



**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

(A State Government University)

**B. Tech - 2024**

**SECOND YEAR SYLLABUS  
(GROUP A)**



# **SEMESTER 4**

## **GROUP A**

FOURTH SEMESTER (January-June)														
Sl. No:	Slot	Course Code	Course Type	Course Category	Course Title (Course Name)	Credit Structure				SS	Total Marks		Credits	Hrs./ Week
						L	T	P	R		CIA	ESE		
1	A	GAMAT401	BSC	GC	Mathematics for Information Science-4	3	0	0	0	4.5	40	60	3	3
2	B	PCCST402	PC	PC	Database Management Systems	3	1	0	0	5	40	60	4	4
3	C	PCCST403	PC	PC	Operating Systems	3	1	0	0	5	40	60	4	4
4	D	PBCST404	PC-PBL	PB	Computer Organization and Architecture	3	0	0	1	5.5	60	40	4	4
5		PECST411	PE	PE	Software Engineering	3	0	0	0	4.5	40	60	3	3
5	E	PECST419	PE	PE	Cyber Ethics, privacy and legal Issues	3	0	0	0	4.5	40	60	3	3
6	G S3/S 4	UCHUT346	HMC	UC	Economics for Engineers	2	0	0	0	3	50	50	2	2
		UCHUT347			Engineering Ethics and Sustainable Development									
7	L	PCCSL407	PCL	PC	Operating Systems Lab	0	0	3	0	1.5	50	50	2	3
8	Q	PCCSL408	PCL	PC	DBMS Lab	0	0	3	0	1.5	50	50	2	3
9	R/M/ H		VAC		Remedial/Minor/Honours Course	3	1	0	0	5			4*	4*
Total										31/ 36			24/ 28*	26/ 30*

## SEMESTER S4

### MATHEMATICS FOR COMPUTER AND INFORMATION SCIENCE-4

#### (Group A)

<b>Course Code</b>	<b>GAMAT401</b>	<b>CIE Marks</b>	40
<b>Teaching Hours/Week (L: T:P: R)</b>	3:0:0:0	<b>ESE Marks</b>	60
<b>Credits</b>	3	<b>Exam Hours</b>	2 Hrs. 30 Min.
<b>Prerequisites (if any)</b>	NIL	<b>Course Type</b>	Theory

#### Course Objectives:

To provide a comprehensive understanding of fundamental concepts of graph theory including paths, cycles, trees, graph algorithms, graph coloring and matrix representations, emphasizing their applications across various disciplines.

#### SYLLABUS

<b>Module No.</b>	<b>Syllabus Description</b>	<b>Contact Hours</b>
<b>1</b>	Introduction to Graphs - Basic definition, Application of graphs, finite and infinite graphs, Incidence and Degree, Isolated vertex, Pendant vertex and Null graph. Isomorphism, Sub graphs, Walks, Paths and circuits, Connected graphs, Disconnected graphs and components.  [Text 1: Relevant topics from sections 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.4, 2.5. Proofs of theorems 2.5, 2.7 are excluded.]	<b>9</b>
<b>2</b>	Euler graphs, Operations on Graphs, Hamiltonian paths and circuits, Travelling Salesman Problem, Connectivity, Edge connectivity, Vertex connectivity, Directed graphs, Types of directed graphs.  [Text 1: Relevant topics from sections 2.6, 2.7, 2.8, 2.9, 2.10, 4.1, 4.2, 4.5, 9.1, 9.2. Proofs of theorems 4.6, 4.11, 4.12 are excluded.]	<b>9</b>
<b>3</b>	Trees- properties, Pendant vertices, Distance and centres in a tree, Rooted and binary trees, Counting trees, Spanning trees, Prim's algorithm and Kruskal's algorithm, Dijkstra's shortest path algorithm, Floyd-Warshall shortest path algorithm.	<b>9</b>

	[Text 1: Relevant topics from sections 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.10, 11.5. Proofs of theorems 3.10, 3.16 are excluded.]	
<b>4</b>	<p>Matrix representation of graphs- Adjacency matrix, Incidence Matrix, Circuit Matrix, Path Matrix, Coloring, Chromatic number, Chromatic polynomial, Greedy colouring algorithm.</p> <p>[Text 1: Relevant topics from sections 7.1, 7.3, 7.8, 7.9, 8.1, 8.3. Proofs of theorems 7.4, 7.7, 7.8, 8.2, 8.3, 8.5, 8.6 are excluded.]</p>	<b>9</b>

**Course Assessment Method**  
(CIE: 40 marks, ESE: 60 marks)

**Continuous Internal Evaluation Marks (CIE):**

<b>Attendance</b>	<b>Assignment/ Micro project</b>	<b>Internal Examination-1 (Written)</b>	<b>Internal Examination- 2 (Written)</b>	<b>Total</b>
<b>5</b>	<b>15</b>	<b>10</b>	<b>10</b>	<b>40</b>

**End Semester Examination Marks (ESE)**

*In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions*

<b>Part A</b>	<b>Part B</b>	<b>Total</b>
<ul style="list-style-type: none"> <li>2 Questions from each module.</li> <li>Total of 8 Questions, each carrying 3 marks</li> </ul> <p style="text-align: center;"><b>(8x3 =24marks)</b></p>	<ul style="list-style-type: none"> <li>Each question carries 9 marks.</li> <li>Two questions will be given from each module, out of which 1 question should be answered.</li> <li>Each question can have a maximum of 3 sub divisions.</li> </ul> <p style="text-align: center;"><b>(4x9 = 36 marks)</b></p>	<b>60</b>

### Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
<b>CO1</b>	Understand the fundamental concepts of graph theory such as types of graphs, degree of a vertex, graph isomorphism, connectedness.	<b>K2</b>
<b>CO2</b>	Understand the concepts of Euler graphs, Hamiltonian graphs and connectivity.	<b>K2</b>
<b>CO3</b>	Apply Prim's and Kruskal's algorithms for finding minimum cost spanning tree and Dijkstra's and Floyd-Warshall algorithms for finding shortest paths.	<b>K3</b>
<b>CO4</b>	Illustrate various representations of graphs using matrices and apply vertex coloring in real life problems.	<b>K3</b>

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

### CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	3	2	-	-	-	-	-	-	-	-	2
<b>CO2</b>	3	3	2	-	-	-	-	-	-	-	-	2
<b>CO3</b>	3	3	2	2	-	-	-	-	-	-	-	2
<b>CO4</b>	3	3	2	2	-	-	-	-	-	-	-	2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Graph Theory with Applications to Engineering and Computer Science	Narsingh Deo	Prentice Hall India Learning Private Limited	1st edition, 1979

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Graph Theory 2e	Douglas B. West	Pearson Education India	2nd edition, 2015
2	Introduction to Graph Theory	Robin J. Wilson	Longman Group Ltd.	5th edition, 2010
3	Graph Theory with Applications	J.A. Bondy and U.S.R. Murty	Elsevier Science Publishing Co., Inc	1976

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	<a href="https://onlinecourses.nptel.ac.in/noc22_ma10/preview">https://onlinecourses.nptel.ac.in/noc22_ma10/preview</a>
2	<a href="https://onlinecourses.nptel.ac.in/noc22_ma10/preview">https://onlinecourses.nptel.ac.in/noc22_ma10/preview</a>
3	<a href="https://onlinecourses.nptel.ac.in/noc21_cs48/preview">https://onlinecourses.nptel.ac.in/noc21_cs48/preview</a>
4	<a href="https://onlinecourses.nptel.ac.in/noc21_cs48/preview">https://onlinecourses.nptel.ac.in/noc21_cs48/preview</a>

**SEMESTER S4**  
**DATABASE MANAGEMENT SYSTEMS**  
(Common to CS/CD/CA/CR/AD/AI/CB/CN/CC/CU/CI/CG)

<b>Course Code</b>	<b>PCCST402</b>	<b>CIE Marks</b>	40
<b>Teaching Hours/Week (L: T:P: R)</b>	3:1:0:0	<b>ESE Marks</b>	60
<b>Credits</b>	4	<b>Exam Hours</b>	2 Hrs. 30 Min.
<b>Prerequisites (if any)</b>	PCCST303	<b>Course Type</b>	Theory

**Course Objectives:**

1. Equip the students with a comprehensive understanding of fundamental DBMS concepts as well as the principles and applications of NoSQL databases
2. Enable students to design, implement, and manage both relational and NoSQL databases

