



Savitribai Phule Pune University, Pune

(Formerly University of Pune)

Three Year B.Sc. Degree Program in Cyber and Digital Science (Faculty of Science & Technology)

S.Y.B.Sc.(Cyber and Digital Science)

Choice Based Credit System Syllabus

To be implemented from

Academic Year **2021-2022**

S.Y.B.Sc. (Cyber and Digital Science)

Semester III

Course Type	Paper Code	Paper Title	Credits		Evaluation		
			T	P	CA	UA	Total
CC-IX	CDS-231	Basics of Ethical Hacking	4		30	70	100
	CDS-234	Lab on CDS-231		2	15	35	50
CC-X	CDS-232	Database Management Systems	4		30	70	100
	CDS-235	Lab on CDS-232		2	15	35	50
CC-XI	CDS-233	Data Structure Using Python	4		30	70	100
	CDS-236	Lab on CDS-233		2	15	35	50
AECC-I	CDS-237	Language- English/Marathi	2		15	35	50
AECC-II	CDS-238	Environment Science-1	2		15	35	50

Semester IV

Course Type	Paper Code	Paper Title	Credits		Evaluation		
			T	P	CA	UA	Total
CC-X	CDS-241	Principles of Operating Systems	4		30	70	100
	CDS-244	Lab on CDS-241		2	15	35	50
CC-XI	CDS-242	Web and Mobile Application	4		30	70	100
	CDS-245	Lab on CDS-242		2	15	35	50
CC-XII	CDS-243	Network Security and Cryptography	4		30	70	100
	CDS-246	Lab on CDS-243		2	15	35	50
AECC-III	CDS-247	Language- English/Marathi	2		15	35	50
AECC-IV	CDS-248	Environment Science-2	2		15	35	50

Savitribai Phule Pune University
S.Y.B.Sc. (Cyber and Digital Science)
CDS-231

Title: Basics of Ethical Hacking

Teaching Scheme 4 Hours / week	No. of Credits 4	Examination Scheme CA :30 marks UA: 70 marks
Prerequisites: Fundamentals of Cyber Security Fundamentals of OSI Model and TCP/IP Suite Fundamentals of GNU/Linux Operating System		
Course Objectives <ol style="list-style-type: none"> 1. Understand ethics and legalities related to hackers 2. Understand the process of ethical hacking 3. Understand different type of attacks and its respective security 4. Understand different vulnerabilities and misconfigurations 5. Understand security risks and it's impact 		
Course Outcomes: On completion of the course, student will be able to <ol style="list-style-type: none"> 1. Perform assessment of network, web and system for weaknesses and penetrate if needed 2. Draft detailed report which includes vulnerabilities, threats, risks and it's impact 3. Implement industry standard security protocols to minimize cyber attacks 4. Clearly understand and concur the consequences of cyber attacks 		
Course Contents		
Unit 1	Introduction To Ethical Hacking and Network Refresher	5 hours
Essential Terminologies Confidentiality Integrity Availability (C.I.A) Triad Types of Hackers Ethical Hacking Process OSI Model and TCP/IP Suite Network Addressing Common Ports and Protocols		
Unit 2	Reconnaissance, Scanning and Enumeration	10 hours
Introduction to Reconnaissance Active and Passive Reconnaissance Introduction To Open Source Intelligence (OSINT) Passive OSINT Introduction To Scanning and Enumeration Scanning IP Address, Network and It's Services Enumerating Open Ports - HTTP/S, SMB, SNMP, SMPT Finding Vulnerabilities and It's Proof-of-Concept (POC)		
Unit 3	System Hacking	10 hours
Basics of Shells - Reverse Shell, Bind Shell Automated Exploitation - Metasploit Manual Exploitation - Scripts Password Attacks - Brute Force, Wordlist, Spraying Malware Attacks - Trojans, Backdoors		

Unit 4	Privilege Escalation	10 hours
Introduction To Escalation Linux Privilege Escalation - SUDO, Kernel, SUID, Misconfiguration Windows Privilege Escalation - Impersonation, Registry, DLL, CVE Pivoting and Maintaining Access Cleaning Up		
Unit 5	Web Application Hacking	14 hours
Introduction To Basics of Web Application OWASP Top 10 Web Application Vulnerabilities Subdomain Enumeration Injection Techniques - SQL, XML, CRLF, Cookie Authentication Issues Sensitive Data Exposure Cross-Site Scripting and Cross-Site Request Forgery (XSS & CSRF) Traditional Web Security Issues		
Unit 6	Wi-Fi Hacking	6 hours
Introduction To 802.11 Protocol Types of 802.11 Attacks WEP, WPA and WPA2 Cracking Evil Twin Attack		
Unit 7	Network Sniffing and Social Engineering	5 Hours
Introduction To Sniffing Attacks Traffic and Packet Analyzing Introduction To Social Engineering Social Engineering Techniques Phishing and Vishing		
Reference Books :		
1. Hacking: The Art of Exploitation by Jon Erickson 2. The Web Application Hacker's Handbook: Discovering and Exploiting Security Flaws by Dafydd Stuttard and Marcus Pinto 3. The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy by Patrick Engebretson 4. Penetration Testing: A Hands-on Introduction to Hacking by Georgia Weidman		
Reference Links:		
5. https://assets.ctfassets.net/kvf8rpi09wgk/5Yy2CMOxIE7eLlsTzFZ333/e656ff09a94ff0b63106de8d300903ac/CEH_Notes.pdf 6. https://medium.com/techloop/reconnaissance-the-key-to-ethical-hacking-3b853510d977 7. https://resources.infosecinstitute.com/topic/process-scanning-and-enumeration/		

