FOURTH SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours / week	Credit	Full Marks
1.	Humanities Science – 4	HS 401	Engineering Economics and Accountancy	3	0	0	3	3	100
2.	Program Core - 5	PC CS 402	Digital Logic & Computer Architecture	3	1	0	4	4	100
3.	Program Core – 6	PC CS 403	Discrete Mathematics	3	1	0	4	4	100
4.	Program Core – 7	PC CS 410	Introduction to Data Analytics and Visualization	3	0	0	3	3	100
5.	Program Core – 8	PC CS 405	Operating Systems	3	0	0	3	3	100
6.	Program Core – 9	PC CS 411	Natural Language Processing	3	1	0	4	4	100
7.	Program Core – 10	PC CS 412	Java Programming Lab	0	0	2	2	1	100
8.	Program Core – 11	PC CS 408	Operating System Lab	0	0	2	2	1	100
9.	Program Core – 12	PC CS 413	Web Technology Lab	0	0	2	2	1	100
10.	Program Core – 13	PC CS 414	Data Analytics and Visualization Lab	0	0	2	2	1	100
Total:				18	3	8	29	25	1000

Engineering Economics and Accountancy

Course Code	HS 401
Course Title	Engineering Economics and Accountancy
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	-
Course Category	Humanities Science (HS)
Number of classes	38 hours

Course Outcomes:

At the end of the course, the student will be able to

CO Number	CO Description	K-level
CO-1	Explain the importance of engineering economics in business.	K2
CO-2	Demonstrate the necessary knowledge and skills for running a business organization.	K2
CO-3	Interpret the financial statement and position of an organization.	K2
CO-4	Analyze the accounting information for decision making.	K3
CO-5	Develop the knowledge & skill on business and management.	K4

Course Content:

Module 1: (9 Hours)

Engineering economy and its importance, Demand& supply: Wants, satisfaction of wants, Demand, supply, elasticity of demand, estimation of demand, supply chain economy, production factors of production (land, labor, entrepreneurship, capital), Laws of return, Money – Value of money, quantity theory; inflation and deflection.

Module 2: (9 Hours)

Business Structure: Proprietorship, Partnership and Joint Stock Company, Basic management for businesses: Basic functions of management, Risk Management: Type of risk, Risk management steps, Entrepreneur and Leadership: Leadership styles, qualities of a good leader for a business, Financing and the business: Objectives and Sources of funds, Taxation: Basics of Income tax & Goods and Services Tax (GST).

Module 3: **(10 Hours)**

Transactions: Financial event, Features of transactions, recording of transactions, Basic accounting: Ledger, Trail balance, Cashbook (double column only), Final account: Objectives, Preparation of final accounts (Trading A/C , Profit & Loss A/C and Balance Sheet).

Module 4: **(10 Hours)**

Cost classifications–Material cost control, labor cost control and overhead cost control, Cost sheet: Objective and preparation of Cost sheet (Basics), Capital budgeting: Objectives Pay-back period and NPV method for feasibility testing of investment, Working capital management: Factors and sources of WC, Ratio analysis: Interpretation for industrial control, Basic ratios-Current Ratio, equity ratio, profit ratio

References / Suggested Learning Resources:

- Fundamentals of Engineering Economics, 4thEdition,byChanS.Park,PearsonPublishing;
- Engineering EconomicsAndFinancialAccountingPaperback,byArasu,Scitechpublication
- Engineering Economics and Financial Accounting for Anna University Paper back by A. Bagad, Technical Publications;
- Financial Management-Ananalytical framework, Nayak & Manna, Parul Library;
- Principles of Management, Ghose and Basu, ABS Publishing House

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Digital Logic & Computer Architecture

Course Code	PC CS 402
Course Title	Digital Logic & Computer Architecture
Number of Credits	4 (L: 3, T: 1, P:0)
Prerequisites	ES 204 (Programming for Problem Solving)
Course Category	Program Core (PC)
Number of Classes	44 Hours