**SYLLABUS**

<b>Module No.</b>	<b>Syllabus Description</b>	<b>Contact Hours</b>
<b>1</b>	<p><b>Introduction to Databases :-</b> Database System Concepts and Architecture- Data Models, Schemas and Instances, Three-Schema Architecture and Data Independence, Database Languages and Interfaces, Centralized and Client/Server Architectures for DBMSs.</p> <p><b>Conceptual Data Modelling and Database Design:-</b> Data Modelling Using the Entity, Relationship (ER) Model - Entity Types, Entity Sets, Attributes, and Keys, Relationship Types, Relationship Sets, Roles, and Structural Constraints, Weak Entity Types. Refining the ER Design for the COMPANY Database.</p>	<b>11</b>
<b>2</b>	<p><b>The Relational Data Model and SQL -</b> The Relational Data Model and Relational Database Constraints-Relational Algebra and Relational Calculus - Structured Query Language (SQL)-Data Definition Language, Data Manipulation Language, Assertions, Triggers, views, Relational Database Design Using ER-to-Relational Mapping.</p>	<b>11</b>
<b>3</b>	<p><b>Database Design Theory &amp; Normalization -</b> Functional Dependencies - Basic definition; Normalization- First, Second, and Third normal forms.</p> <p>Transaction Management - Transaction Processing : Introduction, problems and failures in transaction, Desirable properties of transaction, Characterizing schedules based on recoverability and serializability; Concurrency Control</p>	<b>11</b>



	with Two-Phase Locking Techniques- Database Recovery management: Deferred update-immediate update- shadow paging.	
<b>4</b>	<b>Introduction To NoSQL Concepts</b> - types of NoSQL databases- CAP Theorem- BASE properties- Use Cases and limitations of NoSQL. <b>SQL architectural Patterns</b> - Key value Stores, Graph Stores, Column Family stores and Document Stores.	<b>11</b>

**Course Assessment Method**  
(CIE: 40 marks, ESE: 60 marks)

**Continuous Internal Evaluation Marks (CIE):**

<b>Attendance</b>	<b>Assignment/ Micro project</b>	<b>Internal Examination-1 (Written)</b>	<b>Internal Examination- 2 (Written )</b>	<b>Total</b>
<b>5</b>	<b>15</b>	<b>10</b>	<b>10</b>	<b>40</b>

**End Semester Examination Marks (ESE)**

*In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions*

<b>Part A</b>	<b>Part B</b>	<b>Total</b>
<ul style="list-style-type: none"> <li>• 2 Questions from each module.</li> <li>• Total of 8 Questions, each carrying 3 marks</li> </ul> <p style="text-align: center;"><b>(8x3 =24marks)</b></p>	<ul style="list-style-type: none"> <li>• Each question carries 9 marks.</li> <li>• Two questions will be given from each module, out of which 1 question should be answered.</li> <li>• Each question can have a maximum of 3 sub divisions.</li> </ul> <p style="text-align: center;"><b>(4x9 = 36 marks)</b></p>	<b>60</b>

## Course Outcomes (COs)

At the end of the course, students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
<b>CO1</b>	Summarize and exemplify the fundamental nature and characteristics of database systems	<b>K2</b>
<b>CO2</b>	Model and design solutions for efficiently representing data using the relational model or non-relational model	<b>K3</b>
<b>CO3</b>	Discuss and compare the aspects of Concurrency Control and Recovery in Database systems	<b>K3</b>
<b>CO4</b>	Construct advanced SQL queries to effectively retrieve, filter, and manipulate data from relational databases.	<b>K3</b>
<b>CO5</b>	Experiment with NoSQL databases in real world applications	<b>K3</b>

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

## CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	3	3									3
<b>CO2</b>	3	3	3	3						2	2	3
<b>CO3</b>	3	3	3	3								3
<b>CO4</b>	3	3	3	3								3
<b>CO5</b>	3	3	3	3								3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fundamentals of Database Systems [Module 1,2,3,4]	Elmasri, Navathe	Pearson	7/e,
2	Making the Sense of NoSQL : A guide for Managers and rest of us [Module 4]	Dan McCreary and Ann Kelly	Manning	2014

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	A., H. F. Korth and S. Sudarshan, Database System Concepts,	Sliberschatz A., H. F. Korth and S. Sudarshan, Database System Concepts, 6/e, McGraw Hill, 2011.	McGraw Hill,	7/e, 2011
2	Beginning Database Design Solutions	Rod Stephens	Wiley	2/e, 2023
2	NoSQL Distilled	Pramod J. Sadalage, Martin Fowler	Addison-Wesley	1/e, 2012
3	NoSQL Data Models: Trends and Challenges (Computer Engineering: Databases and Big Data),	Olivier Pivert	Wiley	2018

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	<a href="https://onlinecourses.nptel.ac.in/noc21_cs04/preview">https://onlinecourses.nptel.ac.in/noc21_cs04/preview</a>
2	<a href="https://onlinecourses.nptel.ac.in/noc21_cs04/preview">https://onlinecourses.nptel.ac.in/noc21_cs04/preview</a>
3	<a href="https://onlinecourses.nptel.ac.in/noc21_cs04/preview">https://onlinecourses.nptel.ac.in/noc21_cs04/preview</a>
4	<a href="https://archive.nptel.ac.in/courses/106/104/106104135/">https://archive.nptel.ac.in/courses/106/104/106104135/</a>

## SEMESTER S4

### OPERATING SYSTEMS

(Common to CS/CD/CM/CR/CA/AD/AI/CB/CN/CC/CU/CI/CG)

<b>Course Code</b>	<b>PCCST403</b>	<b>CIE Marks</b>	40
<b>Teaching Hours/Week (L: T:P: R)</b>	3:1:0:0	<b>ESE Marks</b>	60
<b>Credits</b>	4	<b>Exam Hours</b>	2 Hrs. 30 Min.
<b>Prerequisites (if any)</b>	None	<b>Course Type</b>	Theory

#### Course Objectives:

1. To introduce the structure of a typical operating system and its core functionalities
2. To impart to the students, a practical understanding of OS implementation nuances based on the Linux operating system

### SYLLABUS

<b>Module No.</b>	<b>Syllabus Description</b>	<b>Contact Hours</b>
<b>1</b>	<p><b>Introduction to Operating Systems</b> (Book 1 Ch 2 introductory part), Operating System Services (Book 3 Ch 2) Overview of Operating Systems and Kernels, Linux Versus Classic Unix Kernels (Book 2 Ch 1)</p> <p><b>Process concepts:</b> Process Creation, Process States, Data Structures, Process API (Book 1 Ch 4, 5), Sharing processor among processes - user and kernel modes, context switching (Book 1 Ch 6), System boot sequence (Book 3 Ch 2)</p> <p><b>Case study:</b> <i>Linux kernel process management (Book 2, Ch 3)</i></p> <p><b>Threads and Concurrency:</b> Concept of a thread, Multithreading benefits, Multithreading models (Book 3 Ch 4)</p> <p><b>Case study:</b> <i>The Linux Implementation of Threads (Book 2, Ch 3)</i></p> <p><b>Process scheduling:</b> Concepts and basic algorithms (Book 1 Ch 7), The Multilevel Feedback Queue: Basic Rules (Book 1 Ch 8)</p> <p><b>Case study:</b> <i>The Linux Completely Fair Scheduler (CFS) (Book 1 Ch 9, Implementation with RB trees not required), The Linux Scheduling Implementation,</i></p>	<b>11</b>

	<i>Preemption and Context Switching (Book 2, Ch 4)</i>	
2	<p><b>Concurrency and Synchronization</b> - Basic principles (Book 3 Sections 6.1, 6.2), Mechanisms - Locks: The Basic Idea, Building Spin Locks with Test-And-Set, Compare and Swap, Using Queues: Sleeping Instead Of Spinning (Book 1 Ch 28), Semaphores - Definition, Binary Semaphores, The Producer/Consumer (Bounded Buffer) Problem and its solution using semaphores, Reader-Writer Locks (Book 1 Ch 31)</p> <p><b>Case study:</b> <i>Linux Kernel Synchronization Methods - Spin Locks, Semaphores, Mutexes (Book 2 Ch 10)</i></p> <p><b>Concurrency:</b> Deadlock and Starvation - Deadlock Characterization, Deadlock Prevention and Avoidance, Deadlock Detection and recovery (Book 3 Ch 8), Dining Philosophers Problem and its solution (Book 1 Ch 31)</p>	12
3	<p><b>Memory management</b> - Address Space, Memory API, Address Translation - An Example, Dynamic (Hardware-based) Relocation, Segmentation: Generalized Base/Bounds, Address translation in segmentation, Support for Sharing (Book 1 Ch 13 to 16)</p> <p><b>Virtual memory</b> - Paging: Introduction, page tables and hardware support, TLBs, Example: Accessing An Array, - TLB hits and misses, Handling TLB misses, TLB structure, Reducing the page table size (Book 1 Ch 18 to 20)</p> <p><b>Going beyond physical memory</b> - Swap space, page fault and its control flow, page replacement policies, Thrashing (Book 1 Ch 21, 22)</p>	11
4	<p><b>I/O system:</b> Modern System architecture, Programmed I/O, Interrupts, DMA, Device interaction methods, The Device Driver (Book 1 Ch 36),</p> <p><b>Hard disk:</b> Geometry (Book 1 Ch 37), disk scheduling (Book 3 Section 11.2)</p> <p><b>Case study:</b> <i>Linux I/O schedulers - Elevator, Complete Fair Queuing (Book 2 Ch 14)</i></p> <p><b>Files and Directories:</b> The File System Interface - File descriptor, reading and writing files (sequential and random access), Removing files - Hard links and Symbolic links, Creating, reading and deleting directories, Permission bits and Access Control Lists, Mounting a file system (Book 1 Ch 39)</p>	10

