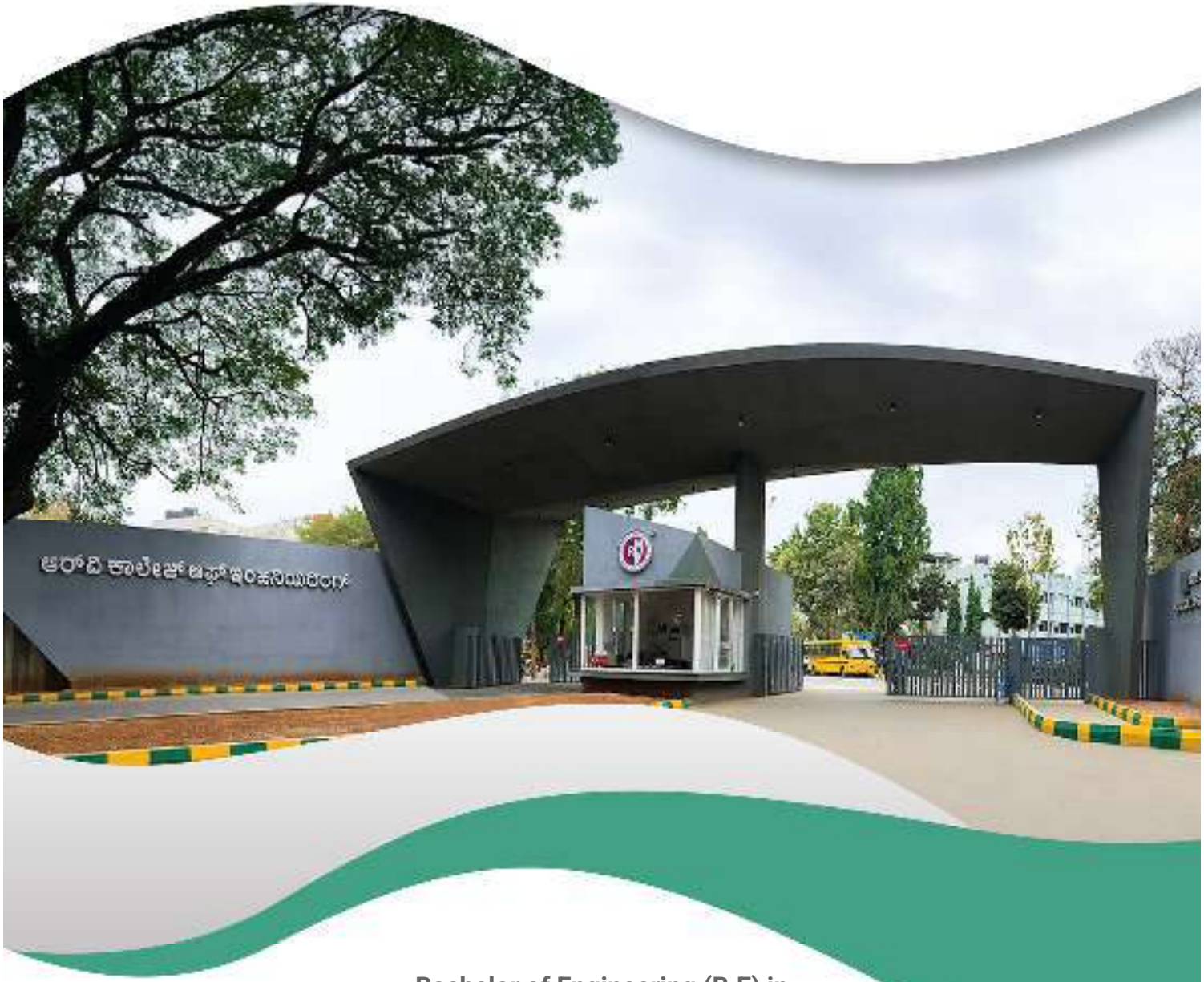
RV College of Engineering®

Undergraduate Programs



Bachelor of Engineering (B.E) in

Computer Science & Engineering (Data Science)

Scheme And Syllabus Of V & VI Semester
(2022 Scheme)

B.E. Programs : AS, BT, CH, CS, CS - AI, CS - CD, CS - CY, CV, EC, EE, EI, ET, IM, IS, ME.
M. Tech (13) MCA, M.Sc. (Engg.)
Ph.D. Programs : All Departments are recognized as Research Centres by VTU Except AI & AS

2024

99TH
NIRF RANKING IN ENGINEERING (2024)

1501+
501-600

BEST PRIVATE ENGINEERING UNIVERSITY (SOUTH)

1001+
SUBJECT RANKING (ENGINEERING)

801+
SUBJECT RANKING (COMPUTER SCIENCE)

IIRF 2023
ENGINEERING RANKING (INDIA)
NATIONAL RANK-10
STATE RANK - 2
ZONE RANK - 5

QS-IGUAGE DIAMOND UNIVERSITY RATING (2021-2024)

CURRICULUM STRUCTURE

61 CREDITS PROFESSIONAL CORES (PC)

23 CREDITS BASIC SCIENCE

22 CREDITS ENGINEERING SCIENCE

18 CREDITS PROJECT WORK / INTERNSHIP

12 CREDITS* OTHER ELECTIVES & AEC

12 CREDITS PROFESSIONAL ELECTIVES

12 CREDITS HUMANITIES & SOCIAL SCIENCE

160 CREDITS TOTAL

*ABILITY ENHANCEMENT COURSES (AEC), UNIVERSAL HUMAN VALUES (UHV), INDIAN KNOWLEDGE SYSTEM (IKS), YOGA.

