K.K. Wagh Institute of Engineering Education and Research, Nashik

Curriculum

B.Tech

Artificial Intelligence & Data Science

2022 Pattern

w.e.f.: AY 2022-2023

Summary of Credits and Total Marks for Under Graduate (UG) Programme:

Class	Semester	Total Credits	Total Marks
FY BTECH	**I**	**19**	**675**
	II	**23**	**825**
SY BTECH	**III**	**21**	**725**
	IV	**21**	**725**
TY BTECH	**V**	**22**	**750**
	VI	**22**	**750**
FINAL BTECH	**VII**	**22**	**750**
	VIII	**20**	**700**
Total		**170**	**5900**

● **Description of various Courses:**

Type of Course	Description	Type of Course	Description
ESC	Engineering Science Course - Workshop -Drawing-Fundamentals of different branches	**DCC**	Department Core Course
BSC	Basic Science Courses	**DEC**	Department Elective Course
LHSM	Liberal arts, Humanities, Social Sciences and Management courses	**OEC**	Open Elective Courses of other technical or emerging areas /Courses designed by Industry
PSI	Project work, Seminar, Internship, PBL	**IMC**	Induction and Mandatory Courses
NC/AC	Non Credit Courses /Audit Courses	**ASM**	Additional Specialized / MOOCs

F.Y. B. Tech Artificial Intelligence & Data Science wef AY 2022-23

SEM-I

Course Code	Course Type	TitleofCourse	TeachingScheme Hrs./week			Assessment Scheme and Marks						Credits			
			TH	TU	PR	In Sem	End Sem	CA	TU/ TW	PR/ OR	Total	TH	TU/ TW	PR/ OR	Total
FYE221001	BSC	Applied Mathematics–I	4	1	0	20	60	20	25	0	125	4	1	0	5
FYE221005	BSC	Applied Chemistry	3	0	2	20	60	20	50	0	150	3	1	0	4
FYE221006	ESC	Fundamentals of Electrical Engineering	3	0	2	20	60	20	50	0	150	3	1	0	4
FYE221010	ESC	Computational Thinking and C Programming	2	0	2	25	50	0	50	0	125	2	1	0	3
FYE221013	ESC	Workshop Practice	0	0	2	0	0	0	50	0	50	0	1	0	1
FYE221014	LHSM	Communication Skills	1	0	2	0	0	25	50	0	75	1	1	0	2
		Total	**13**	**1**	**10**	**85**	**230**	**85**	**275**	**0**	**675**	**13**	**6**	**0**	**19**

Note: Credits are as per the Teaching Scheme.
***Credits for 'PR' head are linked with 'TW' marks**

F.Y. B. Tech Artificial Intelligence & Data Science wef AY 2022-23

SEM-II

Course Code	Course Type	Title of Course	Teaching Scheme Hrs./week			Assessment Scheme and Marks						Credits			
			TH	TU	PR	In Sem	End Sem	CA	TU/ TW	PR / OR	Total	TH	TU/ TW	PR / OR	Total
FYE221002	BSC	Applied Mathematics–II	4	1	0	20	60	20	25	0	125	4	1	0	5
FYE221003	BSC	Applied and Modern Physics(A)	3	0	2	20	60	20	50	0	150	3	1	0	4
FYE221007	ESC	Fundamentals of Electronics Engineering	3	0	2	20	60	20	50	0	150	3	1	0	4
FYE221011	ESC	Programming in C++	3	0	2	25	50	0	50	0	125	3	1	0	4
FYE221012	ESC	Engineering Drawing	1	1	2	25	50	0	50	0	125	1	2	0	3
FYE221015	PSI	Engineering Explorations	0	0	2	0	0	0	100	0	100	0	1	0	1
FYE221016	LHSM	Democracy, Election and Governance	2	0	0	25	25	0	0	0	50	2	0	0	2
		Total	**16**	**2**	**10**	**135**	**305**	**60**	**325**	**0**	**825**	**16**	**7**	**0**	**23**

S.Y.B.Tech Artificial Intelligence & Data Science wef AY2023-24																	
SEM-III																	
Course Code	**Course Type**	**Title of Course**	**Teaching Scheme Hrs./week**			**Evaluation Scheme and Marks**								**Credits**			
			TH	**TU**	**PR**	**In Sem**	**End Sem**	**CCE**	**TU**	**TW**	**PR**	**OR**	**Total**	**TH**	**TU**	**PR ***	**Total**
COM222001	DCC	Fundamentals of Data Structures	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
ADS222001	DCC	Computer Networks	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
COM222003	DCC	Discrete Mathematics	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
COM222004	ESC	Digital Electronics and Logic Design	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
COM222005	DCC	Programming Paradigms and Java Programming	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
ADS222002	LHSM	Emotional Intelligence	1	-	-	-	-	-	-	25	-	-	25	1#	-	-	1
COM222007	DCC	Data Structures Lab	-	-	4	-	-	-	-	25	50	-	75	-	-	2	2
COM222008	ESC	Digital Electronics Lab	-	-	2	-	-	-	-	25	25	-	50	-	-	1	1
ADS222003	DCC	Programming Paradigms and Computer Networks Lab	-	-	2	-	-	-	-	25	25	-	50	-	-	1	1
COM222010	PSI	Python Programming Lab	-	-	2	-	-	-	-	25	-	-	25	-	-	1	1
		Total	**16**	**-**	**10**	**100**	**300**	**100**	**-**	**125**	**100**	**-**	**725**	**16**	**-**	**5**	**21**

Note : Credits are as per the teaching scheme

***Credit for PR head are linked with PR/OR/TW/TU**

#This credit will be assessed as TW

T.Y. B. Tech Artificial Intelligence and Data Science wef AY 2024-25

SEM-IV																	
Course Code	**Course Type**	**Title of Course**	**Teaching Scheme Hrs./week**			**Evaluation Scheme and Marks**								**Credits**			
			TH	**TU**	**PR**	**In Sem**	**End Sem**	**CCE**	**TU**	**TW**	**PR**	**OR**	**Total**	**TH**	**TU**	**PR***	**Total**
SMH222111	BSC	Applied Mathematics –III	3	1	-	20	60	20	25	-	-	-	125	3	1	-	4
COM222012	DCC	Advanced Data Structures	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
COM222013	DCC	Operating Systems	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
ADS222014	DCC	Database Management Systems	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
COM222015	LHSM	Software Engineering and Project Management	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
ADS222016	ASM	Design Thinking	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COM222017	DCC	Advanced Data Structures Lab	-	-	4	-	-	-	-	25	50	-	75	-	-	2	2
COM222018	DCC	Operating Systems Lab	-	-	2	-	-	-	-	25	25	-	50	-	-	1	1
ADS222019	DCC	Database Management Systems	-	-	2	-	-	-	-	25	25	-	50	-	-	1	1
ADS222020	PSI	Project Based Learning - Design Thinking	-	-	2	-	-	-	-	25	-	-	25	-	-	1	1
		Total	**16**	**1**	**10**	**100**	**300**	**100**	**25**	**100**	**100**	**-**	**725**	**15**	**1**	**5**	**21**

SEM-V														
Course Code	**Course Type**	**Title of Course**	**Teaching Scheme**			**Evaluation Scheme and Marks**						**Credits**			
			TH	**TU**	**PR**	**INSEM**	**ENDSEM**	**CCE**	**TUT /TW**	**PR /OR**	**TOTAL**	**TH**	**TU**	**PR**	**TOTAL**
COM223001	DCC	Design and Analysis of Algorithms	3	-	-	20	60	20			100	3	-	-	3
ADS223002	DCC	Artificial Intelligence	3	-	-	20	60	20			100	3	-	-	3
ADS223003	DCC	Data Science and Big Data	3	-	-	20	60	20			100	3	-	-	3
ADS223004	DCC	Artificial Intelligence and Data Science and Big Data Lab	-	-	2	-	-	-	25	25	50	-	-	1	1
COM223005	DCC	Design and Analysis of Algorithms Lab	-	-	2				25	25	50	-	-	1	1
COM223006	DEC	Program Elective Course I	3	-	-	20	60	20			100	3	-	-	3
COM223007	DEC	Program Elective Course I Lab	-	-	2	-	-	-	25	25	50	-	-	1	1
COM223008	OEC	Management Information System	2	-	-	-	-	50	-	-	50	2	-	-	2
CSD223009	ESC	Computer Organization and Architecture	3	-	-	20	60	20	-	-	100	3	-	-	3
ADS223010	PSI	PBL	-	1	2	-	-	-	TUT-25 TW-25	-	050	-	1	1	2
Total			**17**	**01**	**08**	**100**	**300**	**150**	**125**	**75**	**750**	**17**	**1**	**4**	**22**

T.Y. B. Tech Artificial Intelligence & Data Science wef AY 2024-25															
SEM-VI															
Course Code	**Course Type**	**Title of Course**	**Teaching Scheme**			**Evaluation Scheme and Marks**						**Credits**			
			TH	**TU**	**PR**	**INSEM**	**ENDSEM**	**CCE**	**TUT /TW**	**PR /OR**	**TOTAL**	**TH**	**TU**	**PR**	**TOTAL**
ADS223011	DCC	Business Intelligence and Analytics	3	-	-	20	60	20			100	3	-	-	3
COM223012	DCC	Theory of Computation	3	-	-	20	60	20			100	3	-	-	3
ADS223013	DCC	Data Science Techniques and Tools Lab	-	-	2	-	-	-	25	25	50	-	-	1	1
COM223014/ ASD223014	DEC	Department Elective Course-II	3	-	-	20	60	20			100	3	-	-	3
COM223015/ ASD223015	DEC	Department Elective Course-III	3	-	-	20	60	20	-	-	100	3	-	-	3
ADS223016	DEC	Department Elective Course–II+ Department Elective Course–III Lab	-	-	2	-	-	-	25	25	50	-	-	1	1
COM223017	ESC	Micro controllers and Embedded Systems	3	-	-	20	60	20			100	3	-	-	3
COM223018	OEC	Intellectual Property Rights	2	-	-	-	-	50	-	-	50	2	-	-	2
COM223019	ASM	Mobile Application Development	-	1	2				25	25	50	-	1	1	2
ADS223020	PSI	Seminar	-	-	2	-	-	-	50	-	50	-	-	1	1
Total			**17**	**01**	**08**	**100**	**300**	**150**	**125**	**75**	**750**	**17**	**1**	**4**	**22**

Final year B. Tech Artificial Intelligence & Data Science wef AY 2025-26

Department Elective Courses

Course Code	Course Type	Title of Course	Teaching Scheme			Evaluation Scheme and Marks						Credits			
			TH	TU	PR	INSEM	ENDSEM	CCE	TUT /TW	PR /OR	TOTAL	TH	TU	PR	TOTAL
Department Elective Course I (Sem-V) (Student have to choose any one of the following)															
COM223006A	DEC	Internet of Things	3	-	-	20	60	20	-	-	100	3	-	-	3
COM223006B		Augmented Reality and Virtual Reality													
COM223006C		Software Testing and Quality Assurance													
Department Elective Course I Lab (Sem-V) (Student have to choose lab based on selected Program Elective Course I)															
COM223007A	DEC	Internet of Things Lab	-	-	2	-	-	-	25	25	50	-	-	1	1
COM223007B		Augmented Reality and Virtual Reality Lab													
COM223007C		Software Testing and Quality Assurance Lab													
Department Elective Course II (Sem-VI) (Student have to choose any one of the following)															
COM223014A	DEC	User Interface and User Experience Design	3	-	-	20	60	20	-	-	100	3	-	-	3
ADS223014B		Neural Network & Fuzzy Logic													
ADS223014C		Web Technology													
Department Elective Course III (Sem-VI) (Student have to choose lab based on selected Program Elective Course II)															
COM223015A	DEC	Cloud Computing	3	-	-	20	60	20	-	-	100	3	-	-	3
COM223015B		Natural Language Processing													
ADS223015C		Cyber Security													
Department Elective Course II + Program Elective Course Lab III Lab (Sem-VI) (Lab based on chosen elective course II and III by students)															
ADS223016	DEC	Department Elective Course II + Department Elective Course Lab III Lab	-	-	2	-	-	-	25	25	50	-	-	1	1

SEM-VII															
Course Code	**Course Type**	**Title of Course**	**Teaching Scheme**			**Evaluation Scheme and Marks**						**Credits**			
			TH	**TU**	**PR**	**INSEM**	**ENDSEM**	**CCE**	**TUT /TW**	**PR /OR**	**TOTAL**	**TH**	**TU**	**PR**	**TOTAL**
COM224001	DCC	Deep Learning	3	-	-	20	60	20			100	3	-	-	3
ADS224002	DCC	Generative AI & Prompt Engineering	3	-	-	20	60	20			100	3	-	-	3
COM224003	DCC	Deep Learning Lab	-	-	2	-	-	-	25	25	50	-	-	1	1
ADS224004	DCC	Generative AI & Prompt Engineering Lab	-	-	2	-	-	-	25	25	50	-	-	1	1
COM224005/ ADS224005	DEC	Department Elective Course IV	3	-	-	20	60	20	-	-	100	3	-	-	3
COM224006/ ADS224006	DEC	Department Elective Course V	2	-	-	20	30	-	-	-	50	2	-	-	2
COM224007	ASM	Research Methodology -	3	-	-	20	60	20	-	-	100	3	-	-	3
COM224008	LHSM	Banking, Financial Services and Insurance	2	-	-	-	-	50	-	-	50	2	-	-	2
ADS224009	PSI	Project Work	-	-	8	-	-	-	100	50	150	-	-	4	4
Total			**16**	**00**	**12**	**100**	**270**	**130**	**150**	**100**	**750**	**16**	**-**	**6**	**22**

* Considering Internship of 6 months, these courses to be offered in online mode

Final year of B.Tech Artificial Intelligence & Data Science wef AY 2025-26															
SEM-VIII															
Course Code	**Course Type**	**Title of Course**	**Teaching Scheme**			**Evluation Scheme and Marks**						**Credits**			
			TH	**TU**	**PR**	**INSEM**	**ENDSEM**	**CCE**	**TUT /TW**	**PR /OR**	**TOTAL**	**TH**	**TU**	**PR**	**TOTAL**
ADS224011	DCC*	Data Warehousing	3	-	-	-	100	-			100	3	-	-	3
COM224012	DEC*	Blockchain Technology/ Bioinformatics/ Digital Forensics	3	-	-	-	100	-	-	-	100	3	-	-	3
COM224013	LHSM	Digital Marketing	2	-	-	-	-	50	-	-	50	2	-	-	2
ADS224014	INTERNSHIP	Internship	-	-	24	-	-	-	300	150	450	-	-	12	12
Total			**8**	**00**	**24**	**-**	**200**	**50**	**300**	**150**	**700**	**8**	**-**	**12**	**20**

Department Elective Courses

Course Code	Course Type	Title of Course	Teaching Scheme			Evaluation Scheme and Marks						Credits			
			TH	TU	PR	INSEM	ENDSEM	CCE	TUT /TW	PR /OR	TOTAL	TH	TU	PR	TOTAL
Program Elective Course IV (Sem-VII) (Student have to choose any one of the following)															
COM224005A	DEC	Computer Vision	3	-	-	20	60	20	-	-	100	3	-	-	3
COM224005B		Information Retrieval													
ADS224005C		Social Network Analysis													
Program Elective Course V (Sem-VII) (Student have to choose any one of the following)															
COM224006A	DEC	Operation Research	2	-	-	20	30	-	-	-	50	2	-	-	2
ADS224006B		Computational Intelligence													
ADS224006C		Software Architecture and Design Pattern													
Program Elective Course VI (Sem-VIII) (Student have to choose any one of the following)															
COM224012A	DEC	Blockchain	3	-	-	-	100	-	-	-	100	3	-	-	3
COM224012B		Bioinformatics													
COM224012C		Digital Forensic													

B. Tech (Program) Honors/Minor* in Computer Network

Sem	Course Code	Course Type	Title of Course	Teaching Scheme			Evaluation Scheme and Marks						Credits			
				TH	TU	PR	INSEM	ENDSEM	CCE	TUT/TW	PR/OR	TOTAL	TH	TU	PR	TOTAL
VI	COM223021	DCC	Network Protocols and Algorithms	04	-	-	20	60	20	-	-	100	04	-	-	04
	COM223022	DCC	Network Protocols and Algorithms Lab	-	-	04	-	-	-	50	50	100	-	-	02	02
VII	COM224021	DCC	Cloud Infrastructure	04	-	-	20	60	20	-	-	100	04	-	-	04
	COM224022	DCC	Cloud Infrastructure Lab	-	-	04	-	-	-	50	50	100	-	-	02	02
VIII	COM224023	DCC	Wireless Sensor Network	03	-	-	20	60	20	-	-	100	03	-	-	03
	COM224024	DCC	Software Defined Network	03	-	-	20	60	20	-	-	100	03	-	-	03
	Total			**14**	**-**	**08**	**80**	**240**	**80**	**100**	**100**	**600**	**14**	**-**	**04**	**18**

*It will be offered as honors degree for Computer Engineering/Artificial Intelligence and Data Science Engineering/Computer Science and Design Engineering /Information Technology and is offered as minor degree for other programs

B. Tech (Program) Honors/Minor* in Databases

Sem	Course Code	Couse Type	Title of Course	Teaching Scheme			EvaluationSchemeandMarks						Credits			
				TH	TU	PR	INSEM	ENDSEM	CCE	TUT/TW	PR/OR	TOTAL	TH	TU	PR	TOTAL
VI	COM223023	DCC	Relational Database and SQL	04	-	-	20	60	20	-	-	100	04	-	-	04
	COM223024	DCC	Relational Database and SQL Lab	-	-	04	-	-	-	50	50	100	-	-	02	02
VII	COM224025	DCC	Modern Database System	04	-	-	20	60	20	-	-	100	04	-	-	04
	COM224026	DCC	Modern Database System Lab	-	-	04	-	-	-	50	50	100	-	-	02	02
VIII	COM224027	DCC	Query Processing and Optimization	03	-	-	20	60	20	-	-	100	03	-	-	03
	COM224028	DCC	Parallel and Distributed Database System	03	-	-	20	60	20	-	-	100	03	-	-	03
	Total			**14**	**-**	**08**	**80**	**240**	**80**	**100**	**100**	**600**	**14**	**-**	**04**	**18**

*It will be offered as honors degree for Computer Engineering/Artificial Intelligence and Data Science Engineering/Computer Science and Design Engineering/Information Technology and is offered as minor degree for other programs

K. K. Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Artificial Intelligence and Data Science
Pattern 2022 Semester: V
COM223001: Design and Analysis of Algorithms

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses: - COM222001:Fundamentals of Data Structures
COM222003: Discrete Mathematics
COM222012: Advanced Data Structures

Companion Course :- COM223005:Design and Analysis of Algorithms Lab

Course Objectives:

- To study and perform analysis of algorithms
- To study how to solve problems using greedy strategy
- To study how to solve problems using dynamic programming.
- To study how to solve problems using backtracking and branch-n-bound strategies
- To understand computational complexity theory.

Course Outcomes: On completion of the course, students will be able to –

	Course Outcomes	**Bloom's Level**
CO1	Design and analyze algorithms	4-Analyze
CO2	Solve problems using greedy strategy	3-Apply
CO3	Solve problems using dynamic programming strategy	3-Apply
CO4	Solve problems using backtracking and branch-n-bound strategies	3-Apply
CO5	Apply computational complexity theory	3-Apply

COURSE CONTENTS

Unit I	**Problem Solving and Basics of Algorithmic Analysis**	**(06 hrs)**	**CO1**

Problem solving principles: Classification of problem, problem solving strategies, What are algorithms, classification of time complexities (linear, logarithmic etc), Divide and Conquer strategy. Asymptotic notations, Best case, worst case, average case analysis, lower bound and upper bound, amortized analysis. Recurrences: Formulation and solving recurrence equations using Master Theorem

Unit II	**Greedy Strategy**	**(08 hrs)**	**CO2**

Principle, control abstraction, time analysis of control abstraction, knapsack problem, scheduling algorithms-Job scheduling and activity selection problems

Unit III	**Dynamic Programming**	**(08hrs)**	**CO3**

Principle, control abstraction, time analysis of control abstraction, binomial coefficients, OBST, 0/1 knapsack, Chain Matrix Multiplication.

Unit IV	**Backtracking and Branch -and-Bound**	**(08hrs)**	**CO4**

Backtracking: Principle, control abstraction, time analysis of control abstraction, 8-queen problem, graph coloring problem, sum of subsets problem. Branch-and-Bound: Principle, control abstraction, time

analysis of control abstraction, strategies: FIFO, LIFO and LC approaches. TSP, knapsack problem.			
Unit V	**Complexity Theory**	**(06hrs)**	**CO5**
Polynomial and non-polynomial problems, deterministic and non-deterministic algorithms, P class, NP class &NP complete problems- vertex cover and 3-SAT and NP-Hard Problems: Hamiltonian cycle problem, Clique problem.			

