AMERICAN INTERNATIONAL UNIVERSITY-BANGLADESH (AIUB)

Faculty of Science and Technology (FST)
Department of Computer Science (CS)
Undergraduate Program

COURSE PLAN	SEMESTER: Fall 2024-2025
I. Course Code and Title CSC 3214 Operating Systems **II. Credit** 5 credit hours (1 Hour 40 Min. theory and 2 Hours 40 Min. laboratory per week) **III. Nature** Core Course for CS, CSE, CSSE, SE, CIS **IV. Prerequisite** COE 3205 Computer Organization and Architecture	**V. Vision:** Our vision is to be the preeminent Department of Computer Science through creating recognized professionals who will provide innovative solutions by leveraging contemporary research methods and development techniques of computing that is in line with the national and global context. **VI. Mission:** The mission of the Department of Computer Science of AIUB is to educate students in a student-centric dynamic learning environment; to provide advanced facilities for conducting innovative research and development to meet the challenges of the modern era of computing, and to motivate them towards a life-long learning process.

VII - Course Description:

- Explain modern operating systems.
  (The course will begin with an overview of the structure of modern operating systems.)
- Describe the fundamental concepts and issues involved in operating system design and explain the basic services provided by operating systems in general.
  (We will focus on UNIX-based operating systems, though we will also learn about alternative operating systems, including Windows.)
- Discuss the history of modern computers, analyze in detail each of the major components of an operating system (from processes to threads), and explore more advanced topics in the field, including memory management and file input/output.
  (Topics include process description and control, critical sections and mutual exclusion, deadlock, process scheduling, threads, process synchronization, semaphores, and memory management strategies)
- Present two central building blocks of modern operating systems: Processes and Threads. Processes (instances of a running computer program) and threads (a specific task running within a program) are integral to the understanding of how an OS executes a program and the communication of information between each of the computer's architectural layers. We will start with an overview of each concept, including definitions, uses, and types.
- Differentiate between processes and threads.
- Explain process on Context Switching and the important role they play in CPU scheduling, which will be discussed more in depth in scheduling lecture.
- Analyze process synchronization methods and techniques.
- Justify and explain different levels of access control, operating system protection and security.
- Analyze CPU scheduling algorithm.
- Categorize different scheduling algorithms and justify a good algorithm which will allocate resources, allowing an efficient execution of all running programs.
- Describe Deadlock in Operating system. Relate Deadlock with previous two units of CPU Scheduling and Processes and Threads.
- Analyze different algorithms to prevent Deadlock.

- Discuss deadlock detection, as well as methods for recovering from a deadlocked state.

- Discuss the role of memory in an Operating System. Implement error-handling techniques using exception handling.
- Implement error-handling techniques using exception handling.
- Create multithreaded programs and explain the advantage compared with single threaded programs.

VIII - Course outcomes (CO) Matrix:

By the end of this course, students should be able to:

COs*	CO Description	Level of Domain***			PO Assessed ****
		C	P	A	
CO1	**Differentiate** how different types of the modern operating system work, their underlying fundamental concepts, techniques, and applications. Distinguishing how these different techniques and algorithms are used to achieve optimum hardware and software resource utilization.	4			PO-b-4
CO2 **	**Compare** and **analyze** different types of CPU Scheduling, Process Management, Synchronization, deadlock handling mechanisms to get the optimum resource allocation and utilization.	4			PO-b-4
CO3 **	**Explain** various shell commands and system calls to implement Shell Scripts for various fundamental task automation.	5			PO-b-3
CO4	**Analyze** and **compare** user access control, OS security, and protection mechanisms to prevent operating system vulnerability and to ensure the OS stability. Compare virtual, cloud, and distributed OS, etc.	4			PO-b-4

C: Cognitive; P: Psychomotor; A: Affective Domain
* *CO assessment method and rubric of COs assessment is provided in later section*
** *COs will be mapped with the Program Outcomes (POs) for PO attainment*
*** *The numbers under the 'Level of Domain' columns represent the level of Bloom's Taxonomy each CO corresponds to.*
**** *The numbers under 'PO Assessed' column represent the POs each CO corresponds to.*

IX - Topics to be covered in the class and/or lab: *

Time Frame	CO Mapped	Topics	Teaching Activities	Assessment Strategy(s)
Week 1		OBE, Mission & Vision of AIUB		
Week 2	CO1, CO3	Operating Systems overview Subject Topic: Basic definition of Operating System (OS) and its different applications. Lab: Study of UNIX commands with all their important options.	Lecture: Justifying, Group Study Lab: Introduction about OS Lab, Lab rules, Safety issues. Environment setup: Virtual machine setup for Linux. Some basic Linux based commands	Quiz, Lab exam
Week 3	CO1	Computer System Overview and System Structure Subject Topic:	Lecture: Justifying, Group Study, Perform Exercises	Quiz