Savitribai Phule Pune University
S.Y.B.Sc. (Cyber and Digital Science)
CDS-232
Title: Database Management Systems

Teaching Scheme 4 hours / week	No. of Credits 4	Examination Scheme CA: 30 marks UA: 70 marks
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Course Objectives: -

- To learn the fundamentals of data models and to conceptualize and depict a database system using ER diagram.
- To study SQL and relational database design.
- To understand the internal storage structures using different file and indexing techniques which will help in physical DB design.
- To know the fundamental concepts of transaction processing- concurrency control techniques and recovery procedure.
- To have an introductory knowledge about the emerging trends in the area of distributed databases, Object Oriented Databases, Data mining and Data Warehousing etc.

Course Outcomes: - Student will be able to: -

1. Compare and contrast database models.
2. Write standard SQL queries.
3. Understand the concepts and techniques of transaction processing, concurrency control and recovery.
4. Understand the emerging trends and applications of database.

Course Contents

Unit 1	Introduction to Database System	8 hours
1.1 Introduction and Database Applications 1.2 Evolution of Database and DBMS 1.3 Need for Data Management 1.4 File System Vs Database Systems 1.5 Data Models (Relational, Network, and Hierarchical) 1.6 DBMS Architecture 1.7 Data Independence 1.8 Data Modeling using ER model		
Unit 2	Relational Database Concept	14 Hours
2.1 Introduction to Relational Databases 2.2 Structure of Relational Database 2.3 Relational Model Terminology 2.4 Domains, Attributes, Tuples, Relations 2.5 Relational Database schema 2.6 Relational Algebra: Basic operations (Select, Project, set theoretic operations, Union, Intersection, Set Difference and Division) 2.7 Join operations (Inner and outer join, left outer, right outer and full outer join)		

Unit 3	Relational Database Design	10 hours
3.1 Functional Dependency- Definition, trivial and non-trivial FD 3.2 Normalization (1NF, 2NF, 3NF) 3.3 Decomposition using FD dependency preserving 3.4 BNF, Multi-valued Dependency, 4NF 3.5 Join Dependency and 5NF 3.6 Database storage and querying 3.7 Basic Concepts of Indexing and Hashing 3.8 Query Processing 3.9 Measures of Query cost, Query Processing for select, sort join operations 3.10 Basics of query optimization		
Unit 4	Transaction Management	10 hours
4.1 Transaction Processing: Introduction 4.2 Need for Concurrency control 4.3 Desirable properties of Transaction 4.4 Schedule and Recoverability 4.5 Serializability and Schedules with examples		
Unit 5	Concurrency, Recovery and Security	10 hours
5.1 Concurrency Control Definition 5.2 Types of Locks 5.3 Two Phases locking 5.4 Deadlock 5.5 Time stamp-based concurrency control 5.6 Recovery Techniques 5.7 Concepts- Lost Update, Dirty Read, Immediate Update, Deferred Update 5.8 Incorrect Summary Problem due to concurrency 5.9 Shadow Paging 5.10 Multi-versioning		
Unit 6	Current Trends	8 hours
6.1 Object Oriented Databases 6.2 Distributed databases 6.3 XML and Internet Databases 6.4 Data Mining and Data Warehousing 6.5 Mobile and Multimedia Databases		
Reference Books:		
<ol style="list-style-type: none"> 1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts, Fourth Edition, McGraw-Hill, 2002. 2. Ramez Elmasri and Shamkant B. Navathe, Fundamental Database Systems, 3rd Edition, Pearson Education, 2003. 3. Raghu Ramakrishnan, Database Management Systeml, Tata McGraw-Hill Publishing Company, 2003. 4. Hector Garcia-Molina, Jeffrey D.Ullman and Jennifer Widom, Database System Implementation- Pearson Education- 2000. 5. Peter Rob and Corlos Coronel, Database System, Design, Implementation and Managementl, Thompson Learning Course Technology- Fifth edition, 2003. 6. Rajesh Narang “Database Management Systems”, TMH 		

7. Singh S. K., “Database Systems Concepts, Design and Application”, Pearson Education
8. Bipin Desai, “ An Introduction to Database Systems”, Galgotia Publications

Savitribai Phule Pune University
S.Y.B.Sc. (Cyber and Digital Science)
CDS-233
Title: Data Structure using Python

