ST JOSEPH'S UNIVERSITY
BENGALURU-27

Conferred the status of a Public-Private-Partnership University by the Ministry of Human Resource Development (now MoE), GoI,
under *Rashtriya Uchchatar Shiksha Abhiyan* (RUSA) 2.0 and established by the St Joseph's University Act no.24 of 2021

SCHOOL OF INFORMATION TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE AND APPLICATIONS

SYLLABUS FOR MASTER OF COMPUTER APPLICATIONS (MCA)

Based on Outcome-Based Education (OBE)

(For Students admitted in Year 2025 and 2026)

PART - A		
1	Name of the University	St Joseph's University
2	Objectives of the University	1. Academic Excellence 2. Social Concern 3. Character Formation
3	Vision of the University	To form women and men for and with others, who through holistic education, strive for a just, secular, democratic, and ecologically sensitive society which empowers the poor, the oppressed and the marginalized
4	Mission of the University	In keeping with the Jesuit heritage, the university aims at an integral formation of the staff and the students, to be men and women who will be agents of societal change, by enabling them to attain academic and human excellence in a teaching-learning environment that fosters intellectual curiosity, ceaseless enquiry, personal integrity, social commitment, creativity, critical thinking, and innovation.
5	Name of the Degree	Master of Computer Applications (M.C.A.)
6	Title of the Academic Programme	Master of Computer Applications (M.C.A.)
7	Programme Code	MCA
8	Name of the School offering the programme	School of Information Technology
9	Name of the Department offering the programme	Department of Computer Science
10	Vision of the Department offering the programme	The Vision of the Department is to ensure that our students have a deep and analytical understanding of the field and to enable them to use their immense potential to enhance the quality of human life by contributing to the field of Technology, preparing them for their Career in the Industry, and to the needs of the Society with Ethical responsibilities.

11	Mission of the Department offering the Programme	The Department offers quality education in the Science of Computing by providing courses with Computer Applications, Courses in combination with Physical Science and Courses with Specialization and by focusing on the Personal, Emotional and Character development.		
12	Description of the Programme	The MCA programme includes in-depth explorations of software development, artificial intelligence, data science, and cybersecurity; acquisition of in-demand practical skills in databases, programming, and cloud computing; strong career prospects in the IT industry; and specialisations and increased earning potential through a combination of theory and practical projects.		
13	Duration of the Programme	2 Years (Four Semesters)		
14	Total No. of Credits	102		
15	Programme Outcomes (POs)	**PO 1**	**Advanced Knowledge**: Demonstrate in-depth knowledge of computer science principles, including algorithms, programming, software design, databases, networks, and emerging technologies.	**Apply**
		PO 2	**Problem Solving and Innovation**: Analyze complex computing problems and design innovative solutions using appropriate tools and techniques.	Create
		PO 3	**Research Skills**: Conduct research and apply modern tools and techniques to explore new areas in computing and information technology.	Apply
		PO 4	**Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern computing tools for problem-solving with an understanding of limitations.	Create
		PO 5	**Professional Ethics**: Apply ethical principles and commit to professional ethics, responsibilities, and norms of the computing profession.	Apply
		PO 6	**TeamWork and Leadership**: Function effectively as an individual and as a member or leader in diverse teams and multidisciplinary settings.	Create
		PO 7	**Communication Skills**: Communicate effectively on complex computing activities with the IT community and with society at large, such as writing	Evaluate

			reports, documentation, and presentations.	
		PO 8	**Project Management and Finance**: Demonstrate knowledge and understanding of computing and management principles to manage projects in multidisciplinary environments.	Create
		PO 9	**Lifelong Learning**: Recognize the need for and have the ability to engage in lifelong learning to keep pace with technological change.	Analyze
		PO 10	**Societal and Environmental Concern**: Understand the impact of computing solutions on society and the environment, and act responsibly for sustainable development.	Analyze

PART - B

SUMMARY OF CREDITS IN MASTER OF COMPUTER APPLICATIONS

DPARTMENT OF COMPUTER SCIENCE (MCA) (2023-2025)								
Semester 1	**Code Number**	**Title**	**No. of Hours of Instructions**	**Number of Hours of teaching per week**	**Number of credits**	**Continuous Internal Assessment (CIA) marks**	**End Semester Marks**	**Total marks**
1	CA 7125	Database Design and Implementation	60	4	4	50	50	100
1	CA 7225	Data Structures and Analysis of Algorithms	60	4	4	50	50	100
1	CA 7325	Machine Learning with Python	60	4	4	50	50	100
1	CA 7425	Mathematical Foundations for Computer Applications	45	3	3	50	50	100
1	CA 7525	Finance, Accounting, and Company Laws for IT Professionals	45	3	3	50	50	100
1	CA 7625	Entrepreneurship and Innovation	30	2	2	25	25	50
1		Soft Skills – I (SS-I)	15	1	1	--	--	--
Practical 1	CA 7P125	Data Structures and Algorithms Lab	45	4	2	25	25	50
1	CA 7P225	DBMS Lab	45	4	2	25	25	50
1	CA 7P325	Machine Learning with Python Lab	45	4	2	25	25	50
Total Number of credits: 26 + 1 (SS-I)			**450**	**33**	**27**	**350**	**350**	**700**
Semester 2	**Code Number**	**Title**	**No. of Hours of Instructions**	**Number of Hours of teaching per week**	**Number of credits**	**Continuous Internal Assessment (CIA) marks**	**End Semester Marks**	**Total marks**
2	CA 8125	Information and Network Security	60	4	4	50	50	100
2	CA 8225	Advanced Programming with Java	60	4	4	50	50	100
2	CADE 8325	Natural Language Processing **(ELECTIVE I)**	60	4	4	50	50	100
	CADE 8425	Image Processing and Pattern Recognition **(ELECTIVE I)**	60	4	4	50	50	100
2	CADE 8525	Big Data Analytics **(ELECTIVE II)**	60	4	4	50	50	100
	CADE 8625	Data Science **(ELECTIVE II)**	60	4	4	50	50	100
2	CA 8725	Internet of Things	60	4	4	50	50	100

2		Soft Skills – II **(SS-II)**	15	1	1	--	--	--
Practical 2	CA 8P125	Advanced Java Lab	45	4	2	25	25	50
2	CADE 8P225	Natural Language Processing Lab **(ELECTIVE I)**	45	4	2	25	25	50
	CADE 8P325	Image Processing Lab **(ELECTIVE I)**	45	4	2	25	25	50
2	CADE 8P425	Big Data Analytics Lab **(ELECTIVE II)**	45	4	2	25	25	50
	CADE 8P525	Data Science Lab **(ELECTIVE II)**	45	4	2	25	25	50
Total Number of credits: **26 + 1 (SS-II)**			**450**	**33**	**27**	**325**	**325**	**650**
Semester 3	**Code Number**	**Title**	**No. of Hours of Instructions**	**Number of Hours of teaching per week**	**Number of credits**	**Continuous Internal Assessment (CIA) marks**	**End Semester Marks**	**Total marks**
3	CA 9125	Agile Software Engineering	60	4	4	50	50	100
3	CA 9225	Cloud Computing	60	4	4	50	50	100
3	CA 9325	Full Stack Development	60	4	4	50	50	100
3	CA 9425	Deep Learning	60	4	4	50	50	100
3	CA 9525	Research Methodology	45	3	3	50	50	100
Practical 3	CA 9P125	Deep Learning Lab	45	4	2	25	25	50
3	CA 9P225	Cloud Computing Lab	45	4	2	25	25	50
3	CA 9P325	Full Stack Development Lab	45	4	2	25	25	50
Total Number of credits: 31			**420**	**31**	**25**	**325**	**325**	**650**
Semester 4	**Code Number**	**Title**	**No. of Hours of Instructions**	**Number of Hours of teaching per week**	**Number of credits**	**Continuous Internal Assessment (CIA) marks**	**End Semester Marks**	**Total marks**
Project 4	CA 10PR1	Industry Internship / Project Work	384	32	16	200	200	400
4	CA 10CC1	Online Certification Courses **(SWAYAM / NPTEL)**	--	--	3	--	100	100
Total Number of credits: 20			**384**	**32**	**19**	**200**	**200**	**500**

SEMESTER-WISE CREDITS AND MARKS

SEMESTER	Credits	Marks
FIRST SEMESTER	**26**	**700**
SECOND SEMESTER	**26**	**650**
THIRD SEMESTER	**25**	**650**
FOURTH SEMESTER	**19**	**500**
Add. Credits (Ignitors, Outreach, Soft skills)	**6**	**--**
TOTAL	**102**	**2500**

SUMMARY OF COURSE ARTICULATION MATRICES

Course Code & Title	COs	POs									
		1	2	3	4	5	6	7	8	9	10
CA 7125 & Database Design and Implementation	CO1	*	*		*					*	
	CO2	*	*		*						
	CO3	*	*		*						
	CO4	*	*		*						
	CO5	*	*	*	*					*	*

Course Code & Title	COs	POs									
		1	2	3	4	5	6	7	8	9	10
CA 7225 & Data Structures and Analysis of Algorithms	CO1	*	*							*	
	CO2	*	*		*						
	CO3	*	*		*		*				
	CO4	*	*		*						
	CO5	*	*	*	*						

Course Code & Title	COs	POs									
		1	2	3	4	5	6	7	8	9	10
CA 7325 & Machine Learning with Python	CO1	*	*	*	*	*		*		*	
	CO2	*	*	*	*	*	*	*	*	*	*
	CO3	*	*	*	*	*	*	*	*	*	*
	CO4	*	*	*	*	*	*	*	*	*	*
	CO5	*	*	*	*	*	*	*	*	*	*

Course Code & Title	COs	POs									
		1	2	3	4	5	6	7	8	9	10
CA 7425 & Mathematical Foundations for Computer Applications	CO1	*	*	*	*			*		*	
	CO2	*	*	*	*			*		*	*
	CO3	*	*	*	*	*		*	*	*	*
	CO4	*	*	*	*	*		*	*	*	*
	CO5	*	*	*	*	*	*	*	*	*	*

Course Code & Title	COs	POs									
		1	2	3	4	5	6	7	8	9	10
CA 7525 & Finance, Accounting, and Company Laws for IT Professionals	CO1	*	*					*	*	*	
	CO2	*	*		*			*	*	*	
	CO3	*	*			*	*	*	*	*	*
	CO4	*	*		*		*	*	*	*	*

	CO5	*	*	*	*	*		*	*	*	*

Course Code & Title	COs	POs									
		1	2	3	4	5	6	7	8	9	10
CA 7625 & Entrepreneurship and Innovation	CO1	*	*	*	*		*	*	*	*	*
	CO2	*	*	*	*		*	*	*	*	*
	CO3	*	*	*	*	*	*	*	*	*	*
	CO4	*	*	*	*		*	*	*	*	*
	CO5	*	*	*	*	*	*	*	*	*	*

Course Code & Title	COs	POs									
		1	2	3	4	5	6	7	8	9	10
CA 7P125 & Data Structures and Algorithms Lab	CO1	*	*	*	*			*		*	*
	CO2	*	*	*	*		*	*	*	*	*
	CO3	*	*	*	*		*	*	*	*	*
	CO4	*	*	*	*		*	*	*	*	*
	CO5	*	*	*	*		*	*	*	*	*

Course Code & Title	COs	POs									
		1	2	3	4	5	6	7	8	9	10
CA 7P225 & DBMS Lab	CO1	*	*	*	*		*	*	*	*	*
	CO2	*	*	*	*		*	*	*	*	*
	CO3	*	*	*	*		*	*	*	*	*
	CO4	*	*	*	*		*	*	*	*	*
	CO5	*	*	*	*		*	*	*	*	*

Course Code & Title	COs	POs									
		1	2	3	4	5	6	7	8	9	10
CA 7P325 & Machine Learning with Python Lab	CO1	*	*	*	*	*		*		*	
	CO2	*	*	*	*	*	*	*	*	*	*
	CO3	*	*	*	*	*	*	*	*	*	*
	CO4	*	*	*	*	*	*	*	*	*	*
	CO5	*	*	*	*	*	*	*	*	*	*

Course Code & Title	COs	POs									
		1	2	3	4	5	6	7	8	9	10
CA 8125 & Information and Network Security	CO1	*	*	*	*			*		*	*
	CO2	*	*	*	*			*	*	*	
	CO3	*	*	*	*	*	*	*	*	*	*
	CO4	*	*	*	*	*	*	*	*	*	*
	CO5	*	*	*	*	*	*	*	*	*	*

Course Code & Title	COs	POs									
		1	2	3	4	5	6	7	8	9	10
CA 8225 & Advanced Programming with Java	CO1	*	*		*		*	*		*	
	CO2	*	*		*		*	*		*	
	CO3	*	*	*	*		*	*	*	*	
	CO4	*	*		*		*	*	*	*	
	CO5	*	*	*	*	*	*	*	*	*	*

Course Code & Title	COs	POs									
		1	2	3	4	5	6	7	8	9	10
CADE 8325 & Natural Language Processing **(ELECTIVE I)**	CO1	*	*	*	*			*		*	
	CO2	*	*	*	*		*	*	*	*	*
	CO3	*	*	*	*		*	*	*	*	
	CO4	*	*	*	*		*	*	*	*	*
	CO5	*	*	*	*	*	*	*	*	*	*

Course Code & Title	COs	POs									
		1	2	3	4	5	6	7	8	9	10
CADE 8425 & Image Processing and Pattern Recognition **(ELECTIVE I)**	CO1	*	*	*	*			*		*	
	CO2	*	*	*	*			*		*	
	CO3	*	*	*	*		*	*	*	*	
	CO4	*	*	*	*		*	*	*	*	*
	CO5	*	*	*	*	*	*	*	*	*	*

Course Code & Title	COs	POs									
		1	2	3	4	5	6	7	8	9	10
CADE 8525 & Big Data Analytics (ELECTIVE II)	CO1	*	*	*	*			*		*	
	CO2	*	*	*	*		*	*		*	
	CO3	*	*	*	*		*	*	*	*	
	CO4	*	*	*	*		*	*	*	*	*
	CO5	*	*	*	*	*	*	*	*	*	*

Course Code & Title	COs	POs									
		1	2	3	4	5	6	7	8	9	10
CADE 8625 & Data Science (ELECTIVE II)	CO1	*	*	*	*			*	*	*	
	CO2	*	*	*	*		*	*	*	*	
	CO3	*	*	*	*		*	*	*	*	*
	CO4	*	*	*	*		*	*	*	*	*
	CO5	*	*	*	*	*	*	*	*	*	

Course Code & Title	COs	POs									
		1	2	3	4	5	6	7	8	9	10
CA 8725 & Internet of Things	CO1	*	*	*	*	*				*	*
	CO2	*	*	*	*	*	*		*	*	
	CO3	*	*	*	*				*	*	*
	CO4	*	*	*	*	*	*	*	*	*	*
	CO5	*	*	*	*	*	*	*	*	*	*
	CO6	*	*	*	*	*	*	*	*	*	*

Course Code & Title	COs	POs									
		1	2	3	4	5	6	7	8	9	10
CA 8P125 & Advanced Java Lab	CO1	*	*		*		*	*		*	
	CO2	*	*		*		*	*		*	
	CO3	*	*	*	*		*	*	*	*	
	CO4	*	*		*		*	*	*	*	
	CO5	*	*	*	*	*	*	*	*	*	*

Course Code & Title	COs	POs									
		1	2	3	4	5	6	7	8	9	10
CADE 8P225 & Natural Language Processing Lab (ELECTIVE I)	CO1	*	*	*	*			*		*	
	CO2	*	*	*	*		*	*	*	*	*
	CO3	*	*	*	*		*	*	*	*	
	CO4	*	*	*	*		*	*	*	*	*
	CO5	*	*	*	*	*	*	*	*	*	*

Course Code & Title	COs	POs									
		1	2	3	4	5	6	7	8	9	10
CADE 8P325 & Image Processing Lab (ELECTIVE I)	CO1	*	*	*	*			*		*	
	CO2	*	*	*	*			*		*	
	CO3	*	*	*	*		*	*	*	*	
	CO4	*	*	*	*		*	*	*	*	*
	CO5	*	*	*	*	*	*	*	*	*	*

Course Code & Title	COs	POs									
		1	2	3	4	5	6	7	8	9	10
CADE 8P425 - Big Data Analytics Lab (ELECTIVE II)	CO1	*	*	*	*			*		*	
	CO2	*	*	*	*		*	*		*	
	CO3	*	*	*	*		*	*	*	*	
	CO4	*	*	*	*		*	*	*	*	*
	CO5	*	*	*	*	*	*	*	*	*	*

Course Code & Title	COs	POs									
		1	2	3	4	5	6	7	8	9	10
CADE 8P525 - Data Science Lab (ELECTIVE II)	CO1	*	*	*	*			*	*	*	
	CO2	*	*	*	*		*	*	*	*	
	CO3	*	*	*	*		*	*	*	*	*
	CO4	*	*	*	*		*	*	*	*	*
	CO5	*	*	*	*	*	*	*	*	*	

Course Code & Title	COs	POs									
		1	2	3	4	5	6	7	8	9	10
CA 9125 & Agile Software Engineering	CO1	*	*		*					*	
	CO2	*	*	*	*					*	
	CO3	*	*		*		*	*			
	CO4	*	*		*		*	*	*		
	CO5	*	*		*						

Course Code & Title	COs	POs									
		1	2	3	4	5	6	7	8	9	10
CA 9225 & Cloud Computing	CO1	*	*		*					*	
	CO2	*	*		*					*	
	CO3	*	*	*	*						*
	CO4	*	*		*		*	*	*		
	CO5	*	*		*	*					*

Course Code & Title	COs	POs									
		1	2	3	4	5	6	7	8	9	10
CA 9325 & Full Stack Development	CO1	*	*		*					*	
	CO2	*	*		*		*	*			
	CO3	*	*		*		*	*			
	CO4	*	*		*						
	CO5	*	*		*		*	*	*		*
	CO6	*	*		*					*	

Course Code & Title	COs	POs									
		1	2	3	4	5	6	7	8	9	10
CA 9425 & Deep Learning	CO1	*	*		*					*	
	CO2	*	*		*						
	CO3	*	*	*	*		*	*			*
	CO4	*	*	*	*						
	CO5	*	*	*	*	*				*	*

Course Code & Title	COs	POs									
		1	2	3	4	5	6	7	8	9	10
CA 9525 & Research Methodology	CO1	*	*	*						*	
	CO2	*	*	*							
	CO3	*	*	*	*			*			
	CO4	*	*	*	*			*			
	CO5		*	*	*	*		*		*	*
Course Code & Title	**COs**	**POs**									
		1	2	3	4	5	6	7	8	9	10
CA 9P125 & Deep Learning Lab	CO1	*	*		*					*	
	CO2	*	*		*						
	CO3	*	*	*	*		*	*			*
	CO4	*	*	*	*						
	CO5	*	*	*	*	*				*	*
Course Code & Title	**COs**	**POs**									
		1	2	3	4	5	6	7	8	9	10
CA 9P225 & Cloud Computing Lab	CO1	*	*		*					*	
	CO2	*	*		*					*	
	CO3	*	*	*	*						*
	CO4	*	*		*		*	*	*		
	CO5	*	*		*	*					*
Course Code & Title	**COs**	**POs**									
		1	2	3	4	5	6	7	8	9	10
CA 9P325 & Full Stack Development Lab	CO1	*	*		*					*	
	CO2	*	*		*		*	*			
	CO3	*	*		*		*	*			
	CO4	*	*		*						
	CO5	*	*		*		*	*	*		*

