INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTA

SYLLABI

for

B.TECH. (ARTIFICIAL INTELLIGENCE AND DATA ENGINEERING)

w.e.f. 2024-25

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA ENGINEERING

Salient Features of the curriculum:

- Provide holistic multidisciplinary education to the students.
- Facilitate the optimal AI learning environment.
- Facilitate semester long internship.
- Provide industry oriented courses specific to AI and DE.
- Enhance the personality development and soft skills of the students.
- Promote the research attitude in students.
- Make the students ready for current industry trends.

B.Tech. (Artificial Intelligence and Data Engineering)
Scheme and Syllabi

First Semester				
S. No	**Code**	**Subject**	**L-T-P**	**Credits**
1	CST101	Computer Systems and Programming	3-0-0	3
2	ECT101	Digital Design	3-1-0	4
3	AIT 101	Foundation of AI	3-0-0	3
4	HST101	Communication Skills	2-0-0	2
5	MAT101	Mathematics–I	3-1-0	4
		Labs		
6	CSP101	Computer Systems and Programming Lab	0-1-2	2
7	AIP 111	AI Tinkering Lab	0-1-2	2
8	ECP101	Digital Design Lab	0-0-2	1
9	HSP101	Communication Skills Lab	0-0-2	1
10	HSP111	Upnayan-The Induction Programme	0-1-2	2
				24

Second Semester				
S. No	**Code**	**Subject**	**L-T-P**	**Credits**
1	CST102	Data Structures and Algorithms	3-0-0	3
2	ECT102	Electronic Devices and Circuits	3-1-0	4
3	AIT 102	Foundation of Data Engineering	3-0-0	3
4	HST102	Technical Writing and Presentation Skills	1-0-0	1
5	MAT102	Discrete Mathematics	3-1-0	4
6	MMT102	Basics of Management	3-0-0	3
		Labs		
7	CSP102	Data Structures and Algorithms Lab	0-1-2	2
8	ECP102	Electronic Devices and Circuits Lab	0-0-2	1

9	AIP102	Foundation of Data Engineering Lab	0-0-2	1
10	CSP112	Python Programming Lab	0-1-2	2
11	HSP102	Technical Writing and Presentation Skills Lab	0-0-2	1
				25

Third Semester				
S. No	**Code**	**Subject**	**L-T-P**	**Credits**
1	AIT201	Digital Systems and Computer Architecture	3-0-0	3
2	CST201	Design and Analysis of Algorithms	3-0-0	3
3	AIT203	Artificial Intelligence	3-0-0	3
4	AIT205	Web and Social Media Analytics	3-0-0	3
5	MAT201	Mathematics-II	3-1-0	4
6	HST201	Social Sciences and Professional Ethics	2-1-0	3
		Labs		
7	CSP201	Design and Analysis of Algorithms Lab	0-0-2	1
8	AIP203	Artificial Intelligence Lab	0-0-2	1
9	AIP211	Web Development Lab	0-1-2	2
				23

Fourth Semester				
S. No	**Code**	**Subject**	**L-T-P**	**Credits**
1	CST202	Theory of Computation	3-1-0	4
2	CST204	Operating Systems	3-0-0	3
3	MAT202	Applied Probability and Random Processes	3-0-0	3
4	AIT202	Machine Learning	3-0-0	3
5	CST206	Database Management Systems	3-0-0	3

6	MMT202	Introduction to Entrepreneurship	3-0-0	3
		Labs		
7	CSP204	Operating Systems Lab	0-0-2	1
8	AIP202	Machine Learning Lab	0-0-2	1
9	CSP206	Database Management Systems Lab	0-0-2	1
				22

Fifth Semester				
S. No	**Code**	**Subject**	**L-T-P**	**Credits**
1	AIT301	Reinforcement Learning	3-0-0	3
2	AIT303	Data Mining and Warehousing	3-0-0	3
3	CST301	Computer Networks	3-0-0	3
4	AIT305	Data Visualization	3-0-0	3
5	CST303	Compiler Design	3-0-0	3
6	AIT307	Elective-1	3-0-0	3
		Labs		
7	CSP301	Computer Networks Lab	0-0-2	1
8	AIP305	Data Visualization Lab	0-0-2	1
9	CSP303	Compiler Design Lab	0-0-2	1
				21

Sixth Semester				
S. No	**Code**	**Subject**	**L-T-P**	**Credits**
1	AIT302	Applications of AI	3-0-0	3
2	AIT304	Natural Language Processing	3-0-0	3
3	AIT306	Big Data Analytics	3-0-0	3
4	AIT308	Deep Learning	3-0-0	3
5	AIT310	AI for Cyber Security	3-0-0	3

6	AIT312	Elective-1	3-0-0	3
		Labs		
7	AIP304	Natural Language Processing Lab	0-0-2	1
8	AIP306	Big Data Analytics Lab	0-0-2	1
9	AIP308	Deep Learning Lab	0-0-2	1
				21

Seventh Semester				
S. No	**Code**	**Subject**	**L-T-P**	**Credits**
1	AIT401	Elective–1	3-0-0	3
2	AIT403	Elective-2	3-0-0	3
3	OTT401	Open Elective-1	3-0-0	3
		Labs		
4	AIP401	Elective–1 Lab	0-0-2	1
5	AID401	Project-I	0-2-6	5
				15

Eighth Semester				
S. No	**Code**	**Subject**	**L-T-P**	**Credits**
1	AIT402	Elective–1	3-0-0	3
2	AIT404	Elective-2	3-0-0	3
3	OTT402	Open Elective-1	3-0-0	3
		Labs		
4	AIP402	Elective–1 Lab	0-0-2	1
5	AID401	Project-II	0-2-6	5
				15

Total Credits: 166

Note 1: Internship allowed either in VII sem or VIII sem

Note 2: If a student opt for an internship, all departmental elective and open elective courses in that semester will be waived off. However, he/she has to complete the Project-I / Project-II in the corresponding semester along with internship.

