foundations of data science and analyze the degree of certainty of predictions using statistical test and models
CO5	Introduce machine learning algorithms for prediction and to derive insights

Course Contents:

Unit 1: Statistical data and Concepts

[07 Hours]

The statistical Methods, Misuse, Misinterpretation and bias, Sampling and sampling size, Data preparation and cleaning, Missing data and data errors, Exploratory Data Analysis, Statistical error, Statistical Modeling, Computational Statistics, Inference, Bias, Cofounding, Hypothesis testing, Types of error, Statistical significance, Confidence Interval, Power and robustness, Degrees of freedom, Non parametric analysis.

Unit 2: Descriptive Statistics

[07 Hours]

Counts and specific values, Measure of central tendency, Measure of spread, Measure of distribution shape, Statistical indices, Moments, Key functions, Measures of complexity and model selection.

Unit 3: Data transformation and standardization**[07 Hours]**

Box-Cox and power transforms, Freeman-Tukey (square root and arcsine) transforms, Log and Exponential transforms, Logit transforms, Normal transform.

Unit 4: Classical Tests and Contingency Tables**[7 Hours]**

Goodness of fit tests: Anderson-Darling, Chi-square test, Kolmogorov-Smirnov, Ryan-Joiner, Shapiro-Wilk, Jarque-Bera, Lilliefors;

Z- test: test of single mean, standard deviation known, Test of the difference between two means, standard deviation known, test for proportions, P;

T-tests: test of single mean, standard deviation not known, Test of the difference between two means, standard deviation not known, test of regression coefficients;

Unit 5: Analysis of Variance and Covariance**[08 Hours]**

Variance test: Chi square test of single variable, F-test of two variables, test of homogeneity; Wilcoxon rank-sum/Mann-Whitney U test; Sign test.

Contingency Tables: Chi-square contingency table test, G contingency table test, Fisher's exact test, Measures of association, McNemar's test.

ANOVA: Single factor or one way ANOVA, Two factor or two-way and higher-way ANOVA, MANOVA, ANCOVA; Non Parametric ANOVA: Kruskal Wallis ANOVA, Friedman ANOVA test, Mood's median

Text Books

1. Dr. Michael J de Smith, Statistical Analysis Handbook, A Comprehensive guide to statistical concepts methods and tools, The Winchelsea Press, Drumlin Security Ltd, Edinburgh 2018 edition. <https://www.statsref.com/HTML/index.html>
2. Douglas C. Montgomery, George C. Runger, Applied Statistics and Probability for Engineers, Sixth Edition, Wiley, 2013
3. Dr.J.Ravichandran, Probability And Statistics For Engineers, First Edition, Wiley, 2010 Scientists

Reference Books

1. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press. 2014. (free online)
2. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. ISBN 0262018020. 2013.
3. Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking. ISBN 1449361323. 2013.
4. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly. 2014.

Semester –IV

Database Management System

BTAIC402	Database Management System	PCC4	3L-1T-0P	4 Credits
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Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam:20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Fundamentals of Database Management Systems and types of DBMS used in data analysis
2. Understand various ways to organize, maintain and retrieve - efficiently, and effectively – information from different DBMS
3. Design and maintenance of the database systems
4. Discuss the computational efficiency of the principal algorithms for sorting, searching, and hashing

Course Outcomes:

On completion of the course, students will be able to:

CO1	Master the basic concepts of relational DBMS and its types.
CO2	Perform various types of operations on relational databases using DDL, DML, DCL in SQL
CO3	Understand the concept of how non-relational databases differ from relational databases from a practical perspective.
CO4	Master the basic concepts of designing NoSQL database management system.
CO5	Able to Identify what type of NoSQL database to implement based on business requirements

Course Contents:

Unit 1: Introduction to Databases

[06 Hours]

Introduction to Data and Database, Significance of Database Management System, Various Types of DBMS- relational & non-relational, Data Independence - The Three Levels Of Architecture - The External Level - Conceptual Level - Internal Level - Client/Server Architecture- System Structure , Instance and schema

Unit 2: Relational Database Management System [07 Hours]

Data Models & Types, ER to Relational Mapping , Structure Of Relational Databases, Creation and Manipulation of Database using Basic SQL(DDL, DML,DCL,TCL)
Normalization –Anomalies- Functional Dependency, Normal forms- 1NF, 2NF, 3NF, Boyce - Codd Normal Form

Unit 3: Non-Relational Database Management System [07 Hours]

NOSQL Systems-Introduction to NoSQL, Disadvantages of NoSQL technology, NOSQL Systems, weakness of RDBMS, CAP theorem, Types of NoSQL Databases,
Key-value database-Key values database, More elements of key values database, Properties of Key-value store, Redis implementation (Basic CRUD operation)

Unit 4: Columnar & Document Databases [8 Hours]