Course Outcomes:

By the end of this course, students will be able to:

CO Number	CO Description	K-level
CO1	Describe the basic Combinational and Sequential circuits in behavioral and structural paradigm; and the fundamental organization of a computer system including processor, memory and I/O subsystem.	K2
CO2	Explain various components of the machine instructions and addressing modes for operands, instruction formats, program control statements; and the I/O mechanisms and various modes including polling, interrupt driven and DMA.	K2
CO3	Illustrate the mechanisms of instruction execution including fetch, decode and execute, and relate the instructions to its execution through the understanding of the hardware for basic arithmetic.	K4
CO4	Examine a memory module and analyze its operation by interfacing with the CPU.	K4
CO5	Apply design techniques to enhance performance using pipelining, parallelism.	K4

Course Contents:

Module 1: (14 Hours)

Binary Systems & Code conversion, Boolean Algebra & Logic Gates – Truth Tables – Universal Gates – Simplification of Boolean functions: SOP, POS methods – K-map, – Combinational Logic: Adders & Subtractors – Multiplexer – Demultiplexer - Encoder – Decoder. Sequential Logic: RS, Clocked RS, D, JK, Master Slave JK, T Flip-Flops – Shift Registers – Types of Shift Registers – Counters: Ripple Counter – Synchronous Counters – Up-Down Counter.

Module 2: (14 Hours)

Functional blocks of a computer - CPU, memory, input-output subsystems, control unit. Data representation -Signed number representation, fixed and floating-point representations (IEEE 754), Computer arithmetic – integer addition, subtraction, Booth's multiplication, division, floating point arithmetic. Introduction to x86 architecture. Instruction set architecture of a CPU,

registers, instruction formats, instruction execution cycle, addressing modes, instruction set. CPU control unit design- hardwired and micro-programmed design approaches.

Module 3: (8 Hours)

Memory organization: Memory Technology, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies, updation schemes. Techniques for reducing cache misses; Virtual memory organization, mapping and management techniques, memory replacement policies.

Module 4: (8 Hours)

I/O subsystems, interfacing with IO devices, I/O transfers–program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Pipeline Processing, Instruction and Arithmetic Pipeline, Pipeline hazards and their resolution, concept of Parallel Processing.

Text Books:

1. M. Morris Mano, Computer System Architecture, 3/e, Pearson Education.
2. William Stallings, Computer Organization and Architecture: Designing for Performance, 8/e, Pearson Education India. 2010.
3. M. Morris Mano and Michael D. Ciletti, "Digital Design", Prentice Hall; 5th Edition 2012.

Reference Books:

- S. Tanenbaum, Structured Computer Organization, 5/e, Prentice Hall of India, 2009.
- V. C. Hamacher, Z. G. Vranesic and S. G. Zaky, Computer Organization, 5/e, McGraw Hill, 2002.
- J. L. Hennessy and D. A. Patterson, Computer Architecture: A Quantitative Approach, 4/e, Morgan Kaufmann, 2006.
- D. V. Hall, Microprocessors and Interfacing, 2/e, McGraw Hall, 2006.
- D. A. Patterson and J. L. Hennessy, Computer Organization and Design, 4/e, Morgan Kaufmann, 2008.

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Discrete Mathematics

Course Code	PC CS 403
Course Title	Discrete Mathematics
Number of Credits	4 (L: 3, T: 1, P: 0)
Prerequisites	BS 101, BS 202
Course Category	Program Core(PC)
Number of classes	48 hours

Course Outcome:

At the end of the course, the student will be able to:

CO Number	CO Description	K-level
CO-1	Construct a logic sentence in terms of predicates, quantifiers, and logical connectives	K3
CO-2	Derive the solution for a given problem using deductive logic and prove the solution based on logical inference.	K4
CO-3	Classify its algebraic structure for a given a mathematical problem.	K4
CO-4	Analyze and Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra.	K4
CO-5	Develop the given problem as graph networks and solve with techniques of graph theory	K4

Course Content:

Module 1: (10 Hours)

Sets, Relation and Function: Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum and Product of Functions, Bijective functions, Inverse and Composite Function, Size of a Set, Finite and infinite Sets, Countable and uncountable Sets, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem. Principles of Mathematical Induction: The Well Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.

