PROGRAMME: BACHELOR OF COMPUTER APPLICATIONS (BCA)
SEMESTER – II

Teaching-Learning & Evaluation Plan

Course Information: Core Course

Course Code: **23BCA2C05**   Course Title: **Operating System**

Credits Units: **03**   Contact Hours: **45**   L-T-P: **3-0-0**

IA: ESE Weightage - **50:50**   Pass Marks (IA & ESE) – **0 and 18**   Aggregate Pass Marks: **40%**

ESE Question Paper Marks: **50**   Special Examination Fees: **NA**   Pre-requisite (if any): **NA**

Course Facilitator (s): Sonali Karale, Dr. Preeti, Dr. Pandikumar and Dr. Santhalakshmi

Programme Outcomes (POs)
At the end of the programme, students will be able to

PO 1	**Computational Knowledge:** Understand and apply mathematical foundation, computing and domain knowledge for the conceptualization of computing models from defined problems.
PO 2	**Problem Analysis:** Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO 3	**Design / Development of Solutions:** Ability to transform complex business scenarios and contemporary issues into problems, investigate, understand, and propose integrated solutions using emerging technologies.
PO 4	**Conduct Investigations of Complex Computing Problems:** Ability to devise and conduct experiments, interpret data and provide well-informed conclusions.
PO 5	**Modern Tool Usage:** Ability to select modern computing tools, skills and techniques necessary for innovative software solutions.
PO 6	**Professional Ethics:** Ability to apply and commit professional ethics and cyber regulations in a global economic environment.
PO 7	**Life-long Learning:** Recognize the need for and develop the ability to engage in continuous learning as a Computing professional.
PO 8	**Project Management:** Ability to understand management and computing principles with computing knowledge to manage projects in multidisciplinary environments.
PO 9	**Communication Efficacy:** Communicate effectively with the computing community as well as society by being able to comprehend effective documentations and presentations.
PO 10	**Societal & Environmental Concern:** Ability to recognize economic, environmental, social, health, legal, ethical issues involved in the use of computer technology and other consequential responsibilities relevant to professional practice.

| PO11 | **Individual & Team Work:** Ability to work as a member or leader in diverse teams in multidisciplinary environment. |
| PO12 | **Innovation and Entrepreneurship**: Identify opportunities, entrepreneurship vision and use of innovative ideas to create value and wealth for the betterment of the individual and society. |

Program Specific Outcomes (PSO's)	
PSO 1	Pertain current knowledge and adapting to emerging applications of Mathematics, Science fundamentals in the field of Computer science and its applications.
PSO 2	Exhibit proficiency in identifying, formulating and analyzing complex problems in the computer environment.
PSO 3	Ability to create, select and apply appropriate modern techniques for solving complex issues.
PSO 4	Explore technical knowledge in diverse areas of Computer Applications and experience a conductive environment in nurturing skills for successful career and higher studies.

Course Objectives (COB's)

COB1: To understand the fundamental components of an operating system, system calls, managing the process and implementing the scheduling algorithms.

COB2: To analyze and solve the process synchronization problem and deadlock.

COB3: To analyze various memory management schemes, file system implementations and protection mechanisms.

Course Outcomes (CO's)
At the end of the course, students will be able to

Sl. No.	Course Outcome	Description	Bloom's Taxonomy Level
1	CO1	**Explain** the fundamental components of a computer operating system	Understanding (L2)
2	CO2	**Analyze** different scheduling algorithms for process management	Analyze (L4)
3	CO3	**Solve** process synchronization problems using different methods.	Solve (L3)
4	CO4	**Demonstrate** the memory and storage management schemes.	Demonstrate (L3)
5	CO5	**Illustrate** the implementation of file system and disk management.	Illustrate (L3)

CO-PO/PSO Mapping:

Course Outcome	Blooms Taxonomy Levels	Program Outcomes (PO's) Mapped												Program Specific Outcomes (PSO's)			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1 L3	PSO2 L4	PSO3 L6	PSO4 L4
CO1	L2	3	1	2	-	-	-	3	2	3	-	3	-	3	2	2	3
CO2	L4	3	3	3	-	-	-	3	3	3	-	3	-	3	3	3	3
CO3	L3	3	3	3	-	-	-	3	3	3	-	3	-	3	3	3	3
CO4	L3	3	3	3	-	-	-	3	3	3	-	3	-	2	3	3	3
CO5	L3	3	3	3	-	-	-	3	3	3	-	3	-	2	2	2	2
Total		15	13	14	-	-	-	15	14	15	-	15	-	13	13	13	14
Average		3	2.6	2.8	-	-	-	3	2.8	3	-	3	-	2.6	2.6	2.6	2.8