	<p><b>File Organization:</b> The Inode, The Multi-Level Index (Book 1 Ch 40)</p> <p><i>Case study: VFS Objects and Their Data Structures - The Inode Object, Inode Operations (Book 2 Ch 13)</i></p>	
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**Course Assessment Method**  
(CIE: 40 marks, ESE: 60 marks)

**Continuous Internal Evaluation Marks (CIE):**

Attendance	Assignment/ Micro project	Internal Examination-1 (Written)	Internal Examination- 2 (Written )	Total
5	15	10	10	40

**End Semester Examination Marks (ESE)**

*In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions*

Part A	Part B	Total
<ul style="list-style-type: none"> <li>2 Questions from each module.</li> <li>Total of 8 Questions, each carrying 3 marks</li> </ul> <p>(8x3 =24marks)</p>	<ul style="list-style-type: none"> <li>Each question carries 9 marks.</li> <li>Two questions will be given from each module, out of which 1 question should be answered.</li> <li>Each question can have a maximum of 3 sub-divisions.</li> </ul> <p>(4x9 = 36 marks)</p>	60

**Course Outcomes (COs)**

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply the concepts of process management and process scheduling mechanisms employed in operating systems.	K3
CO2	Choose various process synchronization mechanisms employed in operating systems.	K3
CO3	Use deadlock prevention and avoidance mechanisms in operating systems.	K3
CO4	Select various memory management techniques in operating systems.	K3
CO5	Understand the storage management in operating systems.	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

**CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	3	3									3
<b>CO2</b>	3	3	3									3
<b>CO3</b>	3	3	3									3
<b>CO4</b>	3	3	3									3
<b>CO5</b>	3	3	3									3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

<b>Text Books</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
1	Operating Systems: Three Easy Pieces	Andrea Arpaci-Dusseau, Remzi Arpaci-Dusseau	CreateSpace	1/e, 2018
2	Linux Kernel Development	Robert Love	Pearson	3/e, 2018
3	Operating System Concepts	Abraham Silberschatz, Peter B. Galvin, Greg Gagne	Wiley	10/e, 2018

<b>Reference Books</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
1	Modern Operating Systems	Andrew S. Tanenbaum Herbert Bos	Pearson	5/e, 2012
2	The Design of the UNIX Operating System	Maurice J. Bach	Prentice Hall of India	1/e, 1994
3	The Little Book of Semaphores	Allen B. Downey	Green Tea Press	1/e, 2016

<b>Video Links (NPTEL, SWAYAM...)</b>	
<b>No.</b>	<b>Link ID</b>
1	<a href="https://archive.nptel.ac.in/courses/106/105/106105214/">https://archive.nptel.ac.in/courses/106/105/106105214/</a>
2	<a href="https://www.youtube.com/playlist?list=PLDW872573QAb4bj0URobvQTD41IV6gRkx">https://www.youtube.com/playlist?list=PLDW872573QAb4bj0URobvQTD41IV6gRkx</a>

## SEMESTER S4

### COMPUTER ORGANIZATION AND ARCHITECTURE

(Common to CS/CD/CR/CA/AD/CB/CN/CC/CU/CG)

<b>Course Code</b>	<b>PBCST404</b>	<b>CIE Marks</b>	60
<b>Teaching Hours/Week (L: T:P: R)</b>	3:0:0:1	<b>ESE Marks</b>	40
<b>Credits</b>	4	<b>Exam Hours</b>	2 Hrs. 30 Min.
<b>Prerequisites (if any)</b>	GAEST305	<b>Course Type</b>	Theory

#### Course Objectives

1. Introduce principles of computer organization and the basic architectural concepts using RISC.
2. Introduce the concepts of microarchitecture, memory systems, and I/O systems.

#### SYLLABUS

<b>Module No.</b>	<b>Syllabus Description</b>	<b>Contact Hours</b>
<b>1</b>	<b>Basic Structure of computers :-</b> Functional units - Basic operational concepts; Memory map; Endianness. <b>CISC vs RISC architectures:-</b> RISC Introduction - Assembly Language, Assembler directives, Assembling. <b>Programming concepts</b> - Program flow, Branching, Conditional statements, Loops, Arrays, Function calls; Instruction execution cycle. <b>Machine language</b> - Instructions, addressing modes, Stored program concept. Evolution of the RISC Architecture.	<b>11</b>
<b>2</b>	<b>Microarchitecture</b> - Introduction; Performance analysis; Single-Cycle Processor - Single Cycle Datapath, Single Cycle Control; Pipelined Processor - Pipelined Data Path, Pipelined Control: Hazards, Solving Data/Control Hazards, Performance Analysis.	<b>11</b>
<b>3</b>	<b>Memory Systems:</b> Introduction; performance analysis; Caches - basic concepts, Cache mapping, Cache replacement, Multiple-Level Caches, Reducing Miss Rate, Write Policy; Virtual Memory - Address Translation; Page Table; Translation Lookaside Buffer; Memory Protection.	<b>11</b>
<b>4</b>	<b>Input / Output</b> - External Devices; I/O Modules; Programmed I/O, Interrupt Driven I/O; Direct Memory Access; Embedded I/O Systems - Embedded I/O, General Purpose I/O, Serial I/O, Other Peripherals.	<b>11</b>



### Suggestion on Project Topics

Use simulators such as Ripes (<https://github.com/mortbopet/Ripes>) / GEM5 (<https://www.gem5.org/>) implement components of computer systems such as Various Cache organization and study the effect, Solutions to hazards, TLBs.

### Course Assessment Method (CIE: 60 marks, ESE: 40 marks)

#### Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Ex-1	Internal Ex-2	Total
5	30	12.5	12.5	60

#### End Semester Examination Marks (ESE)

*In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions*

Part A	Part B	Total
<ul style="list-style-type: none"><li>2 Questions from each module.</li><li>Total of 8 Questions, each carrying 2 marks (8x2 =16 marks)</li></ul>	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 subdivisions. Each question carries 6 marks. (4x6 = 24 marks)	40

### Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Identify the basic structure and functional units of a digital computer and the features of RISC architecture.	K2
CO2	Experiment with the single cycle processor, pipelining, and the associated problems.	K3
CO3	Utilize the memory organization in modern computer systems.	K3
CO4	Experiment with the I/O organization of a digital computer.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

**CO-PO Mapping Table:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	3	3									3
<b>CO2</b>	3	3	3	3								3
<b>CO3</b>	3	3	3	3								3
<b>CO4</b>	3	3	3	3								3

<b>Text Books</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
<b>1</b>	Digital Design and Computer Architecture - RISC-V Edition	Sarah L. Harris, David Harris	Morgan Kaufmann	1/e, 2022
<b>2</b>	Computer Organization and Architecture Designing for Performance	William Stallings	Pearson	9/e, 2013

<b>Reference Books</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
<b>1</b>	Computer Organization and Design : The Hardware/Software Interface: RISC-V Edition	David A. Patterson John L. Hennessy	Morgan Kaufman	1/e, 2018
<b>2</b>	Computer Organization and Embedded Systems	Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian	McGraw Hil	6/e, 2012
<b>3</b>	Modern Computer Architecture and Organization	Jim Ledin	Packt Publishing	1/e, 2020