Module 2: (10 Hours)

Basic counting techniques-inclusion and exclusion, pigeon-hole principle, permutation and combination. Propositional Logic: Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.

Module 3: (15 Hours)

Algebraic Structures and Morphism: Algebraic Structures with one Binary Operation, Semi

Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form.

Module 4: (13 Hours)

Graphs and Trees: Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Colouring, Colouring maps and Planar Graphs, Colouring Vertices, Colouring Edges, List Coloring, Perfect Graph, definition properties and Example, rooted trees, trees and sorting, weighted trees and prefix codes, Bi-connected component and Articulation Points, Shortest distances.

Suggested books:

1) Russell Merris, Combinatorics, Wiley-Interscience series in Discrete Mathematics and Optimization
2) N. Chandrasekaran and M. Umaparvathi, Discrete Mathematics,PHI
3) Gary Haggard, John Schlipf and Sue Whitesides, Discrete Mathematics for Computer Science, CENGAGELearning
4) Gary Chartrand and Ping Zhang – Introduction to Graph Theory,TMH
5) J.K. Sharma, Discrete Mathematics,Macmillan
6) Winfried Karl Grassmann and Jean-Paul Tremblay, Logic and Discrete Mathematics, PEARSON.

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Introduction to Data Analytics and Visualization

Course Code	PC CS 410
Course Title	Introduction to Data Analytics and Visualization
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Basic linear algebra, calculus, introductory probability
Course Category	Program Core(PC)
Number of classes	36 hours

Course Outcome:

At the end of the course, the student will be able to:

CO Number	CO Description	K-level
CO-1	Explain and demonstrate various techniques for automatic data collection, data cleaning and exploration using visualizations	K2
CO-2	Understand modeling and analysis techniques for various types of datasets including e-commerce transactions, review datasets, time series datasets, text documents etc.	K2
CO-3	Evaluate different models and their strengths and weakness for a given dataset and task.	K3
CO-4	Select methods and create effective visualizations to explain the artifacts in the data, distributions of attributes, relationships between the attributes, efficacy of the models and predictions.	K3

Course Content:

Module 1: (9 Hours)

Scope and Significance, Understanding the various levels of data, dealing with categorical variable, quantifications of opinion and attitude of people, Primary data and Secondary data, Kinds of Data Analytics – Descriptive, Diagnostic, Predictive and Data Mining, Arrays and the Vectorized computation, Summarizing and Computing Descriptive Statistics, Binary Data & Formats. Interacting with Databases: Data Cleaning and Preparation, Handling the Missing Data, Data Transformation, string manipulation.

Module 2: (9 Hours)

Data Wrangling: Hierarchical Indexing, Combining and Merging Data Sets, Reshaping and the Pivoting. Data Aggregation and Group operations: Group by Mechanics, Data aggregation, the General split- apply-combine, Pivot tables and cross tabulation.

Module 3: **(9 Hours)**

Date and Time Data Types and Tools, Time series Basics, Data Ranges, Frequencies and Shifting, Time Zone Handling, Periods and Periods Arithmetic, Resampling and Frequency conversion, Moving window Functions. Categorical Data, Advanced Group By Use, Techniques for method chaining.

