



Tulsiramji Gaikwad-Patil College of Engineering & Technology, Nagpur

(An Autonomous Institution Affiliated to RTM Nagpur University, Nagpur)

SCHEME OF INSTRUCTIONS & SYLLABI

Programme: Computer Science & Engineering

Scheme of Instructions: Second Year B.Tech. in Computer Science & Engineering

Semester-IV



Sr. No.	Course Category	Course Code	Course Title	T/P	Contact Hours			Credits	Exam Scheme			ESE Duration (Hours)	Total Marks
					L	P	Hrs.		CT/IA	CA	ESE		
1	PCC	BCS42401	Operating Systems	T	3	-	3	3	30	10	60	3	100
2	PCC	BCS42402	Database Management System	T	3	-	3	3	30	10	60	3	100
3	PCC	BCS42403	Theoretical Foundations of Computer Science	T	3	-	3	3	30	10	60	3	100
4	MDM	BSH32401	Discrete Mathematics & Graph Theory	T	2	-	2	2	14	6	30	2	50
5	OEC	BCS42404	OE-II – Introduction to Programming	T	2	-	2	2	14	6	30	2	50
6	VSEC	BCS42405	Introduction to Data Science	P	-	4	4	2	-	50	50	-	100
7	HSSM	BBA42408	Business Economics & Entrepreneurship	T	2	-	2	2	14	6	30	2	50
8	VEC	BSH424XX	Intellectual Property Rights	T	2	-	2	2	14	6	30	2	50
9	PCC	BCS42406	Operating Systems - Lab	P	-	2	2	1	-	25	25	-	50
10	PCC	BCS42407	Database Management System - Lab	P	-	2	2	1	-	25	25	-	50
11	AEC	BSH424XX	Liberal Learning Module-IV	P	-	2	2	1	50		-	-	50
Total				-	17	10	27	22	196	154	400	17	750

Course Category	BSC/ESC (Basic Science Course/Engineering Science Course.)	PCC (Programme Core courses)	PEC (Programme Elective courses)	OEC (Open Elective Course)	Multi-disciplinary courses	VSEC (Skill Course)	VEC (Value Education Courses)	Humanities Social Science & Management		Experiential Learning Courses	VAC (Value added Course)
								AEC (Ability Enhancement Course)	IKS (Indian Knowledge System)		
Credits		8	-	2	2	2	-	1		-	-
Cumulative Sum	16/13	20	-	6	4	6	2	6		2	2

PROGRESSIVE TOTAL CREDITS: 62+22=84

				June, 2026	1.00	Applicable for AY 2026-27
Chairperson HOD	Director Academics / Vice-Principal Director Academics Tulsiramji Gaikwad-Patil College Of Engineering And Technology, Nagpur	Director Administration Dr. Premnand Naktode Principal TGPCET, Nagpur	Principal	Date of Release	Version	

	Tulsiramji Gaikwad-Patil College of Engineering and Technology Wardha Road, Nagpur-441108 NAAC Accredited (A+ Grade) An Autonomous Institute affiliated to RTMNU Nagpur		
Second Year (Semester-IV) B.Tech. (CSE)			
Course Name:- Operating System (BCS42401)			
Teaching Scheme		Examination Scheme	
Lectures	3Hrs/week	CT-1	15 Marks
Tutorial	-	CT-2	15 Marks
Total Credit	3	TA	10 Marks
		ESE	60 Marks
		Total	100 Marks
		Duration of ESE:03Hrs 00Min.	
Course Objective:			
1	To understand the architecture, services, and functions of operating systems.		
2	To learn process management, scheduling, and inter-process communication techniques.		
3	To analyze synchronization mechanisms and deadlock management strategies.		
4	To study memory management and virtual memory techniques used in operating systems.		
5	To understand operating system security, protection mechanisms, and performance optimization techniques.		
Course Contents			