First Semester				
S. No	**Code**	**Subject**	**L-T-P**	**Credits**
1	CST101	Computer Systems and Programming	3-0-0	3
2	ECT101	Digital Design	3-1-0	4
3	AIT 101	Foundation of AI	3-0-0	3
4	HST101	Communication Skills	2-0-0	2
5	MAT101	Mathematics–I	3-1-0	4
		Labs		
6	CSP101	Computer Systems and Programming Lab	0-1-2	2
7	AIP 111	AI Tinkering Lab	0-1-2	2
8	ECP101	Digital Design Lab	0-0-2	1
10	HSP101	Communication Skills Lab	0-0-2	1
11	HSP111	Upnayan-The Induction Programme	0-1-2	2
				24

Course Code : CST101	**Course Credit : 3**
Course Name : Computer Systems and Programming	**L-T-P : 3-0-0**
Course Prerequisite: Nil	

Course Syllabus:

Basics: C language introduction, C language Standards, System Software, Application Software. Compiler - Compilation process - Compiler and interpreter. **[6 Lectures]**

Data Types and Storage Classes: Different data types, Storage Classes – auto, static, extern, register. Macro & Preprocessor in C. Operator Precedence and Associativity. Control Statements: If-else condition, If-else if Ladder, Switch case, Loop – for, while, do while. Nested loop, break, continue, exit, goto and problem with goto. **[10 Lectures]**

Functions: Passing arguments in main() function, Call by value, Call by reference. Array & Strings: Introduction to Array, Number type array, Character type array (String), Multi-dimensional array, Operations on strings (User defined functions for strlen, strcpy, strcmp, strrev, etc.), gets(), puts(), getc(), getch(), getchar(), putc(), putch(), putchar() functions. **[10 Lectures]**

Pointers: Introduction to pointer, Double pointer. Pointer to int, Pointer to char, Pointer to function, Function to pointer, Pointer to array, Pointer to structure, Array of pointers.Static & Dynamic Memory Allocation: malloc(), calloc(), realloc() and free() functions. **[8 Lectures]**

Structure and Union: Structure in C, Union in C, Enum operator. File Handling: Basics of working with text files, File read, write, append and other similar operations, EOF and feof() functions, File pointer, fopen(), fgetc() and fgets() functions, fputc and fprintf() functions. **[6 Lectures]**

Text/Reference Books:

1. The C Programming Language, Brian W. Kernighan and Dennis Ritchie, Latest Edition, Prentice Hall.
2. Programming in ANSI C, E. Balagurusamy, Latest Edition, McGraw Hill
3. Let us C, Yashavant Kanetkar, Latest Edition, BPB Publication

Course Outcome (CO):

CO1: To be able to understand and operate Linux the operating system.
CO2: Basic understanding of the compiler, interpreter, assembler, and library functions.
CO3: Develop the ability to implement the fundamental knowledge of mathematics and science in computer programming.
CO4: Design the flowchart of the solution and develop the computer program to solve real-life problems.
CO5: Develop the ability to analyze the problem, develop an algorithm and finally implement using the C programming language.

Course Code : ECT101	**Course Credit : 4**
Course Name : Digital Design	**L-T-P : 3-1-0**

Course Prerequisite: Nil

Course Syllabus:

Number base conversion (binary, octal, decimal, hexadecimal), Binary codes (weighted, unweighted, self-complementary), Signed and unsigned binary numbers, complements (1's, 2's, 9's, 10's), Binary arithmetic (addition, subtraction, multiplication, division), Binary logic (positive and negative logic) **[8 Lectures]**

Boolean algebra (basic theorems and properties, truth tables, DeMorgan's theorem, duality, operator precedence), Boolean function (canonical and standard forms), Digital logic gates, Boolean function simplification (2 to 4 variable Karnaugh maps, don't care conditions, Quine-McCluskey method), NAND and NOR implementation. **[9 Lectures]**

Analysis and design of combinational logic circuits (code conversion, error detector, binary adder and subtractor, look-ahead carry and BCD adders, binary magnitude comparator, decoder, encoder, priority encoder, multiplexer, demultiplexer), Programmable logic devices (design using read only memory, and programmable logic arrays). **[9 Lectures]**

Level and edge-triggered flip-flops (RS flip-flop, D flip-flop, JK flip-flop, T flip-flop, timing specifications of flip-flops, characteristic table and equation of flip-flops, excitation table of flip-flops). **[7 Lectures]**

Analysis of clocked sequential circuits (state table, state diagram, state reduction and assignment), Design of synchronous and asynchronous counters, Shift registers and its timing considerations. **[7 Lectures]**

Text/Reference Books:

1. M. Morris Mano, Michael D. Ciletti, "Digital Design", Prentice Hall, 4th Edition
2. R.P. Jain, "Modern Digital Electronics", Tata McGraw Hill, 3rd Edition
3. Albert Paul Malvino, Donald P. Leach, "Digital Principles and Applications", Tata McGraw Hill, 6th Edition
4. John F. Wakerly, "Digital Design: Principles and Practices", Pearson Education, 4th Edition

Course Outcome (CO):

CO1: Represent and convert decimal numbers in various other number systems.
CO2: Use Boolean algebra to construct, minimize and implement real time problems in digital system design.
CO3: Implement, analyze, optimize and debug design based on various logic gates.
CO4: Design and analyze circuits for digital arithmetic. To describe the operation and timing constraints for latches, Flip-flops and registers etc.

Course Code : AIT101	**Course Credit : 3**
Course Name : Foundation of AI	**L-T-P : 3-0-0**
Course Prerequisite: None	

Course Syllabus:

Vector spaces, Linear Functions, Matrix, Linear Algebra Scalars, Vectors, Matrices and Tensors, Multiplying Matrices and Vectors , Identity and Inverse Matrices, Linear Dependence and Span, Norms, Special Kinds of Matrices and Vectors, Eigen decomposition, Singular Value Decomposition, The Moore-Penrose Pseudoinverse, The Trace Operator, The Determinant, Principal Component Analysis. **[10 Lectures]**

Euclidean vector spaces, Eigenvalues and eigenvectors, Orthogonal matrices, Linear transformations, Projections, Solving systems of equations with matrices, Mathematical operations with matrices (i.e. addition, multiplication), Matrix inverses and determinants, Positive-definite matrices, Singular value decomposition, Linear dependence and independence. **[10 Lectures]**

The samples mean, the sample variance, sampling distribution from a normal population, Central Limit Theorem (Proof not expected). Parameter Estimation- Point estimator and interval estimates. Confidence interval. **[6 Lectures]**

Statistical hypothesis testing, null and alternate hypotheses. Simple and composite hypotheses, Significance Levels Types of Errors. Test concerning the mean of Normal population, Testing the equality of means of two Normal populations, Type-I and Type-II errors, Z-tests for difference of means, chi-square test, tests for correlation and regression. Testing of significance using t-test, Chi-square test and F test and Paired t-test. Analysis of Variance (one way classification only). Chi-square –test as a goodness of fit. **[10 Lectures]**

Statistical inference: statistical decision theory, statistical assumptions, estimation theory. Methods of estimation: method of moments, method of minimum variance. **[4 Lectures]**

Text/Reference Book(s):

1. Gilbert Strang, “Introduction to Linear Algebra”, Latest Edition,
2. Jim Hefferon, “Linear Algebra”, Latest Edition, Orthogonal Publishing
3. E. L. Lehmann, “Testing Statistical Hypotheses”, Latest Edition, Wiley–Blackwell
4. George Casella, “Statistical Inference”, Latest Edition.

