



DEPARTMENT OF COMPUTER SCIENCE

FACULTY OF SCIENCE

Master of Computer Applications 2020
Two Years Program

Syllabi for Semesters - I and II
With Effect from the Academic Year 2020 - 2021

SATAVAHANA UNIVERSITY
KARIMNAGAR - 505 002
TELANGANA STATE

MASTER OF COMPUTER APPLICATIONS (MCA)
Two Years Program - 2020
 Under Choice Based Credit System

SU - M.C.A - I SEMESTER

Paper Code	Title	Workload Per Week		Marks			No. of Credits	Duration of the Exams
		Theory	Lab	Internal	External	Total		
PCC 101	Mathematical Foundations of Computer Science	3	--	20	80	100	3	3 Hrs
PCC 102	Data structures using C	3	--	20	80	100	3	3 Hrs
PCC 103	Database management Systems	3	--	20	80	100	3	3 Hrs
PCC 104	Computer Architecture	3	--	20	80	100	3	3 Hrs
PCC 105	Probability and Statistics	3	--	20	80	100	3	3 Hrs
MGC 106	Software Process and Project Management	3	--	20	80	100	3	3 Hrs
LCC 111	Data structures using C - Lab	--	4	10	40	50	3	3 Hrs
LCC 112	Database management Systems - Lab	--	4	10	40	50	3	3 Hrs
LCC 113	Information Technology - Lab	--	4	10	40	50	3	3 Hrs
HSC 114*	Soft Skills - Lab	--	2	50*	--	50*	--	2 Hrs
TOTAL		18	14	150	600	750	27	

*Every student must pass this paper since it is mandatory. However the credits will not be included in the calculation of SGPA and CGPA

SU - M.C.A - II SEMESTER

Paper Code	Title	Workload Per Week		Marks			Credits	Duration of the Exams
		Theory	Lab	Internal	External	Total		
PCC 121	Operating Systems	3	--	20	80	100	3	3 Hrs
PCC 122	Object Oriented Programming Using Java	3	--	20	80	100	3	3 Hrs
PCC 123	Python Programming	3	--	20	80	100	3	3 Hrs
PCC 124	Design and Analysis of Algorithms	3	--	20	80	100	3	3 Hrs
PCC 125	Machine Learning	3	--	20	80	100	3	3 Hrs
MGC 126	Agile Programming	3	--	20	80	100	3	3 Hrs
LCC 131	Operating Systems Lab	--	4	10	40	50	3	3 Hrs
LCC 132	Java Lab	--	4	10	40	50	3	3 Hrs
LCC 133	Python Programming Lab	--	4	10	40	50	3	3 Hrs
MPC 134*	Mini Project	--	--	--	--	--	--	--
TOTAL		18	12	150	600	750	27	

*After second semester the students are expected to finish mini project its grade will be credited in the III semester Memo after evaluation

SU - M.C.A - III SEMESTER

Paper Code	Title	Workload Per Week		Marks			No. of Credits	Duration of the Exams
		Theory	Lab	Internal	External	Total		
PCC 141	R - Programming	3	--	20	80	100	3	3 Hrs
PCC 142	Internet of Things	3	--	20	80	100	3	3 Hrs
PCC 143	Web Technologies	3	--	20	80	100	3	3 Hrs
PCC 144	Computer Networks	3	--	20	80	100	3	3 Hrs
PEC 145*	Elective - I	3	--	20	80	100	3	3 Hrs
PEC 146*	Elective - II	3	--	20	80	100	3	3 Hrs
LCC 151	R - Programming - Lab	--	4	10	40	50	3	3 Hrs
LCC 152	Internet of Things - Lab	--	4	10	40	50	3	3 Hrs
LCC 153	Web Technologies - Lab	--	4	10	40	50	3	3 Hrs
MPC 134*	Mini Project	--	2	50*	--	50*	--	2 Hrs
TOTAL		18	14	150	600	750	27	

*Every student must pass this paper since it is mandatory. However the credits will not be included in the calculation of SGPA and CGPA

Course Code	Professional Elective - I
PEC 145A	Network Security
PEC 145B	Cyber Security
PEC 145C	Information Security

Course Code	Professional Elective - II
PEC 146A	Automata Theory
PEC 146B	Compiler Design
PEC 146C	Data Visualization

SU - M.C.A - IV SEMESTER

Paper Code	Title	Workload Per Week		Marks			No. of Credits	Duration of the Exams
		Theory	Lab	Internal	External	Total		
PEC 161*	Elective - I	3	--	20	80	100	3	3 Hrs
PEC 162*	Elective - II	3	--	20	80	100	3	3 Hrs
OEC 163*	Elective - I	3	--	20	80	100	3	3 Hrs
MPW 171	Major Project Work		20	50	100	150	15	3 Hrs
TOTAL		12	20	130	420	550	27	

Course Code	Professional Elective - I
PEC 161A	Cloud Computing
PEC 161B	Natural Language Processing
PEC 161C	Software Quality Testing

Course Code	Professional Elective - II
PEC 162A	Big Data Analytics
PEC 162B	Block Chain Technologies
PEC 162C	Deep Learning

Abbreviation	Full Form
PCC	Professional Core Course
MGC	Management Course
LCC	Laboratory Core Course
HSC	Humanities & Social Science Course
PEC	Professional Elective Course
OEC	Open Elective Course
MPC	Mini Project Course
MPW	Major Project Work

Course Code	Open Elective - I
OEC 163A	Environmental Science
OEC 163B	Constitution of India
OEC 163C	Disaster Management

PCC 101: Mathematical Foundations of Computer Science

Work Load: 3 PPW

Internal Marks: 20

External Marks: 80

UNIT-I

Fundamentals of Logic: Basic Connectives and Truth Tables, Logical Equivalence, Logical Implication, Use of Quantifiers, Definitions and the Proof of Theorems.

Set Theory: Set and Subsets, Set Operations, and the Laws of Set theory, Counting and Venn Diagrams.

Properties of the Integers: The well - ordering principle, Recursive Definitions, Division Algorithms, Fundamental theorem of Arithmetic.

UNIT-II

Relations and Functions: Cartesian product, Functions onto Functions, Special Functions, Pigeonhole Principle, Composition and Inverse Functions.

Relations: Partial Orders, Equivalence Relations and Partitions.

Principle of Inclusion and Exclusion: Principles of Inclusion and Exclusion, Generalization of Principle.

UNIT-III

Generating Functions: Introductory Examples, Definition And Examples, Partitions of Integers.

Recurrence Relations: First - order linear recurrence relation, second - order linear homogenous recurrence relation with constant coefficients.

UNIT-IV

Algebraic Structures: Algebraic System - General Properties, Semi Groups, Monoids, Homomorphism, Groups, Residue Arithmetic.

UNIT -V

Graph Theory: Definitions and examples, sub graphs, complements and graph Isomorphism, Vertex degree, Planar graphs, Hamiltonian paths and Cycles.

Trees: Definitions, properties and Examples, Rooted Trees, Spanning Trees and Minimum Spanning Trees.

Suggested Readings:

1. Mott Joe L Mott, Abraham Kandel, and Theodore P Baker, Discrete Mathematics for Computer Scientists & Mathematicians, Prentice Hall NJ, 2nd Edition, 2015.
2. Jr. P. Tremblay and R Manohar Discrete Mathematical Structures with Applications to Computer Science, McGraw Hill, 1987.
3. R.K.Bisht and H.S.Dhami, Discrete Mathematics Oxford Higher Education, 2015
4. Bhavanari Satyanarayana, Tumurukota Venkata Pradeep Kumar and Shaik Mohiddin Shaw, Mathematical Foundation of Computer Science, BSP, 2016
5. Ralph P. Grimaldi Discrete and Combinatorial Mathematics, 5th Edition, Pearson, 2004.

PCC 102: Data Structures Using C

Work Load: 3 PPW

Internal Marks: 20

External Marks: 80

UNIT-I

C PROGRAMMING BASICS: Structure of a C program - compilation and linking processes - Constants, Variables - Data Types - Expressions using operators in C - Managing Input and Output operations - Decision Making and Branching - Looping statements. Arrays - Initialization - Declaration - One dimensional and Two-dimensional arrays. Strings- String operations - String Arrays. Simple programs- sorting- searching - matrix operations.

UNIT-II

FUNCTIONS: Pass by value - Pass by reference - Recursion, **POINTERS:** Definition - Initialization - Pointers arithmetic, **STRUCTURES:** Definition - Structure within a Structure, **UNION:** Programs using structures and Unions - Storage classes, Pre-processor directives.

UNIT-III

LINEAR DATA STRUCTURES: Arrays and its representations, Stacks and Queues - Applications, Linked lists - Single, circular and doubly Linked list-Application

UNIT-IV

NON-LINEAR DATA STRUCTURES: Trees - Binary Trees - Binary tree representation and traversals , - Applications of trees. Binary Search Trees , AVL trees. Graph and its representations - Graph Traversals.

UNIT-V

SEARCHING AND SORTING ALGORITHMS: Linear Search - Binary Search. Sorting: Selection Sort, Bubble Sort, Insertion sort , Merge sort , Quick Sort

Suggested Readings:

1. Brian W. Kernighan / Dennis Ritchie ,The C Programming Language ,Second Edition , Pearson 2015
2. Pradip Dey and Manas Ghosh, –Programming in C, Second Edition, Oxford University Press, 2011.
3. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, –Fundamentals of Data Structures in C, Second Edition, University Press, 2008.
4. Mark Allen Weiss, –Data Structures and Algorithm Analysis in C, Second Edition, Pearson Education, 1996
5. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, –Data Structures and Algorithms, Pearson Education, 1983.

PCC 103: Database Management Systems**Work Load: 3 PPW****Internal Marks: 20****External Marks: 80****UNIT-I**

Introduction: Database System Applications, Purpose of Database Systems, View of Values, Nested Sub-queries, Complex Queries, Views, Modification of the Database, Joined Relations Data, Database Languages, Relational Databases, Database Design, Object-based and Semi-structured Databases, Data Storage and Querying, Transaction Management, Data Mining and Analysis, Database Architecture, Database Users and Administrators.

Database Design and the E-R Model: Overview of the Design Process, The Entity- Relationship Model, Constraints, Entity-Relationship Diagrams, Entity - Relationship Design Issues, Weak Entity Sets, Extended E-R Features, Database Design for Banking Enterprise, Reduction to Relational Schemas, Other Aspects of Database Design

UNIT-II

Relational Model: Structure of Relational Databases, Fundamental Relational-Algebra Operations, Additional Relational - Algebra Operations, Extended Relational - Algebra Operations, Null Values, Modification of the Databases. Structured Query Language: Data Definition, Basic Structure of SQL Queries, Set Operations, Aggregate Functions, Null

UNIT-III

Advanced SQL: SQL Data Types and Schemas, Integrity Constraints, Authorization, Embedded SQL, Dynamic SQL, Functions and Procedural Constructs, Recursive Queries, Advanced SQL Features. Relational Database Design: Features of Good Relational Design, Atomic Domains and First Normal Form, Functional-Dependency Theory, Decomposition using Functional Dependencies.

UNIT-IV

Indexing and Hashing: Basic Concepts, Ordered Indices, B+-tree Index Files, B-tree Index Files, Multiple-Key Access, Static Hashing, Dynamic Hashing, Comparison of Ordered Indexing and Hashing, Bitmap Indices. Index Definition in SQL Transactions: Transaction Concepts, Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for Serializability

UNIT-V

Concurrency Control: Lock-based Protocols, Timestamp-based Protocols, Validation-based Protocols, Multiple Granularity, Multi-version Schemes, Deadlock Handling, Insert and Delete Operations, Weak Levels of Consistency, Concurrency of Index Structures.

