ACADEMIC AFFAIRS OFFICE
INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

No. Acd./5310/IAPC-134 Dated: December 09 , 2023

Head, Mehta Family School of Data Science and Artificial Intelligence

The IAPC in its 134th meeting held on 17.11.2023 vide Item No. 134.2.3 (9) has approved the syllabi of following PCCs of B.Tech. in Data Science and Artificial Intelligence of New UG curriculum with modifications:

a) DAC-101: Computer Programming in C++
b) DAC-102: Computer Organization and Architecture
c) DAC-104: Programming in Python

The modified syllabi of above courses are attached as **Appendix-A.**

Assistant Registrar
(Curriculum)

Encl. Appendix-A

Copy to (through e mail):-

1. All faculty
2. Chairperson, ScAPC of Mehta Family School of Data Science and Artificial Intelligence
3. Dean, Academic Affairs
1. Associate Dean of Academic Affairs (Curriculum)
2. Deputy Registrar, Academic Affairs Office
3. Channel i/ AIS (acad.iitr.ac.in)/ Academic webpage of iitr.ac.in

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF SCHOOL: Mehta Family School of Data Science and Artificial Intelligence

1. **Subject Code:** DAC-101 **Course Title**: Computer Programming in C++
2. **Contact Hours:** **L:** 3 **T:** 1 **P:** 0
3. **Examination Duration (Hrs.):** **Theory:** 3 **Practical:** 0
4. **Relative Weightage:** **CWS:** 20-35 **PRS:** 0 **MTE:** 20-30 **ETE:** 40-50 **PRE:** 0
5. **Credits:** 4 **6. Semester:** Autumn **7. Subject Area:** PCC
8. **Pre-requisite:** Nil
9. **Objective:** To introduce the concepts of Programming in C++.
10. **Details of the Course:**

S.No.	Contents	Contact Hours
1.	**Object-Oriented Programming Concepts:** Introduction, procedural programming paradigm versus object-oriented programming paradigm, basic data types, derived data types, type modifiers, type casting, constants, tokens, keywords, identifiers, variables, concepts of object and class, data abstraction, encapsulation, data hiding, inheritance, overloading, polymorphism, file I/O, header files, pre-processor directives, concept of compiling, loading and linking	6
2.	**Control Statements:** Input and Output statements in C++, various operators, operator precedence, if-then-else, elseif statement, nested if, switch – case, break, goto, continue, for, while, do-while loops, logical operators, equality and assignment operators	10
3.	**Classes, Objects, Member Functions, and Strings:** Implementation of class, operations on objects, relationship among objects, data members, member functions, creating class objects, accessing class members, function prototypes, default parameters, access specifiers, constructors, destructors, get set functions, const member functions, function call stack, inline functions, reference parameters, this pointer, friend function, operators, function overloading, function template, recursion, arrays, dynamic arrays, pointers, pointer operators, static members, use of const keyword, friends of a class, empty classes, nested classes, local classes, abstract classes, container classes, value returning, parameter passing, pass by value, pass by reference, passing constant references, default arguments, recursive functions, static class members	14
4.	**Operator Overloading, Inheritance, Polymorphism:** Overloading of operators, base class, derived class, relationship between base class and derived class, relationship between objects in an inheritance hierarchy, virtual functions and virtual destructors, pure virtual functions	12
Total		**42**

11. Suggested Books:

S.No.	Name of Authors/Books/ Publisher	Year of Publication/Reprint
1.	Deitel P.J. and Deitel H.M., "C++ How to Program," 10th Ed., Prentice Hall Publishers	2016
2.	Stroustrup, B., "The C++ Programming Language," 4th Ed., Addison Wesley	2013
3.	Lafore, R., "Object Oreinted Programming in C++," 4th Edition, Addison Wesley – Pearson.	2021

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF SCHOOL: Mehta Family School of Data Science and Artificial Intelligence

1. **Subject Code:** DAC-102 **Course Title**: Computer Organization and Architecture
2. **Contact Hours:** **L:** 3 **T:** 1 **P:** 0
3. **Examination Duration (Hrs.):** **Theory:** 3 **Practical:** 0
4. **Relative Weightage:** **CWS:** 20-35 **PRS: 0** **MTE:** 20-30 **ETE:** 40-50 **PRE:** 0
5. **Credits:** 4 **6. Semester:** Spring **7. Subject Area:** PCC
8. **Pre-requisite:** Nil
9. **Objective:** Introductory knowledge of Boolean algebra, digital logic, sequential/memory elements and finite state machines.