17
Centers of Excellence

11
Centers of Competence

212
Publications On Web Of Science

669
Publications Scopus (2023 - 24)

1093
Citations

70
Patents Filed

39
Patents Granted

61
Published Patents

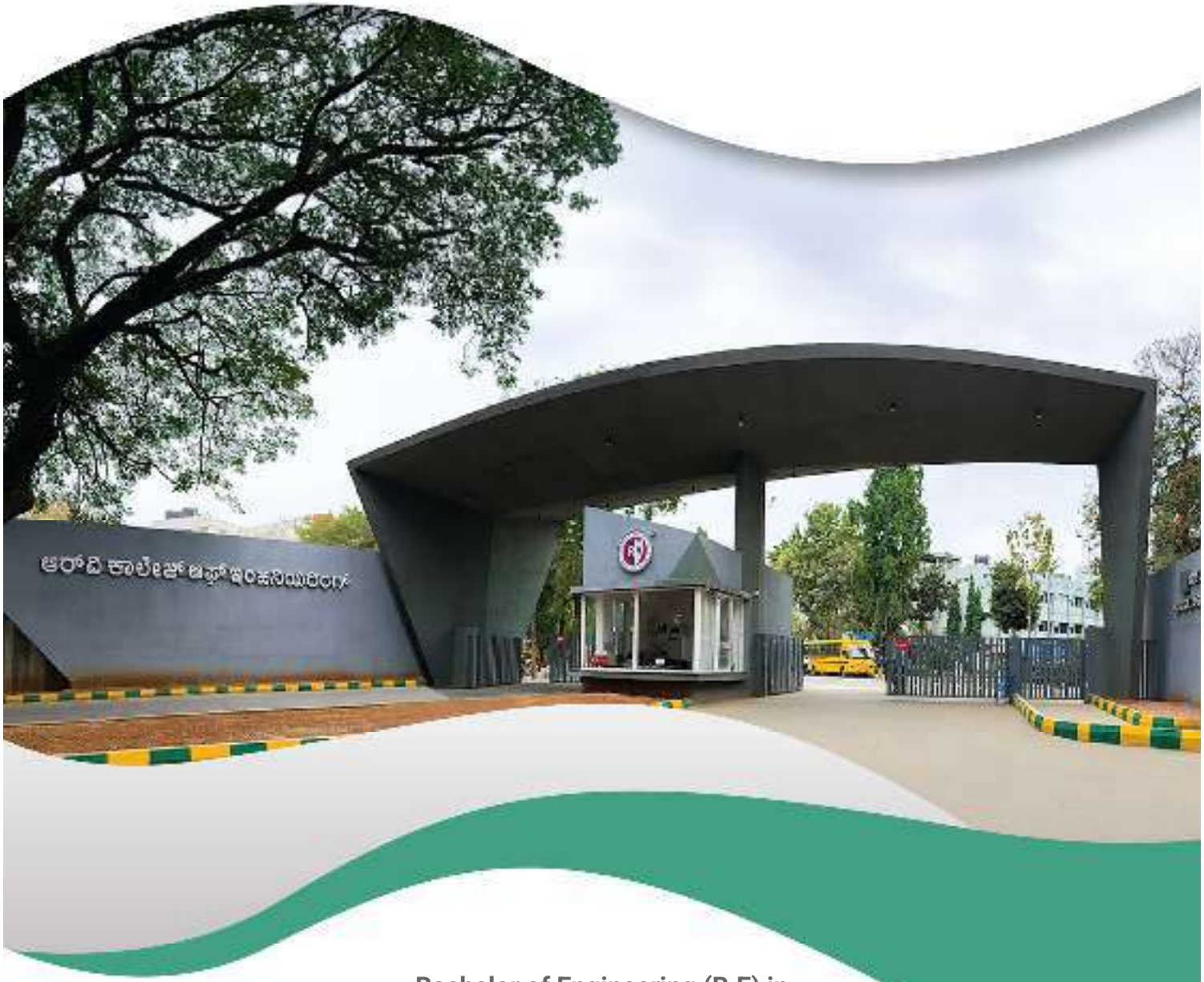
11
Skill Based Laboratories Across Four Semesters

MOUS: 90+WITH INSDUSTRIES / ACADEMIC INSTITUTIONS IN INDIA & ABROAD

EXECUTED MORE THAN RS.40 CRORES WORTH SPONSORED RESEARCH PROJECTS & CONSULTANCY WORKS SINCE 3 YEARS

RV College of Engineering®

Undergraduate Programs



Bachelor of Engineering (B.E) in

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2024

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

DEPARTMENT VISION

To achieve leadership in the field of Computer Science & Engineering by strengthening fundamentals and facilitating interdisciplinary sustainable research to meet the ever growing needs of the society.

DEPARTMENT MISSION

- To evolve continually as a centre of excellence in quality education in computers and allied fields.
- To develop state-of-the-art infrastructure and create environment capable for interdisciplinary research and skill enhancement.
- To collaborate with industries and institutions at national and international levels to enhance research in emerging areas.
- To develop professionals having social concern to become leaders in top-notch industries and/or become entrepreneurs with good ethics.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Develop Graduates capable of applying the principles of mathematics, science, core engineering and Computer Science to solve real-world problems in interdisciplinary domains.

PEO2: To develop the ability among graduates to analyze and understand current pedagogical techniques, industry accepted computing practices and state-of-art technology.

PEO3: To develop graduates who will exhibit cultural awareness, teamwork with professional ethics, effective communication skills and appropriately apply knowledge of societal impacts of computing technology.

PEO4: To prepare graduates with a capability to successfully get employed in the right role /become entrepreneurs to achieve higher career goals or take up higher education in pursuit of lifelong learning.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO	Description
PSO1	**System Analysis and Design** The student will be able to: 1. Recognize and appreciate the need of change in computer architecture, data organization and analytical methods in the evolving technology. 2. Learn the applicability of various systems software elements for solving design problems. 3. Identify the various analysis & design methodologies for facilitating development of high quality system software products with focus on performance optimization. 4. Display team participation, good communication, project management and document skills.
PSO2	**Product Development** The student will be able to: 1. Demonstrate the use of knowledge and ability to write programs and integrate them with the hardware/software products in the domains of embedded systems, databases/data analytics, network/web systems and mobile products. 2. Participate in planning and implement solutions to cater to business – specific requirements displaying team dynamics and professional ethics. 3. Employ state-of-art methodologies for product development and testing / validation with focus on optimization and quality related aspects.

