RAJALAKSHMI ENGINEERING COLLEGE

CURRICULUM AND SYLLABUS

B.Tech. COMPUTER SCIENCE AND BUSINESS SYSTEMS

REGULATION 2023

RAJALAKSHMI ENGINEERING COLLEGE
CURRICULUM AND SYLLABUS
B.Tech. COMPUTER SCIENCE AND BUSINESS SYSTEMS
REGULATION 2023

VISION

- To promote highly ethical and innovative computer professionals through excellence in teaching, training and research.

MISSION

- To produce globally competent professionals, motivated to learn the emerging technologies and to be innovative in solving real world problems.
- To promote research activities amongst the students and the members of faculty that could benefit the society.
- To impart moral and ethical values in their profession.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. To equip students with state-of-the-art contemporary technology in computer science and basic engineering science.
2. To expose students to the business principles aligned with their domain.
3. To educate on the service orientation principles for various business disciplines.
4. To encourage innovative research through creative thinking and critical analytical ability.
5. To inculcate ethical and moral values in the individuals benefitting the society.

PROGRAM OUTCOMES (POs)

A graduate of the Computer Science and Business Systems program will demonstrate:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

A graduate of the Computer Science and Business Systems program will demonstrate:

1. The students graduating will have sound knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

2. The students will explore emerging topics such as Analytics, Machine Learning, Cloud Computing, and Internet of Things and apply the knowledge to design and develop solutions to societal needs.

3. The students will be industry ready with required business skills in service orientation.

CURRICULUM

B. Tech COMPUTER SCIENCE AND BUSINESS SYSTEMS
Regulation 2023 | Total Credits: 165

CHOICE BASED CREDIT SYSTEM

SEMESTER I

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY COURSES								
1.	HS23112	Business Communication and Value Science – I	HS	2	2	0	0	2
2.	MA23115	Discrete Mathematics	BS	4	3	1	0	4
3.	MA23114	Probability and Calculus	BS	4	3	1	0	4
4.	GE23117	தமிழர் மரபு / Heritage of Tamils	HS	1	1	0	0	1
LAB ORIENTED THEORY COURSES								
5.	CB23131	Fundamentals of Computer Science	PC	6	2	0	4	4
6.	EE23131	Principles of Electrical Engineering	ES	4	2	0	2	3
7.	PH23133	Physics for Computing Science	BS	5	3	0	2	4
MANDATORY COURSES								
8.	MC23111	Indian Constitution and Freedom Movement	MC	3	3	0	0	0
			TOTAL	29	19	2	8	22

SEMESTER II

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY COURSES								
1.	MA23211	Linear Algebra	BS	4	3	1	0	4
2.	BA23217	Fundamentals of Economics	MS	2	2	0	0	2
3.	GE23217	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HS	1	1	0	0	1
LAB ORIENTED THEORY COURSES								
4.	MA23231	Statistical Modeling	BS	5	3	0	2	4
5.	CB23231	Data Structures and Algorithms	PC	7	2	1	4	5
6.	EC23242	Principles of Electronics	ES	4	2	0	2	3
LABORATORY COURSES								
7.	CS23221	Python Programming Lab	PC	4	0	0	4	2
8.	HS23223	Business Communication and Value Science – II	HS	4	0	0	4	2
			TOTAL	31	13	2	16	23

SEMESTER III

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY COURSES								
1.	CB23311	Formal Language and Automata Theory	PC	3	3	0	0	3
2.	CB23312	Computer Organization and Architecture	PC	3	3	0	0	3
LAB ORIENTED THEORY COURSES								
3.	CB23331	Computational Statistics	PC	5	3	0	2	4
4.	CB23332	Software Engineering	PC	5	3	0	2	4
5.	CB23333	Database Technology	PC	5	3	0	2	4
6.	CS23333	Object Oriented Programming Using Java	PC	7	1	0	6	4
MANDATORY COURSES								
7.	MC23313	Environmental Sciences	MC	3	3	0	0	0
			TOTAL	**31**	**19**	**0**	**12**	**22**

SEMESTER IV

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY COURSES								
1.	CB23411	Introduction to Innovation, IP Management and Entrepreneurship	EEC	3	3	0	0	3
2.	BA23412	Fundamentals of Management	MS	2	2	0	0	2
LAB ORIENTED THEORY COURSES								
3.	CB23431	Operating System Concepts	PC	5	3	0	2	4
4.	CB23432	Software Design with UML	PC	4	2	0	2	3
5.	CB23433	Analysis of Algorithms and Design	PC	5	2	1	2	4
6.	MA23437	Optimization Techniques	BS	5	3	0	2	4
LABORATORY COURSES								
7.	HS23421	Business Communication and Value Science – III	HS	4	0	0	4	2
EMPLOYABILITY ENHANCEMENT COURSES								
8.	GE23421	Soft Skills-I	EEC	2	0	0	2	1
			TOTAL	**30**	**15**	**1**	**14**	**23**

SEMESTER V

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY COURSES								
1.	BA23511	Principles of Financial Management	MS	2	2	0	0	2
2.		Open Elective I	OE	3	3	0	0	3
LAB ORIENTED THEORY COURSES								
3.	CB23531	Computer Network Technology	PC	5	3	0	2	4
4.	CB23532	Artificial Intelligence	PC	5	3	0	2	4
5.		Professional Elective I	PE	5	2	1	2	4
LABORATORY COURSE								
6.	GE23627	Design Thinking and Innovation	PC	4	0	0	4	2
EMPLOYABILITY ENHANCEMENT COURSES								
7.	GE23521	Soft Skills- II	EEC	2	0	0	2	1
8.	CB23621	Internship	EEC	2	0	0	2	1
			TOTAL	28	13	1	14	21

SEMESTER VI

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY COURSES								
1.	BA23611	Financial and Cost Accounting	MS	2	2	0	0	2
2.	BA23612	Business Strategy	MS	2	2	0	0	2
LAB ORIENTED THEORY COURSES								
3.	CB23631	Machine Learning	PC	5	2	1	2	4
4.	CB23632	Cloud, Micro services and Application	PC	5	2	1	2	4
5.	CB23633	Usability Design of Software Applications	PC	4	2	0	2	3
6.		Professional Elective II	PE	3	3	0	0	3
LABORATORY COURSES								
7.	HS23621	Business Communication and Value Science – IV	HS	4	0	0	4	2
EMPLOYABILITY ENHANCEMENT COURSES								
8.	GE23621	Problem Solving Techniques	EEC	2	0	0	2	1
			TOTAL	27	13	2	12	21

SEMESTER VII

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY COURSES								
1.		Open Elective – II	OE	3	3	0	0	3
LAB ORIENTED THEORY COURSES								
2.	CB23731	Data Visualization Techniques	PC	4	2	0	2	3
3.	CB23732	IT Project Management	PC	4	2	0	2	3
4.		Professional Elective III	PE	5	3	0	2	4
5.		Professional Elective IV	PE	5	2	1	2	4
LABORATORY COURSES								
6.	CB23721	Project Evaluation I	EEC	4	0	0	4	2
			TOTAL	25	12	1	12	19

SEMESTER VIII

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
LAB ORIENTED THEORY COURSES								
1.		Professional Elective V	PE	3	3	0	0	3
2.		Professional Elective VI	PE	4	2	0	2	3
LABORATORY COURSES								
3.	CB23821	Project Evaluation II	EEC	16	0	0	16	8
			TOTAL	23	5	0	18	14

TOTAL NO. OF CREDITS: 165

PROFESSIONAL ELECTIVES

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
		Business Analytics						
1.	MCB2301	Fundamentals of Business Statistics	PE	3	3	0	0	3
2.	MCB2302	Digital Marketing and Web Analytics	PE	3	3	0	0	3
3.	MCB2303	Operation and Supply Chain Analytics	PE	3	3	0	0	3
4.	CB23A11	Enterprise Resource planning and Development	PE	3	2	0	2	3
5.	MCB2341	Data Science for Business Analytics	PE	5	3	0	2	4
6.	MCB2342	Programming for Data Analytics	PE	6	2	0	4	4

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
		Business Systems						
7.	BA23B11	Behavioral Economics	PE	3	3	0	0	3
8.	BA23B31	Computational Finance and Modeling	PE	3	3	0	0	3
9.	BA23B12	Industrial Psychology	PE	3	3	0	0	3
10.	BA23B13	Advance Finance	PE	3	3	0	0	3
11.	BA23B14	Essentials of Human Resources Management	PE	3	3	0	0	3
12.	BA23B15	Marketing Research and Marketing Management	PE	3	3	0	0	3
13.	BA23P12	Fintech and Blockchain Applications in Finance	PE	3	3	0	0	3
14.	BA23B16	Services Science and Service Operational Management	PE	3	3	0	0	3

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
		AI Systems						
15.	CB23C11	Cognitive Science and Analytics	PE	3	3	0	0	3
16.	CB23C31	Image Processing and Pattern Recognition	PE	4	2	0	2	3
17.	CB23C12	Generative Artificial Intelligence	PE	3	3	0	0	3
18.	CB23C32	Conversational Systems	PE	4	2	0	2	3
19.	CB23C33	Algorithmic Business Thinking	PE	3	3	0	0	3
20.	AI23632	Natural Language Processing	PE	5	3	0	2	4
21.	IT23531	Computer Vision	PE	5	3	0	2	4

Data Analytics

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
22.	CB23D31	Data Mining and Analytics	PE	5	3	0	2	4
23.	CB23D32	Decision Support Systems	PE	5	3	0	2	4
24.	CB23D33	Advanced Social, Text and Media Analytics	PE	5	3	0	2	4
25.	AI23531	Deep Learning	PE	5	3	0	2	4
26.	AI23A36	Big Data Analytics	PE	5	2	0	2	3
27.	AD23A35	Healthcare Analytics	PE	4	2	0	2	3

Cloud, IoT and Security

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
28.	CB23E31	Information Security	PE	5	3	0	2	4
29.	CB23E32	Fundamentals of IoT	PE	5	2	1	2	4
30.	CB23E33	Mobile Computing	PE	4	2	0	2	3
31.	CB23E34	Cyber security for Business	PE	4	2	0	2	3
32.	CB23E35	Enterprise Systems	PE	4	2	0	2	3
33.	CR23A34	Security and Privacy in cloud	PE	4	2	0	2	3
34.	CB23E36	Cryptology	PE	5	2	1	2	4

Programming and Testing

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
35.	CB23F31	Modern Web Applications	PE	4	2	0	2	3
36.	CB23F32	Scripting Languages	PE	4	2	0	2	3
37.	IT23B31	C# and .Net programming	PE	4	2	0	2	3
38.	IT23C31	Software Testing	PE	4	2	0	2	3
39.	IT23B33	DevOps	PE	4	2	0	2	3
40.	CB23F33	IT Workshop	PE	4	2	0	2	3
41.	CB23F34	Compiler Design Techniques	PE	5	2	1	2	4

		Emerging Technologies						
S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
42.	CB23G11	Quantum Computation and Quantum Information	PE	3	3	0	0	3
43.	CB23G31	Robotics and Embedded Systems	PE	4	2	0	2	3
44.	CS23A32	Robotic Process Automation	PE	5	1	0	4	3
45.	CR23A33	Cryptocurrency and Blockchain Technologies	PE	4	2	0	2	3
46.	CS23B31	Introduction to Metaverse	PE	4	2	0	2	3
47.	CS23A39	Game Development	PE	4	2	0	2	3

Summary:

		B.Tech Computer Science and Business Systems								
		Credits per semester								Total Credits
S.No.	Category	1	2	3	4	5	6	7	8	
1.	HS	3	3		2		2			10
2.	BS	12	8		4					24
3.	ES	3	3							6
4.	PC	4	7	22	11	10	11	6		71
5.	MS		2		2	2	4	0		10
6.	PE					4	3	8	6	21
7.	OE					3		3		6
8.	EEC				4	2	1	2	8	17
9.	Mandatory Course	0	0	0	0	0	0	0	0	0
	Total	22	23	22	23	21	21	19	14	165

I SEMESTER

Course Code	Course Title	Category	L	T	P	C
HS23112	**BUSINESS COMMUNICATION AND VALUE SCIENCE – I** **For I Semester B.Tech. - CSBS**	HS	2	0	0	2

Objectives:	
●	To enable learners, understand what life skills are and their importance in leading a happy life.
●	To equip students with better grammar and vocabulary skills
●	To improve the learners' basic proficiency in workplace communication
●	To aid students write effectively in all kinds of communicative contexts.
●	Introduce them to key concepts of values, life skills and business communication.

UNIT-I	HUMAN VALUES	6
Values – Self exploration – Values of individuals: Presentation on favorite personality and the skills and values they demonstrate – interviewing a maid, watchman, sweeper, cab driver, beggar and narrate what you think are the values that drive them – Writing: Good and bad writing - Common errors, punctuation rules, use of words - newspaper report on an IPL match – record conversation between a celebrity and an interviewer.		

UNIT-II	GRAMMAR AND LANGUAGE DEVELOPMENT	6
Parts of Speech - Applications of tenses - Sentence formation, sentence structure, show sequence - Voices – Questioning – **Vocabulary:** Word formation: - Synonyms, antonyms, abbreviations - compound words –single word substitution.		