COURSE CONTENT AND COURSE OUTCOMES

DEPARTMENT OF COMPUTER SCIENCE

Semester	**I**
Course Code	**CA 7125**
Course Title	**Database Design and Implementation**
Number of teaching hours per week	4
Total number of teaching hours per semester	60
Number of credits	4

Course Outcomes (COs)

On successful completion of this course, the students will be able to:

CO Number	Course Outcome (CO) Statement	Bloom's Taxonomy Level
CO1	Explain the fundamentals of database systems, data abstraction, database architectures, data models, and conceptual database design using ER and relational models.	**Understand (L2)**
CO2	Apply relational algebra operations and normalization techniques to analyze relational schemas and design efficient, anomaly-free databases.	**Analyze (L4)**
CO3	Use SQL to create, manipulate, query, and manage relational databases, including views, constraints, nested queries, set operators, and built-in functions.	**Apply (L3)**
CO4	Analyze database storage mechanisms, indexing techniques, transaction processing, concurrency control, recovery mechanisms, and implement database logic using PL/SQL.	**Analyze (L4)**
CO5	Apply advanced database concepts including cursors, triggers, distributed databases, Big Data, NoSQL systems, and vector databases to modern data-driven applications.	**Apply (L3)**

Unit	Course contents	Hours
I	**Introduction-Database System Applications:** Purpose of Database Systems, View of Data – Data, Data Abstraction, Three Schema Architecture, Data Independence, Database Users and Administrators, Data Models. **Introduction to Data model: ER model:** Entities, Attributes and Entity sets, relationships and Relationship sets, Additional features of ER Model, Conceptual Design with the ER Model, Conceptual Design for Large enterprises. **Relational Model:** Foundations of the Relational Model, Basics of Relational Algebra and Calculus.	08
II	**Relational algebra:** Introduction, Basic Operations: Union, Intersection, Cartesian Product, Difference, Relational Algebraic Operations: Projection, Join, Selection	13

	and Division, Relational model constraints: Domain constraints, Key constraints, Entity integrity, referential integrity **Normalization:** Concept of normalization, Need for Normalization, Anomalies in DB, Normalization Process, Functional Dependency, Full Functional Dependency, Partial Dependency, trivial functional dependency, 2NF, 3NF, BCNF, 4NF and 5NF, Join and Multivalued Dependency. Denormalization, Database design with Normal forms.	
III	**SQL: Components of SQL:** Data Definition Language, Data Manipulation Language, Data Control Language, Data Query Language, Transaction Control Language Creating Tables, Altering Tables and Schema, Manipulation of Data, Querying Single Table and Multiple Tables, Adding /Altering Constraints and Business Rules, Sorting, Join Operations, and Data Dictionary. **Views:** Concept, purpose of views, types of views, Advantages and disadvantages of views, implementing views in SQL, Altering Views Nested queries: Features of subquery, Rules, types of subquery **Set operators in SQL:** Using Union, Union All, Intersect, and Minus Functions: Scalar and aggregate functions: types of scalar functions, Aggregate functions, Conversion functions	14
IV	**File Organization:** Heap Files, Sequential Access Methods, Indexed Sequential Access Method, **Indexes:** Purpose Index, Types of Indexes, Advantages and Disadvantages of creating Indexes, Multi-level indexes, Creating Indexes in SQL, purpose of Index, types of indexes, Implementing Indexes in SQL, Sequences **Transactions:** Concept of Transaction, States of Transaction, ACID properties, Concurrent Transaction: Lost update, Dirty Read, Unrepeatable Read, Inconsistent summary, **Concurrency control Mechanism:** Database Lock, 2 PL: Basic 2 PL, Strict 2 PL, Rigorous 2 PL, Timestamp: Deadlock, deadlock prevention algorithms: Wait-Die and Wound-Wait **Failures in DB/Transaction:** Reasons for Database failures, Catastrophic failure, Transaction Log, Backup, transaction Failure, Deferred update, Immediate update, Log-based recovery **PL/SQL:** A Programming Language: History – Fundamentals – Block Structure – Comments – Data Types, Assignment operation – Bind variables, Conditional statement, Branching and Looping, Transaction Control statements, DCL: Commit and Rollback	13
V	**PL/SQL Cursors and Exceptions:** Cursors – Implicit & Explicit Cursors and Attributes – Cursor FOR loops, Cursor with Parameters – Cursor Variables – Exceptions – Types of Exceptions. Stored Procedures and Triggers **Distributed Database Systems:** Components, Advantages over centralized database system, Transparencies in DDB, Issues in DDB: Fragmentation, Replication and Allocation, DDB architecture: SPSD, MPSD, MPMD, Distributed query processing, 3-phase commit protocol **Big data:** Concept of Big Data, 4 V's of Big Data, ACID vs BASE, NoSQL, Types of NoSQL Data. Vector Databases: Introduction to Vector Databases – Applications in AI.	12
Total		**60**

Text Book(s):

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Database System Concepts, Seventh Edition, McGraw-Hill Education, 2020.

2. R. Elmasri and S.B. Navathe: "Fundamentals of Database System", Pearson, 7th Edition, 2018.
3. Nilesh Shah, "Database Systems using ORACLE: A simplified guide to SQL, and PL/SQL", 2nd Edition, Prentice Hall of India Ltd.
4. Akmal Chaudhri, Arnaud Comet, Eric Hanson, Madhukar Kumar, Vector Databases and AI Applications for Dummies, SingleStore Special Edition, 2025

Reference Book(s):

1. Raghurama Krishnan, Johannes Gehrke, Database Management Systems, 3rd Edition, 2014, McGraw-Hill Education,
2. Bipin C. Desai, "Introduction to Database Systems", Galgotia Publications.
3. Date, C. J. , "An introduction to database systems", 3rd Edition, Narosa publishing house.
4. Hansen & Hansen, "Database Management and Design", Prentice Hall of India ltd.
5. Ullman, J. D., "Principals of Database systems", Galgotia publications
6. Narang, "Database Management System", Prentice Hall of India Ltd
7. Ivan Bayross "SQL, PL/SQL : The programming language of Oracle", BPB Publications

BLUEPRINT

Course Code: **CA 7125**

Course Title: **Database Design and Implementation**

Unit Number	Number of Hours	Total marks for which the questions are to be asked (including bonus questions)
Unit I	08	8
Unit II	13	8
Unit III	14	10
Unit IV	13	20
Unit V	12	20
Total	60	66
Maximum marks for the course (Excluding bonus questions) = 50)		

Semester	**I**
Course Code	**CA 7225**
Course Title	**Data Structures and Analysis of Algorithms**
Number of teaching hours per week	4
Total number of teaching hours per semester	60
Number of credits	4

Course Outcomes (COs)
On successful completion of this course, the students will be able to:

CO Number	Course Outcome (CO) Statement	Bloom's Taxonomy Level
CO1	Explain the fundamentals of data structures, memory allocation, pointers, arrays, strings, and sparse matrices, and their applications in problem solving.	**Understand (L2)**
CO2	Implement linear data structures such as stacks, queues, and linked lists using C and apply them to solve computational problems.	**Apply (L3)**
CO3	Construct and apply tree data structures including binary trees, binary search trees, and self-balancing trees for efficient data representation and processing.	**Create (L6)**
CO4	Apply searching, sorting, and graph algorithms to solve problems involving data organization, traversal, and optimization.	**Apply (L3)**
CO5	Analyze algorithms using time and space complexity, asymptotic notations, and algorithm design techniques to evaluate computational efficiency.	**Analyze (L4)**

Unit	Course contents	Hours
I	**Introduction:** Introduction to structures, functions, Pointers, and Memory Allocation. Introduction to one dimensional array, two dimensional array, character array – string operations, sparse matrix and its operations . What is data structure, different types of data structures, Application of data structures	07
II	**Stack:** stack as an ADT, Representing Stack using C, Stack Applications – infix to postfix, postfix evaluation, Decimal to binary conversion, Recursion **Queue:** Queue as an ADT, Queue implementation using C, Queue Applications, Queue Types – Circular Queue, Double Ended Queue, Priority Queue – Implementation using array. **Lists:** Introduction to lists, Types of linked list, Node Structure, list operations – insert and delete, circular linked list – insert and delete operations, Double ended and double ended circular queue – insert and delete operations. Representation of Exponential equation and addition of exponential equations. Ordered singly linked list.	15
III	**Trees:** Introduction to trees, Binary trees – Operations on binary trees, Applications of Binary trees – duplicate value deletion, expression representation and traversal. Binary tree representation – Node Representation of binary trees, implicit array representation of binary trees, binary tree traversals, Threaded binary trees. Binary Search trees. Self-balancing trees -AVL trees., B trees, splay trees, Huffman Coding, Quad tree, 2-3 tree, Red Black trees.	15
IV	**Searching:** Linear Search, Binary Search, Hashing – insertion and searching using hashing. **Sorting:** Bubble sort, insertion sort, selection sort, radix sort, merge sort, quick sort, heap sort, address calculation sort. **Graphs:** Definitions, Graph Representations- Adjacency matrix, Adjacency lists, warshall's algorithm, shortest path algorithm, Graph traversal methods: Depth First Search and Breadth First Search, Graph spanning tree – prims algorithm and Kruskal's algorithm.	12
V	**Analysis of Algorithms:** Definition of an Algorithm, Characteristics of a Good Algorithm, Asymptotic Notations, Time and Space Complexity, Growth of	11

	Functions & Complexity Classes, **Complexity Analysis Examples:** Calculation of the complexity of recursive algorithms, Brute Force, Divide and Conquer, Greedy, NP-Completeness & Approximation Algorithms.	
Total		**60**

Text Book(s):

1. Data structures, using C and C++, 2nd Edition, Yedidyah Langsam, Aaron M. Tenenbaum. Pearson
2. Design and Analysis of Algorithms By A.A.Puntambekar Technical Publications, 2010.

Reference Book(s):

1. DATA STRUCTURES THROUGH C IN DEPTH by S. K. srivastava and Deepali Srivastav BPB Publications.
2. Data Structures – R Venkateshan, S. Lovelyn rose – Second Edition – Wiley
3. DATA STRUCTURES AND ALGORITHMS MADE EASY by Narasimha Karumanchi - Careermonk Publications; 5th ed. edition (2016)
4. Data structures and Algorithms in C++, M.T. Goodrich, R. Tamassia and D. Mount, Wiley India.

BLUEPRINT

Course Code: **CA 7225**

Course Title: **Data Structures and Analysis of Algorithms**

Unit Number	Number of Hours	Total marks for which the questions are to be asked (including bonus questions)
Unit I	07	8
Unit II	15	8
Unit III	15	10
Unit IV	12	20
Unit V	11	20
Total	60	66
Maximum marks for the course (Excluding bonus questions) = 50)		

Semester	**I**
Course Code	**CA 7325**
Course Title	**Machine Learning with Python**
Number of teaching hours per week	4
Total number of teaching hours per semester	60
Number of credits	4

Course Outcomes (COs)
On successful completion of this course, the students will be able to:

CO Number	Course Outcome (CO) Statement	Bloom's Taxonomy Level
CO1	Understand the fundamentals of Python programming and apply basic syntax, data types, control flow, and operators for writing efficient code.	2 (Understanding), 3 (Applying)
CO2	Develop modular programs using functions and implement object-oriented programming concepts, including classes, inheritance, and polymorphism.	3 (Applying), 6 (Creating)
CO3	Demonstrate knowledge of machine learning concepts and apply Python libraries for data preprocessing, feature engineering, and visualization.	2 (Understanding), 3 (Applying)
CO4	Implement supervised learning algorithms such as regression and classification while evaluating models using appropriate metrics.	3 (Applying), 5 (Evaluating)
CO5	Explore and apply unsupervised learning techniques such as clustering and dimensionality reduction to solve real-world problems.	4 (Analyzing), 3 (Applying)

Unit	Course contents	Hours
I	**Python for Machine Learning:** Getting Started with Python: Basic Syntax, Interactive Shell, Editing, Saving, and Running Scripts. Programming Concepts: **Data Types:** List, String, tuple, dictionary, set, Slicing and Indexing, Control Flow & Data Processing: Conditional Statements, Looping Constructs, Break, Continue, and Pass Statements, Functions and Modules, Understanding packages, Importing packages. File Handling (Reading/Writing Files, CSV, JSON)	12
II	**Data Handling and Visualization:** NumPy for Scientific Computing: NumPy Arrays and Basic Operations, Indexing, Slicing, and Reshaping Arrays, Mathematical Functions and Linear Algebra in NumPy. **Pandas for Data Manipulation:** Creating and Managing DataFrames, Filtering, Sorting, and Aggregating Data, Handling Missing Values and Duplicates, Merging and Concatenating DataFrames. **Data Visualization using Matplotlib & Seaborn**: Creating Line, Bar, and Scatter Plots, Heatmaps, Histograms, Box Plots for Data Analysis, Interactive Visualizations with Seaborn.	12
III	**Data Preprocessing and Feature Engineering:** Data Cleaning & Handling Missing Data: Identifying and Handling Missing Values, Dropping or Imputing Data Using Statistical Methods. **Feature Engineering:** Encoding Categorical Variables (One-Hot, Label Encoding), Scaling and Normalization (Min-Max Scaling, Standardization), Feature Selection Techniques. Dimensionality Reduction Techniques: Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA).	14
IV	**Supervised Learning & Model Evaluation: Regression Models:** Simple & Multiple Linear Regression, Performance Metrics: Mean Squared Error (MSE), RMSE, R^2. **Classification Models:** Logistic Regression, k-Nearest Neighbors (k-NN), Naïve Bayes Classifier. **Model Evaluation Techniques:** Train-Test Split & Cross-Validation, Confusion Matrix, Precision, Recall, F1-Score, ROC Curve and AUC Score.	13

V	**Unsupervised Learning & Applications: Clustering Techniques:** K-Means Clustering, DBSCAN (Density-Based Spatial Clustering), Hierarchical Clustering. Real-World Applications of Unsupervised Learning: Customer Segmentation in Marketing, Anomaly Detection for Fraud Detection, Recommender Systems.	09
Total		**60**

Text Book(s):

1. Python Programming: A Modern Approach, Vamsi Kurama, Publisher: Pearson Education
2. Machine Learning with Python Cookbook , Chris Albon, O'Reilly Media
3. Introduction to Machine Learning with Python, Andreas C. Müller and Sarah Guido, O'Reilly Media
4. Data Science from Scratch: First Principles with Python, Joel Grus, O'Reilly Media
5. Python Machine Learning, Sebastian Raschka and Vahid Mirjalili, Packt Publishing

Reference Book(s):

1. Think Python: How to Think Like a Computer Scientist, Allen B. Downey, O'Reilly Media
2. Python for Data Analysis, Wes McKinney, O'Reilly Media
3. Programming Python, Mark Lutz, O'Reilly Media
4. Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer
5. An Introduction to Statistical Learning, Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani, Publisher: Springer
6. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, Pearson Education

BLUEPRINT

Course Code: **CA 7325**

Course Title: **Machine Learning with Python**

Unit Number	Number of Hours	Total marks for which the questions are to be asked (including bonus questions)
Unit I	12	8
Unit II	12	8
Unit III	14	10
Unit IV	13	20
Unit V	09	20
Total	60	66
Maximum marks for the course (Excluding bonus questions) = 50)		

Semester	**I**
Course Code	**CA 7425**
Course Title	**Mathematical Foundations for Computer Applications**
Number of teaching hours per week	3

Total number of teaching hours per semester	45
Number of credits	3

Course Outcomes (COs)		
On successful completion of this course, the students will be able to:		
CO Number	**Course Outcome (CO) Statement**	**Bloom's Taxonomy Level**
CO1	Understand and apply core mathematical concepts such as set theory, logic, and linear algebra in machine learning tasks.	L2 (Understanding), L3 (Applying)
CO2	Calculate and interpret probabilities, random variables, and statistical measures such as mean, variance, and correlation.	L3 (Applying), L4 (Analyzing)
CO3	Apply statistical inference methods including hypothesis testing, confidence intervals, and regression to draw meaningful conclusions from data.	L3 (Applying), L5 (Evaluating)
CO4	Solve machine learning problems using advanced probability techniques such as Bayes' theorem, stochastic processes, and Monte Carlo methods.	L3 (Applying), L4 (Analyzing)
CO5	Use statistical methods like PCA, ANOVA, and cross-validation to evaluate, optimize, and interpret the performance of machine learning models.	L3 (Applying), L5 (Evaluating)

Unit	**Course contents**	**Hours**
I	Set Theory - Basics of sets, subsets, operations on sets, and Venn diagrams, Cartesian products and power sets. Propositional Logic - Propositions and logical connectives, Truth tables and logical equivalence, Tautologies, contradictions, implications. Normal Forms - Conjunctive Normal Form (CNF), Disjunctive Normal Form (DNF). Predicates and quantifiers, Introduction to rules of inference. Introduction to Proof Techniques- Direct, indirect, contradiction, and mathematical induction	10
II	Relations - Definition and types of relations- reflexive, symmetric, transitive, Equivalence relations. Functions- Types of functions: one-to-one, onto, bijective, Composition of functions, and inverse functions. Linear Algebra - Matrix operations, Transpose, determinants, and inverse of matrices, solving systems of linear equations using Gaussian elimination, Eigenvalues, and eigenvectors and their role in machine learning	10
III	Probability Theory - Axiomatic definition of probability, sample spaces, and events, Joint and conditional probabilities, independence, Total probability and Bayes' rule. Random Variables- Discrete and continuous random variables, Probability mass function (pmf) and probability density function (pdf), Cumulative distribution function (cdf), Expectation, variance, and moments of random variables	08
IV	Probability Distributions, Applications, Uniform, Gaussian, binomial, Poisson distributions, Law of Large Numbers and the Central Limit Theorem (CLT),	08

	Markov Chains and their applications in machine learning, Conditional probability and Bayes' Theorem in machine learning contexts. Stochastic Processes, Basic Statistical Concepts - Descriptive Statistics, Measures of central tendency (mean, median, mode) and dispersion (variance, standard deviation), Scatter plots and histograms for data visualization. Understanding covariance, correlation, and their interpretation in datasets, Introduction to simple linear regression	
V	Statistical Inference - Point and interval estimation, Hypothesis testing (Z-test, T-test, and Chi-square test), Confidence intervals and significance levels. Regression and Model Evaluation metrics, R-squared, Adjusted R-squared, MSE, MAE. Advanced Statistical Methods for ML - Analysis of Variance (ANOVA), Principal Component Analysis (PCA) for dimensionality reduction, Logistic regression and its connection to machine learning algorithms	09
Total		**45**

Text Book(s):

1. "Discrete Mathematics and Its Applications" by Kenneth H. Rosen
2. "Linear Algebra and Its Applications" by David C. Lay
3. "Probability and Statistics for Engineering and the Sciences" by Jay L. Devore
4. "Pattern Recognition and Machine Learning" by Christopher M. Bishop

Reference Book(s):

1. Sheldon M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists", Academic Press, (2009).
2. D. C. Montgomery and G.C. Runger, "Applied Statistics and Probability for Engineers", 5th edition, John Wiley & Sons, (2009).
3. Robert H. Shumway and David S. Stoffer, "Time Series Analysis and Its Applications with R Examples", Third edition, Springer Texts in Statistics, (2006).