Course Outcome (CO):

CO1: Understand the foundations of linear algebra and statistical testing for engineering applications such as machine learning, etc.
CO2: Evaluate and apply moments & linear functions and understand the concept of hypothesis testing.
CO3: Understand the concept of statistical inference and applied techniques of statistical in learning techniques.

Course Code : HST101	**Course Credit : 2**
Course Name : Communication Skills	**L-T-P : 2-0-0**

Course Prerequisite: Nil

Course Syllabus:
Basic Grammar: Sentence Construction and Types; Simple, Complex and Compound sentences; Tenses; Agreement of Subject and Verb; Conditional Sentences; Direct and Indirect Narration; Active and Passive Voice; Error Spotting; Question tags and short responses. **[9 Lectures]**
Vocabulary and Usage: Word Formation (by adding suffixes and prefixes), Confusing Word Pairs; Homophones, and Homonyms; One Word Substitution; Phrasal Verbs; Punctuation. **[4 Lectures]**
Writing Skills: Precis writing; Note-making; Expressing ideas within a restricted word limit; Email writing; Reading Comprehension. **[5 Lectures]**
Texts for Appreciation and Analysis:
Animal Farm (1945) by George Orwell. Penguin India, 2011.(ISBN: 9781502492791) and
Selected chapters from the prescribed textbook: Insights: A Course in English Literature and Language (2009) by K. Elango, Orient Blackswan Publishers:
'The Diary of a Young Girl'
'Wings of Fire'
'Our Urgent Need for Self-esteem' **[9 Lectures]**

Text/Reference Books:
1. Murphy, Raymond. English Grammar in Use, Cambridge UP. 2012.
2. Stuart Redman, English Vocabulary in Use: Pre-Intermediate and Intermediate, Cambridge UP, 2012.
3. Barker, Alan. Improve Your Communication Skills: How to Build Trust, Be Heard and Communicate with Confidence. Kogan Page, 2019.
4. Swan, Michael. Practical English Usage, Oxford UP, 2017.
5. Barnet, Sylvan, & William E. Cain. A Short Guide to Writing about Literature. Longman, 2005.
6. O'Brien, Terry. Modern Writing Skills, Rupa, 2011.

Course Outcome (CO):
CO1: Understand the essential rules of syntax in the English language.
CO2: Learn the techniques to expand the knowledge of vocabulary.
CO3: Learn to use appropriate idiomatic expressions in speech and writing.
CO4: Learn the techniques for effective written communication.
CO5: Learn to develop the skills of comprehending and analyzing a written work.

Course Code : MAT101	**Course Credit : 4**
Course Name : Mathematics - I	**L-T-P : 3-1-0**

Course Prerequisite: Nil

Course Syllabus:

Differential Calculus: Asymptotes, curve tracing (Cartesian, parametric and five polar curves-Folium of Descartes, Limacon, Cardioids, Lemniscuses of Bernoulli and Equiangular spiral and other simple polar curves). Partial differentiation, Euler's theorem on homogeneous functions, total differentiation, approximate calculation. **[8 Lectures]**

Integral Calculus – Improper integrals, Area and length of curves, Surface area and volume of solid of revolution. Multiple integrals, Change of order of integration. **[6 Lectures]**

Differential Equations – Differential equations of first order and first degree - linear form, reducible to linear form, exact form, reducible to exact form. Linear differential equations of higher order with constant coefficients. Second order ordinary differential equations with variables coefficients –Homogeneous, exact form, reducible to exact form, change of dependent variable (normal form), change of independent variable, method of variation of parameters. **[9 Lectures]**

Matrices – Rank and inverse of matrix by elementary transformations, Consistency of linear system of equations and their solution. Eigenvalues and eigenvectors. Cayley-Hamilton theorem (statement only) & its applications. **[8 Lectures]**

Numerical Analysis- Finite differences, interpolations and numerical differentiations – Forward, Backward, Central differences and relations between them, Newton's forward, backward interpolation formulas and Stirling's central difference interpolation formulas. Lagrange's interpolation formula, Numerical differentiations using Newton's forward, backward, Stirling's central difference interpolation formulas. Numerical integrations - Trapezoidal rule, Simpson's one-third rule, Simpson's 3/8 rule. **[9 Lectures]**

Text/Reference Books:

1. R.K. Jain, S.R.K. Iyengar, "Advanced Engineering Mathematics", Narosa
2. Srimanta Pal and Subodh C. Bhunia, "Engineering Mathematics", Oxford
3. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India
4. D. W. Jordan, P. Smith, "Mathematical Techniques", Oxford
5. Peter V. O'Neil, "Advanced Engineering Mathematics", Cengage Learning, New Delhi
6. B.V. Ramana, "Higher Engineering Mathematics", McGraw–Hill

Course Outcome (CO):

CO1: Understand Differential equations and its applicability in different engineering fields.
CO2: Incorporate the knowledge of calculus to support their concurrent and subsequent engineering studies.
CO3: Have the idea of matrices, its physical interpretation and applications in real life examples.
CO4: To develop mathematical skills so that students are able to apply mathematical methods & principles in solving problems from engineering fields.