UNIT-III	ESSENTIALS OF TECHNICAL COMMUNICATION	6
Email - : Formal and informal emails - words from General Service List (GSL) by West, Academic word list (AWL) - technical specific terms related to the field of technology - phrases, idioms, significant abbreviations - formal business vocabulary.		

UNIT-IV	BASIC WRITING SKILLS	6
Reading articles – Summary writing, story writing - writing your comprehensive CV - Create a podcast on a topic - Promote a play through a social media and gather audience		

UNIT-V	APPLICATION OF LIFE SKILLS	6
Life Skills: Movie based learning – identifying skills and values - critical life skills - appreciation of diversity		

	Total Contact Hours	:	30

Course Outcomes:	
On completion of the course, students will be able to	
●	Recognize the need for life skills and values
●	Frame grammatically correct sentences with appropriate vocabulary
●	Communicate proficiently at the workplace.
●	Write efficiently in various communicative contexts.
●	Understand and follow the basic values and dogmas in life

SUGGESTED ACTIVITIES
- Ice breaker
- Story telling
- Just a Minute (JAM)
- Green Screen

- Vocabulary building
- Case study

SUGGESTED EVALUATION METHODS
- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Reference Books / Web links:	
1	Alan Mc'Carthy and O'dell , "English vocabulary in use",Fourth Edition, Cambridge University Press, 2017.
2	APAART: Speak Well 1 (English language and communication)
3	APAART: Speak Well 2 (Soft Skills)
4	Dr. Saroj Hiremath, "Business Communication", Fourth Edition, NIRALI PRAKASHAN Publication,2017
Web References	
1	Train your mind to perform under pressure- Simon sinek https://curiosity.com/videos/simon-sinek-on-training-your-mind-to-perform-under-pressure-capture-your-flag/
2	Brilliant way one CEO rallied his team in the middle of layoffs https://www.inc.com/video/simon-sinek-explains-why-you-should-put-people-before-numbers.html
3	Will Smith's Top Ten rules for successhttps://www.youtube.com/watch?v=bBsT9omTeh0
Online Resources	
1	https://www.coursera.org/learn/learning-how-to-learn
2	https://www.coursera.org/specializations/effective-business-communication

CO- PO – PSO matrices of course

1: Slight (Low)
2: Moderate (Medium)
3: Substantial (High) If there is no correlation, put "-"

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	**PSO1**	**PSO2**	**PSO3**
HS23112.1	-	-	1	-	1	3	1	3	3	3	2	-	3	-	2
HS23112.2	-	-	1	-	1	1	1	2	3	3	1	-	3	-	1
HS23112.3	-	-	2	2	2	2	1	1	3	3	1	3	2	-	3
HS23112.4	-	-	-	1	-	-	1	-	2	3	1	1	2	-	2
HS23112.5	-	-	-	2	-	2	1	2	2	3	1	1	1	-	3
Average	-	-	1.33	1.66	1.33	2.0	1	2.0	2.6	3	1.2	1.66	2.2	-	2.2

Course Code	Course Title	Category	L	T	P	C
MA23115	**DISCRETE MATHEMATICS**	BS	3	1	0	4
	For I sem. B.Tech. – CSBS					

Objectives:
● To extend student's Logical and Mathematical maturity and ability to deal with abstraction.
● To give an understanding of relations and functions and to determine their properties.
● To Model problems in Computer Science using graphs and trees.
● To provide the basic principles of sets and operations in sets and to prove basic set equalities.
● To construct truth tables and logic gates in Boolean algebra.

UNIT-I	**MATHEMATICAL LOGIC**	**12**

Propositional calculus - Propositions and Connectives, Syntax - Semantics – Truth assignments and Truth tables - Validity and Satisfiability, tautology – Functionally complete set of connectives - Equivalence and normal forms - Compactness and resolution - Formal reducibility - Natural deduction system and axiom system.

UNIT-II	**COMBINATORICS**	**12**

Basic counting sum and product- Balls and bins problems – Generating functions - Recurrence relations- Proof Techniques – Principle of Mathematical Induction - Pigeon hole principle.

UNIT-III	**GRAPH THEORY**	**12**

Graphs and digraphs - Complement – Isomorphism - Connectedness and Reachability - Adjacency matrix - Eulerian paths and Circuits in graphs and digraphs - Hamiltonian paths , Circuits and tournaments in graphs - Trees - Planar graphs :Euler's formula, dual of a planar graph, independence number and clique number, chromatic number - Statement of Four-color theorem.

UNIT-IV	**ABSTRACT ALGEBRA**	**12**

Set – Relation: Equivalence and Partial Ordered Relations - Algebraic System: Groups, sub groups, homomorphism, Cosets, Lagrange's theorem – Ring and Field (definition).

UNIT-V	**BOOLEAN ALGEBRA**	**12**

Introduction of Boolean algebra - Truth table - Basic logic gate - Basic postulates of Boolean algebra -Principle of duality - Canonical form - Karnaugh map.

	Total Contact Hours: 60

Course Outcomes:
On completion of the course, students will be able to
● Demonstrate the ability to write and evaluate a proof or outline the basic structure and give examples of each proof technique described.
● Apply counting principles to determine probabilities in engineering problems.
● Demonstrate different traversal methods for trees and graphs arising in the field of engineering and technology.
● Analyze the concepts and properties of algebraic structures in the solving complex engineering problems.
● Construct truth tables and logic gates in Boolean algebra and provide valid conclusions.

SUGGESTED ACTIVITIES
- Problem solving sessions
- Activity Based Learning
- Implementation of small module

SUGGESTED EVALUATION METHODS
- Problem solving in Tutorial sessions
- Assignment problems
- Quizzes and class test
- Discussion in classroom

Text Book(s):

1.	M. Morris Mano ,"Digital Logic and Computer Design"- Pearson,2017.
2.	C. L. Liu,"Elements of Discrete Mathematics",Second Edition, McGraw Hill ,New Delhi,1985.
3.	R. A. Brualdi ,"Introductory Combinatorics",Fifth Edition, Holland, New York,2004.
4.	J. A. Bondy and U. S. R. Murty ,"Graph Theory with Applications", Macmlillan Press, London, 1976.
5.	I. N. Herstein , John Wiley and Sons,"Topics in Algebra",Second Edition, Wiley,NewYork,2013.

Reference Books(s) / Web links:

Gilbert Strang "Introduction to linear algebra", 5th Edition,, 2016.
N. Deo "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall, Englewood Cliffs, 1979.
E. Mendelsohn, "Introduction to Mathematical Logic,(Second Edition)", Van-Nostrand, London, 1996.
L. Zhongwan ,"Mathematical Logic for Computer Science", World Scientific, Singapore, 1998.
Tremblay, J.P. and Manohar. R, andquot; Discrete Mathematical Structures with Applications to Computer Scienceandquot;,Tata McGraw Hill Pub. Co. Ltd, New Delhi, 30th Reprint, 2011.

CO - PO – PSO matrices of course

1: Slight (Low)
2: Moderate (Medium)
3: Substantial (High) If there is no correlation, put "-"

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA23115.1	3	2	1	-	-	-	-	-	-	-	-	-	1	-	-
MA23115.2	3	2	1	-	-	-	-	-	-	-	-	-	1	-	-
MA23115.3	3	2	3	-	-	-	-	-	-	-	-	-	1	-	-
MA23115.4	3	1	1	-	-	-	-	-	-	-	-	-	1	-	-
MA23115.5	3	2	1	-	-	-	-	-	-	-	-	-	1	-	-
Average	3	1.8	1.4	-	-	-	-	-	-	-	-	-	1	-	-

Course Code	Course Title	Category	L	T	P	C
MA23114	PROBABILITY AND CALCULUS	BS	3	1	0	4
	For I sem. B.Tech. – CSBS					

Objectives:

- To practice the basic rules and methods of differential calculus in the solution of Complex engineering problems.
- To analyse multiple integrals using different methods and analyze the problems in engineering and technology.
- To manipulate data and synthesis of the information to provide valid conclusions.
- To apply the concepts of probability and interpretation of data, and synthesis of the information to provide valid conclusions.
- To exhibit various probability distributions to solve engineering problems.

UNIT-I	DIFFERENTIAL CALCULUS	12
Limits and Continuity – Differentiation – Rules of Differentiation – Maxima and Minima of single variable		
UNIT-II	INTEGRAL CALCULUS	12
Definite and indefinite integrals – Integration by parts – Double and Triple integrals in Cartesian form – Area and Volume.		
UNIT-III	INTRODUCTION TO STATISTICS	12
Definition of Statistics: Basic objectives, applications in various branches of science with examples - Collection of Data: Internal and external data, Primary and secondary Data - Population and sample, Representative sample - Descriptive Statistics: Classification and tabulation of univariate data, graphical representation, Frequency curves - Descriptive measures - Central tendency and Dispersion - Bivariate data: Summarization, marginal and conditional frequency distribution		
UNIT-IV	PROBABILITY AND RANDOM VARIABLES	12
Random experiments, sample space, event - Definition of Combinatorial Probability - Conditional Probability - Bayes Theorem - Random Variables: Discrete and Continuous Random Variables - Mathematical expectation and its properties - Moments (including variance) and their properties - Moment Generating Function.		
UNIT-V	PROBABILITY DISTRIBUTIONS	12
Discrete and Continuous distributions: Binomial, Poisson and Geometric distributions, Uniform, Exponential, Normal, Chi-square, t and F distributions		
	Total Contact Hours: 60	

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

- Apply the basic rules and methods of differential calculus in the solution of Complex engineering problems.
- Evaluate multiple integrals using different methods and analyse the problems in engineering and technology.
- Manage the data and synthesis of the information to provide valid conclusions.
- Apply the concepts of probability in the solution of complex engineering problems.
- Demonstrate various probability distributions in solving engineering problems.

SUGGESTED ACTIVITIES

- Problem solving sessions
- Activity Based Learning
- Implementation of small module (Explain probability distribution and descriptive statistics using R program)

SUGGESTED EVALUATION METHODS
- Problem solving in Tutorial sessions
- Assignment problems
- Quizzes and class test
- Discussion in classroom

	Text Book(s):
1	A. Goon, M. Gupta and B. Dasgupta, "Fundamentals of Statistics", vol. I and II, World Press, 2019.
2	Grewal B.S., " Higher Engineering Mathematics ", Forty Three Edition Khanna Publishers, New Delhi, 2014.
3	S.M. Ross, "A first course in Probability", Tenth Edition ,Prentice Hall,2013.
4	I.R. Miller, J.E. Freund and R. Johnson, "Probability and Statistics for Engineers", Nineth Edition ,PHI,2017.
5	T. Veerarajan, 'Probability, Statistics and Random Processes with Queueing Theory and Queueing Networks', Third Edition ,McGraw Hill,2016.

	Reference Books(s) / Web links:
1.	A.M. Mood, F.A. Graybill and D.C. Boes, "Introduction to the Theory of Statistics", McGraw Hill Education, 2017.
2.	Peter V. O'Neil, "Advanced Engineering Mathematics", (Seventh Edition), Thomson Learning, 2020.
3.	M. D. Greenberg, "Advanced Engineering Mathematics", (Second Edition) Pearson Education,2012.
4.	P. N. Wartikar and J. N. Wartikar, "Applied Mathematics", Vol. I and II, Vidyarthi Prakashan, 2019.
5.	S.M. Ross, "Introduction of Probability Models", Academic Press, N.Y.

CO - PO – PSO matrices of course

1: Slight (Low)
2: Moderate (Medium)
3: Substantial (High) If there is no correlation, put "-"

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA23114.1	3	2	1	-	-	-	-	-	-	-	-	1	1	-	-
MA23114.2	3	2	-	-	-	-	-	-	-	-	-	1	1	-	-
MA23114.3	3	2	-	1	-	-	-	-	-	-	1	1	1	-	-
MA23114.4	3	2	-	1	-	-	-	-	-	-	1	1	1	1	-
MA23114.5	3	3	1	-	-	-	-	-	-	-	-	1	1	1	-
Average	3	2.2	1	1	-	-	-	-	-	-	1	1	1	1	-

Course Code	Course Title	Category	L	T	P	C
GE23117	தமிழர் மரபு/HERITAGE OF TAMILS	HS	1	0	0	1
	Common to all branches of B.E/B. Tech programmes					

அலகு I	மொழி மற்றும் இலக்கியம்:	3

இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமய சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழிக் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II	மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக் கலை:	3

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III	நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்:	3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV	தமிழர்களின் திணைக் கோட்பாடுகள்:	3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V	இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு:	3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

Total Contact Hours: 15

Text Book(s):

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).

2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).

3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)

4. பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

5. Social Life of Tamils (Dr. K. K. Pillay) A joint publication of TNTB and ESC and RMRL – (in print)

6. Social Life of the Tamils – The Classical Period (Dr. S. Singaravelu)(Published by: International Institute of Tamil Studies.

7. Historical Heritage of the Tamils (Dr. S. V. Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies).

9. Keeladi – 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of archaeology and Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)

11. Porunai Civilization (Jointly Published by: Department of Archaeology and Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Course Code	Course Title	Category	L	T	P	C
CB23131	**FUNDAMENTALS OF COMPUTER SCIENCE**	PC	2	0	4	4

Objectives:
• To develop simple algorithms for arithmetic and logical problems.
• To develop C Programs using basic programming constructs.
• To develop C programs using arrays and strings.
• To develop applications in C using functions, pointers and structures.
• To do input/output and file handling in C.