BLUEPRINT

Course Code: **CA 7425**

Course Title: **Mathematical Foundations for Computer Application**

Unit Number	Number of Hours	Total marks for which the questions are to be asked (including bonus questions)
Unit I	10	8
Unit II	10	8
Unit III	08	10
Unit IV	08	20
Unit V	09	20
Total	45	66
Maximum marks for the course (Excluding bonus questions) = 50)		

Semester	**I**
Course Code	**CA 7525**
Course Title	**Finance, Accounting, and Company Laws for IT Professionals**

Number of teaching hours per week	3
Total number of teaching hours per semester	45
Number of credits	3

Course Outcomes (COs)		
On successful completion of this course, the students will be able to:		
CO Number	**Course Outcome (CO) Statement**	**Bloom's Taxonomy Level**
CO1	Explain essential financial and accounting concepts relevant to IT project decision-making.	L2 – Understand
CO2	Apply accounting fundamentals to prepare, analyze, and interpret financial statements.	L3 – Apply
CO3	Analyze key company laws and compliance requirements applicable to IT professionals and organizations.	L4 – Analyze
CO4	Utilize appropriate financial tools and techniques to plan and manage project budgets and contracts in IT contexts.	L4 – Analyze / L5 – Evaluate
CO5	Evaluate financial decisions and strategies to enhance the economic viability and sustainability of IT projects.	L5 – Evaluate

Unit	Course contents	Hours
I	**Basics of Finance: Introduction to Finance:** Role and Importance of Finance in IT, Goals of **Financial Management:** Profit Maximization vs. Wealth Maximization. **Time Value of Money: Concepts:** Present Value (PV) and Future Value (FV). **Applications:** Net Present Value (NPV) and Internal Rate of Return (IRR) in IT projects. **Sources of Finance for IT Startups:** Equity, Debt, Angel Investors, Venture Capital, and Crowdfunding. **Practical:** Develop a simple cash flow analysis for an IT startup. Calculate NPV and IRR for a hypothetical IT project using spreadsheet software.	12
II	**Fundamentals of Accounting: Accounting Basics: Key Concepts:** Double-Entry System, Accrual vs. Cash Accounting. Fundamental Accounting Equation: Assets = Liabilities + Equity. **Preparation of Financial Statements:** Structure and Interpretation of Balance Sheet, Income Statement, and Cash Flow Statement. Relationship between the three statements. **Accounting Cycle:** Journal Entries, Ledger Posting, Trial Balance, Adjustments, and Final Accounts. **Key Financial Ratios: Liquidity Ratios:** Current Ratio, Quick Ratio. Profitability Ratios: Gross Margin, Return on Investment (ROI). **Solvency Ratios:** Debt-to-Equity Ratio.	12
III	**Legal Considerations for IT Businesses:** Intellectual Property Rights (IPR): Copyrights, Patents, and Trademarks. Cyber Laws: IT Act 2000 & 2023 and Amendments. Data Protection and Privacy Laws (e.g., GDPR, India's Data Protection Bill). **Corporate Governance:** Importance of Ethical Practices in IT. Role of Directors and Compliance Officers. **Contracts and Agreements:** Non-Disclosure Agreements (NDAs), Software Licensing, and Vendor Contracts.	12

	Practical: Draft a simple Non-Disclosure Agreement (NDA) for an IT project. Discuss a real-world case of corporate governance failure in the IT industry.	
IV	**Integration and Case Studies: Integration of Finance, Accounting, and Company Laws in IT Project Management:** Financial and Legal Planning for IT Startups. Managing Project Costs and Compliance Simultaneously. **Case Studies:** **Case Study 1:** Funding a tech startup and managing its financial and legal compliance. **Case Study 2:** Budget overruns in IT projects and how to address them. **Case Study 3:** Cybersecurity breaches and the role of company law. **Practical:** Group project: Prepare a financial model, budget, and compliance checklist for a hypothetical IT startup. Presentation of group findings with Q & A.	09
Total		**45**

Reference Book(s):

Accounting

1. "Financial Accounting for Management" by P. C. Tulsian (A comprehensive guide that explains accounting principles and practices with a focus on management decisions)
2. "Advanced Accountancy" by R.L. Gupta & M. Radhaswamy (An in-depth book covering advanced accounting topics like partnership accounts, company accounts, and financial statements)
3. "Financial Accounting" by T.S. Grewal (A well-structured book for understanding the fundamentals of accounting and its various components)

Finance

4. "Financial Management" by I.M. Pandey (This book provides a detailed explanation of financial management concepts and tools like time value of money, capital budgeting, and risk management)
5. "Essentials of Financial Management" by Eugene F. Brigham & Joel F. Houston (A solid textbook covering both the theoretical and practical aspects of financial management)
6. "Corporate Finance" by Ross, Westerfield, and Jaffe (A comprehensive book on corporate finance that covers topics such as capital structure, investments, financial analysis, and valuation)
7. "Fundamentals of Financial Management" by Prasanna Chandra (Focuses on the key areas of finance, including financial analysis, capital budgeting, and risk management)

Company Laws

8. "Company Law" by Avtar Singh (A detailed and easy-to-understand guide to the legal aspects of companies, including provisions of the Companies Act, 2013)
9. "Company Law" by M.C. Kuchhal (This book offers a comprehensive understanding of company law with in-depth discussions on the incorporation, governance, and regulation of companies)
10. "Business Law" by P.K. Agrawal (Covers various business laws, including company law, contract law, and other legal regulations related to business operations)
11. "Corporate Laws and Governance" by S. M. Shukla (Focuses on the regulatory and compliance framework surrounding corporate governance, including sections from the Companies Act, 2013.)

IT and Accounting

12. "Accounting for Managers" by S.N. Maheshwari (This book bridges the gap between accounting and management, with a focus on how accounting principles apply to business management, especially in the IT sector)
13. "Financial Accounting and Management Accounting" by R.N. Gupta (A good reference for students to understand the practical aspects of accounting and how they relate to managerial decision-making)

Legal Aspects for IT

14. "Cyber Law in India" by P.K. Sethi (A valuable book for understanding the legal framework of the internet, data privacy, and intellectual property rights in India)
15. "Information Technology Law: The Law of the Internet, E-Commerce and Digital Communications" by Andrew Murray (A great book for understanding the legal aspects of technology, the internet, and e-commerce in today's digital world)
16. "Law and the Internet" by D. W. S. (David) Clarke (Focuses on the relationship between law and internet technologies, including key issues in cybersecurity and online data protection)

BLUEPRINT

Course Code: **CA 7525**

Course Title: **Finance, Accounting, and Company Laws for IT Professionals**

Unit Number	Number of Hours	Total marks for which the questions are to be asked (including bonus questions)
Unit I	12	14
Unit II	12	12
Unit III	12	20
Unit IV	09	20
Total	45	66
Maximum marks for the course (Excluding bonus questions) = 50)		

Semester	**I**
Course Code	**CA 7625**
Course Title	**Entrepreneurship and Innovation**
Number of teaching hours per week	2
Total number of teaching hours per semester	30
Number of credits	2

Course Outcomes (COs)		
On successful completion of this course, the students will be able to:		
CO Number	**Course Outcome (CO) Statement**	**Bloom's Taxonomy Level**
CO1	Identify and analyze entrepreneurial opportunities by scoping real-world problems with significant user and market impact.	**L4 – Analyze**
CO2	Develop and refine customer personas and problem statements using market research and user feedback.	**L3 – Apply**
CO3	Evaluate and pivot business ideas or customer segments based on insights from customer responses and data analysis.	**L5 – Evaluate**
CO4	Apply entrepreneurial tools to estimate market potential (TAM), identify viable solutions, and create prototype models.	**L3 – Apply / L4 – Analyze**
CO5	Formulate a basic business and sales plan demonstrating entrepreneurial mindset and career-oriented skills.	**L6 – Create**

Unit	Course contents	Hours
I	**Orientation:** Entrepreneurial leadership and its relevance of entrepreneurial mindset for students' career choices-Overview of global/Indian startup ecosystems-Introduction to design thinking/innovation.	05

	Problem Identification: Develop macro industry-problem perspective - Assemble 'real-world' problems - Analyze problems.	
II	**Customer Identification:** Identify customer segments. Assess 'Jobs-To-Be-Done' (JTBD) for a customer segment-Develop customer personal. **Customer Needs Validation:** Understand customer validation-Validate customer-problem fit-Pivot/refine customer-problem fit for feasibility. **Solution Idea Generation:** Examine ideation techniques-Generate solution ideas. **Opportunity and Competition Mapping:** Identify global competitors-Review industry trends-Estimate market size (TAM).	06
III	**Prototype Development and MVP:** Overview of prototypes & MVP - Build an initial prototype-Prototypes for early validation. **Opportunity (feasibility) assessment:** Map your relative position in the market-Estimate opportunity size. **Business Modelling:** Examine revenue models-Review and organize the lean canvas-Build the lean canvas for your startup.	06
IV	**Marketing and Sales Strategy:** Understand marketing and sales-Recommend a GTM approach-Map a sales process. **Financial management for profitability:** Understand startup costs-Get started with financial planning-Analyse the path to profitability-Understand bootstrapping strategies & explore funding options. **Team and talent requirements:** Finding co-founders and mentors-Building an initial team.	07
V	**Venture Idea Pitch Readiness:** Scale orientation - Persuasive story-telling for a feasible venture idea. Final Milestone - Venture Idea Feasibility Presentation - **Milestone 3:** Venture idea feasibility (extrnal) jury presentation **Digital marketing:** Introduction to digital marketing-Search engine optimization-Search Engine Marketing-Social media marketing-Email marketing-Content marketing **Case Study:** eBay thrives in the global marketplace, Boo-Hoo – learning from the largest European dot-com failure, Zopa launches a new lending model, Tesco.com uses the Internet to support its diversification strategy, The new Napster changes the music marketing mix	06
Total		**30**

Text Book(s):

1. Dr. R. Paulmoni, "Entrepreneurship, Innovation And Creativity", AG Publishing House, First Edition, 2024.
2. H. James Harrington, "Creativity, Innovation, and Entrepreneurship", Productivity Press; 1st edition (11 December 2018).
3. Simon Kingsnorth, Digital Marketing Strategy: An Integrated Approach to Online Marketing, Kogan Page Ltd; 3rd edition (31 May 2022)

Reference Book(s):

1. Peter F. Drucker, Innovation and Entrepreneurship, Harper Business; Reprint edition (9 May 2006)
2. Michael Michalko, "Creative Thinkering", New World Library; Original edition (6 September 2011)

BLUEPRINT

Course Code: **CA 7625**

Course Title: **Entrepreneurship and Innovation**

Unit Number	Number of Hours	Total marks for which the questions are to be asked (including bonus questions)
Unit I	05	10
Unit II	06	10
Unit III	06	10
Unit IV	07	10
Unit V	06	10
Total	30	50
Maximum marks for the course (Excluding bonus questions) = 50)		

Practical I

Course Code and Title: CA 7P125 - Data Structures and Algorithms Lab

(3 hours/11 sessions)

CO Number	Course Outcome (CO) Statement	Bloom's Taxonomy Level
CO1	Understand the fundamental concepts of data structures and algorithm analysis.	Level 2 – Understanding
CO2	Apply appropriate data structures (such as arrays, linked lists, stacks, queues, trees, graphs) to solve computational problems.	Level 3 – Applying
CO3	Analyze the time and space complexity of algorithms.	Level 4 – Analyzing
CO4	Design and implement efficient algorithms using strategies such as divide-and-conquer, greedy methods, dynamic programming, and backtracking.	Level 6 – Creating
CO5	Evaluate and compare algorithmic approaches to determine the most efficient solution for a given problem.	Level 5 – Evaluating

Ex. No	List of Exercises
1	**LINKED LIST-QUEUE:** Write a **menu driven program** to show the working of a LINKED LIST having the following options: 1. **Input** a number into the LINKED LIST 2. **Print** the content of the linked list 3. **Delete** the **first node** of the linked list 4. **Delete the last node** 5. Display the **number of nodes** in the linked list. 6. Display the **MAXIMUM** number in the linked list 7. **Search for a given** number in the linked list 7. **Delete** a given number in the linked list 8. EXIT (**Options 1,2 and any two more options**)
2	Write a menu driven program to show the working of a **ORDERED LINKED LIST** with the following options: Input a number 2. Display the Linked list 3. Delete a given number 4. Reverse the Linked list 5. EXIT
3	Write a program in C with function sub programs **to MERGE TWO LINKED LISTS**

4	**QUEUE:** Write a menu driven program to show the working of a **QUEUE** having an integer data item with options: a) **Enqueue** b) **Dequeue** c) **Display** Queue d) Exit
5	Write a menu driven program to show the working of a **CIRCULAR QUEUE**.
6	Write a program in C to show the working of a **DOUBLY LINKED LIST.**
7	**BINARY SEARCH TREE:** Write a menu-driven program to create **BINARY SEARCH TREE** with the following options: 1. Insert a number 2. **INORDER** TRAVERSAL 3. **POST ORDER** TRAVERSAL 4. **PREORDER** traversal. 5. **Search** for a given number in the BST 6. Display all the **LEAF NODES** 7. **Search** for a number in the BST and indicate whether it is a leaf node or not. (Options 1, one of the traversals, + one of the 5, 6, 7)
8	**STACK:** Write and execute MENU DRIVEN program to show the **working of a STACK**.
9	Write a program in C using a STACK to check whether a **given string is a palindrome.**
10	Write a program in C using a stack **to reverse** a string.
11	Write a program in C using a stack to find the first N **FIBONACCI** numbers.
12	Write a program in C using a stack to find the first **FACTORIAL** of a given number.
13	Write a program in C using a STACK to check whether a **given set of brackets** are in order.
14	**SORTING:** Write a program in C with function sub programs to input some numbers into an array and sort them using **BUBBLE SORT**.
15	Write a program in C with function sub programs to input some strings into a **character matrix** and sort them using **BUBBLE SORT**.
16	Write a program in C with function sub programs to SORT some numbers in an array using **SELECTION SORT**./Also write **a function** sub program to sort numbers using selection sort.
17	Write a program in C with **function sub programs** to search for a given number in an array using **LINEAR SEARCH** method. Let the function return 1 it the number is found or else return -1 PROTOTYPE: **int fnSearchNum(int N, int A[20], int SearchNum)**
18	Write a program in C with **function sub programs** to search for a given number in an array using **BINARY SEARCH** method. Let the function return 1 it the number is found or else return -1 PROTOTYPE: **int fnBinarySearch(int N, int A[20], int SearchNum)**

19	Write a function sub program in C to sort some numbers using **INSERTION SORT** technique. Use it in the main program to sort a list f numbers using insertion sort.
20	Write a program in C to sort a list of numbers using **QUICK SORT** technique.
21	Write a program in C to sort a list of numbers using **HEAP SORT**.
22	**GRAPH:** Create and display graph using a) **Adjacency** matrix b) **Linked** list format
23	Write a program in C to do graph traversals BFS and DFS
24	Write a program to find the shortest routes in a graph using Warshall's algorithm

Practical II

Course Code and Title: CA 7P225 - DBMS Lab

(3 hours/11 sessions)

CO Number	Course Outcome (CO) Statement	Bloom's Taxonomy Level
CO1	Understand the fundamental concepts of data structures and algorithm analysis.	Level 2 – Understanding
CO2	Apply appropriate data structures (such as arrays, linked lists, stacks, queues, trees, graphs) to solve computational problems.	Level 3 – Applying
CO3	Analyze the time and space complexity of algorithms.	Level 4 – Analyzing
CO4	Design and implement efficient algorithms using strategies such as divide-and-conquer, greedy methods, dynamic programming, and backtracking.	Level 6 – Creating
CO5	Evaluate and compare algorithmic approaches to determine the most efficient solution for a given problem.	Level 5 – Evaluating

Ex. No	List of Exercises
1	Implementation of DDL and DML Commands of SQL with suitable examples.
2	Implementation of DQL and DCL Commands of SQL with suitable examples.
3	Implement various built-in functions in SQL, providing suitable examples.
4	Implementation of different types of operators in SQL.
5	Implementation of different types of Joins in SQL.
6	Implementation of materialized and non-materialized views in SQL.
7	Implementation of different types of views and nested subqueries in SQL.
8	Implementation of PL/SQL Blocks.
9	Implementation of Exception Handling in PL/SQL.
10	Implementation of PL/SQL Procedures and Functions.
11	Implementation of PL/SQL Packages
12	Implementation of PL/SQL Triggers

Practical III

Course Code and Title: CA 7P325 - Machine Learning with Python Lab

(3 hours/11 sessions)

CO Number	Course Outcome (CO) Statement	Bloom's Taxonomy Level
CO1	Understand the fundamentals of Python programming and apply basic syntax, data types, control flow, and operators for writing efficient code.	2 (Understanding), 3 (Applying)
CO2	Develop modular programs using functions and implement object-oriented programming concepts, including classes, inheritance, and polymorphism.	3 (Applying), 6 (Creating)
CO3	Demonstrate knowledge of machine learning concepts and apply Python libraries for data preprocessing, feature engineering, and visualization.	2 (Understanding), 3 (Applying)
CO4	Implement supervised learning algorithms such as regression and classification while evaluating models using appropriate metrics.	3 (Applying), 5 (Evaluating)
CO5	Explore and apply unsupervised learning techniques such as clustering and dimensionality reduction to solve real-world problems.	4 (Analyzing), 3 (Applying)

Ex. No	List of Exercises
1	Python Basics (i) Write a Python program to demonstrate basic syntax, variables, data types, and operators. (ii) Implement a program to use control flow statements (if-else, loops) and functions. (iii) Perform file handling operations: read, write, and modify CSV and JSON files.
2	NumPy and Pandas for Data Handling (i) Write a Python program using NumPy to perform array creation, reshaping, indexing, and mathematical operations. (ii) Implement data handling using Pandas: create DataFrames, filter, sort, and handle missing values. (iii) Merge, concatenate, and group DataFrames using Pandas.
3	Data Visualization with Matplotlib and Seaborn (i) Create a line plot, bar chart, and scatter plot using Matplotlib. (ii) Implement data visualization with Seaborn: histogram, box plot, heatmap. (iii) Generate an interactive visualization using Seaborn.
4	Data Preprocessing and Feature Engineering (i) Implement techniques for handling missing values (dropping/imputation). (ii) Perform categorical variable encoding using One-Hot and Label Encoding. (iii) Apply scaling techniques (Min-Max Scaling, Standardization).

