NATIONAL EDUCATION POLICY-2020

Common Minimum Syllabus for all Uttarakhand State Universities and Colleges for First Three Years of Higher Education

PROPOSED STRUCTURE OF
UG – COMPUTER SCIENCE
SYLLABUS

2021

Curriculum Design Committee, Uttarakhand

Sr.No.	Name & Designation	
1.	**Prof. N.K. Joshi** Vice-Chancellor , Kumaun University Nainital	Chairman
2.	**Prof. O.P.S. Negi** Vice-Chancellor , Uttarakhand Open University	Member
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Syllabus Developed By

S.No.	Name	Designation	Department	Affiliation
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Syllabus Moderated By

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6.	Dr. Manoj Kumar Bisht	Assistant Professor	Department of Computer Science	S.S.J. University, Almora

Semester-wise Titles of the Papers in Computer Science					
Year	**Semester**	**Course Code**	**Course Title**	**Theory /Practical**	**Credits**
Certificate in Science					
First Year	I	CS101	Computer Fundamentals & Problem Solving	Theory	4
		CS103	Lab: Computer Fundamentals & Problem Solving	Practical	2
			Minor Elective Paper [one from the list] EL1*	Theory	4
	II	CS102	Data Structures & Algorithms	Theory	4
		CS104	Lab: Data Structures & Algorithms	Practical	2
			Minor Elective Paper [one from the list] EL1*	Theory	4
Diploma in Science					
Second Year	III	CS201	Digital Electronics & Computer System Architecture	Theory	6
			Minor Elective Paper [one from the list] EL2**	Theory	4
	IV	CS202	Database Management System with Python	Theory	4
		CS204	Lab: Database Management System with Python	Practical	2
			Minor Elective Paper [one from the list] EL2**		
Bachelor of Science (with specialization in Computer Science)					
Third Year	V	CS301	Computer Graphics with JAVA	Theory	4
		CS303	Computer Networks	Theory	4
		CS305	Lab: Computer Graphics in JAVA	Practical	2
		CS307	Industrial Training/Research Project		Qualifying
	VI	CS302	Operating System & System Administration	Theory	4
		CS304	Information Security	Theory	4
		CS306	Lab: Operating Systems & System Administration	Practical	2
		CS308	Industrial Training/Research Project		Qualifying

*List of Elective Papers EL1			
S. No.	**Course Code**	**Course Title**	**To be Opted in the Semester**
1	CS101	Computer Fundamentals & Problem Solving	I
2	CS105E	Web Based Technologies and Multimedia Applications (SWYAM) https://onlinecourses.swayam2.ac.in/nou22_cs03/preview	I/II
3	CS106E	Introduction to Cyber Security (SWYAM) https://onlinecourses.swayam2.ac.in/nou22_cs04/preview	I/II
4	CS107E	Moodle Learning Management System (SWYAM) https://onlinecourses.swayam2.ac.in/aic20_sp27/preview	I/II
****List of Elective Papers EL2**			
S. No.	**Course Code**	**Course Title**	**To be Opted in the Semester**
1	CS201	Digital Electronics & Computer System Architecture	III
2	CS205E	PHP and MySQL (SWYAM) https://onlinecourses.swayam2.ac.in/aic20_sp27/preview	III/IV
3	CS206E	Cyber Security Tools Techniques and Counter Measures (SWYAM) https://onlinecourses.swayam2.ac.in/nou22_ge24/preview	III/IV
4	CS202	Database Management System with Python	IV

Programme Prerequisites:

1. To study Computer Science, a student must have had the subject Mathematics learnt at 10+2 level with 50% minimum passing marks/grade (overall and in mathematics).
2. Keen interest Computer Science & Technology
3. Skills and aptitude for scientific study and research
4. Creativity and good comprehension while working on scientific procedures and research

Programme Introduction

Computer Science is the study of computers and technology. Computers have been shaping the future of mankind with the great surge in technologies like machine learning and IoT in the last decade. The curriculum of our subject aims to provide any pupil in the course to understand the architecture, theory, and math behind the technologies that drive our modern world forward.

UG and PG in Computer Science facilitate the knowledge about the science behind computers and provide a platform to develop skills like programming, networking, and database administration. It also focuses on the ethics of developing and working with new technologies by providing strong arguments for green computing, security, and user privacy protection.

Programme Outcomes (POs):	
PO 1	Gain a complete exposure to the theories and practices of Computer science.
PO 2	Get transformed into a skilled learner and active programmer, enabling the students to focus on their higher studies.
PO 3	Value computer professionals and programmers.
PO 4	Explore how the concepts and applications of Computer science lead to innovative thinking with a problem-solving attitude.
Programme Specific Outcomes (PSOs) Certificate in Science	
PSO 1	Bridge the fundamental concepts of computers with the present level of knowledge of the students.
PSO 2	Illustrate the process of problem-solving using C++ and apply solutions to real world problems.
PSO 3	Apply applications for a range of problems using object-oriented programming Techniques.
PSO 4	Understand various techniques of data organisation.
Programme Specific Outcomes (PSOs) Diploma in Science	
PSO 1	Understand Digital Computer and Digital Systems.
PSO 2	Remember and understand the basics of computer organization and Design.
PSO 3	Learn fundamentals of Database Management System
PSO 4	Create, Maintain, and query MySQL database
Programme Specific Outcomes (PSOs) Bachelor of Science (with specialization in Computer Science)	
PSO 1	To Gain knowledge of the fundamentals and intermediate-level concepts of Computer Science would have enhanced

