

COMPUTER SCIENCE & ENGINEERING, UEC, UJJAIN.

Syllabus for Four Years Bachelor of Technology Degree Course as per NEP-2020

July-2024

S U B J E C T		Exam Duration	Contact Hours per Week			Credits	Max. Marks	Min Pass Marks
Code	Title		L	T	P			
CS-4401	Operating System	3 Hours	3	1	2	4 + 1	70	22

Course Description : This course will provide an introduction to operating system design and implementation. The course starts with evolution and then covers the major components of operating systems. The discussion will cover the tradeoffs that can be made between performance and functionality during the design and implementation of an operating system. Particular emphasis will be given to three major OS subsystems: process management (processes, threads, CPU scheduling, synchronization, and deadlock), memory management (segmentation, paging swapping) and file systems. Linux/Unix and their shell programming.

Course Objectives :

- To learn the fundamentals of Operating Systems functions, features and services.
- To understand the concepts of process and resource management
- To understand the memory hierarchy, memory technologies and memory management.
- To apply the commands on Linux/Unix system.
- To analysis the operating system performance through appropriate abstraction of CPU memory, files, processes etc.

UNIT - I :

Operating System Introduction : Operating systems objectives, functions, architecture, structures, operations, Evolution. Services, Design and Implementation issues. System calls, system programs, virtual machine.

UNIT - II :

Process Management : Process concept, Inter process communication, multithreading-concepts, issues, examples CPU scheduling: concepts, performance, criteria, algorithms, multiprocessor scheduling.

UNIT - III :

Process Coordination : Critical section problem, software and hardware solutions, semaphores, monitors, atomic transactions, classical synchronization problems. Deadlock: characterization, Prevention, Avoidance and Detection, Recovery, combined approach to handle deadlocks.

UNIT - IV :

Memory Management and File Systems : Memory management Virtual Memory concepts Partitioning, Paging. Segmentation, page replacement, cache memory organization. File system: File organization and access mechanism, File Directories, File sharing and implementation issues.

UNIT - V :

LINUX/UNIX Systems : History and evolution, Design Principals. Process management and scheduling, memory management, file systems, IPC. System calls, Shell Programming.

1 Hour Lecture (L) = 1 Credit 1 Hour Tutorial (T) = 1 Credit 2 Hours Practical (P) = 1 Credit

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Course Outcomes :

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

- Gain an insight into how programming languages, operating systems and architectures interact and provide an environment to the user.
- Analysis the tradeoffs that can be made between performance and functionality during the design and implementation of an operating system.
- Demonstrate about different functions of operating system i.e. Process Management, resource management.
- Be able to conceptualize the components involved in designing a contemporary Operating system.

Text Books :-

1. Operating System Concepts. By Silberschatz and Galvin, Wiley India, 8th edition.
2. Operating System. By William Stallings, Pearson Education, 6th edition.

Reference Books :-

1. Modern Operating Systems, By Andrew S. Tanenbaum, Pearson Education, 4th Edition.
2. Operating System, By Achyut S Godbole and Atul Kahate, TMH. 3rd edition.
3. Operating Systems a Concept Based Approach, By Dhananjay Dhamdhare, TMH, 3rd edition.

Suggested List of Experiments :-

- (1) Basics of LINUX/UNIX commands.
- (2) Write a program to study basic and user status commands in Linux.
- (3) Write a program to find greatest number among the given numbers.
- (4) Write a program to find the factorial of a number.
- (5) Write a program to find the leap year among the given years.
- (6) Write a program to develop a calculator or a switch case.
- (7) Implementation of CPU scheduling a) Round Robin b) SJF c) FCFS d) Priority.
- (8) Implement all file allocation strategies.
- (9) Implement Semaphores.
- (10) Implement II File Organization Techniques a.
- (11) Implement Bankers algorithm for Dead Lock Avoidance.
- (12) Implement an Algorithm for Dead Lock Detection.
- (13) Implement the all page replacement algorithms : (a) FIFO (b) LRU (c) LFU.
- (14) Implement Shared memory and IPC.
- (15) Implement Paging Technique f memory management.

****These are the General List of Experiments & the list of Experiments may vary as per course Instructor.***

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S U B J E C T		Exam Duration	Contact Hours per Week			Credits	Max. Marks	Min Pass Marks
Code	Title		L	T	P			
CS-4402	Analysis and Design of Algorithm	3 Hours	2	1	2	3 + 1	70	22

Course Description : The course emphasizes the relationship between algorithms and programming, and introduces basic performance measures and analysis techniques for algorithms. Also it introduces the classic algorithms in various domains.