Recovery System: Failure Classification, Storage Structure, Recovery and Atomicity, Log-Based Recovery, Recovery with Concurrent Transactions, Buffer Management, Failure with Loss of Nonvolatile Storage, Advanced Recovery Techniques, Remote Backup Systems

NoSQL: Need for NoSQL, aggregate data models, more details on data models, distribution models, consistency, version stamps, map-reduce, key-value databases, document databases, column-family stores, graph databases, Schema Migrations

Suggested Readings

1. Abraham Silberschatz, Henry F Korth, S Sudarshan, Database System Concepts, McGraw-Hill International Edition, 6th Edition, 2010.
2. Ramakrishnan, Gehrke, Database Management Systems, McGraw-Hill International Edition, 3rd Edition, 2003.
3. Elmasri, Navathe, Somayajulu, Fundamentals of Database Systems, Pearson Education, 4th Edition, 2004.
4. Shashank Tiwari, "Professional NoSQL", 1st Edition, Wiley publishers, 2011.

PCC 104: Computer Architecture

Work Load: 3 PPW

Internal Marks: 20

External Marks: 80

UNIT-I

Data Representation: Data types, Complements, Fixed and Floating Point representations, and Binary codes.

Overview of Computer Function and Interconnections: Computer components, Interconnection structures, Bus interconnection, Bus structure, and Data transfer.

UNIT-II

Register Transfer Micro operations: Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic, Logic and Shift micro operations, Arithmetic Logic Shift Unit.

Basic Computer Organization and Design: Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory reference instruction, Input-Output and Interrupt.

UNIT-III

Micro programmed Control: Control memory, Address Sequencing, Micro program example, Design of Control Unit.

Central Processing Unit: General Register Organization, Stack Organization, Instruction formats, Addressing modes, Data Transfer and Manipulation, and Program control.

Computer Arithmetic: Addition and Subtraction, Multiplication, Division, and Floating Point Arithmetic Operations.

UNIT-IV

Memory Organization: Memory Hierarchy, Main Memory, RAM and ROM, Auxiliary memory, Associative memory, Cache memory, Virtual memory, Memory Management hardware.

UNIT-V

Input-Output Organization: Peripheral Devices, Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupt, Direct Memory Access (DMA), I/O Processor, Serial Communication.

Pipeline Processing: Arithmetic, Instruction and RISC Pipelines.

Assessing and Understanding Performance: CPU performance and its factors, evaluating performance.

Suggested Readings

1. Morris Mano M, Computer System Architecture, Pearson Education India, 3rd Edition, 2007.
2. William Stallings, Computer Organization and Architecture, PHI, 7th Edition, 2008.
3. David A Patterson, John L Hennessy, Computer Organization and Design, Morgan Kaufmann, 5th Edition, 2013.
4. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, Tata McGraw-Hill Education, 5th Edition, 2002

PCC 105: Probability and Statistics**Work Load: 3 PPW****Internal Marks: 20****External Marks: 80****UNIT-I**

Descriptive Statistics: Concept of Primary and Secondary Data, Classification of Data, Measures of Central Tendency with simple applications, Absolute and Relative measures of Dispersion with simple applications

UNIT-II

Probability: Basic terminology, Three types of probability, Probability rules, Statistical independence, statistical dependency, Bayes' theorem.

Probability Distributions: Random variables, expected values, binomial distribution, Poisson distribution, normal distribution, choosing correct distribution.

UNIT-III

Sampling and Sampling Distributions: Random sampling, Non-Random Sampling distributions, and operational considerations in sampling.

Estimation: Point estimates, interval estimates, confidence intervals, calculating interval estimates of the mean and proportion, t-distribution, determination of sample size in estimation.

UNIT-IV

Testing Hypothesis - one sample tests: Hypothesis testing of mean when the population standard deviation is known, powers of hypotheses test, hypotheses testing of proportions, hypotheses testing of means when standard deviation is not known.

Testing Hypotheses - Two sample tests: Tests for difference between means - large sample, small sample, with dependent samples, testing for difference between proportions - Large sample.

UNIT-V

Chi-square and Analysis of Variance: chi-square as test of independence, chi-square as a test of goodness of fit, analysis of variance, inferences about a population variance, inferences about two population variances.

Regression and Correlation: Simple Regression - Estimation using regression line, correlation analysis, making inferences about population parameters, limitations, errors and caveats in regression and correlation analysis. Multiple Regression and correlation analysis. Finding multiple regression equations and making inferences about population parameters.

Suggested Reading

1. David C Lay, Linear Algebra and its Applications 4e
2. Richard I Levin, David S Rubin - Statistics for Management, Seventh Edition, PHI -1997
3. R D Sharma "Theory and Problems of Linear Algebra", International Publishing House Pvt. Limited, 2011.
4. A K Sharma, "Linear Algebra", Discovery Publishing House Ltd., 2019.
5. Gilbert Strang, Linear Algebra and its Applications, 2010
6. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics Sultan Chand & Sons, New Delhi.

MGC 106: Software Process and Project Management**Work Load: 3 PPW****Internal Marks: 20****External Marks: 80****UNIT-I**

Software Engineering: The Nature of Software, Changing Nature of Software, Defining the Discipline, Software Process, Software Engineering Practice.

Software Process: A Generic Process Model, Defining a Framework Activity, Process Assessment and Improvement, Prescriptive Process Models, Specialized Process Models, Unified Process, Defining Agility, Agile Process.

UNIT-II

Requirements: Core Principles of Modeling, Requirements Engineering, Establishing the Groundwork, Eliciting Requirements, Developing Use Cases, Building the Analysis Model, Requirements Analysis.

Design Concepts: Design within the Context of SE, Design Process, Design Concepts, Design Model, Software Architecture, Architectural Styles, Architectural Considerations, Architectural Design, Component, Designing Class-Based Components, Conducting Component-Level Design, Component-Based Development, User Interface Design Rules.

UNIT-III

Quality Management: SQA Tasks, Goals, and Metrics, Software Reliability, A Strategic Approach to Software Testing, Test Validation Testing, System Testing, Debugging, Software Testing Fundamentals, White-Box Testing, Black-Box Testing, Path Testing, Control Structure Testing, Object-Oriented Testing Strategies & Methods.

Software Configuration Management: SCM Process, Product Metrics for Requirements Model, Design Model, Source Code, Testing and Maintenance.

UNIT – IV

Managing Software Projects: The Project Management Spectrum, W5HH Principle, Metrics in the Process and Project Domains, Software Measurement, Metrics for Software Quality, Integrating Metrics within the Software Process.

Estimation for Software Projects: Observation on Estimation, Project planning Process, Software scope and Feasibility, Resources, Software Project Estimation, Decomposition Techniques, Empirical Estimation Models.

Project Scheduling: Basic Principles, Relation between People and Effort, Effort distribution, Defining a Task set for software project, Defining a Task Network, scheduling-Time line charts, Tracking the schedule, Tracking progress for an Object Oriented project, Scheduling for Web App projects, Earned value analysis

UNIT-V

Risk Management: Reactive vs Proactive Risk strategies, Software Risks, Risk Identification, Risk Projection, Risk Refinement, Risk Mitigation, Monitoring, and Management.

Maintenance and Reengineering: Software Maintenance, Business Process Reengineering model, Software Reengineering, Restructuring Reverse Engineering, Forward Engineering, The Economics of Reengineering.

Software Process Improvement: SPI Process, The CMMI, The People CMM, SPI return on Investment. Emerging trends in Software Engineering- Identifying trends, Technology directions, Tools related trends.

Suggested Reading

1. Roger s pressman, b r maxim, software engineering-a practitioner's approach (8e)
2. Software engineering by ghezzi (phi)
3. Software engineering fundamentals by behforooz and hudson oxford university press

LCC 111: Data Structures Using C Lab

Work Load: 4 PPW

Internal Marks: 10

External Marks: 40

Programs

1. Basic C Programs - looping, data manipulations, arrays
2. Programs using strings - string function implementation
3. Programs using structures and pointers
4. Programs involving dynamic memory allocations
5. Array implementation of stacks and queues
6. Linked list implementation of stacks and queues
7. Application of Stacks and Queues
8. Implementation of Trees, Tree Traversals
9. Implementation of Binary Search trees
10. Implementation of Linear search and binary search
11. Implementation Insertion sort, Bubble sort, Quick sort and Merge Sort
12. Implementation Hash functions, Collision resolution techniques

LCC 112: Database Management Systems Lab

Work Load: 4 PPW

Internal Marks: 10

External Marks: 40

Creation of database (exercising the commands for creation)

1. Simple to Complex condition query creation using SQL Plus.
2. Usage of Triggers and Stored Procedures.
3. Creation of Forms for Student information, Library information, Pay roll etc.
4. Writing PL/SQL procedures for data validation.
5. Report generation using SQL reports.
6. Creating password and security features for applications.
7. Usage of File locking, Table locking facilities in applications.
8. Creation of small full- fledged database application spreading over 3 sessions.

Note: The creation of sample database for the purpose of the experiments is expected to be pre-decided by the instructor.

LCC 113: Information Technology Lab**Work Load: 4 PPW****Internal Marks: 10****External Marks: 40**

1. Every student should identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor. Every student should disassemble and assemble the PC back to working condition.
2. **Hardware Troubleshooting:** Students have to be given a PC which does not boot due to improper assembly or defective peripherals. They should identify the problem and fix it to get the computer back to working condition. (Under guidance of instructor)
3. **Software Troubleshooting:** Students have to be given a malfunctioning CPU due to system software problems. They should identify the problem and fix it to get the computer back to working condition.
4. Internet & World Wide Web.
5. **Web Browsers, Surfing the Web:** Students customize their web browsers with the LAN proxy settings, bookmarks, search toolbars and pop up blockers.
6. **Search Engines & Netiquette:** Students should know what search engines are and how to use the search engines. Usage of search engines like Google, Yahoo, ask.com and others should be demonstrated by student.
7. **Cyber Hygiene:** Students should learn about viruses on the internet and install antivirus software. Student should learn to customize the browsers to block pop ups, block active x downloads to avoid viruses and/or worms.

Productivity tools: LaTeX and Word

8. **Word Orientation:** An overview of LaTeX and Microsoft (MS) office / equivalent (FOSS) tool word should be learned: Importance of LaTeX and MS office / equivalent (FOSS) tool Word as word Processors, Details of the three tasks and features that should be covered in each, using LaTeX and word – Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter.
9. **Using LaTeX and Word to create project certificate. Features to be covered:** Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in both LaTeX and Word.
10. **Creating project abstract Features to be covered:** Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.
11. **Creating a Newsletter: Features to be covered:** Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs in word.
12. **Spreadsheet Orientation:** Accessing, overview of toolbars, saving spreadsheet files, Using help and resources.
13. **Creating a Scheduler:** Gridlines, Format Cells, Summation, auto fill, Formatting Text
14. **Calculating GPA :** Features to be covered:- Cell Referencing, Formulae in spreadsheet – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function, Sorting, Conditional formatting.
15. **Creating Power Point:** Student should work on basic power point utilities and tools in Latex and Ms Office/equivalent (FOSS) which help them create basic power point presentation. PPT Orientation, Slide Layouts, Inserting Text, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows, Hyperlinks, Inserting Images, Tables and Charts

Suggested Reading

1. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education.
2. LaTeX Companion – Leslie Lamport, PHI/Pearson.
3. Comdex Information Technology course tool kit Vikas Gupta, WILEY Dreamtech
4. IT Essentials PC Hardware and Software Companion Guide by David Anfinson and Ken Quamme. 3rd Edition – CISCO Press, Pearson Education.
5. PC Hardware and A+ Handbook – Kate J. Chase PHI (Microsoft)

HSC 114* : Soft Skills Lab**Work Load: 2 PPW****Internal Marks: --****External Marks: 50****Activities**

1. Conversation skills, Listening dialogues from TV/radio/Ted talk/Podcast
2. Group discussion
3. Interview skills, Making presentation
4. Listening to Lectures and News Programmes, Listening to Talk show
5. Watching videos on interesting events on Youtube,
6. Reading different genres of texts ranging from newspapers to philosophical treatises
7. Reading strategies - graphic organizers, Reading strategies - summarizing
8. Reading strategies - interpretation, Reports
9. Cover letter, Resume,
10. Writing for publications, Letters, Memos, Emails and blogs
11. Civil Service (Language related), Verbal ability
12. Motivation, Self image
13. Goal setting, Managing changes
14. Time management, Stress management
15. Leadership traits
16. Team work
17. Career and life planning.
18. Multiple intelligences
19. Emotional intelligence
20. Spiritual quotient (ethics)
21. Intercultural communication
22. Creative and critical thinking
23. Learning styles and strategies

Suggested Readings:

1. Business English Certificate Materials, Cambridge University Press.
2. Graded Examinations in Spoken English and Spoken English for Work downloadable materials from Trinity College, London.
3. International English Language Testing System Practice Tests, Cambridge University Press.
4. Interactive Multimedia Programs on Managing Time and Stress.
5. Personality Development (CD-ROM), Times Multimedia, Mumbai
6. Robert M Sherfield "Developing Soft Skills" 4th Edition, Pearson Education, 2009.