PSO 2	To understand the basics and intermediate-level soft skills.
PSO 3	To understand of the traditional and current technologies and practices in the world of Computers and digital platforms.
PSO 4	To view the real-world problems from the spectacles of conceptual knowledge of Computer Science and to develop their solutions in a technical oriented way

Year wise Structure of B.Sc. in Computer Science (CORE / ELECTIVE COURSES & PROJECTS)												
Subject: Computer Science												
Type of Programme	**Year**	**Sem**	**Paper I**	**Credit /hrs**	**Paper 2**	**Credit / hrs**	**Paper 3**	**Credits /hrs**	**Elective Paper**	**Credits /hrs**	**Research Project**	**Credit/hrs**
Certificate	I	I	Computer Fundamentals & Problem Solving	4/60	Lab: Computer Fundamentals & Problem Solving	2/60			* Minor Elective Paper [from the list] EL1	4/60		
		II	Data Structures & Algorithms	4/60	Lab: Data Structures & Algorithms	2/60						
Diploma	II	III	Digital Electronics & Computer System Architecture	6/90					** Minor Elective Paper [from the list] EL2	4/60		
		IV	Database Management System with Python	4/60	Lab: Database Management System with Python	2/60						
Bachelor of Science	III	V	Computer Graphics with JAVA	4/60	Computer Networks	4/60	Lab: Computer Graphics in JAVA	2/60			Industrial Training/Research Project	Qualifying
		VI	Operating Systems & System Administration	4/60	Information Security	4/60	Lab: Operating Systems & System Administration	2/60			Industrial Training/Research Project	Qualifying

Subject: Computer Science		
Programme/Class: Certificate	**Year:** 1st	**Semester:** I
Course Code: CS101	**Course Title:** Computer Fundamentals & Problem Solving	
Course outcomes:		
CO 1:	Bridge the fundamental concepts of computers with the present level of knowledge of the students.	
CO 2:	Familiarize operating systems, programming languages, peripheral devices, networking, multimedia and internet	
CO 3:	Understand binary, hexadecimal and octal number systems and their arithmetic.	
CO 4:	Understand the difference between the top-down and bottom-up approach and concepts of object-oriented programming in connection with C++.	
CO 5:	Illustrate the process of data file manipulations using C++ and solve complex programming situations	
Credits: 4	**Core Compulsory and Minor elective for students of other Subject/Faculty**	
Max. Marks: 25+75	**Min. Passing Marks:**	
Total No. of Lectures-Tutorials-Practical (in hours per week): 4-0-0		

Unit	Topic	No. of Lectures
I	**Introduction to Computer:** Computer System, Advantages and Disadvantages of Computer System, Evolution of computers, Generation of Computers, Classification of Computers, , Block Diagram of a Digital Computer, introduction to Input/ Output Devices.	6
II	**Memory:** Memory hierarchy, Registers (Types of Registers), Cache Memory. **Primary Memory** (RAM, how data is stored in a RAM, DRAM and SRAM. ROM (BIOS/Firmware & Types of ROM). **Secondary Memory** (Hard disk: Structure of a hard disk, how data is stored in a hard disk, concept of tracks, sectors, clusters, cylinders, Various Storage Devices (Magnetic Tape, Floppy Disks, Optical Disks, SD/MMC Memory cards, USB Pen drive).	8
III	**Software:** Software and its Need, Types of Software: - System software, Application software . **Operating System:** History of Operating System, Function of Operating System, OS classification (Batch, Multiprogramming, Multitasking, Multithreading, Multiprocessing, Multiuser, Time sharing, real time). Programming languages, **Translators:** Compiler, Interpreter and Assembler. **Network Fundamental**: Categories, Data flow, Topology.	6

IV	**Fundamentals of C++:** Data Types and Sizes, Declaration of variables, Modifiers, Identifiers and keywords, Symbolic constants. Operators, Precedence and Associativity. **Control statements**: if-else, else-if clause, switch. Loops: for, while, do-while, break, continue. **Functions**: Defining a function, function prototyping and function calls, function arguments, passing by reference, inline functions, and default arguments. **Arrays**: linear arrays, multidimensional arrays, passing arrays to functions.	8
V	**Object Oriented Concepts**: Elements of Object-Oriented programming, Objects, Classes, and OOPs features. **Classes & Objects**: Specifying a Class, Creating Objects, Accessing Class members, defining member function, Outside Member Functions as inline, Accessing Member Functions within the class, Static data member, Access Specifiers, Constructors and Destructors, 'this' Pointer	8

VI	**Operator Overloading**: Definition, Overloadable Operators, Unary and Binary Operators overloading through Member Functions and Friend Functions, Function Overloading, Constructor Overloading. **Dynamic Memory Allocation**: Pointers to Objects, Creating and Deleting Dynamic Objects: New and Delete operators, Array of Objects, Array of Pointers to Objects, Pointers to Object Members.	8
VII	Inheritance, Types of Inheritance, Virtual Functions, Pure Virtual Function, Templates, Exception Handling & File Handling.	8
VIII	Standard Template Library: STL containers containing vectors, list, queue, map, set, hash_map, hash_set. STL algorithms functions: Sorting Algorithms functions: sort, partial_sort.	8

Suggested Readings:

- Fundamentals of Computers- P. K. Sinha.
- Robert Lafore, Object Oriented Programming in C++, PHI.

