Placed at the meeting of
Academic Council
held on 26.03.2018

APPENDIX - Q

MADURAI KAMARAJ UNIVERSITY

(University with Potential for Excellence)

M.Sc. Computer Science (Semester)

(With effect from 2018-19 onwards)

CHOICE BASED CREDIT SYSTEM
REVISED SYLLABUS

REGULATIONS SCHEME OF EXAMINATIONS AND SYLLABUS

1. **Course Objective:**

   To prepare the students to manage the software components in a computer independently and to be a Programmer/Project Leader. To motivate the students to take up Academic Research in Computer Science and other streams.

2. **Eligibility for Admission:**
   Students who studied B.Sc.(CS) and BCA.

3. **Duration of the Course:**
   The students shall undergo the prescribed course of study for a period of not less than two academic years (Four semesters).

4. **Medium of Instruction :** English

5. **Subjects/ Structure of Course Study :** See Appendix – PCS1

6. **Scheme of Examinations/ Structure of Question Paper:** : See Appendix - PCS2

7. **Detailed Syllabus**: See Appendix – PCS3

8. **Eligibility for the Degree:**

   i) A Candidate shall be eligible for the award of the degree on completion of the prescribed course of study and passing all the prescribed external examinations.

   ii) Attendance progress, internal examinations, conduct certificate from the Head of the Institution shall be required for taking the external examination.

   iii) The passing minimum and the ranking are as per the existing rule of the Choice Based Credit System for the affiliated college of the University.

Appendix – PCS1 (Subject/Structure of Course Study)

Semester	Subjects						Total Hours	Total Credits
I	CS11(5) [4]	CS12(5) [4]	CS13(5) [4]	CS14(5) [4]	CS15(5) [3]	CS16(5) [3]	30	22
II	CS21(5) [4]	CS22(5) [4]	CS23(5) [4]	ES1(5) [4]	CS24(5) [3]	CS25(5) [3]	30	22
III	CS31(5) [4]	CS32(5) [4]	ES2(5) [4]	NME(4) [4]	CS33(5) [3]	CS34(6) [3]	30	22
IV	CS41(5) [4]	CS42(5) [4]	ES3(5) [4]	CP (15) [12]			30	24
	Total							90

Abbreviations:

( ) – Number of Hours **[ ]** – Number of Credits **CS** - Core Subject **NME** - Non Major Elective **ES** - Elective Subject **CP** - Course Project

I SEMESTER

S No	CODE	Subject	Hours	Credits	Internal Marks	External Marks
1	CS 11	Discrete Mathematical Structures	5	4	25	75
2	CS 12	Advanced JAVA Programming	5	4	25	75
3	CS 13	Data Structures and Algorithms	5	4	25	75
4	CS 14	Data Communication and Computer Networks	5	4	25	75
5	CS 15	**Lab 1:** Advanced JAVA Programming Lab	5	3	40	60
6	CS 16	**Lab 2:** Data Structures and Algorithms Lab	5	3	40	60
			30	22		

II SEMESTER

S No	CODE	Subject	Hours	Credits	Internal Marks	External Marks
1	CS 21	Python Programming	5	4	25	75
2	CS 22	Compiler Design	5	4	25	75
3	CS 23	Operating System Design Principles	5	4	25	75
4	ES1	1. Embedded Systems 2. Advanced Software Engineering 3. Distributed Systems	5	4	25	75
5	CS 24	**Lab 3:** Python Programming Lab	5	3	40	60
6	CS 25	**Lab 4:** Operating System Lab	5	3	40	60
			30	22		

III SEMESTER

S No	CODE	Subject	Hours	Credits	Internal Marks	External Marks
1	CS 31	Advanced Database System	5	4	25	75
2	CS 32	Soft Computing	5	4	25	75
3	ES2	1. Data Mining and Warehousing 2. Cloud Computing 3. Internet of Things	5	4	25	75
4	NME	Principles of Information Technology	4	4	25	75
5	CS 33	**Lab 5**: Soft Computing Lab	5	3	40	60
6	CS 34	**Lab 6:** Advanced Database Lab	6	3	40	60
			30	22		

IV SEMESTER

S No	CODE	Subject	Hours	Credits	Internal Marks	External Marks
1	CS 41	Digital Image Processing	5	4	25	75
2	CS 42	Advanced System Architecture	5	4	25	75
3	ES 3	1.Big Data Analytics 2.Network Security 3.Mobile Computing	5	4	25	75
4	CP	Project Work & Viva voce	15	12	40	60
			30	24		

Project work to be done in the College Lab only.

Non-Major Elective Course to be offered by the Department of Computer Science to other Departments

NME: Principles of Information Technology

Appendix – PCS2

Scheme of Examination /Question Paper Pattern Scheme of Evaluation

Theory Subjects:

Question Paper Pattern

Time: 3 Hours **Max. Marks: 75**

Part – A

Answer all the questions (10*1=10)

Ten Questions, two questions from each Unit: *Multiple Choice Questions*

Part – B

Answer all the questions (5*7=35)

Five Questions, one question set from each Unit: *Either …Or… type*

Part – C

Answer any three questions (3*10=30)

Five Questions, one question from each Unit

The following list of parameters taken into account for the evaluation of the Practical examination and Project work.

For Practical Subjects:

Parameters:

i.	Aim, Procedure / Algorithm and Program	:	15
ii.	Coding and Compilation :	:	10
iii.	Debugging :	:	15
iv.	Results :	:	10
v.	Viva:	:	10
	Total	**:**	**60**

Note: The External Examiner can fix other exercises also, other than those found in the list *(Syllabus)* in consultation with the Internal Examiner without violating the scope of the prescribed syllabus.

For Project Work:

Total Marks: 100 (Internal: 40 marks, External: 60 Marks)

Parameters:

For Internal Marks (40):

Start-up Review	: 5 Marks
Design Review	: 7.5 Marks
Implementation and Validation Review	:7.5 Marks
Final Review	: 10 Marks
Overall Performance	: 10 Marks

For External Marks (60):

Project Report	: 20 Marks
Project work, Demo & Presentation	: 30 Marks
Viva-Voce	: 10 Marks

Unit I:

Appendix – PCS3
(Detailed Syllabus)
CS 11: DISCRETE MATHEMATICAL STRUCTURES
(5 Hours – 4 Credits)

Mathematical Logic: Statements and Notation – Connectives – Negation – Conjunction – Disjunction – Statement Formulas and Truth Tables – Logical Capabilities of Programming Languages – Conditional and Bi-conditional –

Well-formed Formulas – Duality Law – Tautological Implications – Formulas with Distinct Truth Tables – Functionality Complete Sets of Connectives – Other Connectives – Two-state Devices and Statement Logic – Normal Forms – Disjunctive Normal Forms – Conjunctive Normal Forms – Principal Disjunctive Normal Forms – Principal Conjunctive Normal Forms – Ordering and Uniqueness of Normal Forms – Completely Parenthesized Infix Notation and Polish Notation – The Theory of Inference for the Statement Calculus – Validity Using Truth Tables – Rules of Inference – Consistency of Premises and Indirect Method of Proof – Automatic Theorem Proving – The Predicate Calculus – Predicates – The Statement Function, Variables, and Quantifiers – Predicate Formulas – Free and Bound Variables – The Universe of Discourse – Inference Theory of the Predicate Calculus – Valid Formulas and Equivalences – Some Valid Formulas over Finite Universes – Special Valid Formulas Involving Quantifiers – Theory of Inference for the Predicate Calculus – Formulas Involving More Than One Quantifier.

Unit II:

Relations and Ordering: Relations – Properties of Binary Relations in a Set – Relation Matrix and the Graph of a Relation – Partition and Covering of a Set – Equivalence Relations

– Compatibility Relations – Composition of Binary Relations – Partial Ordering – Partially Ordered Set: Representation and Associated Terminology.

Unit III:

Lattices and Boolean Algebra: Lattices as Partially Ordered Sets – Definition and Examples

– Some Properties of Lattices – Lattices as Algebraic Systems – Sublattices, Direct Product, and Homomorphism – Some Special Lattices – Boolean Algebra – Definitions and Examples

– Subalgebra, Direct Product and Homomorphism – Boolean Functions – Boolean Forms and

Free Boolean Algebras – Values of Boolean Expressions and Boolean Functions – Representation and Minimization of Boolean Functions – Representation of Boolean Functions – Minimization of Boolean Functions.

Unit IV:

Graph Theory: Basic Concepts of Graph Theory – Basic Definitions, Paths, Reachability and Connectedness – Matrix Representation of Graphs, Trees - Storage Representation and Manipulation of Graphs – Trees-Their Representation and Operations – List Structures and Graphs.

Unit V:

Introduction to Computability Theory: Introduction – Finite-state Acceptors and Regular Grammars – Turing Machines and Partial Recursive Functions.

Text Book:
Discrete Mathematical Structures with Applications to Computer Science, J.P. Tremblay and R.Manohar, McGraw Hill Book Company, New York, 1988.

Unit I – Chapter 1 – 1.1, 1.2, 1.3, 1.4, 1.5, 1.6
(Exercises Excluded) Unit II – Chapter 2 – 2.3
(Exercises Excluded)
Unit III –Chapter 4 – 4.1,4.2,4.3,4.4
(Exercises Excluded) Unit IV –Chapter 5 –
5.1 & 5.2 (Exercises Excluded) Unit V –
Chapter 6 – 6.1 & 6.2 (Exercises Excluded)

Reference Books:

1. Discrete Mathematics for Computer Scientists – John Truss – II Edition - Addison Wesley – 2000.
2. Introduction to Automata Theory, Languages and Computation – John E.HopCroft R.Motwani, Jeffery D.Ullman – III Edition Pearson Education – 2008.
3. Discrete Mathematics with Graph Theory – GoodaireParmenter – Prentice Hall Inc., 1998.
4. Discrete and Combinational Mathematics – Ralph P.Grimaldi – Fourth Edition Pearson Education – 1999.
5. Discrete Mathematics and Graph Theory – Satyanarayana – PHI Pvt. Ltd., - 2009.