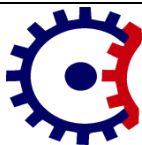
Unit I	Importance of Operating Systems, Basic Concepts, and Terminology, An Operating System Architecture, types of Operating System, Operating System as a Manager: Manager Memory Management Functions, Processor Management Functions, Device Management Functions, Information Management Functions, Files and Security, System calls for Process Management, File Management and Directory Management.
Unit II	Management Processes Concept: Processes and Threads. Process Model and Thread Model. Job Scheduler, Process Scheduling, operation on the process, Overview of Inter-process communication: Race Conditions, Critical Regions, Mutual Exclusion with busy waiting etc. CPU Scheduling: Introduction to Scheduling, Scheduling criteria, Scheduling Algorithms, Algorithm Evaluation and Scheduling in different Systems.
Unit III	Process Synchronization Synchronization Hardware, Semaphores, and Classical Problem of Synchronization, Monitors and Atomic Transaction Introduction to Deadlocks: Graphical representation of a deadlock, Deadlock strategies: Ignore a deadlock, detect a deadlock ,Recover from a deadlock ,Prevent a deadlock, Avoid a deadlock
Unit IV	Memory Management :Single Contiguous Memory Management ,Fixed Partition Memory Management : Introduction ,Allocation Algorithm, swapping , relocation and address translation Variable Parttion: Introduction ,Allocation Algorithm, swapping ,relocation and address translation, Non-contiguous Allocation -general concepts
Unit V	Paging, Segmentation Virtual Memory Management system :general concepts, Page replacement algorithm Operating system Security and protection, Introduction, Security Threats, Attacks on Security, Security Violation through parameters, Computer Worms,
Text Books	
T1	Operating System Concepts Silberschatz,Galvin 8 or 10th edition Wiley
T2	Operating Systems, 9e by William Stallings Pearson Education
Reference Books	

1	Operating System A.Godbole 3 rd Edition The McGraw-Hill.
2	Operating System Concepts, 8 th Edition, Silberschtz, Galvin, Gagne
Useful Links	
1	https://www.youtube.com/watch?v=lmlLdGMrdGU
2	https://nptel.ac.in/courses/106106144

BCS42401	Course Outcomes	CL	Class Session
BCS42401.1	Explain operating system architecture, functions, and services.	2	9
BCS42401.2	Apply process management and CPU scheduling techniques.	3	9
BCS42401.3	Analyze synchronization and deadlock management mechanisms.	4	9
BCS42401.4	Analyze memory management and virtual memory techniques.	4	9
BCS42401.5	Evaluate security, protection, and page replacement strategies in operating systems.	5	9


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Second Year (Semester-IV) B.Tech. (CSE)			
Course Name:- Database Management System (BCS42402)			
Teaching Scheme		Examination Scheme	
Lectures	3Hrs/week	CT-1	15 Marks
Tutorial	-	CT-2	15 Marks
Total Credit	3	TA	10 Marks
		ESE	60 Marks
		Total	100 Marks
		Duration of ESE:03Hrs 00Min.	
Course Objective:			
1	To Understand the basic concepts and the applications of database systems.		
2	To Master the basics of SQL and construct queries using SQL.		
3	To understand the relational database design principles.		
4	To become familiar with the basic issues of transaction processing and concurrency control.		
5	To become familiar with database storage structures and access techniques.		
Course Contents			

Unit I	Data base System Applications, Purpose of Database Systems, View of Data – Data Abstraction – Instances and Schemas – data Models – the ER Model – Relational Model – Other Models – Database Languages – DDL – DML – database Access for applications Programs – data base Users and Administrator – Transaction Management – data base Architecture – Storage Manager – the Query Processor Data base design and ER diagrams – ER Model - Entities, Attributes and Entity sets – Relationships and Relationship sets – ER Design Issues – Concept Design – Conceptual Design.
Unit II	Relational Query Languages, Relational Operations. Relational Algebra – Selection and projection set operations – renaming – Joins – Division – Examples of Algebra overviews – Relational calculus – Tuple relational Calculus – Domain relational calculus. Overview of the SQL Query Language – Basic Structure of SQL Queries, Set Operations, Aggregate Functions – GROUPBY – HAVING, Nested Sub queries, Views, Triggers.
Unit III	Normalization – Introduction, Non loss decomposition and functional dependencies, First, Second, and third normal forms – dependency preservation, Boyee/Codd normal form. Higher Normal Forms - Introduction, Multi-valued dependencies and Fourth normal form, Join dependencies and Fifth normal form
Unit IV	Transaction Concept- Transaction State- Implementation of Atomicity and Durability – Concurrent – Executions – Serializability- Recoverability – Implementation of Isolation – Testing for serializability- Lock –Based Protocols – Timestamp Based Protocols- Validation- Based Protocols – Multiple Granularity. Recovery and Atomicity – Log – Based Recovery – Recovery with Concurrent Transactions – Buffer Management – Failure with loss of nonvolatile storage-Advance Recovery systems- Remote Backup systems.