Text Books

1. Horowitz and Sahani, "Fundamentals of Computer Algorithms", Second edition, University Press, ISBN: 978-8173716126
2. Gills Brassard and Paul Bartly, "Fundamentals of Algorithmic", PHI New Delhi.
3. Aho, Hopcroft, Ullman, "The Design and Analysis of Computer Algorithms", Pearson Education, New Delhi, 2003

Reference Books

1. Fayez Gebali, "Algorithms and Parallel Computing",Willy, ISBN 978-0470902103
2. Thomas H. Coreman and Charles R. L. Leiserson, "Introduction to Algorithm", PHI New Delhi

Strength of CO-PO /PSO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	2	2	2	2	2	2	-	-	-	2	3	2
CO2	2	2	2	2	2	2	2	2	-	-	-	2	3	2
CO3	2	2	2	2	2	2	2	2	-	-	-	2	3	2
CO4	2	2	2	2	2	2	2	2	-	-	-	2	3	2
CO5	2	2	2	2	2	2	2	2	-	-	-	2	3	2
Average	2	2	2	2	2	2	2	2	-	-	-	2	3	2

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Quiz on Unit-1, Unit-2, Unit-3 , Unit-4, Unit-5 each of 10 marks (Total marks will be converted to 20 out of 50)	20
	Total	**20**

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech Artificial Intelligence and Data Science
Pattern 2022 Semester: V
ADS223002: Artificial Intelligence

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory: 03 hrs/week	03	Continuous Comprehensive Evaluation: 20 Marks InSem Exam: 20 Marks EndSem Exam: 60 Marks

Prerequisite Courses: - COM222001 Fundamentals of Data Structures, COM222012: Advanced Data Structures

Course Objectives:

- To study the concept of Artificial Intelligence
- To illustrate problem solving using search strategies for AI
- To learn adversarial search methods for AI
- To get acquainted with the fundamentals of logical reasoning related to AI
- To get familiar with the fundamentals of knowledge representation in AI

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Identify Intelligent agents for various AI applications	3-Apply
CO2	Illustrate different informed search / uninformed search or heuristic approaches for AI	2-Understand
CO3	Identify adversarial search methods for AI	3-Apply
CO4	Relate reasoning for making AI enabled systems	2-Understand
CO5	Make use of knowledge representation for AI systems	2-Understand

COURSE CONTENTS

Unit I	Introduction of Artificial Intelligence	(06 hrs)	CO1

Foundations of Artificial Intelligence, History of Artificial Intelligence, State of the Art, Risks and Benefits of AI, Agents and Environments, Intelligent Agents, Typical Intelligent Agents, Problem Solving Approach to Typical AI problems.

Unit II	Problem Solving using Search Techniques	(08 hrs)	CO2

Problem solving agents, Searching for solutions, Uniform search strategies, Breadth first search, Depth first search, Depth limited search, Bidirectional search, Heuristic search strategies, Greedy best -first search, A* search, Memory bounded heuristic search, Local search algorithms & optimization problems, Hill climbing search, Simulated Annealing.

Unit III	Adversarial search	(08hrs)	CO3

Games, Optimal Decisions in Games, Alpha-beta pruning. Constraint Satisfaction Problems (CSP), Defining CSP, Constraint Propagation, Inference in CSP, Backtracking Search for CSPs, Local Search for CSPs.

Unit IV	Logical Reasoning	(08hrs)	CO4

Knowledge-based agents, Propositional Logic, First-order logic, syntax and semantics, knowledge representation and engineering, inferences in first-order logic, forward chaining,

backward chaining, resolution.			
Unit V	**Knowledge Representation**	**(06hrs)**	**CO5**
Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects. Case study of The Internet Shopping World.			
Text Books			
1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", 4th Edition, University of California at Berkeley, Pearson education, 2020. 2. Vinod Chandra, A. Hareendran, Artificial Intelligence- principles and applications, PHI, Second Edition, 2021.			
Reference Books			
1. M. Tim Jones, "Artificial Intelligence: A Systems Approach (Computer Science)", Jones and Bartlett Publishers, Inc.; First Edition, 2008 2. Nils J. Nilsson, "The Quest for Artificial Intelligence", Cambridge University Press, 2009. 3. I. Bratko, "Prolog: Programming for Artificial Intelligence", Fourth Edition, Addison-Wesley Educational Publishers Inc., 2011			

Strength of CO-PO / PSO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	2	2
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	2	2
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	-	**2**	**2**

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Quiz on Unit-1, Unit-2, Unit-3 (Quiz 10 marks on each unit and will be converted to 10 Marks) 10 2	10
2	Theory assignment on Unit- 4 and 5 (10 marks assignment on unit 4 and 5 each and that will be converted in to 10 Marks)	10
	Total	**20**

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Artificial Intelligence and Data Science **Pattern 2022 Semester: V** **ADS223003 : Data Science and Big Data**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**
Prerequisite Courses: - ADS222014 : Database Management System		
Companion Course:- ADS223004: Artificial Intelligence and Data Science and Big Data Lab		

Course Objectives:

- To understand the data analytics life cycle
- To study big data characteristics and preprocessing techniques
- To get familiar with supervised and unsupervised learning algorithm

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Illustrate various data pre-processing techniques to simplify and speed up machine learning algorithms	2-Understand
CO2	Compare various regression algorithms	2-Understand
CO3	Compare different classification algorithms	2-Understand
CO4	Compare different clustering algorithms	2-Understand
CO5	Describe data analytics life cycle	2-Understand

COURSE CONTENTS

Unit I	**Feature Engineering**	**(09 hrs)**	**CO1**

Concept of Features, **preprocessing of data:** Normalization and Scaling, Standardization, Managing missing values,
Dimensionality Reduction, Feature Extraction: Principal Component Analysis(PCA), Kernel PCA, Local Binary Pattern. Feature Selection Techniques: Sequential Forward Selection, Sequential Backward Selection. Multidimensional Scaling, Matrix Factorization Techniques.

Unit II	**Regression**	**(06 hrs)**	**CO2**

Regression: Bias, Variance, Generalization, Underfitting, Overfitting, Linear regression, Logistic regression, Lasso regression, Ridge regression
Evaluation Metrics: MAE, RMSE, R2.

Unit III	**Classification**	**(09 hrs)**	**CO3**

Classification: K-nearest neighbor, Support vector machine, Decision Tree
Ensemble Learning: Bagging, Boosting, Adaboost. Binary-vs-Multiclass Classification, Balanced and Imbalanced Multiclass Classification Problems, Variants of Multiclass Classification: One-vs-One and One-vs-All
Evaluation Metrics: Accuracy, Precision, Recall, Fscore, Cross-validation.

Unit IV	**UnSupervised Learning**	**(06 hrs)**	**CO4**

Cluster Analysis, Partition Methods: K-Means, K-Medoids. Hierarchical Methods: Agglomerative and

Divisive Hierarchical Clustering. Dynamic Clustering, Multi-view Clustering.
Measuring Clustering Quality

Unit V	**Big Data and Analytics**	**(06 hrs)**	**CO5**

Data explosion, Sources of Big Data, Big Data Characteristics.
Data Analytic Lifecycle: Introduction, Phase 1: Discovery, Phase 2: Data Preparation, Phase 3: Model Planning, Phase 4: Model Building, Phase 5: Communication results, Phase 6: Operationalize.

Text Books

1. Jiawei Han, Micheline Kamber, and Jian Pie, "Data Mining: Concepts and Techniques" Elsevier Publishers Third Edition, ISBN: 9780123814791, 9780123814807
2. David Dietrich, Barry Hiller, "Data Science and Big Data Analytics", EMC education services, Wiley publication, 2012, ISBN0-07-120413-X

Reference Books

1. EMC Education Services, "Data Science and Big Data Analytics- Discovering, analyzing Visualizing and Presenting Data"
2. 2. DT Editorial Services, "Big Data, Black Book", DT Editorial Services, ISBN: 9789351197577, 2016 Edition
3. Chirag Shah, "A Hands-On Introduction To Data Science", Cambridge University Press, (2020), ISBN : ISBN 978-1-108-47244-9
4. Wes McKinney, "Python for Data Analysis ", O' Reilly media, ISBN: 978-1-449-31979-3

Strength of CO-PO PSO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	-	3	-	-	-	-	-	-	-	3	3	-
CO2	3	3	-	3	-	-	-	-	-	-	-	3	3	-
CO3	3	3	-	3	-	-	-	-	-	-	-	3	3	-
CO4	3	3	-	3	-	-	-	-	-	-	-	3	3	-
CO5	3	3	-	3	-	-	-	-	-	-	-	3	3	-
Average	3	3	-	3	-	-	-	-	-	-	-	3	3	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Quiz on Unit I, Unit II and Unit III each of 10 marks (Total marks will be converted to 10 marks)	10
2	Assignment on Unit IV and Unit V each of 10 marks (Total marks will be converted to 10 marks)	10
	Total	**20**

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech Artificial Intelligence and Data Science
Pattern 2022 Semester: V
ADS223004: Artificial Intelligence & Data Science and Big Data Lab

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical: 02 hrs/week	01	Term work: 25 Marks Practical Exam : 50 Marks

Prerequisite Courses: - COM222001 Fundamentals of Data Structures
COM222012: Advanced Data Structures

Companion Courses:- ADS223002: Artificial Intelligence, ADS223003: Data Science and Big Data

Course Objectives:

- To study different informed search / uninformed search or heuristic approaches
- To use of adversarial search algorithms to solve a given problem
- To select a method to solve constraint satisfaction problem
- To acquaint with the fundamentals of knowledge and reasoning

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Apply different informed search / uninformed search or heuristic approaches	3-Apply
CO2	Make use of adversarial search algorithms to solve a given problem	3-Apply
CO3	Choose a method to solve constraint satisfaction problem	3-Apply
CO4	Implement a knowledge-based agent using propositional logic.	3-Apply
CO5	Make a use of suitable AI algorithms to solve problems.	3-Apply
CO6	Make use of data pre-processing techniques to simplify and speed up machine learning algorithms	3-Apply
CO7	Analyze the performance of classification algorithms for given datasets	4-Analyze
CO8	Analyze the performance of clustering algorithms for given datasets	4-Analyze
CO9	Analyze the performance of regression algorithms for given datasets	4-Analyze

List of Laboratory Experiments / Assignments

Sr. No.	Laboratory Experiments / Assignments	CO
1	Implement A star (A*) Algorithm for any game search problem.	CO1
2	Implement MiniMax algorithm for Tic-Tac-Toe game.	CO2
3	Implement Alpha-Beta Tree search for any game search problem.	CO2
4	Implement a solution for a Constraint Satisfaction Problem using i)Branch and Bound n-queens problem ii)Backtracking for a graph coloring problem. iii) Backtracking for solving a 9 x 9 Sudoku puzzle.	CO3

5	Develop an elementary chatbot for any suitable customer interaction application	CO4
6	Mini Project: Implement any one of the following Expert System: Hospitals and medical facilities, Employee performance evaluation, Airline scheduling and cargo schedules	CO5
7	Perform the following operations using Python on any open source dataset 1. Import all the required Python Libraries. 2. Locate open source data from the web (e.g. https://www.kaggle.com). Provide a clear description of the data and its source (i.e., URL of the web site). 3. Load the Dataset into the pandas data frame. 4. Display the initial statistics. 5. Scan all variables for missing values and inconsistencies. If there are missing values and/or inconsistencies, use any of the suitable techniques to deal with them. 6. Scan all numeric variables for outliers. If there are outliers, use any of the suitable techniques to deal with them. 7. Apply data transformations on at least one of the variables. 8. Turn categorical variables into quantitative variables in Python.	CO6
8	Implement PCA Feature extraction technique on any data set	CO6
9	A) Create a **Linear Regression Model** using Python/R to predict home prices using Boston Housing Dataset (https://www.kaggle.com/c/boston-housing). OR B) Implement **logistic regression** using Python/R to perform classification on Social_Network_Ads.csv dataset. Evaluate the model	CO9
10	A) Classify the email using the binary classification method. Email Spam detection has two states: a)Normal State – Not Spam, b) Abnormal State – Spam. Use **Support Vector Machine** classification algorithm for classification. Analyze its performance. Dataset: The emails.csv dataset on the Kaggle https://www.kaggle.com/datasets/balaka18/email-pam-classification-dataset-csv. OR B) Implement **KNN** classification algorithm using Python/R on iris.csv dataset. Compute Confusion matrix to find TP, FP, TN, FN, Accuracy, Error rate, Precision, Recall on the given dataset.	CO7
11	Implement **K-Means clustering** on a dataset. Determine the number of clusters using the elbow method. Dataset: https://www.kaggle.com/datasets/kyanyoga/sample-sales-data or any dataset of your choice	CO8

Guidelines for Laboratory Conduction
Use of coding standards and Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged. Operating System recommended: - Linux or its derivative Programming tools recommended: - Open Source line gcc/g++/python/prolog
Guidelines for Student's Lab Journal
The laboratory assignments are to be submitted by students in the form of a journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, problem statement, theory concepts in brief, algorithm, flowchart, test cases and conclusions). Program codes with sample outputs shall be submitted in soft form.
Guidelines for Term-work Assessment
Continuous assessment of laboratory work shall be based on the overall performance of a student. Assessment of each laboratory assignment shall be based on rubrics that include R1- timely completion (10), R2- understanding of assignment (10) and R3- presentation/clarity of journal writing (10) (Coding standard, Indentation, Hungarian notation, input validation etc)

Strength of CO-PO/ PSO Mapping														
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	-
CO2	3	3	3	3	-	-	-	-	-	-	-	-	3	3
CO3	3	3	3	3	3	-	-	-	-	-	-	-	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	3
CO5	3	3	3	3	3	-	-	3	-	-	3	3	3	3
CO6	3	2	-	-	3	-	-	-	-	-	-	-	-	-
CO7	3	3	-	-	3	-	-	-	-	-	-	-	-	-
CO8	3	3	-	-	3	-	-	-	-	-	-	-	-	-
CO9	3	3	-	-	3	-	-	-	-	-	-	-	-	-
Average	3	2.88	3	3	3	-	-	3	-	-	3	3	3	3

K. K. Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Artificial Intelligence and Data Science
Pattern 2022 Semester: V
COM223005: Design and Analysis of Algorithms Lab

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical: 02 hrs/week	**01**	**Termwork: 25 Marks** **Practical Exam : 25 Marks**

Prerequisite Courses: - COM222007:Data Structures Lab
COM222017:Advanced Data Structures Lab

Companion Course :- COM223001:Design and Analysis of Algorithms

Course Objectives:

- To develop problem solving abilities using mathematical modeling
- To apply algorithmic strategies and analyze while solving problems
- To develop time and space efficient algorithms
- To design algorithmic assignments using various algorithmic strategies

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Build efficient design, analysis and testing of algorithms and calculate its computational complexities	3-Apply
CO2	Apply greedy algorithm to various problems.	3-Apply
CO3	Develop a program based on dynamic programming and backtracking.	3-Apply
CO4	Make use of branch and bound concept to solve various problems.	3-Apply

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Develop a program to design a function for Binary Search using Divide and Conquer Strategies. Also compute it's time complexity.	CO1
2	Develop a program to design a class for Concurrent Quick Sort Using Divide and Conquer Strategies. Also Compute it's time complexity.	CO1
3	Develop a program to implement Huffman Encoding using a greedy strategy.	CO1,CO2
4	Develop a program to solve a fractional Knapsack problem using a greedy method.	CO1,CO2
5	Develop a program to implement 0/1 Knapsack problem using Dynamic Programming.	CO1,CO3
6	Develop a program to implement Optimal Binary Search Tree using Dynamic Programming.	CO1,CO3
7	8-Queen matrix is stored having first queen placed; use backtracking to	CO1,CO3

	place remaining queens to generate the final 8-queen matrix using python.	
8	Develop a program to implement Graph Coloring using backtracking method.	CO1,CO3
9	Develop a program to implement 0/1 Knapsack problem using branch and bound.	CO1,CO4
10	Develop a program for Job Assignment Problem using Branch and Bound.	CO1,CO4

Guidelines for Laboratory Conduction

Use of coding standards and Hungarian notation, proper indentation and comments.
Use of open source software is to be encouraged.
Operating System recommended: - Linux or its derivative
Programming tools recommended: - Open Source line gcc/g++
Programming Language :- C++/Java/Python

Guidelines for Student's Lab Journal

The laboratory assignments are to be submitted by students in the form of a journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, problem statement, theory concepts in brief, algorithm, flowchart, test cases and conclusions). Program codes with sample outputs shall be submitted in soft form.

Guidelines for Termwork Assessment

Continuous assessment of laboratory work shall be based on overall performance of a student. Assessment of each laboratory assignment shall be based on rubrics that include R1- Timely completion (10), R2- Understanding of assignment (10) and R3- Presentation/clarity of journal writing (10) (Coding standard, Indentation, Hungarian notation, input validation etc)

Strength of CO-PO /PSO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	3	2	2	2	2	2	-	-	-	2	3	2
CO2	2	3	3	2	3	2	2	2	-	-	-	2	3	2
CO3	2	3	3	2	3	2	2	2	-	-	-	2	3	2
CO4	2	3	3	2	3	2	2	2	-	-	-	2	3	2
Average	2	3	3	2	2	2	2	2	-	-	-	2	3	2

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Artificial Intelligence and Data Science
Pattern 2022 Semester: V
COM223006A: Internet of Things

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Mark**

Prerequisite Courses: ------

Companion Course : COM223007A: Internet of Things Lab

Course Objectives:

- To understand fundamentals of IoT system.
- To study various IoT protocols.
- To learn various elements of IoT security
- To use python programming in IoT

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Explain the characteristics and methodology to design IoT system	2-Understand
CO2	Identify various devices required for different IoT applications.	3-Apply
CO3	Describe various IoT protocols for communication between different endpoints to develop client server application.	2-Understand
CO4	Explain various elements of IoT Securities	2-Understand
CO5	Make use of various cloud offering available for IoT Platform	3-Apply

COURSE CONTENTS

Unit I	**Introduction to IoT and its Platforms Design Methodology**	**(09 hrs)**	**CO1**

Definition and characteristics of IoT, Applications, Physical design of IoT, Things of IoT, IoT Protocols, Logical design of IoT, IoT functional blocks, IoT communication models, IoT Communication APIs, IoT enabling technologies, IoT levels and deployment templates, IoT Issues and Challenges.

IoT Platform Design Methodology: Purpose and requirement specification, Process specification, Domain model specification, Information model specification, Service specifications level specification, Functional view specification, Operational view specification, Device and component integration, Application development

Unit II	**IoT Physical Devices and Programming Raspberry Pi with Python**	**(07 hrs)**	**CO2**

Basic building blocks of IoT device, Sensors and actuators, Connectivity technologies, Exemplary device: Raspberry Pi, Raspberry Pi interfaces, Beagle board and Other IoT Devices.

Programming Raspberry Pi with Python: Working with digital and analog input output, Retrieving data from the real world with sensors, Working with accelerators, Temperature sensor, Displaying information and performing action using LCD and Servo motors, Working with cloud publishing data to the cloud-Python pub nub.

Unit III	IoT Protocols	(07 hrs)	CO3
Four pillars of IoT: M2M, WSN , SCADA and RFID. **Protocol Standardization for IoT**: Issues with IoT Standardization, Unified Data Standards. **IoT Protocols:** IEEE 802.15.4, BACNet, Modbus, KNX, Zigbee, 6LoWPAN,LoRa			
Unit IV	**IoT Security**	**(06 hrs)**	**CO4**
Vulnerabilities of IoT, Security Requirements, Challenges for Secure IoT, Threat Modeling, Key elements of IoT Security: Identity establishment, Access control, Data and message security, Non-repudiation and availability, Security model for IoT.			
Unit V	**IoT Physical servers and Cloud offering**	**(07 hrs)**	**CO5**
Introduction to Cloud Storage Models, Communication API, WAMP: AutoBahn for IoT, Xively Cloud for IoT, Python Web Application Framework: Djanjo, Amzon Web Services for IoT, SkyNet IoT Messaging Platform.			

Text Books

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, ISBN: 0: 0996025510, 13: 978-0996025515
2. Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press, 2012. ISBN : 9781439892992
3. Gastón C. Hillar, Internet of Things with Python Interact with the world and rapidly prototype IoT applications using Python
4. Dieter Uckelmann, Mark Harrison, Florian Michahelles, “Architecting the Internet of Things”, Springer, 2011. ISBN: 978-3-642-19156-

Reference Books

1. David Easley and Jon Kleinberg, “Networks, Crowds, and Markets: Reasoning About a Highly Connected World”, Cambridge University Press, 2010, ISBN:10: 0521195330
2. Olivier Hersent, Omar Elloumi and David Boswarthick, “The Internet of Things: Applications to the Smart Grid and Building Automation”, Wiley, 2012, 9781119958345
3. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012, ISBN:978-1-119-99435-0
4. Barrie Sosinsky, “Cloud Computing Bible”, Wiley-India, 2010.ISBN : 978-0-470-90356-8
5. Adrian McEwen, Hakim Cassimally, “Designing the Internet of Things”, Wiley, 2014, ISBN: 978-1-118-43063-7

Strength of CO-PO/PSO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	-	-	2	-	-	-	-	-	-	3	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	3	-	3	-	-	-	3	-	-
CO5	3	-	-	-	2	-	-	-	-	-	-	3	-	-
Average	3	2.33	-	-	2	3	-	3	-	-	-	3	-	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Quiz on Unit I, Unit II and Unit III each of 10 marks (Total marks will be converted to 10 marks)	10
2	Assignment on Unit IV and Unit V each of 10 marks (Total marks will be converted to 10 marks)	10
	Total	**20**

K. K. Wagh Institute of Engineering Education and Research, Nashik
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T. Y. B. Tech Artificial Intelligence and Data Science
Pattern 2022 Semester: V
COM223006B: Augmented Reality & Virtual Reality

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory: 03 hrs / week	03	Continuous Comprehensive Evaluation: 20 Marks InSem Exam: 20 Marks EndSem Exam: 60 Marks

Prerequisite Courses: - COM222012: Advanced Data Structures
FYE221011: Programming in C++

Companion Course: COM223007B : Augmented Reality & Virtual Reality Lab

Course Objectives:

- To study concepts of Augmented Reality
- To gain knowledge of various input and output devices required for interacting in virtual world
- To explain AR techniques
- To know Virtual Reality and its applications

Course Outcomes: On completion of the course, students will be able to –

	Course Outcomes	Bloom's Level
CO1	Explain the concepts of the Augmented Reality (AR).	2-Understand
CO2	Describe architecture of AR	2-Understand
CO3	Interpret different AR techniques	2-Understand
CO4	Describe fundamental principles of Virtual Reality (VR)	2-Understand
CO5	Outline Human Factors in VR Evaluations.	2-Understand

COURSE CONTENTS

Unit I	Augmented Reality	(06 hrs)	CO1

Introduction to Augmented Reality, History of Augmented Reality, Taxonomy, Technology and Features of Augmented Reality, Difference Between AR and VR, Challenges With AR, AR Systems and Functionality, Augmented Reality Methods, Visualization Techniques For Augmented Reality, Mobile Projection Interfaces.