Module 4: Data Visualization **(9 Hours)**

Visualization Design, Multidimensional Data, Graphical Perception, Interaction dynamics for Visual Analysis, Using Space Effectively, Stacked Graphs, Geometry & Aesthetics. Networks, Graph Visualization and navigation in information Visualization, mapping & Cartography, Text Visualization

References / Suggested Learning Resources:

1. Skiena, Steven S, The Data Science Design Manual, CRC press
2. Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, Vipin Kumar, Introduction to Data Mining (Second Edition)
3. V.K. Jain, Data Science and Analytics (with Python, R and SPSS Programming), Khanna Book Publishing Company.
4. V.K. Jain, Big Data and Hadoop, Khanna Book Publishing Company, 2022.
5. Tamara Munzner, “Visualization Analysis and Design”, A K Peters/CRC Press; 1st edition (December 1, 2014)
6. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
7. Matthew O. Ward, Georges Grinstein, Daniel Keim, “Interactive Data Visualization: Foundations, Techniques, and Applications”, 2nd Edition, CRC press, 2015.

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Operating Systems

Course Code	PC CS 405
Course Title	Operating Systems
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Computer Basics
Course Category	Program Core(PC)
Number of classes	38 hours

Course Outcome:

At the end of the course, the student will be able to:

CO Number	CO Description	K-level
CO-1	Create processes and threads.	K3
CO-2	Develop algorithms for process scheduling for a specification of CPU utilization, Throughput, Turnaround Time, Waiting Time, and Response Time.	K4
CO-3	Develop the techniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time.	K4
CO-4	Implement file management functions in OS as part of a uniform device abstraction by performing operations for synchronization between CPU and I/O controllers.	K4

Course Content:

Module 1: (8 Hours)

Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS-Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System.

Module 2: (10 Hours)

Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching. Thread: Definition, various states, Benefits of threads, Types of threads, Concept of multithreads, Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling of criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR, Multiprocessor scheduling: Real Time scheduling: RM and EDF. Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution,

Strict Alternation, the Peterson's Solution, The Producer\ Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc.

Module 3: **(10 Hours)**

Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction; Paging: Principle of operation – Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging. Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault, Working Set, Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out(FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used(LRU)

Module 4: **(10 Hours)**

I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithm File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks

Suggested books:

1. Operating System Concepts Essentials, 9th Edition by Avi Silberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.
2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.
3. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin
4. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison Wesley
5. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India

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Natural Language Processing

Course Code	PC CS 411
Course Title	Natural Language Processing
Number of Credits	04 (L: 3, T: 1, P: 0)
Prerequisites	AI
Course Category	Program Elective-5
Number of classes	48 hours

Course Outcome:

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Explain the various challenges of NLP.	K2
CO-2	Implement a parser by providing suitable grammar and words.	K3
CO-3	Perform syntax and semantic analysis using language analysis tools.	K3
CO-4	Design the NLP applications.	K4

Course Content:

Module 1: (10 Hours)

Overview: Origins and challenges of NLP – Language and Grammar – Processing Indian Language – NLP Applications: Machine Translation – Information Extraction. Language Modeling: Introduction – Various Grammar-Based Language Models – Statistical Language Model

Module 2: (14 Hours)

English Word classes – Tag sets for English – Part-of-Speech Tagging – Rule based Part-of- Speech Tagging – Stochastic Part-of-Speech Tagging – Transformation-Based Tagging. Stemming – Context-Free Grammars for English: Constituency – Context Free Rules and Trees– Sentence Level Constructions – The Noun Phrase - Coordination – Agreement – The Verb Phase and Sub categorization – Auxiliaries – Spoken Language Syntax – Grammars Equivalence and Normal Form–Finite-State and Context-Free Grammars – Grammars and Human Processing.

Module 3: (14 Hours)

Parsing and Advanced Features: Parsing as Search – A Basic Top-Down Parser – Problems with the Basic Top-Down Parser – The Early Algorithm – Finite-State Parsing Methods. Features and Unification: Feature Structures – Unification of Feature Structures – Features Structures in the Grammar – Implementing Unification – Parsing with Unification Constraints – Types and Inheritance. Semantics Analysis and Lexical Semantics: Semantic Representing Meaning–Meaning Structure of Language – First Order Predicate Calculus – Semantic Analysis : Syntax-Driven

Semantic Analysis – Attachments for a Fragment of English – Integrating Semantic Analysis into the Early Parser–Idioms and Compositionality – Robust Semantic Analysis–Lexical Semantics: Relational among Lexemes and their Senses – Word Net: A database of Lexical Relations – The Internal Structure of Words.