Columnar Databases with Apache Cassandra- Characteristics of a columnar database, Concepts of columnar databases, Cassandra Introduction and its use-cases, implement a columnar database using Apache Cassandra
Introduction to Document databases, Document databases with MongoDB - Implement a document database with MongoDB

Unit 5: Graph and Future databases [8 Hours]

Graph Databases - Graph databases, graph traversal and graph problems, graph data structures edge list, adjacency matrix, properties of graph model.
Implementation and systems - Reliable, maintainable and scalable, Different information systems, NEO4J implementation (Basic CRUD operation), Introduction to Advance Databases- PostgreSQL

Text Books

1. Abraham Silberchatz, Henry K.Forth, Sudharshan, “Database system Concepts” – (6th edition), McGraw Hill, 2010.
2. Guy Harrison, “Next Generation Databases”, Apress, 2015.
3. Eric Redmond, Jim R Wilson, “Seven Databases in Seven Weeks”, LLC. 2012

Reference Books

1. K. Pakhira, “Database Management System”, Phi Learning Pvt. Ltd., 2012
2. MongoDB: The Definitive Guide, 2nd Edition , Powerful and Scalable Data Storage, By Kristina Chodorow, Publisher: O'Reilly Media
3. MongoDB Basics - EelDavid Hows,Peter Membrey,coPlugge, Publisher Apress - Ebook(free) <https://it-ebooks.info/book/4527/>

Semester –IV

Basic Human Rights

BTHM403	Basic Human Rights	HSSMC3	3L- 0T -0P	3 Credits
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Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam:20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:

1. To train the young minds facing the challenges of the pluralistic society and the rising conflicts and tensions in the name of particularistic loyalties to caste, religion, region and culture.
2. To give knowledge of the major "signposts" in the historical development of human rights, the range of contemporary declarations, conventions, and covenants.
3. To enable them to understand the basic concepts of human rights (including also discrimination, equality, etc.), the relationship between individual, group, and national rights.
4. To develop sympathy in their minds for those who are denied rights.
5. To make the students aware of their rights as well as duties to the nation

Course Outcomes:

On completion of the course, students will be able to:

CO1	Students will be able to understand the history of human rights.
CO2	Students will learn to respect others caste, religion, region and culture.
CO3	Students will be aware of their rights as Indian citizen.
CO4	Students will be able to understand the importance of groups and communities in the society.
CO5	Students will be able to realize the philosophical and cultural basis and historical perspectives of human rights.

Course Contents:

UNIT 1: The Basic Concepts:

[08 Hours]

Individual, group, civil society, state, equality, justice. Human Values, Human rights and Human Duties: - Origin, Contribution of American bill of rights, French revolution. Declaration of independence, Rights of citizen, Rights of working and exploited people.

UNIT 2 Fundamental rights and economic programme: [07 Hours]

Society, religion, culture, and their inter relationship. Impact of social structure on human behavior, Social Structure and Social Problems: - Social and communal conflicts and social harmony, rural poverty, unemployment, bonded labor.

UNIT 3: Migrant workers: [07 Hours]

Migrant workers and human rights violations, human rights of mentally and physically challenged. State, Individual liberty, Freedom and democracy. NGOs and human rights in India: - Land, Water, Forest issues.

UNIT 4: Human rights in Indian constitution and law [07 Hours]

i) The constitution of India: Preamble ii) Fundamental rights. iii) Directive principles of state policy. iv) Fundamental duties. v) Some other provisions.

UNIT 5: Universal declaration: [07 Hours]

Universal declaration of human rights and provisions of India. Constitution and law. National human rights commission and state human rights commission

Text / Reference Books

1. Shastry, T. S. N., India and Human rights: Reflections, Concept Publishing Company India (P Ltd.), 2005
2. Nirmal, C.J., Human Rights in India: Historical, Social and Political Perspectives(Law in India), Oxford India

Semester –IV
Probability Theory and Random Processes

BTBS404	Probability Theory and Random Processes	BSC8	3L- 0T -0P	3 Credits
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Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam:20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:

1. To develop basic of statistics, probability and random variables.
2. The primary objective of this course is to provide mathematical background and sufficient experience so that the student can read, write, and understand sentences in the language of probability theory, as well as solve probabilistic problems in engineering and applied science.

Course Outcomes:

On completion of the course, students will be able to:

CO1	Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon
CO2	Understand the basic concepts of one and two dimensional random variables and apply in engineering applications
CO3	Apply the concept random processes in engineering disciplines
CO4	Understand and apply the concept of correlation and spectral densities
CO5	The students will have an exposure of various distribution functions and help in acquiring skills in handling situations involving more than one variable. Able to analyze the response of random inputs to linear time invariant systems

Course Contents:

UNIT 1: Probability Theory

[07 Hours]

Definition of probability: classical, empirical and axiomatic approach of probability, Addition theorem of probability, Multiplication theorem of probability, Bayes' theorem of inverse probability, Properties of probabilities with proofs, Examples.