Lead Society: Institute of Electrical and Electronics Engineers (IEEE)

ABBREVIATIONS

Sl. No.	Abbreviation	Meaning
1.	VTU	Visvesvaraya Technological University
2.	BS	Basic Sciences
3.	CIE	Continuous Internal Evaluation
4.	SEE	Semester End Examination
5.	PE	Professional Core Elective
6.	GE	Global Elective
7.	HSS	Humanities and Social Sciences
8.	PY	Physics
9.	CY	Chemistry
10.	MA	Mathematics
11.	AS	Aerospace Engineering
12.	AI & ML	Artificial Intelligence & Machine Learning
13.	BT	Biotechnology
14.	CH	Chemical Engineering
15.	CS	Computer Science & Engineering
16.	CV	Civil Engineering
17.	EC	Electronics & Communication Engineering
18.	EE	Electrical & Electronics Engineering
19.	EI	Electronics & Instrumentation Engineering
20.	ET	Electronics & Telecommunication Engineering
21.	IM	Industrial Engineering & Management
22.	IS	Information Science & Engineering
23.	ME	Mechanical Engineering

INDEX

Computer Science & Engineering [Data Science]

FIFTH SEMESTER

Slo. No.	BoS	Course Code	Course Title	L	T	P	Credits	Category	Max Marks CIE		SEE Duration (H)	Max Marks SEE	
									Theory	Lab	Hours	Theory	Lab
1	HS	HS251TA	Principles of Management and Economics	3	0	0	3	Theory	**100**	***	**3**	**100**	***
2	CD	CD252IA	Database Management Systems (Common to CS & IS, AI, CD) (Theory & Practice)	3	0	1	4	Theory + Practice	**100**	**50**	**3**	**100**	**50**
3	IS	IS353IA	Artificial Intelligence and Machine Learning Common to CS, CY, CD & IS) (Theory & Practice)	3	0	1	4	Theory + Practice	**100**	**50**	**3**	**100**	**50**
4	CS	CS354TA	Theory of Computation (Common to CS, CY, CD & IS)	3	1	0	4	Theory	**100**	***	**3**	**100**	***
5	CD	XX355TBX	Professional Core Elective-I (Group-B)	3	0	0	3	Theory	**100**	***	**3**	**100**	***
6	CS	XX256TCX	Professional Core Elective-II (Group C)	2	0	0	2	**NPTEL**	***	***	**2**	**50**	***
				Total			**20**						

Group B: Professional Core Elective – I Courses				
Sl. No.	**BoS**	**Course Code**	**Course Title**	**Credits**
5	CD	CD355TBA	Soft and Evolutionary Computing	3
	CD	CD355TBB	Data Mining	3
	IS	IS355TBC	Natural Language Processing (Common to CS, CD & IS)	3
	IS	IS355TBD	Cloud Computing (Common to CS, CD & IS)	3

Group C: NPTEL COURSES (Professional Core Elective – II Courses)					
Sl. No.	**BoS**	**Course Code**	**Course Title**	**Category**	**Credits**
6	AI	AI256TCA	Information Security - 5 - Secure Systems Engineering (Common to CS, CY, CD, IS & AI)	NPTEL	2
	CS	CS256TCB	AI: Constraint Satisfaction (Common to CS, CD & CY)	NPTEL	2
	CS	CS256TCC	Foundation of Cloud IoT Edge ML (Common to CS, IS, CD & CY)	NPTEL	2
	CS	CS256TCD	Edge Computing (Common to CS, CY, CD & AI)	NPTEL	2
	IS	IS256TCE	Introduction To Soft Computing (Common to CS, IS, CD & CY)	NPTEL	2

Computer Science & Engineering [Data Science]

SIXTH SEMESTER									Max Marks CIE		SEE Duration (H)	Max Marks SEE	
Slo. No.	**BoS**	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credits**	**Category**	**Theory**	**Lab**	**Hours**	**Theory**	**Lab**
1	HS	HS361TA	Entrepreneurship and Intellectual Property Rights	3	0	0	3	Theory	**100**	***	**3**	**100**	***
2	CD	CD362IA	Big Data Systems (Theory & Practice)	3	0	1	4	Theory + Practice	**100**	**50**	**3**	**100**	**50**
3	CD	CD363IA	Data Analytics & Visualization (Theory & Practice)	3	0	1	4	Theory + Practice	**100**	**50**	**3**	**100**	**50**
4	IS	IS364TA	Software Engineering with Agile Technologies (Common to CS, IS, CD & CY)	4	0	0	4	Theory	**100**	***	**3**	**100**	***
5	CD	XX365TDX	Professional Core Elective-III **(Group- D)**	3	0	0	3	Theory	**100**	***	**3**	**100**	***
6	XX	XX366TEX	Institutional Electives – I **(Group E)**	3	0	0	3	Theory	**100**	***	**3**	**100**	***
7	CD	CD367P	Interdisciplinary Project	0	0	3	3	Project	***	**100**	**3**	***	**100**
			Total				**24**						

Group D: Professional Core Elective – III Courses				
Sl. No.	**BoS**	**Course Code**	**Course Title**	**Credits**
5	CS	CS365TDA	Computer Vision (Common to CS & CD)	3
	CD	CD365TDB	Semantic Web and Social Network Analysis	3
	CD	CD365TDC	Deep Learning (Common to CD & CY)	3
	AI	AI365TDD	Generative Artificial Intelligence (Common to AI, CS, CD & IS)	3
	CD	CD365TDE	Data Security and Privacy	3

Group E: Institutional Electives-I Courses				
Sl. No.	**BoS**	**Course Code**	**Course Title**	**Credits**
6	AS	AS266TEA	Fundamentals of Aerospace Engineering	3
	BT	BT266TEB	Bioinformatics	3
	CH	CH266TEC	Industrial Safety Engineering	3
	CS	CS266TED	Robotics Process Automation	3
	CV	CV266TEE	Intelligent Transport Systems	3
	CV	CV266TEF	Integrated Health Monitoring of Structures	3
	CM	CM266TEG	Advanced Energy Storage for E-Mobility	3
	EC	EC266TEH	Human Machine Interface(HMI)	3
	EE	EE266TEJ	Energy Auditing and Standards	3
	EI	EI266TEK	Biomedical Instrumentation	3
	ET	ET266TEM	Telecommunication Systems	3
	ET	ET266TEN	Mobile Communication Networks and Standards	3
	IS	IS266TEO	Mobile Application Development	3
	IM	IM266TEQ	Elements of Financial Management	3
	IM	IM266TER	Optimization Techniques	3
	ME	ME266TES	Automotive Mechatronics	3
	MA	MA266TEU	Mathematical Modelling	3
	MA	MA266TEV	Mathematics of Quantum Computing	3
	HS	HS266TEW	Applied Psychology for Engineers	3
	HS	HS266TEY	Universal Human Values	3