Unit II	AR & VR Architecture	(08 hrs)	CO2

Audio Displays, Haptic Displays, Visual Displays, Visual Perception, Spatial Display Model. Tracking, Sensors Tracking, Calibration, and Registration, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors, Optical Tracking, Sensor Fusion.

Unit III	AR Techniques	(08hrs)	CO3

Introduction to Marker Based Approach, Marker-Based Tracking, Types of Markers, Marker Camera Pose and Identification, Visual Tracking, Marker Types, Template Markers, 2D Barcode Markers, Imperceptible Markers.
Marker Less Approach, Localization Based Augmentation, Real World Examples, Tracking Methods Visual Tracking, Feature Based Tracking, Hybrid Tracking, Initialization and Recovery.

Unit IV	Introduction to Virtual Reality	(08hrs)	CO4
Introduction to Virtual Reality, The three I's of virtual reality, Commercial VR technology, five classic components of a VR system. Input Devices, Trackers, Navigation, Gesture Interfaces, Three-dimensional position trackers, Manipulation Interfaces, Output Devices, Graphics displays, Sound displays, Haptic feedback.			
Unit V	**VR Applications**	**(06hrs)**	**CO5**
Testbed Evaluation of Universal VR Tasks, VR Health and Safety Issues, Direct Effects of VR Simulations on User, VR in social aspects. VR applications in industry, Medical applications, Military applications, Robotics applications.			

Text Books

1. Steve aukstakalnis, Practical Augmented Reality: A Guide to the Technologies, Applications and Human Factorsfor AR and VR, Adision Wesley.
2. Dr. Rajiv Chopra, Virtual and Augmented Reality, Khanna Book Publishing, 2021.

Reference Books

1. Burdea, G. C., P. Coffet., "Virtual Reality Technology", 2nd edition, Wiley-IEEE Press, 2006.
2. Steven M. LaValle, "Virtual Reality", Cambridge University Press, 2016
3. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005.
4. William R Sherman, Alan B Craig, "Understanding Virtual Reality: Interface, Application and Design", "The Morgan Kaufmann Series in Computer Graphics", Morgan Kaufmann Publishers, San Francisco, CA, 2002.

Strength of CO-PO / PSO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	-	-	-	3	-	-	-	-	-	-	-	3	3
CO3	3	-	-	-	3	-	-	-	-	-	-	-	3	3
CO4	3	-	-	-	3	-	-	-	-	-	-	-	3	3
CO5	3	-	-	-	-	3	-	3	-	-	-	-	3	3
Average	**3**	**-**	**-**	**-**	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**3**	**3**

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Quiz on Unit-1, Unit 2 and Unit -3 each of 10 marks. (Total marks will be converted to 10 marks)	10
2	Assignment on Unit-4 and Unit-5 each of 10 marks. (Total marks will be converted to 10 marks)	10
	Total	**20**

K. K. Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Artificial Intelligence and Data Science
Pattern 2022 Semester: V
COM223006C :Software Testing and Quality Assurance

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses: - COM222015 Software Engineering and Project Management

Companion Course: COM223007C : Software Testing and Quality Assurance Lab

Course Objectives:

- To study the basic principles of software testing
- To understand various methods of software testing
- To learn the basic concepts of software testing life cycle and test case design
- To know concepts of the software quality assurance, metrics, and defect prevention techniques

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Explain the systematic approach of software testing	2- Understand
CO2	Apply both black box and white box testing techniques	3-Apply
CO3	Make use of software testing methodologies	3-Apply
CO4	Build appropriate test cases	3-Apply
CO5	Select appropriate testing metrics	3-Apply

COURSE CONTENTS

Unit I	**Introduction of Software Testing**	**(06 hrs)**	**CO1**

What is software testing? Why is testing necessary? Testing Principles, Best Practices in Testing, Skills for Testing, Various Task Involved In Testing, Difference between Verification & Validation, Difference between QA & QC, V-Model, Test Case Generation, SDLC Vs. STLC, SDLC – Software Development Life Cycle, Waterfall, Prototype, Spiral , Incremental (Agile methodology and Scrum Framework).

Unit II	**Software Testing Strategies**	**(08 hrs)**	**CO2**

Testing Strategies: Unit Testing, Integration Testing, System Testing, Smoke, Regression Testing, Acceptance Testing. Functional/Non Functional Testing. Testing Tools, Categorization of testing methods: Manual Testing, Automation Testing and Automated Testing Vs. Manual Testing

Non Functional Testing: Performance Test, Memory Test , Scalability Test, Compatibility Test, Security Test, Cookies Test, Session Test, Recovery Test, Installation Test, Ad-hoc Test, Risk Based Test, Compliance Test. McCall's Quality Factors, FURPS.

Unit III	**Software Testing Methodologies**	**(08hrs)**	CO3

Validation & Verification, White/Glass Box Testing, Black Box Testing, Grey Box Testing, Statement Coverage Testing, Branch Coverage Testing, Path Coverage Testing, Conditional Coverage Testing, Loop Coverage Testing, Boundary Value Analysis, Equivalence Class Partition, State Based Testing,

Cause Effective Graph, Decision Table, Use Case Testing, Exploratory testing and Testing Metrics, Testing GUI.

Unit IV	Software Testing Life Cycle and Test Cases	**(08hrs)**	**CO4**

Software Testing Life Cycle: Requirements Analysis/Design, Traceability Matrix, Test Planning, Objective, Scope of Testing, Schedule, Approach, Roles & Responsibilities, Assumptions, Risks & Mitigations, Entry & Exit Criteria, Test Automation, Deliverables

Test Cases Design: Write Test cases, Review Test cases, Test Cases Template, Types of Test Cases, Difference between Test Scenarios and Test Cases. Test Environment setup; Understand the SRS, Hardware and software requirements, Test Data.

Test Execution: Execute test cases, Error/Defect Detecting and Defect Life Cycle, Types of Bugs , Art of Debugging,. Debugging Approaches, Reporting the Bugs, Severity and priority, Test Closure, Criteria for test closure, Test summary report.

Unit V	**Quality and Process Improvement**	**(06hrs)**	**CO5**

Define What Is Quality, Application of Concept of Quality to Software Application, Quality Assurance, Quality Control, Testers Contribution To Quality of Software Application,

Software Testing Metrics: Test Measurements, Test Metrics, Metric Life Cycle, Types of Manual Test Metrics. TQM, Four Principles of TQM.

Quality Standards: CMMI (Capability Maturity Model Integration), ISO, IEEE, Six Sigma, Motorola.

Text Books

1. M G Limaye, “Software Testing Principles, Techniques and Tools‖”, Tata McGraw Hill, ISBN: 9780070139909.
2. Srinivasan Desikan, Gopal Swamy Ramesh, “Software Testing Principles and Practices”, Pearson, ISBN-10: 817758121X .

Reference Books

1. Naresh Chauhan, “Software Testing Principles and Practices", OXFORD, ISBN-10: 0198061846. ISBN-13: 9780198061847
2. Allan C. Gillies, “Software Quality: Theory and Management”, Cengage Learning
3. Stephen H. Kan, “Metrics and Models in Software Quality Engineering”, Pearson Education, 2002.
4. Daniel Galin, “Software Quality Assurance: From Theory to Implementation”, Pearson Education, 2004

Strength of CO-PO / PSO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	-	3	-	-	-	-	-	-	3	-	-
CO2	3	3	3	-	2	-	-	-	-	-	-	3	-	-
CO3	3	3	3	2	3	-	-	-	-	-	-	3	-	3
CO4	3	3	3	2	3	-	-	-	-	-	-	3	-	3
CO5	3	3	3	2	3	-	-	-	-	-	-	3	-	-
Average														

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Quiz on Unit I, Unit II and Unit III (Quiz of 10 marks each will be converted to 10 marks)	10
2	Assignment on Unit IV and Unit V (Assignment of 10 marks each will be converted to 10 marks)	10
	Total	**20**

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Artificial Intelligence and Data Science **Pattern 2022 Semester: V** **COM223007A : Internet of Things Lab**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical: 02 hrs/week	**01**	**Continuous Comprehensive Termwork: 25 Marks** **Oral : 25 Marks**
Prerequisite Courses: -----		
Companion Course: COM223006A: Internet of Things		
Course Objectives: ● To test the functionality of various sensors and actuators ● To use python for GPIO programming in IOT ● To develop client server application in IoT using various protocols		
Course Outcomes: On completion of the course, students will be able to–		

	Course Outcomes	**Bloom's Level**
CO1	Make use of various actuators and sensors available for sensing the real world	3-Apply
CO2	Design and construct IoT application for specified requirement	3-Apply
CO3	Apply various IoT protocols for communication between different endpoints to develop client server applications.	3-Apply
CO4	Construct an application for remote sensing, monitoring and controlling appliances.	3-Apply

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Interface the I/O devices like LED, Switch, Buzzer to Raspberry Pi and write GPIO programming in python to test its functionality	CO1
2	Write an application to detect obstacles using Proximity sensor and notify the user using LED or Buzzer.	CO1, CO2
3	Write an application to read the environment temperature. If temperature crosses a threshold value, the application indicates the user using LED or Buzzer.	CO1, CO2
4	Using the light sensor, monitor the surrounding light intensity and automatically turn on/off the high intensity LED by taking some predefined threshold light intensity value.	CO1, CO2
5	Display any RSS news feed headline on a LCD display connected to a device. Extract data from any website and flash it on an LCD	CO1, CO3
6	Interface the USB webcam with the device and capture the image .	CO1
7	Create an account on Thing speak cloud and write an application to	CO1, CO3

	publish the temperature information and interested applications can subscribe.	
8	Create a simple web interface for Raspberry-Pi to control the connected LEDs remotely through the interface	CO1, CO3,CO4
9	Interface an Android smartphone with an Arduino /Raspberry pi via Bluetooth to control an LED from your phone.	CO1, CO3,CO4
10	Mini Project using Raspberry pi to identify and solve any real world problem	CO1 to CO4

Guidelines for Laboratory Conduction

Use of coding standards and Hungarian notation, proper indentation and comments.
Use of open source software is to be encouraged.
Programming tools recommended: - Raspberry-Pi/Arduino

Guidelines for Student's Lab Journal

The laboratory assignments are to be submitted by students in the form of a journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, problem statement, theory concepts in brief, algorithm, flowchart, test cases and conclusions). Program codes with sample outputs shall be submitted in soft form

Guidelines for Termwork Assessment

Continuous assessment of laboratory work shall be based on overall performance of a student. Assessment of each laboratory assignment shall be based on rubrics that include R1- timely completion (10), R2- understanding of assignment (10) and R3- presentation/clarity of journal writing (10) (Coding standard, Indentation, Hungarian notation, input validation etc)

Strength of CO-PO PSO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	-	2	-	-	-	-	-	-	3	-	-
CO2	3	3	3	-	2	-	-	-	-	-	-	3	-	3
CO3	3	2	-	-	2	-	-	-	-	-	-	3	-	-
CO4	3	3	3	-	2	-	-	-	-	-	-	3		-
Average	3	2.75	3	-	2	-	-	-	-	-	-	3	-	3

K. K. Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech Artificial Intelligence and Data Science
Pattern 2022 Semester: V
COM223007B: Augmented Reality & Virtual Reality Lab

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical: 02 hrs/week	**01**	**Term work: 25 Marks** **Oral Exam : 25 Marks**

Prerequisite Courses: - COM222012: Advanced Data Structures
FYE221011: Programming in C++

Companion Course: COM223006B: Augmented Reality & Virtual Reality

Course Objectives:
- To study software and hardware requirements of AR and VR
- To get acquainted with methods of designing and rendering immersive environment
- To design and develop virtual reality tasks
- To evaluate VR application

Course Outcomes: On completion of the course, students will be able to –

	Course Outcomes	**Bloom's Level**
CO1	Make use of AR and VR development tools	2- Understand
CO2	Demonstrate the use of AR,VR and MR devices	3- Apply
CO3	Design and develop a game scene	6- create
CO4	Build AR and (or) VR application	6- create

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1.	Study of various AR & VR Development tools such as UNITY 3D IDE and its documentation.	CO1
2.	Create a C# script that plays a video when an image is scanned using AR App (AR Core & Unity).	CO3
3.	Develop & Deploy a simple marker-based AR app in which you have to write a C# program to play video on tracking a particular marker.	CO3,CO4
4.	Design and Develop the following using Vuforia Engine developer portal: I. Plane detection II. Marker based Tracking (Create database of objects to be tracked in Vuforia) III. Object Tracking and deploy it on AR devices.	CO3, CO4
5.	Demonstration of the working of HTC Vive, Oculus Quest 2, Microsoft Hololens2.	CO2
6.	Develop a scene in Unity that includes: I. A cube, plane and sphere, apply transformations on the 3 game objects.	CO4

	II. Add a video and audio source.	
7.	Develop a scene in Unity that includes a cube, plane and sphere. Create a new material and texture separately for three Game objects. Change the color, material and texture of each Game object separately in the scene. Write a C# program in visual studio to change the color and Material/texture of the game objects dynamically on button click.	CO4
8.	Develop and deploy a VR app, Add interactive elements to the environment, such as objects that can be picked up, manipulated, or triggered by the user's actions.	CO4
9.	A. Create a multiplayer VR game (battlefield game). The game should keep track of score, no. of chances/lives, levels (created using different scenes), involve interaction, animation and immersive environment. OR B. Create a treasure hunt AR application which should have the following features: • A help button for instruction box to appear • A series of markers which would give hints on being scanned • Involve interaction, sound, and good UI OR C. Evaluate an existing VR application or a VR game.	CO1 to CO4

Guidelines for Laboratory Conduction

Use of coding standards and Hungarian notation, proper indentation and comments.
Use of open source software is to be encouraged.
Practice using AR & VR tools such Unity, Vuforia, Blender, Unreal.
Operating System recommended: - Linux or its derivative , Windows 10 and above
Programming tools recommended: - Open Source line gcc/g++/C#

Guidelines for Student's Lab Journal

The laboratory assignments are to be submitted by students in the form of a journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, problem statement, theory concepts in brief, algorithm, flowchart, test cases and conclusions). Program codes with sample outputs shall be submitted in soft form

Guidelines for Term-work Assessment

Continuous assessment of laboratory work shall be based on overall performance of a student. Assessment of each laboratory assignment shall be based on rubrics that include R1- timely completion (10), R2- understanding of assignment (10) and R3- presentation/clarity of journal writing (10) (Coding standard, Indentation, Hungarian notation, input validation etc)

Strength of CO-PO PSO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	-	1	2	-	2	-	-	-	-	-	-	-	3	3
CO3	2	2	-	-	2	-	-	-	-	-	-	-	3	3
CO4	2	-	2	1	2	-	-	-	-	-	-	-	3	3
CO5	2	2	2	1	2	-	-	-	-	-	-	2	3	3
Average	**2**	**1.66**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**3**

K.K.Wagh Institute of Engineering Education and Research, Nashik
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T. Y. B. Tech. Artificial Intelligence and Data Science **Pattern 2022 Semester: VII** **COM223007C: Software Testing and Quality Assurance Lab**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical: 02 hrs/week	**02**	**Term work: 25 Marks** **Oral : 25 Marks**

Prerequisite Courses: - COM222015: Software Engineering and Project Management

Companion Course : COM2301306C Software Testing and Quality Assurance

Course Objectives:

- To analyse the requirements for the given problem statement
- To design and implement various solutions for the given problem
- To employ various design strategies for software testing
- To construct control flow graphs for white box testing
- To create appropriate document for the software artifact

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Understand and describe the basic concepts of functional (black box) software testing.	2-Understand
CO2	Identify a number of test styles and techniques and assess their usefulness in the context of software testing	3-Apply
CO3	Understand the basic application of techniques used to identify useful ideas for testing	2-Apply
CO4	Verify that the end result meets the end user requirements	3-Apply
CO5	Characterize a good bug report, peer-review reports to improve report writing	3-Apply

Strength of CO-PO PSO Mapping														
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	-	2	-	-	-	-	-	-	3	-	-
CO2	3	3	3	-	2	-	-	-	-	-	-	3	-	3
CO3	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	2	-	-	-	2	-	2	-	-	-	3		-
CO5	3	2	-	-	-	-	-	-	-	-	-	3	-	-
Average	3	2.4	3	-	2	2	-	2	-	-	-	3	-	3

List of Laboratory Experiments / Assignments		
Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Design and develop a code for binary search algorithm C++/Java. Determine the basis paths and use them to derive different test cases, execute these test cases and discuss the test results.	
2	Design, and develop a code for quick sort algorithm using C++/Java. Determine the basis paths and use them to derive different test cases, execute these test cases and discuss the test results.	
3	Design and develop a code using C++/Java to implement an absolute letter grading procedure, making suitable assumptions. Determine the basis paths and using them derive different test cases, execute these test cases and discuss the test results.	
4	Design and develop a code using C++/Java to implement the Next Date function. Analyze it from the perspective of boundary value testing, derive different test cases, execute these test cases and discuss the test results.	
5	**Leave Management System with following modules:** **a. Login** – Two types of User: Admin and User **b. Admin Functionalities:** i. Manage Leave Types ii. Manage User Leaves iii. Manage Users iv. Manage Different Shifts v. Manage Reporting Groups and Team Structure **c. Time and Attendance** i. User can view his/her attendance detail ii. Admin can view user's attendance log iii. Admin can generate various reports like LateIn, EarlyOut, etc. **d. Leaves** i. User can apply leave and Admin can reject/approve ii. User can view his leave request log, can modify and cancel as well **** Many other functionalities can be added to make it more complex**	
6	**In Airline reservation system, the following features need to be tested namely**, **a. Login** **b. Search and book flights** **c. Search and book packages** **d. Register Feature not in scope,** **e. Search and book hotels** – Pre-requities: Database & Payment gateway's sandbox environment access should be available. – Prepare the Test Plan for the above with all the possible criteria need to be considered. – Prepare the Test Cases for the features in scope to be tested.(At least one for each above mentioned feature) – Prepare the Defect Report.	
7	**Healthcare Web application with following modules:** a. Patient Registration b. Scheduling c. Treatment d. Billing	

Follow the instructions for assignment Number 5, 6, and 7

Part 1: Test Planning

a) Prepare Quality Plan for any Application like online shopping etc.

b) Prepare Test Plan for any Application like Railway Reservation System etc.

Part 2: Test Case Design

Part 3: Software Testing (Manual)

a) Create Test cases : Unit testing, Integration testing , System testing and Acceptance testing for Application

b) Perform manual testing using test case created and prepare test Metrics

Suggested Template for Test case creation.

Sr. No. #	Test condition / Steps	Input	Expected Result	Actual Result	Pass/Fail

Write test cases using following techniques (Suggested)

- Coverage
- Boundary Value Analysis (BVA)
- Equivalence Partition (EP)
- State Transition Technique
- Error Guessing Technique

Part 4: Software Testing (Automated)

Tools: Selenium, Jira

Test automation – script creation and execution

Guidelines for Laboratory Conduction

Use of coding standards and Hungarian notation, proper indentation and comments.
Use of open source software is to be encouraged.
Operating System recommended: - Linux or its derivative

Guidelines for Student's Lab Journal

The laboratory assignments are to be submitted by students in the form of a journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, problem statement, theory concepts in brief, algorithm, flowchart, test cases and conclusions). Program codes with sample outputs shall be submitted in soft form

K.K.Wagh Institute of Engineering Education and Research, Nashik
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T. Y. B. Tech. Artificial Intelligence and Data Science **Pattern 2022 Semester: V** **COM223008: Management Information Systems**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 02 hrs/week	**02**	**Continuous Comprehensive Evaluation: 50 Marks**

Prerequisite Courses: - -

Course Objectives:

- To understand concepts of Management Information System and Business intelligence for MIS.
- To recognize the need of an information system in today's global business with tools and technologies.
- To identify IT infrastructure components and to study security in the Information System.
- To understand the importance of project management and the international information system.
- To understand the concepts of decision support systems for business applications.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Explain the concepts of management information system and business intelligence for MIS.	2-Understand
CO2	Illustrate the need of information system using global business and ethical issues.	3-Apply
CO3	List the IT infrastructure components and explain security in the information system	2-Understand
CO4	Demonstrate the importance of project management and extend its use in the international information system	3-Apply
CO5	Illustrate the concepts of decision support systems for business applications.	3-Apply

COURSE CONTENTS

Unit I	**An Overview of Management Information System**	**(04hrs)**	**CO1**

Management information system: Concept, Definition, Role of MIS, Impact of MIS, Management as a Control System: The functions of Management, Managerial Roles, The Levels of Management, Support to the Management, Management effectiveness and MIS, Organization as a System. Decision Making, Business intelligence for MIS.

Unit II	**Organization, Management and Network Enterprise**	**(05hrs)**	**CO2**

Perspectives on Information System. Global E-business and collaboration: Business Processes, Types of Information Systems, Tools and technologies for collaboration and teamwork, E-mail and Instant Messaging, Social Networking, Virtual worlds, Internet based Collaboration Environments. Information system organization and strategy, Ethical and social issues in information system.

Unit III	**Information Technology Infrastructure**	**(05hrs)**	**CO3**

IT infrastructure and Emerging Technologies: IT infrastructure and its components, Hardware and software platform trends, Management issues.
Foundation of Business intelligence: Databases and information management. Telecommunication, The

Internet and Wireless technology, Securing information systems: system vulnerability, Business value of security and control.