Course Contents:

Module	Details	Contact Hours
I	**Introduction to Operating System:** Introduction, Objectives and Functions of OS, Evolution of OS, OS Structures, OS Components, OS Services, System calls, Types of System calls, System programs, Virtual Machines	06
II	**Process Management:** Processes: Process concept, processes, Operations on processes, Inter process communication, Communication in client-server: Socket, RPC and RMI Threads: Introduction to Threads, Single and Multithreaded processes and its benefits, User and Kernel threads, Multithreading models, Threading issues. Process Scheduling: Basic concepts, Scheduling criteria, Scheduling Algorithms	12
III	**Process Synchronization and Deadlocks:** Mutual Exclusion, Critical – section problem, Peterson's solution, Semaphores, Classic problems of synchronization. Deadlocks: System Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock	12
IV	**Memory and Storage Management:** Logical and physical Address Space, Swapping, Contiguous Memory Allocation, Paging, Page table structure, Segmentation with Paging. Virtual Memory Management: Demand paging, Process creation, Copy-on-write, Page Replacement Algorithms, Demand segmentation.	06
V	**File-System Implementation and Protection:** File concept, Access Methods, Directory structure, File-System structure, File-System Implementations, Directory Implementation, Allocation Methods, Free-space Management, Recovery Disk Management: Disk Structure, Disk Scheduling and Algorithms, Disk Management, Swap-Space management, Disk Attachment Protection and Security: Goals of Protection, Domain of Protection, Access Matrix, Implementation of Access Matrix	09

Text Books (TB):

TB-1	Operating System Concepts, by Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Wiley, Jan 2018.

Reference Books (RB):

RB-1	Modern Operating Systems, by Andrew Tanenbaum, Herbert Bos, Pearson PLC, 2022.
RB-2	Operating System (A Practical App), by Rajiv Chopra, S. Chand, 2009
RB-3	Operating Systems, by William Stallings, Pearson, 2018

Other Reading (OR):

OR-1	Operating system fundamentals https://www.tutorialspoint.com/operating_system/index.htm [Accessed on Dec, 2022]
OR-2	Inter Process Communication (IPC) https://www.geeksforgeeks.org/inter-process-communication-ipc/?ref=leftbar-rightbar [Accessed on Dec, 2022]
OR-3	CPU Scheduling https://www.javatpoint.com/os-cpu-scheduling [Accessed on Dec, 2022]
OR-4	Deadlocks in operating system https://www.guru99.com/deadlock-in-operating-system.html [Accessed on Dec, 2022]

Relevant Website (RW):

RW-1	https://www.javatpoint.com/os-tutorial
RW-2	https://www.tutorialspoint.com/operating_system/index.htm
RW-3	https://www.w3schools.in/operating-system-tutorial/intro/
RW-4	https://www.guru99.com/os-tutorial.html
RW-5	https://www.geeksforgeeks.org/operating-systems/
RW-6	https://www.tutorialandexample.com/operating-system-tutorial/
RW-7	https://www.studytonight.com/operating-system/
RW-8	https://edu.gcfglobal.org/en/computerbasics/understanding-operating-systems/1/

Video Links (VL):

VL-1	Introduction to operating system https://www.youtube.com/watch?v=2i2N_Qo_FyM&list=PLEbnTDJUr_If_BnzJkkN_J0Tl3iXTL8vq
VL-2	Process Management https://www.youtube.com/watch?v=OrM7nZcxXZU
VL-3	CPU Scheduling https://www.youtube.com/watch?v=EWkQl0n0w5M&list=PLBlnK6fEyqRitWSE_AyyySWfhRgyA-rHk
VL-4	Process Synchronization https://www.youtube.com/watch?v=ph2awKa8r5Y
VL-5	Deadlocks https://www.youtube.com/watch?v=UVo9mGARkhQ
VL-6	Memory Management https://www.youtube.com/watch?v=UDPYpf-nsDY
VL-7	Virtual Management https://www.youtube.com/watch?v=qlH4-oHnBb8
VL-8	File-System Implementation https://www.youtube.com/watch?v=B49kLQA3uPg
VL-9	Disk Management https://www.youtube.com/watch?v=ZjMwUhapSEM
VL-10	Security in operating system https://www.youtube.com/watch?v=3kKkOBClw1Q