Unit V	File organization: – File organization – various kinds of indexes. Query Processing – Measures of query cost - Selection operation – Projection operation, - Join operation – set operation and aggregate operation – Relational Query Optimization – Transacting SQL queries – Estimating the cost – Equivalence Rules.
Text Books	
T1	Data base System Concepts, Silberschatz, Korth, McGraw hill, Sixth Edition.
T2	Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGrawHill 3rd Edition.
Reference Books	
1	Fundamentals of Database Systems, Elmasri Navathe Pearson Education
2	An Introduction to Database systems, C.J. Date, A.Kannan, S.Swami Nadhan, Pearson, Eight Edition.
Useful Links	
1	https://www.youtube.com/watch?v=sEaYXwmsLw0
2	https://nptel.ac.in/courses/106105175

BCS42402	Course Outcomes	CL	Class Session
BCS42402.1	Explain database concepts, architecture, data models, and ER design.	2	9
BCS42402.2	Apply relational algebra, relational calculus, and SQL for database manipulation.	3	9
BCS42402.3	Analyze database schemas using normalization techniques.	4	9
BCS42402.4	Analyze transaction management, concurrency control, and recovery protocols.	4	9
BCS42402.5	Evaluate indexing, query processing, and query optimization techniques.	5	9


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Second Year (Semester-IV) B.Tech. (CSE)					
Course Name: - Theoretical Foundations of Computer Science (BCS42403)					
Teaching Scheme				Examination Scheme	
Lectures	3Hrs/week			CT-1	15 Marks
Tutorial	-			CT-2	15 Marks
Total Credit	3			TA	10 Marks
				ESE	60 Marks
				Total	100 Marks
				Duration of ESE:03Hrs 00Min.	
Course Objective:					
1	To understand formal languages, grammars, finite automata, and their applications in language recognition.				
2	To study regular expressions, regular grammars, and finite-state machines for representing regular languages.				
3	To analyze context-free languages, context-free grammars, and Pushdown Automata.				
4	To understand Turing Machines and their role in modeling computational processes.				
5	To explore computability theory, recursive functions, decidability, and unsolvable problems.				

Course Contents	
Unit I	Set theory, Strings , Induction proof , Pigeon-hole principle , Concept of language , Formal grammars ,Chomsky hierarchy , Finite automata, Regular languages ,Deterministic Finite Automata (DFA) , Non-deterministic Finite Automata (NFA) , ϵ -closures ,Minimization of automata, Equivalence of automata
Unit II	Regular expressions, Identities of regular expressions, Regular grammar, Right linear grammar, Left linear grammar, Pumping lemma for regular sets, Moore machine, Mealy machine
Unit III	Context-Free Languages (CFLs), Parse trees and ambiguity, Reduction of CFGs, Normal forms for CFG, Push Down Automata (PDA), Non-determinism in PDA, Conversion of PDA to CFG, Conversion of CFG to PDA, Closure properties of CFLs, Decision properties of CFLs, Pumping lemma for CFL
Unit IV	Turing Machines (TM), TM as acceptor, TM as transducer, Variations of TM, Linear Bounded Automata (LBA), TM as computer of function, Universal Turing Machine
Unit V	Turing Machines (TM), TM as acceptor, TM as transducer, Variations of TM, Linear Bounded Automata (LBA), TM as computer of function, Universal Turing Machine
Text Books	
T1	Introduction to Theory of Computation – John Martine, TMH Publication
T2	Introduction to Theory of Computation – Michael Sipser
T3	Introduction to Theory of Computations – O. G. Kakade, Laxmi Publication
Reference Books	
1	Introduction of Automata Theory, Languages and Computation – Hopcroft, Ullman and Motwani, Pearson Education

2	Introduction to Formal Languages and Automata – Peter Linz
3	Elements of the Theory of Computation – H. R. Lewis, C. H. Papadimitriou, PHI
Useful Links	
1	http://www.digimat.in/nptel/courses/video/106104148/L01.html
2	http://www.digimat.in/nptel/courses/video/128106003/L01.html

BCS42403	Course Outcomes	CL	Class Session
BCS42403.1	Execute finite automata for regular languages.	3	9
BCS42403.2	Analyze regular languages using regular expressions.	4	9
BCS42403.3	Illustrate PDA for context-free languages.	4	9
BCS42403.4	Analyze Turing Machines for language recognition and computation.	4	9
BCS42403.5	Apply recursive functions for problem decomposition and solution.	3	9