Course Code : CSP101	**Course Credit : 2**
Course Name : Computer Systems and Programming Lab	**L-T-P : 0-1-2**

Course Prerequisite: Nil

Course Syllabus:

First program in C, Variable Declaration and Initialization, Scope of a variable, Use of Constant, Use of Escape sequences, Use of printf() and scanf() functions, Different data types, Use of static, extern, Use of Macro, Use of Logical and Relational operators, Operator Precedence and Associativity, Evaluation order, Post-increment and

Pre-increment, sizeof operator, If-else condition, If-else if Ladder, Switch case, Loop – for, while, do while. Nested loop, break, continue, exit. **[3 Labs]**

User defined functions, Function prototype, Argument passing, return type, Passing arguments in main() function, Evaluation order of arguments, Return multiple values from a function, Number type array, Character type array (String), Multi-dimensional array. **[3 Labs]**

Operations on strings (User defined functions for strlen, strcpy, strcmp, strrev, etc.), gets(), puts(), getc(), getch(), getchar(), putc(), putch(), putchar() functions, Call by value, Call by reference. **[2 Labs]**

Null, void pointers, Double pointer, Pointer to int, Pointer to char, Pointer to function, Function to pointer, Pointer to array, Pointer to structure, Array of pointers. **[2 Labs]**

Structure in C, Different operations on struct variables, Enum operator, malloc(), calloc(), realloc() and free() functions, Basics of working with text files, File read, write, append and other similar operations, EOF and feof() functions, File pointer, fopen(), fgetc() and fgets() functions, fputc and fprintf() functions. **[2 Labs]**

Text/Reference Books:

1. The C Programming Language, Brian W. Kernighan and Dennis Ritchie, Latest Edition, Prentice Hall.
2. Programming in ANSI C, E. Balagurusamy, Latest Edition, McGraw Hill
3. Let us C, YashavantKanetkar, Latest Edition, BPB Publication

Course Outcome (CO):

CO1: To understand and use variables, data types and functions to implement various algorithms.
CO2: To handle loop execution, if-else conditions, array and preprocessing directives.
CO3: To understand the use and implementation of arrays, structures and unions as user defined datatypes.
CO4: To handle pointer variables, static and dynamic memory allocation, array of pointers and other uses of pointers.

Course Code : AIP111	**Course Credit : 2**
Course Name : AI Tinkering Lab	**L-T-P : 0-1-2**
Course Prerequisite: None	

Course Syllabus:

<u>Part 1:</u> <u>MATLAB and Simulink for Artificial Intelligence:</u> [6 Labs]

Introduction to AI with MATLAB

Data acquisition

Preprocess and label data:

Build AI model with MATLAB

Visualize decisions and Graph plotting

Integrate AI models into Simulink

Deployment

<u>Part 2: ROBOTICS:</u> [6 Labs]

Introduction to Robots and Autonomous Systems

Getting started with Arduino Uno

Installation of Arduino IDE for coding and sample socket programming

Write the first LED on-off program and transfer it to the Arduino Uno

Connecting Ultrasonic sensor and other sensors

Practice with L298N motor controller and DC motors

Embedding and data transfer using Bluetooth module

Demonstration of an IoT application

Text/Reference Book(s):

1. AI with MATLAB: Tutorials and Examples, MathWorks
2. Shailendra Jain, "Modeling and Simulation using MATLAB - Simulink", Latest Edition, Wiley
3. Mark Geddes, Arduino Project Handbook, No Starch Press
4. Simon Monk, Programming Arduino: Getting Started with Sketches, McGraw-Hill Education, Latest Edition
5. Simon Monk, 30 Arduino Projects for Evil Genius, McGraw-Hill Education, Latest Edition

Course Outcomes (CO):

CO1: To understand the practical implementation with MATLAB and Simulink

CO2: To understand data acquisition basics

CO3: To apply and simulate simple existing AI technique in MATLAB and Simulink

CO4: To understand the microcontrollers, analog and digital sensors and motors.

CO5: To connect sensors and actuators with the microcontroller and power supply system.

CO6: Mathematical simple dynamic modelling and programming to make a working robotic prototype to develop a simple robot control system, environment perception, planning and action.

Course Code : ECP101	**Course Credit : 1**
Course Name : Digital Design Lab	**L-T-P : 0-0-2**
Course Prerequisite: Nil	

Course Syllabus:

Verification of truth table for various logic gates using TTL ICs and implementation of basic gates universal NAND and NOR gates.
Design of four bit Binary to Gray and Gray to Binary code Converter.
Design of Half and Full Adder and Subtractor circuits.
Design of Two-bit multiplier.
Design of One- and Two-bit Comparators.
Design of Even and Odd parity generator and checker.
Design of 2:1 and 4:1 MUX using basic gates, and design of 4:1 MUX using 2:1 MUX.
Design a binary to decimal and octal to decimal decoder.
Design and verification truth table of flip-flops (SR latch with NOR and NAND Gates, SR flip-flop with control input using NOR and NAND Gates).
Design and verification truth table of flip-flops (D, JK and T).
Design and implement binary ripple and synchronous up/down counters using flip-flops.
Design and implement shift registers using flip-flops.

Text/Reference Books:
1. M. Morris Mano, Michael D. Ciletti, "Digital Design", Prentice Hall, 4th Edition
2. R.P. Jain, "Modern Digital Electronics", Tata McGraw Hill, 3rd Edition

Course Outcome (CO):
CO1: Design and verify the truth table of various logic gates.
CO2: Design and analyze the universal gates using basic gates.
CO3: Design and analyses of different combinational circuits.
CO4: Design and analyses of different sequential circuits.

Course Code : HSP101	**Course Credit : 1**
Course Name : Communication Skills Lab	**L-T-P : 0-0-2**

Course Prerequisite: Nil

Course Syllabus: [12 Labs]
Active Listening, Interactive Vocabulary building, Grammar Practice
Extempore Speaking, Group discussions, Interaction on Topics Of Social & General awareness,Turncoat Debates, Grammar practice
Story Telling, Screening Select episodes/Clips from Movies/Series, Viewing Skills (Writing Activities using silent videos), Grammar practice
Jigsaw reading, Drills & training on the combined skills of Vocal, Written, Visual, & Non-verbal Communication, Grammar practice

Text/Reference Books:
1. Daniel Jones, "Cambridge English Pronouncing Dictionary", Cambridge, ELBS Cambridge
2. J. Sethi, P.V. Dhamija, "A Course in Phonetics and Spoken English", PHI Learning
3. Matthew McKay, Martha Davis, Patrick Fanning, "Messages: The Communication Skills Book", New Harbinger Publications, 3rd Edition
4. Barun K. Mitra, "Personality Development and Soft Skills", Oxford University Press

Course Outcome (CO):
CO1: Effective Communication as a Must-have skill
CO2: Receiving Information Successfully.
CO3: Transmitting Information Successfully, Effectively, & Constructively.