MOOC Courses (MC):

Sr.No.	Platform	Topic	CO	Link	Duration
MC-1	LinkedIn Learning	Operating Systems and You: Becoming a Power User – Offered by Google – Coursera.	CO1	https://www.coursera.org/learn/os-power-user	59 min
MC-2	LinkedIn Learning	CompTIA IT Fundamentals (FC0-U61) Cert Prep 1: Computer Basics, Hardware, and Operating Systems	CO1 CO5	https://www.linkedin.com/learning/comptia-it-fundamentals-fc0-u61-cert-prep-1-computer-basics-hardware-and-operating-systems	1 hour 44 min
MC-3	Georgia Tech	Introduction to Operating Systems – Offered by Georgia Tech	CO1-CO5	https://omscs.gatech.edu/cs-6200-introduction-operating-systems	1 hour 36 min
MC-4	Udemy	Operating Systems from scratch – Part 1	CO1-CO5	https://www.udemy.com/course/operating-systems-from-scratch-part1/	8 hours 50 min
MC-5	Charles Sturt University, Australia	Introduction to Operating Systems – Revised – Alison	CO1 CO3 CO4 CO5	https://alison.com/course/introduction-to-operating-systems-revised	3 hours
		Total MOOC Course integration with Certification			**14 hours**

Session-wise Planning:

Module	Session	Topic	TB/RB/OR/RW/VL	Pedagogy/ Activity planned	CO	Mode of delivery
Bride Course	Zero Lecture	**Applications of Operating System**	**VL-1 to VL-5**	Blended Learning Approach		Asynchronous- Video
I	1-2	Introduction to Operating System, Types of Operating Systems, Functions of OS, Evolution of OS	TB-1 RB-1 MC-1 VL-1	Open Discussion Session, Blended Learning, PPT Presentation and Classroom Interaction with Demo **Activity 1:** Report on comparative study of different OS and types of OS	**CO1**	Synchronous-PPT Asynchronous- Video Assessment
	3-4	OS Structures and OS Components, OS Services				
	5	System Calls, Types of System Calls				
	6	System Programs and Virtual Machines				
II	7-8	Introduction, Process Concept and Process Operation	TB-1 RB-1 MC-2 VL-2	PPT Presentation & Classroom interaction, Blended Learning, Demonstration and Problem Solving, Interactive Assessment with Report, **Activity:** Online Certification Course – 13 to 15 Hours Linked in Learning Mini Project	**CO2**	Synchronous - PPT Asynchronous- Video and Assessment
	9-10	Inter-Process Communication and Communication in Client - Server System				
	11-12	Introduction to Threads, Single and Multithreaded processes, User and Kernel threads				
	13	Multithreading model, Threading issues.				
	14-18	Basic Concepts, Scheduling Criteria and Algorithms				
III	19-20	Mutual Exclusion and Critical Section Problem	TB-1 RB-1 MC-3 VL-3	PPT Presentation & Demonstration, Classroom interaction, Classroom		Synchronous-PPT Asynchronous- Video and Assessment
	21-22	Peterson's Solution Semaphores,				

	23	Classic problems of synchronization.		discussion on problems and scenarios. **Activity-2:** Mini Project	**CO3**	
	24	System Model, Deadlock characterization				
	25-26	Methods for handling Deadlock and Deadlock prevention				
	27-30	Deadlock Avoidance, Detection and Recovery				
IV	31	Logical and physical Address Space, Swapping, Contiguous Memory Allocation	TB-1 RB-1 RB-2 RW-2 RW-5 VL-6 VL-7	PPT Presentation & Classroom interaction, Demonstration **Flip Class Activity:** Mini Project		Synchronous-PPT Asynchronous- Video
	32	Paging, Page table structure, Segmentation with Paging				
	33	Demand paging, Process creation, Copy-on-write		Problem Solving	**CO4**	
	34-35	Page Replacement Algorithms, Demand segmentation		Report Writing -Different storage management scheme used by different OS		
	36	File concept, Access Methods, Directory structure, File-system Mounting, File sharing				
V	37	File-System structure, File-System Implementations	TB-1 RB-1 RB-2 RW-2 RW-5 VL-8 VL-9 VL-10	PPT Presentation & Classroom interaction **Activity:** Mini Project Presentation and VIVA		Synchronous-PPT Asynchronous- Video
	38-39	Directory Implementation, Allocation Methods, Free-space Management, Efficiency and Performance, Recovery		Problem Solving Examine	**CO5**	