UNIT 2: Random Variable and Mathematical Expectation

[07 Hours]

Random variables, Probability distributions, Probability mass function, Probability density function, Mathematical expectation, Joint and marginal probability distributions, Properties of expectation and variance with proofs. Theoretical Probability Distributions : Binomial distribution, Poisson distribution, Normal distribution, Fitting of binomial distributions, Properties of binomial, Poisson and normal distributions, Relation between binomial and normal distributions, Relation between Poisson and normal distributions, Importance of normal distribution, Examples.

UNIT 3: Correlation**[07 Hours]**

Introduction, Types of correlation, Correlation and causation, Methods of studying correlation, Karl Pearson's correlation coefficient, Spearman's rank correlation, Coefficient, Properties of Karl Pearson's correlation coefficient and Spearman's rank correlation coefficient, Probable errors.

UNIT 4: Linear Regression Analysis**[07 Hours]**

Introduction, Linear and non-linear regression, Lines of regression, Derivation of regression lines of y on x and x on y , Angle between the regression lines, Coefficients of regression, Theorems on regression coefficient, Properties of regression coefficient.

UNIT 5: Estimation and Hypothesis**[07 Hours]**

Estimation, Large Sample Estimation of a Population Mean, Small Sample Estimation of a Population Mean, Large Sample Estimation of a Population Proportion, Sample Size Considerations, Testing Hypotheses, The Elements of Hypothesis Testing, Large Sample Tests for a Population Mean, The Observed Significance of a Test, Small Sample Tests for a Population Mean, Large Sample Tests for a Population Proportion.

Text Books

1. S. C. Gupta, Fundamentals of Statistics, Himalaya Publishing House, 7th Revised and Enlarged Edition, 2016.

Reference Books

1. G. V. Kumbhojkar, Probability and Random Processes, C. Jamnadas and Co., 14th Edition, 2010.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.
4. G. Haribaskaran, Probability, Queuing Theory and Reliability Engineering, Laxmi Publications, 2nd Edition, 2009.
5. Murray Spiegel, John Schiller, R. ALU Srinivasan, Probability and Statistics, Schaum's Outlines, 4th Edition, 2013.
6. Kishor S. Trivedi, Probability, Statistics with Reliability, Queuing and Computer Science Applications, Wiley India Pvt. Ltd, 2nd Edition, 2001.
7. Vijay K. Rohatgi, A. K. Md. Ehsanes Saleh, An Introduction to Probability And Statistics, Wiley Publication, 2nd Edition, 2001.
8. Roxy Peck, Chris Olsen, Jay Devore, Introduction to Statistics and Data Analysis, Third Edition, Thomson Books/Cole.
9. Ronald Walpole; Raymond Myers; Sharon Myers; Keying Ye, Probability & statistics forengineers & scientists, 9th edition, Prentice Hall.

Semester –IV

Numerical Methods and Computer Programming

BTAIPE405A	Numerical Methods and Computer Programming	PEC1	3L- 1T -0P	4 Credits
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Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam:20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:

1. To prepare students for successful career in industries, for Post Graduate programmes and to work in research institutes.
2. To understand different numerical techniques used for solving algebraic and transcendental equations.
3. To understand numerical methods to solve a system of linear equations.
4. To understand numerical integration and differentiation techniques.
5. To understand various difference operators and interpolation techniques.
6. To understand object-oriented programming fundamentals and features.
7. To mold students professionally by course contents and sufficient problem solving and programming exercises and to acquaint them with different types of numerical techniques and programming concepts.

Course Outcomes:

On completion of the course, students will be able to:

CO1	Able to solve algebraic and transcendental equations by using numerical techniques and will be able to compare different numerical techniques used for this purpose and also will be able to choose a proper one as per the requirement of the problem
CO2	Able to solve a system of linear equations with any number of variables using different direct and iterative numerical techniques
CO3	Understand the concept of interpolation, finite difference operators and their relations, and can apply different interpolation techniques on equi-spaced or non equi-spaced data values
CO4	Prepare them to solve Integration and Differentiation
CO5	Understand application of the NMCP course in many engineering core subjects like signal processing, digital communication, numerical techniques in electromagnetics etc.

Course Contents:

UNIT 1: Introduction to Computational Methods and Errors: **[07 Hours]**

Computational Methods: General principles of computational techniques, Introduction, common ideas and concepts of computational methods, various computational techniques.

Errors: Types and sources of errors, Concept in error estimation, Error propagation, Error due to floating point, Representation of errors, Elementary uses of series in calculation of errors.

UNIT 2: Solution of Transcendental / Polynomial Equations and System of Linear Equation: [07 Hours]

Solution of Transcendental / Polynomial Equations: Finding root of polynomial equations deploying computational methods such as Bisection, Regula-falsi, Newton-Raphson, Secant, Successive approximation. System of linear equation: Solving linear equations deploying computational methods such as Gauss elimination, Gauss Jordan, Partial pivoting, Matrix triangularisation (LU decomposition), Cholesky, Gauss Seidel and Jacobi methods.