Unit IV	Key System Applications for Digital Age	(05hrs)	CO4

Enterprise Applications, E-Commerce: Digital Markets and Digital Goods, Managing knowledge, Enhancing Decision Making, Building information Systems, Managing project: The importance of project Management, the business value of information systems, Managing project risk, Managing Global Systems: The growth of international information systems, organizing international information systems, Technology issues and opportunities for global value chain.

Unit V	Business Applications	(05hrs)	CO5

Introduction to e-business systems: Functional Business systems, cross functional Enterprise systems. Customer Relationship Management: The Business focus, Enterprise Resource Planning: The business backbone, Supply chain Management: Business Network. Electronic Commerce Systems: Fundamentals, e-commerce applications and issues. Decision support systems: Decision support in Business, DSS Components, Data Mining for Decision Support, benefits and challenges in enterprise system.

Text Books

1. Waman S. Javadekar,"Management Information System: A Global Digital Enterprise Perspective", McGraw Hill Education Pvt. Ltd. 5thEdition, ISBN– 13:978-1-25-902669-0.
2. James A.O' Brien, George MMarakas, "Management Information Systems", The McGraw-Hill Companies, 7th Edition, ISBN-0-07-062-003-2

Reference Books

1. Kenneth C. Laudon, Jane P. Laudon, "Management information Systems: Managing the Digital Firm", Perason, 12th Edition, ISBN-978-81-317-8746-5.
2. James A. O'Brien,"Management Information Systems: Managing information Technology in the Business Enterprise", Tata McGraw Hill Edition, 6th Edition, ISBN- 0-07-058739-6.
3. Robert Schultheis, Marry sumner, "Management information system: The Manager's View", Tata McGraw Hill Edition, 4thEdition, ISBN-0-07-463879-3.
4. Gordon B. Davis, Margrethe H. Olson, "Management Information Systems: Conceptual Foundations, Structure and Development",TataMcGrawHillEdition,2ndEditon,ISBN-13:978-0-07-040267-6

Strength of CO-PO /PSO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2	1	1	-	-	-	-	-	-	-	-	1	2
CO2	1	1	1	-	-	-	-	1	1	-	-	-	1	1
CO3	2	1	1	-	-	-	-	-	-	-	-	-	2	1
CO4	2	1	1	1	-	-	-	-	-	-	1	-	2	1
CO5	2	2	2	1	1	-	-	-	-	-	-	-	2	2
Average	1.6	1.4	1.2	1	1	-	-	1	1	-	1	-	1.6	1.4

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Quiz on Unit-1, Unit-2, Unit-3 (Quiz 10 marks on each)	30
2	Theory assignment on Unit- 4 and 5 (10 marks assignment on unit 4 and 5)	20
	Total	50

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Artificial Intelligence and Data Science
Pattern 2022 Semester: V
CSD223009: Computer Organization and Architecture

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses: - COM222004: Digital Electronics and Logic Design

Course Objectives:

- To get familiar with basics of computer organization and architecture
- To explain the function of elements of memory hierarchy and compare different methods for computer Input/Output
- To understand the concept of processor organization

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Explain the functions & organization of building blocks of computer	2- Understand
CO2	Illustrate processor instruction characteristics and concepts related to Assembly Language Programming	2- Understand
CO3	Explain characteristics of memory system and I/O devices.	2-Understand
CO4	Illustrate the organization of computer processor	2-Understand
CO5	Compare hardwired and micro programmed control unit	2-Understand

COURSE CONTENTS

Unit I	**Introduction**	**(06 hrs)**	**CO1**

Introduction to computer organization and architecture, Structure and Function, Computer components, Computer functions, Interconnection structure, Bus interconnection

Unit II	**Instruction Set**	**(08 hrs)**	**CO2**

Machine Instruction Characteristics, Type of operands, Addressing Modes, Types of operations: Data transfer, Arithmetic, Logical, Conversion, I/O , Transfer of Control, Introduction to assembly language

Unit III	**Memory and Input/output**	**(08hrs)**	**CO3**

Memory: Characteristics of memory systems, The memory hierarchy, Cache memory principles, Elements of cache design: Direct, Associative Mapping, Memory replacement algorithms
Input/Output: I/O Modules, Programmed I/O, Memory mapped I/O, Interrupt driven I/O, Direct Memory Access

Unit IV	**Processor Organization**	**(08hrs)**	**CO4**

Processor Organization, Register Organization, Instruction Cycle, Instruction Pipelining, Superscalar Vs Super pipelined, Design Issues

Unit V	**Control Unit**	**(06hrs)**	**CO5**

Control Unit and its Operation: Micro operation, Control of the processor, Hardwired Implementation, Micro programmed Control: Microinstruction, Microinstruction sequencing and execution

Text Books
W. Stallings, “Computer Organization and Architecture: Designing for Performance”, Eighth Edition, Prentice Hall of India, 2010, ISBN 13: 978-0-13-607373-4
Reference Books
1. C. Hamacher, V. Zvonko, S. Zaky, “Computer Organization”, Fifth edition, McGraw Hill, 2002, ISBN: 007-120411-3 2. Morris Mano, “Computer System Architecture”, PHI, Third Edition, ISBN- 81-7808-687-5

Strength of CO-PO/PSO Mapping														
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	3	-	-	-	-	-	-	-	-	-	-	-	-	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Quiz on Unit 1, Unit 2, Unit 3 each of 15 marks (Total marks will be converted to 15 Marks)	15
2	Theory assignment on Unit 4, Unit 5 each of 10 marks (Total marks will be converted to 5 Marks)	5
	Total	**20**

K.K.Wagh Institute of Engineering Education and Research, Nashik
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T. Y. B. Tech. Artificial Intelligence and Data Science **Pattern 2022 Semester: V** **ADS223010 : Project Based Learning**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical : 2 hrs./week **Tutorial: 1hr/Week**	**02**	**Termwork:25 Marks** **Tutorial : 25 Marks**
Prerequisite Courses: --		
Companion Course: --		

Course Objectives:

- To develop critical thinking and problem solving ability by exploring and finding solutions to social problem.
- To evaluate alternative approaches and justify the use of selected methods.
- To provide every student the opportunity to get involved either individually or as a group so as to develop team skills.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Identify the real life problem from societal need point of view	3-Apply
CO2	Compare alternative approaches to select the most feasible method	4-Analyze
CO3	Develop the reliable and scalable solution to meet challenges	3-Apply
CO4	Develop communication skill through demonstration of their ideas	3-Apply

Guidelines for Laboratory Conduction

Selection of Project/Problem: The problem-based project oriented model for learning is recommended. The model begins with the identifying of a problem, often growing out of a question or "wondering". This formulated problem then stands as the starting point for learning. Students design and analyze the problem within an articulated interdisciplinary or subject frame. A problem can be theoretical, practical, social, technical, symbolic, cultural and/or scientific and grows out of students' wondering within different disciplines and professional environments. A chosen problem has to be exemplary. The problem may involve an interdisciplinary approach in both the analysis and solving phases. By exemplarity, a problem needs to refer back to a particular practical, scientific, social and/or technical domain. The problem should stand as one specific example or manifestation of more general learning outcomes related to knowledge and/or modes of inquiry. There are no commonly shared criteria for what constitutes an acceptable project. Projects vary greatly in the depth of the questions explored, the clarity of the learning goals, the content and structure of the activity.

- A few hands-on activities that may or may not be multidisciplinary
- Use of technology in meaningful ways to help them investigate, collaborate, analyze, synthesize and present their learning.
- Activities may include- Solving real life problem, investigation /study and Writing reports of in depth study, field work.

Group Structure:

Working in supervisor/mentor monitored groups; the students plan, manage, and complete a task/project/activity which addresses the stated problem.
1. There should be team/group of 4-5 students
2. A supervisor/mentor teacher assigned to individual groups

Guidelines for Student's Lab Journal

The laboratory work are to be submitted by students in the form of detailed documentation which may include requirements, design and modelling, implementation/execution, use of technology and other documents

Guidelines for Term work Assessment

Assessment:
Progress of PBL is monitored regularly on weekly basis. Weekly review of the work is necessary. During process of monitoring and continuous assessment and evaluation of the individual and the team performance is to be measured.
Group may demonstrate their knowledge and skills by developing a public product and/or report and/or presentation.
1. Individual assessment for each student (Understanding individual capacity, role and involvement in the project)
2. Group assessment (roles defined, distribution of work, intra-team communication and togetherness)
3. Documentation and presentation

Recommended parameters for assessment/evaluation and weightage:
1. Idea Inception and Awareness /Consideration of -Environment/ Social /Ethics/ Safety Measures /Legal aspects (15%)
2. Outcomes of PBL/ Problem Solving Skills/ Solution provided/ Final product (Individual Assessment and team assessment) (50%)
3. Documentation (Gathering requirements, design and modelling, implementation/execution, use of technology and final report, other documents) (15%)
4. Demonstration (Presentation, User Interface, Usability) (20%)

Strength of CO-PO / PSO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	3	3	-	3	-	-
Average	3	3	2	-	-	-	-	-	3	3	-	3	-	-

K. K. Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Artificial Intelligence and Data Science
Pattern 2022 Semester: VI
ADS223011: Business Intelligence and Analytics

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory: 03 hrs/week	03	Continuous Comprehensive Evaluation: 20 Marks In-Sem Exam: 20 Marks End-Sem Exam: 60 Marks

Prerequisite Courses: - ADS223003: Data Science and Big Data
ADS222014: Database Management System

Companion Courses: -

Course Objectives:

- To study and understand the fundamentals of business intelligence and big data analytics.
- To learn techniques for data visualization and reporting to facilitate effective decision-making
- To explain different data pre-processing techniques
- To explore emerging trends and machine learning models in Business Intelligence
- To understand the BI Applications in various industries

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Apply conceptual knowledge how BI is used in decision support systems	2- Understand
CO2	Use Modelling Concepts in Business Intelligence	3-Apply
CO3	Understand and apply the concept of data provisioning and data Visualization	3-Apply
CO4	Implement machine learning algorithms as per business needs	3-Apply
CO5	Identify the role of BI in Management, Inventory, Production, Logistics and Management	3-Apply

COURSE CONTENTS

Unit I	Introduction to BI and Decision Support system	(06 hrs)	CO1

A Framework for Business Intelligence, Business Analytics Overview, Brief Introduction to Big Data Analytics , Information Systems Support for Decision Making, An Early Framework for Computerized Decision Support, The Concept of Decision Support Systems, Decision Support Systems Capabilities, Decision Support Systems Classification, Decision Support Systems Components.

Unit II	Modelling in Business Intelligence	(08 hrs)	CO2

Models and modelling in BI, Model Presentation, Model Building, Model Assessment and Quality of Models, Modelling using Logical Structures: ontology & Frame, Modelling using graph structure: Business process model and notation (BPMN), Modelling using probabilistic structures, Modelling using analytical structure. Model and Data: data Generation, The Role of time, Data Quality.

Unit III	Data Provisioning and Data Visualization	(08hrs)	CO3

Data Provisioning: Data warehouse, schemas, Data Quality, Data profiling, Data enrichment, data duplication, ETL Architecture and what is ETL, Extraction concept and Change data capture, Transformation concept, lookups, time lag, formats, consistency, Loading concept, Initial and Incremental loading, late arriving facts, What is Staging, Data marts, Cubes.

Data Visualization: What Is a Business Report, Components of Business Reporting Systems, Data and Information Visualization, Types of Charts and Graphs, Visual Analytics, Performance Dashboards, Business Performance Management?

BI Tools: Tableau, power BI, Dundas BI, Oracle BI,bMs excel

Unit IV	**Impact of Machine Learning in BI**	**(08hrs)**	**CO4**

Regression: Regression problems, Evaluation of regression models, Linear regression.

Classification: Classification problems, Evaluation of classification models, Bayesian methods, Logistic regression.

Clustering: Clustering methods, Partition methods, Hierarchical methods, Evaluation of clustering models. Association Rule: Structure of Association Rule, Apriori Algorithm

Unit V	**BI Applications, Emerging Trends and Future Impacts**	**(06hrs)**	**CO5**

BI Applications: Applications of Business Intelligence in Higher Education, Healthcare Monitoring, Logistics and Supply Chain Management, Customer Relationship Management, Banking Industry, Telecommunication Industry, Manufacturing Industry.

Emerging Trends and Future Impacts: Location based analytics for organisations, Mobile BI, Web 2.0 and Online Social Networking, Cloud Computing and BI. Issues related to analytics.

Text Books

1. Ramesh Sharda, Dursun Delen, EfraimTurban, J.E.Aronson,Ting-Peng Liang, David King, "Business Intelligence and Analytics: System for Decision Support", 10th Edition, Pearson Global Edition, 2015
2. Grossmann W, Rinderle-Ma, "Fundamental of Business Intelligence", Springer, ISBN 978-662-46531-8

Reference Books

1. Data Analytics: The Ultimate Beginner's Guide to Data Analytics Paperback – 12 November 2017 by Edward Mize
2. "Data Analytics for Beginners: Your Ultimate Guide to Learn and Master Data Analysis. Get Your Business Intelligence Right – Accelerate Growth And Close More Sales" by Victor Finch
3. Introduction to business Intelligence and data warehousing, IBM, PHI
4. Business Intelligence: Data Mining and Optimization for Decision Making, Carlo Vercellis, Wiley, 2019
5. "Business Intelligence Guidebook: From Data Integration to Analytics" by Rick Sherman, Elsevier Inc.

Strength of CO-PO /PSO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	-	3	-	-	-	-	-	-	3	-	-
CO2	3	3	3	-	2	-	-	-	-	-	-	3	-	-
CO3	3	3	3	2	3	-	-	-	-	-	-	3	-	3
CO4	3	3	3	2	3	-	-	-	-	-	-	3	-	3
CO5	3	3	3	2	3	-	-	-	-	-	-	3	-	-
Average	3	3	3	3	3							3		3

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Quiz on Unit I, Unit II and Unit III (Quiz of 10 marks each will be converted to 10 marks)	10
2	Assignment on Unit IV and Unit V (Assignment of 10 marks each will be converted to 10 marks)	10
	Total	**20**

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Artificial Intelligence and Data Science
Pattern 2022 Semester: VI
COM223012: Theory of Computation

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses: - COM222003: Discrete Mathematics

Companion Course: -

Course Objectives:

- To introduce the students about the basic concepts of formal language, natural language and finite state machines.
- To study abstract computing models to provide a formal connection between algorithmic problem solving and the theory of languages
- To understand Grammar, Pushdown Automata and Turing Machine for language processing and algorithm design
- To learn about the theory of computability and complexity for algorithm design

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Construct finite automata and regular expression, for given regular language and their inter conversion.	2-Understand
CO2	Classify between pumping lemma for regular expression and Context Free Grammar.	2-Understand
CO3	Construct Context Free Grammars and convert a given grammar in one form to other form	3-Apply
CO4	Construct Pushdown Automata for the given Context Free language	3-Apply
CO5	Construct Turing Machine for regular and non regular languages and understand the concept of different classes of problems	3-Apply

COURSE CONTENTS

Unit I	**Formal Language Theory and Finite Automata**	**(09 hrs)**	**CO1**

Basic Concepts: Symbols, Strings, Language, Formal Language, Natural Language. Basic Machine and Finite State Machine.
Finite Automata (FA): An informal picture of FA, Finite State Machine (FSM), Language accepted by FA, Definition of Regular Language.
FA without output: Deterministic and Nondeterministic FA (DFA and NFA), epsilon- NFA and inter-conversion.
FAwithoutput:MooreandMealymachines-Definition,models,inter-conversion

Unit II	**Regular Expressions**	**(06 hrs)**	**CO2**

Introduction, Operators of RE, Precedence of operators, Algebraic laws for RE, Language to Regular Expressions, Equivalence of two REs.
Conversions: RE to NFA, DFA, DFA to RE using Arden's theorem, Pumping Lemma for Regular languages, Closure and Decision properties of Regular languages
Case study: To study the use of RE in text processing systems for pattern matching

Unit III	Context Free Grammar (CFG)and Context Free Language (CFL)	(07hrs)	CO3

Basic Elements of Grammar, Formal Definition of Context Free Grammar, Sentential form, Derivation and Derivation Tree/ Parse Tree, Context Free Language (CFL), Ambiguous Grammar, writing grammar for language.

Simplification of CFG: Eliminating Є-productions, unit productions, useless production, and useless symbols.

Normal Forms: Chomsky Normal Form, Greibach Normal Form, Pumping Lemma for CFG, Closure properties of CFL

Unit IV	Pushdown Automata	(07hrs)	CO4

Introduction, Formal definition of PDA, Equivalence of Acceptance by Final State and Empty stack, Non-deterministic PDA (NPDA), PDA and Context Free Language, Equivalence of PDA and CFG, PDAvs CFLs. Deterministic CFLs.

Unit V	Turing Machines	(07hrs)	CO5

Introduction, Formal definition of Turing Machines, Language Acceptability by Turing Machines, Universal Turing Machines, Multi-Tape Turing Machines, Multi-Stack Turing Machines, Multi-Track Turing Machines, Halting Problem of TM, Recursion Theorem

Complexity Classes: The Class P, The Class NP, Examples of problems in NP, NP-hard Problems.

Case Study : To study the use of Application of Halting problem in parallel computing

Text Books

1. Vivek Kulkarni, “Theory of Computation”, Oxford University Press, ISBN0-19-808458
2. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, “Introduction to Automata Theory Languages and Computation”, Addison-Wesley, ISBN 0-201-44124-1
3. Daniel Cohen, “Introduction to Computer Theory”, Wiley & Sons,ISBN97881265133454

Reference Books

1. Sanjeev Aroraand Boaz Barak, “Computational Complexity: A Modern Approach”, Cambridge University Press, ISBN: 0521424267 97805214242643
2. John Martin, “Introduction to Languages and The Theory of Computation”, 2nd Edition, McGraw Hill Education,ISBN-13:978-1-25-900558-9, ISBN-10: 1-25-900558-5

Strength of CO-PO PSO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
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CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	3	-	-	-	-	-	-	-	-	-	-	-	-	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Quiz on Unit-1, Unit-2, Unit-4, Unit-5 each of 15 marks (Total marks will be converted to 15 out of 60 Marks)	15
2	Theory assignment on Unit-3 (One Assignment on Unit-3 of 15 marks will be converted to 5 Marks)	05
	Total	**20**

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Artificial Intelligence and Data Science
Pattern 2022 Semester: VI
COM223012: Theory of Computation

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses: - COM222003: Discrete Mathematics

Companion Course: -

Course Objectives:

- To introduce the students about the basic concepts of formal language, natural language and finite state machines.
- To study abstract computing models to provide a formal connection between algorithmic problem solving and the theory of languages
- To understand Grammar, Pushdown Automata and Turing Machine for language processing and algorithm design
- To learn about the theory of computability and complexity for algorithm design

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Construct finite automata and regular expression, for given regular language and their inter conversion.	2-Understand
CO2	Classify between pumping lemma for regular expression and Context Free Grammar.	2-Understand
CO3	Construct Context Free Grammars and convert a given grammar in one form to other form	3-Apply
CO4	Construct Pushdown Automata for the given Context Free language	3-Apply
CO5	Construct Turing Machine for regular and non regular languages and understand the concept of different classes of problems	3-Apply

COURSE CONTENTS

Unit I	**Formal Language Theory and Finite Automata**	**(09 hrs)**	**CO1**

Basic Concepts: Symbols, Strings, Language, Formal Language, Natural Language. Basic Machine and Finite State Machine.
Finite Automata (FA): An informal picture of FA, Finite State Machine (FSM), Language accepted by FA, Definition of Regular Language.
FA without output: Deterministic and Nondeterministic FA (DFA and NFA), epsilon- NFA and inter-conversion.
FAwithoutput:MooreandMealymachines-Definition,models,inter-conversion

Unit II	**Regular Expressions**	**(06 hrs)**	**CO2**

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Unit III	Context Free Grammar (CFG)and Context Free Language (CFL)	(07hrs)	CO3

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Normal Forms: Chomsky Normal Form, Greibach Normal Form, Pumping Lemma for CFG, Closure properties of CFL

Unit IV	Pushdown Automata	(07hrs)	CO4

Introduction, Formal definition of PDA, Equivalence of Acceptance by Final State and Empty stack, Non-deterministic PDA (NPDA), PDA and Context Free Language, Equivalence of PDA and CFG, PDAvs CFLs. Deterministic CFLs.

Unit V	Turing Machines	(07hrs)	CO5

Introduction, Formal definition of Turing Machines, Language Acceptability by Turing Machines, Universal Turing Machines, Multi-Tape Turing Machines, Multi-Stack Turing Machines, Multi-Track Turing Machines, Halting Problem of TM, Recursion Theorem

Complexity Classes: The Class P, The Class NP, Examples of problems in NP, NP-hard Problems.