<b>Video Links (NPTEL, SWAYAM...)</b>	
<b>No.</b>	<b>Link ID</b>
1	<a href="https://archive.nptel.ac.in/courses/106/105/106105163/">https://archive.nptel.ac.in/courses/106/105/106105163/</a>
2	<a href="https://archive.nptel.ac.in/courses/106/106/106106166/">https://archive.nptel.ac.in/courses/106/106/106106166/</a>

## PBL Course Elements

L: Lecture (3 Hrs.)	R: Project (1 Hr.), 2 Faculty Members		
	Tutorial	Practical	Presentation
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation/ Video Presentation: Students present their results in a 2 to 5 minutes video

## Assessment and Evaluation for Project Activity

Sl. No	Evaluation for	Allotted Marks
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
<b>Total</b>		<b>30</b>

### 1. Project Planning and Proposal (5 Marks)

- Clarity and feasibility of the project plan
- Research and background understanding
- Defined objectives and methodology

### 2. Contribution in Progress Presentation and Question Answer Sessions (4 Marks)

- Individual contribution to the presentation
- Effectiveness in answering questions and handling feedback

### 3. Involvement in the Project Work and Team Work (3 Marks)

- Active participation and individual contribution
- Teamwork and collaboration

**4. Execution and Implementation (10 Marks)**

- Adherence to the project timeline and milestones
- Application of theoretical knowledge and problem-solving
- Final Result

**5. Final Presentation (5 Marks)**

- Quality and clarity of the overall presentation
- Individual contribution to the presentation
- Effectiveness in answering questions

**6. Project Quality, Innovation, and Creativity (3 Marks)**

- Overall quality and technical excellence of the project
- Innovation and originality in the project
- Creativity in solutions and approaches

## SEMESTER S4

### SOFTWARE ENGINEERING

(Common to CS/CD/CM/CR/CA/AD/AM/CB/CN/CU/CI)

<b>Course Code</b>	<b>PECST411</b>	<b>CIE Marks</b>	40
<b>Teaching Hours/Week (L: T:P: R)</b>	3:0:0:0	<b>ESE Marks</b>	60
<b>Credits</b>	3	<b>Exam Hours</b>	2 Hrs. 30 Min.
<b>Prerequisites (if any)</b>	None	<b>Course Type</b>	Theory

#### Course Objectives:

1. To Provide fundamental knowledge in the Software Development Process including Software Development, Object Oriented Design, Project Management concepts and technology trends.
2. To enable the learners to apply state of the art industry practices in Software development.

### SYLLABUS

<b>Module No.</b>	<b>Syllabus Description</b>	<b>Contact Hours</b>
<b>1</b>	<b>Introduction to Software Engineering and Process Models</b> - Software engineering, Software characteristics and types, Layers of Software Engineering-Process, Methods, Tools and Quality focus. Software Process models – Waterfall, Prototype, Spiral, Incremental, Agile model – Values and Principles. <b>Requirement engineering</b> - Functional, Non-functional, System and User requirements. Requirement elicitation techniques, Requirement validation, Feasibility analysis and its types, SRS document characteristics and its structure. <i>Case study:</i> SRS for College Library Management Software	<b>9</b>
<b>2</b>	<b>Software design</b> - Software architecture and its importance, Software architecture patterns: Component and Connector, Layered, Repository, Client-Server, Publish-Subscribe, Functional independence – Coupling and Cohesion <i>Case study:</i> Ariane launch failure <b>Object Oriented Software Design</b> - UML diagrams and relationships– Static and dynamic models, Class diagram, State diagram, Use case diagram, Sequence diagram <i>Case Studies:</i> Voice mail system, ATM Example <b>Software pattern</b> - Model View Controller, Creational Design Pattern types –	<b>9</b>

	Factory method, Abstract Factory method, Singleton method, Prototype method, Builder method. Structural Design Pattern and its types – Adapter, Bridge, Proxy, Composite, Decorator, Façade, Flyweight. Behavioral Design Pattern	
<b>3</b>	<p><b>Coding, Testing and Maintenance:</b></p> <p><b>Coding guidelines</b> - Code review, Code walkthrough and Code inspection, Code debugging and its methods.</p> <p><b>Testing</b> - Unit testing , Integration testing, System testing and its types, Black box testing and White box testing, Regression testing</p> <p><b>Overview of DevOps and Code Management</b> - Code management, DevOps automation, Continuous Integration, Delivery, and Deployment (CI/CD/CD), <i>Case study</i> – Netflix.</p> <p><b>Software maintenance and its types-</b> Adaptive, Preventive, Corrective and Perfective maintenance. Boehm’s maintenance models (both legacy and non-legacy)</p>	<b>9</b>
<b>4</b>	<p><b>Software Project Management</b> - Project size metrics – LOC, Function points and Object points. Cost estimation using Basic COCOMO.</p> <p>Risk management: Risk and its types, Risk monitoring and management model</p> <p><b>Software Project Management</b> - Planning, Staffing, Organizational structures, Scheduling using Gantt chart. Software Configuration Management and its phases, Software Quality Management – ISO 9000, CMM, Six Sigma for software engineering.</p> <p><b>Cloud-based Software</b> -Virtualisation and containers, Everything as a service (IaaS, PaaS), Software as a service. Microservices Architecture - Microservices, Microservices architecture, Microservice deployment.</p>	<b>9</b>

**Course Assessment Method**  
(CIE: 40 marks, ESE: 60 marks)

**Continuous Internal Evaluation Marks (CIE):**

Attendance	Assignment/ Micro project	Internal Examination-1 (Written)	Internal Examination- 2 (Written )	Total
<b>5</b>	<b>15</b>	<b>10</b>	<b>10</b>	<b>40</b>

### End Semester Examination Marks (ESE)

*In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions*

Part A	Part B	Total
<ul style="list-style-type: none"><li>2 Questions from each module.</li><li>Total of 8 Questions, each carrying 3 marks</li></ul> <p><b>(8x3 =24marks)</b></p>	<ul style="list-style-type: none"><li>Each question carries 9 marks.</li><li>Two questions will be given from each module, out of which 1 question should be answered.</li><li>Each question can have a maximum of 3 sub divisions.</li></ul> <p><b>(4x9 = 36 marks)</b></p>	<b>60</b>

### Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Plan the system requirements and recommend a suitable software process model	K3
CO2	Model various software patterns based on system requirements	K3
CO3	Apply testing and maintenance strategies on the developed software product to enhance quality	K3
CO4	Develop a software product based on cost, schedule and risk constraints	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

### CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3									3
CO2	3	3	3									3
CO3	3	3	3									3
CO4	3	3	3									3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Software Engineering: A practitioner's approach	Roger S. Pressman	McGraw-Hill International edition	8/e, 2014
2	Software Engineering	Ian Sommerville	Addison-Wesley	10/e, 2015
3	Design Patterns, Elements of Reusable Object Oriented Software	Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides	Pearson Education Addison-Wesley	1/e, 2009

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Pankaj Jalote's Software Engineering: With Open Source and GenAI	Pankaj Jalote	Wiley India	1/e, 2024
2	Software Engineering: A Primer	Waman S Jawadekar	Tata McGraw-Hill	1/e, 2008
3	Object-Oriented Modeling and Design with UML	Michael Blaha, James Rumbaugh	Pearson Education.	2/e, 2007
4	Software Engineering Foundations : A Software Science Perspective	Yingux Wang	Auerbach Publications	1/e, 2008
5	Object-Oriented Design and Patterns	Cay Horstmann	Wiley India	2/e, 2005
6	Engineering Software Products: An Introduction to Modern Software Engineering	Ian Sommerville	Pearson Education	1/e, 2020

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	<a href="https://www.youtube.com/watch?v=Z6f9ckEElsU">https://www.youtube.com/watch?v=Z6f9ckEElsU</a>
2	<a href="https://www.youtube.com/watch?v=1xUz1fp23TQ">https://www.youtube.com/watch?v=1xUz1fp23TQ</a>
3	<a href="http://digimat.in/nptel/courses/video/106105150/L01.html">http://digimat.in/nptel/courses/video/106105150/L01.html</a>
4	<a href="https://www.youtube.com/watch?v=v7KtPLhSMkU">https://www.youtube.com/watch?v=v7KtPLhSMkU</a>



## SEMESTER S4

### SOFT COMPUTING

(Common to CS/CD/CM/CR/CA/AD/AI/AM/CB/CN/CI)

<b>Course Code</b>	<b>PECST417</b>	<b>CIE Marks</b>	40
<b>Teaching Hours/Week (L:T:P: R)</b>	3:0:0:0	<b>ESE Marks</b>	60
<b>Credits</b>	3	<b>Exam Hours</b>	2 Hrs. 30 Min.
<b>Prerequisites (if any)</b>	None	<b>Course Type</b>	Theory

#### Course Objectives:

1. To give exposure on soft computing, various types of soft computing techniques, and applications of soft computing
2. To impart solid foundations on Neural Networks, its architecture, functions and various algorithms involved, Fuzzy Logic, various fuzzy systems and their functions, and Genetic algorithms, its applications and advances.