CS 12: ADVANCED JAVA PROGRAMMING

(5 Hours – 4 Credits)

Unit I :

Applets : Applet Fundamentals - Applet Class - Applet Life Cycle – Steps for developing an Applet Program – Passing values through Parameters - Graphics in an Applet – Event handling

GUI Applications: Graphical User Interface - Creating Windows - Dialog Boxes – Layout Managers - AWT Component classes - Swing Component classes – Event handling – Other AWT Components – AWT graphics classes – Other Swing controls

Unit II :

Networking: Basics - Networking in Java -Socket Programming using TCP/IP – Socket Programming using UDP – URL and InetAddress Classes

Java Database Connectivity: Types of drivers - JDBC Architecture – JDBC Classes and Interfaces – Basic steps in developing JDBC applications – Creating a new database and table with JDBC - Working with Database metadata

Unit III :
Servlets : - Basics – Advantages - Servlet alternatives – strengths - Architecture - Servlet Life Cycle - Generic Servlet - HTTP Servlet- Passing parameters – Retrieving parameters
– server side include - Cookies –Filters

Unit IV :
Java Server Pages : Overview - JSP and HTTP – JSP Engines - Working of JSP – Anatomy of JSP – JSP Syntax – Creating simple JSP page - Components of JSP -Implicit Objects

Unit V :
Web Programming – Client Side Programming: Client Side Programming technologies
– Form design with HTML and CSS – Client side Validation using JavaScript - Content Structuring using XML – Adding interactivity with AJAX

Web Programming - Server Side Programming: Web Servers - Handling Request and Response - Database Access- Session Management

Text Book:
Java Programming for Core and Advanced Learners - Sagayaraj, Denis , Karthik and Gajalakshmi , University Press, 2018

Unit I	:	Chapters 12,13 and 14
Unit II	:	Chapters 15 and 16
Unit III	:	Chapter 19
Unit IV	:	Chapter 20
Unit V	:	Chapters 21 and 22

Reference Books:

1. Java The Complete Reference - Herbert Schildt, McGraw Hill Education, 10th Edition, New York, 2017
2. Advanced Java Programming – Uttam K.Roy , Oxford University Press, 2017
3. Core and Advanced Java, Black Book – Dreamtech Press, 2017

CS 13: DATA STRUCTURES AND ALGORITHMS
(5 Hours – 4 Credits)

Unit I :

Trees: Heaps – Binary Search Trees – Selection Trees – Forests – Representation of Disjoint Sets – Counting Binary Trees.

Graphs: The Graph Abstract Data type – Elementary Graph Operations – Minimum Cost Spanning Trees – Shortest Paths and Transitive Closure – Activity Networks.

Unit II :

Hashing: Introduction – Static hashing – Dynamic hashing – Bloom filters.

Priority Queues: Single- and Double ended priority queues – Leftist Trees – Binomial Heaps – Fibonacci Heaps – Pairing Heaps – Symmetric Min-Max Heaps – Interval Heaps.

Unit III :

Efficient binary search trees: Optimal Binary Search Trees – AVL Trees – Red-Black Trees – Splay Trees.

Multiway Search Trees: m-way Search Trees – B-Trees – B^+-Trees.

Unit IV :

Dynamic Programming: The General Method – Multistage graphs – All-pairs shortest paths – Single-source shortest paths – Optimal binary search trees – string editing – 0/1 knapsack – reliability design – The Travelling Salesperson problem – flow shop scheduling.

Basic Traversal and Search Techniques: Techniques for Binary Trees – Techniques for Graphs – Connected Components and Spanning Trees – Biconnected Components and DFS.

Unit V :
Backtracking: The General Method – The 8-Queens Problem – Sum of subsets – Graph coloring – Hamiltonian cycles – Knapsack problem.

Branch and Bound: The Method – 0/1 Knapsack problem – Traveling Salesperson(*) – Efficiency considerations.

Text Books:

1. Fundamentals of Data Structures in C++ – Ellis Horowitz, Sartaj Sahni, Dinesh Mehta
   – University Press(India) Private Limited, Second Edition, Reprinted 2017.

   Unit I : Chapter 5.6 – 5.11 and 6
   Unit II : Chapter 8 and 9
   Unit III : Chapter 10 and 11
2. Fundamentals of Computer Algorithms - Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran – University Press(India) Private Limited, Second Edition, Reprinted 2017.

Reference Books:

Unit IV : Chapter 5 and 6
Unit V : Chapter 7 and 8

1. Data Structures and Algorithms, Alfred V.Aho, John E.Hopcraft and Jeffrey D.Ullman, Pearson Education, Fourteenth Impression, 2013.
2. Classic Data Structures in C++, Timothy A. Budd - Addison Wesley Publishing Co., First Edition.,1994.
3. Data Structure and Algorithm Analysis in C, Mark Allen Weiss, Second Edition, Addison Wesley Publishing Company, 1997.
4. Computer Algorithms – Introduction to Design & Analysis, Sara Baase and Allen Van Gelder, Third Edition, Pearson Education, New Delhi, 2000.
5. Data Structures, A. Chitra, P. T. Rajan, Vijay Nicol Imprints Pvt Ltd, Mc Graw Hill Education of India Pvt. Ltd., 2006.
6. Design and Analysis of Algorithms – S.Sridhar, Oxford University Press, 2015

CS 14: DATA COMMUNICATIONS AND COMPUTER NETWORKS

(5 Hours – 4 Credits)

Unit I:

Data Communications, Data Networking and the Internet:
Data Communications and Networking for Today's Enterprise – A Communication Model - Data Communications – Networks – The Internet – An Example Configuration

Protocol Architecture, TCP/IP and Internet-Based Applications
The Need for a Protocol Architecture – The TCP/IP Protocol Architecture – The OSI Model – Standardization within a Protocol Architecture- Traditional Internet-Based Applications – Multimedia

Transmission Media
Guided Transmission Media – Wireless Transmission - Wireless Propagation – Line of Sight Transmission

Unit II:
Digital Data Communication Techniques- Asynchronous and Synchronous Transmission – Types of Errors – Error Detection –Error Correction –Line Configuration

Data Link Control Protocols – Flow Control – Error Control – High Level Data Link Control

Multiplexing – Frequency Division Multiplexing – Synchronous Time Division Multiplexing – Statistical Time Division Multiplexing – Asymmetric Digital Subscriber Line

Unit III:

Wide Area Networks:

Circuit Switching and Packet Switching – Switched Communication Networks – Circuit Switching Networks - Circuit Switching Concepts – Softswitch Architecture – Packet Switching Principles – X .25 – Frame Relay

Asynchronous Transfer Mode – Protocol Architecture – ATM Logical Connections –ATM Cells – Transmission of ATM Cells

Routing in Switched Networks – Routing in Packet switching Networks – Examples : Routing in ARPANET- Least-Cost Algorithms

Unit IV:

Local Area Networks: Background – Topologies of Transmission Media – lan Protocol Architecture – Bridges – Layer 2 and Layer 3 Switches

Internet and Transport Protocols - Internet Protocols – Basic Protocol Functions – Principles of Internetworking – Internet Protocol Operation – Internet Protocol – IPv6

Internetwork Operation

Multicasting – Routing Protocols - Integrated Services Architecture – Differentiated Services

– Service Level Agreements – IP Performance Metrics

Unit V:

Transport Protocols - Connection-Oriented Transport Protocol Mechanisms – TCP –TCP Congestion Control – UDP

Internet Applications - Electronic Mail and Network Management - Electronic Mail: SMTP and MIME – Network Management SNMP

Internet Applications – Internet Directory Service and World Wide Web – Internet Directory Service DNS – Web Access HTTP

Text Book

Data and Computer Communication - William Stallings – 10th Edition – Pearson, 2013

Unit I	:	Chapters 1,2,4
Unit II	:	Chapters 6,7,8.1-8.4
Unit III	:	Chapters 10,11.1-11.4,12
Unit IV	:	Chapters 15,18.1-18.6,19
Unit V	:	Chapters 20,22,23

Reference Books

1. Computer Networks – Andrew S. Tanenbaum and David J Wetherall– 5th Edition – Pearson , 2013
2. Data communications and Networking - Behrouz A. Forouzan – 4th Edition - Mc Graw Hill, 2017.
3. Data Communication and Networks - Bhushan Trivedi , Oxford University Press 2016.

CS 15: LAB 1- ADVANCED JAVA PROGRAMMING LAB

(5 Hours – 3 Credits)

1. Program to display life cycle of an applet
2. Program to display digital clock using applet
3. Program to display different graphical shapes in applet
4. Program to display graphical bar chart by passing parameters in applet
5. Write an Applet which will play two sound notes in a sequence continuously use the play () methods available in the applet class and the methods in the Audio clip interface.
6. Program to find factorial value of N using AWT high level event handling
7. Program to illustrate window closing using AWT low level event handling
8. Program to illustrate TCP based network communication
9. Program to illustrate UDP based network communication
10. Program to find sum of digits using RMI
11. Program to find length of the given string using RMI
12. Write a program in Java to implement a Client/Server application using RMI.
13. Program using HTML/Java script to find length of the given string
14. Program using HTML/Java script to find biggest element of an array
15. Program to compute factorial value of N using GenericServlet
16. Program to compute factorial value of N using HTTPServlet
17. Use JDBC connectivity and create Table, insert and update data.
18. Write a program in Java to create a Cookie and set the expiry time of the same.
19. Write a program in Java to create Servlet to count the number of visitors to a web page.
20. Write a program in Java to create a form and validate a password using Servlet.
21. Develop a Java Bean to demonstrate the use of the same.
22. Write a program in Java to convert an image in RGB to a Grayscale image.
23. Develop Chat Server using Java.

