Course Structure and Evaluation Scheme
(School of Engineering)- 2024-25

Minor Degree in Computer Science offered by Computer Science & Engineering Department, HBTU Kanpur

Sl no.	Course Type	Subject Code	Course Title	Credits (L-T-P)	Sessional Marks				ESE	Total Marks
					MSE	TA	Lab	Total		
1	Minor	NCS-001	Python Programming	4 (3-1-0)	30	20	-	50	50	100
2	Minor	NCS-002	Data Structure & Algorithms	4 (3-1-0)	30	20	-	50	50	100
3	Minor	NCS-003	Web Technology	4 (3-1-0)	30	20	-	50	50	100
4	Minor	NCS-004	Data Science	4 (3-1-0)	30	20	-	50	50	100
5	Minor	NCS-005	Artificial Intelligence	4 (3-1-0)	30	20	-	50	50	100
Total Credits				**20**						**500**

PYTHON PROGRAMMING (NCS-001)

Type	L	T	P	Credits
PCC	3	1	0	4

Course Content

Unit 1: Introduction
Relationship between computers and programs, Basic principles of computers, File systems, Using the Python interpreter, Introduction to binary computation, Input / Output.
The Programming Cycle for Python, Python IDE, Interacting with Python Programs, Elements of Python, Type Conversion. Basics: Expressions, Assignment Statement, Arithmetic Operators, Operator Precedence, Boolean Expression.

Unit 2: Conditionals and Loops
Conditional statement in Python: if-else statement, its working and execution, Nested-if statement and Elif statement in Python, Expression Evaluation & Float Representation, Loops: Purpose and working of loops, while loop including its working, For Loop, Nested Loops, Break and Continue.

Unit 3: Strings and Functions Strings:
Length of the string, Concatenation and Repeat operations, Indexing and Slicing of Strings. Python Data Structure: Tuples, Unpacking Sequences, Lists, Mutable Sequences, List Comprehension, Sets, Dictionaries, Functions: Parts of a Function, Execution of a Function, Keyword and Default Arguments, Scope Rules, Higher Order Functions: Treat functions as first-class Objects, Lambda Expressions.

Unit 4: Classes and Files
Introduction, classes and objects, class method and self-argument, init() method, class and object variables, del() method, other special methods, public and private data members, private methods, calling a class method from another class method, built-in class attributes, garbage collection, class and static methods
File I/O: File input and output operations in Python Programming Exceptions and Assertions Modules: Introduction, Importing Modules, Abstract Data Types: Abstract data types and ADT interface in Python Programming, Classes: Definition and operations in the classes, Special Methods (such as _init_, _str_, comparison methods and Arithmetic methods etc.).

Unit 5: Iterators & Recursion
Recursive Fibonacci, Tower of Hanoi, Search:Simple Search, Binary Search, Estimating Search Time in Simple Search and Binary Search, Sorting & Merging: Selection Sort, Merge List, Merge Sort, Higher Order Sort.

Text Books and References

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist Updated for Python 3, Shroff/O„Reilly Publishers, 2 nd edition 2016, (http://greenteapress.com/wp/thinkpython/)
2. Guido van Rossum and Fred L. Drake Jr, An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
3. John V Guttag, ―Introduction to Computation and Programming Using Python„„„, Revised and expanded Edition, MIT Press, 2013.
4. Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd.,1 st edition 2016.
5. Timothy A. Budd, Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd., 2 nd edition 2015.
6. Kenneth A. Lambert, Fundamentals of Python: First Programs‖, CENGAGELearning, 2 nd edition 2012.

7. Charles Dierbach, Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 1 st edition 2015.
8. Paul Gries,Jennifer Campbell and Jason Montojo, Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2 nd edition 2013. Mapped With: https://ict.iitk.ac.in/product/python- programming-a-practical

Online Resources

1. https://onlinecourses.nptel.ac.in/noc21_cs32/preview
2. https://www.udemy.com/topic/python/
3. https://in.coursera.org/courses?query=python

DATA STRUCTURE & ALGORITHMS
(NCS-002)

Type	L	T	P	Credits
PCC	3	1	0	4

Course Content:

Unit -1:
Introduction to data structure: Definition of data structures, Types of Data Structures: Linear and Non-Linear Data Structure,
Algorithms: definition and introduction, Analysis of algorithms, Growth of Functions, Master's Theorem, Designing of Algorithms, Partitioning Algorithms.
Queues: Representation and implementation of queues, Operations on Queue: Create, Add, Delete, Full and Empty, Priority Queues**.**

Unit-2:
Stacks: Stack operations: Push & Pop, Implementation of Stack in C, Application of stack: Prefix and Postfix Expressions, Evaluation of postfix expression, Iteration and Recursion-Principles of recursion, Hanoi towers.
Linked list: Representation and Implementation of Singly Linked Lists, Overflow and Underflow, Insertion and deletion to/from Linked Lists, Insertion and deletion Algorithms, doubly linked list.

Unit-3:
Trees: Basic terminology used with Tree, Binary Trees, Binary Tree Representation: Array Representation and Pointer (Linked List) Representation, Binary Search Tree, Complete Binary Tree, Extended Binary Trees, Threaded Binary trees, Tree Traversal algorithms: In-order, Preorder and Post-order, Huffman coding using Binary Tree,

Unit-4:
Searching: Sequential search, binary search, Hash search, comparison and analysis, Table, Hash Functions,
Sorting: Sorting: Insertion Sort, Selection Sort, Bubble Sort, Heap Sort, Comparison of Sorting Algorithms,

Unit-5:
Graphs: Terminology used with Graph, Data Structure for Graph Representations: Adjacency Matrices, Adjacency List, Adjacency. Graph Traversal: Depth First Search and Breadth First Search, Connected Component.
Divide and Conquer with Examples Such as Merge Sort, Quick Sort, Matrix Multiplication: Strassen's Algorithm.

Text and Reference Books:

1. Cormen T. H., Leiserson C. E., Rivest R. L., and Stein C., "Introduction to Algorithms", PHI.
2. Horowitz Ellis, Sahni Sartaj and Rajasekharan S., "Fundamentals of Computer Algorithms", 2nd Edition, Universities Press.
3. Dave P. H., H.B.Dave, "Design and Analysis of Algorithms", 2nd Edition, Pearson Education.
4. Lipschuts S., "Theory and Problems of Data Structures", Schaum's Series.
5. 5. Goyal K. K., Sharma Sandeep & Gupta Atul, "Data Structures and Analysis of Algorithms", HP Hamilton.
6. Lipschutz, Data Structures With C - SIE - SOS, McGraw Hill
7. Samanta D., "Classic Data Structures", 2nd Edition Prentice Hall India.
8. Goodrich M. T. and Tomassia R., "Algorithm Design: Foundations, Analysis and Internet examples", John Wiley and sons.
9. Sridhar S., "Design and Analysis of Algorithms", Oxford Univ. Press.
10. Aho, Ullman and Hopcroft, "Design and Analysis of algorithms", Pearson Education.
11. R. Neapolitan and K. Naimipour, "Foundations of Algorithms",4th edition, Jones an Bartlett Student edition.
12. Reema Thareja, Data Structures using C, Oxford Univ. Press

13. A. M. Tenenbaum, "Data Structures using C & C++", PHI Pvt. Ltd., New Delhi.
14. K Loudon, "Mastering Algorithms with C", Shroff Publisher & Distributors Pvt. Ltd.
15. Adam Drozdek, "Data Structures and Algorithms in C++", Thomson Asia Pvt. Ltd.(Singapore)

Online References:

1. https://nptel.ac.in/courses/106102064
2. https://nptel.ac.in/courses/106106127
3. https://nptel.ac.in/courses/106105085
4. https://nptel.ac.in/courses/106103069
5. https://nptel.ac.in/courses/106106133

WEB TECHNOLOGY (NCS-003)

Type	L	T	P	Credits
PCC	3	1	0	4

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Course contents

Unit-1: Introduction

History of the web, Protocols governing the web, Growth of the Web, Web 2.0 and its features. Introduction to Cyber Laws in India, Introduction to International Cyber laws, Web project, Web Team, Team dynamics, Communication Issues, the Client, Multi departmental & large scale Websites, Quality Assurance and testing, Technological advances and Impact on Web Teams.

