

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly known as West Bengal University of Technology)

Syllabus of *B.Sc. in Cyber Security*

Effective from academic session 2023-2024

SEMESTER 3

Python Programming & Python Programming Lab

Credits- 3+2

Course Code FYCYS 301 (Theory) + FYCYS 391 (Practical)

Course Objective: The course is designed to provide a working knowledge and skills of programming with Python language. Students will be able to develop logics which will help them to create programs. Also by learning the basic programming constructs they can easily be able to grasp any other new computer languages in future.

SI	Course Outcome (CO)
1	Explain the basic concepts of Python
2	Explain the different conditions and iterations of Python
3	Explain the concept of recursion, string, dictionary, list and tuples using Python
4	Explain the concept of class and object.

Theory

CO	Blooms Level	Total Hours	%age of questions
CO1	2,3	12	20
CO2	2,3	8	20
CO3	2,3	10	30
CO4	2,3	10	30
		40	100

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Practical

CO	Blooms Level	Total Hours	%age of questions
CO1	2,3,4	18	20
CO2	2,3,4	12	20
CO3	2,3,4	15	30
CO4	2,3,4	15	30
		60	100

Theory (Course Code-FYCYS 301) and Practical (Course Code-FYCYS 391)

Module I: Introduction to Python(12L)

1. Introduction to Python
2. Python variables, expressions, statements
3. Variables, 2.2 Keywords, 2.3 Operators & operands, 2.4 Expressions, 2.5 Statements,
4. 2.6 Order of operations, 2.7 String operations, 2.8 Comments, 2.9 Keyboard input, 2.10 Example programs
5. Functions

Type conversion function, 3.2 Math functions, 3.3 Composition of functions,

3.4 Defining own function, parameters, arguments, 3.5 Importing functions, 3.6 Example programs

Module II: Conditions & Iterations(8L)

Conditions

Modulus operator, 1.2 Boolean expression, 1.3 Logical operators, 1.4 if, if-else, if- elif-else, 1.5 Nested conditions, 1.6 Example programs

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Iteration

while, 2.2 for, 2.3 break, 2.4 continue, 2.5 Nested loop, 2.6 Example programs

Module III: Recursion, Strings, List, Dictionaries, Tuples(10L)

Recursion

Python recursion, 1.2 Examples of recursive functions, 1.3 Recursion error,

1.4 Advantages & disadvantages of recursion

Strings

Accessing values in string, 2.2 Updating strings, 2.3 Slicing strings, 2.4 String methods – upper(), find(), lower(), capitalize(), count(), join(), len(), isalnum(), isalpha(), isdigit(), islower(), isnumeric(), isspace(), isupper() max(), min(), replace(), split(), 2.5 Example programs

List

Introduction, 3.2 Traversal, 3.3 Operations, 3.4 Slice, 3.5 Methods, 3.6 Delete element, 3.7 Difference between lists and strings, 3.8 Example program

Dictionaries

Introduction, 4.2 Brief idea of dictionaries & lists 5 Tuples (1L)

5.1 Introduction, 5.2 Brief idea of lists & tuples, 5.3 Brief idea of dictionaries & tuples

Module IV: Classes& Objects(10L)

Classes & Objects

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Creating class, 1.2 Instance objects, 1.3 Accessing attributes, 1.4 Built in class attributes, 1.5 destroying objects, 1.6 Inheritance, 1.7 Methodoverriding, 1.8 Overloading methods, 1.9 Overloading operators, 1.10 Data hiding, 1.11 Example program

Suggested Readings:

Learn Python The Hard Way, Zed A. Shaw, ADDISON-WESLEY

Introduction to Computing & Problem Solving With PYTHON, Jeeva Jose, Khanna Publishing House (AICTE Recommended Textbook)

Introduction To Python Programming, Venkatesh, Nagaraju Y, Khanna Publishing House (AICTE Recommended Textbook)

Taming PYTHON By Programming, Jeeva Jose, Khanna Publishing House (AICTE Recommended Textbook)

Learning Python, Mark Lutz, O'REILY

Programming In Python, Dr. Pooja Sharma, BPB

Python Programming - Using Problem Solving Approach, Reema Thareja, OXFORD UNIVERSITY PRESS

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Operating Systems and Database Management Systems

Credits- 3T +2P

Course Code – FYCYS 302(Theory), FYCYS 392(Practical)

Course Objective: The course is designed to provide a basic understanding and knowledge of different aspects of operating systems and database management system.