Reference Books

1. Java The Complete Reference - Herbert Schildt, McGraw Hill Education, 10th Edition, New York, 2017

2. Programming in Java – Sachin Malhotra, Saurbh Choudhary, Oxford University Press, Revised Second Edition.

Note: The above are sample problems; Instructor can add more exercises based on their requirements and the current technology

CS 16: LAB 2.DATA STRUCTURES AND ALGORITHMS LAB
(5 Hours – 3 Credits)

1. Implementation of Stack
    a) Using Array
    b) Using Linked List
2. Implementation of Queue
    a) Using Array
    b) Using Linked List
3. Implementation of Heap Tree.
4. Implementation of Tree Traversal.
5. Implementation of BFS.
6. Implementation of DFS.
7. Implementation of Merge Sort using Divide and Conquer.
8. Implementation of Knapsack Problem using Dynamic Programming.
9. Implementation of Warshall's Algorithm using Dynamic Programming.
10. Implementation of Floyd's Algorithm using Dynamic Programming.
11. Implementation of Dijkstra's Algorithm using Greedy Technique.
12. Implementation of Prim's Algorithm using Greedy Technique.
13. Implementation of n-queens Problem using Backtracking.
14. Implementation of Assignment Problem using Branch and bound.

Note: The above are sample problems; Instructor can add more exercises on on their requirements and the current technology

Unit I :

CS 21: PYTHON PROGRAMMING
(5 Hours – 4 Credits)

Python Programming: An Introduction - IDLE an Interpreter for Python, Python Strings, Relational Operators, Logical Operators, Bitwise Operators, Variables and Assignment Statements, Keywords, Script Mode. **Functions -** Built-in Functions, Function Definition and Call, Importing User-defined Module**,** Assert Statement, Command Line Arguments. **Control Structures -** if Conditional Statement, Iteration (for and while Statements).

Unit II :

Scope - Objects and Object ids, Scope of Objects and Names. **Strings -** Strings, String Processing Examples, Pattern Matching. **Mutable and Immutable Objects –** Lists, Sets, Tuples, Dictionary.

Unit III :

Recursion - Recursive Solutions for Problems on Numeric Data, Recursive Solutions for Problems on Strings, Recursive Solutions for Problems on Lists, Problem of Tower of Hanoi. **Files and Exceptions -** File Handling, Writing Structures to a File, Errors and Exceptions, Handling Exceptions Using try…except, File Processing Example.

Unit IV :
Classes I - Classes and Objects, Person: An Example of Class, Class as Abstract Data Type, Date Class. **Classes II -** Polymorphism, Encapsulation, Data Hiding, and Data Abstraction, Modifier and Accessor Methods, Static Method, Adding Methods Dynamically, Composition, Inheritance, Built-in Functions for Classes.

Unit V :
Graphics - 2D Graphics, 3D Objects, Animation – Bouncing Ball. **Applications of Python -** Collecting Information from Twitter, Sharing Data Using Sockets, Managing Databases Using Structured Query Language (SQL), Developing Mobile Application for Android, Integrating Java with Python, Python Chat Application Using Kivy and Socket Programming.

Text Book:
Python Programming a Modular Approach with Graphics, Database, Mobile, and Web Applications – Sheetal Taneja, Naveen Kumar – Pearson Publication, 2018.

Unit I	:	Chapters 1,2,3
Unit II	:	Chapters 5,6,7
Unit III	:	Chapters 8,9
Unit IV	:	Chapters 10,11
Unit V	:	Chapters 17,18

Reference Books:

1. Python Programming - Reema Thareja, Oxford University Press, 2017

2. Fundamentals of Python Programming, Lambert – Cengage Publications, 2017

3. Problem Solving using Python – E. Balagurusamy, Mc Graw Hill Education Ltd., 2017

CS 22: COMPILER DESIGN
(5 Hours – 4 Credits)

Unit I:
Compilers and Translators-Why Do We Need Translators?-The Structure Of A Compiler- Lexical Analysis-Syntax Analysis-Intermediate Code Generation-Optimization-Code Generation-Book Keeping-Error Handling-Compiler-Writing

Tools-Getting started. The role of the lexical analyzer-Simple approach to design of a lexical analyzer-Regular Expressions- Finite Automata-From regular expression to finite automata-Minimizing the number of states of a DFA-A language for specifying lexical analyzer-Implementing a lexical analyzer- The scanner generator as Swiss army Knife.

Unit II:

The Syntactic Specification of Programming Languages-Derivation and Parse Trees- Capability of context free Grammars. Parsers-Shift-reduce Parsing-Operator-precedence parsing-Top-down parsing-Predictive Parsers.

Unit III:

LR parsers-The canonical collection of LR(0) items-constructing SLR parsing tables – constructing canonical LR parsing tables-constructing SLR parsing tables-constructing LALR parsing tables – Using Ambiguous grammars- An automatic parse generator Implementation of LR parsing Tables – constructing LALR set of items. Syntax directed translation schemes – Implementation if syntax directed schemes-Intermediate Code-Parse Tree and Syntax Trees

–Three Address code, quadruples, and triples-Translation of assignment statements-Boolean Expression-Statements that alter the flow of control-postfix translations-Translation with a top-down parser.

Unit IV:

The contents of a symbol tables-Data structure for a symbol table-Representing Scope information. Errors-Lexical-phase errors - syntactic-phase errors-Semantic errors. The principal sources of optimization-Loop optimization -The DAG representation of basic blocks-Value numbers and algebraic laws-Global data-flow analysis.

Unit V:

Dominators-Reducible Flow graphs -Depth-first search-Loop-invariant computations – Induction variable elimination-Some other loop optimization. Code Generation-Object Programs- A machine Model- A simple code generator-Register allocation and assignment- Code generation from DAG's-Peephole Optimization.

Text Book:

Principles of Compiler Design, Alfred V.Aho and Jeffrey D.Ullman.25th Reprint, **Addison- Wesley Series,** 2002.

Unit I	:	Chapters 1,3
Unit II	:	Chapters 4,5
Unit III	:	Chapters 6,7
Unit IV	:	Chapters 9,11,12
Unit V	:	Chapters 13,15

Reference Books:

1. Compiler Principles, Techniques and Tools by Alfred V.Aho, Monica S.Lam, Ravi Sethi, Jeffrey D. Ullman, Second edition, Pearson Publications, 2007.

2. Advanced Compiler Design and Implementation - Steven S. Muchnick, Morgan Kaufmann Publishers - Elsevier Science, India, Indian Reprint 2003.

3. Introduction to Compiler Techniques, J.P. Bennet, Second Edition, Tata McGraw-Hill, 2003.

Unit I:

CS 23: OPERATING SYSTEM DESIGN PRINCIPLES

(5 Hours – 4 Credits)

Computer system overview – basic elements - processor registers – instruction execution – interrupts – memory hierarchy – cache memory – I/O communication techniques. Operating system overview – operating system objectives and functions – evolution of operating systems – major achievements – developments leading to modern operating systems – Microsoft windows overview.

Unit II:

Process description and control – what is a process? – process states – process description – process control – execution of operating system – security issues. Threads, SMP, Micro kernels –processes and threads – symmetric multiprocessing – micro kernels – windows vista thread and SMP management. Concurrency: Mutual exclusion and Synchronization - Principles of concurrency –mutual exclusion: hardware support – semaphores – monitors – message passing – reader/writer problem.

Unit III:

Concurrency: Deadlock and Starvation – principles of deadlock – deadlock prevention – deadlock avoidance – deadlock detection – an integrated deadlock strategy – dining philosophers problem – windows vista concurrency mechanisms. Memory management – memory management requirements – memory partitioning – paging – segmentation – security issues. Virtual memory –hardware and control structures – operating system software– windows vista memory management.

Unit IV:

Uni processor scheduling – types of scheduling – scheduling algorithms. Multiprocessor and Real time scheduling – multiprocessor scheduling – real time scheduling – windows vista scheduling.

Unit V:

I/O management and Disk scheduling – I/O devices – organization of I/O function – operating system design issues – I/O buffering – disk scheduling – RAID – disk cache – windows vista I/O. File management – overview – file

organization and access – file directories – file sharing – record blocking – secondary storage management – file system security – windows vista file system.

Text book:

Operating Systems - Internals and Design Principles, William Stallings, Sixth Edition, Pearson Education Ltd, 2014

Unit I	:	Chapter 1.1 to 1.7, 2.1 to 2.5
Unit II	:	Chapter 3.1 to 3.6, 4.1 to 4.4, 5.1 to 5.6
Unit III	:	Chapter 6.1 to 6.6, 6.10, 7.1 to 7.5, 8.1, 8.2, 8.5
Unit IV	:	Chapter 9.1, 9.2, 10.1, 10.2, 10.5
Unit V	:	Chapter 11.1 to 11.7, 11.10, 12.1 to 12.7, 12.10

Reference Books:

1. Operating System Concepts: Abraham Silberschatz, 8th Edition, Wiley Student Edition 2009
2. Operating system – A Design Oriented Approach, Charles Crowley, McGraw-Hill Education, 2009
3. Operating Systems: Concepts & Design: Milan Milenkovic, 2nd Edition, Mc Graw- Hill Education,2001

ES 1.1: EMBEDDED SYSTEMS

(5 Hours – 4 Credits)

Unit I:

Introduction to 8051 Microcontroller: Comparison between micro controller and general purpose microprocessor- different types of microcontrollers- Architecture of 8051- key features of 8051- I/O ports- memory organization- counters and timers- serial I/O ports- interrupts of 8051.

Unit II:

8051 Instruction Set & Assembly Language Programming: Addressing modes of 8051- instruction set- data move- arithmetic- logical- jump and call Instructions- Program for data transfer- Memory operations- arithmetic- logical- sorting.

Unit III:

Programming and Debugging Using KEIL C: Different types of Header files, declaration of variables, operators, Macro declaration- inclusion of files- I/O functions- String functions- Basic debugging concept- Logic analyzer programming- Timer simulation- I/O port simulation and debug- Program for RPM counting- Program for PWM.