Module 4: **(10 Hours)**

Manual Evaluation – Fluency and Adequacy – Other Evaluation Criteria – The Automatic Evaluation – Precision and Recall – F-Measure – Word Error Rate – Bilingual Evaluation Under study – METEOR – Multiple Reference Translations – Pearson's Correlation of Coefficient – Hypothesis Testing – Pair wise comparison – Task oriented Evaluation, Applications of NLP: NL Interfaces, Text Summarization, Sentiment Analysis, Machine Translation, Question answering. Recent Trends in NLP.

References / Suggested Learning Resources:

1. Jurafsky, Daniel, and James H.Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Speech Recognition, and Computational Linguistics", Prentice Hall,2000.
2. Christopher D. Manning and HinrichSchütze, "Foundations of Statistical Natural Language Processing". Cambridge, MIT Press, 1999.
3. James Allen, "Natural Language Understanding", Benjamin/Cummings, 2ed, 1995.
4. Eugene Charniak, "Statistical Language Learning", MIT Press, 1996.
5. Martin Atkinson, David Britain, Harald Clahsen, Andrew Redford, "Linguistics",Cambridge University Press,1999.
6. P.Lieberman, "Toward an evolutionary biology of language", Harvard University Press, 2006.
7. Philipp Koehn, “Statistical Machine Translation”, 1st Edition, Cambridge University Press, January2010.
8. TanveerSiddiqui,U.S.Tiwary,“NaturalLanguageProcessingandInformationRetrieval”,3rd Edition, Oxford University Press
9. Nitin Indurkhya, Fred J. Damerau, “Handbook of Natural Language Processing”, 2ed, CRC Press, 2010.

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Java Programming Lab

Course Code	PC CS 412
Course Title	Java Programming Lab
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	ES 208 (Programming for Problem Solving Lab)
Course Category	Program Core(PC)
Number of classes	48 hours

Course Outcome:

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Apply Object oriented features and Java concepts.	K3
CO-2	Apply the concept of multithreading and implement exception handling.	K3
CO-3	Compare the development of JAVA applets vs. JAVA applications.	K4
CO-4	Develop program to access data from a Database with java program.	K6

List of Experiments (*Minimum 10 experiments are to be performed. Use of virtual laboratory to perform few experiments may be explored, if available****):***

1. Write a program to swap two values using method.
2. Writeaprogramtodemonstratemethodoverloadingbydefiningtwodifferentpa rametersin the same method.
3. Write a program to demonstrate Java Package.
4. Writeaprogramtoperformcalculationbasedonnumbersandoperatorentered.
5. Write a program to sum the elements of an array and determine the max element.
6. Write a program to add two matrices of the same size
7. Write three differentprogramstoshowusageofdefaultandparameterizedconstructor.
8. Write a program to find area and volume of a rectangle using constructor.
9. Write a program to determine the volume of a room using inheritance.
10. Write a program to demonstrate the use of super key word with a variable.
11. Write a program to calculate the area of circle and sphere using interface.
12. Write a program to demonstrate the usage of Runtime Polymorphism in java.
13. Write a program to demonstrate applet using applet viewer in java.

14. Write a program to demonstrate Digital clock in Applet.
15. Write a program to demonstrate JText area using java swing.
16. Write a program to demonstrate JCombo using java swing.
17. Write a program to demonstrate JTable using java swing.
18. Write a program to creating Edit menu for Notepad using java swing.
19. Write a program to Connect Java Application with mysql database.
20. Write a program to demonstrate transaction management in Jdbc using Prepared Statement.