UNIT 3: Interpolation and Polynomial Approximation: [07 Hours]

Least square approximation, Orthogonal polynomials Chebyshev polynomials, Finite difference operator and their relations, Forward, backward, central and divided difference, Newton's forward divided difference, Backward difference interpolation, Sterling interpolation, Lagrange interpolation polynomials, Spline interpolation, Least square approximation.

UNIT 4: Numerical Integration and Differentiation [07 Hours]

Numerical Integration: Methods based on interpolation such as Trapezoidal rule, Simsons 1/3 and 3/8 rules. Numerical differentiation: Euler's method, Modified Euler's method, Taylor's series, Runge Kutta 2nd and 4th order, Stability analysis of above methods.

UNIT 5: Object Oriented Programming: [07 Hours]

Software Evaluation, Object oriented programming paradigm, Basic concepts of object oriented programming, Benefits of OOP, Object oriented languages, Applications of OOP Beginning with C++: Structure of C++ program, Creating the source file, Compiling & linking, Basic data types, User defined data types, Symbolic constants, Declaration of variables, Dynamic initialization of variables, Reference variables, Operators in C++, Scope resolution operator, Type cast operator. Functions in C++: Function prototyping, Inline functions, Function overloading, Friend and virtual functions. Classes and Objects: Specifying a class, Defining member functions, C++ program with class, Arrays within a class, Memory allocation for objects, Constructors, Multiple constructor in class, Dynamic initialization of objects, Dynamic constructor, Destructors..

Note: OOPS hands-on should cover under Tutorial slots.

Text / Reference Books

1. S. S. Sastry, "Introductory Methods of Numerical Analysis", PHI, 1990, 3rd edition.
2. V. Rajaraman, "Computer Oriented Numerical Methods, PHI, New Delhi", 2000, 3rd Edition.
3. E. V. Krishnamurthy, and Sen S. K., "Numerical Algorithm: Computations in Science and Engg", Affiliated East West, New Delhi, 1996.
4. D. Ravichandran, "Programming with C++", TMH
5. E. Balagurusamy, "Object-Oriented Programming with C++", TMH, New Delhi, 2001, 2nd Edition
6. Yeshwant Kanetkar, "Let us C++, BPB Pub.", Delhi, 2002, 4th Edition.
7. Stroustrup Bjarne, "C++ Programming Language", Addison Wesley, 1997, 3rd Edition.
8. Horton, "Beginning C++: The Complete Language", Shroff Pub., Navi Mumbai, 1998.

Semester –IV
Image Processing and Computer Vision

BTAIPE405B	Image Processing and Computer Vision	PEC1	3L-1T-0P	4 Credits
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Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam:20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Prerequisites: Digital Signal Processing

Course Objectives:

1. To let the students learn the fundamental principles on the aspects of interdisciplinary research including acquiring, processing, analyzing, understanding and utilizing high-dimensional visual data from the real world;
2. To equip the students with the knowledge of how to develop artificial intelligent systems which automate tasks that the human visual system can do;
3. To guide the students to understand the relevant state of art technologies and gain experience throughout a variety of case studies.

Course Outcomes:

On completion of the course, students will be able to:

CO1	To implement fundamental image processing techniques required for computer vision
CO2	Understand Image formation process
CO3	To perform morphological operations on image.
CO4	Extract features form Images and do analysis of Images
CO5	To develop applications using computer vision techniques

Course Contents:

Unit 1: Introduction to Digital Image Processing [07 Hours]

Motivation & Perspective, Applications, Types of images, image file formats, Fundamentals Steps in Image Processing, Components of Image Processing System, Image digitization, Some basic relationships, Distance Measures between pixels, Image basic operation, Special Operations.

Unit 2: Image Enhancement and Transformation [08 Hours]

Image Enhancement: Introduction, Methods, Basic Intensity Transformation: Image Negatives, Log transformation, Power law Transformation, piecewise linear transformation functions, Histogram processing, Histogram Equalization and Matching.

Basics of Spatial Filters, 2D Convolution & 2D Correlation, Smoothing (LPF) (Linear: Box, Gaussian & Non Linear: Median) and Sharpening (HPF): Laplacian operators, Unsharp Masking and Highboost Filtering, Combining Spatial Enhancement Methods.

Image Transforms: Discrete Fourier transform (DFT): Definition and properties, FFT, DCT.

Unit 3: Morphological operations**[06 Hours]**

Introduction, erosion, dilation, opening, closing, Hit or Miss, boundary extraction, hole filling, connected components, the convex hull, thinning, thickening, skeletonization, and pruning.

Unit 4: Segmentation and Feature Extraction**[08 Hours]**

Segmentation: Fundamentals; Point, Line and Edge Detection; Basics of edge detection: Image gradient and operators, Thresholding: Intensity Thresholding, Global thresholding, Segmentation by region growing, region splitting and merging.