Course Code : HSP111	Course Credit : 2
Course Name: Upnayan-The Induction Programme	**L-T-P : 0-1-2**
Course Prerequisite: Nil	

Course Syllabus: Session 90 min each

Unit 1:

Inaugural Session: Welcome Note, Introduction to the institute, Introduction to Leadership
Session : Role of Effective studentship for a better life ahead
Introduction to the curriculum, evaluation metrics, time table and annual calendar
Ice Breaking: Knowing Each Other

Unit 2:

Recap
Understanding and Managing Change and Transition -1
Understanding and Managing Change and Transition -2
Introduction to the functioning of institution: Committees, Clubs, Events, Activities, Student Support Services
Ragging, Regulations (class rules, discipline, ragging etc
Campus tour

Unit 3:

Recap
Expand your learning styles
Study Skills -1(Introduction, Self-Evaluation, Attention Management)
Study Skills -2 (Reading, Note Making, Comprehension)
Study Skills-3 (Memory, Time Management, Test Taking Skills)

Unit 4:

Recap
Enhancing 21st Century Skills-1(Introduction and Relevance)
Enhancing 21st Century Skills-2 : Imagination and Creativity
Enhancing 21st Century Skills-3: Digital Literacy Skills
Enhancing 21st Century Skills-4: Leadership and Team Culture

Unit 5:

Getting ready for career -1
Getting ready for career -2
Evaluation and Feedback: Directions for improvement
Wrap up session

- Sharing of Experience
- An inspirational connect with an influencer
- Vote of Thanks

Second Semester				
S. No	**Code**	**Subject**	**L-T-P**	**Credits**
1	CST102	Data Structures and Algorithms	3-0-0	3
2	ECT102	Electronic Devices and Circuits	3-1-0	4
3	AIT 102	Foundation of Data Engineering	3-0-0	3
4	HST102	Technical Writing and Presentation Skills	1-0-0	1
5	MAT102	Discrete Mathematics	3-1-0	4
6	MMT102	Basics of Management	3-0-0	3
		Labs		
7	CSP102	Data Structures and Algorithms Lab	0-1-2	2
8	ECP102	Electronic Devices and Circuits Lab	0-0-2	1
9	AIP102	Foundation of Data Engineering Lab	0-0-2	1
10	CSP112	Python Programming Lab	0-1-2	2
11	HSP102	Technical Writing and Presentation Skills Lab	0-0-2	1
				25

Course Code: CST102	**Course Credit: 3**
Course Name: Data Structures and Algorithms	**L-T-P: 3-0-0**
Course Prerequisite: Basic programming in C language	

Course Syllabus:

Introduction: Concept of Data Structures, Algorithms and ADT (Abstract Data Type), Program v/s algorithms, Execution time and storage space, Complexity - time and space, Asymptotic notations: O(n), Ω(n) Q(n). [6 lectures]

Array: Array as storage element, computing address in n-dimensional array. Insertion and Deletion, Searching (Sequential and binary), Sorting (Bubble sort, Insertion, Selection, Merge sort, Quick sort, radix sort), Representation of polynomial and its applications, Representation of Sparse matrix and its applications. Linked lists: Single and double linked lists, Insertion/deletion/searching in linked lists, Comparison of arrays and linked lists, Implementation of circular lists. [9 lectures]

Stack and Queue: Stack, Queue, Circular queue, Concept of overflow and underflow, Concept of precedence and associativity in expressions, Resolving precedence of operators and association of operands, Evaluation of Expression: Infix, Prefix & Postfix notations, conversion of expression from one form to other form, Recursion: concepts, use and implementation. Strings, Hash tables (open and close), Dictionary, Sets. [10 lectures]

Trees: Concept of Trees, Binary and Multiway tree, Representing multiway tree as Binary tree, Tree Traversal, constructing Binary tree from Traversal, BST (Binary Search Tree), threaded and unthreaded BST as data structure, Insertion/Deletion/Search in BST, Heap Tree and Heap sort, Introduction to height balanced tree. [9 lectures]

Graphs: Introduction to graphs (directed and undirected), representation of graphs using adjacency matrix and list, Graph Traversals: DFS and BFS, Topological sorting. [6 lectures]

Text/Reference Books:

1. Ellis Horowitz, SartajSahni, Fundamentals of Data Structures, Computer Science Press, Latest Ed.
2. Robert Kruse, et al. Data Structures and Program Design in C, Pearson, Latest Edition.
3. Alfred V. Aho, John E. Hopcroft, and Jeffrey D. Ullman, Data Structures and Algorithms, Addison Wesley, Latest Edition.
4. Aaron M. Tenenbaum, Y. Langsam, Moshe J. Augenstein, Data Structures Using C, PHI.

Course Outcome (CO):

CO1: To understand the basic data structures and analyze them to use in different problems.
CO2: To understand the linear and nonlinear search data structures and their implementation.
CO3: Select the appropriate data structures and analyze time and space complexities.
CO4: To derive the mathematical details to compute the complexity asymptotically.
CO5: Identify different parameters to analyze and implement various types of data structures and design algorithms for solving real world problems.

Course Code: ECT102	**Course Credit: 4**
Course Name: Electronic Devices and Circuits	**L-T-P:** 3-1-0
Course Prerequisite: NIL	

Course Syllabus:

Types of materials, Characteristics of intrinsic and extrinsic semiconductors, Junction diode and its characteristics, Ideal diode and its applications (half-wave and full-wave rectifiers in voltage regulators, positive and negative clippers, positive and negative clampers), Non-ideal diode models, Zener diodes and its applications (clipper, voltage regulator), Diode capacitance and switching times, Types of diodes (LED, Varactor diode, Schottky diode, Photodiode) [8 lectures]

Bipolar Junction Transistor (BJT types, operation, configurations, characteristics), Cutoff and saturation operations, BJT switching times. [8 lectures]

Field Effect Transistor (FET types, operation, configurations, characteristics), Metal-Oxide Semiconductor FET (MOSFET types, operation, configurations, characteristics), Complimentary MOSFET (CMOS). [8 lectures]