Semester: V						
PRINCIPLES OF MANAGEMENT AND ECONOMICS **Category: PROFESSIONAL CORE COURSE** **(Theory)** **(Common to All Programs)**						
Course Code	**:**	**HS251TA**		**CIE**	**:**	**100 Marks**
Credits: L: T: P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**06 Hrs**
Introduction to Management: Management Functions – POSDCORB – an overview, Management levels & Skills, Management History - **Classical Approach:** Scientific Management, Administrative Theory, **Quantitative Approach:** Operations Research, **Behavioral Approach:** Hawthorne Studies, **Contemporary Approach:** Systems Theory, Contingency Theory. **Caselets / Case studies**	
Unit – II	**10 Hrs**
Foundations of Planning: Types of Goals & Plans, Approaches to Setting Goals & Plans, Strategic Management Process, Corporate strategies – types of corporate strategies, BCG matrix, Competitive Strategies – Porters Five force Model, types of Competitive Strategies. **Caselets / Case studies** **Organizational Structure & Design:** Overview of Designing Organizational Structure - Work Specialization, Departmentalization, Chain of Command, Span of Control, Centralization & Decentralization, Formalization, Mechanistic & Organic Structures. **Caselets / Case studies**	
Unit –III	**10 Hrs**
Motivation: Early Theories of Motivation - Maslow's Hierarchy of Needs Theory, McGregor's Theory X & Theory Y, Herzberg's Two Factor Theory. Contemporary Theories of Motivation: Adam's Equitytheory, Vroom's Expectancy Theory. **Caselets / Case studies** **Leadership:** Behavioral Theories: Blake & Mouton's Managerial Grid, Contingency Theories of Leadership: Hersey & Blanchard's Situational Leadership, Contemporary Views of Leadership: Transactional & Transformational Leadership. **Caselets / Case studies**	
Unit –IV	**10 Hrs**
Introduction to Economics: Microeconomics and Macroeconomics, Circular flow model of economics, An Overview of Economic Systems. **Essentials of Microeconomics:** Demand, Supply, and Equilibrium in Markets for Goods and Services, Price Elasticity of Demand and Price Elasticity of Supply, Elasticity and Pricing, Numericals on determining price elasticity of demand and supply. Changes in Income and Prices Affecting Consumption Choices, Monopolistic Competition, Oligopoly.	
Unit –V	**09 Hrs**
Macroeconomic Indicators: Prices and inflation, Consumer Price Index, Exchange rate, Labor Market, Money and banks, Interest rate. Gross Domestic product (GDP) - components of GDP, Measures of GDP: Outcome Method, Income method and Expenditure method, Numericals on GDP Calculations, ESG an overview. **Macroeconomic models**- The classical growth theory, Keynesian cross model, IS-LM-model, The AS-AD model, The complete Keynesian model, The neo-classical synthesis. National Budgeting process in India	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Elucidate the principles of management theory & recognize the characteristics of an organization.
CO2:	Demonstrate the importance of key performance areas in strategic management and design appropriate organizational structures and possess an ability to conceive various organizational dynamics.
CO3:	Compare and contrast early and contemporary theories of motivation and select and implement the right leadership practices in organizations that would enable systems orientation.
CO4:	Demonstrate an understanding on the usage and application of basic economic principles.
CO5:	Appreciate the various measures of macro-economic performance and interpret the prevailing economic health of the nation.

Reference Books	
1	Management, Stephen Robbins, Mary Coulter &NeharikaVohra, 15th Edition, 2021, Pearson Education Publications, ISBN: 13: 978-0-13-558185-8
2	Management, James Stoner, Edward Freeman & Daniel Gilbert Jr, 6th Edition, 2009, PHI, ISBN: 81-203-0981-2.
3	Principles of Microeconomics, Steven A. Greenlaw, David Shapiro, 2nd Edition, 2017, ISBN:978-1-947172-34-0
4	Macroeconomics: Theory and Policy, Dwivedi D.N, 5th Edition, 2021, McGraw Hill Education; ISBN : 9789353163334

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (05), Program specific requirements (05), Video based seminar/presentation/demonstration (10), MATLAB (20). **ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1: (Compulsory)	16
3 & 4	Unit 2: Question 3 or 4	16
5 & 6	Unit 3: Question 5 or 6	16
7 & 8	Unit 4: Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: V						
DATABASE MANAGEMENT SYSTEMS **Category: PROFESSIONAL CORE COURSE** **(Theory and Practice)** **(Common to CS & IS, AI, CD)**						
Course Code	**:**	**CD252IA**		**CIE**	**:**	**100+50 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100+50 Marks**
Total Hours	**:**	**45L+30P**		**SEE Duration**	**:**	**3 +3 Hours**

Unit-I	**09 Hrs**
Introduction to Database Systems -Databases and Database users: Introduction, An example, Characteristics of Database Approach, Data Models, Schemas and Instances, Three-schema Architecture and Data Independence, The Database System Environment. **Data Modeling Using the Entity-Relationship Model-** High-Level Conceptual Data Models for Database Design; A Sample Database Application; Entity Types, Entity Sets, Attributes and Keys; Relationship types, Relationship Sets, Roles and Structural Constraints; Weak Entity Types.	
Unit – II	**09 Hrs**
Refining the ER Design for the COMPANY Database; ER Diagrams, Naming Conventions and Design Issues, ER- to-Relational Mapping. **Relational Model and Relational Algebra-**Relational Model Concepts; Relational Model Constraints and Relational Database Schemas; Update Operations and Dealing with Constraint Violations; Unary Relational Operations: SELECT and PROJECT; Relational Algebra Operations from Set Theory; Binary Relational Operations: JOIN and DIVISION ; Examples of Queries in Relational Algebra.	
Unit –III	**09 Hrs**
Introduction to SQL- SQL Data Definition, Specifying Constraints in SQL, Basic Queries in SQL; Insert, Delete and Update Statements in SQL More Complex SQL Retrieval Queries. **Relational Database Design -** Functional Dependencies – Definition, Inference Rules, Equivalence of sets of FD's, Minimal Set of FD's ; Normal Forms Based on Primary Keys; General Definitions of Second and Third Normal Forms; Boyce-Codd Normal Form; Properties of Relational Decompositions.	
Unit –IV	**09 Hrs**
Transaction Processing Concepts- Introduction to transaction processing, Transaction states and additional operations, Desirable properties of transaction, Schedules of transactions. Characterizing schedules based on Serializability: Serial, Non serial and Conflict- Serializable schedules, Testing for Conflict serializability of schedule **Concurrency Control Techniques:** Two phase locking techniques for concurrency control, types of locks and system lock tables	
Unit –V	**09 Hrs**
Introduction to NoSQL: Aggregate data models: aggregates, key-value and document data models. Distribution models: sharding, master-slave replication, peer-peer replication – combining sharding and replication. Big Data: Types of data: Structured, semi structured, unstructured. Distributed Architectures : Hadoop, Map Reduce Programming Model	

Course Outcomes: After completing the course, the students will be able to:	
CO1	Understand and explore the needs and concepts of relational, NoSQL database and Distributed Architecture
CO2	Apply the knowledge of logical database design principles to real time issues.
CO3	Analyze and design data base systems using relational, NoSQL and Big Data concepts
CO4	Develop applications using relational and NoSQL database
CO5	Demonstrate database applications using various technologies.