Unit IV:

External Peripheral Interfacing: Interfacing switches- LEDs- Matrix Keyboard- Seven Segment Displays- 16 x 2 LCD- pulse measurement- analog to digital and digital to analog converters- interrupt programming- PC interfacing.

Unit V:

Real Time Software Development: Architecture: Study of different architectures- simple Round Robin- Round Robin with Interrupt- Token passing method- Semaphores- Interrupt Latency- RTOS- RTOS applications-VxWorks RTOS study- RTC interfacing with RTOS- Selection procedure for Microcontrollers- SPI mode of operation.

Text Book:

The 8051 Microcontroller Architecture Programming and Applications, Kenneth J Ayala, Penram International Publishing Pvt. Ltd., 2005.

Reference Books:

1. Douglas V Hall-Microprocessor and Interfacing- Tata McGraw Hill, 3rd Edition, 2000.
2. The 8051 Microcontroller and Embedded system - Muhammad Ali Mazidi and Mazidi & McKinlay, R.D, - Pearson Education, 2006
3. Raj Kamal, Microcontroller Architecture programming Interfacing and system design, Pearson Education, 2005

ES 1.2: ADVANCED SOFTWARE ENGINEERING

(5 Hours – 4 Credits)

Unit I :

Software and Software Engineering: The nature of software – Software Engineering – Software Myths. **Process Models:** A generic process model – Process assessment and improvement – Prescriptive process models – The unified process. **Agile Development**: What is Agility? – What is an Agile process? – Extreme programming.

Unit II :

Modeling: Principles that guide each framework activity – **Understanding Requirement:** Requirement engineering – Eliciting requirements – Negotiating requirements – Validating requirements. **Requirement Modeling: Scenarios, Information, and Analysis Classes:** Requirement Analysis – Scenario-based modeling – UML models that supplement the use case – Data modeling concepts – Class-based modeling.

Unit III :

Design Concepts: The design process - Design concepts – **Architectural design:** Software Architecture – Architecture design – **Component level design**: What is component? Designing class based components - **User Interface design:** User Interface analysis & design
– Interface Analysis – Interface Design steps.

Unit IV :

Quality Management**: What is quality? Software quality – Achieving software quality –** Software quality assurance; **Elements of software quality assurance – SQA tasks, Goals & metrics - Software reliability.**

Unit V :

Software Testing strategies: A strategic approach to software testing – Testing strategies for conventional software – Test strategies for object- oriented software – Software testing.
Software configuration Management-SCM.

Text book:

Software Engineering: A Practitioner Approach, Roger S. Pressman, Seventh edition, McGrawHill, 2015.
UNIT I : Chapters 1.1,1.3,1.6; 2.1,2.2,2.3,2.5;3.1,3.3,3.4
UNIT II : Chapters 4.3;,5.1,5.3,5.6,5.7; 6.1 to 6.5
UNIT III: Chapters 8.2,8.3;9.1,9.4;10.1,10.2;11,2,11,4
UNIT IV: Chapters 14.1,14.2,14.4; 16.2,16.3,16.6
UNIT V: Chapters 17.1,17.3,17.4,17.7;22.1

Reference Books:

1. Richard E. Fairley, Software Engineering – A practitioner's approach, McGraw Hill,2008
2. Martin L Shooman, Software Engineering – Design, Reliability and Management McGraw Hill,1983
3. Software Engineering - Ian Sommerville Addison Wesley Publishing company,2004.
4. An Integrated approach to Software Engineering Pankaj Jalote, Third Edition, Springer Verlag,2005.

ES1. 3: DISTRIBUTED SYSTEMS
(5 Hours – 4 Credits)

Unit I:
Introduction to Distributed System: Goals, Hardware concepts, Software concepts, and Client-Server model. Examples of distributed systems.

Communication: Layered protocols, Remote procedures call, Remote object invocation, Message-oriented communication, Stream-oriented communication.

Unit II:
Processes: Threads, Clients, Servers, Code Migration, Software agent.
Naming: Naming entities, Locating mobile entities, Removing un-referenced entities.

Unit III:
Synchronization: Clock synchronization, Logical clocks, Global state, Election algorithms, Mutual exclusion, Distributed transactions.

Consistency and Replication: Introduction, Data centric consistency models, Client centric consistency models, Distribution protocols, Consistency protocols.

Unit IV:
Fault Tolerance: Introduction, Process resilience, Reliable client server communication, Reliable group communication. Distributed commit, Recovery.
Security: Introduction, Secure channels, Access control, Security management.

Unit V:
Distributed File System: Sun network file system, CODA files system.

Case Study: CORBA, Distributed COM, Globe, Comparison of CORBA, DCOM, and Globe.

Text Book:

Distributed Systems: Principles and Paradigms A.S. Tanenbaum and M. van Steen, Pearson/Prentice-Hall, 2nd Edition, 2007.

Unit I	:	Chapters 1,2 and 4
Unit II	:	Chapters 3 and 5
Unit III	:	Chapters 6 and 7
Unit IV	:	Chapters 8 and 9
Unit V	:	Chapters 11

Reference Books:

1. Distributed Systems: Concepts and Design G. Coulouris, J. Dollimore, and T. Kindberg, 5th edition, Addison-Wesley, 2012.
2. Advanced Concepts in Operating Systems M. Singhal, N. Shivaratri, , McGraw-Hill Education (India) Pvt. Limited, 2001.
3. Distributed Operating Systems: Concepts and Design, Pradeep K Sinha, Prentice Hall of India, 2007.

CS 24: LAB3.PYTHON PROGRAMMING LAB

(5 Hours – 3 Credits)

Section: A

1. Write a menu driven program to convert the given temperature from Fahrenheit to Celsius and vice versa depending upon user's choice.
2. Write a Python program to calculate total marks, percentage and grade of a student. Marks obtained in each of the three subjects are to be input by the user. Assign grades according to the following criteria:

Grade A: Percentage >=80

GradeB: Percentage>=70 and <80

Grade C: Percentage>=60 and <70

Grade D: Percentage>=40 and <60

Grade E: Percentage<40

3. Write a menu-driven program, using user-defined functions to find the area of rectangle, square, circle and triangle by accepting suitable input parameters from user.
4. Write a Python program to display the first 'n' terms of Fibonacci series. 5 Write a Python program to find factorial of the given number.
6. Write a Python program to find sum of the following series for n terms: 1 – 2/2! + 3/3! - - -
- - n/n!
7. Write a Python program to calculate the sum and product of two compatible matrices.

Section: B

All the programs should be written using user defined functions, wherever possible.

1. Write a menu-driven program to create mathematical 3D objects
   i. curve
   ii. sphere
   iii. cone
   iv. arrow
   v. ring
   vi. cylinder
2. Write a Python program to read n integers and display them as a histogram.
3. Write a Python program to display sine, cosine, polynomial and exponential curves.
4. Write a Python program to plot a graph of people with pulse rate p vs. height h. The values of p and h are to be entered by the user.
5. Write a Python program to calculate the mass m in a chemical reaction. The mass m (in gms) disintegrates according to the formula m=60/(t+2), where t is

the time in hours. Sketch a graph for t vs. m, where t>=0.

6. Input initial velocity and acceleration, and plot the following graphs depicting equations of motion: velocity wrt time (v=u+at)

i. distance wrt time (s=u*t+0.5*a*t*t)
ii. distance wrt velocity (s=(v*v-u*u)/2*a)

7) A website requires the users to input username and password to register. Write a program to check the validity of password input by users.
Following are the criteria for checking the password:
1. At least 1 letter between [a-z]
2. At least 1 number between [0-9]
3. At least 1 letter between [A-Z]
4. At least 1 character from [$#@]
5. Minimum length of transaction password: 6
6. Maximum length of transaction password: 12
Your program should accept a sequence of comma separated passwords and will check them according to the above criteria. Passwords that match the criteria are to be printed, each separated by a comma.

8) Write a program to sort the (name, age, height) tuples by ascending order where name is string, age and height are numbers. The tuples are input by console. The sort criteria is:
1: Sort based on name;
2: Then sort based on age; 3: Then sort by score.
The priority is that name > age > score.
If the following tuples are given as input to the program: Tom,19,80
Then, the output of the program should be:
[('John', '20', '90'), ('Jony', '17', '91'), ('Jony', '17', '93'), ('Json', '21', '85'), ('Tom', '19', '80')]

9) Define a class with a generator which can iterate the numbers, which are divisible by 7, between a given range 0 and n.

10)_A robot moves in a plane starting from the original point (0,0). The robot can move toward UP, DOWN, LEFT and RIGHT with a given steps. The trace of robot movement is shown as the following:
UP 5
DOWN 3
LEFT 3
RIGHT 2
The numbers after the direction are steps. Write a program to compute the distance from current position after a sequence of movement and original point. If the distance is a float, then just print the nearest integer.
Example:
If the following tuples are given as input to
the program: UP 5
DOWN 3
LEFT 3
RIGHT 2
Then, the output of the
program should be: 2

11)Write a program to compute the frequency of the words from the input. The

output should output after sorting the key alphanumerically.
Suppose the following input is supplied to the program:
New to Python or choosing between Python 2 and Python 3? Read Python 2 or Python 3.

Then, the output should be:

2:2
3.:1
3?:1
New:1 Python:5 Read:1 and:1 between:1 choosing:1 or:2
to:1

Reference Books :

1. Problem solving and Python Prgoramming – s.A.Kulkarni, Yesdee Publisher, 2017
2. Python Programming a Modular Approach with Graphics, Database, Mobile, and Web Applications – Sheetal Taneja, Naveen Kumar – Pearson Publication, 2018.