10. Details of the Course

S.No.	Contents	Contact Hours
1.	Metrics for evaluating application performance, evaluating and summarizing performance, energy management approaches (e.g., DVFS)	4
2.	Floating-point number system (IEEE-754), esp. FP-16, FP-32, FP64 representations. Fixed-point and integer representation.	4
3.	Basics of cache and memory hierarchy, caches in multicore processors, translation lookaside buffer (TLB) for virtual memory, Experiments on designing cache simulator.	7
4.	A simplified RISC-based processor architecture; Instruction set, instruction types and formats; Instruction execution, instruction cycles, different types of machine cycles and timing diagram, Experiments on a simulator for the processor.	7
5.	Instruction set principles, machine instructions, types of operations and operands, encoding an instruction set, assembly language programming, addressing modes and formats for the simplified RISC-based processor	7
6.	Processor design and pipelining, pipelining hazards, superscalar/pipelined/out-of-order designs	7
7.	Systolic array for matrix multiplication, DRAM architecture	3
8.	I/O organization; I/O techniques: interrupts, polling, DMA; Synchronous vs. asynchronous I/O, Multiprocessing, multithreading and vectorization	3
Total		**42**

11. Suggested Books:

S.No.	Name of Autors/Books/ Publisher	Year of Publication/Reprint
1.	Computer Architecture: A quantitative approach (Fifth Edition), by J. L. Hennessy and D. A. Patterson, Morgan Kaufmann.	2012
2.	Computer Organization and Architecture, by S. R. Sarangi, McGraw Hill India	2014
3.	Recent relevant research papers provided by the instructor	-

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF SCHOOL: Mehta Family School of Data Science and Artificial Intelligence

1. **Subject Code:** DAC-104 **Course Title**: Programming in Python
2. **Contact Hours:** **L:** 3 **T:** 1 **P:** 0
3. **Examination Duration (Hrs.):** **Theory:** 3 **Practical:** 0
4. **Relative Weightage:** **CWS:** 20-35 **PRS:** 0 **MTE:** 20-30 **ETE:** 40-50 **PRE:** 0
5. **Credits:** 4 **6. Semester:** Spring **7. Subject Area:** PCC
8. **Pre-requisite:** Nil
9. **Objective:** To provide basic Python programming knowledge.
10. **Details of the Course**

S.No.	Contents	Contact Hours
1.	**Introduction to Python and Computer Programming:** An introduction to computer programming and Python, pros and cons of Python, IDEs, special features of Python, important libraries in Python, Operators, Variables, input/output, introduction to Jupyter notebook, Python installation	2
2.	**Data structures:** Introduction to data structures, Lists, Tuples, Dictionaries, Sets, Strings, operations and built-in functions for data structures, type conversion in data structures, collections, decorators and itertools.	8
3.	**Control structures and loops:** Introduction to control structures, if, elif and else, while loop and for loop, break and continue, looping over data structures.	4
4.	**Functions and Regular Expressions:** Introduction to functions, scope of variables, concept of recursion, lambda function, function arguments, *arg and **kwarg parameters, useful builtin functions.	6
5.	**File Handling:** Reading and writing files and file handling options to operate on files	4
6.	**Useful third party libraries – Numpy (Numerical Python):** Introduction to useful third party libraries, linear algebra and matrix operations with Numpy,	4
7.	**Useful third party libraries – Scipy (Scientific Python):** introduction and application of various packages of Scipy	4
8.	**Useful third party libraries – Pandas (Paneled Data-frame):** preparing the Pandas files, merging different files, important Pandas commands, exploratory data analysis through Pandas, interactive Pandas	6
9.	**Useful third party libraries – Matplotlib and Seaborn:** types of plots: line plot, barplot, pie plot, scatter plots etc., arrangements of plots: subplots, sizing of plots etc.	4
Total		**42**

11. Suggested Books:

S.No.	Name of Authors/Books/ Publisher	Year of Publication/Reprint
1.	Wes McKinney Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, O'Reilly	2011
2.	Andreas C. Müller and Sarah Guido Introduction to Machine Learning with Python: A Guide for Data Scientists, O'Reilly	2019
3.	Kalilur Rahman, Python Data Visualization Essentials Guide: Become a Data Visualization expert by building strong proficiency in Pandas, Matplotlib, Seaborn, Plotly, Numpy, and Bokeh, O'Reilly	2021