### SYLLABUS

<b>Module No.</b>	<b>Syllabus Description</b>	<b>Contact Hours</b>
<b>1</b>	Introduction to Soft Computing. Difference between Hard Computing & Soft Computing. Applications of Soft Computing. Artificial Neurons Vs Biological Neurons. Basic models of artificial neural networks – Connections, Learning, Activation Functions. McCulloch and Pitts Neuron. Hebb network, Perceptron Networks– Learning rule, Training and testing algorithm. Adaptive Linear Neuron– Architecture, Training and testing algorithm.	<b>10</b>
<b>2</b>	Fuzzy logic, Fuzzy sets – Properties, Fuzzy membership functions, Features of Fuzzy membership functions. operations on fuzzy set. Linguistic variables, Linguistic hedges Fuzzy Relations, Fuzzy If-Then Rules, Fuzzification, Defuzzification– Lambda cuts, Defuzzification methods. Fuzzy Inference mechanism - Mamdani and Sugeno types.	<b>9</b>
<b>3</b>	Evolutionary Computing, Terminologies of Evolutionary Computing, Concepts of genetic algorithm. Operators in genetic algorithm - coding,	<b>8</b>

	selection, cross over, mutation. Stopping condition for genetic algorithm.	
<b>4</b>	Multi-objective optimization problem. Principles of Multi- objective optimization, Dominance and pareto-optimality. Optimality conditions. Collective Systems, Biological Self-Organization, Particle Swarm Optimization, Ant Colony Optimization, Swarm Robotics.	<b>9</b>

### Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

#### Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
<b>5</b>	<b>15</b>	<b>10</b>	<b>10</b>	<b>40</b>

#### End Semester Examination Marks (ESE)

*In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions*

Part A	Part B	Total
<ul style="list-style-type: none"> <li>2 Questions from each module.</li> <li>Total of 8 Questions, each carrying 3 marks</li> </ul> <p><b>(8x3 =24 marks)</b></p>	<ul style="list-style-type: none"> <li>Each question carries 9 marks.</li> <li>Two questions will be given from each module, out of which 1 question should be answered.</li> <li>Each question can have a maximum of 3 subdivisions.</li> </ul> <p><b>(4x9 = 36 marks)</b></p>	<b>60</b>

### Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
<b>CO1</b>	Describe the techniques used in soft computing and outline the fundamental models of artificial neural networks	<b>K2</b>
<b>CO2</b>	Solve practical problems using neural networks	<b>K3</b>
<b>CO3</b>	Illustrate the operations, model, and applications of fuzzy logic.	<b>K3</b>
<b>CO4</b>	Illustrate the concepts of evolutionary algorithms such as Genetic Algorithm	<b>K3</b>
<b>CO5</b>	Describe the concepts of multi-objective optimization models and collective systems.	<b>K2</b>

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

### *CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)*

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	3	3									3
<b>CO2</b>	3	3	2	2								3
<b>CO3</b>	3	3	3	2								3
<b>CO4</b>	3	3	2	2								3
<b>CO5</b>	3	3	3									3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
<b>1</b>	Principles of Soft Computing	S.N.Sivanandam, S.N. Deepa	John Wiley & Sons.	3/e, 2018
<b>2</b>	Multi-objective Optimization using Evolutionary Algorithms	Kalyanmoy Deb,	John Wiley & Sons	1/e, 2009
<b>3</b>	Computational intelligence: synergies of fuzzy logic, neural networks and evolutionary computing.	Siddique N, Adeli H.	John Wiley & Sons	1/e, 2013
<b>4</b>	Bio-inspired artificial intelligence: theories, methods, and technologies.	Floreano D, Mattiussi C.	MIT press; 2008 Aug 22.	1/e, 2023

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fuzzy Logic with Engineering Applications	Timothy J Ross,	John Wiley & Sons,	3/e, 2011
2	Neural Networks, Fuzzy Logic & Genetic Algorithms Synthesis and Applications	T.S.Rajasekaran, G.A.Vijaylakshmi Pai	Prentice-Hall India	1/e, 2003
3	Neural Networks- A Comprehensive Foundation	Simon Haykin	Pearson Education	2/e, 1997
4	Fuzzy Set Theory & Its Applications	Zimmermann H. J,	Allied Publishers Ltd.	4/e, 2001

Video Links (NPTEL, SWAYAM...)	
No.	Link ID
1	<a href="https://archive.nptel.ac.in/courses/106/105/106105173/">https://archive.nptel.ac.in/courses/106/105/106105173/</a>

## SEMESTER S4

### CYBER ETHICS, PRIVACY AND LEGAL ISSUES

(Common to CS/CM/CA/AM)

<b>Course Code</b>	<b>PECST419</b>	<b>CIE Marks</b>	40
<b>Teaching Hours/Week (L: T:P: R)</b>	3:0:0:0	<b>ESE Marks</b>	60
<b>Credits</b>	3	<b>Exam Hours</b>	2 Hrs. 30 Min.
<b>Prerequisites (if any)</b>	None	<b>Course Type</b>	Theory

#### Course Objectives:

1. To provide a comprehensive understanding of the fundamental concepts of cyberspace and cyber law, enabling them to analyse and address the challenges of regulating and securing the digital world
2. To explain cybercrime, intellectual property, cyber ethics, and ethical issues in emerging technologies, enabling them to tackle related challenges effectively.
3. To give awareness on data protection and privacy in cyberspace, and to learn legal frameworks protecting privacy, enabling them to address and manage privacy-related challenges effectively

### SYLLABUS

<b>Module No.</b>	<b>Syllabus Description</b>	<b>Contact Hours</b>
<b>1</b>	<b>Fundamentals of Cyber Law and Cyber Space:-</b> Introduction to cyber law, Contract aspects in cyber law, Security aspects of cyber law, Intellectual property aspects in cyber law and Evidence aspects in cyber law, Criminal aspects in cyber law, Need for Indian cyber law  Cyberspace- Web space, Web hosting and web development agreement, Legal and Technological Significance of domain Names, Internet as a tool for global access.	<b>9</b>
<b>2</b>	<b>Cyber crime and Cyber Ethics:-</b> Cyber crime and Cyber Ethics:- Introduction to cybercrime- Definition and Origins of Cyber crime- Classifications of Cybercrime, Cyber Offences- Strategic Attacks, Types of Attacks, Security Challenges Faced by Mobile Devices. Organizational Measures for Handling Mobile Phones.  Cyber Ethics: The Importance of Cyber Law, Significance of Cyber Ethics, Need for Cyber regulations Based on Cyber Ethics, Ethics in Information	<b>9</b>

	society, Artificial Intelligence Ethics- Ethical Issues in AI and core Principles, Block chain Ethics- Definition and Description.	
<b>3</b>	<b>Data Protection and Privacy Concerns in Cyberspace :</b> Need to protect data in cyberspace, Types of data , Legal framework of data protection, Data protection bill -an overview, GDPR, Concept of privacy, Privacy concerns of cyberspace, Constitutional framework of privacy, Judicial interpretation of privacy in India, Privacy Law and Regulation, Organizational Response, Privacy and Data Surveillance	<b>9</b>
<b>4</b>	<b>Security Policies and Information Technology Act</b>  Need for an Information Security policy, Information Security Standards- ISO, Introducing various security policies and their review process, Information Technology Act, 2000, Penalties, Adjudication and appeals under the IT Act,2000, Offences under IT Act, 2000, Right to Information Act, 2005, IT Act,2008 and its amendments.	<b>9</b>

**Course Assessment Method**  
**(CIE: 40 marks, ESE: 60 marks)**

**Continuous Internal Evaluation Marks (CIE):**

<b>Attendance</b>	<b>Assignment/ Microproject</b>	<b>Internal Examination-1 (Written)</b>	<b>Internal Examination- 2 (Written)</b>	<b>Total</b>
<b>5</b>	<b>15</b>	<b>10</b>	<b>10</b>	<b>40</b>