Suggested equivalent online courses:

- nptel.ac.in/courses/106/105/106105151/

This course can be opted as an elective by the students of following subjects:
Students of Mathematics/Statistics/Physics

Suggested Continuous Evaluation Methods:
Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall

Internal Assessment	Marks
Class Interaction	5
Quiz/ Assignments	5
Seminar/Presentation	5
Unit Test/Class Test	10

Course Prerequisites: To study this course, a student must have had the subject Mathematics in class 12^{th}.

Subject: Computer Science			
Programme/Class: Certificate		**Year:** 1st	**Semester:** I
Course Code: CS103	**Course Title:** Lab: Computer Fundamentals & Problem Solving		
Course outcomes:	On completion of the course, the student will be able to:		
CO 1:	Develop programs with reusability.		
CO 2:	Construct programs for file handling Handle exceptions in programming.		
CO 3:	Apply applications for a range of problems using object-oriented programming Techniques.		
Credits: 2		**Core Compulsory**	
Max. Marks: 25+75		**Min. Passing Marks:**	
Total No. of Lectures-Tutorials-Practical (in hours per week): 0-0-4			

Unit	Topic	No. of Lectures
	Lab Experiment List	
	1. Study of C++ Standard library functions. 2. Implement Programs to showcase the use of branching. 3. Implement Programs to showcase the use of looping. 4. Demonstrate the uses of functions in C++. 5. Implement Programs to showcase the use of pointers. 6. Demonstrate difference in pass by value and pass by reference. 7. Implement programs to showcase the features of 1-D and 2-D Arrays. 8. Write a Program to illustrate New and Delete Keywords for dynamic memory allocation. 9. Write a program Illustrating Class Declarations, Definition, and Accessing Class Members. 10. Program to illustrate default constructor, parameterized constructor and copy constructors 11. Demonstrate OOPs Capabilities of C++. 12. Write a Program to Demonstrate the i) Operator Overloading. ii) Function Overloading. 13. Write a Program to Demonstrate Friend Function and Friend Class. 14. Write a Program to Access Members of a STUDENT Class Using Pointer to Object Members. d) Subtraction of matrices. e) Multiplication of matrices 15. Write C++ programs that illustrate how the following forms of inheritance are supported: a) Single inheritance b) Multiple inheritance c) Multi level inheritance d) Hierarchical inheritance 16. Write a C++ program that illustrates the order of execution of constructors and destructors when new class is derived from more than one base class. 17. Write a Program to Invoking Derived Class Member Through Base Class Pointer. 18. Write C++ Programs to demonstrate the power of STL Library. 19. Write a Program Containing a Possible Exception. Use a Try Block to throw it and a Catch Block to handle it properly. 20. Write a Program to Demonstrate the Catching of All Exceptions.	**60**

Suggested Continuous Evaluation Methods:
Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall

Internal Assessment	**Marks**
Record File	5
Viva Voce	5
Practical Assessment	15
Total	25

Course Prerequisites: To study this course, a student must have had the subject Mathematics in
class 12th and Computer Fundamentals & Problem Solving in 1st Semester.

Subject: Computer Science		
Programme/Class: Certificate	**Year:** 1st	**Semester:** II
Course Code: CS102	**Course Title:** Data Structures & Algorithms	
Course outcomes:	On completion of the course, the student will be able to:	
CO 1:	Understand concepts such as Data Organizations, Need of Data Structures, Types of Data Structure, Algorithm Complexity, and Time-Space trade-off.	
CO 2:	Understand and apply data structures such as Stacks, Queues, Arrays, and Linked List.	
CO 3:	Understand the concept of different searching and sorting algorithms.	
Credits: 4	**Core Compulsory**	
Max. Marks: 25+75	**Min. Passing Marks:**	
Total No. of Lectures-Tutorials-Practical (in hours per week): 4-0-0		

Unit	Topic	No. of Lectures
I	**Introduction to Data Structures & Algorithms:** Basic Terminology, Data type, Data object, Need of Data Structure, Types of Data Structure, Elementary Data Organization, Data Structure operations, Algorithm Complexity and Time-Space trade-off.	10
II	**Arrays & Linked Lists:** Arrays, Single and Multidimensional Arrays, address calculation, application of arrays, linked list: Representation and implementation of Singly Linked Lists, Header List, Traversing and Searching of Linked List, Overflow and Underflow, Insertion and deletion to and from Linked Lists, doubly linked list.	13
III	**Stacks & Queues:** Stacks: Array and linked representation and implementation of stack, Operations on Stacks: Push & Pop, Applications of stack: Conversion of Infix to Prefix and Postfix Expressions, Evaluation of postfix expression using stack. Recursion: Introduction, recursion, example of recursion, recursive functions. Queues: Array and linked representation and implementation of queues, Operations on Queue: Create, Insert, Delete, Full and Empty. Circular queue, Deques, and Priority Queues.	14
IV	**Trees & Graphs:** Trees: Basic terminology, Binary Trees, Binary tree representation, algebraic expressions, Complete Binary Tree., Traversing Binary trees, Binary Search Tree, searching BST, insertion and deletion in BST. Graph: Basic terminology, Traversal: BFS, DFS. Spanning Tree: Prims, Kruskal Algorithm, Dijkstra's Algorithm.	13
V	**Searching & Sorting:** Searching- Sequential search, binary search. Sorting algorithms with efficiency- Bubble sort, selection sort, Insertion sort, Merge sort, Quick Sort.	10

Suggested Readings:

- Data Structures- Seymour Lipschutz
- Data Structures using C and C++- Tanenbaum

Suggested equivalent online courses:

- https://nptel.ac.in/courses/106/102/106102064/
- https://nptel.ac.in/courses/106/106/106106127/

This course can be opted as an elective by the students of following subjects: NONE

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall

Internal Assessment	**Marks**
Class Interaction	5
Quiz/ Assignments	5

	Seminar/Presentation	5	
	Unit Test/Class Test	10	
	Total	25	

Course Prerequisites: To study this course, a student must have had the subject Mathematics in class 12th and Computer Fundamentals & Problem Solving in the first semester.