SI	Course Outcome (CO)
1	Make use of the basics of operating systems
2	Make use of the concept of process
3	Make use of the concept of resource manager
4	Make use of the concept of data and data management
5	Make use of the concept of data models and architecture
6	Make use of the concept of data modeling using ER modeling
7	Explain the concept of relational model and relational database managementsystem

Theory

CO	Blooms Level	Total Hours	%age of questions
CO1	2,3	3	10
CO2	2,3	10	25
CO3	2,3	8	10
CO4	2,3	4	10
CO5	2,3	6	20
CO6	2,3	7	10
CO7	2,3	7	15
		45	100

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Practical

CO	Blooms Level	Total Hour s	%age of questio ns
CO1	2,3,4	3	10
CO2	2,3,4	15	25
CO3	2,3,4	9	10
CO4	2,3,4	6	10
CO5	2,3,4	9	20
CO6	2,3,4	9	10
CO7	2,3,4	9	15
		60	100

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Theory (Course Code – FYCYS 302) and Practical (Course Code – FYCYS 392) :

1. Module I: Introduction

Importance of OS, Basic concepts and terminology, Types of OS, Different views, Journey of a command execution, Design and implementation of OS

2. Module II: Process

Concept and views, OS view of processes, OS services for process management, Scheduling algorithms, Performance evaluation; Inter-process communication and synchronization, Mutual exclusion, Semaphores, Hardware support for mutual exclusion, Queuing implementation of semaphores, Classical problem of concurrent programming, Critical region and conditional critical region, Monitors, Messages, Deadlocks

3. Module III: Resource Manager

Memory management, File management, Processor management, Device management

4. Module IV: Introducing to Data and Data Management

Introduction, Data and Information, Database and Data Base Management System, Components of Database System, Basics of Database Management System, File-based System and Database Management System, Advantages of using Database over File based system, Data Dictionary and Metadata, ANSI-SPARC Architecture, Database Users, Role of Database Administrator (DBA) and Data Administrator(DA), Database Environment, Need for a Database, Characteristics, or Features, or Advantages of Database Systems, Limitations of Database.

5. Module V: Data Models and Architecture of DBMS

Schemas and Instances, DBMS Architecture, Three Level Architecture of Database, Evolution of Data Models, Hierarchical Data Model, Network Data Model, Relational Data Model Object-oriented Data Model, Object-relational Data Model, Data and Structural Independence, Database Languages DDL, DML, DCL, TCL, Database Access, Database Structure

6. Module VI: Data Modeling using ER Modeling

Basic Terminology related to ER Model, Relational Model – Introduction, Advantages and Disadvantages, Identifying Entities, and Relationships, Types of Relationships, Relationship Participation, Notations in ER Model, Strong and Weak entity sets Composite entity, Managing Many-to-many, Relationship, Example of E-R Model, Types of Integrity Constraints, Extended E-R Model, Translating the ER Model into Relational Model, Object Modeling, Subclass and Super class, Specialization, Generalization and Aggregation, Class Diagram

7. Module VII: Relational Model and Relational Database Management System

Introduction, RDBMS Terminology, Various Types of Keys, Relational Integrity Rules Entity integrity Rule, referential integrity rule, Functional Dependency, Armstrong Axioms, Relational Set Operators,

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Retrieval Operators, CODD's Twelve Rules of Relational Database, ACID properties, Views and their purpose, Database Life Cycle, Data Dictionary, Relational Algebra and relational calculus, exercise on Relational calculus and relational algebra, Comparisons of

relational algebra and calculus Tuple Relational Calculus, Domain Relational Calculus, Introduction to SQL

Suggested Readings:

1. Operating System Concepts, Ekta Walia, Khanna Publishing House (AICTE Recommended Textbook)
2. Operating Systems, Galvin, John Wiley
3. Operating Systems, Milankovic, TMH
4. An Introduction to Operating System, Bhatt, PHI
5. Korth, Silberschatz, Sudarshan – Database System Concepts; Tata Mc. Graw Hill
6. R. P. Mahapatra, Database Management Systems, Khanna Publishing House (AICTE Recommended Textbook)
7. Ramez Elmasri, Shamkant B Navathe - Fundamentals of Database Systems; Pearson
8. C.J. Date - An Introduction to Database Systems, 8e, Pearson Education

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SEMESTER 4

Design and Analysis of Algorithms

Credits- 2T +2P

Course Code – FYCYS 401(Theory), FYCYS 491(Practical)

Course Objective:

1	To be familiar with algorithm complexity analysis.
2	To understand and apply several algorithm design strategies.

Sl.No.	Course Outcome
1.	Discuss Complexity Analysis
2.	Demonstrate Algorithm Design by Divide and Conquer.
3.	Analyse Disjoint Set Data Structure.
4.	Make use of Algorithm Design by Greedy Strategy.
5.	Make use of Algorithm Design by Dynamic Programming
6.	Make use of Algorithm Design by Backtracking.