Reference Books	
1.	Elmasri and Navathe: Fundamentals of Database Systems, 6 th Edition, Pearson Education, 2011, ISBN-13: 978-0136086208.
2.	Pramod J Sdalage, Martin Fowler: NoSQL A brief guide to the emerging world of Polyglot Persistence, Addison-Wesley, 2012, ISBN 978-0-321-82662-6,
3.	Raghu Ramakrishnan and Johannes Gehrke : Database Management Systems, 3thEdition, McGraw-Hill, 2003 ISBN : 978-0072465631.
4.	Seema Acharya and Subhashini Chellappan. *Big Data and Analytics*. Wiley India Pvt. Ltd. Second Edition

LABORATORY COMPONENT

PART – A

Open Ended Mini Project should be implemented and shall be carried out in a batch of two students. The students will finalize a topic in consultation with the faculty. The mini project must be carried out in the college only.

The Mini Project tasks would involve:

- Understand the complete domain knowledge of application and derive the complete data requirement specification of the Mini Project
- Design of the project with Integrated database solution (SQL and NOSQL)
- Normalization of the Relational design up to 3NF.
- Appreciate the importance of security for database systems.
- Documentation and submission of report.
- Recent Trends used (Blockchain, NLP, AI, ML, AR, VR etc) and Societal Concern issues addressed

General Guidelines :

- Database management for the project- MySQL, DB2, Oracle, SQL Server, MongoDB (Any NoSQL DB) server or any database management tool.
- Front End for the project – Java , VC++, C#, Python , Web Interface (HTML, Java Script)
    - Use database Programming such as Embedded SQL,/Dynamic SQL/SQLJ.

RUBRICFOR THE CONTINUOUS INTERNAL EVALUATION		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. Each quiz is evaluated for 10 marks adding up to 20 MARKS	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**. Each test will be evaluated for **50Marks**, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing &Modeling (10) **Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
4.	**LAB:** Conduction of laboratory exercises, lab report, observation, and analysis (20 Marks), lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (20 Marks) adding up to 50 Marks. THE FINAL MARKS WILL BE 50 MARKS	**50**
	MAXIMUM MARKS FOR THE CIE (THEORY AND PRACTICE)	**150**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type of questions covering entire syllabus	20
	PART B (Maximum of THREE Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

RUBRIC FOR SEMESTER END EXAMINATION (LAB)		
Q.NO.	**CONTENTS**	**MARKS**
1	Write Up	10
2	Conduction of the Experiments	20
3	Viva	20
	TOTAL	**50**

Semester: V						
ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING **Category: PROFESSIONAL CORE COURSE** **(Theory and Lab)** (Common to CS, CD, CY & **IS**)						
Course Code	**:**	**IS353IA**		**CIE**	**:**	**100 + 50 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100 + 50 Marks**
Total Hours	**:**	**45L + 30P**		**SEE Duration**	**:**	**3 + 3 Hours**

Unit-I	**09 Hrs**
Introduction: What is AI? Intelligent agents: Intelligent Agents: Agents and environment; Rationality; the nature of environments; the structure of agents **Problem Solving & Uninformed Search Strategies:** Problem-solving agents, Breadth-first Search, Depth-first Search, Depth-limited Search and Iterative Deepening Depth First Search.	
Unit – II	**09 Hrs**
Informed (Heuristic) Search Strategies: A*Search, Heuristic Functions **Beyond Classical Search:** Local Search Algorithms and Optimization Problems, Hill-climbing Search, Simulated Annealing, Local-beam Search, Genetic Algorithms **Adversarial search:** Games, Optimal decision in games, Alpha-Beta Pruning	
Unit –III	**09 Hrs**
Supervised Learning: Basic Concepts, General Framework for Classification **Decision Tree Classifier**-A Basic Algorithm to Build a Decision Tree, Methods for Expressing Attribute Test Conditions, Measures for Selecting an Attribute Test Condition, Algorithm for Decision Tree Induction, Characteristics of Decision Tree Classifiers, **Model Overfitting**- Reasons for Model Overfitting **Model Selection** - Using a Validation Set, Incorporating Model Complexity, Estimating Statistical Bounds, Model Selection for Decision Trees, Model Evaluation	
Unit –IV	**09 Hrs**
Nearest Neighbor Classifiers-Characteristics of Nearest Neighbor Classifiers **Naive Bayes Classifier**-Basics of Probability Theory, Naive Bayes assumption **Logistic Regression**-Logistic Regression as a Generalized Linear Model, Learning Model Parameters, Characteristics of Logistic Regression **Ensemble Methods** – Methods for constructing Ensemble classifier, Bagging, Boosting, Random Forests	
Unit –V	**09 Hrs**
Unsupervised Learning- Overview, What Is Cluster Analysis, Different Types of Clustering's, Different Types of Clusters **K-means**-The Basic K-means Algorithm, Additional Issues, Bisecting K-means, K-means and Different Types of Clusters, Strengths and Weaknesses, K-means as an Optimization Problem **Cluster Evaluation**-Overview, Unsupervised Cluster Evaluation Using Cohesion and Separation, Unsupervised Cluster Evaluation Using the Proximity Matrix, Determining the Correct Number of Clusters, Supervised Measures of Cluster Validity, Assessing the Significance of Cluster Validity Measures, Choosing a Cluster Validity Measure	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Explain and apply AI and ML algorithms to address various requirements of real-world problems
CO 2	Design and develop AI and ML solutions to benefit society, science, and industry.
CO 3	Use modern tools to create AI and ML solutions.
CO 4	Demonstrate effective communication through team presentations and reports to analyze the impact of AI and ML solutions on society and nature.
CO 5	Conduct performance evaluation, modeling, and validation of AI and ML solutions benefiting lifelong learning