BJT biasing and small-signal analysis of BJT amplifiers, FET biasing and small-signal analysis of FET amplifiers, Frequency response (low-frequency and high-frequency responses of amplifiers), Large-signal power amplifiers (class A, class B, class AB). [8 lectures]

Feedback (concept of negative and positive feedback, characteristics of negative feedback amplifiers, negative feedback amplifiers topologies, sinusoidal oscillators). [8 lectures]

Text/Reference Books:

1. Robert Boylestad, Louis Nashelsky, “Electronic Devices and Circuit Theory”, Prentice Hall, 7th Edition
2. Jacob Millman, Christos C. Halkias, “Integrated Electronics: Analog and Digital Circuits and Systems”, Tata McGraw Hill
3. Adel S. Sedra, Kenneth C. Smith, “Microelectronic Circuits”, Oxford University Press, 5th Edition
4. Leonard S. Bobrow, Navneet Gupta, “Foundations of Electrical Engineering”, Oxford University Press, Asian Edition
5. Donald A. Neamen, “Microelectronics: Circuit Analysis and Design”, McGraw Hill, 4th Edition

Course Outcome (CO):

CO1: Learn the essentials of semiconductor materials and devices.
CO2: Learn the operation of BJT and FET.
CO3: Learn the design and frequency-domain analysis of amplifiers using BJT and FET.
CO4: Learn the basic power amplifiers.
CO5: Learn the concept of feedback and their circuit applications.

Course Code : AIT102	Course Credit : 3
Course Name : Foundation of Data Engineering	**L-T-P : 3-0-0**
Course Prerequisite: Foundation of Learning	

Course Syllabus:

Roles in a Data Engineering project, Setting expectations, Data Engineering methodology , Business understanding, Data Requirements, Data Acquisition, Data Understanding, Data preparation, Modelling, Model Evaluation, Deployment and feedback, Data Engineering Process, Roles in a Data Engineering project **[10 Lectures]**

About Data- Data quality, Data representation, Data Models, Data Sampling, Data Visualization: Basic principles, ideas and tools for data visualization. Data Wrangling- Feature Engineering, Feature Selection **[10 Lectures]**

Data preprocessing: Data cleaning, data integration, Data Reduction, Data Transformation and Data Discretization. Evaluation of classification methods: Confusion matrix, Students T- tests and ROC curves. Exploratory Data Analysis Basic tools: plots, graphs and summary statistics of EDA, Philosophy of EDA, The Data Science Process. **[10 Lectures]**

Ethics for Data Science: Ethical guidelines for Data Scientist, Societal consequences, Ethics of data scraping and storage, Rightful use of data **[10 Lectures]**

Text/Reference Books:

1. Joe Reis, Fundamentals of Data Engineering, Latest Edition
2. Paul Crickard, Data Engineering with Python: Work with Massive Datasets to Design Data Models and Automate Data Pipelines Using Python, Latest Edition
3. Wes McKinney, Python for Data Analysis, Latest Edition

Course Outcome (CO):

CO1: To learn the basic concepts of search based searching.

CO2: To learn probabilistic learning techniques and their applications.

CO3: Well known artificial intelligence techniques implementation

CO4: Understanding and creating an expert system

Course Code: HST102	Course Credit: 1
Course Name: Technical Writing and Presentation Skills	**L-T-P:** 1-0-0
Course Prerequisite: NIL	

Course Syllabus:

Communication Strategy, Data Visualization and Delivery, Communication Across Cultures [6 lectures]

Communication to Build Brands/Values/Promise (Slogan Writing, Demos, Sales Pitch etc.), Communication in Crisis (Negotiation, Brainstorming for Deadlines, Precision in Extreme Situations) [5 lectures]

Communication in different conversations (Emails, Meetings, Interviews, Presentations, Networking), Style, Tone & Voice [5 lectures]

Types of Presentations (Formal, Informal, Speeches, Demos, etc.), Preparation, Writing, Method, and delivery, Tailoring Information to Suit the Audience) [6 lectures]

Writing to Create Quality Documents: 7Cs of Communication; Structured Writing: Paragraph Expansion, Essay, Presentation; Style, Coherence, Emphasis. [6 lectures]

Text/Reference Books:

1.Handbook of Technical Writing: Charles T Brusaw, Gerald J Alred& Walter E Oliu,
St. Martin's Press, New York.
2.Technical Writing 101: Alan S Pringle & Sarah S O'Keefe, Scriptorium Publishing Services Inc
3. Every Page is Page One: Mark Baker XLM Press
4. How to Talk to Anyone: Leil Lowndes, McGraw Hill
5. Talk Like Ted: Carmine Gallo, Pan Macmillan

Course Outcome (CO):

CO1: Confidence Building.
CO2: Effective Participation
CO3: Developing Skills for Digital Communication
CO4: Developing Critical, Independent, and Creative Thinking

Course Code : MAT102	**Course Credit : 4**
Course Name : Discrete Mathematics	**L-T-P : 3-1-0**
Course Prerequisite: NIL	

Course Syllabus:

Set theory: Definition of Sets, Venn Diagrams, complements, Cartesian products, power sets, counting principle, cardinality and countability, proofs of some general identities on sets. **[4 Lectures]**

Relation and Functions: Definition, types of relation, composition of relations, domain and range of a relation, pictorial representation of relation, properties of relation, equivalence relation partial ordering relation. Function: Definition and types of function, composition of functions), pigeonhole principle. **[5 Lectures]**

Propositional logic: Proposition logic, basic logic, logical connectives, truth tables, tautologies, contradiction, converse, inverse, contrapositive, negation, and contradiction. Deduction, Resolution, Predicates and Quantifiers, Mathematical Proofs. **[10 Lectures]**

Combinatorics: Mathematical induction, recursive mathematical definitions, basics of counting, permutations, combinations, inclusion-exclusion, recurrence relations (nth order recurrence relation with constant coefficients, Homogeneous recurrence relations, and Inhomogeneous recurrence relation), and generating function (closed form expression, properties of G.F., solution of recurrence relation using G.F, solution of combinatorial problem using G.F.) **[8 Lectures]**

Algebraic Structure: Binary composition and its properties definition of algebraic structure; Semi group, Monoid Groups, Abelian Group, properties of groups, Homomorphism, isomorphism, Permutation Groups, Sub Group, Cyclic Group, Rings and Fields (definition and standard results). **[6 Lectures]**