Feature Extraction: Boundary Preprocessing: Boundary Following (Tracing), Chain Codes (freeman & slope), Polygonal approximation, Signature, Boundary description: Shape number, Fourier Descriptor, Statistical Moments, Region Feature Descriptors: Topological feature, Texture.

Unit 5: Pattern Recognition**[07 Hours]**

Pattern and pattern classes, pattern classification by prototype matching (Minimum-Distance Classifier & using correlation for 2-D prototype matching), matching by structural prototype. Introduction to Bayes statistical classifiers, Introduction to Neural Network and Deep Learning.

Note: Hands-on practice of Image Processing using openCV should cover under Tutorial slots.

Text Books:

1. Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill.
2. Introductory Techniques for 3D Computer Vision, by E. Trucco and A. Verri, Publisher: Prentice Hall.
3. R. C. Gonzalez, R. E. Woods. Digital Image Processing. Addison Wesley Longman, Inc., 1992.
4. Dhananjay K. Theckedath, Image Processing using MATLAB codes, Nandu Printers and Publishers Pvt. Ltd, Third edition.

Reference Books:

1. D. H. Ballard, C. M. Brown. Computer Vision. Prentice-Hall, Englewood Cliffs, 1982.
2. Richard Szeliski, Computer Vision: Algorithms and Applications (CVAA). Springer, 2010
3. Image Processing, Analysis, and Machine Vision. Sonka, Hlavac, and Boyle. Thomson.
5. Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012
6. Mark Nixon and Alberto S. Aquado, Feature Extraction & Image Processing for Computer Vision, Third Edition, Academic Press, 2012.

Semester –IV

Internet of Things & Embedded System

BTAIPE405C	Internet of Things & Embedded System	PEC1	3L-1T-0P	4 Credits
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Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam:20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Prerequisites: Basics of microprocessor, microcontroller, C language

Course Objectives:

1. To get the understanding of the concepts of Internet of Things
2. To enable the students to build IoT applications.
3. To understand the various protocols in IoT and Networking.
4. To develop the essential programming skill required

Course Outcomes:

On completion of the course, students will be able to:

CO1	The use of concepts of IoT and its areas.
CO2	Understand the basics of C and NodeMCU
CO3	Understand the basics of Python & Raspberry Pi
CO4	Interacting with Web Services and IoT protocol
CO5	Apply the IoT in various applications.

Course Contents:

Unit-1: Introduction to IoT

[07 Hours]

Definition, characteristics of IoT, logical design of IoT, IoT communication models, IoT communication APIs: REST, Websocket, IoT Enabling Technologies: Wireless sensor networks, Cloud computing, Big data analytics, communication protocols, Embedded systems, IoT vs M2M.

Unit-2: Introduction to C and Node Mcu

[07 Hours]

C: Introduction, Data types, variable, operator, branches, loops, functions, Debugging and Optimization of C programs.

NodeMCU: 8266 Wi-Fi module, hardware and pin diagram, Interface with Arduino IDE. Interfacing of analog and digital sensors.

Unit-3: Introduction to Python and Raspberry Pi**[08 Hours]**

Python: Python IDE, Data types, variable, operator, branches, loops, functions, List, Dictionary, Writing to a File, Reading from a File, handling exceptions.

Raspberry Pi: Models of Raspberry pi, R Pi 3 hardware, GPIO pins, operating system for R pi3, Basic of Linux commands, configuring R pi3, Interfacing of Digital and Analog sensors.

Unit-4: Interacting with Web Services**[07 Hours]**

Configuring NodeMCU to connecting to server, NodeMCU interfacing with web services, configuring R pi 3 Wi-Fi and Ethernet, publishing and subscribing data from web using R pi3, interfacing R Pi 3 with twitter and whatsapp.

Unit-5: IoT Protocols**[07 Hours]**

UART, Wi-Fi, Ethernet, Bluetooth Low Energy (BLE), Message Queue Telemetry Transport (MQTT), Extensible Messaging and Presence Protocol (XMPP), Data Distribution Service (DDS), Advanced Message Queuing Protocol (AMQP).

Note: Hands-on practice of Internet of Things should cover under Tutorial slots.

Text Books:

1. Get Started With ESP8266 Programming NodeMCU Using Arduino, Up skill Learning.
2. Internet of Things with Raspberry Pi 3, ManeeshRao, pack
3. Internet of Things with ESP8266, Marco Schwartz
4. Internet of Things with Arduino Cookbook, Marco Schwartz

Reference Books:

1. Internet of Things: A Hands-On Approach- Arsheep Bahga, Vijay Madiseti
2. Raspberry Pi Cookbook for Python Programmers by Tim Cox
3. Learning Internet of Things, Peter Waher

Semester –IV

Programming in JAVA

BTAIPE405D	Programming in JAVA	PEC1	3L-1T-0P	4 Credits
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Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam:20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Basics of programming languages and Concepts of Object Oriented Programming languages.