Unit-2:

HTML: Formatting Tags, Links, List, Tables, Frames, forms, Comments in HTML, DHTML, and Introduction to HTML 5, JavaScript: Introduction, Documents, Documents, forms, Statements, functions, objects in JavaScript, Events and Event Handling, Arrays, FORMS, Buttons, Checkboxes, Text fields and Text areas, Introduction to j-Query.

Unit-3:

XML: Document type definition, XML Schemas, Document Object model, Presenting XML, Using XML Processors: DOM and SAX parsers, Java Beans: Introduction to Java Beans, Advantages of Java Beans, BDK, Introspection, Using Bound properties, Bean Info Interface, Constrained properties, Persistence, Customizes, Java Beans API, Introduction to EJBs.

Unit-4:

Web Servers and Servlets: Tomcat web server, Introduction to Servelets: Lifecycle of a Serverlet, JSDK, The Servelet API, The javax.servelet Package, Reading Servelet parameters, Reading Initialization parameters, The javax.servelet HTTP package, Handling Http Request & Responses, Using Cookies-Session Tracking, Security Issues. Introduction to JSP: The Anatomy of a JSP Page. JSP Application Design with MVC, JSP Application Development: Generating Dynamic Content, Using Scripting Elements Implicit JSP Objects, Conditional Processing Sharing Session and Application Data Memory Usage Considerations.

Unit-5:

Real Time Communication

Database Access: Database Programming using JDBC, Studying Javax.sql.* package, Accessing a Database from a JSP Page, Application – Specific Database Actions, Deploying JAVA Beans in a JSP Page, Introduction to struts framework. Semantic Web: Introduction, growth and evolution, goals and vision, need, problems, Architecture, applications.

Text and References Books:

1. Burdman, "Collaborative Web Development", Addison Wesley.
2. Ivan Bayross, "Web Technologies Part II", BPB Publications.
3. Deitel & Deitel, "Internet and World Wide Web – How to Program", Goldberg, Pearson

Education.
4. Eric Ladd, Jim O" Donnel, Using HTML 4, XML and JAVA", Prentice Hall of India
5. Hans Bergsten, Java Server Pages, SPD O

Online Resources:
1. https://onlinecourses.swayam2.ac.in/nou24_cs09/preview
2. https://www.coursera.org/courses?query=web%20technologies

DATA SCIENCE (NCS-004)

	Type	L	T	P	Credits
	PCC	3	1	0	4

Course Outcomes.

Unit-1: **Introduction to Data Science: Basics of Data Science**
Data science, Data Analytics, Machine Learning (Supervised, Unsupervised Learning & reinforcement), Deep Learning (Artificial Neural Networks, CNN), Working with data sources – (SQL Server, .csv file, excel file etc.), Real world Applications of Machine Learning & Deep Learning, Scope of Data Science.

Unit-2: Data Analysis
Data Definitions and Analysis Techniques: Elements, Variables, and Data categorization; Levelsof Measurement; Data management and indexing; Introduction to statistical learning and Python Programming
Descriptive Statistics; Measures of central tendency; Measures of location of dispersions; Basic analysis techniques: Statistical hypothesis generation and testing; Chi-Square test; t-Test; Analysis of variance; Correlation analysis; Maximum likelihood test; Data analysis techniques: Regression analysis; Classification techniques; Clustering; Association rules analysis

Unit-3: Data Modelling
Data Modelling: Introduction; Uses of Data Modelling Tools; Three Perspectives of a Data Model; Data Modelling Techniques: Linear Regression; Non-linear models; Supported Vector Machines.

Unit-4: **Data Manipulation and Visualization: Understanding** Pandas and its architecture, getting to know Series and Data Frames, Columns and Indexes, Getting Summary Statistics of the Data, Data Alignment, Ranking & Sorting, Combining/Splitting Data Frames, Reshaping,Grouping, Data visualization (Scatter Plot, Histogram, Bar chart, Pie chart etc.)

Unit-5: Applications of Data Science
CASE STUDIES: **Banking Case Study:** Applications of Analytics in the Banking Sector; Predicting Bank-Loan Default; Predicting Fraudulent Activity; Logistic Regression Model; **Telecommunication Case Study:** Types of Telecommunications Networks; Role of Analytics in the Telecommunications Industry; Predicting Customer Churn-Network Analysis and Optimization-Fraud Detection.