UNIT-I	GENERAL PROBLEM-SOLVING CONCEPTS AND C LANGUAGE	6
Algorithm and Flowchart for problem solving with Sequential Logic Structure, Decisions and Loops- Introduction- C Structure- syntax and constructs of ANSI C - Variable Names, Data Type and Sizes (Little Endian Big Endian), Constants, Declarations, proper variable naming and Hungarian Notation - Standard I/O, Formatted Output – printf- Formatted Input – scanf- Statements and Blocks.		
UNIT-II	**TYPES OF OPERATORS, EXPRESSIONS AND CONTROL FLOW**	**6**
Arithmetic Operators, Relational Operators, Logical Operators, Type Conversion, Increment and Decrement Operators, Bitwise Operators, Assignment Operators and Expressions, Precedence and Order of Evaluation, If-Else-If, Switch, Loops – while, do, for, break and continue, goto Labels - structured and unstructured programming.		
UNIT-III	**ARRAYS, STRINGS AND FUNCTIONS**	**6**
Arrays – string – string operations – functions - types, Basics of functions, parameter passing and returning type, External, Auto, Local, Static, Register Variables, Scope Rules, Block structure, Initialization, Recursion, Variable- length argument lists, C Pre-processors, Standard Library Functions and return types.		
UNIT-IV	**POINTERS AND ARRAYS**	**6**
Pointers and addresses, Pointers and Function Arguments, Pointers and Arrays, Address Arithmetic, character Pointers and Functions, Pointer Arrays, Pointer to Pointer, Multi-dimensional arrays and row/column major formats, Initialization of Pointer Arrays, Command line arguments, Pointers to functions, complicated declarations and evaluations.		
UNIT-V	**STRUCTURES AND FILES IN C**	**6**
Basic Structures, Structures and Functions, Array of structures, Pointer of Structures, Self-referential Structures, Table look up, Typedef, Unions, File in C: Buffer and Streams – File operations – File Accessing Modes – File I/O functions - Binary and Text file accessing – Random File accessing.		
	Total Contact Hours	**:**	**30**

List of Experiments	
1	Algorithm and flowcharts of small problems like GCD
	Structured code writing with:
2	Small but tricky codes
3	Proper parameter passing
4	Command line Arguments
5	Variable parameter
6	Pointer to functions
7	User defined header
8	Make file utility
9	Multi file program and user defined libraries
10	Interesting substring matching / searching programs
11	Mini Project

		Contact Hours	:	60
		Total Contact Hours	:	90

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

- Formulate simple algorithms for arithmetic and logical problems.
- Implement conditional branching, iteration and recursion.
- Decompose a problem into functions and synthesize a complete program using divide and conquer approach.
- Use arrays, pointers, structures and files to formulate algorithms and programs.
- Apply programming to solve matrix addition and multiplication problems and searching and sorting problems

Text Book (s):	
1	Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", Second Edition, PHI. 2022
2	Byron Gottfried, "Programming with C", Fourth Edition, McGraw Hill Education,2018.
Reference Books(s) / Web links:	
1	Herbert Schildt, "C: The Complete Reference", Fourth Edition, McGraw Hill.
2	YashavantKanetkar, "Let Us C", BPB Publications.

CO - PO – PSO matrices of course

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High) If there is no correlation, put "-"

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CB2313 1.1	1	2	2	2	1	-	-	-	1	2	1	1	2	3	1
CB2313 1.2	1	1	1	1	1	-	-	-	-	-	1	1	2	2	-
CB2313 1.3	1	1	2	1	1	-	-	-	-	-	1	1	2	2	1
CB2313 1.4	2	2	3	2	1	-	-	-	1	-	2	1	2	3	1
CB2313 1.5	2	2	3	2	1	-	-	-	-	-	2	1	2	2	2
Average	1.4	1.6	2.2	1.6	1.0	-	-	-	1.0	2.0	1.4	1.0	2.0	2.4	1.3

Course Code	Course Title	Category	L	T	P	C
EE23131	**PRINCIPLES OF ELECTRICAL ENGINEERING**	ES	2	0	2	3

Objectives:	
●	To introduce electric circuits and provide knowledge on the analysis of circuits using network theorems.
●	To impart knowledge on series and parallel RC, RL and RLC circuits.
●	To provide knowledge on the principles of electrostatics and electromechanical energy conversion devices.
●	To learn the electrical measurement concepts and different types of wiring system.
●	To provide exposure on analysis of the electrical circuits and transducers through experimentation.

UNIT-I	**INTRODUCTION**	6

Fundamental linear passive and active elements to their functional current-voltage relation, voltage source and current sources, ideal and practical sources, Kirchhoff-s laws and applications to network solutions using mesh and nodal analysis, Concept of work, power, energy, and conversion of energy.

UNIT-II	**DC CIRCUITS**	6

Current-voltage relations of the electric network by mathematical equations to analyze the network, (Superposition theorem, Thevenin's theorem, Norton's Theorem, Maximum Power Transfer theorem) Simplifications of networks using series-parallel, Star/Delta transformation.

UNIT-III	**AC CIRCUITS**	6

AC waveform definitions, form factor, peak factor, study of R-L, R-C, RLC series circuit, R-L-C parallel circuit, phasor representation in polar and rectangular form, concept of impedance, admittance, active, reactive and complex power, power factor, Concept of 3 phase Balanced AC Circuits.

UNIT-IV	**PRINCIPLE OF ELECTROSTATICS AND ELECTROMECHANICS**	6

Electrostatic field, electric field strength, concept of permittivity in dielectrics, energy stored in capacitors, charging and discharging of capacitors, Electromagnetism, magnetic field and Faraday's law, Magnetic material and B-H Curve self and mutual inductance, Ampere's law, Electromechanical energy conversion.

UNIT-V	**MEASUREMENTS AND SENSORS**	6

Introduction to measuring devices/sensors and transducers (Piezoelectric and thermo-couple) related to electrical signals, Elementary methods for the measurement of electrical quantities in DC and AC systems, (Current and Single-phase power) Concept of indicating and integrating instruments, Electrical Wiring types and accessories, Illumination system, Basic layout of the distribution system, Necessity of earthing, Types of earthing, Safety devices and system, Principle of batteries and types.

	Total Contact Hours	**:**	**30**

List of Experiments	
1	Familiarization of electrical Elements, sources, measuring devices and transducers related to electrical circuits.
2	Determination of resistance temperature coefficient.
3	Verification of Network Theorem (Superposition, Thevenin, Norton, Maximum Power Transfer theorem).
4	Simulation of R-L-C series circuits for $X_L > X_C$, $X_L < X_C$ and $X_L = X_C$.
5	Simulation of Time response of RC circuit.
6	Demonstration of measurement of electrical quantities in DC and AC systems.

	Contact Hours	**:**	**30**
	Total Contact Hours	**:**	**60**

Course Outcomes:	
On completion of the course, the students will be able to	
●	Analyse DC and AC circuits and apply circuit theorems.
●	Realize series and parallel RC, RL and RLC circuits.
●	Understand the principles of electrostatics and electromechanical energy conversion devices.
●	Realise the electrical measurement concepts and different types of wiring system.
●	Experimentally analyze the electric circuits and transducers.

Text Book (s):	
1	A. E. Fitzgerald, Kingsely Jr Charles, D. Umans Stephen, "Electric Machinery", Sixth Edition, Tata McGraw Hill. 2022
2	B.L.Theraja, "A Textbook of Electrical Technology", Vol. I,"Basic Electrical Engineering" S. Chand and Company Ltd.,New Delhi.2021

3	V. K. Mehta, "Basic Electrical Engineering", S. Chand and Company Ltd., New Delhi.2019
4	J. Nagrath and Kothari, "Theory and problems of Basic Electrical Engineering", Second Edition Prentice Hall of India Pvt. Ltd.
Reference Books(s) / Web links:	
1	T. K. Nagsarkar and M. S. Sukhija, "Basic of Electrical Engineering", Oxford University Press.
2	D. J. Griffiths "Introduction to Electrodynamics", Cambridge University Press.
3	William H. Hayt and Jack E. Kemmerly "Engineering Circuit Analysis, McGraw-Hill Book Company Inc.8th Edition
4	Smarjith Ghosh," Fundamentals of Electrical and Electronics Engineering", Prentice Hall (India) Pvt. Ltd.

CO - PO – PSO matrices of course

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High) If there is no correlation, put "-"

COs/POsandPSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE 23131.1	3	3	3	3	-	-	-	-	3	-	-	1	-	2	-
EE 23131.2	3	3	3	2	3	-	-	-	2	-	-	1	-	2	-
EE 23131.3	3	3	3	3	-	-	-	-	3	-	-	1	-	2	-
EE 23131.4	3	3	3	3	-	-	-	-	3	-	-	1	-	2	-
EE 23131.5	3	3	3	2	3	-	-	-	3	-	-	1	-	2	-
Average	**3**	**3**	**3**	**2.6**	**3**	**-**	**-**	**-**	**2.8**	**-**	**-**	**1**	**-**	**2**	**-**

Course Code	Course Title	Category	L	T	P	C
PH23133	**PHYSICS FOR COMPUTING SCIENCE** For I sem. B. E. - CSBS	BS	3	0	2	4

Objectives:
• To enhance the fundamental knowledge of oscillations and its applications.
• To understand the fundamentals of waves and optics as applicable to computing.
• To become proficient in properties of semiconductors and fiber optics.
• To understand the principles of laser and role plays in engineering and technology.
• To familiarize the basic principles of heat transfer and electromagnetism for computer applications.

UNIT-I	OSCILLATION	9

Periodic motion-simple harmonic motion-characteristics of simple harmonic motion-vibration of simple springs mass system –resonance: definition, damped harmonic oscillator – heavy, critical and light damping- energy decay in a damped harmonic oscillator- quality factor- forced mechanical and electrical oscillators.

UNIT-II	FUNDAMENTALS OF WAVE OPTICS	9

Theory of interference fringes-types of interference-Fresnel's prism-Newton's rings, Diffraction-Two kinds of diffraction-Difference between interference and diffraction-Fresnel's half period zone and zone plate-Fraunhofer diffraction at single slit-plane diffraction grating - Temporal and Spatial Coherence.

Polarization - Brewster's law - double refraction- Concept of production of polarized beam of light from two SHM acting at right angle; plane, elliptical and circularly polarized light, Brewster's law, double refraction.

UNIT-III	SEMICONDUCTOR PHYSICS AND FIBER OPTICS	9

Conductor, Semiconductor and Insulator: Basic concept of Band theory- Hall effect - determination of Hall co-efficient –Applications. Fiber optics- Types of optical fibers and Applications.

UNIT-IV	LASER	9

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: Ruby Laser, CO2 and Neodymium lasers; Properties of laser beams: mono-chromaticity, coherence, directionality and brightness- laser speckles-applications of lasers in engineering.

UNIT-V	THERMODYNAMICS AND ELECTROMAGNETISM	9

Zeroth law of thermodynamics, first law of thermodynamics, brief discussion on application of 1st law, second law of thermodynamics and concept of Carnot's Engine, entropy, change in entropy in reversible and irreversible processes, third law of thermodynamics.

Electromagnetism: Ampere's circuit law and Biot-Savart's law-Continuity equation for current densities – Maxwell's equations in vacuum and non-conducting medium.

	Contact Hours	:	45

	List of Experiments		
1	Determination of wave length of light by Newton's Ring method		
2	Determination of wave length of light by Laser diffraction method		
3	Determination of Planck's constant		
4	Determination of Hall coefficient of semiconductor		
5	Determination of laser and optical fiber parameters		
6	Magnetic field along the axis of current carrying coil – Stewart and Gee		
7	Determination of Stefan's Constant.		
		Contact Hours :	**30**
		Total Contact Hours :	**75**

Course Outcomes
On completion of the course, students will be able to
● Apply the mathematical model of oscillations to various physical systems
● Understand the various phenomena involving waves and their applications
● Understand the fundamental concepts of semiconducting materials properties and fiber optics in computational sciences.
● Use the concepts of Laser in engineering and technology.
● Apply the concepts of thermodynamics and electromagnetism for various systems.

Text Books:
1 Beiser A, "Concepts of Modern Physics", Fifth Edition, McGraw Hill International.1995
2 David Halliday, Robert Resnick, Jearl Walker, "Fundamentals of Physics", Twelfth Edition, Wileyplus,2021.

Reference Books / Web links:
1 Ajoy Ghatak, "Optics" Fifth Edition, Tata McGraw Hill, 2014.
2 Sears andZemansky, "University Physics", Fifth Edition,Addison-Wesley, 2015.
3 Jenkins and White, "Fundamentals of Optics", Third Edition, McGraw-Hill, 2017.