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Second Year (Semester-IV) B.Tech. (CSE)					
Course Name: - OE-II – Introduction to Programming (BCS42404)					
Teaching Scheme				Examination Scheme	
Lectures	2Hrs/week			CT-1	7 Marks
Tutorial	-			CT-2	7 Marks
Total Credit	2			TA	6 Marks
				ESE	30 Marks
				Total	50 Marks
				Duration of ESE:02Hrs 00Min.	
Course Objective:					
1	To provide understanding of issues involved in design, implementation & manipulation of a relational DBMS				
2	To enable the student to design and build simple database systems and demonstrate the competence with the fundamental tasks involved with modeling, designing and implementing a DBMS.				
3	To develop comprehension of essential concepts of normalization, concurrency, integrity and security along with the advancements in DBMS				
Course Contents					

Unit I	Introduction to JAVA-Introduction to Java, Java Virtual Machine, Object Oriented Principle, Object and Classes, Java Keywords, Variable, Data types and Literals in Java, String, Operators and Casting, Control of Flow, (Selection Statements, Iteration Statements), Command Line Argument.
Unit II	Classes and inheritance: Introduction to Class and Object, Method Overloading, Constructor Inheritance, Multilevel, Hierarchy, Abstract class. Package and Interface: Package (Defining Package, Finding Package), Introduction to Interface, Defining and Implementing Interface, Predefined Package
Unit III	Exception Handling and Threads: Exception Handling, Type of Exception, Try, Catch and Finally. Multiple Catch blocks, Nested Try Statements, throw, throws, Thread Model. Java generics Advantage of Java Generics.
Text Books	
T1	The Complete Reference (8thEdition)by Herbelt Scheldt,TataMcGrawHill Publications.
T2	Head First J ava,2ndEdition by Kathy Sierra ,Bert Bates, O'Reilly Media
Reference Books	
1	Sun Certified Java Programmer for Java 6 by Kathy Sierra.
2	The Java TM Programming Language(3rdEdition)by Arnold,Holmes,Gosling,Goteti
Useful Links	
1	https://nptel.ac.in/courses/106/105/106105191/
2	https://nptel.ac.in/courses/106/105/106105191/

	Course Outcomes	CL	Class Session
1	Define the Principle of Object-oriented approach to design software	1	9
2	Identify Classes ,objects and use of inheritance in programs.	3	9
3	Make Use of Exception handling ,multithreading in real time situations and Generic Programming.	3	9


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Second Year (Semester-IV) B.Tech.(CSE)			
Course Code:BCS42405 (Introduction to Data Science)			
Teaching Scheme		Examination Scheme	
Lectures	2 Hrs/week	CT-1	-
Tutorial	-	CT-2	-
Total Credit	2	CA	50 Marks
		ESE	50 Marks
		Total	100 Marks
		Duration of ESE: - Hrs - Min.	
Course Objective:			
1	Learn how to set up and use basic Data Science tools like NumPy, Pandas, and Jupyter Notebook.		
2	Learn to store, clean, and organize data using NumPy arrays and Pandas DataFrames.		
3	Learn to import data from different files and calculate basic statistics like mean and median.		
4	Learn to import data from different files and calculate basic statistics like mean and median.		
5	Learn to plot maps and location-based data using Basemap tools.		
List of Experiment			
Sr. no.	Name of Experiment		COs
1	To install, set up, and explore basic Python packages for data science, including NumPy, SciPy, Pandas, Statsmodels, and Jupyter Notebook.		CO1
2	To create, manipulate, and perform basic operations on NumPy arrays using Jupyter Notebook.		CO2
3	To create and work with Pandas DataFrames in Jupyter Notebook for efficient data handling and analysis.		CO2
4	To import data from text files, Excel files, and web sources, and perform descriptive data analysis on the Iris dataset.		CO3
5	To calculate statistical measures (Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness, and Kurtosis) using the Diabetes dataset.		CO3
6	To apply and explore various data visualization functions on UCI datasets to generate graphical plots.		CO4
7	To visualize geographic data by plotting maps using the Basemap toolkit in Python.		CO5
8	To create a map centered on North America displaying country boundaries, state boundaries, and rivers using Basemap		CO5
9	To plot the geographic location of Seattle on a zoomed-in North America map using map projections.		CO5
10	To understand and apply different map projections (Cylindrical, Orthogonal, and Perspective projections) using Basemap.		CO5
BCS42405	Course Outcomes		
BCS42405.1	Set up and utilize essential Python data science tools, including Jupyter Notebook, NumPy, SciPy, Pandas, and Statsmodels		
BCS42405.2	Perform efficient data manipulation and array processing using NumPy and Pandas.		
BCS42405.3	Import datasets from various file formats and analyze them using core descriptive statistics.		
BCS42405.4	Apply various visualization functions to represent data insights clearly through charts and plots.		
BCS42405.5	Create spatial maps and apply map projections using Basemap to plot geographical data		

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Second Year(Semester-IV) B.Tech.(CSE)

Course Code:BCS42406 (Operating Systems - Lab)

Teaching Scheme		Examination Scheme	
Lectures	2 Hrs/week	CT-1	-
Tutorial	-	CT-2	-
Total Credit	1	CA	25 Marks
		ESE	25 Marks
		Total	50 Marks
		Duration of ESE: - Hrs - Min.	