Course Objectives:

After completion of the course, the students will be able to:

1. Apply object oriented features to real time entities.
2. Handle exceptions & implement multithreaded programs.
3. Implement database programming.
4. Design & implement GUI with event handling
5. Develop I/O & networking programs.

Course Outcomes:

On completion of the course, students will be able to:

CO1	To understand basics of JAVA
CO2	To use Packages & interfaces
CO3	To apply Exception Handling & Multithreaded Programming
CO4	To acquire Java Database Connectivity
CO5	To recognize Applet, Event Handling and AWT

Course Contents:

Unit 1: Introduction, Packages & interfaces

[8 Hours]

Features of Java, Java Virtual Machine, Byte Code, JIT Compiler, Class fundamentals, Declaring objects, Nested and Inner Classes, Introducing Methods, Constructors, Garbage Collection, Overloading Methods, Using Objects as Parameters, Returning Objects, Access Control, Understanding static & final keyword, Inheritance Basics, Using Super, Method Overriding, Abstract Classes, Using final keyword with inheritance, Arrays, Vectors, Strings, Wrapper classes, Using Command-Line Arguments.

Packages: Defining a Package, Finding Packages and CLASSPATH, A Short Package Example, Access Protection, Importing Packages, Study of java.lang & java.util packages, Interfaces: Defining an Interface, Implementing Interfaces, Variables in Interfaces, Extending Interfaces, Multiple Inheritance.

Unit 2: Exception Handling & Multithreaded Programming [07 Hours]

Exception handling fundamentals, Exception Types, Using try-catch, Multiple try-catch clauses, Nested try statements, throw, throws, finally, Built-in Exceptions, creating your own exception subclasses, The Java Thread Model, The Main Thread, Creating a Thread , Creating Multiple Threads, Using isAlive() and join(), Thread Priorities, synchronization, Suspending, Resuming, and Stopping Threads

Unit 3: Applet, Event Handling and AWT [07 Hours]

Applet: Applet Basics, An Applet Skeleton, Simple Applet Display Methods, Using the Status, Window, The HTML APPLET Tag, Passing Parameters to Applets, Event Handling: The Delegation Event Model, Event Classes, Sources of Events, Event, Listener Interfaces, Handling Mouse and Keyboard Events, Adapter Classes, Introduction to AWT , AWT classes, Window, Creating a Frame Window in an Applet, Working with Graphics.

Unit 4: Input /Output & Networking [07 Hours]

Input /Output: I/O Basics, Reading Console Input, Writing Console Output, The PrintWriter Class, Reading and Writing Files, The Stream Classes, The Byte Streams, The Character Streams, Object Serialization & deserialization, Networking: Networking Basics, The Networking Classes and Interfaces, TCP/IP Client, Sockets, TCP/IP Server Sockets, Datagrams

Unit 5: Java Database Connectivity [07 Hours]

Introduction, Types of JDBC Drivers, Driver interface & DriverManager class, Connection Interface, Statement Interface, PreparedStatement , ResultSet, JDBC Program for executing Statements & processing ResultSet, Using PreparedStatement.

Note: Hands-on practice of Programming in Java should cover under Tutorial slots.

Text / Reference Books:

1. Herbert Schildt, The Complete Reference- Java2, (Seventh Edition), Tata Mc Graw Hill.
2. Steven Holzner, Java 2 Black Book, Dream Tech Press.
3. Deitel & Deitel, Java: How to Program, PHI.
4. Bert Bates, Kathy Sierra, Head First Java, O'Reilly Media, Inc.
5. E Balagurusamy, Programming with Java, Tata Mc Graw Hill.

Semester –IV

Data Analysis Lab and Database Management System Lab

BTAIL406	Data Analysis Lab and Database Management System Lab	LC2	0L-0T-4P	2 Credits
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Teaching Scheme	Examination Scheme
Practical: 04 hrs./week	Continuous Assessment 1: 30 Marks Continuous Assessment 2: 30 Marks End Semester Examination: 40 Marks

Data Analysis Lab

List of practicals:

1. Installing R and R Studio
2. Data types, mathematical operators and functions in R.
3. Vectors, Factors, Lists, Matrix, Data Frames in R.
4. Measurement of Central Tendency Mean, Median and Mode.
5. Measurement of Variation - Range, IQR and Standard Deviation.
6. Descriptive Statistics Using psych Package.
7. One & two Sample z Test Using R
8. One & two Sample t Test Using R
9. Goodness of Fit Test Using R
10. Contingency Table Using R
11. Analysis of Variance (ANOVA) Using R
12. Central Limit Theorem Demonstration Using R
13. R Functions for Normal Distribution - rnorm, pnorm, qnorm and dnorm
14. R Functions for Binomial Distribution - rbinom, pbinom, qbinom and dbinom
15. R Functions for Poisson Distribution - rpois, ppois, qpois and dpois

Database Management System Lab

List of practical:

1. Draw E-R diagram and convert entities and relationships to relation table for a college database.
2. Perform the following:
 - a) Viewing all databases,
 - b) Creating a Database,
 - c) Viewing all Tables in a Database,
 - d) Creating Tables (With and Without Constraints),
 - e) Inserting/Updating/Deleting Records in a Table,
3. Perform the following:
 - a) Altering a Table,
 - b) Dropping/Truncating/Renaming Tables,
 - c) Backing up / restoring a Database.
4. For a given set of relation schemes, create tables and perform the following-
 - a) Simple Queries,
 - b) Simple Queries with Aggregate functions,
 - c) Queries with Aggregate functions (group by and having clause),
5. Perform queries with Date functions and String Functions
6. Perform queries with Math Functions, Join Queries- Inner Join, Outer Join and Subqueries- With IN clause, With EXISTS clause
7. Implement a columnar database using Apache Cassandra
8. Implement a document database with MongoDB
9. Design and Implement any 5 query using MongoDB
10. Write a case study for various types of NoSQL databases.

Note:

1. Lab should be in scope of hands of experience and practice related program must
2. Add case study and Live project experience if any related contents

Semester –IV
Seminar-II

BTAIS407	SEMINAR-II	Seminar	0L-0T-4P	2 Credits
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Guidelines for Seminar

The students shall study in group of two members (or individual) on some special topic beyond the scope of the syllabus under the subjects of Artificial Intelligence, Data Science, Electronics Engineering and Computer Science Engineering or inter discipline branch from current literature, by referring the current technical journal or reference books, under the guidance of the teacher. The students shall prepare his report and deliver talk on the topic for other students of his class in the presence of his guide and internal examiner. The student is permitted to use audio-visual aids or any other such teaching aids.

Continues Assessment:

The Continues Assessment for this head will consists of the report written in a technical reporting manner and presentation of the talk on the subject and will be assessed by the internal examiner appointed by the HOD of concern department of the institution.

Semester –IV
Internship - II

BTAIP408	Field Training / Internship / Industrial Training	Internship	Audit
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Guidelines for Internships

Guidelines for Field Training / Internship / Industrial Training Industrial Training:

1. To apply for a suitable Industrial Training, submit an application form to respective Organization concerned one semester before the Industrial Training Programmed commences.
2. Student can also apply through online platforms such as Internshala for industrial training.
3. Submit one copy of the offer letter for the Industrial Training to the Head of the department or Faculty coordinator (Industrial Training).
4. To complete the Industrial Training process within the specified time based on the Industrial Training Programme schedule.
5. Assessment within the Industrial Training context aims to evaluate the student's work quality and appropriateness to the field of study with reference to the learning outcomes of the Industrial Training Programme.
6. Evaluation of the students' performance should be done in the next upcoming semester.
7. Those students who fails, they can also complete online certification courses which are available at free of cost on various MOOC platforms.

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM NPTEL

Sr No	Name of Subject as per Curriculum	Course Code	Semester	SWAYAM/ NPTEL Course And Web Link	Name of Institute offering course	Relevance %	Duration of Course
1	Engineering Mathematics -III	BTBS301	III	Linear Algebra https://nptel.ac.in/courses/111/106/111106051/	IIT, Madras	90%	12 weeks
2	An Introduction to Artificial Intelligence	BTAIC302	III	Artificial Intelligence : Search Methods For Problem solving	IIT Madras	90%	12 weeks
				An Introduction to Artificial Intelligence	IIT Delhi	90%	12 weeks
3	Data Structure and Algorithm using Python	BTAIC303	III	Programming, Data Structures And Algorithms Using Python https://onlinecourses.nptel.ac.in/noc21_cs67/preview	Chennai Mathematical Institute	90%	8 week
4	Computer Architecture & Operating System	BTAIC304	III	Computer architecture and organization https://onlinecourses.nptel.ac.in/noc21_cs61/preview	IIT KHARAGPUR	100%	12Weeks
5	Digital Logic & Signal Processing	BTESC305	III	Principles Of Signals And Systems https://nptel.ac.in/courses/108/104/108104100/	IIT KANPUR	60%	12Weeks
				Digital Signal Processing https://nptel.ac.in/courses/117/102/117102060/	IIT Delhi	60%	12Weeks
6	Data Analysis	BTAI401	IV	Data Science for Engineers https://onlinecourses.nptel.ac.in/noc21_cs69/preview	IIT Madras	60%	8 week
7	Database Management System	BTAI402	IV	Database Management System https://onlinecourses.nptel.ac.in/noc19_cs46/preview	IIT Kharagpur	50%	8 week
8	Basic Human Rights	BTHM403	IV	https://nptel.ac.in/courses/109/104/109104068/	IIT KANPUR	50%	8 week
9	Probability Theory and Random Processes	BTBS404	IV	Introduction to Probability Theory and Stochastic Processes https://onlinecourses.nptel.ac.in/noc21_ma66/preview	IIT Delhi	90%	12 weeks
10	Numerical Methods and Computer Programming	BTSE405A	IV	Numerical methods and programming https://nptel.ac.in/courses/122/106/122106033/	IIT Madras	70%	12 week
11	Image Processing & Computer Vision	BTSE405B	IV	Computer Vision and Image Processing - Fundamentals and Applications https://onlinecourses.nptel.ac.in/noc21_ee23/preview	IIT Guwahati	80%	12 week
12	Internet of Things & Embedded System	BTSE405C	IV	Introduction To Internet Of Things https://nptel.ac.in/courses/106/105/106105166/	IIT Kharagpur	70%	12 Weeks
				Design for Internet of things https://nptel.ac.in/courses/108/108/108108098/	IISc Bangalore	40%	8Weeks
13	Programming In Java		IV	https://onlinecourses.nptel.ac.in/noc19_cs84/preview	IIT Kharagpur	100%	12 Weeks