Course Objectives :

- To learn the fundamental techniques for effective problem solving in computing.
- To understand the different algorithmic design strategies.
- To analysis the performance of algorithms using time and space complexity theory.
- To explain different computational models (e.g., divide-and-conquer), order notation and various complexity measures (e.g., running time, disk space).

UNIT - I :

Introduction : Algorithm's specification and performance analysis, asymptotic notations. Recursion and Recurrence relation.

Divide-and-Conquer Method : The general method, application to binary search, merge sort, quick sort. Strassen's matrix multiplication.

UNIT - II :

Greedy Method : Study of Greedy strategy, and algorithms based on greedy method like Fractional Knapsack problem, Prim's algorithm, Dijkstra's algorithm, optimal merge patterns, Huffman coding, activities selection, and job sequencing.

UNIT - III :

Dynamic Programming : Dynamic Programming (DP) the general method, DP and Recursion, DP and Divide & Conquer, application of DP to multistage graphs, all pair shortest paths, optimal binary search trees, 0/1-Knapsack problem, travelling salesman problem, and Floyd-Warshall algorithm.

UNIT - IV :

Backtracking & Branch and Bound :

Backtracking : The general method, State space tree, DFS. Backtracking application to Maze problem, N queens problem, Coloring map problem, and Hamiltonian path problem.

Branch and Bound : The general method and traversing the search space. Application to Job assignment problem, traveling salesman problem, and 0/1 Knapsack problem.

UNIT - V :

Hashing and P-NP Problems :

Hashing : Introduction, Hash table structure, Hash functions, Linear Open Addressing, Chaining.

P-NP Problems : Introduction and basic concepts, non-deterministic turing machine, the classes of P, NP, NP-hard, and NP-Complete problems.

1 Hour Lecture (L) = 1 Credit 1 Hour Tutorial (T) = 1 Credit 2 Hours Practical (P) = 1 Credit

Contd. ... 2

Course Outcomes :

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

- Analyze the asymptotic performance of algorithms.
- Understand basic algorithm designing techniques with their strength and weaknesses.
- Analyze and compare the efficiency of algorithms with space requirement for the same.
- Explore various research problems in algorithm like NP-hard and NP-complete problems.
- Synthesize efficient algorithms in common engineering design situations.

Text Books :-

1. Algorithms , by Dasgupta ,TMH, 1st edition.
2. Algorithms Design and Analysis by Udit Agarwal ,Dhanpat Rai Publications, 6th edition.

Reference Books :-

1. Introduction to Algorithms, by Cormen Thomas,Leiserson CE, Rivest RL, PHI, 3rd edition.
2. Analysis & Design of Algorithm, by Ullmann , 1st edition.
3. Algorithm Design by Michael T Goodrich, Roberto Tamassia, Wiley India , 3rd edition.
4. Analysis & Design of Algorithm, by Horowitz & Sahani , 2nd edition.

List of Experiments :-

- (1) Implement the following using array as data structure and analyze its time complexity :
(a) Quick sort (b) Merge sort (c) Heap sort.
- (2) Implement Linear and Binary search and analyze time complexity.
- (3) Implement following algorithms with Greedy approach and analyze its time complexity:
(a) Prim's algorithm to find MSP (b) Dijkstra's Single source shortest path algorithm
(c) Huffman prefix coding (d) Job selection and Activity selection.
- (4) Implement following algorithms with Dynamic programming and analyze time complexity:
(a) Single pair shortest path e.i. source to destination,
(b) Travelling Salesman problem,
(c) All pair shortest path problem by Floyd-Warshall.
- (5) Implement DFS, Hamiltonian Cycle, and 4 Queens problems using Back tracking and analyze their time complexity.
- (6) Implement Single pair shortest path, Job assignment, and Travelling sales man problems using Branch & Bound technique and analyze their time complexity.

**These are the General List of Experiments & the list of Experiments may vary as per course Instructor.*

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S U B J E C T		Exam Duration	Contact Hours per Week			Credits	Max. Marks	Min Pass Marks
Code	Title		L	T	P			
CS-4403	Computer Organization and Architecture	3 Hours	3	1	0	4 + 0	70	22

Course Description : Students will learn the concepts of computer organization for several engineering computing systems. The course emphasizes on instruction set design, pipelining, memory technology, memory hierarchy, virtual memory management, and I/O systems.

Course Objectives :

- Understand the basic principles on which computers work, analyze their performance and appreciate the issues affecting modern processors.
- Understand concepts of register transfer logic and different operations.
- Explain different types of addressing modes and memory organization.
- Summarize the Instruction execution stages and Pipelining.