Graph Theory: Graph terminology, types of graph connected graphs, components of graph, Euler graph, Hamiltonian path and circuits, Graph coloring, Chromatic number. Tree: Definition, types of tree (rooted, binary), properties of trees, binary search tree, tree traversing (preorder, inorder, postorder). **[7 Lectures]**

Text/Reference Book(s):

1. J.P. Tremblay and R. Manohar, "Discrete Mathematical Structures with Applications to Computer Science", McGraw Hill.

2. Kenneth H. Rosen, "Discrete Mathematics and its Applications'', Mc.Graw Hill, 2002.

3. Grimaldi, R.P. "Discrete and Combinatorial Mathematics", Pearson Education, 2002

4. C.L.Liu, Elements of Discrete Mathematics, McGraw-Hill Book

Course Outcome (CO):

CO1: To enable the students to think logically and mathematically.
CO2: To apply mathematical reasoning in which mathematical problems could be solved.
CO3: To see the practical aspects of mathematical reasoning, combinatorial analysis, discrete structures, and mathematical modeling.
CO4: To observe the real life problems where the concepts of logic, set theory, counting, probability theory, graph theory, trees, Boolean algebra, and modeling computation can be applied.

Course Code : MMT102	**Course Credit : 3**
Course Name : Basics of Management	**L-T-P : 3-0-0**

Course Prerequisite:

Course Syllabus:

Planning, Decision-Making, Organization and Staffing: Planning – Meaning and Definition, Features, Steps in Planning Process, Approaches, Principles, Importance, Advantages and Disadvantages of Planning, Types of Plans, Types of Planning, Management by Objectives. Decision-making- Meaning, Characteristics, Decision-Making Process, Guidelines for Making Effective Decision, Types of Decisions. Organizing Process – Meaning and Definition, Characteristics, Process, Need and Importance, Principles, Span of Management. Organization Chart – Types, Contents, Uses, Limitations, Factors Affecting Organizational Chart, Organizational Structure – Line Organization, Line and Staff, Functional, Project, Matrix and Virtual. Informal Organization – Meaning, Characteristics, Importance, Limitations, Difference between Formal and Informal Organization Staffing – Meaning, Nature, Importance, Staffing Process – Manpower Planning, Recruitment, Selection, Orientation and Placement, Training, Remuneration, Performance Appraisal, Promotion and Transfer. **[15 Lectures]**

Direction, Supervision, Controlling and Coordinatiing: Direction – Definition, Nature, Need and Importance, Principles of Directing. Supervision – Role and Functions of a Supervisor, Effective Supervision, Direction and Supervision. Controlling – Meaning, Features, Importance, Control Process, Characteristics of an Effective Control System, Types of Control. Co-ordination – Characteristics, Essentials, Types and Techniques, Principles, Obstacles and Needs. **[10 Lectures]**

Motivation and Leadership, Communication, Social Responsibilities of Business: Motivation: Concept, Theories – Classical and Modern, Importance, Financial and NonFinancial Motivation, Positive and Negative

Motivation, Group Motivation. Leadership: Definition, Meaning, Factors, Theories, Principles and Leadership Styles. Communication: Definition, Meaning, Nature, Communication Process, Types and Barriers to Communication. Social Responsibility – Meaning, Definition, Features, Scope, Social Responsibly of a Manager, Interested Group – Shareholders, Workers, Customers, Creditors, Suppliers, Government, Society. Indian Business and Social Responsibility. Meaning, Definition, Elements, Scope and Dimensions, Process, Importance, Strategic Decisions and SWOT Analysis. **[15 Lectures]**

Text/Reference Books:

1. Philip Kotler, "Principles of Management", TEE Publication, Latest Edition.
2. Shyamal Bannerjee, "Principles and Practice of Management", Oxford and IBM Publishing Co.
3. MY Khan and PK Jain, "Financial Management", Tata McGraw Hill Publishing Co.
4. James AF Stoner, R Edward Freeman and Daniel R Gilbert Jr., "Management", Prentice Hall of India
5. H Koontz, C O' Daniel, "Essentials of Management", McGraw Hill Book Company

Course Outcome (CO):

CO1: Students will understand the principles of management including its functions in an organisation.
CO2: Students will learn about different types of organizational structures.
CO3: Students will inculcate leadership qualities to motivate self and others.
CO4: Students will be able to be a part of healthy work culture in an organisation and will use marketing skills for the benefit of organization .

Course Code: CSP102	**Course Credit: 2**
Course Name: Data Structures and Algorithms Lab	**L-T-P:** 0-1-2

Course Prerequisite: Basic programming in C language

Course Syllabus:

Concepts revision of C Programming Language, Data Types Revisited, Variable and Constant, Static and Dynamic Memory Allocation, Array, Pointer, Structure, Strings. [2 labs]
Sorting (Bubble sort, Selection sort, Insertion sort, Quick sort, Merge sort), Searching (Linear search and binary search). [2 labs]
Linked List (Creation, Insertion, Deletion and Search operations in Singly Linked List, Circular Linked List, Doubly Linked List and Circular Doubly Linked List). [2 labs]
Stack, Queue, Circular Queue, Priority Queue, Double Ended Queue, Infix, Prefix and Postfix expression conversion. [3 labs]
Tree (Creation of Binary and Multiway tree, Insertion, Deletion and Search in Binary Tree, Creation, Insertion, Deletion in Binary Search Tree, Inorder, Preorder and Postorder Traversal, Creation of Heap Tree, Heap sort), Graph (Creation of Directed and Undirected Graph, Depth First Traversal and Breadth First Traversal). [3 labs]

Text/Reference Books:

1.Ellis Horowitz, SartajSahni, Fundamentals of Data Structures, Computer Science Press, Latest Edition.
2.Robert Kruse, et al. Data Structures and Program Design in C, Pearson, Latest Edition.
3.Alfred V. Aho, John E. Hopcroft, and Jeffrey D. Ullman, Data Structures and Algorithms, Addison Wesley, Latest Edition.
4.Aaron M. Tenenbaum, Y. Langsam, Moshe J. Augenstein, Data Structures Using C, PHI.

Course Outcome (CO):

CO1: To implement all basic data structures in C programming language.
CO2: To implement dynamic array, stack, queue, linked list and priority queue.
CO3: To implement various sorting and searching algorithms using linear data structures.
CO4: To analyze and implement binary search trees, graphs, heaps, B-Tree, B+-Tree and other non-linear data structures to solve various computing problems.
CO5: Design algorithms and implement using the combination of linear and nonlinear data structures.