Teaching Scheme 4 Hours / week	No. of Credits 4	Examination Scheme CA :30 marks UA: 70 marks
Prerequisites: Basic knowledge of algorithms and problem solving Knowledge of Python Programming Language Basic Knowledge of Graphs		
Course Objectives 1. To learn the systematic way of solving problem 2. To understand the different methods of organizing large amount of data 3. To efficiently implement the different data structures 4. To efficiently implement solutions for specific problems.		
Course Outcomes: On completion of the course, student will be able to 1. use well-organized data structures in solving various problems. 2. differentiated the usage of various structures in the problem solution. 3. Implement the algorithms to solved problems using appropriate data structures.		
Course Contents		
Unit 1	Introduction to Data Structures	3 hours
1.1 Introduction 1.1.1 Concept 1.1.2 Data type, Data object, ADT, Data Structure 1.1.3 Need of Data Structure 1.1.4 Types of Data Structure 1.2 Algorithm analysis 1.2.1 Space complexity, time complexity 1.2.2 Best, Worst, Average case analysis, Asymptotic notation (Big O, Omega Ω , Theta Θ)		
Unit 2	Array as a Data Structure	8 hours
2.1 ADT of array, Operations 2.1.1 Searching: Linear, Binary, Sentinel, analysis and comparison 2.2 Sorting Terminology- Internal, External, Stable, In-place Sorting 2.2.1 Comparison Based Sorting: Bubble Sort , Insertion Sort, Selection Sort, Quick Sort, Merge Sort 2.2.2 Non Comparison Based Sorting: Radix Sort , Counting Sort 2.2.3 Comparison of sorting methods		
Unit 3	Linked List	10 hours

3.1 List as a Data Structure		
3.2 Dynamic implementation of Linked List		
3.3 Types of Linked List – Singly, Doubly, Circular,		
3.4 Operations on Linked List - create, traverse, insert, delete, search ,reverse		
3.5 Applications of Linked List – polynomial manipulation		
Unit 4	Stack	8 hours
4.1 Introduction		
4.2 Representation- Static & Dynamic		
4.3 Operations – init(), push(), pop(), isEmpty(), isFull(), peek()		
4.4 Application – String reversal, Function Call, infix to postfix, infix to prefix, postfix Evaluation		
Unit 5	Queue	10 hours
5.1 Introduction		
5.2 Representation - Static & Dynamic		
5.3 Operations - init(), enqueue(), dequeue(), isEmpty(), isFull(), peek()		
5.4 Types of Queue		
5.4.1 Simple Queue		
5.4.2 Circular Queue		
5.4.2 Priority Queue		
5.4.3 Double Ended Queue		
Unit 6	Trees	14 hours
6.1 Concept & Terminologies		
6.2 Binary tree, binary search tree		
6.3 Representation – Static and Dynamic		
6.4 Operations on BST		
6.4.1 create, Insert, delete,		
6.4.2 Tree traversals –recursive and non-recursive (preorder, inorder, postorder)		
6.4.3 Counting leaf, non-leaf & total nodes		
6.5 Heap sort		
6.6 AVL tree		
Unit 7	Graph	7 hours
7.1 Concept & terminologies		
7.2 Graph Representation –		
7.2.1 Adjacency matrix,		
7.2.2Adjacency list		
7.2.3 Inverse Adjacency list		
7.2.4 Adjacency multilist,		
7.3 Traversals – BFS and DFS		
7.4 AOV network andTopological sort		
7.5 Spanning Trees : Prims and Kruskals algorithm		
Reference Books:		
1. Fundamentals of Data Structures--Horowitz, Sahani—Galgotia		
2. Data Structures using C and C+++YedidyahLangsam, Moshe J. Augenstein, Aaron M. Tenenbaum--		
3. Introduction to Algorithms—Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein--MIT Press		
4. Fundamentals of Computer Algorithms--Horowitz, Sahani--Computer Science Press		

5. Introduction to Data Structures using C--Ashok Kamthane--Pearson Education
6. Data Structure and Algorithmic Thinking with Python: Data Structure and Algorithmic Puzzles by Karumanchi, Narasimha
7. Data Structures using Python 2021 Edition by Dr Shriram K. Vasudevan
8. Hands-On Data Structures and Algorithms with Python_second Edition by Benjamin Baka Dr Basant Agarwal Dr. Basant Agarwal

Savitribai Phule Pune University

S.Y.B.Sc. (Cyber and Digital Science)

CDS-234

Title: Lab on CDS-231

Teaching Scheme 4 hrs 20 mins / week	No. of Credits 2	Examination Scheme CA:15 marks UA: 35 marks
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Course Objectives: -The course should enable the student:

- To obtain practical knowledge of finding vulnerabilities in network and web applications.
- To understand legal usage of industry standard security tools in an isolated environment.
- To gain hands-on practical on current security threats and its approach.
- To grasp the understanding of breaching different operating systems.

Course Outcomes: The students should be able to:

- Perform internal and external vulnerability analysis on web application and network.
- Comprehend the hackers mindset while conducting reconnaissance and system hacking.
- Implement industry standard security protocols to prevent cyber attacks.
- Carry-out the same tactics, techniques and procedures as actual hackers.

Practical List

Assignment No 1: Reconnaissance (2 slots)

Perform Google Dorking: <https://tryhackme.com/room/googledorking>

Perform Web OSINT: <https://tryhackme.com/room/webosint>

Assignment No 2: Scanning, enumeration and analysis (2 slots)

Perform scanning using Nmap tools: <https://tryhackme.com/room/furthernmap>

Perform vulnerability analysis using Nessus tool:

<https://tryhackme.com/room/rpnessusredux>

Assignment No 3: System hacking (2 slots)

Perform Linux Hacking: <https://tryhackme.com/room/rootme>

Perform Windows Hacking: <https://tryhackme.com/room/blue>

Assignment No 4: Post-Exploitation (2 slots)

Perform Windows Privilege Escalation:

<https://tryhackme.com/room/windowsprivescarena>

Perform Post-Exploitation: <https://tryhackme.com/room/postexploit>

Perform Linux Privilege Escalation: <https://tryhackme.com/room/linuxprivesc>

Assignment No 5: Web-Application Assessment (2 slots)