UNIT - I :

Computer Basics and CPU : Von Newman model, various subsystems, CPU, Memory, I/O, System Bus, CPU and Memory registers. Program Counter, Accumulator, Instruction register, Micro operations, Register Transfer Language, Instruction Fetch, decode and execution, data movement and manipulation, Instruction formats and addressing modes of basic computer, 8085 microprocessor organization.

UNIT - II :

Control Unit Organization : Hardwired control unit. Micro and Nano programmed control unit, Control Memory, Address Sequencing. Micro Instruction formats, Micro program sequencer. Microprogramming, Arithmetic and Logic Unit: Arithmetic Processor, Addition, subtraction, multiplication and division. Floating point and decimal arithmetic, arithmetic units, design of arithmetic unit.

UNIT - III :

Input Output Organization : Modes of data transfer-program controlled, interrupt driven and direct memory access, Interrupt structures, I/O Interface. Asynchronous data transfer, I/O processor, 8085 I/O structure, 8085 instruction set and basic programming. Data transfer-Serial /parallel, synchronous/asynchronous, simplex/half duplex and full duplex.

UNIT - IV :

Memory Organization : Memory Maps, Memory Hierarchy, Cache Memory - Organization and mappings. Associative memory, Virtual memory. Memory Management Hardware.

UNIT - V :

Multiprocessors : Pipeline and Vector processing, Instruction and arithmetic pipelines, Vector and array processors, Parallel architecture: On-chip parallelism, Interconnection structure and inter-processor communication.

1 Hour Lecture (L) = 1 Credit 1 Hour Tutorial (T) = 1 Credit 2 Hours Practical (P) = 1 Credit

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Course Outcomes :

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

- Understand the theory and Basic architecture of CPU.
- Understanding of different number systems, binary addition and subtraction, 2's complement representation and operations with this representation.
- Analysis of different mode of transfer.
- To explain the function of each element of a memory hierarchy.
- Learn the concepts of parallel processing, pipelining and inter processor communication.

Text Books :-

1. Morris Mano; Computer System Architecture, PHI.
2. Tanenbaum: Structured Computer Organization, Pearson Education.
3. William Stallings: Computer Organization and Architecture, PHI.

Reference Books :-

1. J.P. Hayes, Computer Architecture and Organizations, Mc Graw Hills, New Delhi.
2. Gaonkar : Microprocessor Architecture, Programming. Applications with 8085; Penram Int.
3. ISRD group: Computer Organization; TMH.
4. Carter, Computer Architecture (Schaum); TMH 8. Carl Hamacher: Computer Organization, TMH.

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CS-4404	Database Management System	3 Hours	3	1	2	4 + 1	70	22

Course Description : A database management system (DBMS) is designed to manage a large body of information. This course is Emphasis on data dictionaries, normalization, data integrity, data modeling, and creation of simple tables, queries, reports, and forms. Upon completion, students should be able to design and implement normalized database structures by creating simple database tables, queries, and reports.

Course Objectives :

- To understand the basic concepts and the applications of database systems.
- To master the basics of SQL and construct queries using SQL.
- To understand the relational database design principles.
- To become familiar with the basic issues of transaction processing and concurrency control.

UNIT - I :

DBMS Concepts and Architecture : Introduction, Database approach v/s Traditional file accessing approach. Database schemas and Instances. Database users, functions of DBA and database Designer. Various data models, basic concepts of Hierarchical data model, Network data model, and Relational data model.

UNIT - II :

ER Data Model : Entity and attributes, Entity types, E-R diagram. Generalization, Aggregation and Specialization. Transforming the ER diagram into the tables. Relational Data models : Domains, Tuples, Attributes, Relations, Characteristics of relations, Key attributes of relation, Types of Keys. Relational database schemas, Integrity constraints (Referential integrity, Intension, and Extension). Data independence.

UNIT - III :

Relational Algebra, Relational Calculus and SQL : Relational algebra operations like select, Project, Join, Division, outer union. Types of relational calculus i.e. Tuple oriented and domain oriented relational calculus and its operations. Relational Query languages : SQL- DDL, DML. Complex queries, various joints, indexing, triggers and views.

UNIT - IV :

Normalization : Introduction to normalization, Normal forms. Functional dependency. Decomposition, Dependency preservation, and lossless and lossy join. Query processing and Query Optimization.

UNIT - V :

Transaction Processing : Transaction System, Testing of Serializability, Serializability of schedules, conflict & view serializable schedule, recoverability.