Course Objective:

1	To understand the architecture, services, and functions of operating systems.
2	To learn process management, scheduling, and inter-process communication techniques.
3	To analyze synchronization mechanisms and deadlock management strategies.
4	To study memory management and virtual memory techniques used in operating systems.
5	To understand operating system security, protection mechanisms, and performance optimization techniques.

List of Experiment

Sr. no.	Name of Experiment	COs
1	Study of Linux/Unix Operating System commands for file, directory, and process management.	CO1
2	Implementation of system calls in Linux for process creation, file handling, and directory operations using C programs.	CO1
3	Simulation of CPU Scheduling Algorithms: <ul style="list-style-type: none">FCFS (First Come First Serve)SJF (Shortest Job First)	CO2
4	Simulation of CPU Scheduling Algorithms: <ul style="list-style-type: none">Priority SchedulingRound Robin Scheduling	CO2
5	Implementation of Process Synchronization using Semaphores for Producer-Consumer Problem.	CO3
6	Implementation of Deadlock Avoidance using Banker's Algorithm.	CO3
7	Implementation of Memory Allocation Techniques: <ul style="list-style-type: none">First FitBest Fit	CO4
8	Simulation of Fixed and Variable Partition Memory Management with Address Translation and Relocation.	CO4
9	Implementation of Page Replacement Algorithms: <ul style="list-style-type: none">FIFOLRUOptimal Page Replacement	CO5
10	Study and Demonstration of Operating System Security Mechanisms, File Permissions, User Access Control, and Security Threat Analysis in Linux.	CO5

BCS42406	Course Outcomes
BCS42406.1	Explain operating system architecture, functions, and services.
BCS42406.2	Apply process management and CPU scheduling techniques.
BCS42406.3	Analyze synchronization and deadlock management mechanisms.
BCS42406.4	Analyze memory management and virtual memory techniques.
BCS42406.5	Evaluate security, protection, and page replacement strategies in operating systems.


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Second Year(Semester-IV) B.Tech.(CSE)

Course Code:BCS42407 (Database Management System - Lab)

Teaching Scheme		Examination Scheme	
Lectures	2 Hrs/week	CT-1	-
Tutorial	-	CT-2	-
Total Credit	1	CA	25 Marks
		ESE	25 Marks
		Total	50 Marks
		Duration of ESE: - Hrs - Min.	

Course Objective:

1	To Understand the basic concepts and the applications of database systems.
2	To Master the basics of SQL and construct queries using SQL.
3	To understand the relational database design principles.
4	To become familiar with the basic issues of transaction processing and concurrency control.
5	To become familiar with database storage structures and access techniques.

List of Experiment

Sr. No.	Name of Experiment	COs
1	Installation of MySQL Server and Interfacing.	CO1
2	To implement Simple queries: selection, projection, sorting on a simple table.	CO1
3	To implement Multi-table queries (JOIN OPERATIONS)	CO2
4	To implement Set Oriented Operations 1. Union, 2. Intersect, 3. Minus	CO2
5	To implement DDL & TCL Commands.	CO3
6	To Perform following SQL queries on the database.	CO3
7	Execute DML statements which demonstrate the use of views. Update the base table using its corresponding view. Also consider restrictions on updatable views and perform view creation from multiple tables.	CO4
8	Create Table with primary key and foreign key constraints. 1. Alter table with add n modify, 2. Drop table	CO4
9	Perform PL/SQL Programming I 1. Programs using named and unnamed blocks	CO5
10	Perform PL/SQL Programming II 1. Creating stored procedures. 2. Creating functions(). 3. Triggers	CO5

BCS42407	Course Outcomes
BCS42407.1	Explain database concepts, architecture, data models, and ER design.
BCS42407.2	Apply relational algebra, relational calculus, and SQL for database manipulation.
BCS42407.3	Analyze database schemas using normalization techniques.
BCS42407.4	Analyze transaction management, concurrency control, and recovery protocols.
BCS42407.5	Evaluate indexing, query processing, and query optimization techniques.

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