Case Study : To study the use of Application of Halting problem in parallel computing

Text Books

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2. John Martin, “Introduction to Languages and The Theory of Computation”, 2nd Edition, McGraw Hill Education,ISBN-13:978-1-25-900558-9, ISBN-10: 1-25-900558-5

Strength of CO-PO PSO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	3	-	-	-	-	-	-	-	-	-	-	-	-	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Quiz on Unit-1, Unit-2, Unit-4, Unit-5 each of 15 marks (Total marks will be converted to 15 out of 60 Marks)	15
2	Theory assignment on Unit-3 (One Assignment on Unit-3 of 15 marks will be converted to 5 Marks)	05
	Total	**20**

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Artificial Intelligence and Data Science
Pattern 2023 Semester: VI
ADS223013: Data Science Techniques and Tools Lab

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical : 02 hrs/week	**01**	**Continuous Comprehensive Termwork: 25 Marks** **Practical Exam :25 Marks**

Prerequisite Courses: - ADS223003: Data Science and Big Data

Companion Course: ---

Course Objectives:

- To understand exploratory data analysis
- To identify the tools used for data science analytics
- To understand the methodology for preprocessing, analyzing and visualizing big data.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	To make use of various data storage techniques for handling big data	2-Understand
CO2	Apply appropriate exploratory data analysis to gain insights from data	3-Apply
CO3	Apply Time series analysis on the given data set	3-Apply
CO4	Develop interactive dashboard for effective data visualization techniques	3-Apply
CO5	Analyze the data statistically and visually explore the data	4-Analyze

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Study the Hadoop ecosystem its framework and components.	CO1
2	Perform Exploratory data analysis on web logs using Apache Spark. a. Compute statistics regarding the average, minimum, and maximum content sizes. b. Perform HTTP status code analysis to see which status code values appear and how many times. c. Analysing frequent hosts by getting the total count of accesses by each host, sorting by the number of accesses, and displaying only the top 10 most frequent hosts d. Display the top 20 most frequent endpoints e. Display the top 10 error endpoints f. How many unique hosts visited the website in two month g. Find the average number of requests made per host to the website per day h. Listing the top twenty 404 response code endpoints i. list of the top twenty hosts that generate the most 404 errors	CO2

	j. Visualizing 404 errors per day k. top three days of the month with the most 404 errors l. Visualizing hourly 404 errors Use Data Set : http://ita.ee.lbl.gov/html/contrib/NASA-HTTP.html	
3	Perform Time Series Analysis on data a. Import time series in python b. Visualizing time series c. Seasonal plot on time series d. Boxplot of Month-wise (Seasonal) and Year-wise (trend) Distribution e. Patterns in time series f. Perform additive and multiplicative time series g. Decompose a time series into its components h. Identify whether the time series is stationary or non- stationary i. Make a non-stationary series stationary j. Detrend a time series k. Deseasonalize a time series l. test for seasonality of a time series Use Data Set: https://raw.githubusercontent.com/selva86/datasets/master/a10.csv	CO3
4	Perform data visualization using Tableau a. Connect any sales data source to Tableau b. Create basic charts such as line, bar charts, Tree maps using the Show me panel and get insights of the data.	CO4
5	Data analysis using Tableau Load any sales data set of supermarket and Perform analysis on sales using various aggregate function like Sum, AVG,CORR,VAR, COVAR, STDDEV, Count, Max, Min.	CO2
7	Create an dashboard for sales data set and visualize sales in different location and year wise sales.Add the interactive component to the dashboard like sales corresponding to a location of user selection will be displayed.(make use of filters)	CO4,CO5
8	Connect Tableau to R Server and run R Script in Tableau	CO2
9	Perform Exract Transform Load(ETL) using Power BI. a. import data into Power BI Desktop from the sample Northwind ODatafeed(http://services.odata.org/V3/Northwind/Northwind.svc/) b. Remove unnecessary columns except ProductID, ProductName, UnitsInStock, and QuantityPerUnit c. Change the data type of the UnitsInStock column to whole number d. Expand the Order_Details table.i.e combine the table order and order_details into a single table e. Add a custom column field and name it as line_total and enter its value as [Order_Details.UnitPrice] * [Order_Details.Quantity]. f. Create a chart and visualize the data.	CO2,CO5
Guidelines for Laboratory Conduction		

Use of coding standards and Hungarian notation, proper indentation and comments.
Use of open source software is to be encouraged. Installation of Hadoop, Apache Spark, Tableau, R, Power BI in Ubuntu is recommended

Guidelines for Student's Lab Journal

The laboratory assignments are to be submitted by students in the form of a journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, problem statement, theory concepts in brief, algorithm, flowchart, test cases and conclusions). Program codes with sample outputs shall be submitted in soft form

Guidelines for Termwork Assessment

Continuous assessment of laboratory work shall be based on overall performance of a student. Assessment of each laboratory assignment shall be based on rubrics that include R1- timely completion (10), R2- understanding of assignment (10) and R3- presentation/clarity of journal writing (10) (Coding standard, Indentation, Hungarian notation, input validation etc)

Strength of CO-PO/ PSO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	-	3	-	-	-	-	-	-	3	-	-
CO2	3	3	-	2	3	-	-	-	-	-	-	3	-	-
CO3	3	3	-	2	3	-	-	-	-	-	-	3	-	3
CO4	3	3	-	2	3	-	-	-	-	-	-	3	-	-
CO5	3	3	3	2	3	-	-	-	-	-	-	3	-	3
Average	3	2.8	3	2	3	-	-	-	-	-	-	3	-	3

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Artificial Intelligence and Data Science
Pattern 2022 Semester: VI
COM223014A : UI /UX Design

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses: - ADS222016 : Design Thinking

Course Objectives:

- To learn the factors that determine how people use technology
- To explore the challenges associated with information visualization and its societal and individual impacts.
- To learn usability evaluation methods

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Explain the principles of user interface	2-Understand
CO2	Outline user experience phases	2-Understand
CO3	Identify strategies for managing design projects	3-Apply
CO4	Apply the quality of service and data visualization	3-Apply
CO5	Test for the usability of a design through usability evaluations	4-Analyze

COURSE CONTENTS

Unit 1	**Introduction and Overview of UI**	**(08 hrs)**	**CO1**

The Human– I/P, O/P channels, Human Memory, thinking, emotion, individual difference (diversity), human psychology

Introduction to User Interface Design (UI) -The Relationship Between UI and UX , Roles in UI/UX, A Brief historical Overview of Interface Design, Interface Conventions, Approaches to Screen Based UI, Template vs Content, Formal Elements of Interface Design, Active Elements of Interface Design, Composing the Elements of Interface Design, UI Design Process, Visual Communication design component in Interface Design , Application of UI design

Introduction to Design Technologies and Tools Sketch ,Wireframe ,Invision, Axure, Figma, Flutter, Mockups

Unit II	**User Experience**	**(07 hrs)**	**CO2**

UX Basics- Foundation of UX design, Good and poor design, Understanding Your Users, Designing the Experience Elements of user Experience, Visual Design Principles, Functional Layout, Interaction design, Introduction to the Interface, Navigation Design, User Testing, Developing and Releasing Your Design
User experience and user interaction-Usability of interactive systems, goals and measures, Universal Usability, Characteristics of graphical and web user interfaces, guidelines, principles and theories of good design
User Experience- Concept of UX, Trends in UX, 6 Stages used to UX design , Applications of UX design

Unit III	**Design Process**	**(07 hrs)**	**CO3**

Managing design processes, organizational design to support usability, pillars of design, development methodologies, Human considerations in Design
Usability- principles to support usability, assessment in the design process, Usability problems, practical measures of usability,objective measures of usability, golden rules of interface design
Evaluating Interface Design– Introduction, Expert reviews, Usability testing, Acceptance tests, Legal issues

Unit IV	**Interaction Styles and Controls**	**(07 hrs)**	**CO4**

Interaction Styles-
Direct manipulation and virtual environment, Develop system menus and navigation schemes-Structure of menus, Function of menus, content of menus, phrasing the menu, navigating menus, kinds of graphical menus, form fill-in and dialog boxes, command- organization , functionality, strategies and structure, naming and abbreviations, interaction devices, collaboration and social media participation.
Implementation support and Screen Based Controls

Unit V	**Usability Evaluation and Design Issues**	**(07 hrs)**	**CO5**

Quality of service- Models of response time impacts, user productivity, variability in response time, Balancing function and fashion- Error messages, display design, web page design, window design, color,
Information visualization– data type by task taxonomy, challenges for information visualization, societal and individual impact of user interface
Usability Evaluation Methods-
Usability Testing ,Heuristic evaluations , Cognitive walkthrough, Surveys and Questionnaires Eye Tracking, A/B Testing, Remote Usability Testing, Think-Aloud Protocol, Comparative Usability Evaluation Industry Trends and Case Studies, Professional practices and career opportunities in UI/UX design

Text Books

1. Creative Tim ,"Fundamentals of Creating a Great UI/UX", First Edition
2. Jon Yablonski, "Laws of UX: Using Psychology to Design Better Products & Services" , O'Reilly Media, Inc.", 21-Apr-2020 , First Edition
3. Jenifer Tidwell, Charles Brewer, Aynne Valencia "Designing Interfaces: Patterns for Effective Interaction Design", O'Reilly Media, Inc.", First Edition

Reference Books

1. Shneiderman, Plaisant, Cohen, Jacobs, "Designing the User Interface-Strategies for Effective Human Computer Interaction", 5th Edition ,PEARSON Publication, ISBN 97881317-3255-7
2. Wilbert O. Galitz "The Essential Guide to User Interface Design", 2nd Edition, WILEY Publication, 9780471271390, 047127139X
3. Alan Dix, Janet Finlay, Gregory D. Abowd, Russell Beale, "Human–Computer Interaction, 3rd Edition, PEARSON education , 9788131717035, 8131717038
4. Alan Coopen, "The essentials of interaction", Wiley , ISBN:9781568843223, 156884322

e-Books

1. "The Guide to Wireframing" by UXPin: https://www.uxpin.com/studio/ebooks/guide-to-wireframing/ - This eBook provides an in-depth guide to wireframing, covering the basics, best practices, and tips for creating effective wireframes.
2. "UX Design for Startups" by Marcin Treder: https://uxpin.com/studio/ebooks/ux-design-for-startups/ - This eBook focuses on UX design principles and strategies specifically tailored for startups, covering topics like user research, prototyping, and user testing.

MOOC Courses links

- https://onlinecourses.nptel.ac.in/noc21_ar05/preview

Strength of CO-PO/PSO Mapping														
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	-	-	-	-	-	2	-	-	-	1	1	2
CO2	2	2	-	-	-	-	-	2	-	-	-	1	1	2
CO3	3	1	3	-	-	-	-	2	-	-	-	1	1	-
CO4	2	1	3	-	-	-	-	2	-	-	-	1	1	-
CO5	2	2	3	-	-	-	-	2	-	-	-	1	1	-
Average	2.66	1.28	1.50	-	-	-	-	2	-	-	-	1	1	2

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Quiz on Unit 1, Unit-2, Unit-4, Unit 5 Each of 15 marks(Total marks will be converted to 15 Marks)	15
2	Theory assignment on Unit-3 of 15 marks will be converted to 5 Marks	5
	Total	**20**

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T.Y. B. Tech. Artificial Intelligence and Data Science
Pattern 2022 Semester: VI
ADS223014B: Neural Network & Fuzzy Logic

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses: - ADS223002 - Artificial Intelligence

Course Objectives:
- To understand the concept of neuron and Artificial neural network
- To study different neural network learning rules and factors
- To get acquainted to the concept of Single layer and multi layer neural network
- To acquire the knowledge of fuzzy sets and fuzzy logic.
- To learn the concepts of fuzzy systems.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Explain the concept of artificial neural networks	2-Understand
CO2	Illustrate the concept of neural network learning	2-Understand
CO3	Describe the architecture of single layer and multi layer neural network	2-Understand
CO4	Illustrate the concepts of fuzzy sets and fuzzy logic	2-Understand
CO5	Explain the concepts of fuzzy systems	2-Understand

COURSE CONTENTS

Unit I	**Introduction To Neural Networks**	**(07 hrs)**	**CO1**

Biological Neuron, McCulloch-Pitts Neuron Model, Neuron Modeling for Artificial Neural Systems, Models of Artificial Neural Networks- Feed-forward Network, Feedback Network, Neural Processing, Learning and Adaptation- Supervised and Unsupervised Learning

Unit II	**Neural Network Learning Rules and Factors**	**(08 hrs)**	**CO2**

Hebbian Learning Rule, Perceptron Learning Rule, Delta Learning Rule, Widrow-Hoff Learning Rule, Correlation Learning Rule, Winner-Take-All Learning Rule
Learning factors: Initial weights, Cumulative verses incremental weight updating, Steepness of activation function, learning constant and Momentum

Unit III	**Single Layer and Multi Layer Neural Network**	**(08hrs)**	**CO3**

Single layer perception, Multilayer feed forward networks and Its architecture, Training neural networks, Back propagation learning
Activation functions: Linear, Sigmoid, Tanh, Hard Tanh, Softmax, Rectified linear
Loss Functions for regression, Loss Functions for classification, Loss Functions for reconstruction
Hyper parameters: Learning rate, regularization, Momentum, Sparsity

Unit IV	**Fuzzy Sets and Logic**	**(08hrs)**	**CO4**

Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy arithmetic,

Fuzzy relations, Characteristic of membership functions, Membership functions, Fuzzy logic, Fuzziness and Probability

Unit V	**Fuzzy Systems**	**(06hrs)**	**CO5**

Fuzzy Controller, Fuzzy rule base and approximate reasoning: truth values and tables in fuzzy logic, fuzzy propositions formation of rules
Fuzzy Logic: Linguistics Variables and Hedges, Fuzzy Rules.
Fuzzy Inferencing: neuro inferencing, Fuzzification, Defuzzification
Fuzzy logic Controllers: Fuzzy logic Controllers, Fuzzy logic Controller Types

Text Books

1. Josh Patterson and Adam Gibson,"Deep Learning – A practitioners approach", O'Reilly Publication, First Edition, ISBN- 978-93-5213-604-9
2. Jacek M. Zurada, "Introduction to Artificial Neural Systems" West Publishing Company, ISBN 0-3 14-93391 -3
3. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, "Neuro-Fuzzy and Soft Computing A Computational Approach to Learning and Machine Intelligence", Prentice Hall, ISBN: 978-0132610667
4. S.Rajasekaran, and G. A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms : Synthesis, and Applications", Prentice Hall of India

Reference Books

1. Nikola K. Kasabov, "Foundations of Neural Networks, Fuzzy Systems, and Knowledge Engineering", MIT Press, ISBN:978-0-262-11212-3
2. Andries P. Engelbrecht, "Computational Intelligence: An Introduction", 2nd Edition-Wiley India- ISBN: 978-0-470-51250-0

Strength of CO-PO /PSO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-	3	-	-
CO3	3	-	2	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	2	-	-	-	-	-	-	-	-	3	-	-
CO5	3	-	2	-	-	-	-	-	-	-	-	3	-	-
Average	3	2	2	-	-	-	-	-	-	-	-	3	-	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Quiz on Unit-1, Unit-2, Unit-4, Unit-5 each of 15 marks (Total marks will be converted to 15 out of 60 Marks)	15
2	Theory assignment on Unit-3 (One Assignment on Unit III of 10 marks will be converted to 5 Marks)	05
	Total	**20**

K. K. Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Artificial Intelligence and Data Science
Pattern 2022 Semester: VI
ADS223014C: Web Technology

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory: 03 hrs/week	03	Continuous Comprehensive Evaluation: 20 Marks InSem Exam: 20 Marks EndSem Exam: 60 Marks

Prerequisite Courses: - ADS222014: Database Management Systems
ADS222001: Computer Network

Course Objectives:
- To understand the fundamentals of web essentials and markup languages
- To use the Client side technologies in web development
- To use the Server side technologies in web development
- To understand the web development frameworks

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Make use of HTML and CSS for developing web pages	3-Apply
CO2	Demonstrate handling of web page events using JavaScipt, DOM and jQuery	3-Apply
CO3	Demonstrate the concepts of PHP and MYSQL to design dynamic website	3-Apply
CO4	Design a front end for web application using React	6-Create
CO5	Design a back end for web application using Node.js and Express	6-Create

COURSE CONTENTS

Unit I	Web Essentials and Mark-up language- HTML	(06 hrs)	CO1

The Internet, basic internet protocols, the World Wide Web, HTTP Request message, HTTP response message, web clients, web servers HTML: Introduction, history and versions HTML elements: headings, paragraphs, line break, colors and fonts, links, frames, lists, tables, images and forms, Difference between HTML and HTML5 CSS: Introduction to Style Sheet, CSS features, CSS core syntax, Style sheets and HTML, Style rule cascading and inheritance, text properties. Bootstrap

Unit II	Client Side Technologies: JavaScript, DOM and jQuery	(07 hrs)	CO2

JavaScript: Introduction to JavaScript, JavaScript in perspective, basic syntax, variables and data types, statements, operators, literals, functions, objects, arrays, built in objects, JavaScript debuggers
Document Object Model: Introduction, DOM history and levels, intrinsic event handling, modifying element style, the document tree, DOM event handling
jQuery: Basics, syntaxes, selectors, events, effects, access/ manipulate web browser elements using jQuery

Unit III	Server-Side Programming & Database Access	(07 hrs)	CO3

PHP: Introduction, syntax, combining PHP and HTML, understanding PHP code blocks like Arrays, strings, functions, looping and branching, file handling, processing forms on server side, cookies and sessions
PHP MyAdmin: Introduction, connection to MySQL server from PHP, execution of MySQL queries from

PHP, receiving data from database server and processing it on webserver using PHP			
Unit IV	**React**	**(08hrs)**	**CO4**
React: Introduction, Working With React – Components and States, State management , React Routers, switching Between Components, Single page applications, UI design, Forms, Events, Animations			
Unit V	**Node.js and Express**	**(08hrs)**	**CO5**
Node JS: Introduction and Advantages, Environment setup, First application, Asynchronous programming, Callback concept, Event loops, Event emitter, Networking module, Buffers, Streams, File system, Web module, Setting up a Node.js server with Express, Creating RESTful APIs, Middleware and routing Node.js with Mongodb			

Text Books

1. Jeffrey C. Jackson, "Web Technologies: A Computer Science Perspective", Second Edition, Pearson Education, 2007, ISBN 978-0131856035

2. Ethan Brown, ”Web Development with Node and Express”, Second Edition, O'Reilly Media, Inc. November 2019, ISBN: 9781492053514

3. Andrew Mead, “Learning Node.js Development”, Packt Publishing.

4. Alex Banks, Eve Porcello, “Learning React”, Second Edition, O'Reilly Media, Inc. June 2020, ISBN: 9781492051725

Reference Books

1. Alex Banks and Eve Porcello, “Learning React Functional Web Development with React and Redux”, Second Edition , O’Reilly, ISBN 9781491954621

2. Daniel Bugl, “Learning Redux”, Packt Publishing , August 2017, ISBN: 9781786462398

3. Valentin Bojinov, “RESTful Web API Design with Node.js”, Packt Publishing Ltd., March 2015, ISBN 978-1-78398-586-9

Strength of CO-PO /PSO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	-	2	-	-	2	-	-	-	3	-	2
CO2	3	2	3	-	2	-	-	2	-	-	-	3	-	2
CO3	3	3	3	-	3	-	-	2	-	-	-	3	-	2
CO4	3	3	3	-	3	-	-	2	-	-	-	3	-	2
CO5	3	3	3	-	3	-	-	2	-	-	-	3	-	2
Average	3	2.8	3	-	2.6	-	-	2	-	-	-	3	-	2

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Quiz on Unit-1, Unit-2, Unit-3 , Unit-4, Unit-5 each of 10 marks (Total marks will be converted to 20 out of 50)	20
	Total	**20**

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Artificial Intelligence and Data Science
Pattern 2022 Semester: VI
COM223015A:Cloud Computing

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory: 03 hrs/week	03	Continuous Comprehensive Evaluation: 20 Marks InSem Exam: 20 Marks EndSem Exam: 60 Marks

Prerequisite Courses: - ADS222001 Computer Networks

Course Objectives:

- To understand the concepts of Cloud Computing.
- To learn Taxonomy of Virtualization Techniques.
- To learn Cloud Computing Architecture.
- To acquire knowledge on various Cloud Application Platform.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Understand the different Cloud Computing environment	2-Understand
CO2	Use appropriate data storage technique on Cloud, based on Cloud application	2-Understand
CO3	Analyze virtualization technology and install virtualization software	2-Understand
CO4	Develop and deploy applications on Cloud	3-Apply
CO5	Apply security providing techniques for cloud applications	3-Apply

COURSE CONTENTS

Unit I	Introduction	(06 hrs)	CO1

Importance of Cloud Computing, Characteristics, Pros and Cons of Cloud Computing, Migrating into
the Cloud, Seven-step model of migration into a Cloud, Trends in Computing. Cloud Service Models:
SaaS, PaaS, IaaS, Storage. Cloud Architecture: Cloud Computing Logical Architecture, Developing Holistic Cloud Computing Reference Model, Cloud System Architecture, Cloud Deployment Models

Unit II	Data Storage and Cloud Computing	(08 hrs)	CO2

Data Storage: Introduction to Enterprise Data Storage, Direct Attached Storage, Storage Area Network, Network Attached Storage, Data Storage Management, File System, Cloud Data Stores, Using Grids for Data Storage. Cloud Storage: Data Management, Provisioning Cloud storage, Data Intensive Technologies for Cloud Computing. Cloud file system (gfs and hdfs), Distributed Data Storage

Unit III	Virtualization in Cloud Computing	(08hrs)	CO3

Introduction: Definition of Virtualization, Adopting Virtualization, Types of Virtualization, Virtualization Architecture and Software, Virtual Clustering, Virtualization Application, Pitfalls of Virtualization. Virtualization in Grid, Virtualization in Cloud, Virtualization and Cloud Security. Virtualization and Cloud Computing: Anatomy of Cloud Infrastructure, Virtual infrastructures, CPU Virtualization, Network and Storage Virtualization.

Unit IV	**Cloud Platforms and Cloud Applications**	**(08hrs)**	**CO4**

Amazon Web Services (AWS): Amazon Web Services and Components, Amazon Simple DB, Elastic Cloud Computing (EC2), Amazon Storage System, Amazon Database services (Dynamo DB). Cloud Computing Applications: ECG Analysis in the Cloud, Protein Structure Prediction, Satellite Image Processing, CRM and ERP, Social Networking, Google App Engine. Overview of OpenStack architecture.