Reference Books	
1.	AI – A Modern Approach ,Stuart Russel, Peter Norvig, 3rd Edition, 2010, Pearson, ISBN-13: 978-0136042594
2.	Artificial Intelligence Basics: A Self Teaching Introduction, Neeru Gupta and Ramita Mangla, Mercury Learning and Information, 1st Edition, 2020, ISBN: 978-1-68392-516-3
3.	Machine Learning ,Tom M. Mitchell, Indian Edition, 2013, McGraw Hill Education, ISBN – 10 – 1259096955
4.	Introduction to Data Mining ,Pang-Ning Tan, Michael Steinbach, Vipin Kumar,2nd edition, 2019,Pearson , ISBN-10-9332571406, ISBN-13 -978-9332571402

LABORATORY COMPONENT

PART – A	
Sl. No.	• Implement the following algorithms (5 to 8) using required statistical formulae and do not use direct API's. • Demonstrate the working of the algorithms by considering appropriate datasets • Display the values of all the model parameters
1	Solve the Tic-Tac-Toe problem using the Depth First Search technique
2	Demonstrate the working of Alpha-Beta Pruning.
3	Solve the 8-Puzzle problem using the A* algorithm
4	Implement a Hill-climbing search algorithm to maximize a single variable function f(x).
5	Logistic regression algorithm.
6	Naïve Bayes Classifier
7	KNN algorithm.
8	K- means algorithm

PART – B

Two students from the same batch must develop a Machine Learning model on the problem statements chosen from Agriculture, Health Care, Manufacturing, Automobiles and Process Control/Automation Domains preferably for Indian Scenarios. (Point No. 3 and 4 are optional)

1. The data collected should be cleansed and pre-processed.
2. The complete EDA process has to be demonstrated
3. Selection of the suitable algorithms and model-building
4. Model evaluation has to be carried out by selecting the proper metrics
    a) Prediction/classification results have to be obtained
    b) GUI should be created for demonstrating the results

RUBRICFOR THE CONTINUOUS INTERNAL EVALUATION		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. Each quiz is evaluated for 10 marks adding up to 20 MARKS	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**. Each test will be evaluated for **50Marks**, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing &Modeling (10) **Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
4.	**LAB:** Conduction of laboratory exercises, lab report, observation, and analysis (20 Marks), lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (20 Marks) adding up to 50 Marks. THE FINAL MARKS WILL BE 50 MARKS	**50**
	MAXIMUM MARKS FOR THE CIE (THEORY AND PRACTICE)	**150**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type of questions covering entire syllabus	20
	PART B (Maximum of THREE Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

RUBRIC FOR SEMESTER END EXAMINATION (LAB)		
Q.NO.	**CONTENTS**	**MARKS**
1	Write Up	10
2	Conduction of the Experiments	20
3	Viva	20
	TOTAL	**50**

Semester: V						
THEORY OF COMPUTATION **Category: PROFESSIONAL CORE COURSE** **(Theory)** **(Common to CS, CD, CY & IS)**						
Course Code	**:**	**CS354TA**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:1:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L + 30T**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**09 Hrs**
Regular Languages and Regular Expressions, Memory Required to Recognize a Language, Deterministic Finite Automata (DFA), Non Deterministic Finite Automata (NFA), Non Deterministic Finite Automata with ϵ -transitions (NFA-ϵ), Equivalence, Regular Expressions and Finite Automata, Applications of Regular Expressions, Algebraic laws of Regular Expressions, Minimization of Finite Automata.	
Unit – II	**09 Hrs**
Pumping Lemma for Regular Languages, Closure properties of Regular Languages, Decision properties of Regular languages. Context-free grammars (CFG), Parse trees, Applications, Ambiguity in grammars & languages, Simplification of CFG, Normal forms of CFGs. Regular Grammars, Equivalence of Regular Grammars and Finite Automata.	
Unit –III	**09 Hrs**
Push Down Automata (PDA): Definition, the languages of a PDA, Equivalence of PDA's & CFG's, Deterministic PDA. The Pumping Lemma for Context Free Languages (CFL), Closure properties of CFLs, Decision properties of CFLs	
Unit –IV	**09 Hrs**
Context Sensitive Languages (CSL) and Linear Bounded Automata (LBA), Turing Machines (TM): Definitions and Examples, TM as a Language Accepter, Computing Partial Functions with Turing Machine, Variations of Turing Machines, Combining Turing Machines, Non Deterministic TM, Universal TM.	
Unit –V	**09 Hrs**
Recursively Enumerable Languages (REL) and Recursive Languages. Properties of REL and Recursive Languages. More General Grammars: Context Sensitive Grammar and Unrestricted Grammar, Chomsky Hierarchy, Not all languages are Recursively Enumerable, Unsolvable Problem, Reducing One problem to another, The halting problem of TM, Post's Correspondence Problem (PCP), Time and Space Complexity of TM.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the fundamental concepts of theory of computations.
CO 2	Analyze the tools of finite automata to various fields of computer science.
CO 3	Design solution model for complex problems, using the appropriate skills of automata theory for better results.
CO 4	Apply automata skills in situations that describe computation effectively and efficiently.