References / Suggested Learning Resources:

1. Introducing Java 8 Author: by Raoul-Gabriel Urma.
2. Object-Orientedvs.FunctionalProgrammingAuthor:byRichardWarburton
3. Data Structures and Algorithm Analysis in Java (3rdEdition) by Mark Allen Weiss, Addison Wesley,(2011).
4. Deitel&Deitel,JAVA:HowtoProgram,Pearsoneducation,7e(2008)
5. IvanBayRoss,WebEnabledCommercialApplicationusingJava2,bpbpublication(1998)

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Operating Systems Lab

Course Code	PC CS 408
Course Title	Operating Systems Lab
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Computer Basics
Course Category	Program Core (PC)
Number of classes	24 hours

Course Outcome:

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Implement deadlock avoidance, and Detection Algorithms	K3
CO-2	Create processes and implement IPC	K3
CO-3	Compare the performance of various CPU scheduling Algorithm	K4
CO-4	Analyze the performance of the various page replacement algorithms	K4
CO-5	Implement C programs using Unix system calls	K4

List of Experiments (*Minimum 6 experiments are to be performed. Use of virtual laboratory to perform few experiments may be explored, if available****):***

1. Basics of UNIX commands.
2. Shell Programming- creating a bash shell script, making a script executable, shell syntax (variables, conditions, control structures, functions, commands)
3. Password security, Shadow file, Groups and the group file, Shells, restricted shells, user- management commands, homes and permissions, default files, profiles, locking accounts, setting passwords, Switching user, Switching group, Removing users & user groups.
4. Implement the following CPU scheduling algorithms a) Round Robin b) SJF c) FCFS d) Priority
5. Implement all file allocation strategies a) Sequential b) Indexed c)Linked
6. Implement Inter-process communication-pipes (use functions pipe, popen, pclose), named pipes (FIFOs, accessing FIFO), message passing & shared memory (IPC version V).
7. Implement Semaphores
8. Implement all File Organization Techniques:
   a) Single level directory b)Two level c) Hierarchical d)DAG
9. Implement Bankers Algorithm for Dead Lock Avoidance
10. Implement an Algorithm for Dead Lock Detection
11. Implement e all page replacement algorithms a) FIFO b) LRU c)LFU
12. Implement Shared memory and IPC
13. Implement Paging Technique of memory management.
14. Implement Threading & Synchronization Applications
15. Implement disk management algorithms-FCFS, SSTF, SCAN,C-SCAN

SUGGESTED TEXT BOOKS:

1. Operating System Principles- Abraham Silberchatz, Peter B. Galvin, Greg Gagne 7th Edition, John Wiley
2. Advanced programming in the Unix environment, W.R. Stevens, Pearson education.

REFERENCE BOOKS:

1. Operating Systems – Internals and Design Principles, William Stallings, Fifth Edition– 2005, Pearson Education/PHI
2. Operating System - A Design Approach-Crowley, TMH.
3. Modern Operating Systems, Andrew S Tanenbaum, 2nd edition, Pearson/PHI
4. UNIX Programming Environment, Kernighan and Pike, PHI/Pearson Education
5. UNIX Internals: The New Frontiers, U. Vahalia, Pearson Education

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Web Technology Lab

Course Code	PC CS 413
Course Title	Web Technology Lab
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	ES 208(Programming for Problem Solving Lab)
Course Category	Program Core(PC)
Number of classes	24 hours

Course Outcome:

After completion of the course, students will be able to:

CO No	CO Description	K-level
CO-1	Utilize JavaScript to create functional forms	K3
CO-2	Utilize PHP and database connectivity to create dynamic website.	K3
CO-3	Utilize XML to access information methodically	K3
CO-4	Apply the HTML, CSS, XML, Java Script and protocols to build websites.	K4

List of Experiments (*Minimum 6 experiments are to be performed. Use of virtual laboratory to perform few experiments may be explored, if available****):***

1. To create a simple html file to demonstrate the use of different tags.
2. To create an html file to link to different html page which contains images, tables, and also link within a page.
3. To create a registration form.
4. To create an html file by applying the different styles using inline, external &internal style sheets.
5. To write a JavaScript program to define a user defined function for sorting the values in an array.
6. To create an html page to explain the use of various predefined functions in a string and math object in javascript.
7. To create an html page to explain the use of various predefined functions in a array& Date object in JavaScript.
8. To create an html page to demonstrate exception handling in JavaScript.
9. To create a html registration form and to validate the form using JavaScript code.