### End Semester Examination Marks (ESE)

*In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions*

Part A	Part B	Total
<ul style="list-style-type: none"><li>• 2 Questions from each module.</li><li>• Total of 8 Questions, each carrying 3 marks</li></ul> <p>(8x3 =24 marks)</p>	<ul style="list-style-type: none"><li>• Each question carries 9 marks.</li><li>• Two questions will be given from each module, out of which 1 question should be answered.</li><li>• Each question can have a maximum of 3 subdivisions.</li></ul> <p>(4x9 = 36 marks)</p>	<b>60</b>

### Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Describe the concepts of cyber law and the various components and challenges associated with cyberspace.	K2
CO2	Discuss the concept of cybercrime and computer crime, the challenges faced by law enforcement, and the importance of intellectual property in the digital age.	K2
CO3	Explain the importance of cyber law and ethics, the need for regulations, and the ethical considerations in emerging technologies like AI and blockchain.	K2
CO4	Identify data protection and privacy issues in cyberspace and describe various laws and regulations to address these challenges in the digital age, ensuring comprehensive privacy protection and compliance.	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

**CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2										2
CO2	2	2										2
CO3	2	2										2
CO4	2	2										2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Cyber Security and Cyber Laws	Nilakshi Jain, Ramesh Menon	Wiley	1/e, 2020
2	Cyber Security understanding Cyber Crimes, Computer Forensics and Legal Perspectives	Sumit Belapure , Nina Godbole	Wiley India Pvt.Ltd.	1/e, 2011
3	Cyber Ethics 4.0: Serving Humanity with Values	Christoph Stückelberger, Pavan Duggal	Globethics	1/e, 2018
4	Cyber Laws: Intellectual property & E Commerce, Security	K. Kumar	Dominant Publisher	1/e,2011
5	Introduction to Information Security and Cyber Laws	Surya Prakash Tripathi, Ritendra Goel, Praveen Kumar Shukla	Dreamtech Press	1/e, 2014
6	Cyber Law: The Law of the Internet and Information Technology	Craig B	Pearson Education	First Edition,2013

Video Links (NPTEL, SWAYAM...)	
No.	Link ID
1	<a href="https://www.wbnsou.ac.in/NSOU-MOOC/mooc_cyber_security.shtml">https://www.wbnsou.ac.in/NSOU-MOOC/mooc_cyber_security.shtml</a>
2	<a href="https://onlinecourses.swayam2.ac.in/cec22_lw07/preview">https://onlinecourses.swayam2.ac.in/cec22_lw07/preview</a>
3	<a href="https://www.coursera.org/learn/data-security-privacy#modules">https://www.coursera.org/learn/data-security-privacy#modules</a>
4	<a href="https://jurnal.fh.unila.ac.id/index.php/fiat/article/download/2667/1961/12044">https://jurnal.fh.unila.ac.id/index.php/fiat/article/download/2667/1961/12044</a>



## SEMESTER S3/S4

### ENGINEERING ETHICS AND SUSTAINABLE DEVELOPMENT

Course Code	UCHUT347	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

#### Course Objectives:

1. Equip with the knowledge and skills to make ethical decisions and implement gender-sensitive practices in their professional lives.
2. Develop a holistic and comprehensive interdisciplinary approach to understanding engineering ethics principles from a perspective of environment protection and sustainable development.
3. Develop the ability to find strategies for implementing sustainable engineering solutions.

### SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	<b>Fundamentals of ethics</b> - Personal vs. professional ethics, Civic Virtue, Respect for others, <b>Profession and Professionalism</b> , Ingenuity, diligence and responsibility, Integrity in design, development, and research domains, Plagiarism, a balanced outlook on law - challenges - case studies, <b>Technology and digital revolution</b> -Data, information, and knowledge, Cybertrust and cybersecurity, Data collection & management, <b>High technologies: connecting people and places</b> -accessibility and social impacts, <b>Managing conflict</b> , Collective bargaining, <b>Confidentiality</b> , Role of confidentiality in moral integrity, <b>Codes of Ethics</b> . <b>Basic concepts in Gender Studies</b> - sex, gender, sexuality, gender	6

	spectrum: beyond the binary, gender identity, gender expression, gender stereotypes, <b>Gender disparity and discrimination in education</b> , employment and everyday life, History of women in Science & Technology, Gendered technologies & innovations, <b>Ethical values and practices in connection with gender</b> - equity, diversity & gender justice, <b>Gender policy and women/transgender empowerment initiatives</b> .	
<b>2</b>	<b>Introduction to Environmental Ethics:</b> Definition, importance and historical development of environmental ethics, key philosophical theories (anthropocentrism, biocentrism, ecocentrism). <b>Sustainable Engineering Principles:</b> Definition and scope, triple bottom line (economic, social and environmental sustainability), life cycle analysis and sustainability metrics. <b>Ecosystems and Biodiversity:</b> Basics of ecosystems and their functions, Importance of biodiversity and its conservation, Human impact on ecosystems and biodiversity loss, An overview of various ecosystems in Kerala/India, and its significance. <b>Landscape and Urban Ecology:</b> Principles of landscape ecology, Urbanization and its environmental impact, Sustainable urban planning and green infrastructure.	<b>6</b>
<b>3</b>	<b>Hydrology and Water Management:</b> Basics of hydrology and water cycle, Water scarcity and pollution issues, Sustainable water management practices, Environmental flow, disruptions and disasters. <b>Zero Waste Concepts and Practices:</b> Definition of zero waste and its principles, Strategies for waste reduction, reuse, reduce and recycling, Case studies of successful zero waste initiatives. <b>Circular Economy and Degrowth:</b> Introduction to the circular economy model, Differences between linear and circular economies, degrowth principles, Strategies for implementing circular economy practices and degrowth principles in engineering. <b>Mobility and Sustainable Transportation:</b> Impacts of transportation on the environment and climate, Basic tenets of a Sustainable Transportation design, Sustainable urban mobility solutions, Integrated mobility systems, E-Mobility, Existing and upcoming models of sustainable mobility solutions.	<b>6</b>
<b>4</b>	<b>Renewable Energy and Sustainable Technologies:</b> Overview of renewable energy sources (solar, wind, hydro, biomass), Sustainable technologies in	<b>6</b>

	<p>energy production and consumption, Challenges and opportunities in renewable energy adoption. <b>Climate Change and Engineering Solutions:</b> Basics of climate change science, Impact of climate change on natural and human systems, Kerala/India and the Climate crisis, Engineering solutions to mitigate, adapt and build resilience to climate change. <b>Environmental Policies and Regulations:</b> Overview of key environmental policies and regulations (national and international), Role of engineers in policy implementation and compliance, Ethical considerations in environmental policy-making. <b>Case Studies and Future Directions:</b> Analysis of real-world case studies, Emerging trends and future directions in environmental ethics and sustainability, Discussion on the role of engineers in promoting a sustainable future.</p>	
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### Course Assessment Method (CIE: 50 marks , ESE: 50)

#### Continuous Internal Evaluation Marks (CIE):

Continuous internal evaluation will be based on individual and group activities undertaken throughout the course and the portfolio created documenting their work and learning. The portfolio will include reflections, project reports, case studies, and all other relevant materials.

- The students should be grouped into groups of size 4 to 6 at the beginning of the semester. These groups can be the same ones they have formed in the previous semester.
- Activities are to be distributed between 2 class hours and 3 Self-study hours.
- The portfolio and reflective journal should be carried forward and displayed during the 7th Semester Seminar course as a part of the experience sharing regarding the skills developed through various courses.

Sl. No.	Item	Particulars	Group/Individual (G/I)	Marks
1	Reflective Journal	Weekly entries reflecting on what was learned, personal insights, and how it can be applied to local contexts.	I	5
2	Micro project  (Detailed documentation of the project, including methodologies, findings, and reflections)	1 a) Perform an Engineering Ethics Case Study analysis and prepare a report  1 b) Conduct a literature survey on ‘Code of Ethics for Engineers’ and prepare a sample code of ethics	G	8
		2. Listen to a TED talk on a Gender-related topic, do a literature survey on that topic and make a report citing the relevant papers with a specific analysis of the Kerala context	G	5
		3. Undertake a project study based on the concepts of sustainable development* - Module II, Module III & Module IV	G	12
3	Activities	2. One activity* each from Module II, Module III & Module IV	G	15
4	Final Presentation	A comprehensive presentation summarising the key takeaways from the course, personal reflections, and proposed future actions based on the learnings.	G	5
Total Marks			<b>50</b>	

\*Can be taken from the given sample activities/projects

#### Evaluation Criteria:

- **Depth of Analysis:** Quality and depth of reflections and analysis in project reports and case studies.
- **Application of Concepts:** Ability to apply course concepts to real-world problems and local contexts.
- **Creativity:** Innovative approaches and creative solutions proposed in projects and reflections.
- **Presentation Skills:** Clarity, coherence, and professionalism in the final presentation.

### Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop the ability to apply the principles of engineering ethics in their professional life.	K3
CO2	Develop the ability to exercise gender-sensitive practices in their professional lives	K4
CO3	Develop the ability to explore contemporary environmental issues and sustainable practices.	K5
CO4	Develop the ability to analyse the role of engineers in promoting sustainability and climate resilience.	K4
CO5	Develop interest and skills in addressing pertinent environmental and climate-related challenges through a sustainable engineering approach.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

### CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						3	2	3	3	2		2
CO2		1				3	2	3	3	2		2
CO3						3	3	2	3	2		2
CO4		1				3	3	2	3	2		2
CO5						3	3	2	3	2		2

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Ethics in Engineering Practice and Research	Caroline Whitbeck	Cambridge University Press & Assessment	2nd edition & August 2011
2	Virtue Ethics and Professional Roles	Justin Oakley	Cambridge University Press & Assessment	November 2006
3	Sustainability Science	Bert J. M. de Vries	Cambridge University Press & Assessment	2nd edition & December 2023
4	Sustainable Engineering Principles and Practice	Bhavik R. Bakshi,	Cambridge University Press & Assessment	2019
5	Engineering Ethics	M Govindarajan, S Natarajan and V S Senthil Kumar	PHI Learning Private Ltd, New Delhi	2012
6	Professional ethics and human values	RS Naagarazan	New age international (P) limited New Delhi	2006.
7	Ethics in Engineering	Mike W Martin and Roland Schinzinger,	Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi	4" edition, 2014

### Suggested Activities/Projects:

#### Module-II

- Write a reflection on a local environmental issue (e.g., plastic waste in Kerala backwaters or oceans) from different ethical perspectives (anthropocentric, biocentric, ecocentric).
- Write a life cycle analysis report of a common product used in Kerala (e.g., a coconut, bamboo or rubber-based product) and present findings on its sustainability.
- Create a sustainability report for a local business, assessing its environmental, social, and economic impacts
- Presentation on biodiversity in a nearby area (e.g., a local park, a wetland, mangroves, college campus etc) and propose conservation strategies to protect it.
- Develop a conservation plan for an endangered species found in Kerala.
- Analyze the green spaces in a local urban area and propose a plan to enhance urban ecology using native plants and sustainable design.
- Create a model of a sustainable urban landscape for a chosen locality in Kerala.

### **Module-III**

- Study a local water body (e.g., a river or lake) for signs of pollution or natural flow disruption and suggest sustainable management and restoration practices.
- Analyse the effectiveness of water management in the college campus and propose improvements - calculate the water footprint, how to reduce the footprint, how to increase supply through rainwater harvesting, and how to decrease the supply-demand ratio
- Implement a zero waste initiative on the college campus for one week and document the challenges and outcomes.
- Develop a waste audit report for the campus. Suggest a plan for a zero-waste approach.
- Create a circular economy model for a common product used in Kerala (e.g., coconut oil, cloth etc).
- Design a product or service based on circular economy and degrowth principles and present a business plan.
- Develop a plan to improve pedestrian and cycling infrastructure in a chosen locality in Kerala

### **Module-IV**

- Evaluate the potential for installing solar panels on the college campus including cost-benefit analysis and feasibility study.
- Analyse the energy consumption patterns of the college campus and propose sustainable alternatives to reduce consumption - What gadgets are being used? How can we reduce demand using energy-saving gadgets?
- Analyse a local infrastructure project for its climate resilience and suggest improvements.
- Analyse a specific environmental regulation in India (e.g., Coastal Regulation Zone) and its impact on local communities and ecosystems.
- Research and present a case study of a successful sustainable engineering project in Kerala/India (e.g., sustainable building design, water management project, infrastructure project).
- Research and present a case study of an unsustainable engineering project in Kerala/India highlighting design and implementation faults and possible corrections/alternatives (e.g., a housing complex with water logging, a water management project causing frequent floods, infrastructure project that affects surrounding landscapes or ecosystems).

## SEMESTER S4

### OPERATING SYSTEMS LAB

(Common to CS/CD/CM/CR/CA/AI/CB/CN/CC/CU/CI/CG)

Course Code	PCCSL407	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	GYEST204	Course Type	Lab

#### Course Objectives:

1. To familiarize various Linux commands related to Operating systems.
2. To give practical experience for learners on implementing different functions of Operating systems such as process management, memory management, and disk management.

Expt. No.	Experiments
1	Familiarisation with basic Linux programming commands: ps, strace, gdb, strings, objdump, nm, file, od, xxd, time, fuser, top
2	Use <b>/proc</b> file system to gather basic information about your machine:  (a) Number of CPU cores (b) Total memory and the fraction of free memory (c) Number of processes currently running. (d) Number of processes in the running and blocked states. (e) Number of processes forked since the last bootup. How do you compare this value with the one in (c) above? (f) The number of context switches performed since the last bootup for a particular process.
3	Write a simple program to print the system time and execute it. Then use the <b>/proc</b> file system to determine how long this program (in the strict sense, the corresponding process) ran in user and kernel modes.
4	Create a new process using a <b>fork</b> system call. Print the parent and child process IDs. Use the <b>ps</b> command to find the process tree for the child process starting from the <b>init</b>



	process.
5	Write a program to add two integers (received via the command line) and compile it to an executable named “ <b>myadder</b> ”. Now write another program that creates a new process using a <b>fork</b> system call. Make the child process add two integers by replacing its image with the “ <b>myadder</b> ” image using <b>execvp</b> system call.
6	Create a new process using a <b>fork</b> system call. The child process should print the string “ <b>PCCSL407</b> ” and the parent process should print the string “ <b>Operating Systems Lab</b> ”. Use a <b>wait</b> system call to ensure that the output displayed is “ <b>PCCSL407 Operating Systems Lab</b> ”
7	<p><b>Inter-process Communication (<a href="https://www.linuxdoc.org/LDP/lpg/node7.html">https://www.linuxdoc.org/LDP/lpg/node7.html</a>)</b></p> <p>(a) Using Pipe – Evaluate the expression <math>\sqrt{b^2 + 4ac}</math>. The first process evaluates <math>b^2</math>. The second process evaluates <math>4ac</math> and sends it to the first process which evaluates the final expression and displays it.</p> <p>(b) Using Message Queue - The first process sends a string to the second process. The second process reverses the received string and sends it back to the first process. The first process compares the original string and the reversed string received from the second one and then prints whether the string is a palindrome or not.</p> <p>(c) Using Shared Memory - The first process sends three strings to the second process. The second process concatenates them to a single string (with whitespace being inserted between the two individual strings) and sends it back to the first process. The first process prints the concatenated string in the flipped case, that is if the concatenated string is “<b>Hello S4 Students</b>”, the final output should be “<b>hELLO s4 sTUDENTS</b>”</p>
8	Write a multithreaded program that calculates the mean, median, and standard deviation for a list of integers. This program should receive a series of integers on the command line and will then create three separate worker threads. The first thread will determine the mean value, the second will determine the median and the third will calculate the standard deviation of the integers. The variables representing the mean, median, and standard deviation values will be stored globally. The worker threads will set these values, and the parent thread will output the values once the workers have exited.
9	Input a list of processes, their CPU burst times (integral values), arrival times, and priorities. Then simulate FCFS, SRTF, non-preemptive priority (a larger priority number implies a higher priority), and RR (quantum = 3 units) scheduling algorithms on the

	process mix, determining which algorithm results in the minimum average waiting time (over all processes).
10	Use semaphores to solve the readers-writers problem with writers being given priority over readers.
11	Obtain a (deadlock-free) process mix and simulate the banker's algorithm to determine a safe execution sequence.
12	Obtain a process mix and determine if the system is deadlocked.
13	Implement the deadlock-free semaphore-based solution for the dining philosopher's problem.
14	<p>Simulate the address translation in the paging scheme as follows: The program receives three command line arguments in the order</p> <ul style="list-style-type: none"> <li>• size of the virtual address space (in megabytes)</li> <li>• page size (in kilobytes)</li> <li>• a virtual address (in decimal notation)</li> </ul> <p>The output should be the physical address corresponding to the virtual address in &lt;frame number, offset&gt; format. You may assume that the page table is implemented as an array indexed by page numbers. (NB: If the page table has no index for the page number determined from the virtual address, you may just declare a page table miss!)</p>
15	Simulate the FIFO, LRU, and optimal page-replacement algorithms as follows: First, generate a random page-reference string where page numbers range from 0 to 9. Apply the random page-reference string to each algorithm, and record the number of page faults incurred by each algorithm. Assume that demand paging is used. The length of the reference string and the number of page frames (varying from 1 to 7) are to be received as command line arguments.
16	Simulate the SSTF, LOOK, and CSCAN disk-scheduling algorithms as follows: Your program will service a disk with 5,000 cylinders numbered 0 to 4,999. The program will generate a random series of 10 cylinder requests and service them according to each of the algorithms listed earlier. The program will be passed the initial position of the disk head (as a parameter on the command line) and will report the total number of head movements required by each algorithm.