CO – PO – PSO matrices of course

1: Slight (Low)
2: Moderate (Medium)
3: Substantial (High) If there is no correlation, put "- "

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
PH2313 3.1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
PH2313 3.2	2	2	1	-	-	-	-	-	-	-	-	-	1	1	-
PH2313 3.3	2	2	1	-	-	-	-	-	-	-	-	-	1	1	-
PH2313 3.4	3	2	2	-	-	-	-	-	-	-	-	-	1	-	-
PH2313 3. 5	2	1	-	-	-	-	-	-	-	-	-	-	1	-	-
Average	2.4	1.6	1.3	-	-	-	-	-	-	-	-	-	1	1	-

Course code	Course Title (Theory course)	Category	L	T	P	C
MC23111	INDIAN CONSTITUTION AND FREEDOM MOVEMENT	MC	3	0	0	0
	Common to all branches of B.E/B. Tech Programmes – First / Second/third Semester					

Objectives:
• To apprehend the sacrifices made by the freedom fighters.
• To inculcate the values enshrined in the Indian constitution.
• To instil a sense of responsibility as the citizens of India.
• To familiarise about the functions of the various levels of Government.
• To be informed about Constitutional and Non- Constitutional bodies.

UNIT-I	INDIAN FREEDOM MOVEMENT	9
British Colonialism in India-Colonial administration till 1857- Revolt of 1857- Early Resistance to British Rule-Rise of Nationalism in India-Indian Freedom Struggle under Mahatma Gandhi-Non- Cooperation Movement-Civil Disobedience Movement- Quit India Movement-British Official response to National movement- Independence of India Act 1947-Freedom and Partition.		
UNIT-II	CONSTITUTION OF INDIA	9
Historical Background – Indian Constitution: Constitution' meaning of the term, Sources and constitutional history, Constituent Assembly of India – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Citizenship – Constitutional Remedies for citizens.		
UNIT-III	STRUCTURE AND FUNCTIONS OF CENTRAL GOVERNMENT	9
Union Government – Structure of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review.		
UNIT-IV	STRUCTURE AND FUNCTION OF STATE GOVERNMENT AND LOCAL BODY	9
State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts- Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati Raj: Introduction, Elected officials and their roles, Village level: Role of Elected and Appointed officials.		
UNIT-V	CONSTITUTIONAL FUNCTIONS AND BODIES	9
Indian Federal System – Centre – State Relations – President's Rule – Constitutional Functionaries – Assessment of working of the Parliamentary System in India- CAG, Election Commission, UPSC, GST Council and other Constitutional bodies-. NITI Aayog, Lokpal, National Development Council and other Non –Constitutional bodies.		
	Total Contact Hours: 45	

Course Outcomes: Upon completion of the course, students will be able to:
• Appreciate the sacrifices made by freedom fighters during freedom movement.
• Be responsible citizens and abide by the rules of the Indian constitution.
• Be aware of the functions of the Indian government.

- Be knowledgeable about the functions of the state Government and the Local bodies.
- Apply the knowledge on constitutional functions and role of constitutional bodies and non-constitutional bodies.

SUGGESTED ACTIVITIES

- Famous speeches from around the world relating to independence
- Case study
- Quiz on Portfolio and Cabinet
- Discussions on International Associations like the UN, BRICS, QUAD
- Presentation on issues around the world

SUGGESTED EVALUATION METHODS
- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous assessments (CAT)

Text Book(s):

1. M. Laxmikanth , "Indian Polity:, Seventh Edition ,McGraw-Hill ,New Delhi,2023.
2. Durga Das Basu, "Introduction to the Constitution of India ",Twenty First Edition, Lexis Nexis, New Delhi,2013.
3. P K Agarwal and K N Chaturvedi , First Edition, Prabhat Prakashan, New Delhi, 2017.

Reference Books(s) / Web links:
1. Sharma, Brij Kishore, "Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.
2. U.R.Gahai, "Indian Political System ", New Academic Publishing House, Jalaendhar
3. Bipan Chandra, India's Struggle for Independence, Penguin Books, 2016.
4. Maciver and Page, "Society: An Introduction Analysis ", Mac Milan India Ltd., New Delhi.2nded, 2014.
5. Bipan Chandra,   History of Modern India, Orient Black Swan, 2009.

CO – PO – PSO matrices of course

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High) If there is no correlation, put "- "

PO/PSO MC23111.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MC23111.1	-	-	-	-	-	-	-	-		-	-	-	-	-	-
MC23111.2	-	-	-	-	-	-	-	-		-	-	-	-	-	-
MC23111.3	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-
MC23111.4	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
MC23111.5	-	-	-	-	-	1	-	1	1	-	-	-	-	-	-
AVERAGE	-	-	-	-	-	1	-	1	1	-	-	-	-	-	-

SEMESTER II

Course Code	Course Title	Category	L	T	P	C
MA23211	**LINEAR ALGEBRA**	BS	3	1	0	4
	For II sem. B.Tech. – CSBS					

Objectives:
● To express the matrix algebra techniques in the solutions of relevant problems in engineering.
● To provide the concept of applications of matrices in computer generated images.
● To obtain the necessary basic concepts of a few vector spaces in designing and solving problems.
● To acquire knowledge in linear transformations using Eigen values and Eigen vectors and to apply them in solving problems that occur in the field of Engineering and Technology.
● To explain the concept of vector spaces to use in the principal component analysis.

UNIT-I	MATRICES AND DETERMINANTS		12
Introduction to Matrices and Determinants – Solution of Linear Equations: Cramer's rule – Inverse of a Matrix.			
UNIT-II	**APPLICATION OF MATRICES**		**12**
Vectors and linear combinations – Rank of a matrix – Gaussian elimination – LU Decomposition – Solving Systems of Linear Equations using the tools of Matrices.			
UNIT-III	**VECTOR SPACE**		**12**
Vector space – Dimension, Basis, Orthogonality – Projections – Gram-Schmidt orthogonalization and QR decomposition.			
UNIT-IV	**EIGENVALUE PROBLEMS**		**12**
Eigenvalues and Eigenvectors – Positive definite matrices – Linear transformations – Hermitian and unitary matrices.			
UNIT-V	**PRINCIPAL COMPONENT ANALYSIS**		**12**
Singular value decomposition – Principal component analysis – Introduction to their applications in Image Processing and Machine Learning.			
		Total Contact Hours: 60	

Course Outcomes:
After completing the course, the students will be able to
● Demonstrate matrix algebra techniques in the solutions of relevant problems in engineering.
● Apply the concept of LU decomposition of matrices in the solution of complex engineering problems.
● Use the concepts of vector spaces in the solutions of problems in data science.

- Interpret the concepts of Eigen value problems in expander graphs and also to find the page rank algorithm.
- Apply the concept of principal component analysis in image processing, pattern recognition and time series prediction.

SUGGESTED ACTIVITIES
- Problem solving sessions.
- Flipped classroom
- Activity Based Learning

SUGGESTED EVALUATION METHODS
- Problem solving in Tutorial sessions
- Assignment problems
- Quizzes and class test
- Discussion in classroom

Text Book(s):	
1	Friedberg, S.H., Insel, A.J. and Spence, E., "Linear Algebra", Fifth Edition, Pearson Education, New Delhi, 2022.
2	Peter V. O'Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage Learning,2020.
3	T Veerarajan , "Linear Algebra and Partial Differential Equations", Mc Graw Hill Education,2018
4	Grewal B.S., " Higher Engineering Mathematics ", Fourtythree Edition , Khanna Publishers, New Delhi, 2014.
5	Williams, G, "Linear Algebra with Applications", , First Indian Edition, Jones and Bartlett Learning, New Delhi, 2017.

Reference Books(s) / Web links:	
1.	Michael. D. Greenberg, "Advanced Engineering Mathematics", 2nd Edition, 2012.
2.	Gilbert Strang, "Introduction to linear algebra", 5th Edition, 2016.
3.	Wartikarand J. N. Wartikar, "Applied Mathematics" (Vol. I and II), P. N. 2019.
4.	R C Gonzalez and R E Woods, "Digital Image Processing", 3rd Edition, 1992.
5.	Richard Branson, "Matrix Operations", Schaum's outline series, McGraw Hill, New York, 1989.

CO – PO – PSO matrices of course

1: Slight (Low)
2: Moderate (Medium)
3: Substantial (High) If there is no correlation, put "- "

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA23211. 1	2	2	-	-	-	-	-	-	-	-	-	-	-	1	-
MA232311.2	2	2	-	-	-	-	-	-	-	-	-	-	-	1	-
MA23211. 3	2	3	-	-	-	-	-	-	-	-	-	-	-	1	-
MA23211. 4	2	3	-	-	-	-	-	-	-	-	-	1	-	2	-
MA23211.5	2	3	-	-	-	-	-	-	-	-	-	1	-	2	1
Average	2	2.6	-	-	-	-	-	-	-	-	-	1	-	1.4	1

Course Code	Course Title (Theory course)	Category	L	T	P	C
BA23217	**FUNDAMENTALS OF ECONOMICS**	MS	2	0	0	2

Objectives:	
☐	To explain the fundamental principles of micro economics relevant to managing an organization.
☐	To describe the fundamental principles of macroeconomics to have the understanding of economic environment of business.
☐	To understand the various aspects of India's economy.

UNIT-I	INTRODUCTION	6
	Principles of Demand and Supply- Supply Curves of Firms – Elasticity of Supply; Demand Curves of Households-Elasticity of Demand; Equilibrium and Comparative Statics (Shift of a Curve and Movement along the Curve)	

UNIT-II	CONSUMER ANALYSIS	6
	Welfare Analysis- Consumers' and Producers' Surplus – Price Ceilings and Price Floors; Consumer Behavior – Axioms of Choice – Budget Constraints and Indifference Curves; Consumer's Equilibrium- Effects of a Price Change, Income and Substitution Effects –Derivation of a Demand Curve	

UNIT-III	PRODUCTION AND COSTING	6
	Applications- Tax and Subsidies – Intertemporal Consumption – Suppliers' Income Effect; Theory of Production – Production Function and Iso-quants – Cost Minimization; Cost Curves- Total, Average and Marginal Costs – Long Run and Short Run Costs; Equilibrium of a Firm Under Perfect Competition; Monopoly and Monopolistic Competition	

UNIT-IV	MACROECONOMIC REFORMS	6
	National Income and its Components- GNP, NNP, GDP, NDP; Consumption Function; Investment; Simple Keynesian Model of Income Determination and the Keynesian Multiplier; Government Sector- Taxes and Subsidies; External Sector- Exports and Imports; Money- Definitions; Demand for Money-Transactionary and Speculative Demand; Supply of Money- Bank's Credit Creation Multiplier; Integrating Money and Commodity Markets- IS, LM Model	

UNIT-V	POLICY GOVERNANCE	6
	Business Cycles and Stabilization- Monetary and Fiscal Policy – Central Bank and the Government; The Classical Paradigm- Price and Wage Rigidities – Voluntary and Involuntary Unemployment	
	Total Contact Hours :	**30**

Course Outcomes:	
On completion of the course, students will be able to	
☐	Become familiar with both principles of micro and macroeconomics.
☐	Understand about approaches to consumer behavior and relation between production and cost function.
☐	Describe and discuss on interaction of product and factor market.
☐	Get awareness about importance and development of Indian economy and economic reforms.
☐	Have thorough knowledge in the areas of inflation, unemployment, monetary policy, fiscal policy and international trade.

	Text Books:
1	Pindyck, Robert S., and Daniel L. Rubinfeld, "Microeconomics", Seventh Edition ,Pearson,2017
2	Dornbusch, Fischer and Startz," Macroeconomics", Thirteen Edition McGraw Hill,2018.
3	Paul Anthony Samuelson, William D. Nordhaus, "Economics", Nineteen edition, McGraw Hill,2006
	Reference Books / Web links:
1	Hal R, Varian, "Intermediate Microeconomics: A Modern Approach", 8th edition
2	N. Gregory Mankiw, "Principles of Macroeconomics", 6th edition, Cengage India

CO – PO – PSO matrices of course

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High) If there is no correlation, put "- "

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO 1	PSO2	PSO3
BA23217.1	2	2	1	2	1	1	3	3	3	3	3	3	2	1	3
BA23217.2	2	2	1	2	1	2	2	3	2	3	3	3	3	1	3
BA23217.3	2	2	1	2	3	1	1	3	3	3	3	3	3	2	3
BA23217.4	2	3	2	3	2	2	2	2	2	3	3	3	3	2	3
BA23217.5	2	3	1	2	2	1	1	3	3	3	3	3	1	2	2
Average	2	2.4	1.2	2.2	1.8	1.4	1.8	2.8	2.6	3	3	3	2.4	1.6	1.6

Course Code	Course Title	Category	L	T	P	C
GE23217	தமிழரும் தொழில்நுட்பமும்/TAMILS AND TECHNOLOGY	HS	1	0	0	1
	Common to all branches of B.E/B. Tech programmes					

அலகு I	நெசவு மற்றும் பானைத் தொழில்நுட்பம்:	3

சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பண்டங்களில் கீறல் குறியீடுகள்.

அலகு II	வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்:	3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் and சங்க காலத்தில் வீட்டுப்பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் - நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாடு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ - சாரோசெனிக் கட்டிடக் கலை.

அலகு III	உற்பத்தித் தொழில் நுட்பம்:	3

கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத்துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV	வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்:	3

அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குழுமித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கல்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.

அலகு V	அறிவியல் தமிழ் மற்றும் கணித்தமிழ் :	3

அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.

