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**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.

| Sl | 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, 3.6Example 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

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

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

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 ofoperating 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 Hours | %age of questions |
|---|---|---|---|
| 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 andimplementation 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 andMetadata, 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, ManagingMany-to-many, Relationship, Example of E-R Model, Types ofIntegrity 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,RDBMSTerminology,VariousTypesofKeys,RelationalIntegrityRulesEntityintegrity Rule, referential integrity rule,FunctionalDependency,ArmstrongAxioms,RelationalSetOperators,

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, IntroductiontoSQL

**Suggested Readings:**

1. Operating Systems, Galvin, John Wiley
2. Operating Systems , Milankovic,TMH
3. An Introduction to Operating System, Bhatt,PHI
4. Korth, Silberschatz, Sudarshan – Database System Concepts; Tata Mc. Graw Hill
5. Ramez Elmasri, Shamkant B Navathe - Fundamentals of Database Systems;Pearson
6. 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 | Blooms Level |
|---|---|---|---|---|
| 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,Ø , Little o,,ω andtheirmathematical significance and proof.

**Module 2: Algorithm Design by Divide and Conquer**

Basic concept of divide and conquer, Merge sort, Quick sort, heap sort and theircomplexity analysisin 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, Jobsequencing withdeadline, Prims, Kruskal.

**Module 5: Algorithm Design by Dynamic Programming**

Basic concept, 0/1 Knapsack Problem, Matrix Chain Multiplication, All Pair Shortest Path -FloydWarshall 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 |
| T. H. Cormen, C. E. Leiserson, R. L. Rivestand 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 defencetechniques.

| Sl | 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 | TotalHours | %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-OverviewConcepts and PortScanning | 14 | 30 | 2,3,4 |
| M4 | Desktop and Server OS Vulnerabilities | 10 | 20 | 2,3,4 |
| | | **48** | **100** | |

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Practical

| 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 involvedin ethical hacking, Role of Ethical Hacking, Common Hacking Methodologies, Profilesof 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.

**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-toolsfor identifyingvulnerabilities 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 Michael T. Simpson, Kent Backman, James Corley —Hands-On EthicalHacking andNetwork Defense‖,2016

2 Steven DeFino, Barry Kaufman, Nick Valenteen —Official Certified EthicalHackerReview Guide‖,2015

REFERENCE BOOKS 1 The Basics of Hacking and Penetration Testing: Ethical Hackingand 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 thedifferent 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 |

| | | | | |
|---|---|---|---|---|
| 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, mathematicsof SecureCommunications; Classical Cryptosystems etc.

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

**MODULE 3**: Block ciphers, message integrity:

Symmetric key encryption, block cipher mode of operations, Fiestel Cipher, DES,AES, 3-DES, useof 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 andprogramming.

**MODULE 6**: Cryptography algorithm design and programming:

Polynomial arithmetic, implementation of symmetric and asymmetric keyalgorithms, design ofcryptography 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.