Perform OWASP Top 10 vulnerability assessment:

<https://tryhackme.com/room/owasptop10>

Perform Web Scanning: <https://tryhackme.com/room/rpwebsscanning>

Assignment No 6: Wi-Fi Cracking and Phishing (2 slots)

Wi-Fi Hacking: <https://tryhackme.com/room/wifihacking101>

Phishing: <https://tryhackme.com/room/phishinghiddeneye>

Savitribai Phule Pune University
S.Y.B.Sc. (Cyber and Digital Science)
CDS-235
Title: Lab on CDS-232

Teaching Scheme 4hours 20min / week	No. of Credits 2	Examination Scheme CA:15 marks UA: 35 marks
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Course Objectives: -The course should enable the student:

- To present the concepts and techniques relating to query processing
- To acquire a knowledge of procedures and functions supported by SQL.
- To make use of PL/SQL language component, variables and data types.
- To understand the scope of the Block, Nested blocks and Labels.

The students should be able to:

1. Design and implement the database schema for a general problem domain.
2. Normalize the database.
3. Populate and query a database using SQL DDL / DML commands.
4. Programming PL/SQL including stored procedures, stored functions, cursors, packages.

Practical List

Assignment No. 1: (1 slot)

Data Definition Language (DDL) commands in RDBMS.

Assignment No. 2: (2 slots)

Write queries for Data Manipulation Language (DML) and Data Definition Language (DDL)

- Write SQL queries using logical operations and operators.
- Write SQL query using group by function.
- Write SQL queries for sub queries, nested queries.
- Write SQL queries to create views.
- Write an SQL query to implement JOINS.
- Write a query for extracting data from more than one table.

Assignment No. 2: (2 slots)

- Nested Queries with embedded SQL
- High-level language extension with Cursors.

Assignment No. 3: (2 slots)

- High level language extension with Triggers
- Procedures and Functions.

Assignment No. 4: (2 slots)

- Database design using E-R model and Normalization.

Assignment No. 5: (2 slots)

- Design and implementation of Payroll Processing System.

Assignment No. 6: (2 slots)

- Design and implementation of Banking System.

Assignment No. 7: (2 slots)

- Design and implementation of Library Information System.

Savitribai Phule Pune University
S.Y.B.Sc. (Cyber and Digital Science)
CDS-236
Title: Lab on CDS-233

Teaching Scheme
4 hrs 20 mins / week

No. of Credits
2

Examination Scheme
CA:15 marks
UA: 35 marks

Course Objectives: -The course should enable the student:

- To acquire a knowledge of data structures
- To make use of Python programming and implements the data structures dynamically.

Course Outcomes: The students should be able to:

- Correctly implement the right data structure for a given problem.
- Apply or create a suitable algorithm to solve a particular problem.

Practical List

Assignment No 1: Sorting (2 slots)

Write a Python program for sorting integer array using:

Bubble Sort, Selection sort, Insertion Sort, Quick Sort, Merge sort

Assignment No 2: Searching (1 slots)

Write a Python program to search an element in an integer array using: Linear Search, Sentinel Search, Binary Search

Assignment No 3: Linked List (2 slots)

Dynamic implementation of Singly Linked List and Doubly Linked List, Performed all operations on the Linked List.

Assignment No 4: Stack (2 slots)

Write Python program for dynamic implementation of Stack with all the operations.

Write a Python program for conversion of Infix expression to Postfix

Assignment No 5: Queue (2 slots)

Python program for Static and Dynamic implementation of Queue. Performed all the operations on Queue.

Assignment No 6: Tree (3 slots)

Implement Binary Search Tree (BST) to perform following operations on BST—Create, Recursive Traversals - Inorder, Preorder, Postorder

Implement a BST to perform following operations: insert, delete and create mirror image of BST.

Implement BST for counting leaf, non-leaf and total nodes.

Assignment No 7: Graph (2 slots)

Implement Graph in Python to perform following operations - Create, Adjacency Matrix, Adjacency List, In degree, Out degree

Savitribai Phule Pune University S.Y.B.Sc. (Cyber and Digital Science) CDS-241 Title: Principles of Operating Systems		
Teaching Scheme 4 hours / week	No. of Credits: 4	Examination Scheme CA:30marks UA: 70 marks
Prerequisites : - 1. Basic understanding of Array and Structure 2. Basic knowledge of algorithms		
Course Objectives: - 1. To understand the principles of Operating Systems 2. To study different system calls, system programs, functions and services of Operating System 3. To understand the concept of process, memory and deadlock handling		
Course Outcomes: - Student will be able to: - 1. Learn scheduling algorithms and synchronization. 2. Handle Deadlock handling methods and Demand Paging.		
Course Contents		
UNIT 1	Introduction to Operating System and Structure	7 Hours
1.1 What is an Operating System? 1.2 Interaction between 1.3 Types of Operating Systems - Time-Sharing Systems, Personal Computer Systems, Parallel Systems, Distributed Systems, Real Time Systems, 1.4 System Components 1.5 Operating System Services 1.6 System Calls 1.7 System Programs		
UNIT 2	Processes and CPU Scheduling	14 Hours
2.1 Process Concepts 2.2 Process Scheduling 2.3 Operations on Processes		