Total Contact Hours: 15

Text Book(s):	
1.	தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2.	கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3.	கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4.	பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5.	Social Life of Tamils (Dr. K. K. Pillay) A joint publication of TNTB and ESC and RMRL – (in print)
6.	Social Life of the Tamils – The Classical Period (Dr. S. Singaravelu)(Published by: International Institute of Tamil Studies.
7.	Historical Heritage of the Tamils (Dr. S. V. Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8.	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies).
9.	Keeladi – 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of archaeology and Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10.	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11.	Porunai Civilization (Jointly Published by: Department of Archaeology and Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12.	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Course Code	Course Title	Category	L	T	P	C
MA23231	STATISTICAL MODELING	BS	3	0	2	4
	For II sem. B.Tech. – CSBS					

Objectives:
• To gather data from a population subset and make accurate and reliable inferences about the population based on the sample data.
• To identify the strength and direction of a linear relationship between two variables and using regression and correlation to predict dependency for data-driven decisions regarding our processes.
• To formulate and test a hypothesis, using critical values to draw conclusions and determining probability of making errors in hypothesis tests.
• To Characterize, compare, and contrast different nonparametric hypothesis tests.
• To Model time series to analyses the underlying structure(s) in both the time and frequency domains.

UNIT-I	SAMPLING AND ESTIMATION THEORY	9
Random sampling – Sampling from finite and infinite populations – Estimates and standard error (sampling with replacement and sampling without replacement) – Sampling distribution of sample mean – Stratified random sampling – Point estimation - Criteria for good estimates (un-biasedness, consistency) - Methods of estimation including maximum likelihood estimation: Concept and Examples – Complete sufficiency and its application in estimation.		
UNIT-II	LINEAR STATISTICAL MODELS	9
Scatter diagram – Linear Regression and Correlation - Least squares method - Rank correlation - Multiple regression and Multiple correlation - Analysis of variance (one way, two way with as well as without interaction).		
UNIT-III	TEST OF HYPOTHESIS	9
Concept and formulation : Type I and Type II errors, Neyman Pearson lemma – Procedures of testing: Z test: Single mean, difference of means – t: Single mean, difference of means - F test - Chi square test.		
UNIT-IV	NON PARAMETRIC TESTS	9
Non-parametric Inference: Sign test, Wilcoxon signed rank test, Mann-Whitney test, Run test, Kolmogorov-Smirnov test. Spearman's and Kendall's test. Tolerance region- Comparison with parametric inference – Use of order statistics.		
UNIT-V	BASICS OF TIME SERIES ANALYSIS and FORECASTING	9
Stationary – ARIMA Models: Identification, Estimation and Forecasting.		
	Total Contact Hours: 45	

Description of the Experiments	Total Contact Hours: 30
1. Introduction to R, Functions,	
2. Control flow and Loops	
3. Working with Vectors and Matrices	
4. Reading in and Writing Data	
5. Working with Data	
6. Manipulating Data	
7. Simulation	
8. Linear model	
9. Data Frame	
10. Graphics in R	

Course Outcomes:
On completion of the course, students will be able to
• Apply the concept of sampling distribution and estimation theory to the solution of forecasting problems in engineering.
• Use the concepts of regression and correlation in real life problems such as predict trends and adjust product and services or advertising and marketing campaigns. That is, analyze complex engineering problems reaching substantiated conclusions using R programming.
• Use the concepts of Testing of Hypothesis in the solution of real life and industrial problems.
• Formulate, test and interpret various nonparametric tests for problems in engineering and technology. That is, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
• Run and interpret time series models and regression models and reaching substantiated conclusions in relevant engineering problems using time series.

SUGGESTED ACTIVITIES
• Problem solving sessions using R programming
• Activity Based Learning
• Implementation of small module

SUGGESTED EVALUATION METHODS
● Problem solving in Tutorial sessions
● Assignment problems
● Quizzes and class test
• Discussion in classroom

Text Book(s):

1.	I.R. Miller, J.E. Freund and R. Johnson , "Probability and Statistics for Engineers ",Nineth Edition , Pearson,2018.
2.	A. Gun, M. Gupta and B.Dasgupta , "Fundamentals of Statistics ",Vol. I and Vol. II,World Press, 2016.
3.	Chris Chatfield ,"The Analysis of Time Series: An Introduction", Sixth edition, Chapman and Hall/CRC,Sixth Edition,2003.
4.	D.C. Montgomery and E.Peck,G.Geoffery Vining, "Introduction to Linear Regression Analysis" , Fifth Edition,Wiley, 2012.

Reference Books(s) / Web links:

1.	A.M. Mood, F.A. Graybill and D.C. Boes , "Introduction to the Theory of Statistics" III edition, 2017.
2.	N. Draper and H. Smith,"Applied Regression Analysis" III edition, 1998.
3.	Garrett Grolemund,"Hands-on Programming with R, Reilly Media, R,2014".
4.	Jared P. Lander,"R for Everyone: Advanced Analytics and Graphics" I edition, 2014.

CO – PO – PSO matrices of course

1: Slight (Low)
2: Moderate (Medium)
3: Substantial (High) If there is no correlation, put " - ".

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA23231.1	3	3	3	2	-	-	-	-	-	-	-	1	-	2	-
MA23231.2	3	2	2	2	-	-	-	-	-	-	-	1	-	2	-
MA23231.3	3	2	2	2	-	-	-	-	-	-	-	1	-	1	-
MA23231.4	3	2	2	1	-	-	-	-	-	-	-	1	-	1	-
MA23231.5	3	2	2	2	-	-	-	-	-	-	-	1	-	2	-
Average	**3**	**2.2**	**2**	**1.4**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**-**

Course Code	Course Title	Category	L	T	P	C
CB23231	DATA STRUCTURES AND ALGORITHMS	PC	2	1	4	5

Objectives:	
•	To learn about basic terms and searching techniques
•	To learn linear and its applications.
•	To learn nonlinear and its applications.
•	To analyze the concepts of sorting and Hashing
•	To be able to incorporate various techniques in real time scenarios.

UNIT-I	BASIC TERMINOLOGIES and INTRODUCTION TO ALGORITHM AND SEARCHING	9
	Algorithm specification, Recursion, Performance analysis, Asymptotic Notation – The Big-O, Omega and Theta notation, Programming Style, Refinement of Coding – Time-Space Trade Off, Searching- Linear Search and Binary Search techniques and their complexity analysis.	
UNIT-II	LINEAR DATA STRUCTURE (STACKS AND QUEUE)	9
	ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation– Corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each type of Queues: Algorithms and their analysis.	
UNIT-III	LINEAR DATA STRUCTURE (LIST ADT)	9
	Abstract Data Type (ADT) – List ADT- Arrays based Implementation-linked list implementation-singly linked lists-circularly linked lists-doubly linked list-Application of list-polynomial manipulation-all operations (insertion, deletion, and merge, traversal).	
UNIT-IV	NON – LINEAR DATA STRUCTURE (TREES and GRAPHS)	9
	Tree ADT-tree traversals-Binary Tree ADT-expression Trees-applications of Trees-Binary search tree ADT-Threaded Binary Tree-AVL Tree -B-Tree-B+Tree. Graph ADT-Representation of graph-Types of graph-Breadth-first traversal-Depth-first-Traversal-Applications of Graph.	
UNIT-V	SORTING AND HASHING	9
	Sorting-Bubble sort-Selection Sort-Insertion Sort-Shell sort-Divide and Conquer Methods: Quick Sort and Merge Sort. Hashing-Hash functions-Separate chaining-Open Addressing-Rehashing- Extendible hashing.	
	Contact Hours :	45

List of Experiments	
1.	Implementations of Stack and Queue
2.	Applications of Stack and Queue (Tower of Hanoi, Infix, Postfix and Prefix Conversion, Expression Evaluation)
3.	Implementations of Singly, Doubly and Circular List
4.	Polynomial Manipulations
5.	Implementations Binary Search Tree and AVL Tree (All Operations)
6.	Implementation of BFS and DFS
7.	Linear and Binary Search Operations
8.	Implementation of Bubble Sort, Quick and Merge Sort
9.	Implementation of Hashing Techniques

10.	Mini Projects
	• Snakes Game • Sudoku • Travel Planner • Cash Flow Minimiser • Text Editor Cut, Copy, Paste

	Contact Hours	60
	Total Contact Hours	**105**

Course Outcomes:

•	Analyze the various data structure concepts.
•	Apply the different linear data structures to problem solutions.
•	Apply the different non-linear data structures to problem solutions.
•	Critically analyze the various sorting and hashing algorithms.
•	Design the real life projects by applying the data structure concepts

Text Book(s):

1	E. Horowitz, S. Sahni,S. A-Freed, "Fundamentals of Data Structures", Third Edition, Computer Sciences Press, 2013.
2	Alfred V. Aho, John E. Hopperoft, Jeffrey D. Uilman, "Data Structures and Algorithm",Fourth Edition, Pearson Education,2018

Reference Books(s) / Web links:

1	Donald E. Knuth , "The Art of Computer Programming: Fundamental Algorithms", Volume 1.
2	Thomas, H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein," Introduction to Algorithms".
3	Pat Morin ,"Open Data Structures: An Introduction (Open Paths to Enriched Learning)", 31st ed. Edition.

CO – PO – PSO matrices of course

1: Slight (Low)
2: Moderate (Medium)
3: Substantial (High) If there is no correlation, put "- "

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CB23231.1	3	3	2	3	2	-	1	1	1	-	2	1	3	1	-
CB23231.2	3	3	3	3	2	-	-	1	1	-	1	1	3	1	-
CB23231.3	3	3	3	3	2	-	-	1	1	-	1	1	3	1	-
CB23231.4	3	3	3	3	1	-	-	1	1	-	1	1	3	1	-
CB23231.5	3	3	3	3	2	-	-	1	1	-	1	1	3	1	-
Average	**3**	**3**	**2.8**	**3**	**1.8**	**-**	**0.2**	**1**	**1**	**-**	**1.2**	**1**	**3**	**1**	**-**

Course Code	Course Title (Theory course)	Category	L	T	P	C
EC23242	**PRINCIPLES OF ELECTRONICS**	ES	2	0	2	3

Objectives:
- To study the operation of semiconductor diodes and their characteristics.
- To acquire knowledge about the operation and characteristics of BJT under various configurations.
- To introduce the structure and terminal characteristics of FET and MOSFET.
- To understand the concepts of feedback and operational amplifiers with its applications.
- To gain knowledge about digital logic circuits.

UNIT-I	SEMICONDUCTORS DIODES AND CIRCUITS	6

Introductory idea of semiconductors: Formation of P-N junction, energy band diagram, built-in-potential, forward and reverse biased P-N junction, formation of depletion zone. Diodes and Diode Circuits:, V-I characteristics, Zener breakdown, Avalanche breakdown and its reverse characteristics; Junction capacitance and Varactor diode. Simple diode circuits, load line, linear piecewise model; Rectifier circuits: half wave, full wave, PIV, DC voltage and current, ripple factor, efficiency, idea of regulation.

UNIT-II	BIPOLAR JUNCTION TRANSISTORS	6

Transistor: Formation of PNP / NPN junctions, energy band diagram; Transistor mechanism and principle of transistors, CE, CB, CC configuration, transistor characteristics: cut-off active and saturation mode.

UNIT-III	FIELD EFFECT TRANSISTORS	6

Concept of Field Effect Transistors (channel width modulation), Gate isolation types, JFET Structure and characteristics, MOSFET Structure and characteristics, depletion and enhancement type; CS, CG, CD configurations; CMOS: Basic Principles

UNIT-IV	OPERATIONAL AMPLIFIERS	6

Introduction to integrated circuits, operational amplifier and its terminal properties; Application of operational amplifier; inverting and non-inverting mode of operation, Proportional, Integral, Derivative circuits.

UNIT-V	DIGITAL ELECTRONICS FUNDAMENTALS	6

Basic idea of switching circuit, Realization of Logic gates, multiplexers and demultiplexers, Flip flop, Registers and Counters.

Total Contact Hours:30

Description of the Experiments	Total Contact Hours:30
1. VI Characteristics of PN Junction Diode.	
2. VI Characteristics of Zener Diode.	
3. Rectifier circuits.	
4. Characteristics of BJT in Common Emitter Configuration.	
5. JFET Characteristics.	
6. Inverting and Non-Inverting amplifier using IC741.	
7. Implementation of Adders and Subtractors using logic gates.	

Course Outcomes:
On completion of the course, students will be able to
- Demonstrate the characteristics of the diode.
- Analyse the BJT terminal characteristics and its utilization.
- Develop a high degree of familiarity with the FET and MOSFET.
- Design suitable amplifiers for any specific applications.
- Construct simple digital logic circuits.

Text Book(s):
1. Adel S. Sedra and Kenneth Carless Smith, "Microelectronics Circuits", 5th Edition, Oxford University Press, 2004.
2. Jacob Millman, Christos Halkias and Chetan Parikh, "Millman's Integrated Electronics", Second Edition,Pearson, 2010.
3. M. Morris Mano, "Digital Logic and Computer Design", Pearson India Education Services, 2016.

Reference Books(s) / Web links:
● Electronic Devices and Circuit Theory,Robert L. Boylestad, Louis Nashelsky.
● Solid State Electronic Devices,6th Edition, Ben Streetman, Sanjay Banerjee
● Electronic Principle, Albert Paul Malvino.
● Electronics Circuits:Discrete and Integrated, D Schilling C Belove TApelewiczRSaccardi.
● Microelectronics, Jacob Millman, Arvin Grabel.
● Electronics Devices and Circuits,S. Salivahanan, N. Suresh Kumar,A. Vallavaraj
● Electronic Devices and Circuit Theory, 11th Edition, Robert L. Boylestad,Louis Nashelsky.