Web Sources

1. <http://www.slideshare.net/rohitjsh/presentation-on-group-discussion>
2. http://www.washington.edu/doi/TeamN/present_tips.html
3. <http://www.oxforddictionaries.com/words/writing-job-applications>
4. <http://www.kent.ac.uk/careers/cv/coveringletters.htm>
5. http://www.mindtools.com/pages/article/newCDV_34.htm

PCC 121: Operating Systems

Work Load: 3 PPW

Internal Marks: 20

External Marks: 80

UNIT - I

INTRODUCTION: Operating system as extended Machine and Resource Manager, Computer-System Architecture,

Types of operating systems: Mainframe, Server, Multiprocessor, Personal computer, Handheld, Embedded, Sensor Node , Real time, Smart card ,Operating-System Structure- Monolithic system, layered system, MicroKernels, Client server Model, Virtual Machines Operating-System concepts: Processes, Address space, Files, Input and output, Protection and shell

System calls: Process Management, File Management and Directory Management.

UNIT - II

PROCESS & THREADS: Process- Model, Creation, termination, hierarchies, states, Implementation of process. Thread-usage, Classical thread model, POSIX Thread Implementation of thread in User space and in the Kernel, Hybrid Implementation

Inter process Communication- Race condition, Critical region, Mutual exclusion, Sleep and waiting, semaphores, Mutex , Monitors, Message passing, Barriers.

UNIT-III

CPU SCHEDULING: Introduction, Categories of scheduling- Batch, Interactive, Real time, Scheduling, Thread Scheduling

MEMORY MANAGEMENT: Memory Abstraction: Addressing, Swapping, Virtual Memory: Paging, Page Tables, Speeding Up Pages, Page replacement algorithms, segmentation. Design and implementation issues for paging systems

UNIT-IV

MASS STORAGE STRUCTURE: Overview, Disk structure, Disk scheduling, Disk Management, Swap-Space Management, RAID structure, Stable- Storage implementation.

FILE SYSTEMS: File Concept, Access Methods, Directories, File-System Implementation, File system Management and Optimization, Disks, clocks, User interface, thin clients, power managements

UNIT-V

DEADLOCKS: Introduction, Deadlock detection and Recovery, Deadlock avoidance, Deadlock prevention

PROTECTION AND SECURITY: Goals of Protection, Principles of Protection,, Domain of Protection, Access Matrix, Access Control, Revocation of Access Rights, The security Environment, Basics of cryptography, Protection Mechanism, Authentication, Insider attacks, Exploiting code bugs, Malware, Defences,

Suggested Readings

1. Andrew s. Tanenbaum, Modern Operating Systems
2. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Concepts (9e)
3. Dhananjay m. Dhandhere, Operating Systems-A Concept Based Approach
4. William Stallings, Operating Systems-Internal And Design Principles
5. Thomas w. Doeppner, Operating Systems In Depth

PCC 122: Object Oriented Programming Using Java

Work Load: 3 PPW

Internal Marks: 20

External Marks: 80

UNIT-I

Object Oriented System Development: Understanding Object Oriented Development, Understanding Object Concepts, Benefits of Object Oriented Development. **Java Programming Fundamentals:** Introduction, Overview of Java, Data Type, Variables and Arrays, Operators, Control statements, Classes, Methods, Inheritance, Packages and Interfaces, Inner Classes.

UNIT-II

I/O basics: Stream and Byte classes, Character Streams, Reading Console input and output, Print Writer Class, String Handling, Exceptions Handling, Multithreaded Programming.

UNIT-III

Exploring Java Language: Collections Overview, Collections Interfaces, Collections Classes, Iterators, Random Access Interface, Maps, Comparators, Arrays, Legacy classes and interfaces, Sting Tokenizer, BitSet, Date, Calendar, Timer.

UNIT-IV

Introducing AWT working With Graphics: AWT Classes, Working with Graphics.

Event Handling: Two Event Handling Mechanisms, The Delegation Event Model, Event Classes, Source of Events, Event Listener Interfaces.

AWT Controls: Control Fundamentals, Labels, Using Buttons, Applying Check Boxes, CheckboxGroup, Choice Controls, Using Lists, Managing Scroll Bars, Using TextField, Using TextArea, Understanding Layout Managers, Menu bars and Menus, Dialog Boxes, FileDialog, Handling events by Extending AWT Components, Exploring the controls, Menus and Layout Managers.

UNIT-V

Introduction to Swing Package: Java I/O classes and interfaces, Reading and Writing Files, Serialization, Introduction to Java Network Programming, Object Class, Exploring Image package.

Suggested Readings

1. Herbert Schildt, The Complete Reference Java, 9th Edition, Tata McGraw Hill, 2005.
2. Bruce Eckel, Thinking in Java, 4th Edition, Pearson Education
3. Dietel and Dietel, Java: How to Program, 5th Edition, Prentice Hall
4. James M Slack, Programming and Problem solving with JAVA, Thomson Learning, 2002
5. C Thomas Wu, An Introduction to Object Oriented programming with Java, Tata McGraw Hill, 2005.
6. Kathy Sierra, Bert Bates , Head First Java, 2nd Edition, A Brain-Friendly Guide, Publisher: O'Reilly Media, February 2005.

PCC 123: Python Programming**Work Load: 3 PPW****Internal Marks: 20****External Marks: 80****UNIT - I**

Introduction to Python: Installing Python. How a Program Works, Using Python, Program Development Cycle, Input, Processing, and Output, Displaying Output with the Print Function, Comments, Variables, Reading Input from the Keyboard, Performing Calculations, Operators. Type conversions, Expressions, More about Data Output.

Decision Structures and Boolean Logic: if, if-else, if-elif-else Statements, Nested Decision Structures, Comparing Strings, Logical Operators, Boolean Variables

Repetition Structures: Introduction, while loop, for loop, Calculating a Running Total, Input Validation Loops, Nested Loops.

UNIT - II

Data types and Expressions: Strings, Assignment and Comments, Numeric Data Types and Character Sets, Expressions. Control Statements: Definite Iteration, Formatting Text for Output, Selection, Conditional Iteration.

Functions: Introduction, Defining and Calling a Void Function, Designing a Program to Use Functions, Local Variables, Passing Arguments to Functions, Global Variables and Global Constants,

Recursion: Introduction, Problem Solving with Recursion, Examples of Recursive Algorithms. Value-Returning Functions-Generating Random Numbers, The math Module, Time module, Storing Functions in Modules.

UNIT - III

Strings: Accessing Characters and Substrings in a String, Strings and Number System, String Methods, Basic String Operations, String Slicing, Testing, Searching, and Manipulating Strings.

File and Exceptions: Introduction to File Input and Output, Using Loops to Process Files, Processing Records, Exceptions.

Lists, Tuples, Dictionaries: Introduction to Lists, List slicing, Finding Items in Lists with the in Operator, List Methods and Useful Built-in Functions, Copying Lists, Processing Lists, Two-Dimensional Lists, Tuples Sequences, Tuples. Dictionaries and Sets: Dictionaries, Sets, Serializing Objects.

UNIT- IV

Design with Classes: Classes and Objects, Classes and Functions, Classes and Methods, Working with Instances, Inheritance and Polymorphism. Object-Oriented Programming: Procedural and Object-Oriented Programming, Classes, techniques for Designing Classes.

UNIT - V

Graphical User Interfaces: Behavior of terminal based programs and GUI-based programs, other useful GUI resources. Graphical User Interfaces, Using the tkinter Module, Display text with Label Widgets, Organizing Widgets with Frames, Button Widgets and Info Dialog Boxes, Getting Input with Entry Widget, Using Labels as Output Fields, Radio Buttons, Check Buttons.

Suggested Readings

1. Tony Gaddis, Starting Out With Python (3e)
2. Kenneth a. Lambert, Fundamentals Of Python
3. James Payne, Beginning Python Using Python 2.6 And Python 3
4. Paul Gries, Practical Programming: An Introduction To Computer Science Using Python 3
5. Charles Dierach, Introduction To Computer Science Using Python
6. Clinton w. Brownley, Foundations For Analytics With Python

PCC 124: Design and Analysis of Algorithms

Work Load: 3 PPW

Internal Marks: 20

External Marks: 80

UNIT - I

Introduction to Algorithms: Algorithm Specification, Performance Analysis, Randomized Algorithms. Elementary Data Structures: Stacks and Queues, Trees, Dictionaries, Priority Queues, Sets and Disjoint Set Union, Graphs.

UNIT - II

Divide and Conquer: Binary Search, Finding the Maximum and Minimum, Merge Sort; Quick Sort, Selection sort, Strassen's Matrix Multiplication, Convex Hull.

The Greedy Method: Knapsack Problem, Tree Vertex Splitting, Job Sequencing with Deadlines, Minimum-Cost Spanning Trees, Single Source Shortest Paths.

UNIT - III

Dynamic Programming: General Method, Multistage Graphs, All-Pairs Shortest Paths, Single-Source Shortest Paths, Optimal Binary Search Trees, 0/1 Knapsack, The Traveling Salesperson Problem.

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

UNIT - IV

Back Tracking: General Method, 8-Queens Problem, Sum of Subsets, Graph Coloring, Hamiltonian Cycles, Knapsack Problem.

Branch-Bound: The Method, 0/1 Knapsack Problem, Traveling Sales Person.

UNIT - V

NP-Hard and NP-Complete Problems: Basic Concepts, Cook's Theorem, NP-Hard. Graph Problems, NP-Hard Scheduling Problems, NP-Hard Code Generation, Some Simplified NP-Hard Problems.

Suggested Readings

1. E Horowitz, S Sahni, S Rajasekaran, "Fundamentals of Computer Algorithms", Second Edition, Universities Press, 2007.
2. R. Pannerselvam, "Design and Analysis of Algorithms", PHI, 2007.
3. Hari Mohan Pandey, "Design, Analysis and Algorithm", University Science Press, 2009.
4. TH Cormen, CE Leiserson, RL Rivert, C Stein, "Introduction to Algorithms", Third Edition, PHI, 2010.

PCC 125: Machine Learning

Work Load: 3 PPW

Internal Marks: 20

External Marks: 80

UNIT - I

The ingredients of machine learning, Tasks: the problems that can be solved with machine learning, **Models:** the output of machine learning, **Features,** the workhorses of machine learning. Binary classification and related tasks: Classification, Scoring and ranking, Class probability estimation

UNIT - II

Beyond binary classification: Handling more than two classes, Regression, Unsupervised and descriptive learning. **Concept learning:** The hypothesis space, Paths through the hypothesis space, Beyond conjunctive concepts

UNIT- III

Tree models: Decision trees, Ranking and probability estimation trees, Tree learning as variance reduction.

Rule models: Learning ordered rule lists, Learning unordered rule sets, Descriptive rule learning, First-order rule learning

UNIT - IV

Linear Models: The least-squares method, The perceptron: a heuristic learning algorithm for linear classifiers, Support vector machines, obtaining probabilities from linear classifiers, Going beyond linearity with kernel methods.