Course Code: ECP102	**Course Credit: 1**
Course Name: Electronic Devices and Circuits Lab	**L-T-P:** 0-0-2
Course Prerequisite: NIL	

Course Syllabus: [12 labs]

List of Experiments:

1. To study following: Basic circuit elements (resistor, capacitor, diode, transistor) and Basic measurements using lab equipment's (DMM, DSO, function generator, power supply).
2. To study I-V characteristics of pn junction and Zener diodes.
3. To study Positive and negative level clippers using diode.
4. To study Positive and negative clamper circuits using diode.
5. To study Voltage regulator using diode.
6. To study BJT input and output characteristics in CB configurations.
7. To study BJT input and output characteristics in CE configurations.
8. To study FET input and output characteristics.
9. To study FET transfer characteristics.
10. To study frequency response of BJT amplifier in CE configurations.
11. To study frequency response of FET amplifier.

To design an oscillator circuit.

Text/Reference Books:

1. Robert Boylestad, Louis Nashelsky, "Electronic Devices and Circuit Theory", Prentice Hall, 7th Edition
2. Jacob Millman, Christos C. Halkias, "Integrated Electronics: Analog and Digital Circuits and Systems", Tata McGraw Hill
3. Adel S. Sedra, Kenneth C. Smith, "Microelectronic Circuits", Oxford University Press, 5th Edition
4. Donald A. Neamen, "Microelectronics: Circuit Analysis and Design", McGraw Hill, 4th Edition
5. Leonard S. Bobrow, Navneet Gupta, "Foundations of Electrical Engineering", Oxford University Press, Asian Edition

Course Outcome (CO):

CO1: Understand the fundamental concepts of various electronic equipment's/components.
CO2: Utilize the various concepts of diodes for various diode circuits such as rectifiers, clippers, clampers, voltage regulators etc.
CO3: Learn and implement the various concepts of transistors.
CO4: To design oscillators.

Course Code : AIP102	**Course Credit : 1**
Course Name : Foundation of Data Engineering Lab	**L-T-P : 0-0-2**
Course Prerequisite: Basic knowledge of programming and mathematics	
Course Syllabus: Implementation in Python: Environment set-up, Jupyter overview, Python Numpy, Computation on NumPy Arrays Basics of NumPy-Computation on NumPy-Aggregations-Computation on Arrays-Comparisons, Masks and Boolean Arrays-Fancy Indexing-Sorting Arrays-Structured Data: NumPy's Structured Array Data Manipulation with Pandas, Matplotlib, Scikit tool Data processing, Implement different techniques to analyze dataset. Data Indexing and Selection Operations on Data, Handling Missing Data Vectorising different operations on Data. High-Performance Pandas: eval() and query(). Implement and analysis important statistical methods on a given data used in data science using python Basic functions of matplotlib-Simple Line Plot, Scatter Plot-Density and Contour Plots Histograms, Binnings and Density-Customizing Plot Legends, Colour Bars-Three-Dimensional Plotting in Matplotlib Data visualization: Tableau. Creating charts, Mapping data in Tableau	
Text/Reference Books: 1. Jake VanderPlas, Python Data Science Handbook - Essential Tools for Working with Data, O'Reilly Media, Inc, 2016 2. Zhang. Y, An Introduction to Python and Computer Programming, Springer Publications, 2016 3. Joel Grus, Data Science from Scratch First Principles with Python, O'Reilly Media, 2016 4. T.R.Padmanabhan, Programming with Python, Springer Publications, 2016	
Course Outcome (CO): CO1: To learn the basic concepts of data science. CO2: To learn the data analysis techniques and their applications. CO3: Understanding and creating a complete analysis system	

Course Code: CSP112	**Course Credit: 2**
Course Name: Python Programming Lab	**L-T-P:** 0-1-2
Course Prerequisite: Basic C programming and computer knowledge	
Course Syllabus: Installation of Python Tool, Introduction to Python programming Data types, Input/Output and library imports Python strings operations, Doc strings Objects - List, Tuples and Dictionaries Control flow, functions working and some advanced functions File handling and third party library integration	

Usage of image processing library

Data exchange mechanism - JSON, Understanding web services - REST APIs

Advanced part of python functions, Database interaction

Regular expressions and their uses in searching

Numpy, Matlabplot, pandas utility functions

JSON format for NoSQL database

Text/Reference Book(s):

1. John Zelle and Michael Smith, Python Programming: An Introduction to Computer Science, Franklin, Beedle& Associates Inc
2. Allen Downey, Jeff Elkner and Chris Meyers, Learning with Python: How to Think Like a Computer Scientist, Latest Edition
3. David Beazley and Brian K. Jones, Python Cookbook: Recipes for Mastering Python 3, O'Reilly Media

Course Outcome (CO): After completing the course, a student will be able:

CO1: To acquire programming skills in core Python.
CO2: To implement basic principles of python programming language and implement object-oriented concepts.
CO3: To use backend database services and make graphical user interface applications.
CO4: To handle large dataset in real-time engineering problems and develop real-time, fast and flexible solutions.

Course Code: HSP102	**Course Credit: 1**
Course Name: Technical Writing and Presentation Skills Lab	**L-T-P:** 0-0-2
Course Prerequisite: NIL	

Course Syllabus:
Exercise to Lower Anxiety, Build Confidence. [4 labs]
Exercise in Clarity of Messaging. [4 labs]
Exercise in Effective Speaking. [5 labs]
Exercise in Structured Writing. [5 labs]
Exercise in Organizing, & delivering a Memorable Presentation. [6 labs]

Text/Reference Books:

1.Handbook of Technical Writing: Charles T Brusaw, Gerald J Alred& Walter E Oliu,
St. Martin's Press, New York.
2.Technical Writing 101: Alan S Pringle & Sarah S O'Keefe, Scriptorium Publishing Services Inc
3. Every Page is Page One: Mark Baker XLM Press
4. How to Talk to Anyone: Leil Lowndes, McGraw Hill

5. Talk Like Ted: Carmine Gallo, Pan Macmillan

Course Outcome (CO):

CO1: Clear Communication
CO2: Communicating Complex Ideas & Projects effectively.
CO3: Practical application of the Lecture Content.
CO4: Building Confidence and effectiveness.