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| **Pokhara University**  **Faculty of Science and Technology** | |
| Course Code.: CMP 230 (3 Credits) | Full Marks: 100 |
| Course Title: Operating Systems (3-0-1) | Pass Marks: 45 |
| Nature of the Course: Theory/Practical | Total Lectures: 48 hours |
| Level: Bachelor | Year: II / Semester: III | Program: Bachelor of Computer Application |

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| **1. Course Description:** | |
| This course is designed to provide the concepts of operating system to various system environments. It incites system software, internal structures, functions and security features of operating system to run the application software and perform various tasks with optimized throughput. This course also introduces the emerging new trended operating system for distributed environment like cloud and mobile systems. After completion of this course, students can select, apply and implement the operating system features and functions for the best utilization of the device specification. | |
| **2. General Objectives**: | |
| The general objectives of this course are as follows:   * + To acquaint the students with structure of operating systems and their functionality.   + To acquaint the students with concepts of resource allocation and management with schedules.   + To acquaint the students with the knowledge of process and thread, I/Os, Memory, CPU, disk management, network security systems.   + To acquaint the students with basic concepts of operating systems new trends such as real-time, distributed, cloud systems and mobile. | |
| **3.** **Methods of Instructions:**   * + Lecture and discussion   + Practical   + Demonstration   + Case studies | |
| **4. Course Contents:** | |
| **Specific Objectives** | **Contents** |
| **Unit 1: Basics of Operating System 6 hours** | |

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| * Familiarize with basic concepts of Operating systems, and its structures. * Explain the features of generation and types of operating systems. | * 1. Introduction, goals of operating system   2. Operating-System Structures and functions   1.3 Types of Operating Systems  *Batch Processing, Multiprogramming, Multiprocessing, Networking, Real Time (RTOS), Distributed, Embedded system*  1.4 System Interface, System Calls  1.5 Virtual Machine |