Distance Based Models: Introduction, Neighbours and exemplars, Nearest Neighbours classification, Distance Based Clustering, Hierarchical Clustering.

UNIT- V

Probabilistic models: The normal distribution and its geometric interpretations, Probabilistic models for categorical data, Discriminative learning by optimising conditional likelihood Probabilistic models with hidden variables. **Features:** Kinds of feature, Feature transformations, Feature construction and selection. **Model ensembles:** Bagging and random forests, Boosting

Suggested Readings

1. Machine Learning: The art and science of algorithms that make sense of data, Peter Flach, Cambridge.
2. Machine Learning, Tom M. Mitchell, MGH.
3. Understanding Machine Learning: From Theory to Algorithms, Shai Shalev-Shwartz, Shai Ben-David, Cambridge.
4. Machine Learning in Action, Peter Harington, 2012, Cengage.

MGC 126: Agile Programming

Work Load: 3 PPW

Internal Marks: 20

External Marks: 80

UNIT - I

Introduction Extreme Programming (XP) - Agile Development: Why Agile - Understanding Success, Beyond Deadlines, Importance of Organizational Success, Introduction to Agility, How to Be Agile - Agile methods, Don't make your own method, Road to mastery, Understanding XP (Extreme Programming) - XP life cycle, XP team, XP Concepts, Adopting XP - Knowing whether XP is suitable, Implementing XP, assessing Agility, Practicing XP - Thinking - Pair Programming, Energized work, Informative Workspace, Root cause Analysis, Retrospectives

UNIT - II

Collaborating: Trust, Sit together, Real customer involvement, Ubiquitous language, meetings, coding standards, Iteration demo, Reporting

UNIT - III

Releasing: Bugfree Release, Version Control, fast build, continuous integration, Collective ownership, Documentation

UNIT - IV

Planing: Version, Release Plan, Risk Management, Iteration Planning, Slack, Stories, Estimating

UNIT - V

Developing: Incremental requirements, Customer tests, Test driven development, Refactoring, Incremental design and architecture, spike solutions, Performance optimization, Exploratory testing

Suggested Readings

1. The art of Agile Development, James Shore and Shane Warden, 11th Indian Reprint, O'Reilly, 2018
2. Learning Agile, Andrew Stellman and Jennifer Greene, O'Reilly, 4th Indian Reprint, 2018
3. Practices of an Agile Developer, Venkat Subramaniam and Andy Hunt, SPD, 5th Indian Reprint, 2015
4. Agile Project Management - Jim Highsmith, Pearson Low price Edition 2004

LCC 131: Operating Systems Lab**Work Load: 4 PPW****Internal Marks: 10****External Marks: 40**

1. Basic UNIX operations.
2. Shell program using 'case', 'then' and 'if' & 'else'.
3. Shell programs on while & do-while loop statements.
4. Shell program on for structure.
5. Inter process communication using pipes.
6. To wish salutation depending on the time.
7. Program using system calls.
8. To create a child process using fork() and exec () system calls.
9. To convert upper case to lower case letters of a given ASCII file.
10. Program to search the given pattern in a file.
11. Program using open, read, write system calls.
12. Implementation of Signals in UNIX.
13. Write a C program to simulate UNIX commands like ls, grep, cp.
14. Program to demonstrate FCFS and SJF process schedules on the given data.
15. Program to demonstrate CPU Priority and Round robin scheduling on the given burst time and arrival times.
16. Program implementing Producer and Consumer problem using Semaphores.

LCC 132: Java Lab**Work Load: 4 PPW****Internal Marks: 10****External Marks: 40**

1. Write a program to calculate salary of n employees using concept of classes with constructors and methods.
2. Write a program to demonstrate e-commerce website using inheritance, abstract class and dynamic polymorphism.
3. Write a program to demonstrate various arithmetic calculations using packages.
4. Write a program to demonstrate client-server environment using multithreading.
5. Write a program to demonstrate mutual exclusion using thread synchronization.
6. Write a program to demonstrate Linked list class.
7. Write a program to demonstrate Hash set and Iterator classes.
8. Write a program to demonstrate Enumeration and Comparator interfaces.
9. Write a program to accept data and display output in key, value pair.
10. Write a program to create a registration form with different controls, menus and demonstrate event handling.
11. Write a program to copy data from one file to another file.
12. Write a program to merge contents of two files and display output on console.
13. Write a program to illustrate Serialization.
14. Write a program to retrieve web page using URL class.
15. Write a program to load and display image and perform gray scale.

LCC 133: Python Programming Lab**Work Load: 4 PPW****Internal Marks: 10****External Marks: 40**

1. Write a program that displays the following information: Your name, Full address, Mobile number, College name, Course subjects.
2. Write a program to find the largest three integers using if-else and conditional operator.
3. Write a program with a loop that asks the user to enter a series of positive numbers. The user should enter a negative number to signal the end of the series. The program should display the numbers in order and their sum.
4. Write a program to find the product of two matrices [A]m_xp and [B]p_xr
5. Write recursive and non-recursive functions for the following:
 - a. To find GCD of two integers.
 - b. To find the factorial of positive integer
 - c. To print Fibonacci Sequence up to given number n
6. Write a program to display two random numbers that are to be added, such as: 247 + 129, the program should allow the student to enter the answer. If the answer is correct, a message of congratulations should be displayed. If the answer is incorrect, a message showing the correct answer should be displayed.
7. Write recursive and non-recursive functions to display prime number from 2 to n.
8. Write a program that writes a series of random numbers to a file from 1 to n and display.
9. Write a program to create file, write the content and display the contents of the file with each line preceded with a line number (start with 1) followed by a colon.
10. In a program, write a function that accepts two arguments: a list and a number n. The function displays all of the numbers in the list that are greater than the number n.
11. Write a program with a function that accepts a string as an argument and returns the no. of vowels that the string contains. Another function to return no. of consonants.
12. Write a program that opens a specified text file and then displays a list of all the unique words found in the file. (Store each word as an element of a set.)
13. Write a program to analyze the contents of two text files using set operations.
14. Write a program to implement the inheritance and dynamic polymorphism.
15. Write a GUI program that converts Celsius temperatures to Fahrenheit temperatures.
16. Write a GUI program that displays your details when a button is clicked.

Note: Programs are to be practiced on the basis of topics covered in corresponding theory paper. Handle the exceptions raised from file operations.

PCC 141: R Programming**Work Load: 3 PPW****Internal Marks: 20****External Marks: 80****UNIT - I**

Overview – Evolution of R, Features of R, ENVIRONMENT SETUP– Try it Option Online, Local Environment Setup, BASIC SYNTAX–R Command Prompt, R Script File, Comments, DATA TYPES–Vectors, Lists, Matrices, Arrays. , Factors, Data Frames, VARIABLES–Variable Assignment, Data Type of a Variable, Finding Variables, Deleting Variables, OPERATORS–Types of Operators, Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operators, Miscellaneous Operators, DECISION MAKING–If Statement, If- Else Statement, The if. else if. else Statement, Switch Statement, LOOPS–Repeat Loop, While Loop, For Loop, Loop Control Statements, Break Statement, Next Statement

UNIT - II

Function–Function Definition, Function Components, Built- In Function, User-defined Function, Calling a Function, Lazy Evaluation of Function, STRINGS–Rules Applied in String Construction, String Manipulation VECTORS–Vector Creation, Accessing Vector Elements, Vector Manipulation, LISTS–Creating a List, Naming List Elements, Accessing List Elements, Manipulating List Elements, Merging Lists, Converting List to Vector, MATRICES–Accessing Elements of a Matrix, Matrix Computations, ARRAYS–Naming Columns and Rows, Accessing Array Elements, Manipulating Array Elements, Calculations Across Array Elements, FACTORS–Factors in Data Frame, Changing the Order of Levels, Generating Factor Levels, DATA FRAMES–Extract Data from Data Frame, Expand Data Frame

UNIT - III

Packages - Introductions, Uses, Install R Package, DATA RESHAPING –Joining Columns and Rows in a Data Frame, Merging Data Frames, Melting and Casting, Melt the Data, Cast the Molten Data, CSV FILES–Getting and Setting the Working Directory, Input as CSV File, Reading a CSV File, Analyzing the CSV File, Writing into a CSV File, EXCEL FILE–Install xlsx Package, Verify and Load the "xlsx" Package, Input as xlsx File, Reading the Excel File, BINARY FILES - Writing the Binary File, Reading the Binary File, XML FILES, Input Data, Reading XML File, Details of the First Node, XML to Data Frame, JSON FILE–Install rjson Package, Input Data, Read the JSON File, Convert JSON to a Data Frame.

UNIT - IV

Pie Charts–Pie Chart Title and Colors, Slice Percentages and Chart Legend, 3D Pie Chart, BAR CHARTS–Bar Chart Labels, Title and Colors, Group Bar Chart and Stacked Bar Chart BOXPLOTS– Creating the Boxplot, Boxplot with Notch, HISTOGRAMS–Range of X and Y values, LINE GRAPHS– Line Chart Title, Color and Labels, Multiple Lines in a Line Chart, SCATTERPLOTS–Creating the Scatterplot, Scatterplot Matrices

UNIT - V

Mean, Median & Mode–Mean, Applying Trim Option, Applying NA Option, Median, Mode, LINEAR REGRESSION–Steps to Establish a Regressionlm() Functionpredict() Function, MULTIPLE REGRESSION–lm() FunctionExample, LOGISTIC REGRESSION–Create Regression Model, NORMAL DISTRIBUTION–norm()pnorm()qnorm()rnorm(), BINOMIAL DISTRIBUTION–dbinom() pbinom() qbinom() rbinom() Poisson Regression, Analysis of Covariance, TIME SERIES ANALYSIS–Different Time Intervals, Multiple Time Series Nonlinear Least Square, Decision Tree, RANDOM FOREST– Survival Analysis, Chi Square Test

Suggested Readings

1. The Art of R Programming: A Tour of Statistical Software Design, by Norman Matloff, No Starch Press, 2011
2. R for Everyone: Advanced Analytics and Graphics by Jared P. Lander, Addison-Wesley Data & Analytics Series, 2013.
3. Beginning R - The Statistical Programming Language, by Mark Gardener, Wiley, 2013
4. Introductory R: A Beginner's Guide to Data Visualisation, Statistical Analysis and Programming in R, by Robert Knell, Amazon Digital South Asia Services Inc, 2013
5. W. N. Venables, D. M. Smith, an introduction to R, r-core team, 2015
6. Alain F. Zuur, Elena n. Ieno, and Erik Meesters. A beginner's guide to R. Use R. Springer, 2009. ISBN: 978-0-387-93836-3
7. Roger D. PengR Programming for Data Science, , <https://leanpub.com/rprogramming>
8. John Verzani, chapman -Using R for introductory statistics, , ISBN- 1584884509
9. <https://www.r-project.org/doc/bib/r-books.html>

PCC 142: Internet of Things**Work Load: 3 PPW****Internal Marks: 20****External Marks: 80****UNIT - I**

Introduction to Internet of Things: Definition and Characteristics of IoT, Physical Design of IoT - IoT Protocols, IoT communication models, IoT Communication APIs IoT enabled Technologies - Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates Domain Specific IoTs - Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle

UNIT - II

IoT and M2M: Software defined networks, network function virtualization, difference between SDN and NFV for IoT Basics of IoT System Management with NETCOZF, YANG- NETCONF, YANG, SNMP NETOPEER, Python packages - JSON, XML, HTTPLib, URLLib, SMTPLib

UNIT - III

IoT Physical Devices and Endpoints: Introduction to Raspberry PI-Interfaces (serial, SPI, I2C) Programming - Python program with Raspberry PI with focus of interfacing external gadgets, controlling output, reading input from pins.