Unit V	**Security in Cloud Computing**	**(08hrs)**	**CO5**

Risks in Cloud Computing, Types of Risks in Cloud Computing, Risk Management, Enterprise-Wide Risk Management,Data Security in Cloud: Security Issues, Challenges, advantages, disadvantages, Cloud Digital persona and Data security, Content Level Security. Cloud Security Services: Confidentiality, Integrity and Availability, Security Authorization Challenges in the Cloud,Secure Cloud Software Requirements, Secure Cloud Software Testing, Cloud Security Audit

Text Books

1. A. Srinivasan, J. Suresh, "Cloud Computing: A Practical Approach for Learning and Implementation", Pearson, ISBN: 978-81-317-7651-3

2. Gautam Shrof "ENTERPRISE CLOUD COMPUTING Technology Architecture, Applications", Cambridge University Press, ISBN: 9780511778476

Reference Books

1. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, "Mastering Cloud Computing",
2. Dr. Kris Jamsa, "Cloud Computing: SaaS, PaaS, IaaS, Virtualization and more", Wiley Publications, ISBN: 978-0-470-97389-9
3. Tim Mather, Subra K, Shahid L.,"Cloud Security and Privacy", Oreilly, ISBN-13 978-81-8404-815-5
4. Dr. Kumar Saurabh, "Cloud Computing, 4ed: Architecting Next-Gen Transformation Paradigms", Wiley publication, ISBN: 9788126570966
5. Rishabh Sharma, "Cloud Computing: Fundamentals, Industry Approach and Trends", Wiley publication

Strength of CO-PO /PSO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3	2	-	-	-	-	-	-	-	3	3	2
CO2	3	3	2	2	-	-	-	-	-	-	-	3	3	3
CO3	3	3	3	2	-	-	-	-	-	-	-	3	3	3
CO4	3	3	3	2	-	-	-	-	-	-	-	3	3	3
CO5	3	3	3	2	-	-	-	-	-	-	-	3	3	3
Average	3	2.8	2.8	2	-	-	-	-	-	-	-	3	3	2.8

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Quiz on Unit 1, Unit-2, Unit-4, (Quiz 15 marks each and will be converted to 15 Marks)	15
2	Theory assignment on Unit-3 and Unit 5	10
	Total	**20**

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Artificial Intelligence and Data Science
Pattern 2022 Semester: VI
COM223015A:Cloud Computing

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory: 03 hrs/week	03	Continuous Comprehensive Evaluation: 20 Marks InSem Exam: 20 Marks EndSem Exam: 60 Marks

Prerequisite Courses: - ADS222001 Computer Networks

Course Objectives:

- To understand the concepts of Cloud Computing.
- To learn Taxonomy of Virtualization Techniques.
- To learn Cloud Computing Architecture.
- To acquire knowledge on various Cloud Application Platform.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Understand the different Cloud Computing environment	2-Understand
CO2	Use appropriate data storage technique on Cloud, based on Cloud application	2-Understand
CO3	Analyze virtualization technology and install virtualization software	2-Understand
CO4	Develop and deploy applications on Cloud	3-Apply
CO5	Apply security providing techniques for cloud applications	3-Apply

COURSE CONTENTS

Unit I	Introduction	(06 hrs)	CO1

Importance of Cloud Computing, Characteristics, Pros and Cons of Cloud Computing, Migrating into
the Cloud, Seven-step model of migration into a Cloud, Trends in Computing. Cloud Service Models:
SaaS, PaaS, IaaS, Storage. Cloud Architecture: Cloud Computing Logical Architecture, Developing Holistic Cloud Computing Reference Model, Cloud System Architecture, Cloud Deployment Models

Unit II	Data Storage and Cloud Computing	(08 hrs)	CO2

Data Storage: Introduction to Enterprise Data Storage, Direct Attached Storage, Storage Area Network, Network Attached Storage, Data Storage Management, File System, Cloud Data Stores, Using Grids for Data Storage. Cloud Storage: Data Management, Provisioning Cloud storage, Data Intensive Technologies for Cloud Computing. Cloud file system (gfs and hdfs), Distributed Data Storage

Unit III	Virtualization in Cloud Computing	(08hrs)	CO3

Introduction: Definition of Virtualization, Adopting Virtualization, Types of Virtualization, Virtualization Architecture and Software, Virtual Clustering, Virtualization Application, Pitfalls of Virtualization. Virtualization in Grid, Virtualization in Cloud, Virtualization and Cloud Security. Virtualization and Cloud Computing: Anatomy of Cloud Infrastructure, Virtual infrastructures, CPU Virtualization, Network and Storage Virtualization.

Unit IV	**Cloud Platforms and Cloud Applications**	**(08hrs)**	**CO4**

Amazon Web Services (AWS): Amazon Web Services and Components, Amazon Simple DB, Elastic Cloud Computing (EC2), Amazon Storage System, Amazon Database services (Dynamo DB). Cloud Computing Applications: ECG Analysis in the Cloud, Protein Structure Prediction, Satellite Image Processing, CRM and ERP, Social Networking, Google App Engine. Overview of OpenStack architecture.

Unit V	**Security in Cloud Computing**	**(08hrs)**	**CO5**

Risks in Cloud Computing, Types of Risks in Cloud Computing, Risk Management, Enterprise-Wide Risk Management,Data Security in Cloud: Security Issues, Challenges, advantages, disadvantages, Cloud Digital persona and Data security, Content Level Security. Cloud Security Services: Confidentiality, Integrity and Availability, Security Authorization Challenges in the Cloud,Secure Cloud Software Requirements, Secure Cloud Software Testing, Cloud Security Audit

Text Books

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2. Gautam Shrof "ENTERPRISE CLOUD COMPUTING Technology Architecture, Applications", Cambridge University Press, ISBN: 9780511778476

Reference Books

1. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, "Mastering Cloud Computing",
2. Dr. Kris Jamsa, "Cloud Computing: SaaS, PaaS, IaaS, Virtualization and more", Wiley Publications, ISBN: 978-0-470-97389-9
3. Tim Mather, Subra K, Shahid L.,"Cloud Security and Privacy", Oreilly, ISBN-13 978-81-8404-815-5
4. Dr. Kumar Saurabh, "Cloud Computing, 4ed: Architecting Next-Gen Transformation Paradigms", Wiley publication, ISBN: 9788126570966
5. Rishabh Sharma, "Cloud Computing: Fundamentals, Industry Approach and Trends", Wiley publication

Strength of CO-PO /PSO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3	2	-	-	-	-	-	-	-	3	3	2
CO2	3	3	2	2	-	-	-	-	-	-	-	3	3	3
CO3	3	3	3	2	-	-	-	-	-	-	-	3	3	3
CO4	3	3	3	2	-	-	-	-	-	-	-	3	3	3
CO5	3	3	3	2	-	-	-	-	-	-	-	3	3	3
Average	3	2.8	2.8	2	-	-	-	-	-	-	-	3	3	2.8

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Quiz on Unit 1, Unit-2, Unit-4, (Quiz 15 marks each and will be converted to 15 Marks)	15
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	Total	**20**

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Artificial Intelligence and Data Science
Pattern 2022 Semester: VI
COM223015A:Cloud Computing

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory: 03 hrs/week	03	Continuous Comprehensive Evaluation: 20 Marks InSem Exam: 20 Marks EndSem Exam: 60 Marks

Prerequisite Courses: - ADS222001 Computer Networks

Course Objectives:

- To understand the concepts of Cloud Computing.
- To learn Taxonomy of Virtualization Techniques.
- To learn Cloud Computing Architecture.
- To acquire knowledge on various Cloud Application Platform.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Understand the different Cloud Computing environment	2-Understand
CO2	Use appropriate data storage technique on Cloud, based on Cloud application	2-Understand
CO3	Analyze virtualization technology and install virtualization software	2-Understand
CO4	Develop and deploy applications on Cloud	3-Apply
CO5	Apply security providing techniques for cloud applications	3-Apply

COURSE CONTENTS

Unit I	Introduction	(06 hrs)	CO1

Importance of Cloud Computing, Characteristics, Pros and Cons of Cloud Computing, Migrating into
the Cloud, Seven-step model of migration into a Cloud, Trends in Computing. Cloud Service Models:
SaaS, PaaS, IaaS, Storage. Cloud Architecture: Cloud Computing Logical Architecture, Developing Holistic Cloud Computing Reference Model, Cloud System Architecture, Cloud Deployment Models

Unit II	Data Storage and Cloud Computing	(08 hrs)	CO2

Data Storage: Introduction to Enterprise Data Storage, Direct Attached Storage, Storage Area Network, Network Attached Storage, Data Storage Management, File System, Cloud Data Stores, Using Grids for Data Storage. Cloud Storage: Data Management, Provisioning Cloud storage, Data Intensive Technologies for Cloud Computing. Cloud file system (gfs and hdfs), Distributed Data Storage

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Introduction: Definition of Virtualization, Adopting Virtualization, Types of Virtualization, Virtualization Architecture and Software, Virtual Clustering, Virtualization Application, Pitfalls of Virtualization. Virtualization in Grid, Virtualization in Cloud, Virtualization and Cloud Security. Virtualization and Cloud Computing: Anatomy of Cloud Infrastructure, Virtual infrastructures, CPU Virtualization, Network and Storage Virtualization.

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Unit V	**Security in Cloud Computing**	**(08hrs)**	**CO5**

Risks in Cloud Computing, Types of Risks in Cloud Computing, Risk Management, Enterprise-Wide Risk Management,Data Security in Cloud: Security Issues, Challenges, advantages, disadvantages, Cloud Digital persona and Data security, Content Level Security. Cloud Security Services: Confidentiality, Integrity and Availability, Security Authorization Challenges in the Cloud,Secure Cloud Software Requirements, Secure Cloud Software Testing, Cloud Security Audit

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2. Dr. Kris Jamsa, "Cloud Computing: SaaS, PaaS, IaaS, Virtualization and more", Wiley Publications, ISBN: 978-0-470-97389-9
3. Tim Mather, Subra K, Shahid L.,"Cloud Security and Privacy", Oreilly, ISBN-13 978-81-8404-815-5
4. Dr. Kumar Saurabh, "Cloud Computing, 4ed: Architecting Next-Gen Transformation Paradigms", Wiley publication, ISBN: 9788126570966
5. Rishabh Sharma, "Cloud Computing: Fundamentals, Industry Approach and Trends", Wiley publication

Strength of CO-PO /PSO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3	2	-	-	-	-	-	-	-	3	3	2
CO2	3	3	2	2	-	-	-	-	-	-	-	3	3	3
CO3	3	3	3	2	-	-	-	-	-	-	-	3	3	3
CO4	3	3	3	2	-	-	-	-	-	-	-	3	3	3
CO5	3	3	3	2	-	-	-	-	-	-	-	3	3	3
Average	3	2.8	2.8	2	-	-	-	-	-	-	-	3	3	2.8

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Quiz on Unit 1, Unit-2, Unit-4, (Quiz 15 marks each and will be converted to 15 Marks)	15
2	Theory assignment on Unit-3 and Unit 5	10
	Total	**20**

K. K. Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Artificial Intelligence and Data Science
Pattern 2022 Semester: VI
COM223015B: Natural Language Processing

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses: -ADS223002: Artificial Intelligence

Course Objectives:
- To study natural language processing & understanding.
- To learn the stages in natural language processing.
- To be familiar with the natural language generation.
- To understand application of natural language processing.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Explain the fundamentals of natural language processing.	2-Understand
CO2	Apply syntactic analysis on natural language.	3-Apply
CO3	Apply semantic analysis on natural language.	3-Apply
CO4	Analyze the natural language text based on relations and knowledge.	3-Apply
CO5	Describe the applications of natural language processing.	2-Understand

COURSE CONTENTS

Unit I	**Introduction to Natural Language Processing**	**(06 hrs)**	**CO1**

NLP in the real world, NLP tasks, What is Language? Building block of Language, Why is NLP Challenging? Study of Language, Applications of Natural Language Processing, Evaluating Language Understanding systems, Different levels of Language Analysis, Representation & Understanding, The Organization of Natural Language Understanding systems.

Unit II	**Word Level Analysis & Syntactic Analysis**	**(08 hrs)**	**CO2**

Word Level Analysis: Regular Expressions- Finite-State Automata-Morphological Parsing-Spelling Error Detection and Correction-Words and Word Classes-Part-of Speech Tagging
Linguistic Background: An outline of English syntax, Grammars & Parsing, Features & Augmented Grammars, Grammars for Natural Language, Toward Efficient Parsing, Ambiguity Resolution: Statistical Methods.
Syntactic Analysis: Context-free Grammar-Constituency- Parsing-Probabilistic Parsing.

Unit III	**Semantic Analysis**	**(08 hrs)**	**CO3**

Semantic & Lexical form, Linking Syntax & Semantics, Ambiguity Resolution, Other Strategies for Semantic Resolution, Meaning Representation, Lexical Semantics, Ambiguity, Word Sense Disambiguation.
Discourse Processing: Introduction, Cohesion, Reference Resolution, Discourse Coherence and Structure.

Unit IV	**Text Processing, Context and World Knowledge**	**(08 hrs)**	**CO4**

Basics of Knowledge Representation: Predicate Calculus, Knowledge Representation & Reasoning, Local Discourse Context & Reference, Using World Knowledge, Discourse Structure, Defining a Conversational Agent, Structured knowledge Representation.
Extracting Relations from Text: From Word Sequences to Dependency Paths: Introduction, Subsequence Kernels for Relation Extraction, A Dependency-Path Kernel for Relation Extraction and Experimental Evaluation.
Mining Diagnostic Text Reports by Learning to Annotate Knowledge Roles: Introduction, Domain Knowledge and Knowledge Roles, Frame Semantics and Semantic Role Labelling, learning to Annotate Cases with Knowledge Roles and Evaluations.

Unit V	**Information Retrieval & Applications of NLP**	**(08 hrs)**	**CO5**

Information Retrieval: Design features of Information Retrieval Systems-Classical, non-classical, Alternative Models of Information Retrieval – valuation Lexical Resources: World Net-Frame Net-Stemmers-POS Tagger- Research Corpora.
Model: Introduction to iSTART.
Information Extraction, Machine translation, Text Generation, Question Answering & Information Retrieval, Chatbots & Dialogue Systems, Automatic Speech recognition & Text-to-Speech.

Text Books

1. Allen James, "Natural Language Understanding", Pearson India, 2nd Edition ISBN: 9788131708958, 8131708950
2. U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.
3. Anne Kao and Stephen R. Poteet (Eds), "Natural Language Processing and Text Mining", Springer-Verlag London Limited 2007

Reference Books

1. Jacob Eisenstein "Introduction to Natural Language Processing", MIT Press, ISBN: 9780262042840, 0262042843
2. James H. Martin, Daniel Jurafsky, "Speech and Language Processing" Pearson 1st Edition, ISBN 9789332518414

Strength of CO-PO / PSO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	3	3	-	-	-	-	-	-	-	3	-
CO3	3	3	3	3	3	-	-	-	-	-	-	-	3	-
CO4	3	3	-	3	3	-	-	-	-	-	-	-	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	3
Average	3	3	3	3	3	-	-	-	-	-	-	-	3	3

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Quiz on Unit 1, Unit 2, Unit 3 each of 10 marks (Total marks will be converted to 10 Marks)	10
2	Theory assignment on Unit 4, Unit 5 each of 10 marks (Total marks will be converted to 10 Marks)	10
	Total	**20**

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Artificial Intelligence and Data Science **Pattern 2022 Semester: VI** **ADS223015C: Cyber Security**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses: - ADS222001:Computer Networks

Course Objectives:

- To understand principles of cyber security
- To understand the concepts of cryptography
- To acquire knowledge of standard algorithms and protocols used to provide confidentiality, integrity and authenticity
- To enhance awareness about personally identifiable information, information management and cyber forensics

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Explain principle concepts, basic approaches in cyber security.	2-Understand
CO2	Estimate the security protections and limitations provided by existing Data Encryption Technology	3-Apply
CO3	Understand Public key Cryptography and its Management	2-Understand
CO4	Analyze threats in order to protect or defend it in cyberspace from cyber-attacks.	3-Apply
CO5	Identify type of intrusion detection system and their limitation and challenges	2-Understand

COURSE CONTENTS

Unit I	**Introduction to cyber security**	**(06 hrs)**	**CO1**

Authentication, Access Control and Cryptography, Threats, Harm, Vulnerabilities, Security Attacks : Active and passive Web attack: Browser Attacks, Web Attacks Targeting Users, Obtaining User or Website Data, Email Attacks, Network Vulnerabilities: Overview of vulnerability scanning, Open Port /Service Identification, Banner /Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples,
Self study-The Information Technology Act, 2000

Unit II	**Data Encryption Techniques And Standards**	**(08 hrs)**	**CO2**

Encryption Methods: Symmetric, Asymmetric Cryptography, Substitution Techniques: Caesar Cipher, Mono alphabetic Ciphers, Play fair Cipher, Hill Cipher, Poly alphabetic Ciphers, Transposition Techniques, Block Ciphers and Data Encryption standards, 3DES, Advanced Encryption standard

Unit III	**Public Key And Management**	**(08hrs)**	**CO3**

Public Key Cryptography, RSA Algorithm: Working, Key length, Security, Key Distribution, Deffie-Hellman Key Exchange, Elliptic Curve, Authentication methods, Message Digest, Kerberos, X.509 Authentication service. Digital Signatures: Implementation, Algorithms, Standards (DSS), Authentication Protocol.

Unit IV	**Security Requirements**	**(08hrs)**	**CO4**

IP Security: Introduction, Architecture, IPV6, IPv4, IPSec protocols, and Operations, AH Protocol, ESP Protocol, ISAKMP Protocol, VPN. WEB Security: Introduction, Secure Socket Layer (SSL), SSL Session and Connection, SSL Record Protocol, Change Cipher Spec Protocol, Alert Protocol, Handshake Protocol. Electronic Mail Security: Introduction, Pretty Good Privacy, MIME, S/MIME, Comparison. Secure Electronic Transaction (SET).

Unit V	**Firewall And Intrusion**	**(08hrs)**	**CO5**

Introduction, Computer Intrusions. Firewall Introduction, Characteristics and types, Benefits and limitations. Firewall architecture, Trusted Systems, Access Control. Intrusion detection, IDS: Need, Methods, Types of IDS, Password Management, Limitations and Challenges

Text Books

1. William Stallings, "Cryptography and Network Security: Principles and Practice", 7/e, Pearson, ISBN:9789332585225. https://pearsoned.co.in/web/books/9789332585225_Cryptography-and-Network-Security_William-Stallings.aspx
2. Dr. V.K. Pachghare, Cryptography and Information Security, PHI, ISBN 978-81-303- 5082-3
3. Nina Godbole,SunitBelapure, Cyber Security,Wiley India, ISBN:978-81-345-2179-1

Reference Books

1. Atul Kahate, "Cryptography and Network Security", Mc Graw Hill Publication, 2nd Edition, 2008, ISBN : 978-0-07-064823-4
2. Stuart McCLURE, Joel Scambray, George Kurtz, Hacking Exposed Network Security Secrets and Solutions, McGrowHill, 2012 ISBN: 978-0-07-178028-5 Digital Ref: http://84.209.254.175/linux-pdf/Hacking-Exposed-7-Network-Security-Secrets.pdf

Strength of CO-PO / PSO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	-	-	-	1	-	-	-	-	-	1	1	-
CO2	2	2	-	1	-	1	-	-	-	-	-	1	-	-
CO3	2	2	-	-	-	1	-	-	-	-	-	1	-	-
CO4	2	2	2	2	2	1	-	-	-	-	-	1	-	-
Average														

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Quiz on Unit-1, Unit-2, Unit-3 (Quiz 10 marks on each unit and will be converted to 10 Marks)	30
2	Theory assignment on Unit- 4 and 5 (10 marks assignment on unit 4 and 5 each and that will be converted in to 10 Marks)	20
	Total	50

K. K. Wagh Institute of Engineering Education and Research, Nashik
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T. Y. B. Tech. Artificial Intelligence & Data Science
Pattern 2022 Semester: VI
ADS223016 Department Elective Course II &III Lab

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical: 02 hrs/week	01	Termwork: 25 Marks Oral Exam : 25 Marks

Prerequisite Courses: - COM223008: Data Communications & Networking, ADS222014: Database Management Systems

Companion Courses :- COM223014A :User Interface and User Experience Design, ADS223014B :Network & Fuzzy Logic:ADS223014C :Web Technology, COM223015A : Cloud computing, COM223015B: Natural Language Processing, ADS223015C: Cyber Security

Course Objectives:

- To learn to create visually appealing and cohesive user interfaces.
- To learn to conduct usability testing and evaluation
- To learn the fundamentals and applications of artificial neural networks
- To learn Client side and Server side technologies in web development.
- To learn the concepts of Cloud Computing.
- To learn Taxonomy of Virtualization Techniques
- NLP
- NLP
- To learn cryptography and its applications.
- To learn various approaches to Encryption techniques

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Explain user-centered design methodologies	2-Understand
CO2	Use effective user interfaces / user experiences	2-Understand
CO3	Understand the basic features of neural systems and be able to build the neural model.	2-Understand
CO4	Apply the concepts of Neural Network and Fuzzy Logic for various real-world problems.	3-Apply
CO5	Develop web pages using web development technologies –HTML, CSS, JavaScript, PHP and MySQL	3-Apply
CO6	Develop a web page using Node.js, Express and React	3-Apply
CO7	Use tools and techniques in the area of Cloud Computing	2-Understand
CO8	Design and develop applications on cloud	2-Understand
CO9	Apply text pre-processing techniques on given text.	2-Understand
CO10	Apply syntactic analysis on given text	3-Apply

CO11	Identify basic security attacks and services	3-Apply
CO12	Implement symmetric and asymmetric key algorithms	3-Apply