2.4 Cooperating Processes		
2.5 Threads		
2.6 Basic Concepts of CPU Scheduling		
2.7 Scheduling Criteria		
2.8 Scheduling Algorithms		
UNIT 3	Concurrency : Mutual Exclusion and Synchronization	8 Hours
3.1 Principles Of Concurrency		
3.2 Mutual Exclusion: Hardware Support		
3.3 Semaphores		
3.4 Monitors		
3.5 Message Passing		
3.6 Readers/Writers Problem		
UNIT 4	Deadlocks	9 Hours
4.1 Resources		
4.2 Deadlocks		
4.3 Deadlock Detection and Recovery		
4.4 Deadlock Avoidance		
4.5 Deadlock Prevention		
4.6 Other Issues		
UNIT 5	Memory Management and Virtual Memory	13 Hours
5.1 Background		
5.2 Logical versus Physical Address Space		
5.3 Swapping		
5.4 Contiguous Allocation		
5.5 Paging		
5.6 Segmentation		
5.7 Segmentation with Paging		
5.8 Demand Pagingh		

5.9 Performance of Demand Paging		
5.10 Page Replacement		
5.11 Page Replacement Algorithms		
UNIT 6	File System	9 Hours
6.1 File concept		
6.2 File Access Methods		
6.3 Directory Structure		
6.4 File System Structure		
6.5 File Allocation Methods		
6.6 Free-Space Management		
Reference Books		
<ol style="list-style-type: none"> 1. Operating System Concepts by Silberschatz, Galvin, Wiley publication 2. Operating Systems: Internals and Design Principles, Seventh Edition, William Stallings, PEARSON 3. Modern Operating Systems by Andrew Tanenbaum, Prentice-Hall 4. Operating Systems by Deitel, Deitel and Choffnes, Pearson Education 		

Savitribai Phule Pune University S.Y.B.Sc. (Cyber and Digital Science) CDS-242 Title: Web and Mobile Application		
Teaching Scheme 4 hours / week	No. of Credits 4	Examination Scheme CA :30 marks UA: 70 marks
Prerequisites <ol style="list-style-type: none"> 1. Basic knowledge of any programming language. 2. Familiarity with web applications. 		
Course Objectives: - <ol style="list-style-type: none"> 1. To understand the basics of web and mobile application 2. To understand how to provide security to web and mobile applications. 		

3. To understand the concept of access control and authentication.

Course Outcomes: - Student will be able to

1. Design the user interface.
2. Develop secure web applications.
3. Use cryptographic functions in mobile application development using Kotlin.

Course Contents

Unit 1	Introduction to Web, HTML and CSS	8 hours
1.1 WWW, Web server and Web browser, HTTP basics [HTTP Request, HTTP Response] 1.2 Client – Server Architecture 1.3 HTML Tags and Attributes 1.4 Form designing/processing 1.5 Introduction to stylesheet 1.6 Types of CSS 1.7 HTML and CSS integration 1.8 Use of id and class attributes		
Unit 2	JavaScript	7 hours
2.1 Basic syntax of JavaScript 2.2 Data types and variables 2.3 Functions and events [onclick, onchange, onload] 2.4 Popup boxes 2.5 String methods [indexOf, lastindexOf, search, replace, match] 2.6 Regular expression		
Unit 3	Fundamentals of PHP	12 hours
3.1 Introduction to PHP 3.2 How does PHP work? 3.3 Lexical structure 3.4 Basic Program 3.5 Function definition and function call 3.6 Types of parameters 3.7 Printing functions 3.8 Encoding and escaping functions 3.9 Encrypting and Decrypting Data 3.10 Introduction to String 3.11 Types of strings 3.12 Comparing and manipulating string 3.13 Regular expressions		
Unit 4	Introduction to Mobile Applications	4 hours
4.1 Brief history of Mobile 4.2 The Mobile Ecosystem		

4.3 Types of Mobile Applications		
4.4 Mobile Architecture		
Unit 5	Mobile Programming using Kotlin	7 hours
5.1 Features of Kotlin		
5.2 Creating a new project		
5.3 Class, Functions, function parameters and Constructor		
5.4 Writing your first class		
5.5 Basic Types		
5.6 Variables		
5.7 Properties		
5.8 Control Structures		
Unit 6	Introduction to Activity, Event Handling and Designing User Interface	15 hours
6.1 Introduction to Activity		
6.2 Activity Life Cycle		
6.3 Event Handling		
6.4 Form widgets- Text Fields, Button, ToggleButton, Spinner, CheckBox, RadioButton, Dialog		
Unit 7	Security	7 hours
7.1 Security with HTTPS and SSL		
7.2 Protecting against security threats		
7.3 Cryptography		
7.3.1 Encryption of message		
7.3.2 Decryption of message		
7.3.3 Generate a message digest.		
Reference Books:		
1. Programming PHP, Rasmus Lerdorf and Kevin Tatroe, O'Reilly publication		
2. PHP Cookbook, David Sklar and Adam Trachtenberg, 3 rd Edition, O'Reilly publication		
3. Beginning PHP 5.3, Matt Doyle, Wrox publication		
4. Learn Android Studio 3 with Kotlin, Hagos, Ted, Apress Publication		
5. Kotlin for Android Developers, Antonio Leiva, Lean Publication		
6. https://developer.android.com/courses/pathways/android-basics-kotlin-two		
7. Cryptography Android Developers		