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Theory

Module Number	Content	Total Hours	%age of questions	BloomsLevel
1	Complexity Analysis	8	20	2,3,4
2	Algorithm Design by Divide and Conquer	8	20	2,3,4
3	Disjoint Set Data Structure	8	20	2,3,4
4	Algorithm Design by Greedy Strategy	8	10	2,3,4
5	Algorithm Design by Dynamic Programming	8	10	2,3,4
6	Algorithm Design by Backtracking	8	20	2,3,4
		48	100	

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Practical

Module Number	Content	Total Hours	%age of questions	Blooms Level
2	Implement Merge sort	9	10	2,3,4
2	Implement Quicksort	9	10	2,3,4
2	Find maximum and minimum elements from an array of integers using divide and conquer strategy.	6	10	2,3,4
4	Implement fractional knapsack	6	10	2,3,4
4	Implement Job sequence with deadline	9	10	2,3,4
4	Implement Kruskal's algorithm	9	10	2,3,4
4	Implement Prim's algorithm	9	10	2,3,4
5	Implement Dijkstra's algorithm	9	10	2,3,4
5	Implement Matrix Chain Multiplication	9	10	2,3,4
5	Implement Floyd Warshall Algorithm	9	10	2,3,4
		58	100	

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Module 1: Complexity Analysis

Time and Space Complexity, Different Asymptotic notations big O, Ω , Θ , Little o, ω and their mathematical significance and proof.

Module 2: Algorithm Design by Divide and Conquer

Basic concept of divide and conquer, Merge sort, Quick sort, heap sort and their complexity analysis in best case, worst case and average case.

Module 3: Disjoint Set Data Structure

Set Manipulation Algorithm by Union-Find, Union by Rank, Path Compression

Module 4: Algorithm Design by Greedy Strategy

Basic concept, Activity Selection Problem, Fractional Knapsack problem, Job sequencing with deadline, Prim's, Kruskal.

Module 5: Algorithm Design by Dynamic Programming

Basic concept, 0/1 Knapsack Problem, Matrix Chain Multiplication, All Pair Shortest Path - Floyd Warshall Algorithm, Dijkstra's Algorithm.

Module 6: Algorithm Design by Backtracking

Basic concept, Use - N-Queen Problem, Graph Coloring Problem, Hamiltonian Path Problem

Suggested Reading-

E. Horowitz and Sahni	Fundamentals of Computer Algorithms
Gajendra Sharma	Design & Analysis of Algorithms

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T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein	Introduction to Algorithms
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Ethical Hacking and Systems Defence

Credits- 3T +2P

Course Code – FYCYS 402(Theory), FYCYS 492 (Practical)

Course Objective: The course is designed to provide an elaborate idea about the different system hacking techniques with proper ethics and applying system defence techniques.

SI	Course Outcome
1	Apply experiment with ethical hacking.
2	Apply experiment with system hacking.
3	Make use of TCP/IP overview concepts and port scanning.
4	Analyse desktop and server operating systems(OS)vulnerabilities.
5	Assess details of system and network security.
6	Inspect vulnerabilities in OS.

Theory

Modules	Headline	Total Hours	%age of questions	Blooms Level
M1	Introduction to Ethical Hacking	10	25	2,3,4
M2	System Hacking	14	25	2,3,4
M3	TCP/IP-Overview Concepts and Port Scanning	14	30	2,3,4
M4	Desktop and Server OS Vulnerabilities	10	20	2,3,4
		48	100	

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Modules	Headline	Total Hours	%age of questions	Bloom s Level
M5	System and Network Security	24	60	2,3,4
M6	Identifying vulnerabilities in OS	24	40	2,3,4
		58	100	

Theory (Course Code – FYCYS402) and Practical (Course Code – FYCYS 492) :

MODULE 1: INTRODUCTION TO ETHICAL HACKING:

Introduction: Hacking/ Ethical hacking, Types of Hacking/Hackers, Cybercrime, Types of cybercrime, Hacker Mind set, Threats, Concept of ethical hacking, Phases involved in ethical hacking, Role of Ethical Hacking, Common Hacking Methodologies, Profiles of Hackers, Benefits of Ethical Hacking, Limitations of Ethical Hacking, Foot printing- Social Engineering-Scanning and enumeration

MODULE 2: SYSTEM HACKING:

System hacking, Types of System hacking, ha4cking tools, Computer Hole, Hacking Process, Various methods of password cracking, Remote Password Guessing, Role of eavesdropping, Keystroke Loggers, Types of Keystroke Loggers, Detection, Prevention and Removal, Rootkits-Trojans-Backdoors-Viruses and worms, sniffers- denial of service-Session hijacking.