Lab equipment required:

S. No	Name of the Equipment	Quantity Required	Remarks
1.	Dual Regulated Power Supply	15	(0-30)V
2.	CRO	15	(0-30)MHz
3.	Function Generator	15	(0-3)MHz
4.	Fixed Power Supply	15	15V
5.	Digital trainer kit	15	

Web links for virtual lab (if any)
● https://be-iitkgp.vlabs.ac.in/exp/characteristics-diode/
● https://be-iitkgp.vlabs.ac.in/exp/full-wave-rectification/
● https://be-iitkgp.vlabs.ac.in/exp/common-emitter-characteristics/
● https://be-iitkgp.vlabs.ac.in/exp/non-inverting-amplifiers/

CO - PO – PSO matrices of course

1: Slight (Low)
2: Moderate (Medium)
3: Substantial (High) If there is no correlation, put "- "

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO2	PSO3
EC23242.1	3	3	2	2	2	1	-	-	1	-	1	1	2	3	2
EC23242.2	3	3	2	2	2	1	-	-	1	-	1	1	2	3	2
EC23242.3	3	3	2	2	2	1	-	-	1	-	1	1	2	3	2
EC23242.4	3	3	2	3	2	1	-	-	2	1	3	1	2	3	2
EC23242.5	3	3	2	3	3	1	-	-	2	2	3	2	3	3	2
Average	**3**	**3**	**2**	**2.4**	**2.2**	**1**	**-**	**-**	**1.4**	**0.6**	**1.8**	**1.2**	**2.2**	**3**	**2**

Course Code	Course Title (Laboratory Course)	Category	L	T	P	C
CS23221	**PYTHON PROGRAMMING LAB**	PC	0	0	4	2

Objectives:
• Learn the basics of Python Programming and Control statements
• Demonstrate various Python data structures like Lists, Tuples, Sets and dictionaries
• Understand about Strings, Functions, Modules and Regular Expressions in Python Programming
• Understand the concepts of file handling using Python
• Understand the concepts of Numpy, Pandas, SciPy modules

Description of the Experiments
1. Experiments based on Variables, Datatypes and Operators in Python.
2. Implement various control statements in python.
3. Implement various String and List operations.
4. Implement Inbuilt functions, User-defined functions and Lambda functions.
5. Implementation of Tuples, sets, Dictionary and its operations.
6. Implementation of Exception Handling and I/O files.
7. Experiments based on Packages : math, datetime, platform, re
8. Experiments based on Packages : NumPy, pandas, matplotlib
9. Experiments based on Packages : collections
10. Experiments based on Packages :SciPy
11. Mini Project
Total Contact Hours:60

Course Outcomes:
On completion of the course students will be able to:
• Use the basics of Python Programming in problem solving and conditionals and loops.
• Use of Python Data structures such as List, Sets, Tuples, Dictionary for Compound Data
• Use Strings, Functions, Modules and Regular Expressions in Python Programming
• Implement the concepts of file handling and Exceptional handling.
• Apply Numpy, Pandas and SciPy for numerical and statistical data

SUGGESTED EVALUATION METHODS (if Any) (UNIT/ Module Wise) – could suggest topic
• Experiment based viva
• Quizzes
• Mind map
• Logical thinking – solving case study problems
• Implementation of small Systems

Web links for virtual lab (if any)
• https://www.python.org/shell/
• https://python-iitk.vlabs.ac.in/
• https://www.hackerrank.com/domains/python

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CS23221.1	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
CS23221.2	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
CS23221.3	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
CS23221.4	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
CS23221.5	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
Average	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-

Course Code	Course Title	Category	L	T	P	C
HS23223	BUSINESS COMMUNICATION AND VALUE SCIENCE – II For II sem. B.Tech. – CSBS	HS	0	0	4	2

Objectives:

- Develop effective writing, reading, presentation and group discussion skills
- Expose students to the key concepts of organizational structure
- Help students identify personality traits and evolve as a better team player.
- Introduce them to key concepts of a) Morality b) Behavior and beliefs c) Diversity and Inclusion
- Inculcate social consciousness among the students and make them realize their responsibility in addressing the social issues

UNIT-I	LAUNCHING E MAGAZINE	12

Writing: - Writing techniques of Catherine Morris and Joanie McMahon's – Creating and launching E-magazine. **Speaking:** Icebreaker - Participating in 'Join Hands Movement' - Individual identification of social issues – addressing social issues - **Reading:** Sharing the learning points from GD – SATORI. **Group Practical** –Research read and generates a report based on social causes and findings. Grade points on the Leader board. **Practical:** Plan, design and launching an E Magazine – contributing article to the magazine – Quiz Time

UNIT-II	FORMULATING AN ORGANIZATIONAL STRUCTURE	12

Each group forming an NGO - create vision, mission, value statement, and tagline and design a logo. Introduction to basic presentation skills and ORAI app - Groups to present their NGOs – Presentation recording and sharing the findings from recording. **Writing**: individual write up for E- magazine and evaluation - preparation and publication of second episode of E Magazine. Speed Reading session: Introduction to skimming and scanning; SATORI – Join the dots - Quiz Time

UNIT-III	TEAM PLAY	12

Ad campaign - Brain storming session - discussing and exploring the means of articulating and amplifying the social issue their NGOs are working for - Designing skits: write the script articulating the message of their respective NGOs - Enact the play - reviews. Group Activity: Prepare and publish the third episode of the E Magazine. Berbin's 8 Team roles and Lindgren's big 5 personality traits – SATORI joining dots and Quiz Time.

UNIT-IV	DIVERSITY AND INCLUSION	12

Learn from movies - film on diversity – discussion on key take away of the film - Theory to connect and concept of empathy. Create story – Group activity – a person's life affected by the social issue – narration of story in first person - Feedbacks by other groups. Research on a book, incident or film based on the topic of your respective NGO - Write a review in a blog on the topics they are covering in their research. Diversity and Inclusion - Different forms of Diversity in our society - Debate on diversity with an angle of ethics, morality and respect for individual. Prepared speech - Every student will narrate the challenges faced by a member of a diverse group. Video recording interviews of people from diverse groups with 5 questions. **Practical:** Touch the target, film: 'The Fish and I' by Babak Habibifar.
Group Activity: Discussion on TCS values, Respect for Individual and Integrity. Preparation of final episode of the E Magazine. **Revisit your resume:** Include your recent achievements in your resume. SATORI and Quiz Time.

UNIT-V	ORGANIZING AWARENESS CAMPAIGN	12

Project- Community service – work with an NGO and make a presentation - 1) Each team to look for an NGO/ social group in the city which is working on the issue their college group issupporting. 2) Spend **a day with the NGO/ social group** to understand exactly how they work and the challenges theyface. 3) Render voluntary service to the group for one day 4) Invite the NGO/ social group to address their university students for couple of hours. Plan the entire event, decide a suitable venue in the university, gather audience, invite faculty members etc. (they need to get their plan ratified their professor). Outcome-- Host an interactive session with
the NGO spokesperson 5) The groups to present their experience of **a day with the NGO** and inspire students to work for the cause.

		Total Contact Hours	:	60

Course Outcomes:

On completion of the course, students will be able to

CO1	Understand and use tools of structured communication including presentation
CO2	Develop materials to create an identity for an organization dedicated to a social cause
CO3	Identify individual personality types and role in a team.
CO4	Understand the basic concepts of Morality and Diversity
CO5	Organize an event to generate awareness and get support for a cause

SUGGESTED ACTIVITIES
- Story Lines
- One truth and two lies
- Hang Man
- Pictionary
- Word Scramble
- Case study

SUGGESTED EVALUATION METHODS
- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Case Study

	Reference Books / Web links:
1	Dr. A.P.J. Abdul Kalam and Arun Tiwari ,"Guiding Souls : Dialogues on the purpose of life;" Ocean Books Pvt. Ltd. ,2011.
2	Dr. A.P.J. Abdul Kalam and Acharya Mahapragya ,"The Family and the Nation" , HarperCollins Publishers India,2014.

CO - PO – PSO matrices of course

1: Slight (Low)
2: Moderate (Medium)
3: Substantial (High) If there is no correlation, put "- "

PO/PSO CO	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO 12	**PS O1**	**PS O2**	**PSO3**
HS23223. 1	1	3	-	2	-	2	1	-	3	3	-	1	1	1	1
HS23223. 2	-	-	2	2	1	2	3	3	3	1	-	3	2	-	2
HS23223. 3	-	-	-	1	-	1	1	1	3	3	3	3	1	-	1
HS23223. 4	-	-	1	-	-	2	2	2	2	2	1	1	2	-	1
HS23223. 5	-	-	-	1	-	2	2	-	1	2	3	3	1	1	-
AVG	1	3	6	1.2		1.8	1.8	1.2	2.4	2.4	1.4	2.2	1.4	0.4	1

SEMESTER-III

Course Code	Course Title (Theory course)	Category	L	T	P	C
CB23311	FORMAL LANGUAGE AND AUTOMATA THEORY	PC	3	0	0	3

Objectives:	
●	To give an overview of the theoretical foundations of computer science and illustrate finite state machine and regular grammar.
●	To illustrate pushdown automata, linear bounded automata and Turing machine to solve problems in computing.
●	To familiarize context frees grammars, context sensitive grammars and various normal forms.
●	To determine the decidability and undecidability of computational problems.
●	To understand the theory of Class P, NP and NP complete problems.

UNIT-I	INTRODUCTION TO LANGUAGES AND FINITE AUTOMATA	9
Introduction: Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages. **Finite automata:** Deterministic finite automata (DFA) and nondeterministic finite automata (NFA) and equivalence with DFA, Finite Automata with Epsilon transitions, Equivalence of NDFA's with and without Epsilon moves.		
UNIT-II	**REGULAR LANGUAGES AND GRAMMARS**	9
Regular expressions and languages, Regular grammars and equivalence with finite automata, properties of regular languages, Kleene's theorem, pumping lemma for regular languages, Myhill-Nerode theorem and its uses, minimization of finite automata. Context-free grammars (CFG) and languages (CFL), parse trees, ambiguity in CFG, Chomsky and Greibach normal forms.		
UNIT-III	**GRAMMARS AND PUSHDOWN AUTOMATA**	9
Nondeterministic pushdown automata (PDA) and equivalence with CFG, pumping lemma for context-free languages, deterministic pushdown automata, closure properties of CFLs. Context-sensitive languages: Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG.		
UNIT-IV	**TURING MACHINES**	9
The basic model for Turing machines (TM), Turing recognizable (recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as enumerators.		
UNIT-V	**UNDECIDABILITY AND THEORY OF P, NP AND NP COMPLETENESS**	9
Undecidability: Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice's theorem, undecidable problems about languages. Introductory ideas on Time complexity of deterministic and nondeterministic Turing machines, P and NP, NP- completeness, Cook's Theorem, other NP - Complete problems.		
	Total Contact Hours :	**45**

Course Outcomes:

On completion of the course, the students will be able to

●	Understand the basics of the languages and grammars, fundamental foundations of theoretical science.
●	Design finite state machines, pushdown automata, linear bounded automata and Turing machine to solve problems in computing.
●	Construct regular expressions, context free grammars, context sensitive grammars for various languages.
●	Determine the decidability and intractability of computational problems.
●	Classify problems into class P, NP and NP complete.

Text Books(s):

1	John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, "Introduction to Automata Theory, Languages, and Computation ",Third Edition, Pearson Education, 2013.

Reference Books(s):

1	Peter Linz, "An introduction to Formal Languages and Automata", Sixth Edition, Jones and Bartlett, 2016
2	K.V.N Sunitha and N.Kalyani , "Formal Languages and Automata Theory", Pearson Education India, 2015
3	Harry R. Lewis and Christos H. Papadimitriou,"Elements of the Theory of Computation", Second Edition, Prentice Hall of India,2003.
4	Dexter C. Kozen, "Automata and Computability", Springer-Verlag, Berlin.
5	Michael Sipser, "Introduction to the Theory of Computation , "Third Edition, Cengage Learning, 2013.
6	John C. Martin, "Introduction to Languages and the Theory of Computation ", Fourth Edition, McGraw-Hill, 2011.
7	M. R. Garey and D. S. Johnson, "Computers and Intractability: A Guide to the Theory of NP Completeness ", A Series of Books in the Mathematical Sciences, W. H. Freeman and Company.

CO - PO – PSO MATRICES OF THE COURSE

PO\PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CB23311.1	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CB23311.2	2	3	2	2	-	-	-	-	-	-	2	-	2	1	1
CB23311.3	2	2	2	-	-	-	-	-	-	-	-	-	2	2	-
CB23311.4	2	3	2	1	-	-	1	-	1	-	1	-	2	2	-
CB23311.5	2	2	2	-	-	1	-	-	-	1	-	-	2	2	2
Average	2.0	2.4	2.0	1.5	-	1.0	1.0	-	1.0	1.0	1.5	-	2.0	1.75	1.5

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)   2: Moderate (Medium) 3: Substantial

(High) No correlation: "-"

Course Code	Course Title (Theory Course)	Category	L	T	P	C
CB23312	**COMPUTER ORGANIZATION AND ARCHITECTURE**	**PC**	**3**	**0**	**0**	**3**

Objectives:	
●	To learn the basic structure, operation of digital computer through Boolean logic and learn instruction set architectures.
●	To familiarize with the arithmetic and logic unit and implementation of fixed point and floating-arithmetic operations.
●	To learn the design of a simple CPU, pipelining and hazards.
●	To understand the input/output systems, interfaces and interrupts.
●	To impart knowledge on memory system organization.