	(iv) Implement Principal Component Analysis (PCA) for dimensionality reduction.
5	Supervised Learning - Regression (i) Implement Simple and Multiple Linear Regression using Scikit-Learn. (ii) Evaluate regression models using MSE, RMSE, and R^2 score. (iii) Visualize regression model performance with Matplotlib.
6	Supervised Learning - Classification (i) Implement Logistic Regression and k-Nearest Neighbors (k-NN) for classification tasks. (ii) Use Naïve Bayes Classifier for text classification (e.g., spam detection). (iii) Evaluate classification models using Confusion Matrix, Precision, Recall, and F1-score.
7	Model Evaluation & Cross-Validation (i) Implement train-test split and k-fold cross-validation. (ii) Generate an ROC Curve and compute AUC score for classification models.
8	Unsupervised Learning - Clustering (i) Implement K-Means Clustering and visualize clusters. (ii) Perform DBSCAN clustering and compare results with K-Means. (iii) Implement Hierarchical Clustering and visualize the dendrogram.
9	Real-World Applications (i) Implement customer segmentation using clustering techniques. (ii) Perform anomaly detection for fraud detection. (iii) Build a simple recommendation system using collaborative filtering.
10	Mini-Project (i) Apply machine learning techniques to a real-world dataset (e.g., Titanic dataset, Boston Housing dataset). (ii) Perform end-to-end model development: data preprocessing, feature engineering, model training, evaluation, and visualization.

Soft Skill Development – Public Speaking Skills
(Modules 1 & 2 conducted over the first two semesters)

Public speaking is a vital skill for leaders in any industry. We aim to train our postgraduate students in effective public speaking during their first two semesters. For this, we adopt the proven methods of the **Toastmasters Club**, which has an excellent framework for developing confident and impactful speakers.

Session **Format**
Each week, students gather in batches of 10–25 for a one-hour session. The structure is as follows:

- **Prepared Speeches**: Five students deliver speeches lasting between 5–7 minutes.
- **Evaluators**: Five students listen attentively and provide constructive feedback.
- **Role Assignments**:
    - *Ah-Counter*: Tracks the use of filler words (e.g., "ah," "um").
    - *Timekeeper*: Records the speaking time for each participant.
    - *Grammarian*: Notes grammatical errors and offers suggestions for improvement.

- *Toastmaster*: Hosts the session and introduces each speaker.

- **Table Topics Session**: Five students deliver impromptu speeches on topics prepared in advance by the Table Topics Master.

At the end of each session, the Grammarian presents a report of errors and suggestions for all speakers.

Program Outcomes

Over the course of two semesters, each student will:

- Deliver **ten prepared speeches**.
- Participate in **an equal number of impromptu speeches**.
- Serve in various evaluator and support roles.

This ensures every student has multiple opportunities to address an audience, receive feedback, and refine their public speaking skills.

Assessment & Recognition

- At the end of the semester, contests are held among 3–4 groups.
- A panel of judges assesses each student's ability to speak effectively before an audience.
- Continuous records of speeches and evaluations are maintained by group leaders.

Final evaluations are based on the quality, improvement, and delivery of all speeches over the two semesters.

Semester	**II**
Course Code	**CA 8125**
Course Title	**Information and Network Security**
Number of teaching hours per week	4
Total number of teaching hours per semester	60
Number of credits	4

Course Outcomes (COs)		
On successful completion of this course, the students will be able to:		
CO Number	**Course Outcome (CO) Statement**	**Bloom's Taxonomy Level**
CO1	Explain the fundamental concepts of computer networks, network architectures, and core security principles.	**L2 – Understand**
CO2	Apply cryptographic algorithms and techniques to achieve data confidentiality, integrity, and authentication in communication systems.	**L3 – Apply**

CO3	Design and evaluate secure network architectures and protocols that defend against common security threats.	**L5 – Evaluate**
CO4	Identify and analyze vulnerabilities in network systems, proposing appropriate mitigation or countermeasure strategies.	**L4 – Analyze**
CO5	Utilize modern security tools, protocols, and practices to manage and address real-world network security challenges.	**L3 – Apply / L4 – Analyze**

Unit	Course contents	Hours
I	**Fundamentals of Computer Networks and Security:** Basics of Computer Networks: OSI and TCP/IP models, types of networks (LAN, WAN, MAN), switching techniques. **Network Devices:** Routers, switches, firewalls, access points. **Introduction to Network Security:** CIA triad, types of attacks (active, passive), vulnerabilities, threats, and risks. **Security Mechanisms:** Authentication, access control, encryption, firewalls, intrusion detection systems. **Overview of Cybersecurity Frameworks:** NIST, ISO 27001.	14
II	**Cryptographic Principles and Algorithms:** Introduction to Cryptography: Symmetric and asymmetric cryptography, hash functions. **Classical Encryption Techniques:** Substitution and transposition ciphers. Symmetric Key Algorithms: DES, AES. Asymmetric Key Algorithms: RSA, Diffie-Hellman. **Hashing and Digital Signatures:** MD5, SHA family, and their applications.	12
III	**Network Security Protocols and Mechanisms:** Secure Communication Protocols: SSL/TLS, IPsec, HTTPS. **User Authentication:** Passwords, biometrics, multi-factor authentication. Email Security: S/MIME, PGP. **Wireless Network Security:** WEP, WPA, WPA2. **Security in Emerging Networks:** IoT security challenges and solutions.	10
IV	**Security in Web Applications and Systems:** Web Security Threats: SQL injection, cross-site scripting (XSS), cross-site request forgery (CSRF). Secure **Web Development Practices:** Input validation, secure coding. Security for Cloud Computing: Virtualization security, data protection in cloud environments. **Malware and Threats:** Types (viruses, worms, Trojans), anti-malware tools. **Incident Response:** Logging, monitoring, and recovery procedures.	12
V	**Emerging Trends and Case Studies in Information Security: Blockchain and Cryptocurrencies:** Overview, security aspects. Ethical Hacking and Penetration Testing: Tools and methodologies. **Case Studies:** Analysis of real-world security breaches. Security Auditing and Risk Management: Tools and best practices. Trends: AI in security, zero trust architecture, quantum cryptography.	12
Total		**60**

Text Book(s):

1. William Stallings, "Cryptography and Network Security: Principles and Practice", Pearson Education.
2. Behrouz A. Forouzan, "Data Communications and Networking", McGraw-Hill.

Reference Book(s):

1. AtulKahate, "Cryptography and Network Security", Tata McGraw-Hill.
2. Michael E. Whitman and Herbert J. Mattord, "Principles of Information Security", Cengage Learning.
3. Charlie Kaufman, Radia Perlman, and Mike Speciner, "Network Security: Private Communication in a Public World", Pearson Education.
4. Nina Godbole and SunitBelapure, "Cyber Security: Understanding Cyber Crimes, Computer Forensics, and Legal Perspectives", Wiley India.
5. Bruce Schneier, "Applied Cryptography", Wiley.

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Course Code: **CA 8125**

Course Title: **Information and Network Security**

Unit Number	Number of Hours	Total marks for which the questions are to be asked (including bonus questions)
Unit I	14	8
Unit II	12	8
Unit III	10	10
Unit IV	12	20
Unit V	12	20
Total	60	66
Maximum marks for the course (Excluding bonus questions) = 50)		

Semester	**II**
Course Code	**CA 8225**
Course Title	**Advanced Programming with Java**
Number of teaching hours per week	4
Total number of teaching hours per semester	60
Number of credits	4

Course Outcomes (COs)		
On successful completion of this course, the students will be able to:		
CO Number	**Course Outcome (CO) Statement**	**Bloom's Taxonomy Level**
CO1	Apply object-oriented principles such as encapsulation, inheritance, and polymorphism to design and implement Java applications using classes, interfaces, packages, arrays, and strings.	L3 – Apply

CO2	Develop reliable and concurrent Java programs by effectively handling exceptions, implementing multithreading, synchronization, and utilizing the Java Collections Framework.	L3 – Apply
CO3	Design and implement database-driven applications using JDBC, including transaction management, prepared statements, result sets, and stored procedure invocation.	L4 – Analyze
CO4	Create dynamic web applications using JSP and JSTL by understanding JSP life cycle, JSP elements, tag libraries, and session handling mechanisms.	L3 – Apply
CO5	Analyze and develop enterprise-level Java applications using EJB components, applying appropriate persistence mechanisms, annotations, dependency injection, and deployment descriptors.	L4 – Analyze

Unit	Course contents	Hours
I	**Classes and Objects:** Class Fundamentals – Variables and Constants, Constructors and Methods, Modifiers, this keyword, Objects – the new operator, reference variables. **Arrays and Strings:** Arrays in Java, Multidimensional Arrays, Using the Length Member, the For-Each Style for Loop. String class Fundamentals, The String Constructors, String class methods, StringBuffer and StringBuilder classes. **Inheritance:** Fundamentals, Forms of Inheritance and their implementation. **Polymorphism:** Method overloading and method overriding. **Abstract Classes, Interfaces and Packages:** Abstract Class – Fundamentals, Abstract Methods, creating and implementing abstract classes and methods, Inheritance with Abstract Classes, Interface – Fundamentals, Creating an Interface, implementing an Interface, Packages – creating a Package, importing a Package.	13
II	**Exception Handling:** Exception Handling Fundamentals, try…catch block, using Multiple catch clauses, throwing an Exception, the Throwable class, using throw, throws, finally, creating user-defined exceptions and their use. **Multithreaded Programming:** Multithreading fundamentals, Thread life cycle, creating a Thread - Thread Class and Runnable Interface, Creating Multiple Threads, Thread Priorities, Synchronization.	10
III	**JDBC & Transaction Management:** Introduction to JDBC API - JDBC Architecture - Types of JDBC Drivers - JDBC Classes & Interfaces: Driver, Connection, Statement, PreparedStatement, ResultSet and their relationship to provider implementations - Stored procedures and functions Invocation. **Introduction to RMI:** Understanding RMI Architecture-Working with RMI-Application Development with RMI-Created Distributed Application Development with RMI-Remote Object Activation Object Activation. RMI Security using SSL Bypassing.	13
IV	**Understanding of JSP and JSTL:** Understanding Javaserver Pages- Introducing JSP Technology-Understanding Page Life-Cycle-JSP Documents-JSP Elements- JSP Tag Extensions – Tag Libraries – Session Handling Mechanisms.	12
V	**Understanding EJB:** EJB Fundamentals – EJB Architecture - The EJB Interfaces - EJB Roles -Session Bean - Stateful versus Stateless Session Bean - Developing Session Bean. Entity Bean. Bean Managed Persistence and Container Managed Persistence in Entity Beans. - Deployment Descriptor - Annotations, Dependency Injection.	12
Total		**60**

Text Book(s): 1. Herbert Schildt, "Java: The Complete Reference", 8th Edition, Indian Edition, Oracle Press, McGraw- Hill. 2. Paul Deitel, Harvey Deitel, "Java How to Program", 8th Edition, PHI 3. Somnath Musib, Spring Boot in Practice, Manning Publications Co., 2022. 4. Kogent Learning Solutions Inc. "Java Server Programming (J2EE 1.7)" Black Book 2014 Platinum Edition.
Reference Book(s): 1. Cay Horstman, Gary Cornel, "Core Java: Fundamentals", 8th Edition, 2010, Pearson Asia. 2. Jana, Debashish, "Java and Object-Oriented Programming Paradigm", PHI Learning 3. Joyce Farrell, "Java For Beginners", Cengage Learning India 4. Rashmi Kanta Das, "Core Java for Beginners", Vikas Publishing House Pvt. Ltd. 5. Khalid A. Mughal, Rolf W. Rasmussen, "A Programmer's Guide to Java SCJP Certification", 3rd Edition, Pearson 6. Walter Savitch, "Java: An Introduction to Problem Solving and Programming", Pearson 7. "Java 7 Programming Black Book", Kogent Learning Solutions Inc., Dreamtech Press.

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Course Code: **CA 8225**

Course Title: **Advanced Programming with Java**

Unit Number	Number of Hours	Total marks for which the questions are to be asked (including bonus questions)
Unit I	13	8
Unit II	10	8
Unit III	13	10
Unit IV	12	20
Unit V	12	20
Total	60	66
Maximum marks for the course (Excluding bonus questions) = 50)		

Semester	**II**
Course Code	**CADE 8325**
Course Title	**Natural Language Processing (ELECTIVE I)**
Number of teaching hours per week	4
Total number of teaching hours per semester	60
Number of credits	4

Course Outcomes (COs)
On successful completion of this course, the students will be able to:

CO Number	Course Outcome (CO) Statement	Bloom's Taxonomy Level
CO1	Explain the fundamental concepts, scope, and applications of Natural Language Processing.	L2 – Understand
CO2	Analyze the capabilities and limitations of current NLP techniques and technologies.	L4 – Analyze
CO3	Apply linguistic theories and formal grammar models to represent and process natural language structures.	L3 – Apply
CO4	Design, implement, and test algorithms to solve specific NLP problems such as tagging, parsing, or information extraction.	L5 – Evaluate / L6 – Create
CO5	Apply NLP techniques to develop real-world applications like machine translation, text categorization, or summarization.	L3 – Apply / L6 – Create

Unit	Course contents	Hours
I	**Introduction to NLP and Preprocessing: Introduction:** History of NLP, Generic NLP system, levels of NLP, Knowledge in language processing, Ambiguity in Natural language, stages in NLP, Applications of NLP. Evaluation of NLP System. **Text Preprocessing:** Tokenization, Stemming and Lemmatization, Stopword removal, Text normalization. Regular Expressions and pattern matching for text manipulation. **Speech Processing:** Basics of Speech Recognition and Synthesis. **Basic English Concepts:** Introduction to CFG, Various Grammar-based Language Models, Sentence, Active and Passive voice, Dictionary Features.	12
II	**Core Techniques for Word and Syntax Analysis:** Word Level Analysis: Morphology analysis –survey of English Morphology, Inflectional morphology & Derivational morphology, Lemmatization, Regular expression, finite automata, finite state transducers (FST), Morphological parsing with FST, Lexicon free FST Porter stemmer. N–Grams-N-gram language model, N-gram for spelling correction. **Syntax Analysis:** Part-Of-Speech tagging (POS)- Tag set for English (Penn Treebank), Rule-based POS tagging, Stochastic POS tagging, Issues –Multiple tags & words, Unknown words. **Sequence labeling:** Hidden Markov Model (HMM), Maximum Entropy, and Conditional Random Field (CRF).	12
III	**Parsing Techniques and Transformer Architectures: Parsing Techniques:** Parsing Process, Algorithm, Efficient Parsing, Types of Parsing Techniques, Transition networks, Human Parsing, Feature Grammar, Parsing with Unification constraints, Parsing Integration and Unification, Prolog Grammar Parser Generator. **Advancements in NLP:** Introduction to Transformers and Attention Mechanisms. Overview of architectures like BERT, GPT, and their applications	12
IV	**Semantic Analysis and Word Representation: Semantic Analysis:** Lexical Semantics, Attachment for fragment of English- sentences, noun phrases, Verb phrases, prepositional phrases, Relations among lexemes & their senses – Homonymy, Polysemy, Synonymy, Hyponymy, WordNet, Robust Word Sense Disambiguation (WSD) Dictionary based approach Syntax Driven Semantic Analysis Approach.	12

	Word Representation: Word Embeddings: Word2Vec, GloVe, FastText, and Transformer embeddings. **Contextual embeddings:** Comparison with traditional models.	
V	**Innovations and Applications in NLP:** Knowledge Representation for NLP: Human Language Technology, Information Discovery, and Issues in Semantic Representation. **Natural Language Generation:** Architecture of NLG Systems- Generation Tasks and Representations- Application of NLG. **Machine Translation:** Challenges in Machine Translation, Characteristics of Indian Languages, Machine Translation Approaches-Statistical and Neural Machine Translation. **Pragmatics:** Discourse–reference resolution, reference phenomenon, syntactic & semantic constraints on coreference. **Conversational AI:** Building chatbots and dialogue systems using frameworks like Rasa or OpenAI API.	12
Total		**60**

Text Book(s):

1. Daniel Jurafsky and James H. Martin, "Speech and Language Processing", 2end Ed, 2014, Pearson Education.
2. James Allen, "Natural Language Understanding", 2nd edition. Bejamin Cummings publishing.

Reference Book(s):

1. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press.
2. Manning, Christopher and Heinrich, Schutze, "Foundations of Statistical Natural Language Processing", 2016, Create Space Independent Publishing Platform.
3. Jacob Eisenstein, "Introduction to Natural Language Processing",2019,MIT Press
4. Carol Genetti, "How Languages Work: An Introduction to Language and Linguistics, 2019, Cambridge University Press.