		Basic OS hardware & software components; functions & features of an OS, interrupts, types of interrupts, interrupt handling; interrupt processing, multiple interrupt processing and I/O concept. Properties of modern OS, Microkernel architecture & symmetric multiprocessing.	Lab: Learn basic Unix commands such as copying/move a file, create a file, write on a file, changing directories, changing permission of directories and files etc. Lab exercise 1 Quiz 1 on 3rd Week	
Week 4	CO2	Processes Concept Subject Topic: Process Concepts, Process Scheduling, Operation on Processes, Cooperating Processes, Threads, Inter-process Communication. Lab: Study system calls related to process & process control	Lecture: Lab: Get more familiar with Linux commands, work on some editors such as Vim and Nano. Quiz 2 on 4th week Lab Exercise	Midterm exam
Week 5	CO2	Multithreaded Programming Subject Topic: Multithreading model, thread library, threading issues. Lab: Utilize scripting language to manage process and create make file.	Lecture: Lab: Utilize scripting language to manage process and create make file.	Midterm exam
Week 6	CO2	Process Scheduling Subject Topic: Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Lab: 1. Simulating CPU scheduling algorithm using any programming language, Simulation of Process scheduling algorithm: Feedback policy, Simulation of I/O requests scheduling algorithm: Elevator algorithm 2. Shell Programming	Lecture Justifying Group Study. Lab: Perform Exercise and Coding.	Midterm exam, Lab Exam
Week 7		Revision		
Midterm (Week 8)				
Week 9	CO4, CO3	Process Scheduling Subject Topic: Multiple-Processor Scheduling, Real-Time Scheduling, Algorithm Evaluation. Lab: 1. Simulating CPU scheduling algorithm using any programming language, Simulation of Process scheduling algorithm: Feedback policy, Simulation of I/O requests	Lecture: Justifying Group Study. Lab: Perform Exercise and Coding.	Final term exam, Lab Exam

		scheduling algorithm: Elevator algorithm 2. Shell Programming		
Week 10	CO4, CO3	Process Synchronization Subject Topic: Critical Section problem, Peterson's solution, Synchronization hardware, Mutex lock, Semaphores	Lecture Justifying Group Study. Lab: Perform Exercise and Coding.	Final term exam, Lab Exam
Week 11	CO4, CO3	Deadlock Subject Topic: Categories of resources, Resource allocation graphs, conditions for deadlock, prevention occurrence of a deadlock, Banker's algorithm, deadlock avoidance, detection and recovery. Lab: 1. Simulation of deadlock handling algorithm: Banker's algorithm 2. Shell Programming	Lecture Justifying Group Study. LAB: Perform Exercise and Coding.	Final term exam, Lab Exam
Week 12	CO4, CO3	Protection and Security Subject Topic: OS protection, access control, domain of protection, access matrix, OS security, program threats, system and network threats etc. Lab: 1. Linux Access Control 2. Shell Programming	Lecture Justifying Group Study. LAB: Perform Exercise and Coding.	Final term exam, Lab Exam
Week 13		Memory Management Subject Topic: Main Memory, Logical and Physical Address Space, Static and Dynamic Loading, Swapping, Fragmentation, Paging.	Lecture Justifying Group Study. LAB: Perform Exercise and Coding.	Final term exam, Lab Exam
Week 14		Virtual Memory	Lecture Justifying Group Study. LAB: Perform Exercise and Coding.	Final term exam, Lab Exam
Week 15		Revision		
Final term (Week 16)				

** The faculty reserves the right to change, amend, add, or delete any of the contents.*

X - Mapping of PO to Courses and K, P, A

PO Indicator ID	PO Indicators Definition (As per the requirement of WKs)	Domain	K	P	A
PO-b-3	Analyze solutions for complex engineering problem reaching substantiated conclusion.	Cognitive Level 5 (Evaluating)	K3	P1 P3 P7	

PO-b-4	Research literature of engineering science and analyze the validity and accuracy of existing solution for complex engineering problems.	Cognitive Level 4 (Analysis)	K4	P1 P2 P6	