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM COURSERA

Sr. No	Name of Subject as per Curriculum	Course Code	Semester	Coursera Course And Web Link	Name of Institute offering course	Relevance %	Duration of Course
1	Engineering Mathematics- III	BTBS301	III	Mathematics for Machine Learning: Linear Algebra	Imperial College Landon	25%	5 week
2	An Introduction to Artificial Intelligence	BTAIC302	III	AI For Everyone	DeepLearning.AI	50%	4 week
3	Programming, Data Structure and Algorithm using Python	BTAIC303	III	Python Data Structures https://www.coursera.org/learn/python-data	University of Michigan	70%	7 weeks
4	Computer Architecture & Operating System	BTAIC304	III	Computer Architecture	Princeton University, US	25	4 Weeks
6	Data Analysis	BTAI401	IV	Statistics with R Specialization	Duke University	50%	5 Weeks
7	Database Management System	BTAI402	IV	Database Management Essentials https://www.coursera.org/learn/database-management	University of Colorado	40%	4 weeks
9	Probability Theory and Random Processes	BTBS404	IV	Probability Theory, Statistics and Exploratory Data Analysis	National Research University Higher School of Economics	80	6 Weeks
11	Image Processing & Computer Vision	BTSE405B	IV	1) Fundamentals of Digital Image and Video Processing 2) Computer Vision Basics	1) Northwestern University 2) University at Buffalo The State University of New York	1)25 2)25	1)4 Weeks 2)4 Weeks
12	Internet of Things & Embedded System	BTSE405C	IV	Hands-on Internet of Things Specialization(4 courses included in it)	University of Illinois at Urbana-Champaign	70	4 week per course
13	Programming in JAVA	BTSE405D	IV	Core Java Specialization https://www.coursera.org/specializations/core-java#courses	Learn Quest	70%	6 week

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM Edx

Sr. No	Name of Subject as per Curriculum	Course Code	Semester	Edx Course And Web Link	Name of Institute offering course	Relevance %	Duration of Course
1	An Introduction to Artificial Intelligence	BTAI C302	III	Artificial Intelligence (AI)	Colombia University	80%	12 Week
2	Data Structure and Algorithm using Python	BTAI C303	III	1) Foundations of Data Structures	1) IIT Bombay	70%	1) 6 Weeks
				2) Algorithms and Data Structures	2) UCSan Diego	60%	2) 4 Weeks
3	Computer Architecture & Operating System	BTAI C304	III	1. Computer Organization	1. MITx	1. 20%	10 Weeks
				2. Computer Architecture	2. MITx	2. 20%	
4	Data Analysis	BTAI4 01	IV	StaStatistics and Data	MITx	60%	1 Year
5	Database Management System	BTAI4 02	IV	Databases: SQL	Stanford Online	50	8 Weeks
6	Probability Theory and Random Processes	BTBS 404	IV	Introduction to Probability	Harvard University	50	8 Weeks
7	Image Processing & Computer Vision			Image Processing and Analysis for Life Scientists	EPFLx	50	7 Weeks
8	Internet of Things & Embedded System	BTSE4 05B	IV	Design for Internet of things https://nptel.ac.in/courses/108/108/108108098/	IISc Bangalore	40	8Weeks
				IoT: from hardware to practice	ITMOx University	40	17 Weeks
9	Programming in JAVA	BTSE4 05D	IV	Introduction to Object-Oriented Programming with Java II: Object-Oriented Programming and Algorithms https://www.edx.org/course/introduction-to-java-programming-ii-object-oriented-programming	Georgia Institute of Technology	100 %	6 week
	Programming in JAVA	BTSE4 05D	IV	Introduction to Object-Oriented Programming with Java III: Exceptions, Data Structures, Recursion, and GUIs https://www.edx.org/course/introduction-to-java-programming-iii-interfaces-polymorphism-and-complexity			6 week
	Programming in JAVA	BTSE4 05D	IV	Introduction to Object-Oriented Programming with Java I: Foundations and Syntax Basics https://www.edx.org/course/introduction-to-java-programming-i-foundations-and-syntax-basics			6 week