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Course Code: **CADE 8325**

Course Title: **Natural Language Processing (ELECTIVE I)**

Unit Number	Number of Hours	Total marks for which the questions are to be asked (including bonus questions)
Unit I	12	8
Unit II	12	8
Unit III	12	10
Unit IV	12	20
Unit V	12	20
Total	60	66
Maximum marks for the course (Excluding bonus questions) = 50)		

Semester	**II**
Course Code	**CADE 8425**
Course Title	**Image Processing and Pattern Recognition (ELECTIVE I)**
Number of teaching hours per week	4
Total number of teaching hours per semester	60
Number of credits	4

Course Outcomes (COs)

On successful completion of this course, the students will be able to:

CO Number	Course Outcome (CO) Statement	Bloom's Taxonomy Level
CO1	Demonstrate a deep understanding of image processing techniques in both spatial and frequency domains.	**L2 – Understand / L3 – Apply**
CO2	Develop skills to apply image enhancement and restoration techniques.	**L3 – Apply**
CO3	Analyze and implement segmentation, feature extraction, and representation methods.	**L4 – Analyze / L3 – Apply**
CO4	Understand and apply statistical and machine learning approaches to pattern recognition.	**L2 – Understand / L3 – Apply**
CO5	Solve real-world problems using modern image processing and pattern recognition techniques.	**L5 – Evaluate / L6 – Create**

Unit	Course contents	Hours
I	**Fundamentals of Digital Image Processing: Introduction to Digital Image Processing:** Historical development and applications of DIP. Components of an image processing system. **Digital Image Fundamentals:** Visual perception principles and image formation models. Sampling, quantization, and image resolution. Pixel relationships (neighborhoods, connectivity, adjacency). **Mathematical Preliminaries:** Linear and nonlinear operations. Basics of convolution and correlation. **Tools and Platforms for Image Processing:** (MATLAB/OpenCV Basics)	10
II	**Image Enhancement and Restoration: Image Enhancement in Spatial Domain:** Point operations (gray-level transformations). Histogram processing and equalization. Spatial filtering techniques (smoothing and sharpening). **Image Enhancement in Frequency Domain:** Fourier transform and discrete Fourier transform (DFT). Frequency domain filters (low-pass, high-pass, bandpass). **Image Restoration:** Image degradation/restoration process. Noise models (Gaussian, impulse, etc.). Wiener and inverse filtering techniques.	12
III	**Image Segmentation and Feature Extraction:** Image Segmentation Techniques: Edge detection (Sobel, Canny). Thresholding (global, adaptive, Otsu's method). Region-based segmentation (region growing, region splitting/merging). **Feature Extraction and Dimensionality Reduction:** Corner detection (Harris), texture features (GLCM). SIFT, SURF, HOG, and Gabor filters. PCA and LDA for feature	13

	reduction. **Image Representation:** Boundary descriptors (perimeter, compactness). Regional descriptors (moments, textures).	
IV	**Pattern Recognition Basics: Introduction to Pattern Recognition:** Components of a pattern recognition system. Supervised vs. unsupervised learning. Feature space, feature selection, and dimensionality. **Statistical Pattern Recognition:** Parametric classification (Bayes classifier). Non-parametric techniques (k-NN, Parzen window). **Unsupervised Learning Methods:** Clustering techniques (k-means, hierarchical clustering). Evaluation metrics for clustering.	13
V	**Advanced Pattern Recognition and Applications: Fuzzy and Syntactic Pattern Recognition:** Fuzzy logic in pattern classification. Fuzzy clustering (FCM). Grammar-based syntactic pattern recognition. **Performance Evaluation:** Risk, error probabilities, and ROC curves. Accuracy, precision, recall, F1 score. **Applications of Pattern Recognition:** Face recognition, object detection, and character recognition. Medical imaging, remote sensing, and biometrics.	12
Total		**60**

Text Book(s):

1. Rafael C. Gonzalez and Richard E. Woods: "Digital Image Processing", 4th Edition, Pearson, 2018.
2. Sergios Theodoridis, Konstantinos Koutroumbas: "Pattern Recognition", 5th Edition, Academic Press, 2018.

Reference Book(s):

1. Milan Sonka, Vaclav Hlavac, Roger Boyle: "Image Processing, Analysis, and Machine Vision", 4th Edition, Cengage Learning, 2014.
2. Christopher M. Bishop: "Pattern Recognition and Machine Learning", Springer, 2016.
3. Richard O. Duda, Peter E. Hart, David G. Stork: "Pattern Classification", 2nd Edition, Wiley, 2012.
4. Scott E. Umbaugh: "Digital Image Processing and Analysis", 3rd Edition, CRC Press, 2017.

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Course Code: **CADE 8425**

Course Title: **Image Processing and Pattern Recognition (ELECTIVE I)**

Unit Number	Number of Hours	Total marks for which the questions are to be asked (including bonus questions)
Unit I	10	8
Unit II	12	8
Unit III	13	10
Unit IV	13	20
Unit V	12	20
Total	60	66
Maximum marks for the course (Excluding bonus questions) = 50)		

Semester	**II**
Course Code	**CADE 8525**
Course Title	**Big Data Analytics (ELECTIVE II)**
Number of teaching hours per week	4
Total number of teaching hours per semester	60
Number of credits	4

Course Outcomes (COs)

On successful completion of this course, the students will be able to:

CO Number	Course Outcome (CO) Statement	Bloom's Taxonomy Level
CO1	Understand the fundamental concepts of Big Data and Big Data Analytics.	L2 – Understand
CO2	Understand and apply the concepts of NoSQL for Big Data Analytics.	L2 – Understand and L3 – Apply
CO3	Understand and apply the concepts of Hadoop for Big Data Analytics.	L2 – Understand and L3 – Apply
CO4	Create applications using MAPREDUCE in Big Data Analytics.	L6 – Create
CO5	Understand and apply HIVE and PIG for Big Data Analytics.	L2 – Understand and L3 – Apply

Unit	Course contents	Hours
I	**Introduction to big data: Data, Characteristics of data, and Types of digital data:** Sources of data, Working with unstructured data, Evolution and Definition of big data, Characteristics and Need of big data, Challenges of big data. **Big data analytics:** Overview of business intelligence, Data science and Analytics, Meaning and Characteristics of big data analytics, Need of big data analytics, Classification of analytics, Challenges to big data analytics, Importance of big data analytics, Basic terminologies in big data environment.	11
II	**NoSQL Data Management:** Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models; relationships, graph databases, schemaless databases, materialized views, distribution models, sharding; master-slave replication; peer-peer replication; sharding and replication; consistency; relaxing consistency; version stamps; Case studies using MongoDB.	12
III	**Introduction to Hadoop:** Introducing Hadoop, need of Hadoop, limitations of RDBMS, RDBMS versus Hadoop, Distributed Computing Challenges, History of Hadoop, Hadoop Overview, Use Case of Hadoop, Hadoop Distributors, HDFS (Hadoop Distributed File System), Types of files in HDFS- Strengths and alternatives of HDFS, Block System- Read-write Process for data, Processing Data with Hadoop, Managing Resources and Applications with Hadoop YARN (Yet another Resource Negotiator), Interacting with Hadoop Ecosystem.	13

IV	**Introduction to MAPREDUCE Programming:** Introduction, Sample MapReduce application: Wordcount- MapReduce Data types and Formats, Writing MapReduce Programming, Testing MapReduce Programs- MapReduce Job Execution- Shuffle and Sort, Managing Failures- Progress and Status Updates. Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression, Real-time applications using MapReduce, Data serialization, and working with common serialization formats, Big data serialization formats.	12
V	**Introduction to Hive:** Introduction to Hive, Hive Architecture, Hive Data Types, Hive File Format, Hive Query Language (HQL), User-Defined Function (UDF) in Hive. Hive Architecture- Components- Data Definition- Partitioning- Data Manipulation- Joins, Views and Indexes, Hive Execution. **Introduction to Pig:** Introduction to Pig, Pig Architecture- Pig Latin Data Model- Latin Operators- Loading Data - Diagnostic Operators. The Anatomy of Pig, Pig on Hadoop, Pig Philosophy, **Use Case for Pig:** ETL Processing, Group Operators- Pig Joins- Row Level Operators- Pig Built-in functions- User-defined functions- Pig Scripts. Data Types in Pig, Running Pig, Execution Modes of Pig, HDFS Commands, Relational Operators, Piggy Bank, Word Count Example using Pig, Pig at Yahoo!, Pig versus Hive	12
Total		**60**

Text Book(s):

1. Seema Acharya, Subhashini Chellappan, "Big Data and Analytics", 1st Edition, 2015, Wiley International
2. S. Mohanthy, Madhu Jagadish, Harsh Srivatsa, "Big Data Imperatives: Enterprise Big Data Warehouse, BI Implementations and Analytics", 1st Edition, 2015, Wiley Apress

Reference Book(s):

1. Jey Liebowitz, "Big Data and Business Analytics", 1st Edition, 2014, CRC Press
2. Tom White, "Hadoop – Definitive Guide", 1st Edition, 2015, O'Reilly Publishers
3. Boris Lublinsky, Kevin t. Smith, Alexey Yakubovich, "Professional Hadoop Solutions",1st Edition, 2015, Wiley India Publications.
4. E Caprilo, Dean Wampler, "Hive Programming", 1st Edition, 2015, O'Reilly Publishers
5. Sherif Sakr, "Large Scale and Big Data: Processing and Management", 2014, CRC Press.

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Course Code: **CADE 8525**

Course Title: **Big Data Analytics (ELECTIVE II)**

Unit Number	Number of Hours	Total marks for which the questions are to be asked (including bonus questions)
Unit I	11	8
Unit II	12	8
Unit III	13	10
Unit IV	12	20
Unit V	12	20
Total	60	66
Maximum marks for the course (Excluding bonus questions) = 50)		

Semester	**II**
Course Code	**CADE 8625**
Course Title	**Data Science (ELECTIVE II)**
Number of teaching hours per week	4
Total number of teaching hours per semester	60
Number of credits	4

Course Outcomes (COs)		
On successful completion of this course, the students will be able to:		
CO Number	**Course Outcome (CO) Statement**	**Bloom's Taxonomy Level**
CO1	Apply data management techniques to efficiently store, organize, and retrieve large datasets.	L3 – Apply
CO2	Use statistical methods and data visualization techniques to explore and summarize datasets.	L3 – Apply
CO3	Analyze datasets using statistical and computational models to make data-driven predictions and decisions.	L4 – Analyze
CO4	Implement and optimize data-intensive computations using distributed and cloud computing frameworks.	L5 – Evaluate / L6 – Create
CO5	Communicate the results of data analysis effectively using descriptive statistics, visualizations, and reports.	L3 – Apply / L4 – Analyze

Unit	**Course contents**	**Hours**
I	**Data Science:** Data science process – roles, stages in data science project; working with data from files; working with relational databases; exploring data, managing data, cleaning and sampling for modeling and validation, introduction to NoSQL. **Data Analytics Life Cycle:** Introduction to Big data Business Analytics; State of the practice in analytics role of data scientists; Key roles for successful analytic project; Main phases of life cycle - Developing core deliverables for stakeholders.	10
II	**Data Mining:** Introduction -Data mining task. Data Preprocessing: Descriptive Data Summarization - Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization. Data visualization **Association Rule Mining:** Basic concepts – Market basket analysis Scalable Frequent Itemset Mining Methods – Improving efficiency – Mining various kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-based Association Mining.	10
III	**Feature selection:** Introduction-Steps in feature selection-Principal-component analysis for feature reduction. **Ensemble learning:** Introduction-Ensemble-learning framework-Supervised ensemble learning-Unsupervised ensemble learning-Semi-supervised ensemble learning-Issues and challenges.	12

	Machine learning: Introduction-Machine Learning paradigms-Inductive bias-Evaluating a classifier	
IV	**Regression:** Introduction-Regression-Evaluating linear regression-Multidimensional linear regression-Polynomial regression-Overfitting in regression-Reducing overfitting in regression: regularization **Classification:** Basic concepts – Decision tree induction - Bayes classification methods – Rule based classification – Support Vector Machine. **Predictive Analytics:** Simple linear regression: Coefficient of determination, Significance tests, Residual analysis, Confidence and Prediction intervals; **Multiple linear regression:** Coefficient of determination, Interpretation of regression coefficients, Categorical variables, outliers, Regression Model Building; **Logistic and Multinomial Regression:** Logistic function, Estimation of probability using logistic regression.	15
V	**Data Science in practice:** Need of Data Science in the real world, Hands-on Data Science with Python, Dataset preprocessing, Feature selection and normalization, Classification, Clustering. **Hypothesis testing:** Null and alternate hypotheses; Types of errors, Level of significance, Power of a test, ANOVA; Test for goodness of fit. **Forecasting:** Moving average, Exponential smoothing, Casual Models. **Application of predictive analytics** in retail, direct marketing, health care, financial services, insurance, supply chain, etc.	13
Total		**60**

Text Book(s):

1. Jugal K. Kalita, Dhruba K. Bhattacharyya, Swarup Roy, Fundamentals of Data Science: Theory and Practice, Academic Press-Elsevier, 2024.
2. Nina Zumel, John Mount, "Practical Data Science with R", Manning Publications, 2014.
3. Jain Pei, Jiawei Han, Micheline Kamber, "Data Mining : Concepts and Techniques", 3rd Ed, 2011, Elsevier
4. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", 2nd Edition, 2011, Springer Series in Statistics.
5. Daniel T. Larose, Chantal D. Larose "Data Mining and Predictive Analytics", 2nd Ed, 2016, John Wiley & Sons Inc.,

Reference Book(s):

1. Ken Black, "Applied BUSINESS STATISTICS Making better business decisions", 7th Ed, 2016, John Wiley & Sons Inc.,
2. R N Prasad, Seema Acharya, "Fundamentals of Business Analytics", 1st Ed, 2011, Wiley India
3. Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, Abhijit Dasgupta, "Practical Data Science Cookbook", 1st Ed, 2014, Packt Publishing Ltd..
4. Nathan Yau, "Visualize This: The Flowing Data Guide to Design, Visualization", 2011, Wiley
5. Daniel T. Larose, "Discovering Knowledge in Data: An Introduction to Data Mining", 2011, Wiley Intl
6. Thomas W Miller, "Modeling Techniques in Predictive Analytics", 1st Ed, 2013, Pearson
7. Peter Adrians, Rolf Zantinge, "Data Mining", 1st Edition, 2010, Pearson Education
8. Vikram Pudi, Radhakrishna, "Data Mining", 2nd Edition, 2011, Oxford University Press.
9. Richard Roiger, Michael Getz, "Data Mining : A Practical Based Primer", 1st Ed, 2010, Pearson
10. Arun K Pujari, "Data Mining Techniques", 2nd Ed, 2013, University Press

BLUEPRINT

Course Code: **CADE 8625**

Course Title: **Data Science (ELECTIVE II)**

Unit Number	Number of Hours	Total marks for which the questions are to be asked (including bonus questions)
Unit I	10	8
Unit II	10	8
Unit III	12	10
Unit IV	15	20
Unit V	13	20
Total	60	66
Maximum marks for the course (Excluding bonus questions) = 50)		

Semester	**II**
Course Code	**CA 8725**
Course Title	**Internet of Things**
Number of teaching hours per week	4
Total number of teaching hours per semester	60
Number of credits	4

Course Outcomes (COs)

On successful completion of this course, the students will be able to:

CO Number	Course Outcome (CO) Statement	Bloom's Taxonomy Level
CO1	Understand IoT networking core, communication protocols, and enabling technologies.	Understand (Comprehension)
CO2	Differentiate IoT and M2M, apply IoT design methodology, and integrate devices and components.	Apply (Application)
CO3	Analyze IoT data link, network, transport, and session layer protocols for efficient communication.	Analyze (Analysis)
CO4	Design and develop IoT applications using Python, Raspberry Pi, and other IoT devices while considering UX and device constraints.	Create (Synthesis)
CO5	Apply IoT knowledge to case studies, advanced applications, and industry-oriented solutions using sensors, embedded boards, and platforms.	Apply (Application)
CO6	Engage in self-learning by exploring sensors, microcontroller boards, and coding to implement practical IoT projects.	Create / Evaluate (Lifelong Learning & Application)

Unit	Course contents	Hours
I	**The IoT Networking Core:** Technologies involved in IoT Development: Internet/Web and Networking Basics OSI Model, Data transfer referred with OSI Model, IP Addressing, Point to Point Data transfer, Point to Multi Point Data transfer & Network Topologies, Sub-netting, Network Topologies referred with Web, Introduction to Web Servers, IoT Communication APIs, IoT Enabling Technologies- Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems, IoT Levels & Deployment Templates.	11
II	**IoT and M2M:** Introduction, M2M, Difference between IoT and M2M, SDN and NFV for IoT, Software Defined Networking, Network Function Virtualization, IoT Platform Design Methodology, Introduction, IoT Design Methodology, Step1: Purpose and requirement specification, Step2: Process Specification, Step 3: Domain Model Specification, Step 4: Information Model Specification, Step 5: Service Specification, Step 6: IoT Level Specification, Step 7: Function View Specification, Step 8: Operational View Specification, Step 9: Device and Component Integration, Step 10: Application Development, IoT System	13
III	**IOT Data Link Layer and Protocols:** PHY/MAC Layer (3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART, Z-Wave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH, ND, DHCP, ICMP, RPL, CORPL, CARP Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)- (TLS, DTLS) – Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT	10
IV	**User Experience Design and the Technology of Connected devices:** UX for IoT Different, Design model for IoT. Logical Design-Functions, Modules, Packages, File Handling, Date Time applications, Classes, Python Packages of Interest for IoT. IoT Physical Devices and End Points: What is an IoT Device, Exemplary Device Raspberry Pi, About the Board, Linux on Raspberry Pi, Raspberry pi interfaces, programming raspberry pi with python, other IoT devices. Bridging physical and digital: sensors and actuators, the challenge of powering devices, conserving battery life	13
V	**Case Study & advanced IoT Applications:** IoT applications in home, infrastructures, buildings, security, Industries, Home appliances, other IoT electronic equipments. Use of Big Data and Visualization in IoT, Industry 4.0 concepts. Sensors and sensor Node and interfacing using any Embedded target boards. Various IoT platforms. **SELF-LEARNING COMPONENT:** Various sensors available in market – application of various sensor – Their specifications – code used to connect these sensors into Microcontroller board – Various microcontroller boards available in market – Arduino IDE download – usage of this IDE to carryout projects.	13
Total		**60**

Text Book(s):

1. Arshdeep Bahga, Vijay audisetti, Internet of Things," A Hands on Approach", University Press, 2014. 2.
2. Michael Millen, "The Internet of Things", Pearson, 2015.
3. Adrian McEwen & Hakim Cassimally, "Designing the Internet of Things", ISBN 978-81-265-5686-1 Wiley Publication, 2013
4. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", 1st Edition, 2016, Willy Publications

Reference Book(s): SWAYAM/NPTEL/MOOCS

1. https://www.udemy.com/ Internet of Things
2. https://www.coursera.org/learn/ Internet of Things
3. https://nptel.ac.in/courses/106106133/

BLUEPRINT

Course Code: **CA 8725**

Course Title: **Internet of Things**

Unit Number	Number of Hours	Total marks for which the questions are to be asked (including bonus questions)
Unit I	11	8
Unit II	13	8
Unit III	10	10
Unit IV	13	20
Unit V	13	20
Total	60	66
Maximum marks for the course (Excluding bonus questions) = 50)		

Practical IV

Course Code and Title: CA 8P125 - Advanced Java Lab

(3 hours/11 sessions)

CO Number	Course Outcome (CO) Statement	Bloom's Taxonomy Level
CO1	Apply object-oriented principles such as encapsulation, inheritance, and polymorphism to design and implement Java applications using classes, interfaces, packages, arrays, and strings.	L3 – Apply
CO2	Develop reliable and concurrent Java programs by effectively handling exceptions, implementing multithreading, synchronization, and utilizing the Java Collections Framework.	L3 – Apply
CO3	Design and implement database-driven applications using JDBC, including transaction management, prepared statements, result sets, and stored procedure invocation.	L4 – Analyze
CO4	Create dynamic web applications using JSP and JSTL by understanding JSP life cycle, JSP elements, tag libraries, and session handling mechanisms.	L3 – Apply
CO5	Analyze and develop enterprise-level Java applications using EJB components, applying appropriate persistence	L4 – Analyze

	mechanisms, annotations, dependency injection, and deployment descriptors.	