Note: The above are sample problems; Instructor can add more exercises based on their requirements and the current technology

CS 25:LAB 4. OPERATING SYSTEM LAB

(5 Hours – 3 Credits)

1. Write programs using the following system calls of UNIX operating system: fork, exec, getpid, exit, wait, close, stat, opendir, readdir
2. Write programs using the I/O System calls of UNIX operating system. (open, read, write, etc)
3. Write C Program to implement fork(), getpid() and wait().
4. Write C program to simulate UNIX command: ls.
5. Write C program to simulate UNIX command: grep.
6. Given the list of processes, their CPU burst times and arrival times. Display/print the Gantt chart for FCFS. Compute and print the average waiting time and average turnaround time.
7. Given the list of processes, their CPU burst times and arrival times. Display/print the Gantt chart for SJF. Compute and print the average waiting time and average turnaround time.
8. Given the list of processes, their CPU burst times and arrival times. Display/print the Gantt chart for Priority Scheduling. Compute and print the average waiting time and average turnaround time (2 sessions).
9. Given the list of processes, their CPU burst times and arrival times. Display/print the Gantt chart for Round robin. Compute and print the average waiting time and average turnaround time (2 sessions).

10. Develop Application using Inter-Process-Communication (Using shared memory, pipes or message queues).
11. Implement the Producer-Consumer problem using semaphores (Using UNIX system calls)
12. Implement some Memory management schemes like Paging and Segmentation.
13. Implement some Memory management schemes like FIRST FIT, BEST FIT & WORST FIT.
14. Implement any file allocation techniques(Contiguous, Linked or Indexed)
15. Write a shell script program to display the process attributes, to change the priority of processes and to change the ownership of processes.

Example for exercises 12 & 13:

Free space is maintained as a linked list of nodes with each node having the starting byte address and the ending byte address of a free block. Each memory request consists of the process-id and the amount of storage space required in bytes. Allocated memory space is again maintained as a linked list of nodes with each node having the process-id, starting byte address and the ending byte address of the allocated space. When a process finishes (taken as input) the appropriate node from the allocated list should be deleted and this free space should be added to the free space list (care should be taken to merge contiguous free blocks into one single block. This results in deleting more than one node from the free space list and changing the start and end address in the appropriate node). For allocation use first fit, worst fit and best fit.

Note: The above are sample problems; Instructor can add more exercises based on their requirements and the current technology

CS 31: ADVANCED DATABASE SYSTEM

(5 Hours – 4 Credits)

Unit I :

Database System: Introduction-Overview of Database Management Systems-Data Independence-Database System Architecture- The External Level – The Conceptual Level – The Internal Level – Mappings – The Database Administrator – Data Dictionary – Data Models – Record-Based Data Models – Object based Data Models – Physical Data Models- Hierarchical Data Models – Network Data Models-Relational Data Model-Entity- Relationship Models – Object Oriented Data Model.

Unit II :

Distributed Databases and Decision Support: Preliminaries-The Objectives and problems of Distributed Databases - Client/Server Systems – DBMS Independence-SQL Facilities – Decision Support-Data Preparation-Data Warehouses and Data Marts – Online Analytical Processing – Object Oriented Databases: Introduction-Object Oriented Data Models-Object Oriented Database-Object Oriented DBMS – Object Oriented Languages.

Unit III :

Temporal Databases: Introduction-Intervals-Packing and Unpacking relations-Generalizing the relational operators – Database Design – Integrity Constraints – Multimedia Databases: Multimedia Sources – Multimedia Database Queries – Multimedia Database Applications.

Unit IV :

Spatial Databases: Spatial Data- Spatial Database Characteristics – Spatial Data Model- Spatial Database Queries – Techniques of Special Database Query- Logic based Databases: Introduction-Overview-Proportional calculus – Predicate Calculus – Deductive Database Systems – Recursive Query Processing.

Unit V :

Emerging Database Technologies: Introduction – Internet Databases – Multimedia Databases – Mobile Databases – MySQL **:** Introduction – An Overview of MySQL – MySQL Database.

Text Book:

An Introduction to Database Systems - C.J.Date, A.Kannan, S.Swamynathan -8th Edition-Pearson Education-2006.

Reference Books:

1. Database Systems: Concepts, Design and Applications -S.K. Singh-2nd Edition, Pearson Education- 2008.
2. Database Management System Concepts - Abraham Silberschatz, Hentry F.Korth and S.Sudarshan-McGraw Hill International Edition-2006.
3. Fundamentals of Database Systems - R. Elmasri, S.B. Navathe- Fifth Edition, Pearson Education- 2006.

CS 32: SOFT COMPUTING
(5 Hours – 4 Credits)

Unit I :

Introduction to Soft Computing – Introduction , Artificial Intelligence, Artificial Neural Networks, Fuzzy Systems, Genetic Algorithm and Evolutionary Programming, Swarm Intelligent Systems, Expert Systems.

Unit 2:

Artificial Neural Networks–First Generation - Introduction to Neural Networks, Biological Inspiration, Biological Neural Networks to Artificial Neural Networks, Classification of ANNs, First-generation Neural Networks.

Unit 3:

Fuzzy Logic - Introduction to Fuzzy Logic, Human Learning Ability, Imprecision, and Uncertainty, Undecidability, Probability Theory vs Possibility Theory, Classical Sets and Fuzzy Sets, Fuzzy Set Operations, Fuzzy Relations, Fuzzy Composition.

Fuzzy Logic Applications : Introduction to Fuzzy Logic Applications, Fuzzy Controllers.

Unit 4 :

Genetic Algorithms and Evolutionary Programming - Introduction to Genetic Algorithms, Genetic Algorithms, Procedures of GAs, Working of GAs, Genetic Algorithm Applications.

Unit 5 :

Introduction to Swarm Intelligence - Background of Swarm Intelligent Systems, Ant Colony System, Working of Ant Colony Optimisation, Ant Colony Optimisation Algorithm for TSP.

Text Book:

Soft computing with Pprogramming, N.P.Padhy, S.P.Simon, Oxford University Press, First Edition, 2015

UNIT 1: Chapter 1 - 1.1 to 1.7 (except 1.8)

UNIT 2: Chapter 2 - 2.1 to 2.5 (except 2.6 to 2.8).

UNIT 3: Chapter 5 - 5.1 to 5.8 , chapter 6 (6.1, 6.2)

UNIT 4: Chapter 7 - 7.1 to 7.5.

UNIT 5: Chapter 8 - 8.1 to 8.5.

REFERENCES:

1. Principles of Soft computing, S.N.Sivanandam and S.N.Deepa, Wiley India Edition, 2nd Edition, 2013.
2. Neural Networks, Simon Haykin, Pearson Education, 2003.
3. Fuzzy Logic – Intelligence Control & Information , John Yen & Reza Langari, Pearson Education, New Delhi, 2003
4. Artificial Intelligence and Intelligent Systems , N.P.Padhy, Oxford University Press, 2013.

Unit I:

ES2.1: DATA MINING AND WAREHOUSING

(5 Hours – 4 Credits)

Introduction - Why Data Mining? - What is Data Mining? - What Kinds of Data Can Be Mined? - What Kinds of Patterns Can Be Mined? - Which Technologies Are Used? Which Kinds of Applications Are Targeted? Major Issues in Data Mining. Getting to Know Your Data: Data Objects and Attribute Types - Basic Statistical Descriptions of Data - Data Visualization –Measuring Data Similarity and Dissimilarity.

Unit II:

Data Preprocessing : Data Preprocessing An Overview - Data Cleaning - Data Integration - Data Reduction - Data Transformation and Data Discretization - Data Warehousing and Online Analytical Processing: **Data Warehouse:** Basic Concepts - Data Warehouse Modeling: Data Cube and OLAP - Data Warehouse Design and Usage - Data Warehouse Implementation - Data Generalization by Attribute - Oriented Induction.

Unit III:

Mining Frequent Patterns, Associations, and Correlations: Basic Concepts and Methods - Frequent Item set Mining Methods - Which Pattern Are Interesting? - Pattern Evaluation Methods. Advanced Pattern Mining : Pattern Mining: A Road Map - Pattern Mining in Multilevel, Multidimensional Space - Constraint - Based Frequent Pattern Mining - Mining High - Dimensional Data and Colossal Patterns - Mining Compressed or Approximate Patterns - Pattern Exploration and Application.

Unit IV:

Classification: Basic Concepts - Basic Concepts - Decision Tree Induction - Bayes Classification Methods - Rule-Based Classification- Model Evaluation and Selection - Techniques to Improve Classification Accuracy.

Unit V:

Cluster Analysis Basic Concepts and Methods: Cluster Analysis - Partitioning Methods - Hierarchical Methods - Density Based Methods - Grid Based Methods - Evaluation of Clustering.

Text Book:

Data Mining Concepts and Techniques - Third Edition, Jiawei Han, Micheline Kamber, Jian Pei, Morgan Kaufmann Publisher, 2012.

Unit I	:	Chapters 1 and 2
Unit II	:	Chapters 3 and 4
Unit III	:	Chapters 6 and 7
Unit IV	:	Chapter 8
Unit V	:	Chapter 10

Reference Books:

1. Insight into Data mining Theory and Practice, K.P. Soman, Shyam Diwakar and V. Ajay, Easter Economy Edition, Prentice Hall of India, 2006.
2. Introduction to Data Mining with Case Studies, G. K. Gupta, Easter Economy Edition, Prentice Hall of India, 2006.
3. Introduction to Data Mining Pang-Ning Tan, Michael Steinbach and Vipin Kumar, , Pearson Education, 2007.
4. Modern Data Warehousing, Mining and Visualization, Marakas, George M, Pearson Education, 2011.

ES 2.2: CLOUD COMPUTING
(5 Hours – 4 Credits)

Unit I:

Cloud Architecture and Model: Technologies for Network-Based System – System Models for Distributed and Cloud Computing –NIST Cloud Computing Reference Architecture. Cloud Models:- Characteristics – Cloud Services – Cloud models (IaaS, PaaS, SaaS) – Public vs Private Cloud –Cloud Solutions - Cloud ecosystem – Service management – Computing on demand.

Unit II:

Virtualization: Basics of Virtualization - Types of Virtualization - Implementation Levels of Virtualization - Virtualization Structures - Tools and Mechanisms - Virtualization of CPU, Memory, I/O Devices - Virtual Clusters and Resource management – Virtualization for Data- center Automation.