10. To create a CD catalog using XML file.

11. To create external style sheet and using the style sheet in XML file.

12. To create a xml style sheet to display the data in the xml using html table.

13. To create a php program to demonstrate the different file handling methods.

14. To create a php program to demonstrate the different predefined function in array, Math, Data & Regular Expression.

15. Write a program to introduce file.

16. Write a program to show database connectivity.

17. Install WordPress.

18. Working with the plugins in WordPress.

References / Suggested Learning Resources:

1. Deitel &Deitel, Internet and World Wide Web How to Program, Pearson education, 3e,(2005)

2. HTML & XHTML: The Complete Reference, Thomas A. Powell, McGrawHill

3. Learning Perl, by R.L. Schwartz, B.D Foy, T. Phoenix, O'Reilly

4. Perl Black Book, by Steven Holzner, DreamTech

5. Learning PHP, MySQL & JavaScript with j Query, CSS & HTML5, by Robin Nixon, O'Reilly

6. JavaScript: The Good Parts, O'Reilly

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Data Analytics and Visualization Lab

Course Code	PC CS 414
Course Title	Web Technology Lab
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Data Analytics And Visualization Theory With (Programming for Problem Solving Lab)
Course Category	Program Core(PC)
Number of classes	24 hours

Course Outcome:

After completion of the course, students will be able to:

CO No	CO Description	K-level
CO-1	Explain various techniques for automatic data collection, data cleaning and exploration using visualizations.	K2
CO-2	Apply modeling and analysis techniques for various types of datasets including e-commerce transactions, review datasets, time series datasets, text documents etc.	K3
CO-3	Implement data collection, data cleaning and exploration techniques in a programming language.	K3
CO-4	Evaluate different models and their strengths and weakness for a given dataset and task.	K3
CO-5	Select methods and create effective visualizations to explain the artifacts in the data, distributions of attributes, relationships between the attributes, efficacy of the models and predictions.	K3
CO-6	Become proficient in data analysis tasks involving real-life datasets with noise	K3

List of Experiments (*Minimum 6 experiments are to be performed. Use of virtual laboratory to perform few experiments may be explored, if available****):***

1. Learn how to collect data via web-scraping, APIs and data connectors from suitable sources as specified by the instructor.

2. Perform various types of data cleaning operations on the data collected in previous lab using data exploration, imputation etc.

3. Perform dimensionality reduction on a given dataset and create various visualizations like histograms, scatter-plots, etc.

4. Perform association analysis on a given dataset and evaluate its accuracy.

5. Build a recommendation system on a given dataset and evaluate its accuracy.

6. Build a time-series model on a given dataset and evaluate its accuracy.

7. Build cartographic visualization for multiple datasets involving various countries of the world; states and districts in India etc.

8. Perform text mining on a set of documents and visualize the most important words in a visualization such as word cloud.

References / Suggested Learning Resources:

1. Skiena, Steven S, The Data Science Design Manual, CRC press
2. Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, Vipin Kumar, Introduction to Data Mining (Second Edition)
3. V.K. Jain, Data Science and Analytics (with Python, R and SPSS Programming), Khanna Book Publishing Company.
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5. Tamara Munzner, “Visualization Analysis and Design”, A K Peters/CRC Press; 1st edition (December 1, 2014)
6. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
7. Matthew O. Ward, Georges Grinstein, Daniel Keim, “Interactive Data Visualization: Foundations, Techniques, and Applications”, 2nd Edition, CRC press, 2015

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