UNIT - IV

IoT Physical Servers and Cloud Offerings: Introduction to Cloud Storage models and communication APIs Webserver - Web server for IoT, Cloud for IoT, Python web application framework Designing a RESTful web API

UNIT - V

Case Studies of IoT Design: home automation, cities, environment, agriculture, productivity applications. introduction to data analytics for iot, apache hadoop, yarn, oozie, spark, storm, health monitoring case study. an iot tool: chef, chef case studies

Suggested Readings

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madiseti, Universities Press, 2015, ISBN: 9788173719547.
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759.
3. Rajkumar Buyya, Amir Vahid Dastjerdi, Internet Of Things
4. Programming world wide web, R. W. Sebesta, 4th Edition, Pearson.
5. Internet and World Wide Web – How to program. Dietel and Nieto, Pearson.
6. Adrian mcewen, hakim cassimally, designing the internet of things
7. Olivier h, david b, omar e, the internet of things: key applications and protocols
8. Jean philippe v, adam dunkel, interconnecting smart objects with ip: the next internet
9. Daniel minoli john, building the internet of things with ipv6 and mipv6 - the evolving world of m2m communications
10. Ovidiu vermesan, peter friess, internet of thinks converging technologies for smart environments and integrated ecosystem.

PCC 143: Web Technologies**Work Load: 3 PPW****Internal Marks: 20****External Marks: 80****UNIT - I**

Introduction To Web, Web Designing And Website Planning: Concept Of WWW, Internet And WWW, HTTP Protocols: Request And Response, Web Browser And Web Servers, Website Hosting-Free Vs. Paid, Linux Vs. Windows Hosting, Concepts And Use Of Database & Mail Servers Associated With Web Sites, Features Of Web 2.0 Concepts Of Effective Web Design, Web Design Issues Including Browsers, Bandwidth And Cache, Display Resolution, Look And Feel Of The Website, Page Layout And Linking, User Centric Design, Sitemap, Planning And Publishing Website, Designing Effective Navigation, Website Hosting Issues, FTP.

UNIT - II

Web Development With HTML: Basics Of HTML, Formatting And Fonts, Commenting Code, Color, Hyperlink, Lists, Tables, Images, Forms, Meta Tags, Character Entities, Frames And Frame Sets, Browser Architecture And Website Structure, Use Of HTML Code Editor And WYSIWYG Editor.

Cascading Style Sheets (CSS): Style Sheets: Need, Introduction - Basic Syntax And Structure, Using CSS-Background Images, Colors And Properties, Manipulating Texts, Using Fonts, Borders And Boxes, Margins, Padding Lists, Positioning Using CSS, CSS2, Overview And Features Of CSS3.

UNIT - III

Technologies for Web Applications Javascript & XML: Javascript: Client Side Scripting with Javascript, Variables, Functions, Conditions, Loops And Repetition, Pop Up Boxes, Javascript Objects, The DOM and Web Browser Environments, Manipulation using DOM, Forms and Validations, DHTML: Combining HTML, CSS and Javascript, Events and Buttons.

XML: Introduction of XML, Validation of XML Documents, Ways to use XML, XML for Data Files, HTML Vs. XML, Embedding XML into HTML Documents, Converting XML to HTML for Display, Displaying XML using CSS and XSL, Rewriting HTML as XML, Relationship between HTML, SGML and XML, Web Personalization, Semantic Web and Services, Transforming XML using XSL and XSLT.

UNIT - IV

Web Design with PHP: Introduction and basic syntax of PHP, Decision and Looping with examples, Arrays, Functions, Browser Control and Detection, String, Form Processing, Files, Cookies and Sessions, Object Oriented Programming with PHP

UNIT - V

Introduction to Database Driven Websites with PHP, PHP and MYSQL, Basic Commands with PHP examples, Connection to Server, Creating Database, Selecting a Database, Listing Database, Listing Table Names, Creating a Table, Inserting Data, Altering Tables, Queries, Deleting Database, Deleting Data and Tables.

Suggested Readings

1. Roger S.Pressman, David Lowe, "Web Engineering", Tata McGraw Hill Publication, 2007
2. Achyut S Godbole and AtulKahate, "Web Technologies", Tata McGraw Hill
3. Gopalan N P, Akilandeswari "Web Technology: a Developer S Perspective", PHI
4. Chris Bates Web Programming: Building Internet Applications Wiley
5. Refter, Fawset- Beginning XML, Wiley India
6. H.M. Deitel, P.J. Deitel, a.B. Goldberg-Internet & World Wide Web How to Program, Pearson Education, 3rd Edition,
7. C. Xavier, "Web Technology &Design", Tata McGraw Hill.
8. Ivan Bay Ross, "HTML, DHTML, JavaScript, Perl CGI", BPB.
9. Developing Web Applications, Ralph Moseley and M. T. Savaliya, Wiley-I
10. Web Technologies, Black Book, Dreamtech Press
11. HTML 5, Black Book, Dreamtech Press
12. Joel Sklar-Web Design, , Cengage Learning
13. Harwani-Developing Web Applications in PHP and Ajax, Mcgrawhill

PCC 144: Computer Networks

Work Load: 3 PPW

Internal Marks: 20

External Marks: 80

UNIT - I

Introduction to Computer Networks, Types of Network - LAN, WAN, MAN, Internet, Network Topologies, Transmission Media, communication Mode - simplex, half Duplex, Full Duplex, Analog & Digital Signals, base Band, Broad Band, Error Detection and Correction, OSI Models- Functions of Each Layer, Services and Protocols, Inter-Networking Devices, Bridge, Switch, Modem, Routers, Gateways

UNIT - II

Multiplexing, Multiplexer FDM, TDM, Statistical Multiplexing, Modulation Hub, Repeater, AM, FM, PM, Switching Technique, Message Switching, Circuit Switching, Packet Switching, Virtual Circuit, IEEE standards, 802.3, 802.4, 802.5, Fast Ethernet, FDDI Token Ring

UNIT - III

Routing Algorithms - Shortest Path Routing, Distance Vector Routing, Unicast Routing, Multicast Routing, Link State Routing, Broadcast Routing, Congestion control, Traffic Hopping, TCP/IP: Introduction, History of TCP/IP, Architecture, Layers of TCP/IP, Comparison between OSI and TCP/IP Models, Transmission Control Protocol, User Datagram Protocol, Internet Protocol, IP Addressing, IP Addressing classes, Internet Protocols - IP Packet, ARP, RARP, ICMP

UNIT - IV

Various Protocols of Application Layer - HTTP, Telnet, FTP, SMTP, Mine, URL, ISDN Channel, ISDN Services, Base Band ISDN, Broad Band ISDN, Network Security - Network Security Issues, Firewalls - Need and features of Firewalls, Types of Firewall technology - Network level and Application level, IP Packets, Filter Screening Routers, Limitations of Firewalls

UNIT - V

Introduction to Wireless Network, Fundamentals of cellular systems, Mobile Ad-hoc and sensor networks, Wireless PAN/LAN/MAN, Multi-path Propagation, Path loss, Slow Fading, Fast Fading, Frequency Reuse, cell splitting, cell sectoring

Suggested Readings

1. Andrew S Tanenbaum - Computer Networks, Pearson Publishers
2. Behrouza Forouzan - Data communications and Networking - Global
3. Willam a Shay - understanding Data Communications and Networks - Course Technology Inc
4. Prakash C.Gupta - Data Communications and Computer Networks, PHI
5. William Stallings - Data and Computer Communications, Pearson Education India
6. Larry L.Peterson and Bruce S.Davie - Compter Networks - A Systems Approach, Morhan Kaufmann Publishers
7. Thomas D. Nadeau & Ken Gray-Sftware Defined Networks, O-reilly Publishers
8. <http://nptel.ac.in/video.php?subjectid=106105081>

PEC 145A: Network Security (Elective - I)**Work Load: 3 PPW****Internal Marks: 20****External Marks: 80****UNIT - I**

Overview of Network Security: Computer Security Concepts, the OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, a Model for Network Security. Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, Steganography.

UNIT - II

Block Ciphers and the Data Encryption Standard: Traditional Block Cipher Structure, the Data Encryption Standard (DES), A DES Example, Strength of DES. Block Cipher Operation: Double DES, Triple DES, Electronic Code Book, Cipher Block Chaining Mode, Cipher Feedback Mode, Output Feedback Mode, Counter Mode. Advanced Encryption Standard (AES): The Origins AES, AES Structure, AES Round Functions, AES Key Expansion, an AES Example AES Implementation.

UNIT - III

Pseudorandom Number Generation and Stream Ciphers: Principles of Pseudorandom Number Generation, Pseudorandom Number Generators, Pseudorandom Number Generation using BlockCipher, StreamCiphers-RC4. Public-Key Cryptography and RSA: Principles of Public-Key Cryptosystems, the RSA Algorithm. Key Management and Distribution: Symmetric Key Distribution Using Symmetric Encryption and Asymmetric Encryption, Distribution of Public Keys, X.509 Certificates, Diffie-Hellman Key Exchange.

UNIT - IV

Cryptographic Hash Functions: Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Secure Hash Algorithm (SHA) & MD5 Algorithm. Message Authentication Codes: Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes, Security of MACs, MACs Based on Hash Functions: HMAC, MACs Based on Block Ciphers: DAA and CMAC. Digital Signatures: Digital Signatures, NIST Digital Signatures Algorithm.

UNIT - V

Transport-Level Security: Web Security Considerations, Secure Sockets Layer (SSL), Transport Layer Security (TLS), HTTPS, Secure Shell (SSH), E-Mail Security: Pretty Good Privacy, S/MIME. IP Security: IP Security Overview, IP Security Architecture, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange. Intruders, Virus and Firewalls: Intruders, Intrusion Detection, Password Management, Virus and Related Threats, Countermeasures, Firewall Design Principles, Types of Firewalls.

Suggested Readings

1. William Stallings, cryptography and network security - principles and practice (6e)
2. Zhenfu Cao, new directions of modern cryptography
3. Douglas R. Stinson, cryptography theory and practices
4. Tom St Denis, Simon Johnson, cryptography for developers
5. Henk C.A. Van Tilborg, Sushil Jajodia, encyclopedia of cryptography and security
6. Keith M. Martin, everyday cryptography-fundamental principles and applications
7. Chwan-hwa Wu, J. David Irwin, introduction to computer networks and cyber security
8. Saiful Azad, Al-Sakib Khan Pathan, practical cryptography-algorithms and implementations using C++

PEC 145B: Cyber Security (Elective - I)

Work Load: 3 PPW

Internal Marks: 20

External Marks: 80

UNIT - I

Introduction to Cybercrime: Introduction, Cybercrime, and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, And Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.

UNIT-II:

Cyber Offenses: How Criminals Plan Them: Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

UNIT - III

Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies an Measures in Mobile Computing Era, Laptops.

UNIT - IV

Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

UNIT - V

Cyber Security: Organizational Implications Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

Suggested Readings

1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and Sunil Belapure, Wiley INDIA.
2. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
3. Introduction to Cyber Security, Chwan-Hwa (John), Wu, J. David Irwin. CRC Press T&F Group.

PEC 145C: Information Security (Elective - I)

Work Load: 3 PPW

Internal Marks: 20

External Marks: 80

UNIT - I

Introduction: History, Critical characteristics of information, NSTISSC security model, Components of an information system, Securing the components, Balancing security and access, The SDLC, The security SDLC.

Need for Security: Business needs, Threats, Attacks- secure software development.

UNIT - II

Legal, Ethical and professional Issues: Law and ethics in information security, Relevant U.S laws- international laws and legal bodies, Ethics and information security.

Risk Management: Overview, Risk identification, Risk assessment, Risk control strategies, selecting a risk control strategy, Quantitative versus qualitative risk control practices, Risk management discussion points, Recommended risk control practices.

UNIT - III

Planning for Security: Security policy, Standards and practices, Security blue print, Security education, Continuity strategies.

Security Technology: Firewalls and VPNs: Physical design, Firewalls, Protecting remote connections

UNIT - IV

Security Technology: Intrusion detection, access control and other security tools: Intrusion detection and prevention systems, Scanning and analysis tools, Access control devices.

