



**NATIONAL UNIVERSITY OF ENGINEERING  
COLLEGE OF MECHANICAL ENGINEERING  
MECHATRONICS ENGINEERING PROGRAM**

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**MT325 – DESIGN OF REAL-TIME SYSTEMS**

**I. GENERAL INFORMATION**

CODE	: MT325 Design of Real-Time Systems
SEMESTER	: 8
CREDITS	: 4
HOURS PER WEEK	: 4 (Theory – Laboratories)
PRE-REQUISITES	: MB536-MT235
CONDITION	: Mandatory

**II. COURSE SUMMARY**

The course provides students with the theoretical concepts of introduction to real-time operating systems, structure of a real-time operating system, process management, real-time process management algorithms, memory management, management of storage devices, input / output and the experience for the development of operating systems in real time through two projects carried out in laboratories.

**III. COMPETENCES**

The student will:

1. Develop the operating system kernel program with the Shell for a microcontroller.
2. Develop the real-time operating system process manager program for a microcontroller.
3. Develop the memory manager program of a real-time operating system for a microcontroller.
4. It develops the administrator program of input and output of a real-time operating system for a microcontroller.

**IV. LEARNING UNITS**

**1. FUNDAMENTALS OF REAL-TIME OPERATING SYSTEMS / 12 HOURS**

Introduction to Computational Systems / Real Time Systems / Basic Elements / Processor Memory / Input and Output Modules / Interconnection between Elements / Processor Registers / Instruction Cycle / Real-Time Operating System Structure / Elements / Evolution / Series Processes / Batch process / Batch system with multiprogramming / Time sharing systems / Real-time

operating system kernel / Command interpreter, interpreter implementation algorithms.

## 2. PROCESS MANAGEMENT / 24 HOURS

Definition of processes / States of a process / Process description / Process block / Process control / Process planning / Process planning algorithms fifo, round robin, priority / Techniques and algorithms for implementing single user operating systems, system Multiuser Operation / Process Interchange Algorithm / Real-Time Process Planning Algorithms / Real-Time Operating System Deployment Techniques and Algorithms / Process Scheduling / Concurrency Problems. Communication between processes. Synchronization of processes.

## 3. MEMORY ADMINISTRATION / 12 HOURS

Memory management. Preliminary concepts. Direction and content of memory / Memory Management Techniques / Real memory multiprogramming / Memory Allocation Algorithms / Memory Allocation Algorithms Implementation Techniques and Algorithms / Virtual Memory Multiprogramming / Pure Paging / Memory Allocation Algorithms / Pure Segmentation / Mixed Systems /

## 4. ADMINISTRATION OF STORAGE DEVICES / 8 HOURS

File Management / File Operations / Request Planning Algorithms / File Management Elements / Access Methods: sequential, direct. Methods of assignment: contiguous, linked, indexed / protected files.

## V. LABORATORIES AND PRACTICAL EXPERIENCES

**Lab 1:** Development of the kernel program of the operating system for a microcontroller.

**Lab 2:** Development of the program manager of a multitasking operating system for a microcontroller.

**Lab 3:** Development of the program manager interface of a multitasking operating system for a microcontroller.

**Lab 4:** Development of the real-time process scheduling program.

**Lab 5:** Development of the program manager of a multitasking real-time operating system for a microcontroller.

## VI. METHODOLOGY

The course is developed in theory and laboratory sessions. In the theory sessions, the teacher presents the concepts, algorithms and techniques of development of the computer programs. In the laboratory sessions the student develops the

program of each component of the operating system in real time multitasking for a microcontroller, combining applications in the personal computer and applications for the microcontroller. In the sixth week the student must present and present the project of the multitasking operating system and in the fourteenth week must present and expose the project of the operating system in real time multitasking.

## **VII. EVALUATION FORMULA**

Evaluation system 'D'. Calculation of the final score:  $FS = (M1 + M2 + M3 + M4)/4$   
M1: Monograph 1, M2: Monograph 2, M3: Monograph 3, M4: Monograph 4.

## **VIII. BIBLIOGRAPHY**

1. James L. Peterson(1993) Operating system concepts. Spain, Reverte Ed.
2. Tanenbaum, Andrew S (1993) Modern Operating Systems. Mexico, Prentice Hall Hispanoamericana.
3. Phillip A. Laplante. Real-Time System Design and Analysis - An Engineers Handbook, Third Edition.pdf