Subject: Computer Science			
Programme/Class: Certificate		**Year:** 1st	**Semester:** II
Course Code: CS104		**Course Title:** Lab: Data Structures & Algorithms	
Course outcomes:	On completion of the course, the student will be able to:		
CO 1:	Implement various data structures in C++		
CO 2:	Implement various Searching and Sorting algorithm in C++ and understand their performance in term of Space and Time complexity.		
CO 3:	Implement tree and graphs in C++		
Credits: 2		**Core Compulsory**	
Max. Marks: 25+75		**Min. Passing Marks:**	
Total No. of Lectures-Tutorials-Practical (in hours per week): 0-0-4			

Unit	Topic	No. of Lectures
	Lab Experiment List	
	Write a program in c++ to implement 1) 1-D, 2-D arrays and different operations in an array. 2) Operations in Singly linked list. 3) Operations in Doubly linked list. 4) Stack operations using arrays. 5) Queue operations using arrays. 6) Stack operations using linked list. 7) Queue operations using linked list. 8) Recursion. 9) Linear search. 10) Binary search. 11) Bubble sort. 12) Selection sort 13) Insertion sort 14) Merge sort 15) Quick Sort. 16) Tree traversal. 17) Graph traversal. 18) Insertion, Deletion and searching in BST.	**60**

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall

Internal Assessment	Marks
Record File	5
Viva Voce	5
Practical Assessment	15
Total	25

Subject: Computer Science		
Programme/Class: Diploma	**Year:** 2nd	**Semester:** III
Course Code: CS201	**Course Title:** Digital Electronics & Computer System Architecture	
Course outcomes:	On completion of the course, the student will be able to:	
CO 1:	Understand Digital Computer and Digital Systems.	
CO 2:	Understand the logic and applications of Boolean algebra and logic gates.	
CO 3:	Remember and understand the basics of computer organization and Design.	
Credits: 6	**Core Compulsory and Minor elective for students of other Subject/Faculty**	
Max. Marks: 25+75	**Min. Passing Marks:**	
Total No. of Lectures-Tutorials-Practical (in hours per week): 6-0-0		

Unit	Topic	No. of Lectures
I	**Fundamental concepts, Boolean algebra and logic gates:** Digital Computer and Digital Systems, Binary Numbers, Number Base Conversion, Complements, Binary Codes. Basic Theorem and Properties of Boolean Algebra, Boolean functions, Canonical and standard forms. Digital logic gates, Simplification of Boolean functions: two and three variable Maps, four variable maps.	15
II	**Combinational & Sequential Logic Design:** Adders, Subtractors, Decoder, Encoder, Multiplexers, De-Multiplexers. Flip-flops: Basic flip-flop, RS, JK, D, T. Triggering of flip-flops, Analysis of clocked sequential circuits, state reduction and assignment, flip-flop excitation tables.	15
III	**Registers, Counters and the Memory:** Registers, shift registers, Counters, Asynchronous and synchronous counters, Memory Hierarchy, Main memory (RAM/ROM chips), Concept of Cache memory and Virtual Memory.	15
IV	**Basic Computer Organization and Design:** Register Transfer Language, Arithmetic and Logical micro-operations, Shift micro-operation. Computer registers, bus system, instruction set, timing and control, instruction cycle, memory reference instructions, input-output and interrupt. Design of basic computer.	15
V	**Central Processing Unit:** Micro programmed control, Control memory, address sequencing, General Register organization, stack organization, Instruction formats, addressing modes, Data transfer and manipulation, Program Control, RISC, and CISC.	15
VI	**Input-Output Organization & Pipelining:** Peripheral devices, I/O interface, Asynchronous data transfer, Strobe Control, Handshaking Modes of Transfer, Priority Interrupt, Direct Memory Access, Input-Output Processor, and Serial Communication. Parallel processing, Amdahl's law, Pipelining, Flynn's classification, space-time diagram, speedup ratio, Arithmetic pipeline, Instruction pipeline.	15

Suggested Readings:

- Digital logic and Computer design- M. Morris Mano
- M. Mano, Computer System Architecture, Pearson Education 1992
- Carl Hamacher, Computer Organization, Fifth edition, McGraw-Hill, 2012.

Suggested equivalent online courses:

- https://nptel.ac.in/courses/108/105/108105132/
- https://nptel.ac.in/courses/106/103/106103068/

This course can be opted as an elective by the students of following subjects: Students of Mathematics/Statistics/Physics
Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks
shall

Internal Assessment	**Marks**
Class Interaction	5
Quiz/ Assignments	5
Seminar/Presentation	5
Unit Test/Class Test	10
Total	25

Course Prerequisites: To study this course, a student must have had the subject Computer
Fundamental and Problem Solving in the First Semester.

