MODULE: **OPERATING SYSTEM DESIGN**

CODE: **BSCH-2-2-10**
Stage: II
Credit Points: 4 semester credits / 6 quarter units

Overview and Aims

The aim of this module is to provide you with an understanding of the concepts involved in designing an OS; impress upon you the complexity and the many requirements of an operating system; to introduce you to some fundamental algorithms used in operating systems; to introduce the concept of concurrency in an OS; to explore the concept of distributed operating systems; and to provide you with a practical knowledge of operating systems.

Upon successful completion of this module, you should be able to:

1. discuss the nature, origin and function of operating systems at a generic level and analyse issues of resource management, especially of processes and memory
2. analyse the role of operating systems in non-traditional environments such as embedded systems, concurrent systems and real-time systems
3. install various operating systems; evaluate and compare the interface, functionality and suitability of different operating systems
4. demonstrate an ability to manipulate an operating system using systems programming
5. display a knowledge of how the operating system relates to the underlying hardware and the software that runs on it
6. demonstrate an ability to use virtual machines and explain how they operate

Module Content

Introduction to operating systems

Introduction: What is an Operating System;

Types of OS: Batch, Time-Sharing, Personal Computer Systems, Parallel Systems, Distributed Systems;

Operating System Structures: System Components, Operating System services, System calls, system programs, system structure. Java.

System Design and Implementation; Virtual machines – theory and practical uses.

Case Studies - introduction to DOS, Linux and another commercial desktop operating system; emerging and experimental operating systems to be used for practical work.

Process management

Definition of process; process control block and process image; process life cycle. Threads - overview and benefits; user and kernel threads.
Process scheduling; types of schedulers. Process switching. CPU scheduling algorithms and scheduling criteria.

Review of process scheduling in case studies. Processes: Process concept, process scheduling, operations on processes, cooperating processes, interprocess communication;

Threads: Overview and benefits, user and kernel threads, multithreading models, Java threads;

CPU Scheduling: basic concepts and scheduling criteria, scheduling algorithms, thread scheduling, Java thread scheduling;

Synchronisation: critical section problem, Two task solution, synchronisation in hardware, Semaphores, classical synchronisation problems, Java synchronisation and OS synchronisation;

Deadlocks: System model, deadlock characterisation, methods for handling deadlocks, recovery from deadlock, deadlock prevention, avoidance and detection.

Storage management

Memory management: swapping, contiguous memory allocation, paging and segmentation;

Virtual memory: demand paging, page replacement, allocation of frames, thrashing;

File Systems: File concept, access methods, directory structure, protection, file system structure, allocation methods, free space management, directory implementation, efficiency and performance.

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Protection and security

Protection: Goals of protection, domain of protection, access matrix, implementation of

access matrix;

Security: the security problem, authentication, program threads, system threats, threat monitoring, encryption, computer security classifications.

Specialised operating Systems

Distributed Operating Systems;

Embedded Operating Systems;

Real-time Operating Systems.