Ex. No	List of Exercises
1	**Classes, Objects, Arrays, Strings, Inheritance, Polymorphism, Packages & Interfaces** Write a Java program to define a class with variables, constants, constructors, and methods, demonstrating access modifiers, use of the this keyword, object creation using new, and reference variables.
2	Develop a Java program to store, search, and process data using single-dimensional and multidimensional arrays, making use of the length member and for-each loop.
3	Write a Java program to demonstrate String class constructors and commonly used String methods, and compare the mutability and performance of String, StringBuffer, and StringBuilder.
4	Implement a Java program demonstrating inheritance and polymorphism, including method overloading (compile-time polymorphism) and method overriding (run-time polymorphism).
5	**Exception Handling and Multithreading** Write a Java program to demonstrate exception handling using try–catch blocks, multiple catch clauses, and the finally block.
6	Create a user-defined exception class and write a program illustrating the use of throw, throws, and the Throwable class.
7	Develop a Java program to create threads using both the Thread class and the Runnable interface, and demonstrate the thread life cycle.
8	Develop a Java program using Multithreading to solve real-world problems.
9	**JDBC, Transaction Management & RMI** Write a Java program to establish a JDBC connection with a database and perform CRUD operations using Statement.
10	Develop a JDBC application using PreparedStatement to execute parameterized queries and ensure secure database access.
11	Implement transaction management in JDBC, demonstrating the use of commit() and rollback() operations.
12	Develop a simple RMI-based distributed application, demonstrating communication between client and server using remote method invocation.
13	**JSP and JSTL** Create a basic JSP page to display dynamic content using JSP scripting elements.
14	Write a JSP program to demonstrate the JSP life cycle, including initialization and destruction phases.
15	Develop a web application using JSTL core tags (c:if, c:forEach) for conditional processing and iteration.
16	Implement session handling in JSP using session objects, cookies, URL rewriting, or hidden form fields.
17	**Enterprise Java Beans (EJB)** Write a program explaining EJB architecture and roles, illustrating the interaction between client, container, and enterprise beans.
18	Develop and deploy a stateless session bean and a stateful session bean, and compare their behavior.

19	Implement a session bean application using annotations and dependency injection.
20	Create an entity bean demonstrating Bean Managed Persistence (BMP) or Container Managed Persistence (CMP) using deployment descriptors and annotations.

Practical V

Course Code and Title: CADE 8P225 - Natural Language Processing Lab

(ELECTIVE I)

(3 hours/11 sessions)

CO Number	Course Outcome (CO) Statement	Bloom's Taxonomy Level
CO1	Explain the fundamental concepts, scope, and applications of Natural Language Processing.	L2 – Understand
CO2	Analyze the capabilities and limitations of current NLP techniques and technologies.	L4 – Analyze
CO3	Apply linguistic theories and formal grammar models to represent and process natural language structures.	L3 – Apply
CO4	Design, implement, and test algorithms to solve specific NLP problems such as tagging, parsing, or information extraction.	L5 – Evaluate / L6 – Create
CO5	Apply NLP techniques to develop real-world applications like machine translation, text categorization, or summarization.	L3 – Apply / L6 – Create

Ex. No	List of Exercises
1	Implement text tokenization, stemming, lemmatization, and stopword removal using Python libraries such as NLTK or SpaCy.
2	Perform text normalization and regular expression-based pattern matching for text manipulation.
3	Implement a menu driven program for basic speech-to-text and text to speech using libraries like Google Speech Recognition API or SpeechRecognition in Python.
4	Create a menu driven program to convert sentences between active and passive voice automatically.
5	Develop a grammar correction tool that identifies and corrects grammatical errors in English sentences.
6	Implement morphological parsing using finite state transducers (FST).
7	Develop a lexicon-free morphological analyzer using the Porter stemmer algorithm.
8	Use the N-gram model for spelling correction and word prediction.
9	Implement a rule-based POS tagging system for English text.
10	Develop a stochastic POS tagging system using Hidden Markov Models (HMM).
11	Create a program to construct and visualize a context-free grammar (CFG) for simple English sentences.
12	Design a program to perform Word Sense Disambiguation (WSD) using dictionary-based approaches.
13	Build a basic Natural Language Generation (NLG) system for generating simple sentences.

14	Develop an application to translate text from English to another language using rule-based or statistical machine translation techniques.
15	Implement extractive summarization techniques using Python libraries.
16	Project Work: Apply multiple NLP techniques to solve a real-world problem.

Practical VI

Course Code and Title: CADE 8P325 - Image Processing Lab (ELECTIVE I)

(3 hours/11 sessions)

CO Number	Course Outcome (CO) Statement	Bloom's Taxonomy Level
CO1	Demonstrate a deep understanding of image processing techniques in both spatial and frequency domains.	**L2 – Understand / L3 – Apply**
CO2	Develop skills to apply image enhancement and restoration techniques.	**L3 – Apply**
CO3	Analyze and implement segmentation, feature extraction, and representation methods.	**L4 – Analyze / L3 – Apply**
CO4	Understand and apply statistical and machine learning approaches to pattern recognition.	**L2 – Understand / L3 – Apply**
CO5	Solve real-world problems using modern image processing and pattern recognition techniques.	**L5 – Evaluate / L6 – Create**

Ex. No	List of Exercises
1	**Image Representation and Basic Operations:** Read, display, and save images; perform pixel-level operations, resizing, rotation, and transformations using Python.
2	**Gray-Level Transformations:** Implement contrast stretching, logarithmic, power-law, and negative transformations on images.
3	**Image Quantization:** Simulate image quantization by reducing bits per pixel and analyze visual degradation using Python.
4	**Spatial Domain Filtering:** Apply smoothing filters (mean, median, Gaussian) and sharpening filters (Laplacian, high-pass) for noise reduction and enhancement.
5	**Frequency Domain Filtering:** Perform Fourier Transform and inverse Fourier Transform; apply Homomorphic filtering to correct uneven lighting and enhance contrast.
6	**Image Restoration:** Simulate image degradation (motion blur, Gaussian noise) and restore images using Wiener filtering and inverse filtering techniques.
7	**Edge Detection:** Implement edge detection algorithms like Sobel, Prewitt, Roberts, and Canny.
8	**Thresholding for Image Segmentation:** Perform global thresholding (Otsu's method) and adaptive thresholding for segmenting images.
9	**Region-Based Segmentation:** Implement region-growing and splitting-merging algorithms for image segmentation.

10	**Feature Extraction:** Extract features using GLCM and SIFT methods with OpenCV.
11	**Classification Techniques:** Implement K-Nearest Neighbors (KNN) and Support Vector Machines (SVM) for image classification and evaluation performance.
12	**Bayesian Classifier and Performance Evaluation:** Implement a Bayesian classifier and evaluate using accuracy, precision, recall, F1-score, and confusion matrix.
13	**Clustering Algorithms:** Apply unsupervised clustering algorithms like K-Means and hierarchical clustering for segmenting image data.
14	**Applications of Pattern Recognition:** Implement real-world applications like OCR, face recognition, or object detection and localization using Haar cascades or pre-trained models.
15	**Fuzzy Logic for Pattern Recognition:** Implement fuzzy classification where objects can belong to multiple classes with varying degrees of membership.
16	**Noise Removal and Image Enhancement:** Apply noise removal techniques like Gaussian, median, and bilateral filters to enhance image quality.

Practical VII

Course Code and Title: CADE 8P425 - Big Data Analytics Lab (ELECTIVE II)

(3 hours/11 sessions)

CO Number	Course Outcome (CO) Statement	Bloom's Taxonomy Level
CO1	Understand the fundamental concepts of Big Data and Big Data Analytics.	L2 – Understand
CO2	Understand and apply the concepts of NoSQL for Big Data Analytics.	L2 – Understand and L3 – Apply
CO3	Understand and apply the concepts of Hadoop for Big Data Analytics.	L2 – Understand and L3 – Apply
CO4	Create applications using MAPREDUCE in Big Data Analytics.	L6 – Create
CO5	Understand and apply HIVE and PIG for Big Data Analytics.	L2 – Understand and L3 – Apply

Ex. No	List of Exercises
1	**MongoDB Basics – Database & Collection Creation** (i) Create a database (ii) Create a collection (iii) Insert a single document with at least five fields of different types of values (iv) Insert many documents with at least five fields of different types of values (v) Display all documents in the collection
2	**MongoDB – CRUD (Create, Read, Update, Delete) Operations** (i) Insert a single document with at least five fields of different types of values (ii) Insert many documents with at least five fields of different types of values (iii) Display the documents that satisfy the given predicate (iv) Update the documents that satisfy the given predicate

	(v) Delete the documents that satisfy the given predicate
3	**Querying with Conditions and Projections (Use filters and field selection)**
4	**Aggregation Framework:** Perform data analysis using aggregation. Execute Aggregation Pipeline and its operations (pipeline must contain $match, $group, $sort, $project, $skip, etc. Students are encouraged to execute several queries to demonstrate various aggregation operators.)
5	**Demonstrate creation of different types of indexes on a collection (unique, sparse, compound and multikey indexes)**
6	**HDFS Basic File and Directory Operations** (i) Create a directory (ii) List all files and directories under that directory (iii) Upload a local text file input.txt to that directory (iv) Display the contents of input.txt stored in HDFS (v) Delete the file input.txt from HDFS
7	**File Management and Permissions** (i) Copy a file from one HDFS directory to another (ii) Move a file from /user/training/data to /user/training/backup (iii) Change file permissions to **read-only** for all users (iv) Change ownership of a file to a different user (v) Check disk usage of /user/training
8	**File Analysis Using Hadoop Commands** (i) Upload a large text file logs.txt to HDFS (ii) Count the number of lines, words, and characters in logs.txt (iii) Display the first 10 lines of the file (iv) Search for all lines containing the word "ERROR" (v) Store the search result in a new HDFS file
9	**Replication and File Status Management** (i) Check the replication factor of a file (ii) Change the replication factor to **3** (iii) Display detailed file information including block size and permissions (iv) Check HDFS health using admin commands (v) Safely remove an HDFS directory
10	**Word Count Program** (i) Write a MapReduce program using Java to count the frequency of each word in a large text file. (ii) Input: Text file stored in HDF
11	**Matrix Multiplication Program** (i) Write a MapReduce program using Java to multiply two matrices **A (m×n)** and **B (n×p)**. (ii) Input: MatrixA.txt and MatrixB.txt stored in HDFS
12	**Transaction Average Program** (i) Write a MapReduce program to compute the Transaction Average using Java. (ii) Input: Transactions.txt stored in HDFS
13	Create a Hive table with a sample dataset (e.g., employee data) and perform queries to filter, group, and aggregate data using Hive Query Language (HQL).
14	Use Hive to partition a dataset (e.g., sales data by region and date) and query specific partitions. Demonstrate the performance difference with and without indexing.

15	Write a Pig script to load a large dataset (e.g., weather data), perform ETL operations, and calculate average values (e.g., temperature or rainfall) using group operators and built-in functions.

Practical VIII

Course Code and Title: CADE 8P525 - Data Science Lab (ELECTIVE II)

(3 hours/11 sessions)

CO Number	Course Outcome (CO) Statement	Bloom's Taxonomy Level
CO1	Apply data management techniques to efficiently store, organize, and retrieve large datasets.	L3 – Apply
CO2	Use statistical methods and data visualization techniques to explore and summarize datasets.	L3 – Apply
CO3	Analyze datasets using statistical and computational models to make data-driven predictions and decisions.	L4 – Analyze
CO4	Implement and optimize data-intensive computations using distributed and cloud computing frameworks.	L5 – Evaluate / L6 – Create
CO5	Communicate the results of data analysis effectively using descriptive statistics, visualizations, and reports.	L3 – Apply / L4 – Analyze

Ex. No	List of Exercises
1	Implementation of Descriptive and Inferential statistics on any dataset from the popular data sources.
2	Implementation of data preprocessing techniques such as data cleaning, data reduction, data transformation, normalization, and data integration on any dataset from the UCI repository.
3	Implement the various regression techniques on any appropriate dataset from the popular data repositories, evaluate them by their assessment metrics and visualise the evaluation results as graphs.
4	Implement the various classification techniques on any appropriate dataset from the popular data repositories, evaluate them by their assessment metrics, and visualise the evaluation results as graphs.
5	Implement the various Hypothesis testing on any appropriate dataset from the popular data repositories.
6	Implement the various Feature Selection techniques on any appropriate dataset from the popular data repositories.
7	Implement the various cluster analysis techniques for any appropriate dataset from the popular data repositories.
8	Implement the various Association-rule mining techniques on any appropriate dataset from the popular data repositories, evaluate them by their assessment metrics, and visualize the evaluation results as graphs.
9	Use the diabetes data set from UCI and Pima Indians Diabetes data set for performing the following: (i) Univariate analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis. (ii) Bivariate analysis: Linear and logistic regression modeling

	(iii) Multiple Regression analysis (iv) Also compare the results of the above analysis for the two data sets
10	Apply and explore various plotting functions on UCI data sets. (i) Normal curves (ii) Density and contour plots (iii) Correlation and scatter plots (iv) Histograms (v) Three-dimensional plotting

Semester	**III**
Course Code	**CA 9125**
Course Title	**Agile Software Engineering**
Number of teaching hours per week	4
Total number of teaching hours per semester	60
Number of credits	4

Course Outcomes (COs)

On successful completion of this course, the students will be able to:

CO Number	Course Outcome (CO) Statement	Bloom's Taxonomy Level
CO1	Explain Agile principles, values, terminology, and the need for Agile approaches in software development.	**Understand (L2)**
CO2	Compare and evaluate different Agile methodologies and select appropriate practices for given project scenarios.	**Evaluate (L5)**
CO3	Apply Agile requirements engineering techniques, iterative planning, and stakeholder role management in software projects.	**Apply (L3)**
CO4	Demonstrate Agile project planning, estimation, communication, and time management techniques for effective project execution.	**Apply (L3)**
CO5	Implement Agile quality assurance and testing practices, including test-driven development and Agile testing principles, to ensure software quality.	**Apply (L3)**

Unit	Course contents	Hours
I	**Introduction:** Why Agile? Agile core terminology; Agile Principles; Development in Agile; Advantages; Disadvantages; Agile methods - Rational Unified Process, Scrum, Crystal Clear, Extreme Programming, Adaptive Software Development, Feature Driven Development, and Dynamic Systems Development Method (DSDM); Benefits of Agile; **Software Development:** Product Development; Iterative Development; Iterative Planning – Risk Driven and Client Driven; DSDM - Requirements, principles;	13

	Extreme Programming(XP) - supporting practices, Feature Driven Development (FDD) - basic activities.	
II	**Agile and Its Significance:** The Agile Manifesto and Principles; Agile software development; incremental model; iteration planning; iterative model; Agile software development approaches; Attributes of Agile Requirements; Quality of Agile Requirements; Requirements Engineering in Agile Software Development - Success Factors, Risk Factors; **Roles for Agile Requirements Engineering**: The Stakeholders, Product Owner, Development Team, Scrum Master, Project Stakeholder, Requirements Manager, Scrum Master, System Stakeholder, Team Member - Common Agile Roles	13
III	**Agile Methodology:** Method overview; Lifecycle – Work products, Roles and Practices values, common mistakes and misunderstanding; Adaptive Software Development – Principle, lifecycle phases, Characteristics; Comparison of agile methods; Sample projects, Process Mixtures; **Agile Project Planning:** Gathering User Documents; Estimation; Agile Planning; Iteration Management; Creating an Agile Communication Plan; Visual Workspace	10
IV	**Creating Agile Software:** Time – Time related problems in Software Projects, Time Management of Agile Project – Time Measurements, Prioritizing Development Tasks, Planning Activities; Measures – Measure Definition, Measure Illustration, Case study – Monitoring a Large-Scale Project by measures; Quality – The Agile approach to Quality Assurance, Process Quality, Product Quality, Test-Driven development; **Agile Testing:** Test Plan for Agile, Agile Testing Strategies, The Agile Testing Quadrant, QA challenges with agile software development, Risk of Automation in Agile Process, Advantages of Agile Testing, Disadvantages of Agile Testing, Principles of Agile Testing	14
V	**Agile Practicing and Testing:** Project Management, Environment, Requirements, Test, The agile alliances, The Manifesto, Supporting the Values, Agile Testing, Nine Principles and Six concrete practices for testing on agile teams.	10
Total		**60**

Text Book(s):

1. Craig Larman, "Agile and Iterative Development - A Manager's Guide", Pearson Education.
2. Lisa Crispin, Janet Gregory, Mike Cohn, Brain Marick, "Agile Testing: A Practical guide for Testers and Agile Teams", Addison-wesley publication.

Reference Book(s):

1. Jonathan Rasmusson, "The Agile Samurai – How Agile Masters Deliver Great Software", Shroff publishers and distributors Pvt. Ltd. July 2016.
2. Hazzan and Dubinsky, "Agile Software Engineering, Series: Topics in Computer Science" Springer 2009.
3. Robert C. Martin, "Agile Software Development, Principles, Patterns and Practices", 1st edition, PHI.
4. Alistair, "Agile Software Development Series", Cockburn Publishers International.
5. Kevin C. Desouza, "Agile information systems: Conceptualization, Construction and Management", Butterworth-Heinemann Publishers.