Subject: Computer Science		
Programme/Class: Diploma	**Year:** 2nd	**Semester:** IV
Course Code: CS202	**Course Title:** Database Management System with Python	

Course outcomes:	On completion of this programme, the student will be able to
CO 1:	Remember fundamentals of Database Management System
CO 2:	Understand RDBMS Concepts like Normalization and Functional Dependencies
CO 3:	Apply Normalization Concepts to create Redundancy Free Databases.
CO 4:	Understand Programming with Python
CO 5:	Create MySQL database and Evaluate MySQL queries through Python

Credits: 4	**Core Compulsory**
Max. Marks: 25+75	**Min. Passing Marks:**

Total No. of Lectures-Tutorials-Practical (in hours per week): 4-0-0

Unit	**Topic**	**No. of Lectures**
I	Introduction to database system: Characteristics of database approach, Advantages of DBMS, Database system architecture, Overview of different types of Data Models and data independence, Schemas and instances, Database languages and interfaces; E-R Model : Entities, Attributes, keys, Relationships, Roles, Dependencies, E-R Diagram.	10
II	Codd's Rules, Introduction to Relational model, Constraints: Domain, Key, Entity integrity, Referential integrity; Keys: Primary, Super, Candidate, Foreign; Relational algebra: select, project, union, intersection, cross product, different types of join operations. Normalization: Definition, Functional dependencies and inference rules, 1NF, 2NF, 3NF, BCNF;	15
III	Introduction to Python, Data Types, Python Interpreter, Strings	5
IV	Program Organization and Functions, Decorators, Lambda Functions, Variable Length Arguments, Keywords Arguments, Generators	10
V	Class and Objects, OOPs Concepts, Operator Overloading, Dunder Methods, Iterators, Exception Handling	10
VI	SQL Fundamentals, MySQL Queries, MySQL using Python, Introduction to MySQL Connector Library, Executing MySQL Queries through Python	10

Suggested Readings:

- Python the Complete Reference, Martin C. Brown
- Silberschatz & Korth,, Database system Concepts, TMH
- C.J.Date, An Introduction to Datbase System, Narosa Pub

Suggested equivalent online courses/content:

- https://nptel.ac.in/noc/courses/noc22/SEM1/noc22-cs57/
- http://docs.python.org/3/tutorial/index.html

This course can be opted as an elective by the students of following subjects:
Students of Mathematics/Statistics/Physics

Suggested Continuous Evaluation Methods:
Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall

Internal Assessment	**Marks**
Class Interaction	5
Quiz/ Assignments	5
Seminar/Presentation	5
Unit Test/Class Test	10

	Total	25

Course Prerequisites: To study this course the student must have had the subject Computer Fundamentals
and Problem Solving in First Semester.

Subject: Computer Science		
Programme/Class: Diploma	**Year:** 2nd	**Semester:** IV
Course Code: CS204	**Course Title:** Lab: Database Management System in Python	
Course outcomes:	On completion of the course, the student will be able to:	
CO 1:	Solve Computer Problems using Python.	
CO 2:	Create and Analyze MySQL Databases with/without python.	
Credits: 2	**Core Compulsory**	
Max. Marks: 25+75	**Min. Passing Marks:**	
Total No. of Lectures-Tutorials-Practical (in hours per week): 0-0-4		

Unit	Topic	No. of Lectures
	Lab Experiment List	
	1. Creation of databases and execution of SQL queries. 2. Creation of Tables using MySQL: Data types, Creating Tables (along with Primary and Foreign keys), 3. Altering Tables and Dropping Tables. 4. Practicing DML commands- Insert, Select, Update, Delete. 5. Practicing Queries using ANY, ALL, IN, EXISTS, NOT, EXISTS, UNION, INTERSECT, and CONSTRAINTS, etc. 6. Practice Queries using COUNT, SUM, AVG, MAX, MIN, GROUP BY, HAVING, VIEWS Creation and Dropping. 7. Demonstrate the use of branching in python. 8. Demonstrate the use of looping in python. 9. Demonstrate the use of functions in python. 10. Demonstrate the use of *aargs, **kwargs in python. 11. Demonstrate the use of lambda functions in python. 12. Implement programs in python to demonstrate the uses of string data type. 13. Implement programs in python to demonstrate the uses of list, tupple, set and dictionary data types. 14. Demonstrate the OOPs Capabilities of python. 15. Implement the following data Structures in python: a) Linked List. b) Graph c) BST 16. Write a program in python to create a link to a local database. 17. Implement Queries given in 2,3,4,5,6 using Python.	**60**

Suggested Continuous Evaluation Methods:
Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall

Internal Assessment	Marks
Record File	5
Viva Voce	5
Practical Assessment	15

Subject: Computer Science			
Programme/Class: Bachelor of Science		**Year:** 3rd	**Semester:** V
Course Code: CS301		**Course Title:** Computer Graphics with JAVA	
Course outcomes:	On completion of this programme, the student will be able to		
CO 1:	Remember the fundamentals of generating graphics using a computer		
CO 2:	Understand various 2D shapes drawing Algorithms.		
CO 3:	Analyze various Computer Graphics Transformation Operations.		
CO 4:	Remember the fundamentals of JAVA programming.		
CO 5:	Understand the workings of JVM.		
CO 6:	Create programs to demonstrate the various Computer Graphics Algorithms.		
Credits: 4		**Core Compulsory**	
Max. Marks: 25+75		**Min. Passing Marks:**	
Total No. of Lectures-Tutorials-Practical (in hours per week): 4-0-0			