Cryptography: Foundations of cryptology, Cipher methods, Cryptographic Algorithms, Cryptographic tools, Protocols for secure communications, Attacks on cryptosystems.

UNIT - V

Implementing Information Security: Information security project management, Technical topics of implementation, Non technical aspects of implementation, Security certification and accreditation.

Security and Personnel: Positioning and staffing security function, Employment policies and practices, Internal control strategies. Information security maintenance : Security management models, The maintenance model, Digital forensics

Suggested Reading

1. Michel E Withman and Herbert J Mattord, Principles and Practices of Information Security, Cengage Learning, 2009.
2. Thomas R Peltier, Justin Peltier, John Blackley, Information Security Fundamentals, Auerbach Publications, 2010.
3. Detmar W Straub, Seymour Goodman, Richard L Baskerville, Information Security, Policy, Processes and Practices, PHI , 2008.
4. Mark Merkow and Jim Breithaupt, Information Security Principle and Practices, Pearson Education, 2007.

PEC 146A: Automata Theory (Elective - II)**Work Load: 3 PPW****Internal Marks: 20****External Marks: 80****UNIT - I**

Fundamentals - alphabets, strings, languages, problems, graphs, trees, Finite State Systems, definitions, Finite Automaton model, acceptance of strings, and languages, Deterministic finite automaton and Nondeterministic finite automaton, transition diagrams, transition tables, proliferation trees and language recognizers, equivalence of DFA's and NFA's.

Finite Automata with ϵ -moves, significance, acceptance of languages, ϵ -closure, Equivalence of NFA's with and without ϵ -moves, Minimization of finite automata, Two-way finite automata, Finite Automata with output- Moore and Mealy machines.

UNIT - II

Regular Languages: regular sets, regular expressions, identity rules, constructing finite automata for a given regular expressions, conversion of finite automata to regular expressions. Pumping lemma of regular sets and its applications, closure properties of regular sets. Grammar Formalism: Regular grammars-right linear and left linear grammars, equivalence between regular linear grammar and finite automata, inter conversion, Context free grammar, derivation trees, sentential forms, right most and leftmost derivation of strings, ambiguity.

UNIT - III

Context Free Grammars: Introduction to Context Free Grammars and Context Sensitive Grammar, Ambiguity, Parse Tree representations of derivations, Simplification of Context Free Grammars, Chomsky normal form, Greiback normal form, Pumping lemma for context free languages and its applications, closure of properties of CFL (proofs omitted).

UNIT - IV

Push Down Automata: PDA definition, Deterministic Push Down Automata, Non-equivalence of PDA & DPDA, Equivalence of CFG & PDA, Pumping lemma for CFL's, acceptance of CFL, acceptance by final state and acceptance by empty state and its equivalence. Membership Algorithm (CYK Algorithm) for Context Free Grammars.

Unit - V

Turing Machine: Introduction, Definition, Types of Turing Machine, Universal Turing Machine and Other Modifications, model, design of TM, computable functions, unrestricted grammars, recursively enumerable languages. Linear bounded automata and Context sensitive language. Computability Theory: Chomsky hierarchy of languages, Introduction to DCFL, DPDA, LR(0) grammar, decidability and undecidable problems.

Suggested Readings

1. J. E. Hopcroft, j. D. Ullman, Introduction To Automata Theory, Languages, And Computation
2. John c. Martin, Introduction To Languages And The Theory Of Computation
3. Mishra, Chandrashekar, Theory Of Computer Science
4. Peter linz, An Introduction To Formal Languages And Automata
5. Zvikohav, Niraj K Jha, Switching And Finite Automata Theory

PEC 146B: Compiler Design (Elective - II)**Work Load: 3 PPW****Internal Marks: 20****External Marks: 80****UNIT - I**

Introduction: language processors, phases of a compiler, a model for a compiler front end, syntax-directed translation, parsing, a translator for simple expressions, Lexical Analysis: role of lexical analyzer, input buffering, specification of tokens, Lex lexical analyzer generator, data structures in compilation.

UNIT - II

Top-Down Parsing: Introduction, Context free grammars, writing a grammar, recursive-descent parsing, LL(1) grammars, predictive parsing, preprocessing steps required for predictive parsing. Bottom-Up Parsing: shift reduce parsing, SLR parsing, CLR parsing and LALR parsing, error recovery in parsing, handling ambiguous grammar, parser generator - YACC.

UNIT - III

Semantic Analysis: syntax-directed definitions, evaluation order for SDD's, application of SDT. Intermediate-Code Generation: syntax trees, three-address code, types and declarations, translation of expressions, type checking.

UNIT - IV

Runtime Environment: storage organization, stack allocation of space, heap management, storage allocation for arrays, strings and records, Introduction to garbage collection and trace-based collection.

UNIT - V

Code Generation: issues in the design of code generator, target language, addresses in the target code, basic blocks and flow graphs, optimization of basic blocks, peephole optimization, register allocation and assignment. Code Optimization: principal sources of optimization, data flow analysis, constant propagation, partial-redundancy elimination, loops in flow graphs.

Suggested Readings

1. A. V. Aho, monica s. Lam, ravi sethi, j. D. Ullman, Compilers Principles, Techniques, & Tools, (2e)
2. Dick grune, henry e. Bal, cariel t. H. Jacobs, Modern Compiler Design
3. Kenneth c. Loudon, Compiler Construction Principles And Practice
4. Thomas w. Parsons, Introduction To Compiler Construction
5. Andrew n. Appel, Modern Compiler Implementation In C
6. John r. Levin, Tony Mason, Doug Brown, Lex & Yacc
7. Cooper, Linda, Engineering A Compiler

PEC 146C: Data Visualisation (Elective - II)**Work Load: 3 PPW****Internal Marks: 20****External Marks: 80****UNIT - I**

Core Skills For Visual Analysis: Information visualization - effective data analysis - traits of meaningful data - visual perception -making abstract data visible - building blocks of information visualization - analytical interaction - analytical navigation - optimal quantitative scales - reference lines and regions - trellises and crosstabs - multiple concurrent views - focus and context - details on demand - over-plotting reduction - analytical patterns - pattern examples.

UNIT - II

Time-Series, Ranking, And Deviation Analysis: Time-series analysis - time-series patterns - time-series displays - time-series best practices - part-to-whole and ranking patterns - part-to-whole and ranking displays - best practices - deviation analysis - deviation analysis displays - deviation analysis best practices.

UNIT - III

Distribution, Correlation, And Multivariate Analysis: Distribution analysis - describing distributions - distribution patterns - distribution displays - distribution analysis best practices - correlation analysis - describing correlations - correlation patterns - correlation displays - correlation analysis techniques and best practices - multivariate analysis - multivariate patterns - multivariate displays - multivariate analysis techniques and best practices.

UNIT - IV

Information Dashboard Design: Information dashboard - Introduction- dashboard design issues and assessment of needs - Considerations for designing dashboard-visual perception - Achieving eloquence.

UNIT - V

Information Dashboard Design: Advantages of Graphics _Library of Graphs - Designing Bullet Graphs - Designing Sparklines - Dashboard Display Media -Critical Design Practices - Putting it all together- Unveiling the dashboard.

Suggested Readings

1. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.
2. Edward R. Tufte, "The visual display of quantitative information", Second Edition, Graphics Press, 2001.
3. Evan Stubbs, "The value of business analytics: Identifying the path to profitability", Wiley, 2011.
4. Gert H. N. Laursen and Jesper Thorlund, "Business Analytics for Managers: Taking business intelligence beyond reporting", Wiley, 2010.
5. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.
6. Stephen Few, "Information dashboard design: Displaying data for at-a-glance monitoring", second edition, Analytics Press, 2013.
7. Stephen Few, "Now you see it: Simple Visualization techniques for quantitative analysis", Analytics Press, 2009.
8. Tamara Munzner, Visualization Analysis and Design, AK Peters Visualization Series, CRC Press, Nov. 2014

LCC 151: R Programming Lab**Work Load: 4 PPW****Internal Marks: 10****External Marks: 40****Programs**

1. Write a R program to enter your details (name, college, class, contact number, address) and display the values.
2. Write a R program to create a sequence of numbers from 10 to 150 and find the mean of numbers from 30 to 90 and sum of numbers from 41 to 91.
3. Write a R program to create a vector which contains 10 random integer values between 100 and 1000.
4. Write a R program to get all prime numbers up to a given number.
5. Write a R program to extract first 10 English letter in lower case and last 10 letters in upper case and extract letters between 22nd to 24th letters in upper case
6. Write a R program to create three vectors a,b,c with 3 integers. Combine the three vectors to become a 3×3 matrix where each column represents a vector. Print the content of the matrix
7. Define multiple vectors then create different data frames using cbind() , rbind().
8. Write a R program to read the .csv file and display the content
9. Write a R program to create an array with three columns, three rows, and two "tables", taking two vectors as input to the array. Print the array.
10. Write a R program to create a simple bar plot, pie chart, histogram and line graph of your semester wise total marks
11. Write a R program to compute sum, mean and product of a given vector elements.
12. Write a R program to create a Dataframes which contain details of 5 employees and display the details
13. Write a R program to create an array of two 3x3 matrices each with 3 rows and 3 columns from two given two vectors.
14. Write a R program to get the statistical summary and nature of the data of a given data frame.
15. Write a R program to extract 3rd and 5th rows with 1st and 3rd columns from a given data frame.
16. Write a R program to compare two data frames to find the row(s) in first data frame that are not present in second data frame.
17. Write a R program to find Sum, Mean and Product of a Vector, ignore element like NA or NaN.
18. Write a R program to create an ordered factor from data consisting of the names of months
19. Write a R program to illustrate normal distribution functions dnorm, pnorm, qnorm ,rnorm.
20. Consider the annual rainfall details in a place of Indiastaarting from January 2020. Create an R time series object for a period of 12 month and plot it.
21. Write a R program to illustrate randomforest() function.
22. Write a R Program to illustrate chisq.test() function.
23. Consider a empolyee Json file and extract information from JSON() function.

LCC 152: Internet of Things Lab**Work Load: 4 PPW****Internal Marks: 10****External Marks: 40****Programs**

1. Familiarization with Arduino/Raspberry Pi and perform necessary software installation.
2. To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds.
3. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
4. To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.
5. To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.
6. To interface OLED with Arduino/Raspberry Pi and write a program to print temperature and humidity readings on it.
7. To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth.
8. To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when '1'/'0' is received from smartphone using Bluetooth.
9. Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to thing speak cloud.
10. Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from thing speak cloud.
11. To install MySQL database on Raspberry Pi and perform basic SQL queries.
12. Write a program on Arduino/Raspberry Pi to publish temperature data to MQTT broker.
13. Write a program on Arduino/Raspberry Pi to subscribe to MQTT broker for temperature data and print it.