Reference Books	
1.	Introduction to Languages & Theory of Computation, John C Martin, Tata McGraw-Hill, 4th Edition, 2011 ISBN: 978-0-07-319146-1.
2.	Introduction to Automata Theory, Languages & Computation, J.P.Hopcroft, Rajeev Motwani, J.D.Ullman, Pearson Education., 3rd Edition, 2008,ISBN:81-3172-047-0.
3.	An Introduction To Formal Languages & Automata, Peter Linz, Narosa Publishing House, 6th Edition, 2007, ISBN: 07-6371-422-4.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks adding up to 20 Marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20)ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: V						
SOFT AND EVOLUTIONARY COMPUTING **Category: PROFESSIONAL CORE COURSE ELECTIVE-I** **(Group-B)** **(Theory)**						
Course Code	**:**	**CD355TBA**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**09 Hrs**
Introduction to soft computing: Introduction, Requirement of Soft computing, Major Areas of Soft Computing, Applications of Soft Computing. **Introduction to Fuzzy logic:** Introduction, Fuzzy membership functions, Operations on Fuzzy sets, Membership value Assignments, Intuition, Inference, Features of the Membership Function.	
Unit – II	**09 Hrs**
Fuzzy Relations and Defuzzification: Fuzzy Relations, Cardinality of Fuzzy Relations, Operations on Fuzzy Relations, Properties of Fuzzy Relations, Fuzzy Cartesian product and Composition, Fuzzy Tolerance and equivalence Relations. Value Assignments - Cosine Amplitude, Max-min Method **Fuzzification and Defuzzification:** Fuzzification, defuzzification to crisp sets, Lambda-cuts for fuzzy relations, Defuzzification to Scalars	
Unit –III	**09 Hrs**
Fundamentals of Artificial Neural Networks: Introduction, learning & acquisition of knowledge, features of artificial neural networks (ANN), Back Propagation networks, fundamentals of connectionist modelling. **Major classes of Neural Networks:** Introduction, the multilayer perceptron, radial basis function network, Kohonen's self-organizing network, the Hopfield network, Industrial and commercial applications of ANN	
Unit –IV	**09 Hrs**
Evolutionary computing: Introduction, overview of evolutionary computing, genetic algorithms (GA) and optimization, the schema theorem, GA operators, Problem solving using GA, Integration of GA with neural networks, integration of GA with fuzzy logic, known issues in GA, Population based incremental learning, Applications of Genetic Algorithm; Hybrid Systems, Evolutionary strategies, ES applications.	
Unit –V	**09 Hrs**
Tools of soft computing in real world applications: Soft computing tools for solving a class of facilities layout planning problem, mobile position estimation using an RBF network in CDMA cellular systems, learning-based resource optimization in ATM networks. **Optimization problems**- Exhaustive vs Heuristic approaches, Typical problems, Heuristic vs Meta heuristics, Local Search, Tabu search, Simulated Annealing, Ant Colony Optimisation.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Apply the principles and components of soft computing in solving problems.
CO 2	Explore and understand basic concepts of of fuzzy sets and relations, fuzzy logic extension principle in the field of computer science and Engineering.
CO 3	Develop program systems using approaches of these theories for solving various real-world problems.
CO 4	Evaluate the concepts of optimization theory genetic computing, and evolutionary computing.
CO 5	Develop intelligent systems through case studies, simulation examples and experimental results.

Reference Books	
1.	Fuzzy Logic with Engineering Applications Timothy J. Ross (Wiley)
2.	Soft Computing and Intelligent Systems Design – Theory Tools and Applications, Fakhreddine O Karray & Clarence De Silva, 2009, PEARSON Education, ISBN: 978-81-317-2324-1.
3.	Neural Networks and Learning Machines Simon Haykin (PHI)
4.	Fuzzy and Soft Computing; A Computational Approach to Learning and Machine Intelligence, J S R Jang, C-T Sun, E Mizatani, Neurp, 1997, Prentice Hall, ISBN: 10:0132610663.
5.	Soft Computing and its Applications, K A Thev & RR Aliev, 2001, World Scientific Publishing Co., Inc. River Edge, NJ, USA, ISBN: 98102 47001.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks adding up to 20 Marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: V						
DATA MINING **Category: PROFESSIONAL CORE COURSE ELECTIVE-I** **(Group-B)** **(Theory)**						
Course Code	**:**	**CD355TBB**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**09 Hrs**
Data Warehousing: Introduction to Datawarehouse, Data Warehousing: A Multitiered Architecture, Data Warehousing: A Multitiered Architecture, Data Warehouse Models: Enterprise Warehouse, Data Mart, and Virtual Warehouse, Data Cube: A Multidimensional Data Model, Stars, Snowflakes, and Fact Constellations: Schemas for Multidimensional Data Models, Typical OLAP Operations, A Starnet Query Model for Querying Multidimensional Databases, A Business Analysis Framework for Data Warehouse Design, Data Warehouse Design Process, Data Warehouse Usage for Information Processing, From Online Analytical Processing to Multidimensional Data Mining	
Unit – II	**09 Hrs**
Introduction to Data Mining: Introduction to data mining - Data mining functionalities - Steps in data mining process Classification of data mining systems - Major issues in data mining. **Data Pre-processing:** Data Pre-processing: An overview - Data cleaning - Data integration -Data reduction - Data transformation	
Unit –III	**09 Hrs**
Frequent Pattern Mining: Frequent Pattern Mining: Basic Concepts and a Road Map - Efficient and scalable frequent item set mining methods: Apriori algorithm, FP-Growth algorithm - Mining frequent item sets using vertical data format **Advanced Pattern Mining:** Pattern Mining in Multilevel, Multidimensional Space, Constraint-Based Frequent Pattern Mining, Mining High-Dimensional Data and Colossal Patterns, Mining Compressed or Approximate Patterns, Pattern Exploration and Application	
Unit –IV	**09 Hrs**
Classification Techniques: General approach to classification - Classification by decision tree induction - Bayes classification methods - Model evaluation and selection - Techniques to improve classification accuracy **Classification: Advanced Methods:** Bayesian Belief Networks, Classification by Backpropagation, Support Vector Machines, Classification Using Frequent Patterns, advanced classification methods: Bayesian belief networks-Lazy learners	
Unit –V	**09 Hrs**
Data Mining Trends and Research Frontiers: Overview of Web Mining-Temporal and Spatial Mining-Other methodologies of data mining: Statistical data mining- Data mining applications, Data Mining and Society, Ubiquitous and Invisible Data Mining, Privacy, Security, and Social Impacts of Data Mining	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Interpret the contribution of data warehousing and data mining to the decision support systems
CO 2	Construct the data needed for data mining using pre-processing techniques.
CO 3	Discover interesting patterns from large amounts of data using Association Rule Mining.
CO 4	Extract useful information from the labelled data using various classifiers and Compile unlabelled data into clusters applying various clustering algorithms.
CO 5	Demonstrate capacity to perform a self-directed piece of practical work that requires the application of data mining techniques.