Text Books and References Books

1. Lillian Pierson, "Data Science for Dummies", For Dummies; 2nd edition.
2. Joel Grus, "Data Science from Scratch: First Principles with Python", Shroff /O'Reilly; Second Edition, 2019.
3. Jake Vander Plas, "Python Data Science Handbook Essential tools for Working with Data", O'Reilly, 1st Edition, 2016.
1. Allen B. Downey, "Think Stats Exploratory Data Analysis in Python", Green Tea Press, 2nd Edition, 2014.
2. Wes McKinney, "Python for Data Analysis: Data Wrangling with Pandas and IPython" , 2nd Edition, 2014.
3. John D. Kelleher and Brendan Tierney "Data Science" The MIT Press; Illustrated edition, 2018.
4. Andrew Oleksy, "Data Science with R: A Step By Step Guide with Visual Illustrations & Examples", 2018.
5. Nina Zumel and John Mount, "Practical Data Science with R", Dreamtech /Manning, 2014
6. Roger D. Peng, "R Programming for Data Science", Lean publishing, 2015.

Online Resources

1. https://onlinecourses.nptel.ac.in/noc21_cs69/preview
2. https://www.coursera.org/specializations/introduction-data-science

ARTIFICIAL INTELLIGENCE (NCS-005)

Type L T P Credits

PCC 3 1 0   4

Course Content:

Unit-1:
Introduction to Artificial Intelligence, Brief history, various approaches to AI, Areas of application, Simulation of sophisticated & Intelligent Behaviour in different area, Problem solving in games, natural language processing, automated reasoning, and visual perception, Knowledge and its role in AI, Heuristic algorithm versus solution guaranteed algorithms, Introduction to soft computing.

Unit-2:
Representing problems in state space, informed versus uninformed search, Production System Model, Evaluation of the Production System, Depth First Search and Breadth First Search, Heuristics, Heuristic Search Techniques: Hill Climbing, Best First search, A* Algorithm, Branch and Bound, Cryptarithmetic Problem, Means End Analysis, AO* Algorithm, Game Playing: MINMAX Search, Alpha-Beta Pruning, Heuristic Estimation.

Unit-3:
Knowledge Representation and Reasoning: Propositional Logic, First Order Predicate Logic, Graphs, Associative Network, Semantic Networks, Conceptual Dependencies, Frames, Scripts, Horn Clauses, Introductory Examples from PROLOG, Case Grammar Theory, Production Rules Knowledge Base, The Interface System, Forward & Backward Deduction, Inference System in Propositional and Predicate Logic, Reasoning under Uncertainty.

Unit-4:
Understanding Natural Languages, Various Approaches of NLP, Parsing techniques, Context free and transformational grammars, Transition nets, Augmented transition nets, Fillmore's grammars, Grammar free analyzers, Sentence generation, and translation, Introduction to Pattern Recognition, Structured Description, Symbolic Description, Machine Perception, Object Identification, Speech Recognition.

Unit-5:
Expert Systems: Architecture of Expert System, Representing and using domain knowledge, Expert System Shell, Explanation System, Knowledge Acquisition System, Case study of Existing Expert Systems like DENDRAL, MYCIN, Development of a small Expert System using programming Languages and tools like LISP, PROLOG, JESS.

Text and Reference Books:

1. Charnick, "Introduction to A.I.", Addison Wesley, 1985.
2. Rich & Knight, "Artificial Intelligence", McGraw-Hill Publication, 3rd Edition, 2017.
3. Winston, Horn, "LISP", Addison Wesley, 3rd Edition, 1985.
4. Marcellous, "Expert System Programming in Turbo Prolog", PHI, 1989.
5. Lioyed, "Foundation of Logic Processing", Springer Verlag, 1984.
6. D. W. Patterson, "Introduction to Artificial Intelligence and Expert Systems", PHI, 1990.
7. N. J. Nilsson, "Artificial Intelligence: A New Synthesis", Elsevier Publications, Standard Edition, 1998

Online References:

1. https://nptel.ac.in/courses/106105077
2. https://www.coursera.org/learn/ai-for-everyone