List of Laboratory Experiments / Assignments - User Interface and User Experience Design Lab		
Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Study of various UI/UX design tools : Wireframe , Mockup , Figma Tools Identify specialized users and related facilities for a selected product /system and make necessary suggestions for its improved accessibility design	CO1, CO2
2	Design user persona for the users of selected product / system.	CO1, CO2
3	Create Low-Fidelity and High Fidelity Wireframes: Start by sketching low-fidelity wireframes for each page using pen and paper or any digital tool you prefer. Focus on the layout, placement of key elements, and overall structure. Use basic shapes and placeholders to represent different elements such as navigation menus, search bars, images, buttons, and form fields. Aim for simplicity and clarity in your wireframes. Refine High-Fidelity Wireframes: Transfer your low-fidelity wireframes to a digital wireframing tool such as Adobe XD, Sketch, Figma, or any other tool you are comfortable with. Create high-fidelity wireframes that incorporate more details, accurate text, and realistic representations of UI components. Pay attention to typography, color schemes, and spacing to improve visual hierarchy and user experience.	CO1, CO2
4	Wireframes & Mockups: task is to create at least one wireframe, and one mockup of a web application. Your wireframe(s) and mockup will need to be responsive and take into account a desktop view and a mobile view.	CO1, CO2

List of Laboratory Experiments / Assignments - Network & Fuzzy Logic Lab		
Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Implementation of Simple Neural Network (McCulloh-Pitts model) for AND function.	CO3, CO4
2	Build a Simple Neural Network Model using TensorFlow.	CO3, CO4
3	Implement Union, Intersection, Complement and Difference operations on fuzzy sets.	CO3, CO4
4	Implement fuzzy logic systems using scikit-fuzzy library(python)	CO3, CO4

List of Laboratory Experiments / Assignments - Web Technology Lab		
Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Develop a web page index.html for any client website (e.g., a restaurant website project) using following: a. HTML syntax: heading tags, basic tags and attributes, frames, tables, images, lists, links for text and images, forms etc. b. Use of Internal CSS, Inline CSS, External CSS` c. Include Java script validation d. Use of prompt, confirm and alert window using Java Scrip	CO5, CO6
2	Build a dynamic web application using PHP and MySQL. a. Create database tables in MySQL and create connection with PHP. b. Create the add, update, delete and retrieve functions in the PHP web app interacting with MySQL database	CO5, CO6
3	Develop a single page web application using following technologies: a. Front end -React b. Back end and server connectivity – Node.js and Express	CO5, CO6
4	Design and implement a dynamic web application by using web development technologies.	CO5, CO6

List of Laboratory Experiments / Assignments – Cloud Computing Lab		
Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Installation and Configuration of virtualization using KVM	CO7, CO8
2	Installation and configure Google App Engine.	CO7, CO8
3	Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.	CO7, CO8
4	Creating an Application in SalesForce.com using Apex programming Language.	CO7, CO8

List of Laboratory Experiments / Assignments - NLP Lab		
Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Perform tokenization (Whitespace, Punctuation-based, Treebank, Tweet, MWE) using NLTK library. Use porter stemmer and snowball stemmer for stemming. Use any technique for lemmatization.	CO1
2	Perform bag-of-words approach (count occurrence, normalized count occurrence), TF-IDF on data. Create embeddings using Word2Vec.	CO2
3	Perform text cleaning, perform lemmatization (any method), remove stop words (any method), label encoding. Create representations using TF-IDF. Save outputs.	CO2
4	POS Taggers For Indian Languages	CO2

List of Laboratory Experiments / Assignments – Cyber Security Lab		
Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Develop a program to implement S-DES	CO1
2	Develop a program of to implement S-AES	CO1
3	Develop a program of to implement RSA	CO1
4	Vulnerability Analysis: Perform a vulnerability assessment to identify weaknesses in the organization's/system's infrastructure, including software vulnerabilities, mis configurations, and inadequate security controls.	CO3

Extra programming Problems
Guidelines for Laboratory Conduction
Use of coding standards and Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged. Operating System recommended: - Linux or its derivative Programming tools recommended: - Open Source line gcc/g++
Guidelines for Student's Lab Journal
The laboratory assignments are to be submitted by students in the form of a journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, problem statement, theory concepts in brief, algorithm, flowchart, test cases and conclusions). Program codes with sample outputs shall be submitted in soft form
Guidelines for Termwork Assessment
Continuous assessment of laboratory work shall be based on overall performance of a student. Assessment of each laboratory assignment shall be based on rubrics that include R1- timely completion (10), R2- understanding of assignment (10) and R3- presentation/clarity of journal writing (10) (Coding standard, Indentation, Hungarian notation, input validation etc)

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T. Y. B. Tech. Artificial Intelligence and Data Science
Pattern 2022 Semester: VI
COM223017: Microcontroller and Embedded Systems

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses: - COM222004: Digital Electronics and Logic Design

Course Objectives:

- To get familiar with 8051 microcontroller
- To understand instruction set and assembly language programing of 8051
- To use C programming to write 8051 programs
- To study features of 8051 microcontroller
- To get introduced to embedded systems

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Explain basics of 8051 microcontroller	2-Understand
CO2	Make use of instruction set to write simple assembly language programs of 8051	3-Apply
CO3	Make use of C to write simple 8051 Programs	3-Apply
CO4	Explain features of 8051 microcontroller	2-Understand
CO5	Illustrate basics of embedded systems	2-Understand

COURSE CONTENTS

Unit I	**Introduction to Microcontroller**	**(06 hrs)**	**CO1**

Difference between microprocessor and microcontroller, Introduction to the Microcontroller, Features and block diagram of 8051 and explanation, Program Status Word (PSW), Programmers model-register set, register bank, SFRs

Unit II	**8051 Assembly Language Programming and I/O Port Programming**	**(08 hrs)**	**CO2**

Addressing modes, Introduction to 8051 assembly programming, Structure of assembly language, instruction set: Jump, Loop , Call, arithmetic , logic instructions, 8051 I/O Port Programming

Unit III	**8051 Programming in C**	**(08 hrs)**	**CO3**

Why program the 8051 in C? , Data types and time delay in 8051 C, I/O Programming in 8051 C, Logic Micro operation in 8051 C, Data Conversion programs in 8051 C

Unit IV	**8051 memory, interrupts and timers/counters**	**(08 hrs)**	**CO4**

Memory organization on-chip data memory, External data memory and program memory, Memory interfacing-external RAM/ROM interface. CPU timings, Interrupt structure, 8051 Timers/counters, operation modes of 8051 and their programming

Unit V	**Embedded System**	**(06 hrs)**	**CO5**

Introduction to Embedded systems, Characteristics, Challenges, Processors in Embedded systems, Application Domain, Real time systems, Real time task, Hardware Units and devices in an embedded system

Text Books

1. Muhammad Ali Mazidi and Janice Gillispie Mazidi, Rolin McKinlay, The 8051 Microcontroller and embedded systems , 2009, Pearson education.
2. V Udayashyankara, M S Mallikarjunaswamy, 8051 Microcontroller, , The McGraw Hill Companies
3. Lyla B. Das, Embedded Systems: An Integrated Approach Pearson , ISBN: 9332511675, 9789332511675
4. Raj Kamal, Embedded Systems: Architecture, programming and Design, 2nd Edition, McGraw-Hill, ISBN: 13: 9780070151253

Reference Books

K. J. Ayala, D. V. Gadre , The 8051 Microcontroller and Embedded systems using Assembly and C., Cengage learning, ISBN 9788131511053

Strength of CO-PO/PSO Mapping														
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	3	-	-	-	-	-	-	-	-	-	-	-	-	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Quiz on Unit 1, Unit 2, Unit 3 each of 15 marks (Total marks will be converted to 15 Marks)	15
2	Theory assignment on Unit 4, Unit 5 each of 10 marks (Total marks will be converted to 5 Marks)	5
	Total	**20**

K. K. Wagh Institute of Engineering Education and Research, Nashik
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T.Y. B. Tech Artificial Intelligence and Data Science
Pattern 2022 Semester: VI
COM223018: Intellectual Property Rights

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 02 hrs / week	**02**	**Continuous Comprehensive Evaluation: 50 Marks**

Prerequisite Courses, if any: -

Course Objectives: Students will be able

1. To define and explain the concept of Intellectual Property Rights (IPR)
2. To develop an understanding of copyright law
3. To gain knowledge of patent law principles, including the criteria for patentability the process of obtaining a patent, and the rights and obligations conferred by patent protection.
4. To understand fundamentals of trademark law
5. To learn about geographical indications (GIs) and their significance in protecting the reputation and quality of goods associated with specific geographical locations

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Define the concepts of Intellectual Property Rights.	1-Remember
CO3	Outline steps of Copyrights registrations.	2-Understand
CO3	Illustrate the process of filing the Patents.	2-Understand
CO4	Explain the fundamentals of Trademarks.	2-Understand
CO5	Illustrate the procedure of filing application of Geographical Indications of Goods.	2-Understand

COURSE CONTENTS

Unit I	**Introduction to Intellectual Property Law**	**(02hrs)**	**CO1**

The Evolutionary Past - The IPR Tool Kit- Para -Legal Tasks in Intellectual Property Law – Ethical obligations in Para Legal Tasks in Intellectual Property Law. Introduction to Cyber Law – Innovations and Inventions Trade related Intellectual Property Right

Unit II	**Introduction to Copyrights in India**	**(02hrs)**	**CO2**

Principles of Copyright Principles -The Subjects Matter of Copy right – The Rights Afforded by Copyright Law – Copy right Ownership, Transfer, and duration – Right to prepare Derivative works – Rights of Distribution – Rights of Perform the work Publicity Copyright Formalities and Registrations - Limitations - Copyright disputes and International Copyright Law – Semiconductor Chip Protection Act

Unit III	**Introduction to Patents in India**	**(04hrs)**	**CO3**

Introduction to the Indian Patent System Patent Laws as Concepts; Understanding the Patents Act, 1970; Understanding the Patents Rules, 2003;Preliminary Sections; Preliminary Rules; Patentability of Inventions Statutory Exceptions to Patentability; Novelty and Anticipation; Inventive Step; Capable of Industrial Application; Patent Specification Provisional and Complete Specifications; Structure of a Patent Specification—Title, Abstract, Description, Claims, etc.; Reading a Patent Specification—Fair basis, Enabling Disclosure, Definiteness, Priority; Introduction to Patent Drafting.

Unit IV	Introduction to Trade Secret and Trademark	(02hrs)	CO4
Maintaining Trade Secret – Physical Security – Employee Limitation - Employee confidentiality agreement - Trade Secret Law - Unfair Competition – Trade Secret Litigation – Breach of Contract – Applying State Law. Trademark Registration Process – Post registration Procedures – Trade mark maintenance - Transfer of Rights - Inter parties Proceeding – Infringement - Dilution Ownership of Trade mark – Likelihood of confusion - Trademarks claims – Trademarks Litigations – International Trademark Laws.			
Unit V	**Introduction to Geographical Indications of Goods**	**(02hrs)**	**CO5**
Definition of Geographical Indications of Goods, Classification of Goods, Articles 22 to 24 of the Trade Related Aspects of Intellectual Property Rights (TRIPS) Agreement, Procedure for Filing G.I Application			

Text Books

1. Debirag E. Bouchoux: "Intellectual Property". Cengage learning, New Delhi
2. Feroz Ali, The Law of Patents, LexisNexis
3. A HAND BOOK OF COPYRIGHT LAW, (https://www.copyright.gov.in/documents/handbook.html)
4. Prof. Rupinder Tewari, Ms. Mamta Bhardwaj, Intellectual Property- A Primer for Academia.
5. Prof. (Dr.) Raju K. D., A Handbook on Geographical Indications in India ,2021

Reference Books

1. Cyber Law. Texts & Cases, South-Western's Special Topics Collections
2. M. Ashok Kumar and Mohd. Iqbal Ali: "Intellectual Property Right" Serials Pub.
3. Ronald D. Slusky, Invention Analysis and Claiming – A Patent Lawyer's Guide, Second Edition, American Bar Association, 2012

MOOC Courses

1. NPTEL Course on Introduction on Intellectual Property to Engineers and Technologists, https://nptel.ac.in/courses/109105112
2. NPTEL course on 'Patent Law for Engineers and Scientists' https://onlinecourses.nptel.ac.in/noc20_hs55/preview

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Quiz on Unit-1, Unit 2 and Unit -3 each of 10 marks. (Total marks will be converted to 30 marks)	30
2	Assignment on Unit-4 and Unit-5 each of 10 marks. (Total marks will be converted to 20 marks)	20
	Total	**50**

K. K. Wagh Institute of Engineering Education and Research, Nashik
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T.Y. B.Tech. Artificial Intelligence and Data Science Pattern 2022 Semester: VI COM223019: Mobile Application Development		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Tutorial: 01 hrs/week Practical: 02 hrs/week	**02**	**Term Work: 25 Marks Oral: 25 Marks**

Prerequisite Courses:- COM222005:Programming Paradigms and Java Programming

Course Objectives:

- To understand the different mobile application Architectures.
- To facilitate students to understand android SDK
- To help students to gain a basic understanding of Android application development

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Understand Mobile Application Architectures	2-Understand
CO2	Apply different types of widgets and Layouts	3-Apply
CO3	Make use of the ways of application handling like intents, adapters, Notifications	3-Apply
CO4	Implement data storing and retrieval methods in android	3-Apply
CO5	Explain Security and Implement Application Deployment	3-Apply

COURSE CONTENTS

Unit I	**Introduction to Mobile Application Development**	**(03hrs)**	**CO1**

Mobile application development architectures: Introduction to Mobile Application technologies**,** Android Architecture, IOS Architecture, Windows Architecture, Hybrid Architecture.
Introduction to Android: Android SDK, Eclipse Installation, Android Installation, Building you First Android application, Android Manifest file.

Unit II	**Creating Android Application**	**(03hrs)**	**CO2**

Creating Android project, Project Structure, Activity and Activity Life Cycle, Fragment and Fragment Life Cycle, Views and View groups

Unit III	**Interactivity Tools**	**(02hrs)**	**CO3**

Interactivity Tools: Intents and Filters, Adapters, Dialogs, Menus, Notifications

Unit IV	**Interaction with Database**	**(02hrs)**	**CO4**

Introduction to Database (SQLite), Cursors and content values, CURD Operations			
Unit V	**Security and Application Deployment**	**(02hrs)**	**CO5**
Location Based Services, Getting the Maps API key, Displaying the map, Displaying the zoom control, Navigating to a specific location, Getting Location data, Monitoring location, Android Security Model			

Text Books

Text Books:

1. **Lauren Darcey and Shane Conder,** "Android Wireless Application Development", PearsonEducation, 2nd ed. (2011)

Reference Books

Reference Books:

1. Professional Android 4 Application Development by Meier, Reto - Wiley Education
2. Beginning Android 4 Application Development by Lee, Wei- Meng - Wiley Education
3. Android application Development: in 24 hours by Delessio, Carmen; Darcey, Lauren; Conder, Shane - Pearson Education
4. Android by Dixit, Prasanna Kumar - Vikas Publishing House Android Studio Development Essentials Book by Neil Smith

MOOC / NPTEL Courses:

https://onlinecourses.swayam2.ac.in/nou21_ge41/preview

Sr. No.	List of Laboratory Assignments/ Experiments	COs Mapped
1	Installation of Android studio.	**CO1**
2	Create an application that can print a message "Welcome to Android ".	**CO1**
3	Create an application that takes the name from a text box and shows hello message along with the name entered in text box, when the user clicks the OK button.	**CO3**
4	Create a screen that has input boxes for user name, password, address, Gender (radio buttons for male and female), Age (numeric), Date of Birth (Date Picket), State (Spinner) and a Submit button. On clicking the submit button, print all the data below the Submit Button (use any layout).	**CO3**
5	Design an android application to create page using Intent and one Button and pass the Values from one Activity to second Activity.	**CO3**
6	Design an Android application Send SMS using Intent.	**CO3**
7	Create an Android application using Fragments.	**CO2**
8	Design an Android application Using Radio buttons.	**CO3**
9	Design an Android application for menu.	**CO3**
10	Create a user registration application that stores the user details in a database table.	**CO4**
11	Develop a Mobile application for simple needs (Mini Project).	**CO2,CO3,CO4**

Guidelines for Laboratory Conduction
Use of coding standards and Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged. Operating System recommended: Linux or its derivative. Programming tools recommended: Eclipse, Android Studio.
Guidelines for Student's Lab Journal
The laboratory assignments are to be submitted by students in the form of a journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, problem statement, theory concepts in brief, algorithm, flowchart, test cases and conclusions). Program codes with sample outputs shall be submitted in soft form.
Guidelines for Term work Assessment
Continuous assessment of laboratory work shall be based on overall performance of a student. Assessment of each laboratory assignment shall be based on rubrics that include R1- timely completion (10), R2- understanding of assignment (10) and R3- presentation/clarity of journal writing (10).

Strength of CO-PO /PSO Mapping														
	PO												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	-	2	-	-	-	-	-	-	-	-	-	2	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CO3	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CO4	2	-	2	-	-	-	-	-	-	-	-	-	2	2
CO5	2	2	2	-	-	-	-	-	-	-	-	2	2	2
Average	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**

K. K. Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Artificial Intelligence and Data Science
Pattern 2022 Semester: VI
ADS223020: Seminar

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical: 2 hrs/week	**01**	**Termwork:50 Marks**

Prerequisite Courses: - FYE221014 Communication Skills

Course Objectives:

- To explore the latest technologies
- To explore the basic principles of communication (verbal and non-verbal) and active, empathetic listening, speaking and writing techniques
- To develop problem analysis skills

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Identify a latest topic of professional interest	3-Apply
CO2	Develop technical writing skills	3-Apply
CO3	Identify an engineering problem, analyze it and propose a work plan to solve it	3-Apply
CO4	Build professional technical presentation skills	3-Apply

Guidelines

- Each student will select a topic in the area of Computer Engineering and Technology preferably keeping track with recent technological trends and development beyond scope of syllabus avoiding repetition in consecutive years.
- The topic must be selected in consultation with the Institute guide.
- Each student will complete literature review for approved topic.
- Each student will make a seminar presentation using audio/visual aids for a duration of 20-25 minutes and submit the seminar report prepared in Latex only.
- Active participation at classmate seminars is essential.
- Seminar Logbook is recommended to use.
- To enhance technical writing skills guide can ask student to write a review paper and publish in reputed journal/conference.

Recommended Format of the Seminar Report

- Title Page with Title of the topic, Name of the candidate with Exam Seat Number / Roll Number, Name of the Guide, Name of the Department, Institution and Year and University
- Seminar Approval Sheet/Certificate
- Abstract and Keywords
- Acknowledgements
- Table of Contents, List of Figures, List of Tables and Nomenclature
- Chapters Covering topic of discussion- Introduction with section including organization of the report, Literature Survey/Details of design/technology/Analytical and/or experimental work, if

any/ .....,Discussions and Conclusions ,Bibliography/References

- Plagiarism Check report
- Report Documentation page

Recommended Format of the Seminar Presentation(PPT)

- Objectives
- Introduction
- Literature Review
- Details of Design/Methodologies/Technologies/Analytical or experimental work
- Algorithms(if any)
- Summary
- References

Guidelines for Termwork Assessment

Panel of staff members along with a guide would be assessing the seminar work based on these Parameters-Topic, Contents and Presentation, regularity, Punctuality and Timely Completion, Question and Answers, Report, Paper presentation/Publication, Attendance and Active Participation. Sample evaluation sheet format given below:

Table 1 : Seminar Evaluation Sheet

Roll. No.	**Name of Student**	**Contents and Quality of Presentation** (Table 2)	**Punctuality and Timely Completion (following of deadline)**	**Seminar Report**	**Question** and **Answers**	**Total**
		25	**05**	**15**	**05**	**50**

Table 2: Contents and Quality of Presentation

Roll No.	**Name of Student**	**Slide Layout**	**Verbal Skill**	**Confidence**	**Contents**	**Total**
		5	**5**	**5**	**10**	**25**

Strength of CO-PO / PSO Mapping														
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	-	2	-	2	-	2	2	3	-	3	-	-
CO2	3	3	-	2	-	2	-	2	2	3	-	3	-	-
CO3	3	3	-	2	-	2	-	2	2	3	-	3	-	-
CO4	3	3	-	2	-	2	-	3	2	3	-	3	-	-
Avg	3	3	-	2	-	2	-	2.25	2	3	-	3	-	-

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Artificial Intelligence and Data Science Honors in Computer Network with MDM
Pattern 2022 : Semester: VI
COM223021: Networks Protocols and Algorithms

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 04 hrs/week	**04**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses: -

Companion Course :- COM223022 Networks and Protocols Lab

Course Objectives:

- To introduce the fundamental various types of computer networks.
- To Analyze Data Communication
- To explore the various layers of OSI Model
- Explore Transport Layer Concepts
- Examine Application Layer Protocols

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Summarize fundamental concepts of Computer Networks, architectures, protocols and technologies	2-Understand
CO2	Illustrate the working and functions of data link layer	2-Understand
CO3	Analyze the working of different routing protocols and mechanisms	3-Apply
CO4	Understand Elements of Transport Layer Protocols	2-Understand
CO5	Illustrate role of application layer with its protocols, client-server architectures	2-Understand

COURSE CONTENTS

Unit I	**Introduction to Network Protocols**	**(10 hrs)**	**CO1**

Basic concepts of network protocols and algorithms, OSI model and TCP/IP model Basics of data transmission and networking fundamentals Physical Layer: Guided Transmission media: twisted pairs, coaxial cable, fiber optics, common networking devices such as routers, switches, and hubs Wireless transmission Types of network protocols (e.g., TCP, UDP, IP, HTTP, FTP),Protocol layers and their functions

Unit II	**Data Link Layer**	**(10 hrs)**	**CO2**

Functions of the Data Link Layer in the OSI model , Relationship between the Data Link Layer and physical layer, Framing and Error Detection Error detection methods such as checksums CRC (Cyclic Redundancy Check),Hamming Code ,Techniques for error correction and retransmission, Flow control Protocols - Stop-and-Wait Protocol, The Go-Back-N ,Sliding Window Protocol, Automatic Repeat request (ARQ), Error Control, Address Resolution Protocol (ARP) and Ethernet Data link layer protocols, HDLC, and Point to Point protocol

Unit III	**Network Layer**	**(10hrs)**	**CO3**

Logical Addressing, Internetworking, Tunneling, Address mapping, ICMP, IGMP, Forwarding, Uni-Cast Routing Protocols, Multicast Routing Protocols

Switching Techniques: Circuit switching, Message Switching, Packet Switching.
IP Protocol: Classes of IP (Network addressing), IPv4, IPv6, Network Address Translation, Sub-netting, CIDR. Network layer Protocols: ARP, RARP, ICMP, IGMP. Network Routing and Algorithms: Static Routing, Dynamic Routing, Distance Vector Routing, Link State Routing, Path Vector. Routing Protocols: RIP, OSPF, BGP

Unit IV	**Transport Layer**	**(09hrs)**	**CO4**

The Transport Service: Services Provided to the Upper Layers, Transport Service Primitives, Berkeley Sockets. Elements of Transport Protocols: Addressing, Connection Establishment, Connection Release, Flow Control and Buffering, Multiplexing, Crash Recovery, TCP/IP handshake process Reliable vs. unreliable data transfer. Transport Layer Protocols: TCP and UDP, SCTP, RTP, Congestion control and Quality of Service (QoS), Differentiated services, TCP and UDP for Wireless networks

Unit V	**Application Layer**	**(09hrs)**	**CO5**

Introduction, Web and HTTP, Web Caching, Application Layer Protocols: DNS, Email: SMTP, MIME,POP3, Webmail, FTP, TELNET,DHCP, SNMP, Client-Server Architecture, APIs and Interfaces, Authentication and Authorization, Error Handling and Recovery

Text Books

1. Data Communication and Networking by Behrouz A. Forouzan (Fourth Edition), Tata McGraw Hill
2. Computer Networks by Andrew S. Tanenbaum (Fifth Edition), Pearson Education

Reference Books

1. Kurose, Ross, “Computer Networking a Top Down Approach Featuring the Internet”, Pearson, ISBN-10: 0132856204
2. L. Peterson and B. Davie, “Computer Networks: A Systems Approach”, 5th Edition, Morgan-Kaufmann, 2012.