Concurrency Control : locking Techniques for concurrency control, time- stamping protocols for concurrency control, validation based protocol. Recovery with the concurrent transaction.

1 Hour Lecture (L) = 1 Credit 1 Hour Tutorial (T) = 1 Credit 2 Hours Practical (P) = 1 Credit

Contd. ... 2

Course Outcomes :

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

- Evaluate business information problem and find the requirements of a problem in terms of data.
- Understand the uses of the database schema and the need for normalization.
- Design the database schema with the use of appropriate data types for storage of data in the database.
- Apply and relate the concept of transaction, concurrency control and recovery in database.
- Identify the purpose of query processing and optimization and also demonstrate the basis of query evaluation.

Text Books :-

1. Date CJ. "An Introduction to Database System". Pearson Educations.
2. Korth, Silbertz Sudarshan, "Fundamental of Database System", McGraw Hill.

Reference Books :-

1. Understanding SQL by Martin Gruber, BPB.
2. An introduction to Database Systems, CJ Date. Addition-Wesley.

List of Experiments :-

- (1) Design a Database and create required tables. For e.g. Bank, College Database.
- (2) Apply the constraints like Primary Key, Foreign key, NOT NULL to the tables.
- (3) Write a SQL statements for implementing ALTER.UPDATE and DELETE.
- (4) Write the queries to implement the joins.
- (5) Write the query for implementing. The following functions: MAX, MIN, AVG, COUNT.
- (6) Write the query to implement the concept of Integrity constraints.
- (7) Write the query to create the views.
- (8) Perform the queries for triggers.
- (9) Perform the operations for demonstrating the insertion, updation, and deletion using the referential integrity constraints.
- (10) Write the query for creating the users and their role.

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S U B J E C T		Exam Duration	Contact Hours per Week			Credits	Max. Marks	Min Pass Marks
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CS-4405	Python Programming for Data Analysis	3 Hours	3	1	2	4 + 1	70	22

Course Description : The goal of this course is to provide students with an understanding of basic concepts of Python Programming Language along with its features and application areas. This course provides a concise introduction to the python for data analysis. Learn various tools and programming language prevalent in solving real world problems related to data analysis.

Course Objectives : To be able to introduce core programming basics of Python programming language. To demonstrate about Python data structures like Lists, Tuples, Sets and dictionaries. To understand about Functions, Modules and Regular Expressions in Python Programming. To be able to choose appropriate machine learning techniques to solve problems.

UNIT - I :

Introduction to Python and history of Python, Unique features of Python, Install Python and Environment Setup, First Python Program, Identifiers, Keywords. Data types and various operators used in python. List, Set, Dictionary, Tuple, Understanding Iterators, Generators, Ranges. If-else Statements, Looping Statements.

UNIT - II :

Numpy : Introduction to Numpy, Creating arrays, Indexing Arrays, Array Transposition, Universal Array Function. Python built in function: Python objects and Functions, Number and Maths. Python user defined functions.

UNIT - III :

Pandas : Introduction of pandas, Series in pandas, Index objects, Reindex, Drop Entry, Selecting Entries, Data Alignment, Ranking and Sorting, Index hierarchy. Case study using pandas.

UNIT - IV :

Introduction of Data analysis, Importance of data analysis, Techniques of data analysis, application of data analysis. Data Pre-processing using Python : Data Cleaning, Data Integration and Transformation. Data Reduction, Statistical analysis of data.

UNIT - V :

Python built in Modules and Packages used for data analysis, Module used for Supervise Learning, Module used for Unsupervised Learning. Data Visualization using Matplotlib.

Course Outcomes :

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

- Apply the principles python programming.
- Write clear and effective python code.
- Create applications using python programming.
- Implementing database using SQL.
- Access database using python programming.

1 Hour Lecture (L) = 1 Credit 1 Hour Tutorial (T) = 1 Credit 2 Hours Practical (P) = 1 Credit

Text Books :-

1. Learning Python, Mark Lutz, Orielly, 3 Edition 2007.
2. Python Programming: A Modern Approach, Vamsi Kurama, Pearson, 2017.