XI – K, P, A Definitions

Indicator	Title	Description
K3	Theory based engineering fundamentals	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline
K4	Forefront specialist knowledge for practice	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline
P1	Depth of knowledge required	Cannot be resolved without in-depth engineering knowledge at the level of one or more of K3, K4, K5, K6 or K8 which allows a fundamentals-based, first principles analytical approach
P2	Range of conflicting requirements	Involve wide-ranging or conflicting technical, engineering, and other issues
P3	Depth of analysis required	Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models
P6	Extent of stakeholder involvement and conflicting requirements	Involve diverse groups of stakeholders with widely varying needs
P7	Interdependence	Are high level problems including many component parts or sub-problems

XII – Mapping of CO Assessment Method and Rubric

The mapping between Course Outcome(s) (COs) and The Selected Assessment method(s) and the mapping between Assessment method(s) and Evaluation Rubric(s) is shown below:

COs	Description	Mapped POs	Assessment Method	Assessment Rubric
CO1	Differentiate how different types of the modern operating system work, their underlying fundamental concepts, techniques, and applications. Distinguishing how these different techniques and algorithms are used to achieve optimum hardware and software resource utilization.	PO-b-4	Quiz	Rubric for Quiz
CO2	Compare and analyze different types of CPU Scheduling, Process Management, Synchronization, deadlock handling mechanisms to get the optimum resource allocation and utilization.	PO-b-4	Term Exam	Rubric for Term Exam
CO3	Explain various shell commands and system calls to implement Shell Scripts for various fundamental task automation.	PO-b-3	Quiz/ Term Exam	Rubric for Quiz/ Term Exam
CO4	Analyze and compare user access control, OS security, and protection mechanisms to prevent operating system vulnerability and to ensure the OS stability. Compare virtual, cloud, and distributed OS, etc.	PO-b-4	Term Exam	Rubric for Term Exam

XIII – Evaluation and Assessment Criteria

CO1: *Differentiate how different types of the modern operating system works, their underlying fundamental concepts, techniques, and applications. Distinguishing how these different techniques and algorithms are used to achieve optimum hardware and software resource utilization.*

Assessment Attribute/Criteria	Missing/Incorrect (0)	Inadequate (1-2)	Satisfactory (3-4)	Excellent (5)
Fundamental concepts and principles	Not demonstrate various operating systems and not show any relevant techniques and algorithms for resource optimization.	Demonstrate a moderate understanding of various operating systems and few relevant techniques and algorithms for resource optimization.	Demonstrate a moderate understanding of various operating systems and relevant techniques and algorithms for resource optimization.	Demonstrate a clear understanding of various operating systems and relevant techniques and algorithms for resource optimization.
Content knowledge	Not present knowledge of computer operating systems and not show any relevant relations with hardware.	Moderately presents compete knowledge of computer operating systems and few relevant relations with hardware.	Moderately present complete knowledge of computer operating systems and relevant relations with hardware.	Present complete knowledge of computer operating systems and relevant relations with hardware.

CO2: *Compare and analyze different types of CPU Scheduling, Process Management, Synchronization, deadlock handling mechanisms to get the optimum resource allocation and utilization.*

Assessment Attribute/Criteria	Missing/Incorrect (0)	Inadequate (1-2)	Satisfactory (3-4)	Excellent (5)
Content knowledge	Not develop a clear understanding and not show any relevant knowledge of algorithms related to operating system optimization and resource allocations.	Develop a moderate understanding and few relevant knowledge of algorithms related to operating system optimization and resource allocations.	Develop a moderate understanding and knowledge of algorithms related to operating system optimization and resource allocations.	Develop a clear understanding and knowledge of algorithms related to operating system optimization and resource allocations.
Completeness	Not understand and not apply any appropriate algorithms for resource optimization and problem solutions.	Moderately understand and apply few appropriate algorithms for resource optimization and problem solutions.	Moderately understand and apply appropriate algorithms for resource optimization and problem solutions.	Understand and apply appropriate algorithms for resource optimization and problem solutions.

CO3: *Explain various shell commands and system calls to implement Shell Scripts for various fundamental task automation.*				
Assessment Attribute/Criteria	**Missing/Incorrect (0)**	**Inadequate (1-2)**	**Satisfactory (3-4)**	**Excellent (5)**
Content knowledge	Not understand and not present the knowledge of scripting commands for various fundamental automation tasks and solutions to problems.	Moderately understand and present the knowledge of scripting commands for few fundamental automation tasks and solutions to problems.	Moderately understand and present the knowledge of scripting commands for various fundamental automation tasks and solutions to problems.	Understand and present the knowledge of scripting commands for various fundamental automation tasks and solutions to problems.
Problem analysis and solutions	Not develop the ability to articulate various automation tasks and problems to relevant solutions through shell scripting.	Moderately develop the ability to articulate few automation tasks and problems to relevant solutions through shell scripting.	Moderately develop the ability to articulate various automation tasks and problems to relevant solutions through shell scripting.	Develop the ability to articulate various automation tasks and problems to relevant solutions through shell scripting.