Unit	Topic	No. of Lectures
I	Basic elements and Applications of Computer Graphics. Graphics Hardware, Video Display Devices,Architecture of Raster and Random scan display devices, Input devices, Hard-copy devices, Graphics software. Line Drawing Algorithms: DDA Algorithm, Bresenham's Line algorithm, Circle Generating,Algorithms: Midpoint Circle Algorithm. Filled-Area Primitives: Scan-line polygon fill algorithm, Inside-Outside Tests, boundary Fill Algorithm, Flood- Fill algorithm.	12
II	Basic Transformations- Translation, Rotation, Scaling. Matrix representations and Homogeneous Coordinates, Composite Transformations. Other Transformations: Reflection, Shearing. The Viewing Pipeline, Clipping operations: Point clipping, Line Clipping: Cohen Sutherland line clipping, Liang-Barsky line clipping, Nicholl-lee-Nicholl line clipping, Polygon Clipping: Sutherland-Hodgeman Polygon Clipping, Weiler-Atherton Polygon Clipping, Curve Clipping, Text Clipping, Exterior Clipping.	15
III	3-D display methods: Parallel projection, Perspective projection, Depth cueing, Visible line and surface identification, Surface rendering. Basic Transformations- Translation, Rotation, Scaling.	12
IV	Introduction to JAVA, JVM, JRE, Garbage Collectors, Structure of a JAVA Program, Data Types,Variables, Operators, Keywords, Naming Conventions Loops, Arrays.Memory Allocation, OOPs Concepts using JAVA, Methods, final keyword Abstract classes and interfaces, Packages, JAVA Built-In Packages, Exception Handling.	9
V	Introduction to AWT and Swing, JFrame and JPanel, Listener and Adapter Classes, Swing Components, Event and Delegation Model, Graphics API Methods, drawing shapes using Graphics API. Implementing Graphics Algorithms for Line Drawing(DDA, Bresenhams), Circle Drawing(Mid-Point), ScanLine Polygon Fill in JAVA, 3D Graphics in JAVA.	12

Suggested Readings:

- Computer Graphics via Java by Ian Ferguson
- D.Hearn, Baker: Computer Graphics, Prentice Hall of India 2008

Suggested equivalent online content/courses:

- https://nptel.ac.in/courses/106/106/106106090/
- https://nptel.ac.in/courses/106/103/106103224/
- https://nptel.ac.in/courses/106/105/106105191/

- https://onlinecourses.nptel.ac.in/noc22_cs47/preview

This course can be opted as an elective by the students of following subjects: NONE

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall

Internal Assessment	**Marks**
Record File	5
Viva Voce	5
Practical Assessment	15
Total	25

Course Prerequisites: Diploma with Computer Science as a Major Subject

Subject: Computer Science			
Programme/Class: Bachelor of Science		**Year:** 3rd	**Semester:** V
Course Code: CS303		**Course Title:** Computer Networks	
Course outcomes:	On completion of the course, the student will be able to:		
CO 1:	Remember the fundamentals of Networking		
CO 2:	Understand Networking Models.		
CO 3:	Evaluate various Networking Devices and understand their workings.		
CO 4:	Analyze Technologies and Protocols of First Four Layers of OSI Models.		
Credits: 4			**Core Compulsory**
Max. Marks: 25+75			**Min. Passing Marks:**

Total No. of Lectures-Tutorials-Practical (in hours per week):
4-0-0

Unit	Topic	No. of Lectures
I	Network definition - Layered network architecture, OSI reference model, TCP/IP Model, Comparison between OSI and TCP/IP.	10
II	Analog and digital signal, data-rate limits, digital to digital line encoding schemes, PCM, digital to analog modulation, multiplexing techniques- FDM, TDM,transmission media, repeaters and hubs	12
III	Framing and Flow control, Stop-And-Wait ARQ, Go-Back-N ARQ, Multiple Access Protocol and Networks:-CSMA/CD protocols,Ethernet LANS, connecting LAN, Bridges and Switches	12
IV	Circuit switching, packet switching- connection-less datagram switching, connection-oriented virtual circuit switching, dial-up modems, digital subscriber line, cable TV for data transfer.	12
V	Networks Layer Functions and Protocols, Distance vector routing and link state routing, IP protocol (IP4), Transport Layer Functions and Protocols, TCP Protocol overview. Routers and Gateways	14

Suggested Readings:

- B. A. Forouzan: Data Communications and Networking, Fourth edition, THM ,2007
- James F. Kurose, Keith W. Ross, “Computer Networking”, Pearson Education

Suggested equivalent online courses:

- https://nptel.ac.in/noc/courses/noc22/SEM1/noc22-cs19/
- https://nptel.ac.in/courses/106/105/106105183/

This course can be opted as an elective by the students of following subjects: NONE

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall

Internal Assessment	Marks
Class Interaction	5
Quiz/ Assignments	5
Seminar/Presentation	5
Unit Test/Class Test	10
Total	25