Unit III:

Cloud Infrastructure: Architectural Design of Compute and Storage Clouds – Layered Cloud Architecture Development – Design Challenges - Inter Cloud Resource Management – Resource Provisioning and Platform Deployment – Global Exchange of Cloud Resources.

Unit IV:

Programming Model: Parallel and Distributed Programming Paradigms – MapReduce , Twister and Iterative MapReduce – Hadoop Library from Apache – Mapping Applications - Programming Support - Google App Engine, Amazon AWS - Cloud Software Environments
-Eucalyptus, Open Nebula, OpenStack, Aneka, CloudSim.

Unit V:

Security in The Cloud: Security Overview – Cloud Security Challenges and Risks – Software-as-a-Service Security – Security Governance – Risk Management – Security Monitoring – Security Architecture Design – Data Security – Application Security – Virtual Machine Security - Identity Management and Access Control – Autonomic Security.

Text Book :

Distributed and Cloud Computing, From Parallel Processing to the Internet of Things Kai Hwang, Geoffrey C Fox, Jack G Dongarra, Morgan Kaufmann Publishers, 2012.

Unit I	-	Chapters 1 and 2
Unit II	-	Chapters 3 and 4
Unit III	-	Chapters 5 and 6
Unit IV	-	Chapters 7 and 8
Unit V	-	Chapters 9

Reference Books:

1. Cloud Computing: Implementation, Management, and Security, John W.Rittinghouse and James F.Ransome, CRC Press, 2010.

2. Cloud Computing, A Practical Approach, Toby Velte, Anthony Velte, Robert Elsenpeter, McGraw Hill Education, 2009.

3. Cloud Computing – Insights into New-Era Infrastructure, Kumar Saurabh, Wiley India, 2011.

ES 2.3: INTERNET OF THINGS
(5 Hours – 4 Credits)

Unit I:

Introduction to Internet of Things: Introduction – Physical Design of IoT – Logical Design of IoT – IoT Enabling Technologies – IoT & Deployment Templates. **Domain Specific IoTs:** Introduction – Home Automation – Cities – Environment – Energy – Retail – Logistics – Agriculture – Industry – Health & Life style.

Unit II:

IoT and M2M : Introduction : M2M – Difference between IoT and M2M – SDN and NFV for IoT.

IoT System Management with NETCONF-YANG : Need for IoT Systems Management – Simple Network Management Protocol (SNMP) – Network Operator Requirements – NETCONF- YANG – IoT Systems Management with NETCONF_YANG.

Unit III:

IoT Platforms Design Methodology: Introduction – IoT Design Methodology – Case Study on IoT System for Weather Monitoring – Motivation for using Python.

IoT Systems –Logical Design using Python: Introduction – Installing Python – Python Data types & Data Structures – Control Flow – Functions – Modules – Packages – File Handling – Date/Time Operations – Classes – Python packages of Interest for IoT.

Unit IV:

IoT Physical Devices & Endpoints: What is an IoT Device – Exemplary Device: Raspberry Pi – About the Board – Linux on Raspberry Pi – Raspberry Pi Interfaces – Programming Raspberry Pi with Python – Other IoT devices.

IoT Physical Servers & Cloud Offerings : Introduction to Cloud Storage Models & Communication APIs – WAMP - AutoBahn for IoT– Xively Cloud for IoT – Python Web application Framework-Django – Designing a REST ful

Web API – Amazon Web Services for IoT – SkynetIoT messaging platform.

Unit V:

Case Studies Illustrating IoT Design: Introduction – Home Automation – Cities – Environment – Agriculture – Productivity applications

Data Analytics for IoT : Introduction – Apache Hadoop – Using Hadoop MapReduce for Batch Data Analysis – Apache Oozier – Apache Spark – Apache Storm – Using Apache Storm for Real-time Data Analysis.

Text Book:

1. Internet of Things, Arshdeep Bahga, Vijay Madisetti, Universities Press (INDIA) Private Ltd., 2015.

Unit I	:	Chapters 1 and2
Unit II	:	Chapters 3 and 4
Unit III	:	Chapters 5 and 6
Unit IV	:	Chapters 7 and 8
Unit V	:	Chapters 9 and 10

Reference Books:

1. Getting Started with the Internet of Things, CunoPfister, O'Relly, 2011.
2. Designing the Internet of Things, AdrianMcewen, HakinCassimally, Willey,2015.
3. The Internet of Things in the Cloud: A Middleware Perspective,Honbo Zhou, CRC Press, 2012.
4. Architecting the Internet of Things, Dieter Uckelmann; Mark Harrison; Florian Michahelles, (Eds.) Springer, 2011.
5. The Internet of Things , Key Applications and Protocols, Oliver Hersent, David Boswarthick, Omar Elloumi, Wiley , 2017

NME: PRINCIPLES OF INFORMATION TECHNOLOGY

(4 Hours – 4 Credits)

Unit I:

Introduction: The Internet – world wide web – Getting connected to web – web Multimedia – Bandwidth – Information Technology introduction – Information Systems.

Unit II:

What is Software – IT in Business and industry – IT in Education – IT in Science – Engineering and Math – Computers in hiding – Global Positioning System.

Unit III:
Input Output Devices – Modern Storage Device – User interfaces – Application Programs
– Operating System – Introduction - Types
Unit IV:
Entering and Editing Documents – Formatting Documents – Database Application – Principles of Data Storage – Network Application – Fax, voice and information services

Unit V :
Multimedia – Introduction – Tools of Multimedia – Graphic effects and techniques – Multimedia Authoring Tools – Multimedia on the Web.

Text Book:

1. Information Technology The Breaking Wave – Denis P.Curtin, Kim Foley, Sen & Cathleen Morin - McGrawHill.

Unit I	:	1.1,1.3,1.6,2.1,2.2
Unit II	:	2.3,2.4,2.6,2.8,2.9,2.10
Unit III	:	4.1,5.2,6.2,6.3,6.4,6.5
Unit IV	:	7.1,73,8.4,8.5,9.1
Unit V	:	10.1,10.3,10.6,10.8

Reference Books :

1. Fundamentals of Information Technology, Alexis Leon, Mathews Leon, Leon Vikas Ltd, Second Edition, 2009.
2. Introduction to Information Systems - Alexis Leon, Mathews Leon, Vijay Nicole Imprints Pvt. Ltd, Second Reprint, 2009.
3. Multimedia Technology and Applications- David Hillman, Delmar Publishers Reprint 2012.

CS 33:LAB 5. SOFT COMPUTING LAB
(5 Hours – 3 Credits)

Section - A (Fuzzy Logic)

1. a) Write a program (m.file) to calculate union, intersection, complement and difference of two fuzzy sets.
   b) Write a program (m.file) to calculate the Demorgan's Law.
2. Find whether the given matrix is (a) reflexive (b) tolerance and (c) transitivity matrix or not.
3. Find whether the given matrix is symmetry or not.
4. Find the fuzzy relation between two

vectors R and S R =

0.7	0.5	
0.8	0.4	

S =

0.9	0.6	0.2
0.1	0.7	0.5

Using max–product and max-min method

5. a) Use command line commands to display the Gaussian membership function. Given
   x = 0–10 with increment of 0.1 and Gaussian function is defined between 0.5 and −5.
   b) Use command line commands to display the triangular membership function. Given x = 0–10 with increment of 0.2 triangular membership function is defined between [3 4 5]
6. Illustrate different types of generalized bell membership functions using a program
7. Using program find the crisp lambda cut set relations for λ = 0.2, the fuzzy matrix is given by

R=

0.2	0.7	0.8	1
1	0.9	0.5	0.1
0	0.8	1	0.6
0.	0.4	1	0.3

8. Temperature control of the reactor where the error and change in error is given to the controller. Here the temperature of the reactor is controlled by the temperature bath around the reactor thus the temperature is controlled by controlling the flow of the coolant into the reactor. Form the membership function and the rule base using FIS editor.
9. Consider the water tank with following rules
   a) IF (level is okay) THEN (valve is no_change) (1)
   b) IF (level is low) THEN (valve is open_fast) (1)
   c) IF (level is high) THEN (valve is close_fast) (1)

   Using Mamdani method and max–min method for fuzzification and method of centroid for defuzzification method construct a FIS. Before editing that rules, membership functions must be defined with membership function editor.

10. a) Form a fuzzy system, which approximates function f, when x [−10, 10].Repeat the same by adding random, normally distributed noise with zero mean and Unit variance.
    b) Simulate the output when the input is sin(t). Observe what happens to the signal shape at the output.
11. Use Fuzzy Logic Toolbox to model the tip given after a dinner for two, where the food can be disgusting, not good, bland, satisfying, good, or delightful, and the service can be poor, average, or good. To get started,

you type fuzzy in a window. Then use the fuzzy inference system and membership function editors to define and tune your rules.

Section - B (Neural Network)

12. Design networks of McCulloch-Pitts neurons that implement logical NOT, AND and OR gates. Draw each network and label all the weight and threshold values.

13. Derive expressions for the weights and thresholds of a McCulloch-Pitts neuron that can compute the following input-output mappings:

in1	*in2*	*out*
0	0	1
0	1	0
1	0	0
1	1	0

Write code for the above ANN.

14. Investigation the use of back-propagation learning using a sigmoidal nonlinearity to achieve one-to-one mapping, as described here:

1. $f(x) = 1/x'$ $1 \leq x \leq 100$
2. $f(x) = \log_{10}x$, $1 \leq x \leq 10$
3. $f(x) = \exp(-x)$, $1 \leq x \leq 10$
4. $f(x) = \sin x$, $0 \leq x \leq \pi/2$ For each mapping, do the following:

(a) Set up two sets of data, one for network training, and the other for testing.
(b) Use the training data set compute the synaptic weights of the network, assumed to have a single hidden layer.
(c) Evaluate the computation accuracy of the network by using the test data. Use a single layer but with a variable number of hidden neurons. Investigate how the network performance is affected by varying the size of the hidden layer.