CO4: *Analyze and compare user access control, OS security, and protection mechanisms to prevent operating system vulnerability and to ensure the OS stability. Compare virtual, cloud, and distributed OS, etc.*				
Assessment Attribute/Criteria	**Missing/Incorrect (0)**	**Inadequate (1-2)**	**Satisfactory (3-4)**	**Excellent (5)**
Fundamental concepts and principles	Not demonstrate a clear understanding of concepts related to Operating System securities and protection concerns, along with the fundamentals of modern cloud and distributed Operating Systems.	Moderately demonstrate a clear understanding of concepts related to Operating System securities and protection concerns, along with the few fundamentals of modern cloud and distributed Operating Systems.	Moderately demonstrate a clear understanding of concepts related to Operating System securities and protection concerns, along with the fundamentals of modern cloud and distributed Operating Systems.	Demonstrate a clear understanding of concepts related to Operating System securities and protection concerns, along with the fundamentals of modern cloud and distributed Operating Systems.
Problem analysis and solutions	Not develop the ability to identify Operating System risks and security concerns and not provide appropriate solutions for the optimum protection of the systems.	Moderately develop the ability to identify Operating System risks and security concerns and provide few appropriate solutions for the optimum protection of the systems.	Moderately develop the ability to identify Operating System risks and security concerns and provide appropriate solutions for the optimum protection of the systems.	Develop the ability to identify Operating System risks and security concerns and provide appropriate solutions for the optimum protection of the systems.

XIV- Course Requirements

- Students are expected to attend at least 80% of the class.
- Students are expected to participate actively in the class.
- For both terms, there will be at least 2 quizzes based on the theoretical knowledge and conceptual understanding of the topic covered discussed in the classes.
- Submit report based on the given course related problems.
- Submission of assignments and projects should be in due time.

XV – Evaluation & Grading System*

The following grading system will be strictly followed in this class

MID TERM		FINAL TERM	
Attendance	10%	Attendance	10%
Quiz	20%	Quiz	20%
Lab performance	20%	Lab performance	20%
Midterm written exam	50%	Final term written exam	50%
Total	100%	Total	100%
Grand Total 100% = 50% of Midterm + 50% of Final Term			

Letter	Grade Point	Numerical %
A+	4.00	90-100
A	3.75	85 - < 90
B+	3.50	80 - < 85
B	3.25	75 - < 80
C+	3.00	70 - < 75
C	2.75	65 - < 70
D+	2.50	60 - < 65
D	2.25	50 - < 60
F	0.00	< 50
I		Incomplete
W		Withdrawal
UW		Unofficially Withdrawal

** The evaluation system will be strictly followed as par with the AIUB grading policy.*
** CO attainment will be achieved with 60% of the evaluation marks.*

XVI – Textbook/ References

1. Silberschatz, A and Galvin, P (and Gagne, G), Operating System Concepts (Ninth Edition or later edition)
2. Modern Operating Systems (3rd Edition) by Andrew S. Tanenbaum
3. William S. Davis and T. M. Rajkumar, Operating Systems, A Systematic View, Sixth Edition, Addison Wesley, 2004
4. Kanetkar, Yashavant P., Unix shell programming, BPB Publications, 1996
5. Online tutorials. (You will be guided in the class)

XVII - List of Faculties Teaching the Course

FACULTY NAME	SIGNATURE
SYEDA ANIKA TASNIM	
DR. RAJARSHI ROY CHOWDHURY	
SYMA KAMAL CHAITY	
MD. RIFAT	

XVI – Verification

Prepared by: Syeda Anika Tasnim ---------- **Syeda Anika Tasnim** *Course Convener* Date:.....	**Moderated by:** ---------- **Dr. M. Mahmudul Hasan** *Point Of Contact* *OBE Implementation Committee* Date:.....	**Checked by:** ---------- **Dr. Akinul Islam Joney** *Head (Undergraduate Program)* *Department of Computer Science* Date:.....
Verified by: ..... **Dr. Md. Abdullah-Al-Jubair** *Director* *Faculty of Science & Information Technology* Date:.....	**Certified by:** ..... **Prof. Dr. Dip Nandi** *Associate Dean,* *Faculty of Science & Information Technology* Date:.....	**Approved by:** ..... **Mr. Mashiour Rahman** *Dean,* *Faculty of Science & Information Technology* Date:.....