Course Prerequisites: Diploma with Computer Science as a Major Subject

Subject: Computer Science		
Programme/Class: Bachelor of Science	**Year:** 3rd	**Semester:** V
Course Code: CS305	**Course Title:** Lab: Computer Graphics in Java	
Course outcomes:	On completion of the course, the student will be able to:	
CO 1:	Solve Computer Problems using Java.	
CO 2:	Implement various Computer Graphics Algorithm using Java Graphics API.	
Credits: 4	**Core Compulsory**	
Max. Marks: 25+75	**Min. Passing Marks:**	
Total No. of Lectures-Tutorials-Practical (in hours per week): 0-0-4		

Unit	Topic	No. of Lectures
	Lab Experiment List	
	1. Implement programs to demonstrate branching in JAVA. 2. Implement programs to demonstrate looping in JAVA. 3. Demonstrate the use of OOPs Features in JAVA. 4. Demonstrate the use of static fields and methods. 5. Implement programs to showcase different uses of final keyword. 6. Demonstrate the role of different types of Constructors in JAVA. 7. Implement programs to showcase the features of exception handling in JAVA. 8. Demonstrate the difference between managed and unmanaged exceptions. 9. Write programs for making Custom Exceptions. 10. Implement the following data Structures in using Collection Framework: Graph, AVL Tree, HashSet. 11. Write Programs to demonstrate features of JAVA AWT. 12. Write Programs to demonstrate features of JAVA Swing. 13. Write a Program to draw various 2D shapes using JAVA Graphics API. 14. Implement following Graphics Algorithms in JAVA a) DDA Line Drawing Algorithm. b) Bresenham's Line Drawing Algorithm. c) Mid-Point Algorithm. d) Polygon Fill Algorithm. 15. Write a Program in JAVA to create a Simple Image Drawing Program	**60**

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall

Internal Assessment	Marks
Record File	5
Viva Voce	5
Practical Assessment	15

Subject: Computer Science			
Programme/Class: Bachelor of Science		**Year:** 3rd	**Semester:** VI
Course Code: CS302	**Course Title:** Operating System & System Administration		
Course outcomes:	On completion of the course, the student will be able to:		
CO 1:	Understand fundamental operating system abstractions such as processes, threads, files, semaphores, IPC abstractions, shared memory regions, etc.,		
CO 2:	Analyze important algorithms eg. Process scheduling and memory management algorithms		
CO 3:	Categorize the operating system's resource management techniques, dead lock management techniques, memory management techniques		
CO 4:	Demonstrate the ability to perform System Administration tasks in LINUX		
Credits: 4		**Core Compulsory**	
Max. Marks: 25+75		**Min. Passing Marks:**	
Total No. of Lectures-Tutorials-Practical (in hours per week): 4-0-0			

Unit	Topic	No. of Lectures
I	Introduction: Basics of Operating Systems: Definition – Generations of Operating systems – Types of Operating Systems, OS Service, System Calls. Process Management: Processes: Definition, Process Relationship, Process states, Process State transitions, Process Control Block, Context switching – Threads – Concept of multithreads. Process Scheduling: Definition, Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time (Definition only), Scheduling algorithms: Pre-emptive and Non, pre-emptive, FCFS – SJF – RR	12
II	Inter-process Communication: Race Conditions, Critical Section, Mutual Exclusion, Peterson's Solution, The Producer Consumer Problem, Semaphores, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc. Deadlocks: Definition, Deadlock characteristics, Deadlock Prevention, Deadlock Avoidance: banker's algorithm, Deadlock detection and Recovery.	10
III	Memory Management: Basic Memory Management: Definition, Logical and Physical address map, Memory allocation: Contiguous 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 (Concepts only), Page Replacement policies: Optimal (OPT), First in First Out (FIFO, Least Recently used (LRU).	10
IV	I/O Management & Disk Scheduling: I/O Devices and the Organization of I/O Disk I/O, Disk Scheduling Algorithm, Operating System Design Issues. File System: File Concept, File Organization and Access Mechanism, File Directories, File Sharing, Implementation Issues.	10

V	Unix Administration: Overview of System Administration – System Administrator Responsibilities, A Brief History of Unix. User Administration – what is a user, the /etc/passwd file, groups, the /etc/group file, passwords adding, deleting and modifying user attributes, /etc/profile file, the login process, /etc/motd file, the wall command. File System Basic - The Hierarchy, files, directories, device files, character and block devices, the /dev directory, links, symbolick links, a file system tour, df command, du command, find	8

	command. Disk Management – Makin a file system, mkfs command, mount command fstab file, fsck command, lost+found directory, prtvtoc command. Unix Process – overview, process space, process table, fork/exec mechanism, ps command, background process, kill command, scheduling jobs, the cron daemon, at command, crontab command, cron files. Configuring TCP/IP - /etc/hosts file, ifconfig command. /etc/services/ file, inetd daemon, /etc/inetd.conf, TCP/IP troubleshooting, the ping and netstat commands. Network Utilities- Network Services, telnet, ftp, rcp, rlogin, rsh.	
VI	Shell introduction and Shell Scripting: What is shell and various type of shell, Various editors present in linux, Different modes of operation in vi editor. What is shell script, Writing and executing the shell script, Shell variable (user defined and system variables) System calls, Using system calls, Pipes and Filters, Decision making in Shell Scripts (If else, switch), Loops in shell, Functions, Utility programs (cut, paste, join, tr , uniq utilities), Pattern matching utility (grep)	10

Suggested Readings:

- Andrew S. Tanenbaum and Herbert Bos,"Modern Operating Systems," Fourth Edition, Pearson, 2014.
- Abraham Silberschatz, Greg Gagne, and Peter B. Galvin, "Operating System Concepts," Tenth Edition, Wiley, 2018.
- William Stallings, "Operating Systems: Internals and Design Principles," Seventh Edition, Prentice Hall, 2011.
- Milan Milankovic "Operating systems, Concepts and Design" McGraw Hill

Suggested equivalent online courses:

- https://nptel.ac.in/courses/106/105/106105214/
- https://nptel.ac.in/courses/106/108/106108101/

This course can be opted as an elective by the students of following subjects: NONE

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall

Internal Assessment	**Marks**
Class Interaction	5
Quiz/ Assignments	5
Seminar/Presentation	5
Unit Test/Class Test	10
Total	25

Course Prerequisites: Diploma with Computer Science as a Major Subject

Subject: Computer Science		
Programme/Class: Bachelor of Science	**Year:** 3rd	**Semester:** VI
Course Code: CS304	**Course Title:** Information Security	
Course outcomes:	On completion of the course, the student will be able to:	
CO 1:	Formulate information security governance, and related legal and regulatory issues.	
CO 2:	Able to device how threats to an organization are discovered, analyzed, and dealt with.	
CO 3:	Evaluate network security threats and countermeasures.	
CO 4:	Understand network security and Acquire the knowledge of advanced security issues.	
Credits: 4	**Core Compulsory**	
Max. Marks: 25+75	**Min. Passing Marks:**	

Total No. of Lectures-Tutorials-Practical (in hours per week): 4-0-0

Unit	Topic	No. of Lectures
I	Introduction to Computer security, Computer Security Concepts (CIA), Threats, Attacks, and Assets, Computer criminals, Security services, Security mechanism.	12
II	Cryptography, Substitution ciphers, Transpositions Cipher, Confusion, diffusion, Symmetric, Asymmetric Encryption. DES, Modes of DES, Hash function, key exchange, Digital Signatures, Digital Certificates	12
III	Program Security: Secure Programs, Non malicious Program Errors, Viruses and other malicious code, Targeted Malicious code, Control against Program Threats, Trap doors, Salami Attacks, Vulnerabilities and protections.	12
IV	Threats, Protection in OS: Memory and Address Protection, Access control, File Protection, User Authentication, Database Security.	12
V	Network Security: Network security issues, Threats in Network, Sniffing, IP spoofing, Common threats, E-Mail security, IPSec, SSL, PGP, Intruders, Virus, Worms, Firewalls-need and features of firewall, Types of firewall, Intruder Detection Systems.	12

Suggested Readings:

- C. P. Pfleeger, S. L. Pfleeger; Security in Computing, Prentice Hall of India, 2006
- W. Stallings; Network Security Essentials: Applications and Standards, 4/E, 2010

Suggested equivalent online courses:

- https://nptel.ac.in/courses/106/106/106106129/

Internal Assessment	Marks
Class Interaction	5
Quiz/ Assignments	5
Seminar/Presentation	5
Unit Test/Class Test	10

This course can be opted as an elective by the students of following subjects:NONE

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall

Course Prerequisites: Diploma with Computer Science as a Major Subject

Subject: Computer Science		
Programme/Class: Bachelor of Science	**Year:** 3rd	**Semester:** VI
Course Code: CS306	**Course Title:** Lab: Operating Systems & System Administration	
Course outcomes:	On completion of the course, the student will be able to:	
CO 1:	Use of Linux operating system and able to write shell programs.	
CO 2:	Simulate and demonstrate the concepts of operating systems.	
Credits: 2	**Core Compulsory**	
Max. Marks: 25+75	**Min. Passing Marks:**	
Total No. of Lectures-Tutorials-Practical (in hours per week): 0-0-4		

Unit	Topic	No. of Lectures
	Lab Experiment List	
	Note: Following exercises can be performed using Linux or Unix **1.** Usage of following commands: ls, pwd, tty, cat, who, who am I, rm, mkdir, rmdir, touch, cd. **2.** Usage of following commands: cal, cat(append), cat(concatenate), mv, cp, man, date. **3.** Usage of following commands: chmod, grep, tput (clear, highlight), bc. **4.** Write a shell script to check if the number entered at the command line is prime or not. **5.** Write a shell script to modify “cal” command to display calendars of the specified months. **6.** Write a shell script to modify “cal” command to display calendars of the specified range of months. **7.** Write a shell script to accept a login name. If not a valid login name display message – “Entered login name is invalid”. **8.** Write a shell script to display date in the mm/dd/yy format. **9.** Write a shell script to display on the screen sorted output of “who” command along with the total number of users. **10.** Write a shell script to display the multiplication table any number, **11.** Write a shell script to compare two files and if found equal asks the user to delete the duplicate file. **12.** Write a shell script to check whether the file have all the permissions or not. **13.** Simulate FCFS CPU scheduling algorithm in Python **14.** Simulate SJF CPU scheduling algorithm in Python. **15.** Simulate Priority CPU scheduling algorithm in Python. **16.** Simulate Round Robin CPU scheduling algorithm in Python. **17.** Simulate FIFO page replacement algorithm in Python. **18.** Simulate LRU page replacement algorithm in Python.	**60**

Suggested Continuous Evaluation Methods:
Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall

Internal Assessment	**Marks**
Record File	5
Viva Voce	5
Practical Assessment	15
Total	25

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