COMP H2014 - Operating Systems (Server) Syllabus

Module Code:	COMP H2014	NFQ Level:	6	ECTS Credits:	5

Module Coordinator:	Dr. Kevin Farrell

Description:	This module is a balance between theoretical and practical aspects of modern operating systems. The module aims to - further develop the students' knowledge of operating systems by covering the theory of how modern, multi-user, network operating systems function; in particular the issues of concurrency and deadlock, which arise, in such systems on uni-processor and multi-processor/multicore platforms. - To enhance the students' operating systems administration skills through the advanced configuration and troubleshooting of the Linux and Windows Server operating systems in a multi-user networked environment.

Learning Outcomes

On successful completion of this module the learner will be able to:

1. Understand and explain the concurrency and deadlock issues, which arise in modern multi-programmed operating systems on uni-processor and multi-processor/multicore systems.
2. Explain different types of operating systems structures
3. Compare and contrast single-threaded and multi-threaded processes.
4. Present software solutions to classic problems of process synchronisation
5. Install and configure a modern multi-user Network Operating System
6. Use monitoring tools and implement proper management and security features on both Linux and Windows Server operating systems
7. Perform advanced system administration tasks on a Linux and Windows Server operating system
8. Write, compile and run multithreaded C/C++ programs on a Linux platform using the ThreadMentor library
9. Configure and compile the Linux kernel

Pre-requisite learning

Module Recommendations	Incompatible Modules
No recommendations listed	No incompatible modules listed

Requirements

COMP H1013 Computer Systems and COMP H1027 Computer Architecture and COMP H2028 Operating Systems (Client) or equivalent of these three modules

Co-Requisites

No co-requisites listed listed

Module Content & Assessment

Indicative Content

- **Operating Systems Structures (8%)**
- System components, OS services, system calls, system programs - OS structures - Virtual machines

- **Network Operating Systems (8%)**
- Overview of NOS characteristics - Difference between client and server operating systems - Multi-user, multitasking and multiprocessor systems. - Different types of NOS and how to choose between them - Determining software requirements for NOS - Case Studies: Comparison of Windows Server 2008 and Linux

- **Processes (8%)**
- Review: Process concept, schedulers, operations on processes - Cooperating processes: Producer-Consumer problem - Interprocess Communication - Communication in client-server systems

- **Threads (8%)**
- Means of supporting threads in an OS - Multithreading models - Threading Issues - Case study: Linux

- **Network Services in Linux and Windows Server (8%)**
- DNS: overview, BIND, updating zone files, security issues, testing and debugging - NFS: overview, server- and client-side NFS - Sharing system files: NIS, NIS+, LDAP, Active Directory - Apache web server

- **Process Synchronisation (24%)**
- The critical-section problem - Synchronisation hardware - Semaphores - Classical problems of synchronisation - Critical regions - Monitors - OS synchronisation - Atomic transactions - Case study: ThreadMentor

- **Deadlocks (12%)**
- System Model - Deadlock characterisation - Methods for handling deadlocks - Deadlock prevention, avoidance, detection and recovery

- **Performance Analysis and Tuning in Linux (8%)**
- Factors affecting performance - Analysing CPU and memory usage - Analysing disk I/O - Configuring and compiling the Linux kernel

- **Mission Criticality in Linux (8%)**
- Backups, drive mapping, partition and logical volume management - RAID - Storage Area Networks and Network Attached Storage

- **Linux-Windows Cohabitation (8%)**
- Samba: CIFS, SMBFS - Secure terminal emulation - X-Windows System emulators - Dual booting - Running MS Windows applications under Linux

Assessment Breakdown	%
Course Work	50%
End of Semester Formal Examination	50%

	Outcome addressed	% of total	Assessment Date
Formal End-of-Semester Examination	1,2,3,4,7	50%	Semester End

Coursework Breakdown

Type	Description	Outcome addressed	% of total	Assessment Date
Project	Practical Project on programming concurrency using the ThreadMentor package.	1,3,4,8	20	n/a
Performance Evaluation	Performance in Practicals.	3,4,5,6,7,8,9	10	Every Week
Multiple Choice Questions	Typically, four multiple choice tests, worth equal marks. Each test assesses OS theory from lectures and knowledge from practicals.	1,2,3,7,9	20	n/a

Reassessment Requirement

Repeat examination
Reassessment of this module will consist of a repeat examination. It is possible that there will also be a requirement to be reassessed in a coursework element

ITB reserves the right to alter the nature and timings of assessment

Module Workload & Resources

Workload	Full-time			
Type	**Description**	**Hours**	**Frequency**	**Average Weekly Learner Workload**
Lecture	OS and System Administration Theory	2	Every Week	2.00
Lab	Practical work will be carried out mainly on PC-based operating systems, focussing on Linux and Windows (Server Editions). Work will be divided between system administration and programming concurrency. The system administration portion will consist of: - Partitioning and formatting hard disk drive(s) using LVM - Installation of a Linux server and a Windows Server Edition - Configuring network services (NFS, NIS, LDAP, Active Directory, ssh and web servers) - System performance analysis and tuning	2	Every Week	2.00
Independent Learning	Independent learning required of the student.	4	Every Week	4.00
Total Weekly Learner Workload				8.00
Total Weekly Contact Hours				4.00

Resources
Recommended Book Resources
• Abraham Silberschatz, Peter Baer Galvin, Greg Gagne 2009, *Operating system concepts*, 8th Edition Ed., Wiley [ISBN: 978-0-470-23399-3] • Nemeth, Snyder, Hein and Whaley 2011, *Unix and Linux System Administration Handbook*, 4th Edition Ed., Pearson Education [ISBN: 978-0-13-148005-6] • William Stallings 2008, *Operating systems: Internals and Design Principles: International Version*, 6th Edition Ed., Pearson Education [ISBN: 9780136033370]
Supplementary Book Resources
• Andrew Tanenbaum 2008, *Modern Operating Systems*, 3rd Edition Ed., Pearson Education [ISBN: 9780138134594] • Sobell, *A practical guide to Linux* • Gary Nutt 2004, *Operating systems*, 3rd Edition Ed., Pearson/Addison Wesley Boston [ISBN: 9780201773446]
Other Resources
• Website: *The Linux Documentation Project* www.tldp.org • Website: *Multithreaded Programming with ThreadMentor* www.cs.mtu.edu/~shene/NSF-3/e-Book/index.html • Website: *Linux-specific Google Search* www.google.ie/linux