Reference Books and Websites :-

1. Think Python, 2 Edition, 2017 Allen Downey, Green Tea Press.
2. Core Python Programming, 2016 W.Chun, Pearson.
3. Introduction to Python, 2015 Kenneth A. Lambert, Cengages.
4. https://www.w3schools.com/python/python_reference.asp
5. <https://www.python.org/doc/>

List of Experiments :-

- (1) Write a program to perform different Arithmetic Operations on numbers in Python.
- (2) Write python program to show use of conditional statement.
- (3) Write a python program to swap two variables without using third variable.
- (4) Write python program to print list of numbers using for loop.
- (5) Write a python program to find factorial of a number using python function.
- (6) Write python program to store strings in list and then print them.
- (7) Write a program to create, append, and remove lists in python.
- (8) Write a program to demonstrate working with tuples in python.
- (9) Write a program to demonstrate working with dictionaries in python.
- (10) Create a list and perform the following methods :
(a) insert (b) remove (c) append (d) len (e) pop (f) clear.
- (11) Write a program to display the multiplication table using python.
- (12) Write a python program to create 3D array using numpy.
- (13) Write a python program to create an empty and a full numpy array.
- (14) Write a python program to demonstrate the use of Data Frame using a data set.
- (15) Write Python programs to demonstrate following with visualization (using a data set):
(a) Data Preprocessing (b) Bayes Classification
(c) kNN classification (d) k-Mean clustering.

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Code	Title		L	T	P			
CS-4406	Linux Shell Scripting Lab	-	0	0	2	0 + 1	-	-

Course Objectives : Upon completion of the course, students will be able to answer the following questions :

- Why are Linux skills essential?
- How do you use the Linux shell to manipulate text files?
- How does a Linux administrator locate and manipulate security log files?
- How do you manage the Linux file system and permissions?
- What are the basic components of the Linux GUI?

UNIT - I :

Concepts, Unix/Linux Installation Process, Hardware Requirements for Unix/Linux, Advantages of Unix/Linux, Reasons for Popularity and Success of Linux/Unix Operating System, Features of Linux/Unix Operating System, Kernel, Kernel Functions, The Shell Basic Commands,

UNIT - II :

Linux Shell : Shell Variables, Branching Control Structures, Loop-Control Structure, Continue and break Statements, Sleep Command, Debugging Script, Viewing a Process, Command to display Process.

UNIT - III :

Physical Security, Controlling System Access, Restricted Shells Controlling File Access, File Access Commands, Access Control List (ACLs), Setting ACL Entries.

UNIT - IV :

GNU text editor using sudo, apt, update, install, yum, nano commands, GUI text editors, Multi-file editing, Syntax highlighting.

UNIT - V :

Case Study : Installation of Linux, Customization of Linux, Installation of SAMBA, APACHE, TOMCAT, Send MAIL.

Course Outcomes :

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

- Apply the principles python programming.
- Write clear and effective python code.
- Create applications using python programming.
- Implementing database using SQL.
- Access database using python programming.

Text Books :-

1. Learning Python, Mark Lutz, Orielly, 3 Edition 2007.
2. Python Programming: A Modern Approach, Vamsi Kurama, Pearson, 2017.

1 Hour Lecture (L) = 1 Credit 1 Hour Tutorial (T) = 1 Credit 2 Hours Practical (P) = 1 Credit

Contd. ... 2

Reference Books and Websites :-

1. Venkatesh Murthy, "Introduction to Unix & Shell", Pearson Edu.
2. Forouzan, "Unix & Shell Programming", Cengage Learning.
3. Sumitab Das, "Unix Concept & Application", TMH.
4. Gopalan, Shivaselvan, "Beginners Guide to Unix " PHI Learning.
5. Venkateshwavle, "Linux Programming Tools Unveil'ed", BS Publication.
6. Richard Peterson, "Linux Complete Reference", TMH

List of Experiments / Programs :-

- Program-1 : About Linux .
- Program-2 : Installation of Linux .
- Program-3 : Various commands in Linux min 10 commands
- Program-4 : Use of GNU editor tp
WTP to print your name using GNU nano text editor.
WTP for addition using GNU nano text editor.
WTP for bubble sort using GNU nano text editor.
- Program-5 : Illustrations of different commands for accessing data :
- Program-6 : Writing a program using Gnome editor in Linux.
- Program-7 : WTP for printing name using shell programming
- Program-8 : WTP for addition of two number using shell programming
- Program-9 : WTP to illustrate if else using shell programming
- Program-10 : WTP to illustrate logical AND and logical OR operation using shell programming
- Program-11 : WTP to find sum of digit using shell
- Program-12 : WTP to find odd / even number using shell
- Program-13 : WTP to reverse a number using shell
- Program-14 : WTP to find lexicographical larger string using bash
- Program-15 : WTP to create a calculator using shell.
- Program-16 : WTP for Fibonacci series using shell
- Program-17 : WTP to draw pyramid pattern using shell
- Program-18 : WTP to make a mark sheet of a student using shell