Strength of CO-PO PSO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3	2	-	-	-	-	-	-	-	3	3	2
CO2	3	3	2	2	-	-	-	-	-	-	-	3	3	3
CO3	3	3	3	2	-	-	-	-	-	-	-	3	3	3
CO4	3	3	3	2	-	-	-	-	-	-	-	3	3	3
CO5	3	3	3	2	-	-	-	-	-	-	-	3	3	3
Average	3	3	2	2	-	-	-	-	-	-	-	3	3	3

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Quiz on Unit 1, Unit-2, Unit-4, (Quiz 15 marks each and will be converted to 15 Marks)	15
2	Theory assignment on Unit-3 and Unit 5	10
	Total	**20**

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Artificial Intelligence and Data Science Honors in Computer Network with MDM **Pattern 2023 Semester: VI** **COM223022: Network Protocols and Algorithms Lab**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical: 04hrs/week	**02**	**Termwork: 50Marks** **Practical Exam : 50 Marks**
Prerequisite Courses: -		
Companion Course:- COM223021 Network Protocols and Algorithms		

Course Objectives:

- To learn computer network hardware and software components
- To learn computer network topologies and types of network
- To develop an understanding of various protocols, modern technologies and applications
- To learn modern tools for network traffic analysis
- To learn network programming

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Analyze the requirements of network types, topology and transmission media	3-Apply
CO2	Demonstrate error control, flow control techniques and protocols and analyze them	3-Apply
CO3	Demonstrate the subnet formation with IP allocation mechanism and apply various routing algorithms	3-Apply
CO4	Develop Client-Server architectures and prototypes	3-Apply
CO5	Implement web applications and services using application layer protocols	3-Apply

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	CP/IP Packet Analysis: In this assignment, students capture network traffic using tools like Wireshark and analyze TCP/IP packets to understand the protocols and their interactions.	CO1
2	Routing Algorithm Simulation: Using network simulation tools like NS-3 or Cisco Packet Tracer, students implement and compare various routing algorithms such as Dijkstra's algorithm, OSPF, and BGP.	CO2,CO4
3	Socket Programming: Students write client-server programs using socket programming in languages like Python or Java to implement basic network protocols like HTTP, FTP, or SMTP	CO1
4	Write a program for error detection and correction for 7/8 bits ASCII codes using Hamming Codes or CRC.	CO2
5	Write a program to simulate Go back N and Selective Repeat Modes of Sliding Window Protocol in Peer-to-Peer mode.	CO2

6	Write a program to demonstrate Sub-netting and find subnet masks	CO3
7	Write a program to implement link state /Distance vector routing protocol to find suitable path for transmission	CO3
8	Write a program using TCP socket for wired network for following a. Say Hello to Each other b. File transfer c. Calculator	CO1,CO4
9	Write a program using UDP Sockets to enable file transfer (Script, Text, Audio and Video one file each) between two machines.	CO1,CO4
10	Write a program for DNS lookup. Given an IP address as input, it should return URL and vice-versa.	CO4
Programming Problems		
1	To study the SSL protocol by capturing the packets using Wireshark tool while visiting any SSL secured website (banking, e-commerce etc.).	CO3
2	Illustrate the steps for implementation of S/MIME email security, POP3 through Microsoft Office Outlook.	CO4

Guidelines for Laboratory Conduction

Use of coding standards and Hungarian notation, proper indentation and comments.
Use of open source software is to be encouraged.
Operating System recommended: - Linux or its derivative
Programming tools recommended: - Open Source line gcc/g++,Cisco Packet Tracer ,Wireshark

Guidelines for Student's Lab Journal

The laboratory assignments are to be submitted by students in the form of a journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, problem statement, theory concepts in brief, algorithm, flowchart, test cases and conclusions). Program codes with sample outputs shall be submitted in soft form

Guidelines for Termwork Assessment

Continuous assessment of laboratory work shall be based on overall performance of a student. Assessment of each laboratory assignment shall be based on rubrics that include R1- timely completion (10), R2- understanding of assignment (10) and R3- presentation/clarity of journal writing (10) (Coding standard, Indentation, Hungarian notation, input validation etc)

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Artificial Intelligence and Data Science Honors in Databases with MDM
Pattern 2022 Semester: VI
COM223023: Relational Database and SQL

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 04 hrs/week	**04**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Companion Courses: - COM223024 :Relational Database Management System and SQL Lab

Course Objectives:

- To understand the fundamentals of database management System and database query languages
- To know the principles of database design and transaction management
- To study database system architecture, storage and indexing

Course Outcomes: On completion of the course, students will be able to

	Course Outcomes	**Bloom's Level**
CO1	Illustrate applications of databases, and features of RDBMS	2-Understand
CO2	Construct database queries using SQL, PL/ SQL	3-Apply
CO3	Demonstrate ability to prepare logical design of database using ER model and normalization technique	3-Apply
CO4	Explain various protocols for Transaction Management	3-Understand
CO5	Illustrate database storage and indexing	2-Understand

COURSE CONTENTS

Unit I	**Introduction to databases and Database models**	**(10 hrs)**	**CO1, CO2**

Introduction to Databases: Basic concepts, Advantage of DBMS over file processing system, Data Abstraction, Database Language, Structure of DBMS, Data Modeling, database applications.
Overview of Database Languages and Architectures: Data Models, Schemas and Instances, Data Independence, Database Languages and Interfaces, Database System environment, Centralized and Client-Server Architecture for DBMSs.
Database Design and ER Model: ER Model, Extended E-R Features, converting ER model and EER model to tables, schema diagrams.
Relational Model: The Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Attributes and Domain

Unit II	**SQL and PLSQL**	**(10 hrs)**	**CO2**

Relational Algebra and Calculus: Preliminaries, Relational Algebra, Relational calculus – Tuple relational Calculus, Domain relational calculus
SQL: Introduction to Relational Algebra and Tuple Relational Calculus, Introduction to SQL, SQL Data types and Literals, DDL, DML, DCL, TCL, SQL Select Query and Clauses.
SQL Advanced Features: Set Operation, Aggregate Function, Null Values, Nested Subquery, Views, Joins, Sequence, Index, Introduction to Embedded and Dynamic SQL.
Introduction to PL/SQL: Data types, Procedures, Functions, Cursor, Trigger, Package, Assertions, Roles and Privileges, Oracle Database Architecture

Unit III	**Database Design & Normalization**	**(10 hrs)**	**CO3**

Codd's Rules, Introduction to Schema Refinement, Functional Dependencies - Reasoning about FDs, Properties of Decompositions, Armstrong's Axioms

Normalization: Normal forms based on Primary Keys, Second and Third Normal Forms, BoyceCodd Normal Form, Multi valued Dependencies and Fourth Normal Form, Schema Refinement in Database Design, Other Kinds of Dependencies.
Relational Database Design: Dependency Preservation, Lossless design, Comparison of Oracle & DB2 or MySQL

Unit IV	**Transaction Management**	**(09 hrs)**	

Transaction: Transaction concept, Transaction state, Transaction Property, Concurrent Executions
Serializability: Conflict serializability, View Serializability, Testing for Serializability, Deadlock prevention, Deadlock Detection and Recovery from deadlock.
Concurrency Control Protocols: Two phase Locking, Timestamp-based protocol.
Recovery: Failure classification, Shadow-Paging and Log-Based Recovery

Unit V	**Storage and Indexing**	**(09 hrs)**	**CO5**

Overview of Storage and Indexing: Data on External Storage, File Organization and Indexing, Index Data Structures, Comparison of File Organizations.
Tree-Structured Indexing: Intuition for tree Indexes, Indexed Sequential Access Method (ISAM),
B+ Trees: A Dynamic Index Structure, Search, Insert, Delete.
HashBased Indexing: Static Hashing, Extendible hashing, Linear Hashing, Extendable vs. Linear Hashing.
Backup and recovery strategies: full backups, differential backups, and transaction log backups

Text Books

1. Abraham Silberschatz, Henry F. Korth and S. Sudharshan, "Database System Concepts", 6 th Edition Tata McGraw Hill Publishers, ISBN 0-07-120413-X.
2. Ramez Elmasri and Shamkant B. Navathe, "Fundamentals of Database Systems" , Addison-Wesley, ISBN 978-0133970777

Reference Books

1. C J Date, "An Introduction to Database Systems" ,Addison-Wesly, ISBN:0201144719
2. Thomas Connolly and Carolyn Begg, Database Systems: A Practical Approach to Design, Implementation And Management,Pearson ISBN-13: 9781292061849

Strength of CO-PO PSO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	-	-	-	-	-	-	-	3	3	2
CO2	3	2	2	-	2	-	-	-	-	-	-	**2**	2	2
CO3	3	2	3	-	2	-	-	-	-	-	-	2	2	-
CO4	2	3	-	-	3	-	-	-	-	-	-	-	-	-
CO5	2	2	2	-	-	-	-	-	-	-	-	-	-	-
Average	3	2	2.	-	2	-	-	-	-	-	-	2	2.	2.

Guidelines for Continuous Comprehensive Evaluation of Theory Courses		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Quiz on Unit 1, Unit 2, Unit 3, Unit 4 (Quiz 15 marks each and will be converted to 15 Marks)	15
2	Theory assignment on Unit-5 (One Assignment on Unit 5 of 10 marks will be converted to 5 Marks)	5
	Total	**20**

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Artificial Intelligence and Data Science Honors in Databases with MDM **Pattern 2022 Semester: VI** **COM223024 :Relational Database and SQL Lab**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical: 04 hrs/week	**02**	**Termwork: 50 Marks** **Practical Exam : 50 Marks**
Companion Courses: - COM223023 :Relational Database Management System and SQL		
Course Objectives: • To understand the fundamentals of database management System and database query languages • To know the principles of database design and transaction management • To study database system architecture and indexing		
Course Outcomes: On completion of the course, students will be able to–		

	Course Outcomes	**Bloom's Level**
CO1	Make use of normalized relational database schemas to represent real-world scenarios	3-Apply
CO2	Build simple and complex SQL queries and PL/ SQL code to retrieve, manipulate relational database	3-Apply
CO3	Construct ER diagram to represent logical design of a database	3-Apply
CO4	Apply the concepts of indexing and DBA queries	3-Apply
CO5	Develop database-driven applications using programming languages and frameworks that interact with relational database systems	3-Apply

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	**SQL Queries** Assume that a Consumer item lease Company which leases various household items to its clients for their use for a specific period of time, maintains the following tables: Clients (clientID, name, address, contact Phone) Itemlist (itemID, itemName, itemCost, purchase Date) Leaselist (clientID, transactionNO, itemID, startDate, FindDate, amountTObeCharged) Note: A client may lease an item many times. Amount to be charged is calculated as per a fixed rate multiplied by the number of days the item is leased. All items have a unique itemID. However, two or more items may have the same name. Create the tables having appropriate referential integrity constraints. Make and state assumptions, if any. Write and run the following SQL queries on the tables: a. Find all the client names that have not got any item leased during the last month and no leased item is pending with them.	CO1, CO2

	b. Find the list of all the items that were leased or Finded last month. c. Find the names of all those clients who have given the business to the company in the decreasing order of total amount paid by a client. d. List the client's details and the items leased to them at present. e. Find the client who has been leased at least two items.	
2	**Index, Sequence and View** Consider the given relational table: employee(empno , empname, designation, city, salary, zipcode, county) Write SQL queries for the following 1. Create a sequence used to generate employee numbers for the empno column of the emp table. 2. Create an Index on county. 3. Find the country whose zipcode = 071 and check whether the query uses the Index and write your observation. 4. Create a view for employees having salary < 50000 and stays in 'Mumbai' 5. Display a Count of employees who stays in 'Mumbai' 6. Find average salary of employees of a created view 7. Display employee names who stays on same street of a view	CO1, CO2
3	**SQL Joins** Consider the given database schema: Professor (ssn , profname, status, salary) Course(crscode ,crsname,credits) Taught(crscode,semester,ssn) Assumptions: a. Each course has only one instructor in each semester. b. All professors have different salaries. c. All professors have different names. d. All courses have different names. e. Status can take value from "full","associate" , and "assistant". i) Find those professors who have taught "csc6710" but never "csc7710" ii) Find those professors who have taught "csc6710" and "csc7710" in the same semester. iii) Find those professors who have taught "csc6710 " or "csc7710" but not both. iv) Find the course which has never been taught. v) Find courses that have been taught at least in two semesters. vi) Find the names of all professors who have ever taught "csc7710". vii) Change all credits to 4 for those courses that are taught in semester "f2006:. viii) Find the professor who earns the second highest salary. ix) Delete those professors who have never taught.	CO1, CO2
4	**ER Modelling and Normalization:** Conceptual Design using ER features using tools like ERD plus, ER Win etc. (Identifying entities, relationships between entities, attributes, keys, cardinalities, generalization, specialization etc.) Convert the ER diagram into relational tables and normalize the Relational data model.	CO3
5	**Normalization** Wholesale Dealer Consider the following relation that keeps track of the sales of a wholesale dealer in trousers: TrousersSold(customerID, customerName, model, size, day,	CO1

	numberSold, price) Suppose the following functional dependencies hold on the relation: customerID -> customerName customerID, model, size, day -> numberSold model, size -> price model, price -> size a. Decompose the relation in smaller relations such that – each of the smaller relations is in BNCF with respect to the projection of the original dependencies; – the decomposition is a loss less join decomposition. b. Is your decomposition dependency preserving? If your answer is "yes", argue why. If your answer is "no", show which dependencies have been lost.	
6	**PL/SQL block** Create a database with following schemas Employee(Id, Name, mobile, address, salary) & Sales(Id, Month, Amount) Write a PL/SQL block to accept employee id and calculate the bonus according to sale amount if sale amount < 50000 then no bonus if sale amount between 50000 to 150000 then bonus is 5% If sale amount >150000 bonus is 10% Display the final salary of the employee (salary + bonus)	CO1, CO2
7	**Cursors** Write a block in PL/SQL to modify the accounts table according to instructions stored in the action table. Each row in the action table contains an account number, an action to be taken (I, U, or D for insert, update, or delete), an amount by which to update the account, and a time tag used to sequence the transactions. Use explicit cursor	CO1, CO2
8	**Database Trigger** Create a Library database with the schema Books(AccNo, Title, Author, Publisher, Count). a. Create a table Library_Audit with same fields as of Books and Date and status column b. Create a before trigger to insert records into Librry_Audit table if there is deletion in Books table, insert date of deletion and status as deleted Create a after trigger to insert records into Librry_Audit table if there is updation in Books table , insert date of updation and status as updated	CO1, CO2
9	**Database Connectivity**: Write a program to implement Menu driven MySQL/Oracle database connectivity with any front end language for Python/Java/PHP to implement Database navigation operations (add, delete, edit etc.)	CO1,CO4
10	**Write queries for Database Administrative work** a. Develop an SQL script to delete all inactive user accounts that have not been logged in for more than six months from a user database b. User Management: i. Create a new user account with appropriate privileges and Modify the privileges of an existing user account to grant or revoke specific permissions.	CO4

	c. Security: i. Enforce password policies to ensure strong and secure passwords for user accounts ii. Implement encryption for sensitive data stored in the database. d. Backup and Recovery: i. Perform a full database backup using appropriate backup tools or commands. ii. Schedule automated backups to run at regular intervals	
11	Write a program in C++ to implement B+ tree	CO4
12	**Mini Project:** Form a group of 3 or 4 students and Using the database concepts covered, develop an application with following details: 1. Define a problem statement 2. Follow the Software Development Life cycle and other concepts learnt in Software Engineering Course throughout the implementation. 3. Develop application considering: Front End: Java/Perl/PHP/Python/Ruby/.net/any other language Backend : MySQL/Oracle 4. Test and validate applications using Manual/Automation testing.	CO1 to 5
Additional Lab Assignments		
1	**ER Modeling** Conceptual Design using ER features using tools like ERD plus, ER Win etc. (Identifying entities, relationships between entities, attributes, keys, cardinalities, generalization, specialization etc.) Convert the ER diagram into relational tables and normalize the Relational data model. ER model of a Hospital management using the following description . Each of these entities have their respective attributes which are – Patients - ID(primary key), name, age,visit_date Tests- Name(primary key), date, result Doctor- ID(primary key), name, specialization	CO3
2	**SQL Queries** SQL queries involving the supplier, product, and part tables: 1. Retrieve the names of all suppliers from the suppliers table. 2. Retrieve the names of all products along with their corresponding suppliers from the products and suppliers tables. 3. Retrieve the list of parts supplied by each supplier, including supplier names and the names of parts supplied, from the suppliers, products, and parts tables. 4. Retrieve the details of products supplied by a specific supplier, including product names, descriptions, and prices, from the products, suppliers, and parts tables. 5. Retrieve the details of parts used in a specific product, including part names, descriptions, and quantities used, from the products,	CO1, CO2

	parts, and product_parts tables. 6. Retrieve the total number of products supplied by each supplier from the products and suppliers tables. 7. Retrieve the names of suppliers who provide high-quality parts, where quality is defined as parts with a rating above a certain threshold, from the suppliers, parts, and product_parts tables. 8. Retrieve the names of parts that are not supplied by any supplier from the parts and product_parts tables. 9. Retrieve the names of products that do not require any parts from the products and product_parts tables. 10. Retrieve the names of suppliers who provide a diverse range of products, where diversity is defined as supplying products from multiple categories, from the suppliers, products, and categories tables.	
3	**PLSQL Block** Write a Stored Procedure namely proc_Grade for the categorization of students. If marks scored by students in examination is <=1500 and marks>=990 then students will be placed in distinction category if marks scored are between 989 and 900 category is first class, if marks 899 n 825 category is Higher Second Class and Less than 825 and > 600 have 'Pass Class'. Insert the result in Result table for all Write a Stored Procedure for calculating Number of students getting each class e.g Distinction - 10 students, First class -5 students. Insert count in the Analysis table Write a PL/SQLblock to use procedures created with the above requirement. Stud_Marks(roll, name, total_marks) Result(Roll,Name, Class) Analysis(class , count)	CO1, CO2

Guidelines for Laboratory Conduction

Use of coding standards and Hungarian notation, proper indentation and comments.
Use of open source software is to be encouraged.
Operating System recommended: - Linux or its derivative
Programming tools recommended: - Open Source like MySQL

Guidelines for Student's Lab Journal

The laboratory assignments are to be submitted by students in the form of a journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, problem statement, theory concepts in brief, algorithm, flowchart, test cases and conclusions). Program codes with sample outputs shall be submitted in soft form

Guidelines for Termwork Assessment

Continuous assessment of laboratory work shall be based on the overall performance of a student. Assessment of each laboratory assignment shall be based on rubrics that include R1- timely completion (10), R2- understanding of assignment (10) and R3- presentation/clarity of journal writing (10) (Coding standard, Indentation, Hungarian notation, input validation etc)

Strength of CO-PO PSO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	-	-	-	-	-	-	-	3	3	2
CO2	2	2	2	-	2	-	-	-	-	-	-	**2**	2	2
CO3	3	2	3	-	2	-	-	-	-	-	-	2	2	-

CO4	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	3	-	-	3	-	-	-	-	-	-	-	-	-
Average	2.40	2.20	2.25	-	2.25	-	-	-	2	-	-	2.33	2.33	2.00