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MODULE 3: TCP/IP OVERVIEW CONCEPTS AND PORT SCANNING:

Review of TCP/IP Internetworking, Networking and Security Overview, Attack Methods, Access Control and Site Security, Host Security, Security issues in Internet protocols: TCP, DNS, and routing, Overview of TCP/IP-IP addressing-numbering systems- Introduction to port scanning-types of port scan port scanning tools-ping sweeps- Understanding scripting- Enumeration.

MODULE 4: DESKTOP AND SERVER OS VULNERABILITIES: OS Security Vulnerabilities, Programming Bugs and Malicious code, Windows OS vulnerabilities-tools for identifying vulnerabilities in windows-Linux OS vulnerabilities, vulnerabilities of embedded OS.

MODULE 5: System and Network Security: Desktop Security, Operating System Security: Designing Secure Operating Systems, Understanding routers-understanding firewalls-risk analysis tools for firewalls- understanding intrusion and detection and prevention systems- honeypots, Disaster recovery, Digital Signature, International Standards maintained for Cyber Security, Security Audit, and Investigation by Investing Agency.

MODULE 6: Practical: Identifying vulnerabilities in OS, Computer Forensics, Practical: hacking the server (through virtual machine), Micro Project.

Suggested Readings:

- 1 Hacking by Harsh Bothra, Khanna Publishing House (AICTE Recommended)
- 2 Cyber Crime & Its Prevention in Easy Steps by Chatterjee, Khanna Publishing House (AICTE Recommended)
- 3 Michael T. Simpson, Kent Backman, James Corley —Hands-On Ethical Hacking and Network Defense||, 2016
- 4 Steven DeFino, Barry Kaufman, Nick Valenteen —Official Certified Ethical Hacker Review Guide||, 2015

REFERENCE BOOKS 1 The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy (Syngress Basics Series)

E BOOKS: <https://www.nationalcyberwatch.org/resource/ethical-hacking-systems-defense-nationalcyberwatch-center-edition/>

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Cryptography and Information Security

Credits-2T+2P

Course Code – FYCYS 403(Theory), FYCYS 493(Practical)

Course Objective: The course is designed to provide an elaborate idea about the different cryptography techniques, development of key generation algorithms for information protection.

Sl. No.	Course Outcome
1.	Apply the concept of cryptography.
2.	Apply One time pad and stream ciphers.
3.	Apply Block ciphers
4.	Apply message integrity
5.	Apply public key cryptography.
6.	Make use of digital signature and protocols

Theory

Module Number	Headline	Total Hours	%age of questions	Blooms Level
M1	Overview of cryptography, numbersystem	10	20	2,3,4
M2	One time pad andstream ciphers	10	20	2,3,4

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M3	Block ciphers, message integrity	14	30	2,3,4
M4	Public key cryptography, digital signature	14	30	2,3,4
		48	100	

Practical

Module Number	Headline	Total Hours	%age of questions	Blooms Level
M5	Arithmetic modulo, programming	28	40	2,3,4
M6	Cryptography algorithm design and programming	30	60	2,3,4
		58	100	

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Theory (Course Code – FYCYS 403) and Practical (Course Code – FYCYS 493)

MODULE 1: Overview of cryptography, number system:

Arithmetic modulo operations, Abstract algebra, modular inverse, mathematics of Secure Communications; Classical Cryptosystems etc.

MODULE 2: Classical cryptosystem, one time pad and stream ciphers: Classical Cryptosystems, Substitution Cipher, Play Fair Cipher, Vignere cipher, Introduction to stream cipher, RC4, ARC4 algorithms.

MODULE 3: Block ciphers, message integrity:

Symmetric key encryption, block cipher mode of operations, Feistel Cipher, DES, AES, 3-DES, use of block cipher,

MODULE 4: Public key cryptography, digital signature:

Public key Cryptosystems Diffie-Hellman key exchange, semantically secure El-Gamal encryption, RSA and other Cryptosystems, Key Exchange Protocols, Hash Functions, Digital signature.

MODULE 5: Arithmetic modulo, programming:

Euclidean Algorithm, Extended Euclidean Algorithm, random number generation and programming.

MODULE 6: Cryptography algorithm design and programming:

Polynomial arithmetic, implementation of symmetric and asymmetric key algorithms, design of cryptography algorithms.

Suggested Readings:

William Stallings: Cryptography and Network security, Pearson Education

V.K. Jain: Cryptography and Network security, Khanna Publishing House

Alfred Menezes: Handbook of Applied Cryptography.