LCC 153: Web Technologies Lab**Work Load: 4 PPW****Internal Marks: 10****External Marks: 40****Programs**

1. Write an HTML page with Javascript that takes a number from one text field in the range 0- 999 and display it in other text field in words. If the number is out of range, it should show “out of range” and if it is not a number, it should show “not a number” message in the result box.
2. Develop static pages (using only HTML) of an online Book store
The pages should resemble: www.amazon.com. The website should consists the following pages.
 - a. Home page
 - b. Registration and user Login
 - c. User profile page
 - d. Books catalog
 - e. Shopping cart
 - f. Payment by credit card Order Conformation
3. Write an HTML page that has one input, which can take multi-line text and a submit button. Once the user clicks the submit button, it should show the number of characters, lines and words in the text entered using an alert message. Words are separated with whitespace and lines are separated with new line character.
4. Write an HTML page that contains a selection box with a list of 5 countries. In this page when the user selects a country, its capital should be printed next to the list, and add CSS to customize the properties of the font of the capital.
5. Create an XML document that contains 10 users information. Write a script which takes user id as input and returns the user details by taking the user information from XML document.
6. Implement a user validation web application, where user submits the login name and password to server. These are checked against the data already available in the database and if the data matches a successful login page is returned otherwise a failure message is shown to the user.
7. A simple calculator web application that takes 2 numbers and an operator (+, -, *, /, %) from an HTML page and returns the result page with the operation performed on the operands.
8. A web application shows a start time at the right top corner of the page and takes a name as input and provides the logout button at bottom. On clicking logout button it should show a logout page with thank you message with the duration of Usage.
9. A web application that takes name and age from an HTML page. If the age is less than 18, it should send a page with “hello, and you are not authorized to visit this site” otherwise it should send “You are welcome to this site” message.
10. Write a web application in which the user is first served a login page which takes users name and password. After submitting the details the server checks these values against the data from a database and takes the following decisions if name and password matches, serves a welcome page with user’s full name. If name matches and password doesn’t match then serves password mismatch page. If name not found in database, serves a registration page where user’s full name is asked and on submitting the full name, it stores the login name, password and full name in the database.
11. A web application that lists all cookies stored in the browser on clicking “list cookies” button, add cookies if necessary

PEC 161A: Cloud Computing (Elective - I)**Work Load: 3 PPW****Internal Marks: 20****External Marks: 80****UNIT - I**

Era of Cloud Computing (CC): introduction, cloud and other similar configurations, CC vs. peer-to-peer architecture, CC vs. client-server architecture, CC vs. GC, components of CC, impact of CC on businesses. Introduction Virtualization: Introduction, virtualization benefits, implementation levels of virtualization, virtualization at the OS level, virtualization structure, open source virtualization technology, Xen virtualization architecture, binary translation with full virtualization, para-virtualization with compiler support, virtualization of CPU, memory, I/O devices, hardware support for virtualization, virtualization in multicore processors.

UNIT - II

Cloud Computing Services: IaaS, PaaS, leveraging PaaS for productivity, guidelines for selecting a PaaS provider, concerns with PaaS, languages and PaaS, SaaS, DBaaS. Cloud Computing and Business Value: key drivers for CC, CC and outsourcing, types of scalability, use of load balancers to enhance scalability, variable operating costs using CC, time-to-market benefits of CC, distribution over the internet, levels of business values from CC. Cloud Types and Models: private cloud, public cloud, hybrid cloud. Open Source Cloud Implementation and Administration: Eucalyptus & Open Stack cloud architectures, CSB - Recent Trends in Cloud Computing and Standards: conflicts of interest for public cloud and IT product providers, BYOD and encryption exposures, cloud standards, cloud ratings, CC trends that are accelerating adoption.

UNIT - III

Host Security in the Cloud: security for virtualization products, host security for SaaS, PaaS, IaaS. **Data Security in the Cloud:** challenges with cloud data and data security, data confidentiality and encryption, data availability, data integrity, CSGs. Cloud application requirements, SOA for cloud applications. **Adoption and Use of Cloud by Small and Medium Businesses:** place of adoption, benefits, adoption phases, vendor roles and responsibilities, selection phases, provider liability, provider capabilities, success factors for CC Adoption process of public clouds by enterprises. Cloud migration techniques, Phases during the migration of an application to the cloud. **IT Service Management for Cloud Computing:** ITIL based service management, service strategy, service design, service transition, service operations, continual service improvement. **SLA with Cloud Service Providers:** concept, aspects and requirements of SLA, credit calculation, samples 1 and 3.

UNIT - IV

Risks, Consequences, and Costs for Cloud Computing: introduction, risk assessment and management, risk of vendor lock-in, loss of control, not meeting regulatory compliances, resource scarcity, multitenant environment, failure, inadequate SLA, malware and internet attacks, management of cloud resources, network outages, in fracture, legal, licensing, TCO, cloud costs, cost allocations, chargeback models and methodology, billable items.

UNIT - V

AAA Administration for Cloud: AAA model, single signon for clouds, industry implementation for AAA, authentication management in the cloud, SAML, authentication for resource utilization. **Security as a Service:** benefits of security as a service, concerns with security as a service, security service providers, IdMaaS, attributes of IdMaaS providers. **Cloud Certifications and Audits:** certifications, cloud audit framework, cloud auditing requirements. **Application Security in the Cloud:** cloud application SDLC, cloud service reports by providers, application security in IaaS, PaaS and SaaS environments. **Mobile Cloud Computing (MCC):** architecture of MCC, benefits of MCC, MCC challenges.

Suggested Readings

1. Kailash j, Jagannath K, Donald J H, Deven Shah, Cloud Computing - Black Book
2. Rajkumar Buyya, Cloud Computing: Principles And Paradigms
3. Arshdeep Bahga, Vijay Madiseti, Cloud Computing - A Hands-On Approach
4. David e.y. Sarna, Implementing And Developing Cloud Computing Applications

PEC 161B: Natural Language Processing (Elective - I)

Work Load: 3 PPW

Internal Marks: 20

External Marks: 80

UNIT - I

Introduction of Elementary Probability Theory, Essential Information Theory. Linguistic Essentials Corpus-Based Work Collocations.

UNIT - II

Statistical Inference: Bins: Forming Equivalence Classes, Reliability vs. Discrimination, n-gram models, Building ngram models, An Information Theoretic Approach.

UNIT - III

Word Sense Disambiguation: Methodological Preliminaries, Supervised and unsupervised learning, Pseudo words, Upper and lower bounds on performance, Supervised Disambiguation, Bayesian classification.

UNIT - IV

Evaluation Measures, Markov Models: Hidden Markov Models, Use, General form of an HMM Part-of-Speech Tagging

UNIT - V

Probabilistic Context Free Grammars: Introduction of Clustering Information Retrieval: Background, The Vector Space Model.

Suggested Reading

1. Christopher D. Manning, Hinrich Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.
2. James Allan, Natural Language Understanding, Pearson Education, 1994.
3. Tanveer Siddiqui, US Tiwary, Natural Language Processing and Information Retrieval, Oxford University Press, 2008.

PEC 161C: Software Quality Testing (Elective - I)**Work Load: 3 PPW****Internal Marks: 20****External Marks: 80****UNIT - I**

Software Testing Process, Objectives, Testing Techniques, Software Testing Life Cycle, Concept of Testing, Types of Errors, Stubs and Drivers Verification and Validation, Different Types of Verification & Validations Mechanisms, Concepts of Software Reviews, Code inspection and Code Walkthrough, Testing of Component Based Software System, Energy Efficient Testing, Mobile Application Testing.

UNIT - II

Software Testing Methods, Testing Fundamentals, Test Case Design, White Box Testing and its Types, Black Box Testing and its Types, Software Testing Strategies, Strategic Approach to Software Testing, UNIT Testing, Integration Testing, Validation Testing, System Testing, Test Planning, Budgeting and Scheduling

UNIT-III

Software Testing Metrics, Concept and Developing Testing Metrics, Different Types of Metrics, Complexity Metrics, Defect Management, Definition of Defects, Defect Management Process, Defect Reporting, Metrics Related to Defects, Using Defects for Process Improvement.

UNIT-IV

Software Quality, Factors Affecting Software Quality, Quality Models, Software Quality Estimation, Quality Metrics, Quality Assurance, SQA Activities, Software Reviews, Formal Technical Reviews, Quality Control Quality Management, and, SQA Plan. Quality Improvement, Pareto Diagrams, Cause-Effect Diagrams, Scatter Diagrams, Run Charts, Total Quality Management, Statistical Quality Assurance, Software Reliability, the ISO 9001 Quality Standard, Six Sigma, Informal Reviews.

UNIT-V

Quality Costs, Quality Cost Measurement, Utilizing Quality Costs for Decision-Making. Manual Vs Automatic Testing, Basics of Automated Testing, Drawback of Manual Testing, Advantages of Automation of Testing, Factors for Automation Testing, Types Automation of Testing Tools, Introduction to QTP, QTPIDE, Basic Components in QTP, QTP Framework, Write Scripts, Introduction to Winrunner, and Rational Robot.

Suggested Readings

1. Roger S. Pressman, Software Engineering - a Practitioners Approach, McGraw Hill Education;1 April 2009.
2. K.K. Aggarwal&Yogesh Singh, "Software Engineering", New Age International Publishers, New Delhi, 2005.
3. KshirsagarNaik, PriyadarshiTripathy, Software Testing and Quality Assurance Theory and Practice, Wiley-Spektrum;August 18, 2008.
4. Donna C. S. Summers, Quality Management, Pearson; April 26, 2008
5. Yogesh Singh, Software Testing, Cambridge University Press, 2012
6. William Perry, "Effective Methods for Software Testing", John Wiley & Sons, New York, 1995
7. Louise Tamres, "Software Testing", Pearson Education Asia, 2002
8. CemKaner, Jack Falk, Nguyen Quoc, "Testing Computer Software", Second Edition, Van Nostrand Reinhold, New York, 1993.
9. Boris Beizer, "Black-Box Testing - Techniques for Functional Testing of Software and Systems", John Wiley & Sons Inc., New York, 1995.

PEC 162A: Big Data Analytics (Elective - II)**Work Load: 3 PPW****Internal Marks: 20****External Marks: 80****UNIT - I**

Overview of Big Data: What is Big Data? Evolution of Big Data, Structuring Big Data, Elements of Big Data, Big Data Analytics. Exploring the Use of Big Data in Business Context: Use of Big Data in Social Networking, Use of Big Data in Preventing Fraudulent Activities, Use of Big Data in Detecting Fraudulent Activities in Insurance Sector, Use of Big Data in Retail Industry. Introducing Technologies for Handling Big Data: Distributed and Parallel Computing for Big Data

UNIT - II

Introducing Hadoop: Understanding Hadoop Ecosystem: Hadoop Ecosystem, HDFS, MapReduce, Hadoop YARN, HBase, Hive, Pig and Pig Latin, Sqoop, ZooKeeper, Flume, Oozie. Understanding MapReduce Fundamentals and HBase: The MapReduce Framework, Techniques to Optimize MapReduce Jobs, Role of HBase in Big Data Processing. Exploring the Big Data Stack, Virtualization and Big Data, Virtualization Approaches.

UNIT - III

Storing Data in Databases and Data Warehouses: RDBMS and Big Data, Non-Relational Database, Integrating Big Data with Traditional Data Warehouses, Big Data Analysis and Data Warehouse, Changing Deployment Models in Big Data Era. Processing Your Data with MapReduce: Developing Simple MapReduce Application, Points to Consider while Designing MapReduce. Customizing MapReduce Execution: Controlling MapReduce Execution with InputFormat, Reading Data with Custom RecordReader, Organizing Output Data with OutputFormats, Customizing Data with RecordWriter, Optimizing MapReduce Execution with Combiner, Implementing a MapReduce Program for Sorting Text Data.

UNIT - IV

Understanding Hadoop YARN Architecture: Introduction YARN, Advantages of YARN, YARN Architecture, Working of YARN. Exploring Hive: Introducing Hive, Getting Started with Hive, Hive Services, Data Types in Hive, Built-In Functions in Hive, Hive DDL, Data Manipulation in Hive, Data Retrieval Queries, Using JOINS in Hive. Analyzing Data with Pig: Introducing Pig, Running Pig, Getting Started with Pig Latin, Working with Operators in Pig, Working with Functions in Pig, Debugging Pig, Error Handling in Pig.

UNIT - V

NoSQL Data Management: Introduction to NoSQL, Types of NoSQL Data Models, Schema-Less Databases, Materialized Views, Distributed Models, Sharding, MapReduce Partitioning and Combining, Composing MapReduce Calculations. Understanding Analytics and Big Data: Comparing Reporting and Analysis, Types of Analytics, Developing an Analytic Team. Analytical Approaches and Tools to Analyze Data: Analytical Approaches, History of Analytical Tools, Introducing Analytical Tools, Comparing Various Analytical Tools.