**Course Assessment Method**  
(CIE: 50 marks, ESE: 50 marks)

**Continuous Internal Evaluation Marks (CIE):**

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

**End Semester Examination Marks (ESE):**

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- *Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.*
- *Endorsement by External Examiner: The external examiner shall endorse the record*

**Course Outcomes (COs)**

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Illustrate the use of various systems calls in Operating Systems.	K3
CO2	Implement process creation and inter-process communication in Operating Systems	K3
CO3	Compare the performance of various CPU scheduling algorithms	K4
CO4	Compare the performance of various disk scheduling algorithms	K4

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

**CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	3	3	3				3				3
<b>CO2</b>	3	3	3	3				3				3
<b>CO3</b>	3	3	3	3				3				3
<b>CO4</b>	3	3	3	3				3				3
<b>CO5</b>	3	3	3	3				3				3

*1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

<b>Text Books</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
1	Operating Systems: Three Easy Pieces	Andrea Arpaci-Dusseau, Remzi Arpaci-Dusseau	CreateSpace	1/e, 2018
2	Linux Kernel Development	Robert Love	Pearson	3/e, 2018
3	Unix Network Programming - Volume 2: Interprocess Communications	Richard Stevens	Prentice Hall	2/e, 1999

<b>Reference Books/Websites</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
1	The Design of the UNIX Operating System	Maurice J. Bach	Prentice Hall of India	1/e, 1994
2	The Little Book of Semaphores	Allen B. Downey	Green Tea Press	1/e, 2016

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	<a href="https://archive.nptel.ac.in/courses/106/105/106105214/">https://archive.nptel.ac.in/courses/106/105/106105214/</a>
2	<a href="https://www.youtube.com/playlist?list=PLDW872573QAb4bj0URobvQTD41IV6gRkx">https://www.youtube.com/playlist?list=PLDW872573QAb4bj0URobvQTD41IV6gRkx</a>

## Continuous Assessment (25 Marks)

### 1. Preparation and Pre-Lab Work (7 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

### 2. Conduct of Experiments (7 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

### 3. Lab Reports and Record Keeping (6 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

### 4. Viva Voce (5 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

***Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.***

## **Evaluation Pattern for End Semester Examination (50 Marks)**

### **1. Procedure/Preliminary Work/Design/Algorithm (10 Marks)**

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

### **2. Conduct of Experiment/Execution of Work/Programming (15 Marks)**

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

### **3. Result with Valid Inference/Quality of Output (10 Marks)**

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

### **4. Viva Voce (10 Marks)**

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

### **5. Record (5 Marks)**

- Completeness, clarity, and accuracy of the lab record submitted

## SEMESTER S4

### DBMS LAB

(Common to CS/CD/CR/CA/AD/AI/CB/CN/CC/CU/CI/CG)

<b>Course Code</b>	<b>PCCSL408</b>	<b>CIE Marks</b>	50
<b>Teaching Hours/Week (L: T:P: R)</b>	0:0:3:0	<b>ESE Marks</b>	50
<b>Credits</b>	2	<b>Exam Hours</b>	2 Hrs. 30 Min.
<b>Prerequisites (if any)</b>	None	<b>Course Type</b>	Lab

#### Course Objectives:

1. To equip students with comprehensive skills in SQL, PL/SQL, and NoSQL databases.
2. To enable the learner to proficiently design, implement, and manage relational and non-relational databases to meet diverse data management needs

<b>Expt. No.</b>	<b>Experiments</b>
<b>1</b>	Design a database schema for an application with ER diagram from a problem description.
<b>2</b>	Creation of database schema - DDL (create tables, set constraints, enforce relationships, create indices, delete and modify tables). Export ER diagram from the database and verify relationships (with the ER diagram designed in step 1).
<b>3</b>	Database initialization - Data insert, Data import to a database (bulk import using UI and SQL Commands).
<b>4</b>	Practice SQL commands for DML (insertion, updating, altering, deletion of data, and viewing/querying records based on condition in databases).
<b>5</b>	Implementation of various aggregate functions, Order By, Group By & Having clause in SQL.
<b>6</b>	Implementation of set operators nested queries, and join queries.
<b>7</b>	Practice of SQL TCL DCL commands like Rollback, Commit, Savepoint, Practice of SQL DCL commands for granting and revoking user privileges.
<b>8</b>	Practice of SQL commands for creation of views and assertions.
<b>9</b>	Creation of Procedures, Triggers and Functions.
<b>10</b>	Creation of Packages and cursors.
<b>11</b>	Design a database application using any front-end tool for any problem selected in experiment number 1. The application constructed should have five or more tables**.
<b>12</b>	Perform basic CRUD (Create, Read, Update, Delete) operations on a Cassandra table.
<b>13</b>	Write and execute CQL queries to retrieve specific data from Cassandra tables
<b>14</b>	Create a simple application using MongoDB with python

\*\* The problem must be designed to convey the difference of NoSQL from SQL databases.

**Course Assessment Method**  
(CIE: 50 marks, ESE: 50 marks)

**Continuous Internal Evaluation Marks (CIE):**

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

**End Semester Examination Marks (ESE):**

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- *Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.*
- *Endorsement by External Examiner: The external examiner shall endorse the record*

**Course Outcomes (COs)**

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop database schema for a given real world problem-domain using standard design and modeling approaches	K3
CO2	Construct queries using SQL for database creation, interaction, modification, and updation.	K3
CO3	Plan and implement triggers and cursors, procedures, functions, and control structures using PL/SQL	K3
CO4	Perform CRUD operations in NoSQL Databases	K3
CO5	Design database applications using front-end tools and back-end DBMS	K5

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create



### CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1						3		3
CO2	3	3	3	1						3		3
CO3	3	3	3	1						3		3
CO4	3	3	3	2	3					3		3
CO5	3	3	3	2	3					3	3	3

*1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fundamentals of Database Systems	Elmasri, Navathe	Pearson	7/e, 2017
2	Professional NoSQL	Shashank Tiwari	Wiley	1/e, 2011

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Database System Concepts,	Sliberschatz Korth and S. Sudarshan	McGraw Hill,	7/e, 2017
2	NoSQL for Dummies	Adam Fowler	John Wiley & Sons	1/e, 2015
3	NoSQL Data Models: Trends and Challenges (Computer Engineering: Databases and Big Data),	Olivier Pivert	Wiley	1/e, 2018
4	Making the Sense of NoSQL : A guide for Managers and Rest of us.	Dan McCreary and Ann Kelly	Manning	1/e, 2014

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	<a href="https://onlinecourses.nptel.ac.in/noc21_cs04/preview">https://onlinecourses.nptel.ac.in/noc21_cs04/preview</a>
2	<a href="https://onlinecourses.nptel.ac.in/noc21_cs04/preview">https://onlinecourses.nptel.ac.in/noc21_cs04/preview</a>
3	<a href="https://onlinecourses.nptel.ac.in/noc21_cs04/preview">https://onlinecourses.nptel.ac.in/noc21_cs04/preview</a>
4	<a href="https://archive.nptel.ac.in/courses/106/104/106104135/">https://archive.nptel.ac.in/courses/106/104/106104135/</a>

## **Continuous Assessment (25 Marks)**

### **1. Preparation and Pre-Lab Work (7 Marks)**

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

### **2. Conduct of Experiments (7 Marks)**

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

### **3. Lab Reports and Record Keeping (6 Marks)**

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

### **4. Viva Voce (5 Marks)**

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

***Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.***

## **Evaluation Pattern for End Semester Examination (50 Marks)**

### **1. Procedure/Preliminary Work/Design/Algorithm (10 Marks)**

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.

- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

## **2. Conduct of Experiment/Execution of Work/Programming (15 Marks)**

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

## **3. Result with Valid Inference/Quality of Output (10 Marks)**

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

## **4. Viva Voce (10 Marks)**

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

## **5. Record (5 Marks)**

- Completeness, clarity, and accuracy of the lab record submitted