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| **Unit 2: Process, Threads and Scheduling 13 hours** | | |
| * Familiarize with task, process and threads * Implement of resource allocation techniques * Describe the mutual exclusion for resource utilization | **2.1 Process**  2.1.1 The Process Model  2.1.2 Process Creation and Process Termination  2.1.3 Process Hierarchies  2.1.4 Process States  2.1.5 Implementation of Processes  **2.2 Threads**  2.2.1 Thread Usage  2.2.2 Threads Models (Many-to-one model, One-to-One Model, Many-to many model)  2.2.3 User Space and Kernel Space Threads  2.2.4 Hybrid Implementations  2.2.5 Difference between Threads and Processes  **2.3 Inter-process Communication**  2.3.1 Race Conditions  2.3.2 Critical Regions  2.3.3 Mutual Exclusion with Busy Waiting  2.3.4 Sleep and Wakeup, Semaphores, Mutexes, Monitors, Message Passing  2.3.9 Avoiding Locks: Read-Copy-Update  **2.4 Process Scheduling**  2.4.1 Basic Concept  2.4.2 Type of scheduling (Preemptive scheduling, Non-preemptive scheduling, batch, Interactive, real time scheduling),  2.4.3 Scheduling Criteria or performance analysis, Scheduling Algorithm (Round-robin, First come first served, Shortest-job- first, Shortest process next, Shortest remaining Time next, real time, priority fair share, guaranteed, Lottery scheduling)   * 1. **Deadlocks**       1. System Resources: Preemptable and Non-preempable      2. Method of handling Deadlocks,      3. Deadlock prevention      4. Deadlock avoidance: Banker’s Algorithm,      5. Protection- *System Protection, Goals of Protection, Principles of Protection, Domain of Protection, Access Matrix, Implementation of Access Matrix, access Control list*   2. Research on Processes and Threads | |
| **+ Unit 3: Storage Management 13 hours** | | |
| * Explain the role and working procedure of memory * Familiarizing with virtual memory management * Implement the page replacement algorithms * Explain the mechanism file and filing | **3.1 Memory Management**  3.1.1 Logical & physical Address Space  3.1.2 Swapping  3.1.3 Contiguous Allocation  3.1.4 Paging, Structure of Page Table  3.1.5 Segmentation, Segmentation with Paging  **3.2 Virtual Memory**  3.2.1 Background  3.2.2 Demand Paging,  3.2.3 Performance of Demanding Paging,  3.2.4 Page Replacement, Page Replacement Algorithms, Allocation of Frames,  3.2.5 Thrashing.  **3.3. File System Interface and Implementation**  3.3.1 File System Interface- *The Concept of a File, Access methods, Directory Structure, File System Mounting, File Sharing, Protection*  3.3.2 File System Implementation- *File System Structure, File System Implementation, and Allocation methods, Free-space Management, Directory Implementation, Efficiency and Performance* | |
| **Unit 4: Input/output Management 7 hours** | | |
| * Describe the role of input/output devices * Explain the different approaches for optimal output | 4.1 Principles of I/O Hardware- *I/O Device, Device Controller, Memory Mapped I/O, Direct Memory Access*  4.2 Principles of I/O Software- *Goals of I/O Software, Polled I/O verses Interrupt Driven I/O, Character User Interface and Graphical User Interface, Device Driver, Device Independent I/O Software, User-space I/O Software*  4.3 Mass Storage Structure - Overview of Mass Storage Structure, Disk Structure, Disk Attachment, Disk Scheduling, Disk Management, Swap space Management Redundant Array of Inexpensive Disks , RAM Disks, Optical Disk | |
| **Unit 5: New Trend in Operating System 4 hours** | | |
| * Familiarize with current trends of operating systems | * 1. Concept, character and role of Distributed, Cloud, Mobile and Multimedia operating systems   2. Memory wall and bottleneck for operating system | |
| **Unit 6: Case Study** | | **5 hours** |
| * Compare operating system structure and functionality | * 1. **UNIX/Linux -** Design principles, Inter-process communication, Kernel modules, Network structure   2. **Windows -** Design principles, Programmer interface, System components   3. Security level in Linux/Windows | |
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| **5. List of Practices:** | | |
| Laboratory work should cover the operating system structure and functions of any two popular operating system. It also insist the students to design model of operating system with the reference of open source guideline. Students should complete the following tasks in laboratory:  1. Understanding and running all the internal command and external commands in Microsoft Disk Operating Systems.  2. Installation and user, application management in Windows (current version)  3. Simulation of Process Scheduling Algorithms  4. Simulation of Page Replacement Algorithms  4. Simulation of Disk Arm Scheduling Algorithms  5. System Administration (user, disk, role, etc.) in any open source operating system. | | |
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| **6. 6. Evaluation System and Students’ Responsibilities:** | | |
| **6.1 Evaluation System:** | | |
| In addition to the formal exam(s) conducted by the Office of the Controller of Examination of Pokhara University, the internal evaluation of a student may consist of class attendance, class participation, quizzes, assignments, presentations, written exams, etc. The tabular presentation of the evaluation system is as follows.     |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Internal Evaluation** | **Weight** | **Marks** | **External Evaluation** | **Marks** | | **Theory** |  | **30** | **Semester End examination** | **50** | | Attendance / Class Participation | 10% |  | | Assignments | 20% |  | | Project Work/Presentations | 10% |  | | Term Exam | 60% |  | | **Practical** |  | **20** | | Attendance and Lab Participation | 10% |  | | Lab Report | 20% |  | | Lab Examination | 40% |  | | Viva Examination | 30% |  | | **Total Internal Marks** |  | **50** | | **Full marks=50+50** | | | | | | | |
| **6.2 Students’ Responsibilities**: | | |
| To be eligible for the Semester End Examinations, each student must secure at least 45% marks in the internal evaluation with 80% attendance in the class to appear in the Semester End Examination. Failing to obtain such score will be given NOT QUALIFIED (NQ) and the student will not be eligible to appear in the End-Term examinations. Students are advised to attend all the classes and complete all the assignments within the specified time period. If a student does not attend the class(es), it is his/her sole responsibility to cover the topic(s) taught during the period. If a student fails to attend a formal exam, quiz, test, etc. there won’t be any provision for a re-exam. | | |

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| **7. Prescribed Books and References:** |
| Books  1. Andrew S. Tanenbaum, Herbert Bos, *“Modern Operating Systems”*, Pearson, 4th Edition, ISBN-10: 0-13-359162-X. 2011   **References**   1. A. Silberschatz, P.B. Galvin, G. Gagne *“Applied Operating System Concepts*”, Wiley, 8th Ed. 2. D. M. Dhamdhere , “*System Programming and Operating System*” - Tata McGraw-Hill, 20 3. Andrew S. Tanenbaum, *“Distributed Operating System*”, Pearson 4. Naresh Chauhan, Principles of Operating Systems, Oxford University Press 2014, Oxford University Press, ISBN-13: 978-0-19-808287-3 |