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Course Code: **CA 9125**

Course Title: **Agile Software Engineering**

Unit Number	Number of Hours	Total marks for which the questions are to be asked (including bonus questions)
Unit I	13	8
Unit II	13	8
Unit III	10	10
Unit IV	14	20
Unit V	10	20
Total	60	66
Maximum marks for the course (Excluding bonus questions) = 50)		

Semester	**III**
Course Code	**CA 9225**
Course Title	**Cloud Computing**
Number of teaching hours per week	4
Total number of teaching hours per semester	60
Number of credits	4

Course Outcomes (COs)		
On successful completion of this course, the students will be able to:		
CO Number	**Course Outcome (CO) Statement**	**Bloom's Taxonomy Level**
CO1	Explain the concepts, characteristics, reference models, and historical evolution of Cloud Computing and virtualization technologies.	**Understand (L2)**
CO2	Describe and differentiate cloud architectures, service models, deployment models, and standards related to interoperability and fault tolerance.	**Understand (L2)**
CO3	Analyze energy-efficient, market-oriented, and federated cloud computing models and identify suitable cloud applications.	**Analyze (L4)**
CO4	Design cloud-based applications using multi-tier and multi-tenant architectures and estimate operational costs on cloud platforms.	**Create (L6)**
CO5	Apply principles of scalability, high availability, and security to develop robust cloud solutions using platforms such as AWS and Microsoft Azure.	**Apply (L3)**

Unit	Course contents	Hours
I	Introduction, Cloud Computing at a Glance, The Vision of Cloud Computing, Defining a Cloud, A Closer Look, Cloud Computing Reference Model, Characteristics and Benefits, Challenges Ahead, Historical Developments, Distributed Systems, Web 2.0, Service-Oriented Computing, Utility-Oriented Computing, Building Cloud Computing Environments, Application Development, Infrastructure and System Development, Computing Platforms and Technologies. Virtualization: Introduction, Characteristics of Virtualized, Environments Taxonomy of Virtualization Techniques, Execution Virtualization, Other Types of Virtualization, Virtualization and Cloud Computing, Pros and Cons of Virtualization. VMware,Virtualbox	13
II	Cloud Computing Architecture, Introduction, Cloud Reference Model, Architecture, Infrastructure / Hardware as a Service, Platform as a Service, Software as a Service, Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds, Open Challenges, Cloud Definition, Cloud Interoperability and Standards Scalability and Fault Tolerance Security, Trust, and Privacy Organizational Aspects	12
III	Energy efficiency in clouds, Energy-efficient and green cloud computing architecture, Market-based management of clouds, Market-oriented cloud computing, Reference model, A reference model for MOCC , Technologies and initiatives supporting MOCC, Federated clouds/ InterCloud-Characterization, Cloud federation stack, Aspects of interest. Cloud Applications- Scientific applications(Healthcare, Biology, Geoscience), Business and consumer applications	12
IV	Designing Cloud Applications: Introducing cloud-based multitier architecture , Designing for multi-tenancy , Understanding cloud applications design principles Understanding emerging cloud-based application architectures , Estimating your cloud computing costs , A typical e-commerce web application, AWS and MS Azure Components, Managing costs on Cloud, Application development environments	12
V	Scalability: Objectives, Designing scalable application architecture, architecture – increasing loads, Event handling at scale . High Availability: Objectives, Nature of failures, MS Azure High availability architecture, Security – Security objectives, Best practices in implementing Azure security	11
Total		**60**

Text Book(s):

1. Rajkumar Buyya, Christian Vecchiola, S Thamarai Selvi, "Mastering Cloud Computing", 1st Edition, 2015, Tata Mcgraw Hill Publishing Co Ltd
2. Aurobindo Sarkar, Amith Shah "Learning AWS" Second edition 2018,Packt Publishing Ltd

Reference Book(s):

1. Atul V. Mistry ,"Expert AWS Development", Packt Publishing Ltd ,First edition 2018
2. Kris Jamsa, "Clooud Computing", 1st Edition, 2013, Jones & Bartlett Publishers
3. Anthony T Velte, "Cloud Computing: A practical Approach", 1st Ed, 2010, Tata McGraw Hill.
4. Fern Halper, Kaufman, Bloor Robin, Hurwit, "Cloud Computing for Dummies", 1st Ed, 2010, Wiley
5. Joshy Joseph , Craig Fellenstein, "Grid Computing", 4th Ed, 2013, PearsonAsia

6. Ahmar Abbas, "Grid Computing: A Practical Guide to technology and Applications", 2010, CRC Press
7. Kaittwang Geoffrey C.Fox, Jack J Dongrra,"Distributed and Cloud Computing",1st Ed, 2012, Elsevier

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Course Code: **CA 9225**

Course Title: **Cloud Computing**

Unit Number	Number of Hours	Total marks for which the questions are to be asked (including bonus questions)
Unit I	13	8
Unit II	12	8
Unit III	12	10
Unit IV	12	20
Unit V	11	20
Total	60	66
Maximum marks for the course (Excluding bonus questions) = 50)		

Semester	**III**
Course Code	**CA 9325**
Course Title	**Full Stack Development**
Number of teaching hours per week	4
Total number of teaching hours per semester	60
Number of credits	4

Course Outcomes (COs)		
On successful completion of this course, the students will be able to:		
CO Number	**Course Outcome (CO) Statement**	**Bloom's Taxonomy Level**
CO1	Explain the fundamentals of web technologies, internet protocols, and client–server architecture.	**Understand (L2)**
CO2	Design responsive, interactive user interfaces with HTML, CSS, and JavaScript.	**Create (L6)**
CO3	Develop dynamic front-end applications using modern JavaScript frameworks and libraries.	**Apply (L3)**
CO4	Implement backend services, RESTful APIs, and database operations using server-side technologies.	**Apply (L3)**

CO5	Integrate front-end and back-end components and deploy full-stack applications in accordance with industry best practices.	**Create (L6)**
CO6	Explain the fundamentals of web technologies, internet protocols, and client–server architecture.	**Understand (L2)**

Unit	Course contents	Hours
I	**Introduction to Web Technologies** Introduction to Web Applications, Client–Server Architecture, Working of the Internet, HTTP/HTTPS Protocols, URLs and Web Browsers, Overview of Frontend and Backend Technologies, Introduction to HTML5 (Structure, Elements, Forms, Semantic Tags), Introduction to CSS3 (Selectors, Box Model, Layouts), Responsive Web Design Principles, Introduction to Version Control Systems, Git and GitHub Basics.	10
II	**JavaScript and Client-Side Programming** Introduction to JavaScript, Variables, Data Types, Operators, Control Structures, Functions and Scope, Arrays and Objects, Document Object Model (DOM), Event Handling, Form Validation, ES6 Features (Arrow Functions, Modules, Classes), Asynchronous JavaScript, Promises, Async/Await, Fetch API, Error Handling and Debugging Techniques.	11
III	**Front-End Frameworks and Libraries** Need for Frontend Frameworks, Introduction to React.js, Component-Based Architecture, JSX, Props and State, Functional Components, React Hooks (useState, useEffect), Routing using React Router, State Management Concepts, Handling Forms and User Input, API Integration, Styling Techniques (CSS Modules, Bootstrap, Tailwind CSS), Introduction to Single Page Applications (SPA).	13
IV	**Back-End Development and Databases** Introduction to Server-Side Programming, Node.js Architecture, NPM Modules, Express.js Framework, Middleware, RESTful Web Services, CRUD Operations, Authentication and Authorization (JWT Basics), Introduction to Databases, SQL vs NoSQL Databases, MongoDB Architecture, Schema Design, Mongoose ODM, Database Connectivity and Query Handling.	13
V	**Full Stack Integration, Deployment and Industry Practices** Integration of Frontend and Backend Applications, Environment Configuration, API Security Best Practices, Error Handling and Logging, Deployment Concepts, Hosting Frontend and Backend Applications, Cloud Platforms Overview (AWS, Vercel, Netlify, Heroku), CI/CD Basics, Project Structure and Documentation, Introduction to Agile Development, Real-World Full Stack Applications and Case Studies.	13
Total		**60**

Text Book(s):

1. Chris Northwood, The Full Stack Developer, Apress, 2018.
2. Jon Duckett, HTML and CSS: Design and Build Websites, Wiley, 2014.
3. Marijn Haverbeke, Eloquent JavaScript, No Starch Press, 2018.

Reference Book(s):

1. Azat Mardan, Full Stack JavaScript, Apress, 2019.
2. Ethan Brown, Web Development with Node and Express, O'Reilly Media, 2020.

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Course Code: **CA 9325**

Course Title: **Full Stack Development**

Unit Number	Number of Hours	Total marks for which the questions are to be asked (including bonus questions)
Unit I	10	8
Unit II	11	8
Unit III	13	10
Unit IV	13	20
Unit V	13	20
Total	60	66
Maximum marks for the course (Excluding bonus questions) = 50)		

Semester	**III**
Course Code	**CA 9425**
Course Title	**Deep Learning**
Number of teaching hours per week	4
Total number of teaching hours per semester	60
Number of credits	4

Course Outcomes (COs)		
On successful completion of this course, the students will be able to:		
CO Number	**Course Outcome (CO) Statement**	**Bloom's Taxonomy Level**
CO1	Explain neural network fundamentals, activation functions, and training process.	**Understand (L2)**
CO2	Implement supervised and unsupervised learning neural network models.	**Apply (L3)**
CO3	Design and evaluate CNN architectures for image-based applications.	**Create (L6)**
CO4	Apply RNN/LSTM/GRU models for sequence data and NLP tasks.	**Apply (L3)**
CO5	Develop solutions using generative models and reinforcement learning approaches.	**Create (L6)**

Unit	Course contents	Hours
I	**Fundamentals of Neural Networks and Learning** Introduction to Artificial Neural Networks (ANN), History and evolution of Neural Networks, Biological inspiration: neuron model, synapse, learning, McCulloch-	10

	Pitts neuron model, Activation functions: Sigmoid, Tanh, ReLU, Softmax, Loss functions: MSE, Cross-Entropy, Gradient Descent and Backpropagation.	
II	**Supervised and Unsupervised Neural Networks** **Supervised Learning Networks:** Perceptron Network, Adaline and Madaline, Backpropagation Neural Network, Radial Basis Function (RBF) Networks **Unsupervised Learning Networks:** Competitive Learning Networks, Kohonen Self-Organizing Maps (SOM), Learning Vector Quantization (LVQ), Adaptive Resonance Theory (ART) Network	12
III	**CNN Architectures and Applications** Motivation and applications of CNN, Convolution operation, filters, feature maps, Pooling layers: Max pooling and Average pooling, CNN training pipeline and hyperparameters, Popular CNN architectures: LeNet, AlexNet, VGG, ResNet, Transfer learning and fine-tuning, Object Detection basics, R-CNN, Fast R-CNN, Faster R-CNN, SSD and YOLO (overview)	13
IV	**Sequence Learning and RNN Models** Introduction to sequence modelling, Vanilla RNNs and limitations, LSTM and GRU architectures, Bidirectional RNNs, Deep RNNs, Sequence-to-sequence (Seq2Seq) models, Attention mechanism, Transformer architecture	12
V	**Generative Models and Deep Reinforcement Learning** **Generative Deep Learning: Autoencoders:** Basic and Denoising Autoencoders, Variational Autoencoders (VAE), Generative Adversarial Networks (GANs): concept and training, Conditional GANs. **Reinforcement Learning and Deep RL:** Reinforcement learning fundamentals, Markov Decision Process (MDP), Value-based and policy-based learning, Deep Q Networks (DQN).	13
Total		**60**

Text Book(s):

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.
2. S.N. Sivanandam & S.N. Deepa, "Principles of Soft Computing", 3rd Edition, Wiley, 2015.

Reference Book(s):

1. "Neural Networks and Deep Learning: A Textbook" by Charu C. Aggarwal
2. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron
3. "Deep Learning for Computer Vision" by Rajalingappaa Shanmugamani
4. "Reinforcement Learning: An Introduction" by Richard S. Sutton and Andrew G. Barto
5. "Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play" by David Foster

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Course Code: **CA 9425**

Course Title: **Deep Learning**

Unit Number	Number of Hours	Total marks for which the questions are to be asked (including bonus questions)
Unit I	10	8
Unit II	12	8
Unit III	13	10

Unit IV	12	20
Unit V	13	20
Total	60	66
Maximum marks for the course (Excluding bonus questions) = 50)		

Semester	**III**
Course Code	**CA 9525**
Course Title	**Research Methodology**
Number of teaching hours per week	3
Total number of teaching hours per semester	45
Number of credits	3

Course Outcomes (COs)		
On successful completion of this course, the students will be able to:		
CO Number	**Course Outcome (CO) Statement**	**Bloom's Taxonomy Level**
CO1	Explain traditional and modern research concepts, processes, and methodologies.	**Understand (L2)**
CO2	Compare classical research methods with research practices.	**Analyze (L4)**
CO3	Apply suitable research designs, sampling techniques, and data collection tools.	**Apply (L3)**
CO4	Analyze and interpret research data using statistical, programming, and tools.	**Analyze (L4)**
CO5	Create ethical research proposals, reports, and publications using digital platforms.	**Create (L6)**

Unit	Course contents	Hours
I	**Introduction:** Meaning of Research, Characteristics of Research, Steps in Research, Criteria of Good Research, Types of Research, Normative Research and Value-Free Research. **Scientific Methods:** Defining the Problem of Research, Concepts and Constructs, Meaning and Function of Research Design, Interdisciplinary and computational research, Data-driven research paradigms.	5
II	**Research Design:** Characteristics of a Good Research Design, Phases in Research Design, Informal Experimental Designs, Formal Experimental Designs, Steps in Sample Design. **Sampling:** Principles of Sampling, Sample Size Determination, Non-Random Sampling, Complex Random Sampling, Classification of Measurement Scales, Criteria of Good Measurement, Comparative Scaling Techniques, Non-comparative Scaling Techniques, Likert Scales.	10

	Data Collection: Definition, Types of Data, Primary data collection Questionnaires, Secondary data sources, online databases, APIs, repositories. Case Study, Pilot Study and Pre-Testing, Questionnaire Checking, Editing and Coding of Data.	
III	**Data Preparation and Analysis:** Graphical Representation, Types of Analysis, Data preparation, Data cleaning, validation, and transformation, Classification and tabulation using software tools. **Hypotheses:** Basic Concepts, Testing of Hypothesis, Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test. Python and AI tools as a statistical tool. **Research Proposal Writing:** Synopsis Writing I, Synopsis Writing II, Synopsis Writing III, Steps in Writing a Research Report Appraisal of the Research Proposal/Project. **Self-study:** Problem identification and objectives, Literature review and methodology, Data analysis plan and expected outcomes.	10
IV	**Philosophy and Ethics** Introduction to philosophy: definition, nature and scope, concept, branches. Ethics: definition, moral philosophy, nature of moral judgements and reactions. **Scientific Conduct** Ethics with respect to science and research, Intellectual honesty and research integrity, Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP). Redundant publications: duplicate and overlapping publications, salami slicing, selective reporting and misrepresentation of data. **Publication Ethics** Publication ethics: definition, introduction and importance. Best practices / standards setting initiatives and guidelines: COPE, WAME, etc., Conflicts of interest. Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, types. Violation of publication ethics, authorship and contributorship. Identification of publication misconduct, complaints and appeals, Predatory publishers and journals.	10
V	**Open Access Publishing** Open access publications and initiatives, SHERPN/RoMEO online resource to check publisher copyright & self-archiving policies, Software tool to identify predatory publications developed by SPPU, Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc. Publication Misconduct : Subject specific ethical issues, FFP, authorship, Conflicts of interest. Complaints and appeals: examples and fraud from India and abroad. Software tools: Use of plagiarism software like Turnitin, Urkund and other open source software tools. **Databases and Research Metrics** Databases and Indexing databases. Citation databases: Web of Science, Scopus, etc. Research Metrics: Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score. Metrics: h-index, g index, i10 index and alternative metrics.	10
Total		45

Text Book(s):

1. Kothari, C. R., Research Methodology: Methods and Techniques, New Age International Publishers, New Delhi, 2004.

Reference Book(s):

1. Creswell, J. W., & Creswell, J. D, Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, SAGE Publications, Thousand Oaks, 2018.
2. Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E, Multivariate Data Analysis, Cengage Learning, 2019.
3. Field, A, Discovering Statistics Using IBM SPSS Statistics, SAGE Publications, 2018.
4. Subramanyam, K, Scientific and Technical Writing, Wiley Eastern Limited, New Delhi, 2nd Edition, 2001.

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Course Code: **CA 9525**

Course Title: **Research Methodology**

Unit Number	Number of Hours	Total marks for which the questions are to be asked (including bonus questions)
Unit I	8	8
Unit II	10	8
Unit III	10	10
Unit IV	12	20
Unit V	5	20
Total	45	66
Maximum marks for the course (Excluding bonus questions) = 50)		

Practical IX

Course Code and Title: CA 9P125 & Deep Learning Lab

(3 hours/11 sessions)

CO Number	Course Outcome (CO) Statement	Bloom's Taxonomy Level
CO1	Explain neural network fundamentals, activation functions, and training process.	**Understand (L2)**
CO2	Implement supervised and unsupervised learning neural network models.	**Apply (L3)**
CO3	Design and evaluate CNN architectures for image-based applications.	**Create (L6)**
CO4	Apply RNN/LSTM/GRU models for sequence data and NLP tasks.	**Apply (L3)**
CO5	Develop solutions using generative models and reinforcement learning approaches.	**Create (L6)**

Ex. No	List of Exercises
1	Implement Sigmoid, Tanh, ReLU, Softmax and Plot graphs and compare outputs.
2	Implement Single Layer Perceptron for AND/OR classification.

3	Implement Gradient Descent for Linear Regression (from scratch).
4	Implement 2-layer Neural Network using NumPy (Forward pass + loss + backward pass + weight update).
5	Train MLP using Keras/TensorFlow for Iris dataset classification.
6	Train neural network with and without Dropout, Compare accuracy and loss curves.
7	Implement SOM for clustering 2D data points.
8	Implement competitive learning for unsupervised classification.
9	Build CNN using TensorFlow/Keras, Evaluate accuracy and confusion matrix.
10	Design CNN and compare model performance.
11	Apply VGG16 / ResNet50 for image classification (custom dataset).
12	Predict next value in time-series (stock/sample dataset).
13	Implement both GRU and LSTM models and compare performance.
14	Implement Autoencoder for image reconstruction (MNIST).
15	Add noise to images and train model to recover original image.

Practical X

Course Code and Title: CA 9P225 & Cloud Computing Lab

(3 hours/11 sessions)

CO Number	Course Outcome (CO) Statement	Bloom's Taxonomy Level
CO1	Explain the concepts, characteristics, reference models, and historical evolution of Cloud Computing and virtualization technologies.	**Understand (L2)**
CO2	Describe and differentiate cloud architectures, service models, deployment models, and standards related to interoperability and fault tolerance.	**Understand (L2)**
CO3	Analyze energy-efficient, market-oriented, and federated cloud computing models and identify suitable cloud applications.	**Analyze (L4)**
CO4	Design cloud-based applications using multi-tier and multi-tenant architectures and estimate operational costs on cloud platforms.	**Create (L6)**
CO5	Apply principles of scalability, high availability, and security to develop robust cloud solutions using platforms such as AWS and Microsoft Azure.	**Apply (L3)**

Ex. No	List of Exercises
1	Demonstrate types of virtualization used in cloud environments.
2	Install and configure a virtual machine using VMware Workstation.
3	Create and manage multiple virtual machines using VMware and analyze resource allocation.
4	Demonstrate hardware and OS-level virtualization using a suitable virtualization tool.

5	Launch and configure a virtual machine instance in Amazon Web Services (AWS EC2).
6	Create and manage storage services in AWS (S3) and analyze access permissions.
7	Implement Identity and Access Management (IAM) users and roles in AWS.
8	Configure basic security rules using AWS Security Groups and Network ACLs.
9	Create and deploy a virtual machine in Microsoft Azure.
10	Implement role-based access control (RBAC) in Microsoft Azure for secure resource access.
11	Configure and analyze security policies using Azure Network Security Groups (NSG).
12	Demonstrate data encryption and key management in Microsoft Azure.
13	Compare security features and compliance models of AWS and Microsoft Azure.
14	Monitor and analyze cloud resource usage and security alerts using cloud monitoring tools.

Practical XI

Course Code and Title: CA 9P325 & Full Stack Development Lab

(3 hours/11 sessions)

CO Number	Course Outcome (CO) Statement	Bloom's Taxonomy Level
CO1	Explain the fundamentals of web technologies, internet protocols, and client–server architecture.	**Understand (L2)**
CO2	Design responsive, interactive user interfaces with HTML, CSS, and JavaScript.	**Create (L6)**
CO3	Develop dynamic front-end applications using modern JavaScript frameworks and libraries.	**Apply (L3)**
CO4	Implement backend services, RESTful APIs, and database operations using server-side technologies.	**Apply (L3)**
CO5	Integrate front-end and back-end components and deploy full-stack applications in accordance with industry best practices.	**Create (L6)**

Ex. No	List of Exercises
1	**Basic Level** Create a static web page using HTML5 demonstrating headings, lists, images, tables, and hyperlinks.
2	Design a student registration form using HTML5 form elements and validations.
3	Apply CSS styling to a webpage using selectors, colors, fonts, and box model properties.
4	Design a responsive webpage using CSS media queries.
5	Implement Flexbox and Grid layouts for a webpage.
6	Write a JavaScript program to perform basic arithmetic operations.
7	Develop a JavaScript program for form validation.
8	Create a webpage demonstrating DOM manipulation using JavaScript.