<p style="text-align: center;">Savitribai Phule Pune University S.Y.B.Sc. (Cyber and Digital Science) CDS-243 Title: Network Security and Cryptography</p>		
Teaching Scheme: 4 hours / week	No. of Credits 4	Examination Scheme CA :30 marks UA: 70 marks
Prerequisites: <ol style="list-style-type: none"> 1. Basic knowledge of Networking and Data Communication. 2. Algorithmic and problem-solving skills. 3. Basic knowledge of Discrete Mathematics and Linear Algebra. 		
Course Objectives: <ol style="list-style-type: none"> 1. To gain sound necessary knowledge of network and internet security. 2. To get acquainted with symmetric and asymmetric cryptographic algorithms. 3. To understand various cryptographic techniques. 		
Course Outcomes: - Student will be able to: - <ol style="list-style-type: none"> 1. Understand cryptographic algorithms. 2. Design secure applications. 3. Develop attitude to apply appropriate encryption technique for the problem. 		
Course Contents		
Unit 1	Computer Security Essentials	3 hours
<ol style="list-style-type: none"> 1.1 Computer and Network Security – an Introduction 1.2 Need for Security 1.3 Security Approaches and Principles 1.4 OSI Security Architecture 1.5 Types of security Attacks (General view and Technical view) 1.6 Security Services and Mechanisms 		
Unit2	Network and Internet Security	7 hours
<ol style="list-style-type: none"> 2.1 Network Security Model 2.2 Email Security (Domain Key Identified Mail (DKIM)) 2.3 Wireless Network Security (IEEE 802.11i Wireless LAN Security, Wireless Application Protocol (WAP) Security, WAP End-to-End Security) 2.4 Transport Level Security (Web Security Issues, HTTPS, Secure Shell SSH) 2.5 IP Security (Policy, Security Payload and Associations, Internet Key Exchange, Cryptographic Suits) 2.6 Internet Security Protocols (Time Stamping Protocol (TSP), Secure Electronic Transaction (SET), 3-D Secure Protocol, Electronic Money, Security in GSM and 3G) 		

Unit3	Symmetric Key Cryptographic Algorithms - I	15 hours
3.1 Symmetric Cipher Model (Plain Text and Cipher Text, Cryptography, Cryptanalysis, Brute-Force Attack) 3.2 Substitution Techniques (Caesar Cipher, Monoalphabetic Ciphers, Playfair Cipher, Hill Cipher, Polyalphabetic Ciphers, One-Time Pad) 3.3 Transposition Techniques (Single Columnar, Double Columnar) 3.4 Encryption and Decryption 3.5 Rotor Machines 3.6 Steganography (Applications, Limitations) 3.7 Key Range and Key Size 3.8 Possible Types of Attacks		
Unit4	Symmetric Key Cryptographic Algorithms - II	15 hours
4.1 Introduction, Algorithm Types and Modes 4.3 Symmetric Key Cryptography- An outline 4.4 Block Cipher Principles 4.5 Data Encryption Standard (DES): Example and Strength 4.6 International Data Encryption Algorithm (IDEA) 4.7 Differential and Linear Cryptanalysis 4.8 Block Cipher Design Principles 4.9 Finite Field Arithmetic 4.10 Advanced Encryption Standard (AES): Structure, Transformation Function, Key Expansion, Example, Implementation 4.11 Stream Ciphers 4.12 RC4 4.12 RC5 4.13 Blowfish		
Unit5	Asymmetric Key Cryptographic Algorithms	9 hours
5.1 Asymmetric Key Cryptography – Introduction, History and Outline 5.2 Principles of Public Key Cryptosystems 5.3 RSA Algorithm 5.4 Diffie Hellman Key Exchange 5.5 ElGamal Cryptosystems 5.6 Elliptic Curve Cryptography 5.7 Digital Signatures-Direct Digital Signature,ElGamal Digital Signature Scheme, Schnorr Digital Signature Scheme, Digital Signature Standard (DSS) 5.8 Knapsack Algorithm		
Unit6	Public Key Infrastructure	5 hours
6.1 Introduction, 6.2 Digital Certificates 6.3 Private Key Management (PKI and PKIX Model) 6.4 Public Key Cryptographic Standards (PKCS), PKI and XML Security 6.5 Creation of Digital Certificates		