Suggested Readings

1. DT EDITORIAL SERVICES, BIG DATA - BLACK BOOK (DREAMTECH)
2. RADHA S, M. VIJAYALAKSHMI, BIG DATA ANALYTICS
3. ARSHDEEP B AND VIJAY M, BIG DATA SCIENCE & ANALYTICS - A HANDS-ON APPROACH.
4. FRANK OHLHORST, BIG DATA FUNDAMENTALS - CONCEPTS, DRIVERS, TECHNIQUES
5. KUAN-CHING LI, H JIANG, L T YANG, A CUZZOCREA, BIG DATA ALGORITHMS, ANALYSIS AND APPLICATIONS
6. TOM WHITE, HADOOP: THE DEFINITIVE GUIDE
7. SHIVA ACHARI, HADOOP ESSENTIALS

PEC 162B: Bloch Chain Technologies (Elective - II)

Work Load: 3 PPW

Internal Marks: 20

External Marks: 80

UNIT - I

Introduction to Cryptography: Cryptographic Hash Functions, SHA-256, Hash Pointers and Data Structures, Merkle tree.

UNIT - II

Digital Signatures: Elliptic Curve Digital Signature Algorithm (ECDSA), Public Keys as identities, A Simple Cryptocurrency.

UNIT - III

Centralization vs Decentralization, Distributed consensus, Consensus without identity using a block chain, Incentives and proof of work. Mechanics of Bitcoin: Bitcoin Transactions, Bitcoin Scripts, Applications of Bitcoin Scripts, Bitcoin Blocks, The Bitcoin Network.

UNIT - IV

Storage and Usage of Bitcoins: Simple Local Storage, Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets.

UNIT - V

Bitcoin Mining: The Task of Bitcoin miners, Mining Hardware, Mining pools, Mining incentives and strategies. Bitcoin and Anonymity: Anonymity Basics, Mixing, Zerocoin and Zerocash. Applications of Block Chain Technologies.

Suggested Reading

1. Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction by Arvind
2. Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder,
3. Princeton Press, 2016.
4. Mastering Bitcoin: Programming the Open Blockchain by Andreas M. Antonopoulos Shroff, O'Reilly; 2nd Edition, 2017.

PEC 162C: Deep Learning (Elective - II)**Work Load: 3 PPW****Internal Marks: 20****External Marks: 80****UNIT - I**

Introduction: A motivating example, the key components - data, models, and algorithms, kinds of machine learning, the road to deep learning, success stories, Linear regression, multilayer perceptrons, model selection, underfitting and overfitting, weight decay, dropout, forward propagation, backward propagation and computational graphs, numerical stability and initialization, considering the environment, predicting house prices on Kaggle Optimization algorithms - optimization and deep learning, convexity, gradient descent, momentum, adagrad, RMSProp, Adadelta, Adam, learning rate scheduling

UNIT - II

Deep learning computation: Layers and blocks, parameter management, deferred initialization, custom layers, file I/O, GPUs Convolutional neural networks - from dense layers to convolutions, convolutions for images, padding and stride, multiple input and output channels, pooling, convolutional neural networks(LeNet) Modern Convolutional neural networks - deep Convolutional neural networks(AlexNet), Networks using blocks(VGG), Networks with parallel concatenations(GoogleNet), batch normalization, residual networks(ResNet), densely connected networks(DenseNet)

UNIT - III

Recurrent neural networks: Sequence models, text processing, language models and the dataset, recurrent neural networks, back propagation through time
Modern Recurrent neural networks - gated recurrent units(GRU), long short term memory(LSTM), deep recurrent neural networks, bidirectional recurrent neural networks, machine translation and the dataset, encoder-decoder architecture, sequence to sequence
Attention mechanisms - attention mechanism, sequence to sequence with attention mechanism, transformer

UNIT - IV

Computer vision: Image augmentation fine tuning, object detection and bounding boxes, anchor boxes, multiscale object detection, the object detection dataset, single shot multibox detection(SSD), region based CNNs(R-CNNs), semantic segmentation and the dataset, transposed convolution, fully convolutional networks(FCN), neural style transfer, image classification(CIFAR-10) on kaggle, dog breed identification (Imagenet dogs) on kaggle

UNIT - V

Generative adversarial networks: Generative adversarial networks, deep convolutional generative adversarial networks
Tools for deep learning - using jupyter, using amazon sagemaker, using AWS EC2 instances, using google colab, selecting servers and GPUs

Suggested Reading

1. Ian goodfellow, Yoshua bengio, Aaron courville, "Deep learning" Zhang, Aston, et al. "Dive into deep learning." arXiv preprint arXiv:2106.11342 (2021).

OEC 163A: Environmental Science (Open Elective - I)**Work Load: 3 PPW****Internal Marks: 20****External Marks: 80****UNIT - I**

Environmental Studies: Introduction - Definition, Scope and Importance - Basic principle of ecosystem functioning - Concept of ecosystem, structure and functioning of ecosystem, introduction and characteristic features, structures and functions, different ecosystems.

Biodiversity and its conservation: Introduction - Bio-geographical classification of India. Value of biodiversity - consumptive and predictive use, social, ethical and optional values. Biodiversity - Global, National and local levels. Hot spots of biodiversity - Threats to biodiversity - Endangered and endemic species of India - Conservation of biodiversity - In-situ and Ex-situ conservant.

UNIT - II

Environmental and Natural Resources: Forest resources - Use and over-exploitation, Deforestation, Timber extraction, Mining and dams - their effects on forests and tribal' people. Water resources - Use and over-utilization of surface and ground water, floods, droughts, conflicts over water, dams - effects of extracting and using mineral resources. Food resources - World food problems - change caused by agricultural and overgrazing, effects of modern agricultural fertilizer pesticide problems, water logging and salinity.

Environmental Valuation: Welfare measure and environmental values, definition and classification of environmental values, valuation methods. **Environmental Economics:** Economic approach to environmental preservation and conservation, property rights and externalities, management of natural resources.

UNIT - III

Environmental Pollution: Causes, effects and control measures of air pollution, water pollution, soil pollution, marine pollution, noise pollution.

Environmental Problems in India: Effects of human activities on the quality of life, Water and River, Ground water, Wasteland reclamation.

UNIT - IV

Regional and Sectoral Issues: Urbanization, Agro-forestry, Dry lands, Goods and services, Mountain development, River basin water resources management. sustainable tourism, and Costal zone management. **Environment and Development:** The economy and environment interaction, State of the Environment - Economics of development; Preservation and conservation.

Sustainability: Theory and Practice, Equitable use of resources for sustainable life styles - Role of an individual in prevention of pollution.

Human Population and the Environment: Population growth and environment - Human Rights.

UNIT - V

Social Issues and the Environment: Sustainable Development - Resettlement and rehabilitation of people and its problems and concerns.

Environmental ethics: Issues and possible solutions-Consumerism and waste products - Public awareness. Sustainable resources management. Design of Environmental Policy -- Direct regulation by Government - Command and control instrumentation.

Suggested Readings

1. B. Sudhakara Reddy, T. Sivaji Rao, U. Tataji & K. Purushottam Reddy, An Introduction to Environmental Studies, Maruti Publications.
2. C.Manohar Chary and P.Jayaram Reddy, Principles of Environmental Studies, B.S. Publications, Hyderabad.
3. Y.Anjaneyulu, Introduction to Environmental Science, B.S. Publications, Hyderabad.

OEC 163B: Constitution of India (Open Elective - I)

Work Load: 3 PPW

Internal Marks: 20

External Marks: 80

UNIT - I

The Constitution: Introduction, The History of the Making of the Indian Constitution, Preamble and the Basic Structure, and its interpretation, Fundamental Rights and Duties and their interpretation, State Policy Principles

UNIT - II

Union Government: Structure of the Indian Union, President - Role and Power, Prime Minister and Council of Ministers, Lok Sabha and Rajya Sabha

UNIT - III

State Government: Governor - Role and Power, Chief Minister and Council of Ministers, State Secretariat

UNIT - IV

Local Administration: District Administration, Municipal Corporation, Zilla Panchayat

UNIT - IV

Election Commission: Role and Functioning, Chief Election Commissioner, State Election Commission

Suggested Readings

1. Ethics and Politics of the Indian Constitution Rajeev Bhargava Oxford University Press, New Delhi, 2008
2. The Constitution of India B.L. Fadia Sahitya Bhawan; New edition (2017)
3. Introduction to the Constitution of India DD Basu Lexis Nexis; Twenty-Third 2018 edition

Suggested Software/Learning Websites

1. <https://www.constitution.org/cons/india/const.html>
2. <http://www.legislative.gov.in/constitution-of-india>
3. <https://www.sci.gov.in/constitution>
4. <https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/>

OEC 163C: Disaster Management (Open Elective - I)**Work Load: 3 PPW****Internal Marks: 20****External Marks: 80****UNIT - I**

Understanding Disaster: Understanding the Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, Capacity, Disaster and Development, and disaster management.

UNIT - II

Types, Trends, Causes, Consequences and Control of Disasters, Geological Disasters (earthquakes, landslides, tsunami, mining); Hydro-Meteorological Disasters (floods, cyclones, lightning, thunder-storms, hail storms, avalanches, droughts, cold and heat waves) Biological Disasters (epidemics, pest attacks, forest fire); Technological Disasters (chemical, industrial, radiological, nuclear) and Manmade Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters) Global Disaster Trends - Emerging Risks of Disasters - Climate Change and Urban Disasters.

UNIT - III

Disaster Management Cycle and Framework: Disaster Management Cycle - Paradigm Shift in Disaster Management. Pre-Disaster - Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness. During Disaster - Evacuation - Disaster Communication - Search and Rescue - Emergency Operation Centre - Incident Command System - Relief and Rehabilitation -Post-disaster - Damage and Needs Assessment, Restoration of Critical Infrastructure - Early Recovery - Reconstruction and Redevelopment; IDNDR, Yokohama Strategy, Hyogo Framework of Action.

UNIT - IV

Disaster Management in India: Disaster Profile of India - Mega Disasters of India and Lessons Learnt. Disaster Management Act 2005 - Institutional and Financial Mechanism, National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national), Non-Government and Inter Governmental Agencies

UNIT - V

Applications of Science and Technology for Disaster Management: Geo-informatics in Disaster Management (RS, GIS, GPS and RS). Disaster Communication System (Early Warning and Its Dissemination). Land Use Planning and Development Regulations, Disaster Safe Designs and Constructions, Structural and Non Structural Mitigation of Disasters S&T Institutions for Disaster Management in India

Suggested Readings

1. Publications of National Disaster Management Authority (NDMA) on Various Templates and Guidelines for Disaster Management
2. Bhandani, R. K., An overview on natural & man-made disasters and their reduction, CSIR, New Delhi
3. Srivastava, H. N., and Gupta G. D., Management of Natural Disasters in developing countries, Daya Publishers, Delhi
4. Alexander, David, Natural Disasters, Kluwer Academic London
5. Ghosh, G. K., Disaster Management, A P H Publishing Corporation
6. Murthy, D. B. N., Disaster Management: Text & Case Studies, Deep & Deep Pvt. Ltd.

MPW 171: Major Project Work

Work Load: 20 PPW

Internal Marks: 50

External Marks: 100

Project has to be carried out by each student individually in a period of 15 weeks of duration. Students should submit a synopsis at the end of 2nd week in consultation with the Project Guide. The synopsis should consist of definition of the problem, scope of the problem and plan of action. After completion of eight weeks students are required to present a Project Seminar on the topic covering the aspects of analysis, design and implementation of the project work.

At the end of the semester the students are required to present themselves for a University Viva-voce examination.

A committee consisting of two faculty members of the respective college along with a guide will evaluate the project and award CIE marks.

Each student will be required to:

- Submit one page of synopsis on the project work for display on notice board.
- Give a 20 minutes presentation followed by 10 minutes discussion.
- Submit a technical write-up on the project.

At least two teachers will be associated with the Project Seminar to evaluate students for the award of CIE marks which will be on the basis of performance in all the 3 items stated above.

The project seminar presentation should include the following components of the project:

- Problem definition and specification.
- Literature survey, familiarity with research journals.
- Broad knowledge of available techniques to solve a particular problem.
- Planning of the work, preparation of bar (activity) charts, Presentation both oral and written.