UNIT-I	INTRODUCTION and INSTRUCTION SET	9

Revision of basics in Boolean logic and Combinational/Sequential Circuits. Functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU: Registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Outlining instruction sets of some common CPUs.

UNIT-II	DATA REPRESENTATION AND COMPUTER ARITHMETIC	9

Data representation: Signed number representation, fixed and floating point representations, character representation. Computer arithmetic: Integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-and-add, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic, IEEE 754 format.

UNIT-III	PROCESSOR AND CONTROL UNIT	9

Introduction to x86 architecture. CPU control unit design: Hardwired and micro-programmed design approaches, design of a simple hypothetical CPU. Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards. Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency.

UNIT-IV	INPUT/OUTPUT SYSTEMS	9

Peripheral devices and their characteristics: Input-output subsystems, I/O device interface, I/O transfers – program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes – role of interrupts in process state transitions, I/O device interfaces – SCII, USB.

UNIT-V	MEMORY ORGANIZATION	9

Memory system design: Semiconductor memory technologies, memory organization. Memory organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.

	Contact Hours	:	45

Course Outcomes:
On completion of the course, the students will be able to
● Apply boolean logic to understand basic system architecture and instruction sets.
● Apply fixed and floating-point arithmetic operations.
● Gain knowledge on simple CPU design, pipelining and hazards.
● Understand the input/output systems and interfaces.
● Acquire knowledge on memory system design organization.

Text Books(s):	
1.	M. Mano," Computer System Architecture", Third Edition, Prentice Hall of India, New Delhi, 2017.
2.	David A. Patterson and John L.Hennessy," Computer Organization and Design: The Hardware/Software Interface",Fifth Edition, Morgan Kaufmann, 2014.
3.	Carl Hamacher, ZvonkoVranesic, SafwatZakyand NaraigManjikian," Computer Organization and Embedded Systems", Sixth Edition, McGraw Hill, 2023.

Reference Books(s):	
1	John P. Hayes, "Computer Architecture and Organization ", Third Edition, Tata Mc-Graw Hill, 2017.
2	William Stallings," Computer Organization and Architecture: Designing for Performance", Eleventh Edition, Pearson, 2019.
3	Vincent P. Heuring and Harry F. Jordan," Computer System Design and Architecture", Second Edition, Pearson, 2008.

CO - PO – PSO MATRICES OF THE COURSE

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CB23312.1	3	3	2	3	3	2	2	1	-	1	1	2	3	2	-
CB23312.2	3	3	2	3	3	2	2	1	-	1	1	2	3	2	-
CB23312.3	3	2	2	3	2	-	2	1	-	1	1	2	3	2	-
CB23312.4	3	2	2	2	2	-	-	1	-	1	1	2	3	2	-
CB23312.5	3	2	2	2	2	-	-	1	-	1	1	2	3	2	-
Average	3.0	2.4	3.0	2.6	2.4	2.0	2.0	1.0	-	1.0	1.0	2.0	3.0	2.0	-

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)2: Moderate (Medium) 3:

Substantial (High) No correlation: "-"

Course Code	Course Title (Lab Oriented Theory Course)	Category	L	T	P	C
CB23331	COMPUTATIONAL STATISTICS	PC	3	0	2	4

Objectives:

●	To study the mean, variance, linear regression models and error term for use in Multivariate data analysis.
●	To understand the relationship of the data collected for decision making.
●	To know the concept of principal components, factor analysis and cluster analysis for profiling and interpreting the data collected.

UNIT-I	MULTIVARIATE NORMAL DISTRIBUTION	9
	Multivariate Normal Distribution Functions, Conditional Distribution and its relation to regression model, Estimation of parameters.	
UNIT-II	DISCRIMINANT ANALYSIS	9
	Statistical background, linear discriminant function analysis, Estimating linear discriminant functions and their properties.	
UNIT-III	PRINCIPAL COMPONENT ANALYSIS	9
	Principal components, Algorithm for conducting principal component analysis, deciding on how many principal components to retain, H-plot.	
UNIT-IV	FACTOR ANALYSIS	9
	Factor analysis model, Extracting common factors, determining number of factors, Transformation of factor analysis solutions, Factor scores.	
UNIT-V	CLUSTER ANALYSIS	9
	Introduction, Types of clustering, Correlations and distances, clustering by partitioning methods, hierarchical clustering, overlapping clustering, K-Means Clustering-Profiling and Interpreting Clusters	
	Contact Hours	:	45

List of Experiments
1. Find the skewness and kurtosis for the given data set.   2. Perform the statistical analysis on the Iris data set.   Load Iris data set and print the following   ● first 10 records,   ● Total number of rows and columns in the data set   ● Column names or data list.   ● Find the mean of all the attributes   3. Perform the statistical analysis on a data set.   Under each attribute   ● Count the total number of records based on the values.   ● Plot the Normal Distribution of each attribute and print the SD and Mean of the same set of attributes.   ● Plot the distribution of each attribute using Histogram.   4. Perform the statistical analysis on a data set.   Generate   ● The statistical description of Iris data set   ● The Box plot for any one attribute and compare it with the relevant statistical data   ● The distribution Curve of the attribute considered for constructing the box plot.   5.Parameter Estimation Process   6.Data Aggregation Process   7.Perform the Following using LDA: ● Find the variance of each LDA component   ● Plot the variance of any two LDA components   8.PCA Implementation for a given data set   9.H-Plot construction for the given data set   10.Clustering the data using any one clustering Algorithm   11.Mini Project

	Contact Hours	:	30
	Total Contact Hours	:	75

Course Outcomes:	
On completion of the course, students will be able to	
•	Analyze means and variances of the individual variables in a multivariate set and also the correlations between those variables.
•	To find discriminants, rules to optimally assign new objects to the labelled classes.
•	Apply the principal component techniques to reduce data and to interpret.
•	To reduce the number of variables in regression models using Factor analysis
•	Apply the techniques of clustering methods for massive amounts of data.

Text Books:	
1	T.W. Anderson."An Introduction to Multivariate Statistical Analysis". Third edition ,Wiley, , 2003
2	J.D. Jobson,"Applied Multivariate Data Analysis", Volume I and II, Fourth Edition,Springer texts in statistics, New York, 1999.
3	Tim Hall and J-P Stacey, Python 3 for Absolute Beginners,.APress,2009,
4	Mark Lutz.,"ProgrammingPython" Fourth edition ,O'Reilly Media ,Germany, 2011.

Reference Books / Web links:	
1	D.A. Belsey, E. Kuh and R.E. Welsch ,"Regression Diagnostics , Identifying Influential Data and Sources of Collinearety"
2	Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining, "Introduction to Linear Regression Analysis", Fifth Edition, Wiley, 2012.
3	Johnson R.A. andWichern, D.W, "Applied Multivariate Statistical Analysis ", Sixth Edition, Pearson, 2018.
4	Magnus Lie Hetland, "Beginning Python: From Novice to Professional", Third Edition, Apress, 2005.
5	M.R. Anderberg, "Cluster Analysis for Applications", Academic Press.

CO - PO – PSO MATRICES OF THE COURSE

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CB23331.1	3	2	3	3	2	1	-	-	-	2	2	-	2	2	2
CB23331.2	3	3	2	3	2	1	-	-	-	1	2	-	2	2	2
CB23331.3	3	3	2	3	3	1	-	-	-	1	2	-	2	3	2
CB23331.4	3	3	2	3	3	2	-	-	-	2	2	-	2	3	3
CB23331.5	3	3	2	3	3	2	-	-	-	2	2	-	2	3	3
Average	3.0	2.8	2.2	3.0	2.6	1.4	-	-	-	1.6	2.0	-	2.0	2.6	2.4

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)   2: Moderate (Medium) 3: Substantial (High)

No correlation: "-"

Course Code	Course Title (Lab oriented Theory Course)	Category	L	T	P	C
CB23332	SOFTWARE ENGINEERING	PC	3	0	2	4

Objectives:
● Understand the phases in a software project.
● Gain knowledge in fundamental concepts of software project management and quality.
● Obtain knowledge on requirements engineering and Analysis Modelling.
● Learn various testing and maintenance measures

UNIT-I	INTRODUCTION	9
Programming in the small vs. programming in the large; software project failures and importance of software quality and timely availability; of software engineering towards successful execution of large software projects; emergence of software engineering as a discipline, Software Engineering Historical Development from Jackson Structured Programming to Agile Development.		
UNIT-II	SOFTWARE PROJECT MANAGEMENT	9
Basic concepts of life cycle models – different models and milestones; software project planning –identification of activities and resources; concepts of feasibility study; techniques for estimation of schedule and effort; software cost estimation models and concepts of software engineering economics; techniques of software project control and reporting; introduction to measurement of software size; introduction to the concepts of risk and its mitigation; configuration management. Agile Software Engineering: Concepts of Agile Methods, Extreme Programming; Agile Process Model - Scrum, Feature; Scenarios and Stories		
UNIT-III	SOFTWARE QUALITY AND RELIABILITY	9
Software quality; Garvin's quality dimensions, McCall's quality factor, ISO 9126 quality factor; Software Quality Dilemma; Introduction to Capability Maturity Models (CMM and CMMI); Introduction to software reliability, reliability models and estimation.		
UNIT-IV	SOFTWARE REQUIREMENTS AND OO ANALYSIS, DESIGN AND CONSTRUCTION	9
Introduction to Software Requirements Specifications (SRS) and requirement elicitation techniques; techniques for requirement modelling – decision tables, event tables, state transition tables, Petri nets; requirements documentation through use cases; introduction to UML, introduction to software metrics and metrics-based control methods; measures of code and design quality. Concepts -- the principles of abstraction, modularity, specification, encapsulation and information hiding; concepts of abstract data type; Class Responsibility Collaborator (CRC) model; quality of design; design measurements; concepts of design patterns; Refactoring; object-oriented construction principles; object oriented metrics.		
UNIT-V	SOFTWARE TESTING	9
Introduction to faults and failures; basic testing concepts; concepts of verification and validation; black box and white box tests; white box test coverage – code coverage, condition coverage, branch coverage; basic concepts of black-box tests – equivalence classes, boundary value tests, usage of state tables; testing use cases; transaction-based testing; testing for non-functional requirements – volume, performance and efficiency; concepts of inspection; Unit Testing, Integration Testing, System Testing and Acceptance Testing.		
	Contact Hours	:	45

List of Experiments	
1	Development of requirements specification.
2	Function oriented design using SA/SD.
3	Object-oriented design using UML.
4	Test case design.
5	Implementation using C++.
6	Testing.
7	Use of CASE tools and other tools such as configuration management tools.
8	Program analysis tools.
	Contact Hours	:	30
	Total Contact Hours	:	75

Course Outcomes:
On completion of the course, students will be able to
●	Work in software projects.
●	Identify the key activities in managing a software project.
●	Know the various quality models and reliability in software.
●	Make analysis, modelling and coding for software projects.
●	Perform the various testing methods for software projects

Text Books:	
1	Software Engineering, "Ian Sommerville", Tenth edition, Pearson Education, 2017.
2	Roggers S. Pressman and Bruce R. Maxim., "Software Engineering A Practitioner's Approach", Seventh Edition, McGraw Hill Education, 2019.

Reference Books:	
1	Roger S. Pressman," Software Engineering – A Practitioner's Approach", Ninth edition, 2023.
2	Carlo Ghezzi, Jazayeri Mehdi, Mandrioli Dino," Fundamentals of Software Engineering", second edition, Pearson publication.
3	Michael Jackson," Software Requirements and Specification: A Lexicon of Practice, Principles and Prejudices", first edition, ACM Press.
4	Ivar Jacobson, Grady Booch, James Rumbaugh,"The Unified Development Process", Addison-Wesley, 1999.
5	Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, "Design Patterns: Elements of Object-Oriented Reusable Software", First edition.
6	Norman E Fenton, Shari Lawrence Pfleeger," Software Metrics: A Rigorous and Practical Approach", Second edition, International Thomson Computer Press, 1997.
7	Shari Lawrence Pfleeger and Joanne M. Atlee, "Software Engineering: Theory and Practice", fourth edition, Pearson.
8	Bertrand Meyer, second edition," Object-Oriented Software Construction", Prentice-hall International Series, 1997.
9	Ivar Jacobson, "Object Oriented Software Engineering: A Use Case Driven Approach", First edition, ACM Press.
10	Bertrand Meyer, "Touch of Class: Learning to Program Well with Objects and Contracts ", First edition, Springer-Verlag Berlin Heidelberg.
11	Martin Fowler, "UML Distilled: A Brief Guide to the Standard Object Modeling Language ", Third edition, Addison Wesley, 2003.
12	Manoj Kumar Lal, "Introduction to Business Domains for Software Engineers", Kindle Edition, 2021.
13	Manoj Kumar Lal, "Knowledge Driven Development – Bridging Waterfall and Agile Methodologies", Kindle Edition, 2018.
14	Cynthia Andres, Kent Beck "Extreme Programming Explained: Embrace Change", Second Edition 2004.