15. The data presented in the Table P4.17 show the weights of eye lenses of wild Australian rabbits as a function of age. No simple analytical function can exactly interpolate these data, because we do not have a single valued function. Instead, we have a nonlinear least squares model of this data set, using a negative exponential, as described by Y = 2.33.846(1 – exp(- an error term.
Using the back- propagation algorithm, design a multiplayer perceptron that provides a nonlinear least-squares approximation to this data set. Compare your result against the least-sequence model described.

Table P4.17 Weights of Eye Lenses of Wild Australian Rabbits

Ages (days)	Weights (mg)	Ages (days)	Weights (mg)	Ages (days)	Weights (mg)	Ages (days)	Weights (mg)
15	21.66	75	94.6	218	174.18	338	203.23
15	22.75	82	92.5	218	173.03	347	188.38
15	22.3	85	105	219	173.54	354	189.7
18	31.25	91	101.7	224	178.86	357	195.31
28	44.79	91	102.9	225	177.68	375	202.63
29	40.55	97	110	227	173.73	394	224.82
37	50.25	98	104.3	232	159.98	513	203.3
37	46.88	25	134.9	232	161.29	535	209.7
44	52.03	142	130.68	237	187.07	554	233.9
50	63.47	142	140.58	26	176.13	591	234.7
50	61.13	147	155.3	258	183.4	648	244.3
60	81	147	152.2	276	186.26	660	231
61	73.09	150	144.5	285	189.66	705	242.4
64	79.09	159	142.15	300	186.09	723	230.77
65	79.51	165	139.81	301	186.7	756	242.57
65	65.31	183	153.22	305	186.8	768	232.12
72	71.9	192	145.72	312	195.1	860	246.7
75	86.1	195	161.1	317	216.41		

Section - C (Genetic Algorithm)

16. Write a program to implement Roulette wheel and ranking selection method.
17. Write a program to maximize a function
    f(x,y)=xsin(4 x) + ysin(20
    □□□ □x) subject to - 3.0 x
    □ □ 12.1
    4.1 y 5.8

Reference Books :

Soft computing with Pprogramming, N.P.Padhy, S.P.Simon, Oxford University Press, First Edition, 2015

Note: The above are sample problems; Instructor can add more exercises based on their requirements and current technology

CS 34: LAB 6. ADVANCED DATABASE LAB
(6 Hours – 3 Credits)

1. Creation of base tables and views.
2. Data Manipulation INSERT, DELETE and UPDATE in Tables. SELECT, Sub Queries and JOIN
3. Data Control Commands
4. High level language extensions – PL/SQL. Or Transact SQL – Packages
5. Use of Cursors, Procedures and Functions
6. Embedded SQL or Database Connectivity.
7. Oracle or SQL Server Triggers – Block Level – Form Level Triggers
8. Working with Forms, Menus and Report Writers for a application project in any domain
9. Front-end tools – Visual Basic.

Using weka tool

1. Demonstration of preprocessing on dataset student.arff
2. Demonstration of preprocessing on dataset labor.arff
3. Demonstration of Association rule process on dataset contactlenses.arff using apriori algorithm
4. Demonstration of Association rule process on dataset test.arff using apriori algorithm
5. Demonstration of classification rule process on dataset student.arff using j48 algorithm
6. Demonstration of classification rule process on dataset employee.arff using j48 algorithm
7. Demonstration of classification rule process on dataset employee.arff using id3 algorithm
8. Demonstration of classification rule process on dataset employee.arff using naïve bayes algorithm
9. Demonstration of clustering rule process on dataset iris.arff using simple k-means
10. Demonstration of clustering rule process on dataset student.arff using simple k- means

Using R-Tool :

1. Find Sum, Mean and Product of Vector in R
2. R Program to sample from a Population
3. R Program to Sort a Vector.
4. To combine the matrix using rbind and cbind methods.
5. Use seq() to create sequence.
6. Write a program to convert the table data into data frame.
7. Calculate student mark list and output it in data frame.
8. R Program to Check Prime Number
9. R Program to Check for Leap Year.
10. R Program to Check if a Number is Odd or Even in R

11. R Program to Find the Sum of Natural Numbers
12. Convert Decimal into Binary using Recursion in R
13. R program to Find the Factorial of a Number Using Recursion
14. R Program to Make a Simple Calculator
15. Write a R Program to import CSV data into R.
16. Write a R Program to move the result data from R to CSV.
17. Draw the Line Graph for Student Data.
18. Draw the Pie-Chart for Employee Data.
19. Create a Table from the existing data set in R and draw the chart.
20. Apply K-Means Algorithm for IRIS data set and output it in graph
21. Get some input from mtcar data set and perform analysis.

Reference Book :

1.R Programming – An approach to Data Analytics – Dr. Sudhamathy & Dr. Jothi Venkateshwaran, MJP Publishers, 2018
2. Statistical Programming in R - K G Srinivasa , G M Siddesh, Chetan Shety, B.J Sowmya, - Oxford University Press, 2017
3. Design and Implementation of Data Mining Tools – M.Awad, Latifur Khan, Bhavani Thirissingham, Lei Wang – CRC Press, Taylor & Francis Group, 2015.

Note: The above are sample problems; Instructor can add more exercises based on their requirements and the current technology

Unit I:

CS 41: DIGITAL IMAGE PROCESSING
(5 Hours – 4 Credits)

Digital Image Processing: Origins of Digital Image Processing, Fundamental Steps in Digital Image Processing, **Components of an Image Processing System**. Digital Image Fundamentals: Elements of Visual Perception, Light and the Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Basic Relationships between Pixels, Mathematical Tools used in Digital Image Processing.

Unit II:

Image Transformation and Spatial filters: Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement methods, Fuzzy techniques for Intensity Transformation and Spatial Filtering. Filtering in the Frequency Domain: Preliminary Concepts, Sampling and the Fourier Transforms of Sampled Functions, The Discrete Fourier Transform (DFT), Properties of the 2-D DFT, Filtering in the Frequency Domain, Image Smoothing and Sharpening using Frequency Domain Filters, Selective Filtering.

Unit III:

Image Restoration and Reconstruction : A model of the Image Degradation/Restoration Process, Noise Models, Restoration in the presence of Noise only-Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, **Minimum Mean Square Error (Wiener) Filtering**, Constrained Least Square Filtering, Geometric Mean Filter, Image Reconstruction from Projections. Image Segmentation: Fundamentals, Point, Line and Edge Detection, Thresholding, Region-Based Segmentation, Segmentation Using Morphological Watersheds, Use of Motion in Segmentation.

Unit IV:

Color Image Processing: Color Fundamentals, Color Models, Pseudocolor Image Processing, Full Color Image Processing, Color Transformation, Smoothing and Sharpening, Image Segmentation Based on Color, Noise in Color Images. Wavelets and Multiresolution Processing: Background, Multiresolution Expansion, Wavelet Transforms in One Dimension, The Fast Wavelet Transform, Wavelet Transforms in Two Dimensions, Wavelet Packets. Image Compression: Fundamentals, Basic Compression Methods, Digital Image Watermarking.

Unit V:

Morphological Image Processing: Erosion and Dilation, Opening and Closing, The Hit-Or- Miss Transformation, Basic Morphological Algorithms, Gray-Scale Morphology. Object Recognition: Patterns and Pattern Classes, Recognition Based on Decision-Theoretic Methods, Structural Methods.

Text Book:

Digital Image Processing, Rafael C. Gonzalez, Richard E. Woods, 3rd Edition, Pearson Education, 2008.

Unit I	:	Chapter 1 and 2
Unit II	:	Chapter 3 and 4
Unit III	:	Chapter 5 and 10
Unit IV	:	Chapter 6,7 and 8
Unit V	:	Chapter 9 and 12

Reference Books:

1. Digital Image Processing using MATLAB, Rafael C. Gonzalez, Richard E. Woods,2nd Edition, Prentice Hall of India, 2002.
2. Fundamentals of Digital Image Processing, A.Jain, Prentice Hall of India, 2010.
3. Digital Image Processing, Willliam K Pratt, John Willey, 2002.

CS 42: ADVANCED SYSTEM ARCHITECTURE
(5 Hours – 4 Credits)

Unit I:

Introduction to Advanced Computer Architecture and Parallel Processing : Four Decades of Computing - Flynn's Taxonomy of Computer Architecture - SIMD Architecture - MIMD Architecture - Interconnection Networks **Multiprocessors Interconnection Networks :** Interconnection Networks Taxonomy - Bus-Based Dynamic Interconnection Networks - Switch-Based Interconnection Networks - Static Interconnection Networks - Analysis and Performance Metrics.

Unit II:

Shared Memory Architecture : Classification of Shared Memory Systems - Bus-Based Symmetric Multiprocessors - Basic Cache Coherency Methods - Snooping Protocols - Directory Based Protocols - Shared Memory Programming

Unit III:

Message Passing Architecture : Introduction to Message Passing - Routing in Message Passing Networks - Switching Mechanisms in Message Passing - Message Passing Programming Models - Processor Support for Message Passing - Example Message Passing Architectures - Message Passing Versus Shared Memory Architectures.

Unit IV:

Parallel Programming in the Parallel Virtual Machine : PVM Environment and Application Structure - Task Creation - Task Groups - Communication Among Tasks - Task Synchronization - 6 Reduction Operations - **Message Passing Interface (MPI) :** Communicators - Virtual Topologies - Task Communication - Synchronization - Collective Operations - Task Creation - One-Sided Communication.

Unit V:

Scheduling and Task Allocation: The Scheduling Problem - Scheduling DAGs without Considering Communication - Communication Models - Scheduling DAGs with Communication - The NP-Completeness of the Scheduling Problem - Heuristic Algorithms - Task Allocation - Scheduling in Heterogeneous Environments.

Text Book:

Advanced Computer architecture and parallel processing, Hesham El-Rewini and Mostafa Abo-El-Barr, , A John Wiley & sons, publication, 2005.