Reference Books	
1.	Jiawei Han and Micheline Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann Publishers, third edition, 2013.
2.	Parteek Bhatia, Data Mining and Data Warehousing: Principles and Practical Techniques, Cambridge University Press, 2019.
3.	Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, Vipin Kumar, Introduction to Data Mining, Pearson, 2nd Edition, 2019.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks adding up to 20 Marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20)ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: V						
NATURAL LANGUAGE PROCESSING **Category: PROFESSIONAL CORE COURSE ELECTIVE-I** **(Group-B)** **(Theory)** **(Common to CS, CD & IS)**						
Course Code	**:**	**IS355TBC**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39L**		**SEE Duration**	**:**	**3 Hours**

Unit-I	08 Hrs
Introduction to NLP: NLP in the Real-world, NLP Tasks, what is Language: Building Blocks of Language, Why NLP is Challenging, Machine Learning, Deep Learning, and NLP: An Overview, Approaches to NLP: Heuristic based NLP, Machine Learning for NLP, Deep Learning for NLP, Why Deep Learning is not Yet the Silver Bullet for NLP, An NLP Walkthrough: Conversational Agents **NLP Pipeline:** Data Acquisition, Text Extraction and Cleanup: HTML Parsing and Cleanup, Unicode Normalization, Spelling Correction, System-Specific Error Correction, Pre-Processing: Preliminaries, Frequent Steps, Other Pre-Processing Steps	
Unit – II	**08 Hrs**
Accessing Text Corpora Accessing Text Corpora, Brown Corpus, Loading your own corpus, Annotated text corpus, Conditional Frequency Distributions, WordNet. **Processing Raw Text** : Regular Expressions for Detecting Word Patterns, Useful Applications of Regular Expressions, Normalizing Text ,Regular Expressions for Tokenizing Text **Extracting Information from the text :** Information Extraction, Chunking, Developing, Named Entity Recognition, Term weighting, Inverse document frequency	
Unit –III	**07 Hrs**
Analyzing Sentence Structure: Some Grammatical Dilemmas, What's the Use of Syntax?, Context-Free Grammar, Parsing with Context-Free Grammar. **Analyzing the Meaning of words and Sentences :** The semantics of English sentences, Representing Meaning, Semantic Analysis, Lexical semantics, Word- sense disambiguation.	
Unit –IV	**08 Hrs**
Transformers Basics The Encoder-Decoder Framework, Attention Mechanisms, Transfer Learning in NLP, Hugging Face Transformers: Bridging the Gap, A Tour of Transformer Applications: Text Classification, Named Entity Recognition, Question Answering, Summarization, Translation, Text Generation, The Hugging Face Ecosystem: The Hugging Face Hub, Hugging Face Tokenizers, Hugging Face Datasets, Hugging Face Accelerate, Main Challenges with Transformers. **Text Classification** The Dataset: A First Look at Hugging Face Datasets, From Datasets to Data Frames, looking at the Class Distribution, How Long Are Our Tweets? From Text to Tokens: Character Tokenization, Word Tokenization, Subword Tokenization, Tokenizing the Whole Dataset, Training a Text Classifier: Transformers as Feature Extractors, Fine-Tuning Transformers	

Unit –V	08 Hrs
NLP Applications: Machine translation, Basic issues in MT. Statistical translation, Sentiment Analysis, Chat-Bot, Question Answering System, Text Classification, Spell Checking and Market Intelligence. **Information Retrieval:** Vector space model, term weighting	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the approaches to syntax and semantics in Natural Language Processing, the various types of language processors, the elements of formal language theory, the types of grammar, and the computational morphology.
CO 2	Understand the basic parsing technique for context-free grammars, the data structures and algorithms for parsing, and the approaches to ambiguity resolution.
CO 3	Design and Develop agents that use Transformers for natural language understanding and generation
CO 4	Comprehend and compare different natural language models.

Reference Books	
1.	Practical Natural Language Processing: A Comprehensive Guide to Building Real-World NLP Systems, Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta & Harshit Surana , 1st Edition, 2020, O'Reilly, ISBN: 978-1-492-05405-4
2.	Steven Bird, Ewan Klein, Edward Loper, ―Natural Language Processing with Python,‖ Publisher: O'Reilly Media, June 2009, ISBN : 9780596516499
3.	Python 3 Text Processing with NLTK 3 Cookbook, Jacob Perkins 2014, 1st Edition, Packt Publishing, ISBN 978-1-78216-785-3
4.	Natural Language Processing with Transformers: Building Language Applications with Hugging Fac,Lewis Tunstall, Leandro von Werra, and Thomas Wolf, 2022, 1st Edition, O'Reilly Media, ISBN: 978-1-098-10324-8

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks adding up to 20 Marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20)ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: V						
CLOUD COMPUTING **Category: PROFESSIONAL CORE COURSE ELECTIVE-I** **(Group-B)** **(Theory)- (Common to CS, CD & IS)**						
Course Code	**:**	**IS355TBD**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42L**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**08 Hrs**
Defining Cloud Computing Cloud Types, Examining the Characteristics of Cloud Computing, Assessing the Role of Open Standards **Understanding Services and Applications by Type** Defining Infrastructure as a Service (IaaS), Defining Platform as a Service (PaaS), Defining Software as a Service (SaaS), Defining Identity as a Service (IDaaS), Defining Compliance as a Service (CaaS).	
Unit – II	**08 Hrs**
Understanding Cloud Architecture Exploring the Cloud Computing Stack, Connecting to the Cloud **Understanding Service Oriented Architecture** Introducing Service Oriented Architecture, Defining SOA Communications, Managing and Monitoring SOA, Relating SOA and Cloud Computing	
Unit –III	**09 Hrs**
Cloud Computing Technology Hardware and Infrastructure: Clients, Security, Network, Services Accessing the Cloud: Platforms, Web Applications, Web APIs, Web Browsers Cloud Storage: Overview, Cloud Storage Providers Standards: Application, Client, Infrastructure, Service	
Unit –IV	**09 Hrs**
Understanding Abstraction and Virtualization Using Virtualization Technologies, Load Balancing and Virtualization, Understanding Hypervisors, Understanding Machine Imaging, Porting Applications **Capacity Planning** Capacity Planning, Defining Baseline and Metrics, Network Capacity, Scaling	
Unit –V	**08 Hrs**
Developing Applications Google, Microsoft, Intuit QuickBase, Cast Iron Cloud, Bungee Connect, Development, Troubleshooting, Application Management	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the basics of cloud computing models and virtualization.
CO 2	Analyse the issues related to the development of cloud applications.
CO 3	Apply the concepts to design cloud based simple applications.
CO 4	Identify solutions through cloud based software for real world case studies.

Reference Books	
1.	Barrie Sosinsky,"Cloud computing bible", CRC Press, 2010, ISBN: 978-0-470-90356-8.
2.	Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A practical Approach", Wiley India, 2011, ISBN: 0071626948.
3.	George Reese, "Cloud Application Architectures", Wiley India 2011, ISBN: 978-0596156367.
4.	Eugene Ciurana, "Developing with Google App Engine" Wiley India 2011 ISBN: 978-1430218319.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks adding up to 20 Marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20)ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**