Unit7	Cryptographic Hash Functions	6 hours
7.1 Introduction and Applications 7.2 Simple Hash Functions (XOR and rotated XOR, XOR with Cipher Block Chaining (CBC) mode) 7.3 Requirements and Security 7.4 Hash Functions based on Cipher Block Chaining 7.5 Secure Hash Algorithms (SHA), SHA-3, SHA-256		
Reference Books:		
[1] William Stallings, <i>Cryptography And Network Security</i> , Prentice Hall, 2018. [2] Atul Kahate, <i>Cryptography And Network Security</i> , TMH, 2019. [3] V.K. Pachghare, <i>Cryptography and Information Security</i> , PHI Learning, Private Limited, 2019. [4] Behourz A Forouzan, <i>Cryptography And Network Security</i> , McGraw Hill Education, 2015. [5] Matt Bishop and Sathyanarayana, <i>Introduction to Computer Security</i> , Pearson Education, 2005. [6] Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone, <i>Hand-book of Applied Cryptography</i> , Taylor & Francis Excl. Spl Reprint, 2018. [7] Margaret Cozzens, Steven J Miller, <i>The Mathematics of Encryption</i> , American Mathematical Society, 2017. [8] Bruce Schneier, <i>Applied Cryptography</i> , John Wiley and Sons, 2012. [9] Mark Stamp, <i>Information Security: Principles and Practice</i> , John Wiley and Sons, 2020. [10] S. Bose, <i>Cryptography And Network Security</i> , Pearson Education India, 2016. [11] Bernard L., Menezes, Ravinder Kumar, <i>Cryptography, Network Security, and Cyber Laws</i> , Cengage Learning India Pvt. Ltd., 2018.		
EBooks URL:		
<ul style="list-style-type: none"> • http://libgen.li/ 		
Online Learning References:		
[1] https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-857-network-and-computer-security-spring-2014/lecture-notes-and-readings/ [2] https://nptel.ac.in/courses/106/105/106105031/ [3] https://www.khanacademy.org/computing/computer-science/cryptography [4] https://www.tutorialspoint.com/cryptography/index.htm [5] https://www.edureka.co/blog/what-is-cryptography/ [6] https://www.geeksforgeeks.org/cryptography-introduction/ [7] https://www.khanacademy.org/computing/computer-science/cryptography/crypt/v/intro-to-cryptography		

Savitribai Phule Pune University
S.Y.B.Sc. (Cyber and Digital Science)
CDS-244
Title: Lab Course on CDS-241
(Lab Course on Principles of Operating Systems)

Teaching Scheme: 4 hours / week	No. of Credits 4	Examination Scheme CA :30 marks UA: 70 marks
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Prerequisites:

1. Basics of operating System.
2. Intermediate Level Skills of Python Programming.

Course Objectives:

1. To get hands-on Kali and Ubuntu Linux.
2. To get acquainted with various algorithms in operating systems.

Course Outcomes: - Student will be able to: -

1. Install Linux distribution.
2. install security tools on operating systems
3. Implement algorithm from operating systems concepts.

Practical List

No.	Title	Details	Mandatory	Slots
1	Operating Systems for Learning Security Tools	1. Install UBUNTU operating system using all below methods: <ul style="list-style-type: none"> • <i>Plain (Raw/Native) Installation AND/OR</i> • <i>Installation on Virtual Machine (VMWare or VirtualBox)</i> • <i>Installation of Ubuntu app on Windows 10 using MS Store</i> <hr style="border-top: 1px dashed black;"/> ----- 2. Install KALI Linux operating system using all below methods: <ul style="list-style-type: none"> • <i>Plain (Raw/Native) Installation AND/OR</i> • <i>Installation on Virtual Machine (VMWare or VirtualBox)</i> <i>Installation of Ubuntu app on Windows 10 using MS Store</i>	Both	01

2	Installation of Security tools	<ul style="list-style-type: none"> Install following security tools on Ubuntu operating system: <i>Nmap, lynis, WPScan, aircrack-ng, hydra, wireshark, Metasploit Framework, skipfish, maltego, Nessus, Burp Suite Scanner, BeEF, apktool, sqlmap, john the ripper, Autopsy Forensic Browser, King Phisher, nikto, Yersinia, Social Engineering Toolkit (SET), netcat, Unicornscan, Fierce, OpenVAS, CMSMap, Fluxion, Kismet Wireless, findmyhash, RainbowCrack, Yersinia, DHCPig, FunkLoad, SlowHTTPTest, Inundator, t50</i> 	Any 20	01
3	Hands-on Kali Linux	<ul style="list-style-type: none"> Execute remaining commands (from above) on Kali Linux 	Remaining 15	01
4	Linux Commands Simulation	<p>Implement following commands in Linux using command line arguments in python (Use <i>multiprocessing package</i>):</p> <ul style="list-style-type: none"> wc, ls, cat, pwd, cp, rm, mkdir, mv, head, tail 	Any 5	02
5	CPU Scheduling Simulation	<p>Implement following algorithms in python:</p> <p>FCFS SJF (Primitive), SJF Non-Primitive, Priority ((Primitive), Priority (Non-Primitive) Round Robin</p>	Min. 3	03
6	Paging Simulation	<p>Implement following algorithms in python:</p> <p>FIFO Second Chance LRU MRU LFU MFU Optimal</p>	Min. 3	03
7	Deadlock Algorithms Simulation	<p>Implement Banker's algorithm in Python</p>	---	01
8	Review papers on Operating System Security	<p>Write review paper on operating systems security. Write review paper on security tools in Kali Linux. Write review paper on Android OS Security. Write review paper on iOS Security. Write review paper on Windows Security. Write review paper on Linux Security.</p> <p><i>(Note : 1. Use Mind map technique. 2. Topics not limited to this, can take another topic from curriculum of Operating System)</i></p>	Any one (Group Activity)	02

Savitribai Phule Pune University
S.Y.B.Sc. (Cyber and Digital Science)

CDS-245

Title: Lab on CDS-242

Teaching Scheme
4 hrs 20 mins / week

No. of Credits
2

Examination Scheme
CA:15 marks
UA: 35 marks

Course Objectives: -The course should enable the student:

- To design validated and verified web applications.
- To develop mobile applications.

Course Outcomes: The students should be able to:

- Code well designed web applications with validations using JavaScript..
- Develop secure mobile applications using cryptographic functions.