	40-41	Disk Structure, Disk Scheduling		operating system security as well as Tool Utilization and prepare a report on it		
	42	Disk Management, Swap-Space management, Disk Attachment				
	43-45	Goals of Protection, Domain of Protection, Access Matrix, Implementation of Access Matrix, Revocation of Access Rights				

Assessment Scheme: CA: UE – 50:50

Sl. No.	Assessment Instrument	Formative/ Summative	Frequency/Stages	Weightage (%)	CO
1.	**Skill Enhancement Activity-1** - Report on Comparative study of different OS and types of OS	**Formative**	1	15	CO1, CO2
2.	**Content Improvement Activity-2** -**Mini Project** on OS Concepts using C/DS Concepts		1/ 4	15	CO2,CO3, CO4, CO5
3.	Class Participation	**Continuous**	-	5	-
4.	Periodic Test	**Formative**	1	5	CO1, CO2
5.	Preparatory Exam	**Formative**	1	10	CO1, CO2, CO3, CO4, CO5
5.	End Semester Examination	**Summative**	1	50	CO1, CO2, CO3, CO4, CO5
Total				**100**	

Assessment Sheet with Rubrics for Grading & Evaluation

Activity 1:

Rubrics for Activity 1

Criteria	Poor Below Expectation	Fair Needs improvement	Good Meets Expectations	Excellent Exceeds Exceptions	Weightage
On-time Submission	Poor: more than one week delay (2 Marks)	Moderate: 3-6 days late (4 Marks)	Good Execution: 1-2 days late (7 Marks)	Very Good: on or before time (10 Marks)	10
Learning Outcome	Poor: No idea (3 Marks)	Moderate: Average understanding of types of OS (7 Marks)	Good: Good Understanding of types of OS and difference (10 Marks)	Very Good: Very good understanding of types of OS and difference (15 Marks)	15
Report	Poor: No Clarity of topics presented, poor formatting (5Marks)	Moderate: No much Clarity of topics presented, no formatting, diagrams (10 Marks)	Good Report: Clarity of topics presented, average formatting (12 Marks)	Very Good Report: Clarity of topics presented, formatting, diagrams (15 Marks)	15
VIVA	Answer less than 3 questions correctly (4 Marks)	Answer all 3 questions correctly (6 Marks)	Answer 4 questions correctly (8 Marks)	Answer all 5 questions correctly (10 Marks)	10

Activity 2:

Rubrics for Activity 2

Criteria	Poor Below Expectation	Fair Needs improvement	Good Meets Expectations	Excellent Exceeds Exceptions	Weightage
On-time Submission	Poor: more than one week delay (1 Marks)	Moderate: 3-6 days late (3 Marks)	Good Execution: 1-2 days late (4 Marks)	Very Good: on or before time (5 Marks)	5
Abstract Submission	Poor: No explanation and example (2 Marks)	Moderate: Not detailed explanation of algorithm and example (5 Marks)	Good: Explanation of algorithm and example (7 Marks)	Very Good: On time with detail explanation of algorithm and example (10 Marks)	10
Implementation	Poor: Errors, no operations, no output (1-7 Marks)	Moderate: Errors & operations not up to the mark, output (8-13 Marks)	Good Execution: No Errors but operations not up to the mark, output (14-17 Marks)	Very Good Execution: No Errors, no copy and output (18-20 Marks)	20
Report	Poor: No Clarity of topics presented, poor formatting (2 Marks)	Moderate: No much Clarity of topics presented, no formatting, diagrams (5 Marks)	Good Report: Clarity of topics presented, average formatting (7 Marks)	Very Good Report: Clarity of topics presented, formatting, diagrams (10 Marks)	10
VIVA	Answer less than 3 questions correctly (1 Marks)	Answer all 3 questions correctly (3 Marks)	Answer 4 questions correctly (4 Marks)	Answer all 5 questions correctly (5 Marks)	5

Activity-1 Report on Comparative study of different OS and types of OS

Sr. No.	USN No.	Student Name	On-time Submission	Learning Outcomes	Report with details	Viva-Voce	Total	Conversion
			10 Marks	15 Marks	15 Marks	10 Marks	50 Marks	15 Marks

Activity-2 Mini Project on OS Concepts using C and DS Concepts

Sr. No.	USN No.	Student Name	On-time Submission	Abstract Submission	Implementation	Viva - Voce	Report	Total	Conversion
			5 Marks	10 Marks	20 Marks	5 Marks	10 Marks	50 Marks	15 Marks