Unit I : Chapter 1.1, 1.2, 1.3, 1.4, 1.5 and Chapter 2.1,2.2,2.3,2.4, 2.5
Unit II : Chapter 4.1, 4.2, 4.3, 4.4, 4.5, 4.6
Unit III : Chapter 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7
Unit IV : Chapter 8.1,8.2,8.3,8.4,8.5,8.6 and Chapter 9.1,9.2,9.3,9.4,9.5,9.6,9.7 Unit V : Chapter 10.1, 10.2, 10.3, 10.4, 10.5, 10.6, 10.7, 10.8

Reference Books:

1. Advanced Computer Architecture, Kai Hwang Kai Hwang & F. A. Briggs, McGraw Hill, Third Edition, 2015.
2. Advanced Computer Architectures – A Design Space approach , DezsoSima, Terence Fountain, Peter Kacsuk, Pearson Education, 2009
3. Kai Hwang, Advanced Computer Architecture – Parallelism, Scalability, Programmability, Tata McGraw-Hill, 2008.
4. John L. Hennessey and David A. Patterson, Computer architecture – A quantitative approach, Morgan Kaufmann / Elsevier Publishers, 5th Edition.

Unit I:

ES 3.1: BIG DATA ANALYTICS
(5 Hours – 4 Credits)

Introduction to Big Data: Types of Digital Data: Classification of Digital Data, Introduction to Big Data: Characteristics of data-Evolution of Big data-Challenges of Big data-Other Characteristics of Data Which are not Definitional Traits of Big Data-Why Big Data?-Are we Just an Information Consumer or Do we also produce Information?-Traditional Business Intelligence (BI) versus Big Data – A Typical Data Warehouse Environment – A Typical Hadoop Environment – What is New Today? – What is changing in the Realms of Big Data?

Unit II:

Analytics Basics: Big Data Analytics: Where do we Begin? – What is Big Data Analytics? – What Big Data Analytics Isn't? – Why this Sudden Hype Around Big Data Analytics? – Classification of Analytics – Greatest Challenges that Prevent Business from capitalizing on Big Data – Top Challenges Facing Big Data – why is Big Data Analytics Important? – What kind of Technologies are

we looking Toward to Help Meet the Challenges Posed by Big Data? – Data Science – Data Scientist… Your New Best Friend – Terminologies Used in Big Data Environments – Basically Available Soft State Eventual Consistency (BASE) – Few Top Analytics Tools.

Unit III:

Big Data Technologies: The Big Data Technology Landscape: NoSQL (Not Only SQL) – Hadoop, Introduction to Hadoop: Introducing Hadoop – Why Hadoop? – Why not RDBMS?

– RDBMS versus Hadoop – Distributed Computing Challenges – History of Hadoop – Hadoop Overview – Use Case of Hadoop – Hadoop Distributors – HDFS(Hadoop Distributed File System) – Processing Data with Hadoop – Managing Resources and Applications with Hadoop YARN(Yet another Resource Negotiator) – Interacting with Hadoop Ecosystem.

Unit IV:

Introduction to MAPREDUCE Programming: Introduction – Mapper – Reducer – Combiner – Partitioner – Searching – Sorting – Compression, Introduction to Hive: What is Hive? – Hive Architecture – Hive Data Types – Hive File Format – Hive Query Language (HQL) – RCFile Implementation – SerDe – User – Defined Function (UDF).

Unit V:

Analytical Algorithms: Introduction to Machine Learning: Introduction to Machine Learning – Machine Learning Algorithms.

Text Book:

Big Data and Analytics, SeemeAcharya, and Subhashini Chellappan, Wiley India Pvt.Ltd. First Edition-2015.

Unit I	:	Chapters 1 and 2
Unit II	:	Chapter 3
Unit III	:	Chapters 4 and 5
Unit IV	:	Chapters 8 and 9
Unit V	:	Chapter 12

Reference Books:

1. Big Data – Principles and best practices of scalable real-time data systems, Nathan Marz, and James Warren, Manning Publication CP., USA-2015.
2. Analytics in a Big Data World: The Essential Guide to Data Science and its Applications, Bart Baesens, Wiley India Pvt.Ltd-2015.
3. Big Data, Data Mining and Machine Learning, Jared Deamn, Willey India Pvt.Ltd- 2015.

Unit I:

ES 3.2: NETWORK SECURITY
(5 Hours – 4 Credits)

Introduction: Security Goals – Attacks – Services and Mechanism –

Techniques. **Mathematics of Cryptography:** Integer Arithmetic – Modular Arithmetic – Matrices – Linear Congruence - Traditional Symmetric Key Ciphers: Instruction – Substitution Ciphers
– Transposition Ciphers – Stream and Block Ciphers. **Introduction to Modern Symmetric Key Ciphers:** Modern Block Ciphers – Modern Stream Ciphers.

Unit II:
Data Encryption Standard (DES): Introduction – DES Structure – DES Analysis – Multiple DES – Security of DES. **Advanced Encryption Standard (AES):** Introduction – Transformations – Key Expansion – Ciphers – Examples – Analysis of AES.

Unit III :
Asymmetric Key Cryptography: Introduction – RSA Crypto System. **Message Integrity and Message Authentication:** Message Integrity – Random Oracle Model – Message Authentication.

Unit IV:
Cryptographic Hash Functions: Introduction – SHA – 512 – WHIRLPOOL. **Digital Signature:** Comparison – Process – Services – Attacks on Digital Signature – Digital Signature Schemes.

Unit V:
Entity Authentication: Introduction – Passwords – Challenge Response – Zero Knowledge
– Bio Metrics. **Key Management:** Symmetric Key Distribution – Kerberos – Symmetric Key Agreement – Public Key Distribution.

Text Book:
Cryptography and Network Security – Behrouz A. Forouzan, TheMcGraw Hill, 2011.

Reference Books:

Unit I	:	Chapters 1,2,3 and 5
Unit II	:	Chapters 6 and 7
Unit III	:	Chapters10 and 11
Unit IV	:	Chapters 12 and 13
Unit V	:	Chapters 14 and 15

1. Cryptography and Network Security – William Stallings, PHI, 2008.
2. Cryptography and Network Security – Atul Kahate, McGraw Hill Education, 2013.
3. Network Security The Complete Reference – Roberta Bragg, Mark
Rhodes Ousley and Strassberg – McGraw Hill Education, 2003.

Unit I :

ES 3.3: MOBILE COMPUTING

(5 Hours – 4 Credits)

Introduction: Mobility Of Bits And Bytes – Wireless: The Beginning - Mobile Computing - Networks - Middleware And Gateways - Applications And Services - Standard Bodies. **Mobile computing Architecture:** Architecture For Mobile Computing - Three Tier Architecture. **Emerging Technologies:** Bluetooth - Radio Frequency Identification (RFID) – Wireless Broadband (Wimax) - Mobile IP - Internet Protocol Version 6(IPv6).

Unit II :

Global System For Mobile Communications (GSM): Global For Mobile Communications

- GSM Architecture - GSM Entities - Call Routing In GSM. **Short message Service (SMS)**: Mobile computing over SMS – Short Message service – Value added service through SMS. **General Packet Radio Service:** Introduction – GPRS and Packet Data Network – GPRS network architecture - GPRS network operations - Data services in GPRS - Applications for GPRS – Limitations for GPRS – Billing and Charging in GPRS – Enhanced Data Rates for GSM Evolution(EDGE).

Unit III :

Wireless Application Protocol (WAP): Introduction – WAP – MMS – GPRS Application. - **CDMA AND 3G:** Third generation networks – Applications on 3G. **Wireless LAN:** Wireless LAN advantages - IEEE 802.11 standards - wireless LAN architecture.

Unit IV :

Client Programming: Introduction - Moving Beyond The Desktop - A Peek Under The Hood: Hardware Overview - Mobile Phones – Features of Mobile Phones – PDA – Design Constraints In Applications For Handle Held Devices. **Programming for the palm OS:** Palm OS Architecture. **Wireless devices with Symbian OS:** Symbian Os Architecture. **Wireless devices with windows CE:** Windows CE Architecture.

Unit V :

Multimedia: Networked Multimedia Application – Issues in Multimedia delivery over the Internet – Multimedia Delivery over the Internet – Multimedia Networking Protocols. **IP Multimedia Subsystem:** Introduction – IMS and its Evolution – Benefits from IMS – Architecture of IMS Networks – Protocols used in IMS – Building Blocks in IMS Networks. **Security issues in mobile computing:** Introduction-Information Security-Security Techniques and Algorithms-Security Protocols-Public Key Infrastructure.

Text Book:

Mobile Computing Technology,Applications and Service Creation - Asoke.K.Talukder, Roopa.R.Yavagal, Hasan Ahmed -McGraw Hill Publishing Company. , 2nd Edition, 2011.

Unit I	:	Chapter 1.1, 1.2, 1.3, 1.5, 1.6, 1.7, 1.11, 2.4, 2.5, 4.2, 4.3, 4.4, 4.5, 4.6
Unit II	:	Chapters 5.1, 5.2, 5.3, 5.4, 6.1, 6.2, 6.3, 7.1 to 7.9
Unit III	:	Chapters 8.1 to 8.4, 9.6, 9.7, 10.2, 10.3, 10.4
Unit IV	:	Chapters 12.1 to 12.7, 13.3, 14.2, 16.3
Unit V	:	Chapters 18.6 to 18.9, 19.1 to 19.6, 20.1 to 20.5

Reference Books:

1. Mobile Computing Theory and Practice – Kumkum Garg – Pearson Education 2010.
2. Mobile Computing – Sipra Dasbit, Biplab K. Sikdar – PHI Learning, Eastern Economy Edition, 2009.
3. Principles Of Mobile Computing, Uwe Hansmann, Lothar Merk, Martin S. Nicklous,Thomas Stober – Second Edition – Springer (India) Private Limited – Seventh Indian Reprint2008.