9	Implement event handling (button click, mouse over) using JavaScript.
10	Use Git to create a repository, commit files, and push them to GitHub.
11	**Intermediate Level** Develop a dynamic webpage that updates content using JavaScript and DOM APIs.
12	Write a JavaScript program using ES6 features such as arrow functions, classes, and modules.
13	Consume a public REST API using Fetch API and display the data dynamically.
14	Create a single-page application (SPA) using React components.
15	Implement React Hooks (useState, useEffect) for state management.
16	Design a multi-page React application using React Router.
17	Build a basic Node.js server to handle HTTP requests.
18	Develop RESTful CRUD APIs using Express.js.
19	Connect a Node.js application to MongoDB using Mongoose.
20	Implement user authentication using JWT in a backend application.
21	**Advanced Level** Develop a full stack application using React (frontend) and Express + MongoDB (backend).
22	Implement role-based authentication and authorization in a full stack application.
23	Design and implement RESTful APIs with proper error handling and middleware.
24	Integrate frontend and backend using secure API calls.
25	Implement file upload and storage functionality in a backend application.
26	Create a real-time application using WebSockets or Socket.IO.
27	Implement environment variables and configuration management for deployment.
28	Deploy the frontend application using Netlify/Vercel.
29	Deploy the backend application using Heroku/DigitalOcean and connect it to the frontend.
30	Develop and deploy a capstone full stack project (e.g., task manager, e-commerce catalog, or blog platform) with complete documentation.

Semester	**IV**
Course Code	**CA 10PR1**
Course Title	**Industry Internship / Project Work**
Number of teaching hours per week	16
Total number of teaching hours per semester	256
Number of credits	16

After successful completion of the internship/project, the student will be able to:

CO Number	**Course Outcome (CO) Statement**	**Bloom's Taxonomy Level**
CO1	Analyze real-world industry problems and requirements to identify suitable computing solutions using appropriate software engineering practices.	**L4 – Analyze**

CO2	Design and develop an industry-relevant software system or application by applying programming skills, tools, frameworks, and technologies learned during the program.	**L6 – Create**
CO3	Apply project management techniques including planning, scheduling, documentation, and version control to execute the internship/project effectively.	**L3 – Apply**
CO4	Demonstrate professional skills such as teamwork, communication, ethical responsibility, and adherence to industry standards in a corporate or organizational environment.	**L3 – Apply**
CO5	Evaluate the developed solution through testing, performance analysis, and validation, and effectively present the project outcomes through reports, demonstrations, and presentations.	**L5 – Evaluate**

Learning Objectives:

To provide students with an opportunity to gain work experience that will enhance and complement their academic learning. The course requirements are designed to provide a structure that enables students to connect what they learn in the classroom and on the job, further develop analytical and interpersonal skills, and practice business writing.

Course Requirements

1. The Internship / Project work / Dissertation for credit requires students to spend the majority of their time in technical, analytical, or administrative work that will contribute to their learning as outlined in the course objectives.
2. Work of a clerical nature must be limited to a maximum of 15 per cent of the time spent on the job.
3. Prior to beginning an internship for credit, students must receive an internship orientation at the Training and Placement Cell of SoIT
4. A meeting with the faculty advisor / Guide to cover the ground rules and requirements.
5. Submission of the Final Report within seven days of the completion of the internship

The body of the Final Report will cover the following:

- **Job description:** Describe in detail your internship position duties and responsibilities. Discuss what duties were performed on a daily basis, periodic (e.g., weekly) basis, and one-time special projects.

- **Knowledge gained:** Describe the knowledge gained or enhanced as a result of your internship experience. Relate this knowledge to what you learned in specific courses at AIMIT. Did your courses prepare you to handle the responsibilities of your position?
- **Skills learned:** Describe the skills that you learned or sharpened on the job. Discuss any skills that you learned as part of a course at SJIIT that were useful on the job. Consider a skill as the ability to do something like problem solving, analyze a problem, work in a groups, etc.
- **Attitudes/values:** Describe the attitudes or values that you found to be important for success in your job. Think of attitudes as a way of thinking or behavior, e.g., stubborn, patient, confrontational, etc. Consider values as the things you regard as important in life, e.g., dependability, integrity, hard work, etc.
- **Learning outcomes:** Identify the outcomes or results from the knowledge, skills and attitudes or values that you have described above. For example, what can you do for an organization today that you could not have done, or could not have done as well, before your internship

Guidelines to prepare the Project Document / Dissertation

The following format guidelines are intended to help you prepare your master's thesis or dissertation and should be used in conjunction with the specific style adopted by your IT program. It is your responsibility to conform to the following format requirements and ensure that your manuscript's presentation is of the highest quality. Because requirements may change over time, students should not use existing library or departmental copies of manuscripts as examples of proper format.

Format

All pages of your manuscript must be in 'Letter Size', 8 ½ X 11 inch format.

Reproduction Quality

The copies of your manuscript must be clean, unshaded, and free of spots and smudges. Faint, streaked, or uneven copies are unacceptable.

Margins

The left margin of each page must be 1 1/2 inches, and the top, right, and bottom margins 1 inch.

Placement of Page Numbers

There are only two ways to paginate your manuscript; upper right hand corner and bottom center. If your page numbers are at the bottom, leave two blank line spaces between the

last line of text and the line on which the page number is placed. Whether they are at the top or the bottom, page numbers should appear just outside the 1-inch margins (.5 to .8 inches from the top or bottom edge of the page. Whichever pagination method is selected must be followed consistently. Use lower-case Roman numerals for the front matter (which is all pages before the body of research), create a section break and continue (beginning again with page "1") with Arabic numerals for the remainder of the manuscript, including the text, illustrations, appendices and references.

Type and Font

Your manuscript should be double-spaced (one and a half spaces can be used if approved by the chair of your committee) and single-sided. References may be single-spaced with a double space between each reference. Indented quotations may also be single-spaced. Use a professional quality font (e.g., Arial, Times Roman, Courier or Helvetica). Font size for your text should be 12 points; headings may be up to 14 points. Fonts for tables, figures, and appendices may range from 8 to 12 point.

Style

The style of your thesis or dissertation may follow any one of many standard style guides, as preferred by your graduate unit, or the style considered standard in your particular discipline. You should consult your advisor for preferences or additional requirements your department may have. In any case, your manuscript must be internally consistent.

Format Guidelines

Thesis or dissertation manuscripts are generally divided into three sections – the Front Matter, the Body of Research, and the Reference Matter.

For a visual reference to format the Front Matter, utilize the Example of Completed Front Matter link at the Approval Template page. A Thesis Example and a Dissertation Example will help you format the Front Matter for pagination and the placement of the proper order of the front matter pages which can be generated at the “MS Word Templates" page.

Approval (Signature) Page

The Approval Page is the first page of the Front Matter and the manuscript. Count this as page "i". Type the names of the committee members on the lines provided at the center of the page.

Title Page

The Title page contains the title of your manuscript, your name, your previous degrees (including your majors, institutions and years centered on the page). Count the title page as page "ii". The degree you will be receiving at SJU, and the month and year of your

graduation should be listed toward the bottom of the page (check with Graduate Studies for the graduation date). When listing the degree to be awarded, please refer to the Master's Degree List included with these guidelines. Do not use abbreviations.

Dedication Page

This is an optional page. If you use one, number it in appropriate sequence with a lower-case Roman numeral. The title must be in capital letters, centered just below the top margin of the page. The dedication itself may be single or double-spaced.

Acknowledgement Page

This is also an optional page. If you use one, number it in appropriate sequence with a lower-case Roman numeral. The title must be in capital letters, centered just below the top margin of the page. The acknowledgment itself may be single or double-spaced.

Abstract Page

On the Abstract page first list the title of your manuscript, your name, all degrees you have already earned (in chronological order), and the degree to be awarded. These lines should be centered on the page, beginning just below the top margin. Then double-space, and on the following line, center the word ABSTRACT. Double-space again before beginning the text of your abstract. Use paragraph indentation as appropriate. The text should be either single- or double-spaced.

Number the Abstract Page in appropriate sequence with a lower-case Roman numeral.

Table of Contents

The Table of Contents page is counted and numbered with lowercase Roman numerals. If you have used a List of Figures (Optional) and/or a List of Tables (Optional), they must be included in your Table of Contents. Tab leaders should be used between the heading levels and the page numbers. (DO NOT simply type dots across the page--the spacing will not work out. Instead, set a dot leader tab. If you have multiple appendices, each must be listed (see the section on Appendices).

List of Figures

Placed on a separate page after the Table of Contents. This page is numbered and counted with a lowercase Roman numeral. It may be single or double-spaced. Tab leaders should be used between the title of the figures and the page numbers. This page should be listed at the beginning of the Table of Contents.

List of Tables

Placed on a separate page after the Table of Contents. This page is numbered and counted with a lowercase Roman numeral. It may be single or double-spaced. Tab leaders should

be used between the table title and the page number. This page should be listed after the List of Figures at the beginning of the Table of Contents.

Preface Page

This page is numbered and counted with a lowercase Roman numeral.

The Text

Beginning with the first page of the text (begin again with page "1"), pages are numbered with sequential Arabic numerals through the end of your manuscript. Each chapter/major division of the text must start on a new page. Each of these lead pages should be counted and numbered.

Figures

Figures may include diagrams, charts, drawings, schematics, photographs, etc. Each of the two required copies of your manuscript must contain its own original figures, with the exception of photographs, in which case both may be high-quality copies, either in colour or black and white. Figures should be inserted as near as reasonably possible to the text to which they relate. They should be numbered consecutively with Arabic numerals as part of the continuing text.

Figures and their captions must appear on the same page, within the required margins. If captions are more than one line long, they may be single-spaced. They should be placed on paper of the same size and weight as the rest of the manuscript. Coloured materials are acceptable, but since colour does not reproduce on microfilm, an alternate key should be provided if it will be needed for interpreting the figure in black and white.

Oversized figures may be presented in one of two ways: A horizontal figure that is too wide to fit on a regular manuscript page may be mounted on another piece of paper at the left-hand margin and folded like a fan. The folds must be within the right-hand margin.

A figure that is both too long and too wide may be folded and inserted into a 6 ½ x 9 '' envelope that is mounted on another sheet of paper.

Tables

Tables that are a half-page or shorter in size may be placed at the top or the bottom of the page, or in the center, with text above and below. Tables may also be placed alone on the page immediately following the page that refers to them. The placement of tables should be consistent throughout the manuscript. Tables continuing for more than one page should be labeled [e.g., Table 1 (cont.)], and oversized tables should be treated in the same way as oversized figures.

Reference matter

It may include notes to the text, appendices, a glossary, a list of references, and an index. The appendices and the list of references are the two most commonly used categories, and are discussed in detail below.

Appendices

The appendix (or a series of appendices) usually follows the main text, and contains material that is useful for a detailed review of the study, but is not essential to an understanding of the text. For example, an appendix is the appropriate section in which to place material such as raw data, the results of individual laboratory analyses, or sample forms. This may be useful supporting data even though it is not specifically utilized in the text. Note, however, that some reference should be made in the text to the fact that these materials appear in the appendix. The pages of the appendices are numbered in sequence with those of the text. Although it is preferable, you do not have to meet margin requirements for the material in your appendix, except for the left-hand margin.

After the last page of text, include a list of Appendices on a separate page. Individual appendices should start on a separate page and should be clearly marked.

The List of Appendices should also be included in the Table of Contents. To list appendices in your Table of Contents, use "Appendices" as your major heading. On the next line, indent five spaces, and begin listing each appendix with its title (for example, "Appendix A. Survey Data") and page number.

List of References

No manuscript is complete without a full listing of the necessary bibliographic information about the sources upon which the study is based. In most cases, only those sources actually cited in the study are listed. This section will be called "List of References", "References Cited", or simply "References", and all pages are counted and numbered. The list is most often arranged alphabetically, although it may follow some other logical plan. It will follow the appendices.

Problems encountered:

Front Matter

Formatting on front material is very detailed. Make sure that formatting matches examples. Make sure that pages are numbered correctly.

Margins

Margins for the entire manuscript must be:

left – 1.5 inches; top, right, bottom – 1 inch

Exceptions: Top, right and bottom margins may vary in the Appendix pages, but the left margin must be 1.5 inches throughout the ENTIRE manuscript. Page numbers in the Appendices must also appear consistently as in the rest of the manuscript.

Landscape-oriented figures and tables

Margin requirements must be met, and page numbers must be placed consistently as in the rest of the manuscript.

Table of Contents/Headings & Subheadings within manuscripts

Your Table of Contents will be checked against the body of your manuscript.

Page numbers must be correct.

All headings/sub-headings that appear at the same level should have the same appearance in the body of the manuscript and be distinguished from other heading-levels by appearance or numbering.

All headings and subheadings (as many levels as you include in the Table of Contents) should appear in the Table of Contents. If you have some third-level headings in the Table of Contents, then ALL third-level subheadings should appear in the Table of Contents. The major section headings (usually Chapter headings) should each begin on a new page. Other levels should not be started on a new page.

Forms

Your manuscript must be accompanied by ALL required completed forms; otherwise, it will not be accepted.

SCHEME OF EVALUATION

Rubric for Continuous Internal Assessment (CIA) of CA 10PR1: INDUSTRY INTERNSHIP / PROJECT WORK (200 Marks)

Review 1:			**(25 Marks)**
Criteria	**Weightage**	**Marks**	**CO Mapping**
Clarity of Problem Statement	40%	10	CO1
Defined Objectives and Scope	60%	15	CO1
Review 2:			**(25 Marks)**
Criteria	**Weightage**	**Marks**	**CO Mapping**
Feasibility and Innovation	20%	5	CO1
Methodology and Planning	40%	10	CO1
Overall Presentation and Articulation	40%	10	CO1

Review 3:			**(25 Marks)**
Criteria	**Weightage**	**Marks**	**CO Mapping**
Initial Progress and Milestones	50%	12.5	CO2
Effective Team Collaboration and Communication	50%	12.5	CO2
Review 4:			**(25 Marks)**
Criteria	**Weightage**	**Marks**	**CO Mapping**
Initial Resource Allocation and Utilization	50%	12.5	CO2
Quality of Initial Deliverables	50%	12.5	CO2
Review 5:			**(25 Marks)**
Criteria	**Weightage**	**Marks**	**CO Mapping**
Intermediate Progress and Milestones	30%	7.5	CO3
Technical Problem-Solving	70%	17.5	CO3
Review 6:			**(25 Marks)**
Criteria	**Weightage**	**Marks**	**CO Mapping**
Implementation of Technical Solutions	60%	15	CO3
Quality of Intermediate Deliverables	40%	10	CO3
Review 7:			**(25 Marks)**
Criteria	**Weightage**	**Marks**	**CO Mapping**
Advanced Progress and Milestones	40%	10	CO4
Technical Implementation and Testing	60%	15	CO4
Review 8:			**(25 Marks)**
Criteria	**Weightage**	**Marks**	**CO Mapping**
Analysis and Discussion of Results	50%	12.5	CO4
Quality of Documentation	50%	12.5	CO4
Review 9,10: End Term Internal Project Evaluation			**(25 Marks)**
Criteria	**Weightage**	**Marks**	**CO Mapping**
Final Presentation and Articulation	30%	7.5	CO5
Overall Project Execution and Delivery	30%	7.5	CO5
Ability to Address Questions and Critical Feedback	40%	10	CO5

Dissertation - Phase I thru Phase III: Two internal teachers mandate and each teacher should give separate marks in a sheet without discussing and submit to the MCA coordinator.

Dissertation - Phase IV (Final Viva-voce): One external and Two internal teachers mandate and each teacher should give separate marks in a sheet without discussing and submit to the MCA coordinator.

Please note: The problems listed above are among the most common, but manuscripts can also be returned for other issues.

St Joseph's University
School of Information Technology
Bangalore

MCA Major Project Evaluation Form (Viva Voce)
CA 10PR1 - Industry Internship / Project Work

Register Number of the candidate: _____

Date:

VIVA VOCE (Marks: 200)		
	Max Mks	**Mks Obtained**
1. **Documentation** (For the submission of the final project documentation) **(** For complete documentation with as much information - 40 marks, falls short of neatness: 32 marks: **minimum: 24 marks**)	**40**	
2. One page **summary of the project** **(**7 minutes **)**	**24**	
3. **Project Demo (** 10 minutes **)** **(**For well-prepared ppt demo covering all the aspects of the project : 56 marks **Minimum** : **20 marks**)	**56**	
4. **Q & A** **(**13 minutes **)** **(** At least 5 questions to be asked: Answering all the 5 questions : 80 marks Answering 4 questions : 56 marks Answering 3 questions : 48 marks **Minimum** : **32 marks**)	**80**	
TOTAL	**200**	

COMMENTS BY THE EXAMINER	
NAME	SIGNATURE

Semester	**IV**
Course Code	**CA 10CC1**
Course Title	**Online Certification Courses (SWAYAM / NPTEL)**
Number of credits	3

Guidelines for Online Certification Courses

1. **Eligibility**
   - Online certification courses are applicable to MCA students as prescribed by the University regulations.
   - III Semester MCA students are eligible to register for online certification courses.
   - The selection of the course is under the purview of the Department.
2. **Commencement of Course**
   - The online certification course for IV Semester MCA students may be commenced during the III Semester.
   - This provision is made considering the examination schedule of SWAYAM/NPTEL, which is conducted twice a year.
3. **Approved Platforms**

   Students shall enrol only in university-approved platforms such as SWAYAM / NPTEL.

4. **Course Duration and Credits**
    - The selected course must satisfy the minimum duration of 12 weeks and credit requirements as approved by the BOS.
    - Courses not meeting the prescribed criteria will not be considered for credit transfer.
5. **Examination and Certification**
    - Students who commence the course in the III Semester may appear for the certification examination during the same semester.
    - The certificate shall be submitted in the IV Semester for verification and credit consideration.
6. **Re-attempt Policy**
    - If a student fails to clear the examination in the first attempt, they may reappear in the subsequent examination cycle, similar to a supplementary attempt.
7. **Submission of Certificate**
    - Students must submit the original/verified certificate along with relevant enrolment and completion details within the stipulated deadline, and the same will be verified by the department and submitted to the COE office for approval.
8. **Verification and Approval**
    - The submitted certificates shall be verified by the department and submitted to the COE office for approval.
9. **Compliance**
    - Students are solely responsible for timely enrolment, completion, examination registration, and submission of certificates.
    - Non-compliance with guidelines may result in non-recognition of the course.