Practical List

Assignment No 1: HTML Tags and CSS (2 slots)

1. Design an HTML form to accept Company name, Address, Phone number and Email-ID.
2. Design an HTML to generate the following output.

Expenditures of a Company (in Lakh Rupees) per Annum Over the given Years.

Year	Item of Expenditure				
	Salary	Fuel and Transport	Bonus	Interest on Loans	Taxes
1998	288	98	3.00	23.4	83
1999	342	112	2.52	32.5	108
2000	324	101	3.84	41.6	74
2001	336	133	3.68	36.4	88
2002	420	142	3.96	49.4	98

3. Create an html page with 7 separate lines in different colors and sizes. State size and color of each line in its text.

Assignment No 2: JavaScript (2 Slots)

1. Write a JavaScript function to accept text from user and display appropriate message if the entered text contains special symbols and numbers [Use match function]
2. Write a JavaScript function to accept the name of person if name is empty and display message “Please enter the name” else display the name of person [Use alert function].
3. Write a JavaScript function to perform following string functions:
indexof, lastindexof, search and replace.

Assignment No 3: Cryptography and regular expressions in PHP (2 Slots)

1. Write a PHP program to accept a string from the user and encode the data using base64_encode function. Also decode the encoded string.
2. Write a PHP program to accept a number from the user and write a functions to perform following task:
 - a. calculate a factorial of a number
 - b. display the sum of digits of a number
 - c. print the fibonacci series upto that number
3. Write a PHP program to accept email-id from the user and check for the validity of entered email-id using regular expressions.
4. Write a PHP program that accepts two strings from the user and perform the following operation:
 - a. compare strings using strcmp function
 - b. tokenized the first string into words
 - c. append the second string to first string
 - d. accept three strings from the user and replace all the occurrences of the second string with the third string in the first string.

Assignment No 4: Designing User Interface (2 Slots)

1. Write a Kotlin program to design the user interface that accepts username and password for login form.
2. Write a Kotlin program to design the user interface that accepts student name, class of

student and student hobbies.

Assignment No 5: Event Handling (2 Slots)

1. Write a Kotlin program to accept two numbers and display the least common multiple (LCM) of numbers in the textbox.
2. Write a Kotlin program to accept a number and check if the number is a perfect number or not (display the output using a popup box).
3. Write a Kotlin program to accept a number of days and convert the number of days into Years, Weeks and Days. For example, 438 days is equal to 1 Year 10 Week 3 Days (Ignore leap year).
- 4.

Assignment No 6: Security (2 Slots)

1. Write a Kotlin program to accept a text and encrypt a text using appropriate methods and decrypt the encoded message to the original message.
2. Write a Kotlin program to generate a message digest.

Savitribai Phule Pune University
S.Y.B.Sc. (Cyber and Digital Science)
CDS-246

Title : Lab Course on CDS-243
(Lab Course on Cryptography and Network Security)

Teaching Scheme: 4 hours / week	No. of Credits 4	Examination Scheme CA :30 marks UA: 70 marks
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Prerequisites:

2. Algorithmic and problem-solving skills.
3. Intermediate Level Skills of Python Programming.

Course Objectives:

1. To solve real world case studies related to computer security.
2. To get acquainted with symmetric and asymmetric cryptographic algorithms.
3. To know various cryptographic techniques.

Course Outcomes: - Student will be able to: -

1. Implement cryptographic algorithms.
2. Design secure applications.
3. Develop attitude to apply appropriate encryption technique for the problem.

Practical List

No.	Title	Details	Mandatory	Slots
1	Network Security Essentials (Sample Case Studies)	<ol style="list-style-type: none"> 1. Consider an automated teller machine (ATM) in which users provide a personal identification number (PIN) and a card for account access. Give examples of confidentiality, integrity, and availability requirements associated with the system and, in each case, indicate the degree of importance of the requirement. 2. Consider a desktop publishing system used to produce documents for various organizations. <ol style="list-style-type: none"> a. Give an example of a type of publication for which confidentiality of the stored data is the most important requirement. b. Give an example of a type of publication in which data integrity is the most important requirement. c. Give an example in which system availability is the most important requirement. <p>Note: Make a report/ppt/pdf of above. Case Studies are not limited to only this two, can take any case study from reference books.</p>	Any one	01
2	Substitution Techniques	Implement Following substitution techniques in Python: Caesar Cipher, Monoalphabetic Ciphers, Playfair Cipher, Hill Cipher, Polyalphabetic Ciphers, One-Time Pad.	Any Four	02

3	Symmetric Algorithms	Implement DES algorithm in python. Implement AES algorithm in python.	Both	02
		Implement differential cryptanalysis in python Implement linear cryptanalysis in python.	Any one	01
		Implement RC4 in python. Implement RC5 in python. Implement Blowfish in Python. Implement IDEA Algorithm in python.	Any three	03
4	Asymmetric Algorithms	Implement RSA algorithm in python. Implement IDEA Algorithm. Implement Knapsack algorithm in python. Implement Diffie Hellman Key Exchange. Implement ElGamal Encryption algorithm in python.	Any three	03
5	Review papers on cryptography and network security	Write review paper on network security. Write review paper on substitution techniques. Write review paper on cryptographic algorithms. Write review paper on symmetric algorithms. Write review paper on asymmetric algorithms. <i>(Note : 1. Use Mind map technique. 2. Topics not limited to this, can take other topics related to network security and cryptography)</i>	Any one (Group Activity)	02