CO - PO – PSO MATRICES OF THE COURSE

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CB23332.1	3	2	2	2	2	2	2	2	2	2	2	1	2	2	1
CB23332.2	2	2	2	2	2	2	1	1	3	2	3	1	2	1	1
CB23332.3	1	1	1	1	1	2	2	1	3	1	2	1	1	1	1
CB23332.4	2	2	3	2	2	1	1	1	3	3	2	1	2	2	1
CB23332.5	2	2	2	3	2	1	1	2	3	3	1	2	2	2	1
Average	2.0	1.8	2.0	2.0	1.8	1.6	1.4	1.4	2.8	2.2	2.0	1.2	1.8	1.6	1.0

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High) No correlation: "-"

Course Code	Course Title (LAB ORIENTED THEORY COURSE)	Category	L	T	P	C
CB23333	DATATBASE TECHNOLOGY	PC	3	0	2	4

Objectives:	
●	To discuss the fundamentals of data models to conceptualize and depict a database system.
●	To illustrate the relational database implementation using SQL with effective relational model.
●	To explain the fundamental concepts of transaction processing- concurrency control.
●	To demonstrate Query evaluation and optimization techniques.
●	To introduce the concepts of Database Security, Object Oriented, Data Warehousing and Data Mining.

UNIT- I	INTRODUCTION AND DATA MODELS	9
	Introduction – Purpose of Database Systems - View of Data –Database Architecture - Relational Databases – Database Schema – Keys. **Data Models** - Hierarchical, Network and Relational Models - Entity-relationship model and object oriented data model.	

UNIT- II	RELATIONAL QUERY LANGUAGES	9
	Relational query languages: Relational algebra, Tuple and domain relational calculus. **SQL:** Data Definition – Domain types – Structure of SQL Queries - Modifications of the database – Set Operations – Aggregate Functions – Null Values – Nested Sub queries – Complex Queries – Views – Joined relations. **Open source and Commercial DBMS** - MYSQL, ORACLE, DB2, SQL server.	

UNIT-III	RELATIONAL DATABASE DESIGN AND QUERY OPTIMIZATION	9
	Relational database design: Domain and data dependency, Armstrong's axioms, Functional Dependencies, Normal forms, Dependency preservation, Lossless design. **Query processing and optimization:** Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.	

UNIT-IV	STORAGE STRATEGIES AND TRANSACTION PROCESSING	9
	Storage strategies: Indices, B-trees, Hashing. **Transaction processing:** Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp-based schedulers, multi-version and optimistic Concurrency Control schemes, Database recovery.	

UNIT- V	DATABASE SECURITY AND ADVANCED TOPICS	9
	Database Security: Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection. **Advanced topics:** Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Introduction to NoSQL.	
	Contact Hours : 45	

LIST OF EXPERIMENTS	
1.	Conceptual Database design using E-R DIAGRAM
2.	Implementation of SQL commands DDL, DML, DCL and TCL
3.	Queries to demonstrate implementation of Integrity Constraints
4.	Practice of Inbuilt functions
5.	Implementation of Join and Nested Queries and Set operators
6.	Implementation of virtual tables using Views
7.	Practice of Procedural extensions (Procedure, Function, Cursors, Triggers)
8.	Implementation of NoSQL basic commands using Cassandra/Mongo DB.

9.	Implementation of Data Model in NoSQL.
10.	Implementation of Aggregation, Indexes in NoSQL.
11.	**MINI PROJECT** Database Connectivity with Front End Tools (Python/C/JAVA) For any problem selected, Design the ER Diagram, apply ER mapping rules, normalize the relations, and follow the application development process. Make sure that the application should have five or more tables, at least one trigger and one stored procedure, using suitable frontend tool. Indicative areas include a) Inventory Control System. b) Material Requirement Processing. c) Hospital Management System. d) Railway Reservation System. e) Personal Information System. f) Web Based User Identification System. g) Timetable Management System. h) Hotel Management System i) Library Management System.

	Contact Hours	:	**30**
	Total Contact Hours	:	**75**

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

●	Describe data models and DBMS architecture.
●	Write SQL queries for database manipulation and compare the various commercial and open source DBMS.
●	Demonstrate the relational database design applying normalization and query optimization.
●	Design storage strategies and solve concurrent transaction problems
●	Implement security aspects in DB management

Text Books:	
1.	Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts, Seventh Edition, McGraw Hill Publisers, 2021.

Reference Books:	
1.	J. D. Ullman, Principles of Database and Knowledge – Base Systems, Volume 1, Computer Science Press, 1993.
2.	R. Elmasri and S. Navathe, Fundamentals of Database Systems, Seventh Edition, Pearson Education, 2017.
3.	Serge Abiteboul, Richard Hull, Victor Vianu, Foundations of Databases, Pearson Education, 1994.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CB23333.1	2	2	2	2	2	-	-	-	1	-	1	1	2	2	2
CB23333.2	2	2	3	3	3	-	-	-	2	2	2	1	2	2	2
CB23333.3	2	2	2	3	2	-	-	-	2	2	2	1	2	2	2
CB23333.4	2	2	2	2	2	-	-	-	2	2	1	1	2	3	2
CB23333.5	2	2	3	3	2	-	-	-	2	-	2	2	2	2	3
Average	2	2	2.2	2.6	2.2	-	-	-	1.8	2	1.6	1.2	2	2.2	2.2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low), 2: Moderate (Medium) 3: Substantial (High) No correlation: "_"

Course Code	Course Title (Lab Oriented Theory course)	Category	L	T	P	C
CS23333	**OBJECT ORIENTED PROGRAMMING USING JAVA**	**PC**	**1**	**0**	**6**	**4**

Objectives:	
•	To understand Object Oriented Programming concepts and characteristics of Java.
•	To know the principles of classes, abstraction and inheritance.
•	To create packages, define exceptions and use interface.
•	To use I/O streams and collections in applications.
•	To design and build simple programs using Streams, Lambda and JDBC

UNIT I	INTRODUCTION TO OOP AND JAVA FUNDAMENTALS	3
Introduction to Object Oriented Programming – An overview of Java - Java Architecture - Data Types - Variables-Operators.	
UNIT II	CLASSES AND INHERITANCE	3
	Classes – Class Fundamentals - A Simple Class - Declaring Objects - Methods – Constructors Inheritance - Inheritance Basics - Member Access - Method Overriding - Abstract Classes - Object Class	
UNIT-III	PACKAGES, INTERFACE & EXCEPTION HANDLING	3
	Packages - Defining a Package - Access Protection - Imports - Interfaces - Implements - Nested Interfaces - Exception Handling - Types - try - catch - throw - throws – finally.	
UNIT IV	I/O AND COLLECTIONS	3
	Input / Output Basics – Streams – Byte streams and Character streams – Collection Interfaces – Collection Classes.	
UNIT-V	STREAMS API, LAMBDA AND JDBC	3
	Stream API – Reduction – Parallel – mapping – Collecting – Iterator - Lambda Expressions Functional Interfaces - Predefined Functional Interfaces - Accessing Databases with JDBC	
	Total Contact Hours **:**	**15**

	List of Experiments	
1	Programs using control structures.	
2	Programs using arrays.	
3	Programs using strings and string buffer.	
4	Programs using classes and objects.	
5	Programs using inheritance.	
6	Programs using default & static methods in interfaces.	
7	Programs using functional interface.	
8	Programs to create user defined exceptions.	
9	Programs to implement Object Serialization.	
10	Programs using collections-LIST.	
11	Programs using collections-SET.	
12	Programs using collections-MAP.	
13	Programs using STREAMS.	
14	Programs using LAMBDA.	
15	Simple applications using JDBC.	
	Contact Hours :	**60**
	Total Contact Hours :	**75**

Course Outcomes: On completion of the course, the students will be able to
• Develop Java programs using OOP principles and Strings.
• Develop Java programs with the concepts inheritance.
• Build Java applications using exceptions and interfaces.
• Develop Java applications using I/O and collections.
• Develop interactive Java applications using Streams and JDBC.

Suggested Activities:
• **Quizzes** – basic concepts of JAVA & language basics**.**
• **Tutorial** – Class & Inheritance **.**
• **Flipped Classroom** – Packages & Interface **.**
• **Mind Map, Poster Design** – IO & Collections **.**
• **Implementation of small Systems-** JDBC **.**

Textbooks:	
1.	Herbert Schildt, "Java The Complete Reference", Ninth Edition, McGraw Hill Education, 2014
2.	Cay S. Horstmann, Gary Cornell, "Core Java Volume –I Fundamentals", Ninth Edition, Prentice Hall, 2013.

Reference Books (s)/Web links:	
1.	Paul Deitel, Harvey Deitel, "Java SE 8 for programmers", 3rd Edition, Pearson, 2015.
2.	Steven Holzner, "Java 2 Black book", Dreamtech press, 2011.
3.	Timothy Budd, "Understanding Object-oriented programming with Java", Updated Edition, Pearson Education, 2000.
4.	SCJP Sun Certified Programmer for Java 6 Study Guide. 6th edition, McGrawHill.
5.	https://www.javatpoint.com/java-tutorial
6.	https://java-iitd.vlabs.ac.in/
7.	https://www.hackerrank.com/domains/java.

CO - PO – PSO matrices of Course

COs/Pos PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS23333.1	3	3	3	2	-	-	-	-	-	-	-	-	3	3	2
CS23333.2	3	3	3	2	-	-	-	-	-	-	-	-	3	3	2
CS23333.3	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3
CS23333.4	3	3	3	3	3	-	-	-	-	-	-	3	3	3	3
CS23333.5	3	3	3	3	3	-	2	-	2	2	3	3	3	3	3
Average	3	3	3	2.6	3	-	2	-	2	2	3	3	3	3	2.6

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low)   2: Moderate (Medium)
3: Substantial (High) No correlation : "-"

Course Code	Course Title	Category	L	T	P	C
MC23313	ENVIRONMENTAL SCIENCE	MC	3	0	0	0
	III sem. B.Tech. Computer Science and Business Systems					

Objectives:

- To make students understand and appreciate the components of ecosystem and importance of biodiversity.
- To comprehend the importance of resources and various causes for environmental degradation.
- To know the various forms of pollution and their control.
- To provide the students about the current social issues pertaining to environment.
- To comprehend the tools for sustainable development.

UNIT-I	ECOSYSTEM AND BIODIVERSITY	9

Environment-scope and importance of environmental science- segments of environment - Ecosystem -structural components - functions - energy flow in ecosystems - food web- Ecological succession- stages involved- primary and secondary succession-Biodiversity-types – value of biodiversity – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT-II	WATER POLLUTION AND ITS MANAGEMENT	9

Definition-causes-effects of water pollution-point and nonpoint sources of wastewater-marine pollution - thermal pollution - Control of water pollution by physical, chemical and biological methods – wastewater treatment-primary, secondary and tertiary treatment-sources and characteristics of industrial effluents- zero liquid discharge.

UNIT-III	SOLID WASTE AND HAZARDOUS WASTE MANAGEMENT	9

Solid waste – types- municipal solid waste management: sources, characteristics, collection, and transportation- sanitary landfill, recycling, composting, incineration, energy recovery options fromwaste - Hazardous waste – types, characteristics, and health impact - hazardous waste management: neutralization, oxidation reduction, precipitation, solidification, stabilization, incineration and final disposal.

E-waste-definition-sources-effects on human health and environment- E-waste management-steps involved - Role of E-waste management within the initiatives of the Govt. of India- Swachh Bharat Mission.

UNIT-IV	SUSTAINABLE DEVELOPMENT	9

Sustainable development- concept-dimensions-sustainable development goals - value education-gender equality – food security - poverty – hunger - famine - Twelve principles of green chemistry - Green technology - definition, importance - Cleaner development mechanism - carbon credits, carbon trading, carbon sequestration, eco labeling-International conventions and protocols-Disaster management.

UNIT-V	ENVIRONMENTAL MANAGEMENT AND LEGISLATION	9
	Environmental Management systems - ISO 14000 series- Environmental audit-Environmental Impact Assessment- life cycle assessment- human health risk assessment - Environmental Lawsand Policy- Objectives - Polluter pays principle, Precautionary principle - The Environment (Protection) Act 1986 - Role of Information technologyin environment and human health.	
	Total Contact Hours:45	

SUGGESTED EVALUATION METHODS
- Continuous assessment tests
- Assignments
- Classroom presentations on case studies (or) Site visits, instead of CAT-I (or)CAT-II or CAT

Course Outcomes:
On completion of the course, the students will be able to
- Associate air and noise quality standards with environment and human health.
- Illustrate the significance of water and devise control measures for water pollution.
- Analyze solid wastes and hazardous wastes.
- Outline the goals of sustainable development in an integrated perspective.
- Comprehend the significance of environmental laws.

Text Book(s):

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016
2. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publisher, 2018.
3. Johri R., E-waste: implications, regulations, and management in India and current global best practices, TERI Press, New Delhi

Reference Books(s) / Web links:

1. ErachBharucha, "Textbook of Environmental Studies", Third Edition, UniversitiesPress(I) Pvt Ltd, Hydrabad, 2015.,
2. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Fifteenth edition, CengageLearning India PVT, LTD, Delhi, 2014.
3. De. A.K., "Environmental Chemistry", New Age International, New Delhi,1996.

Web links:	
1	https://onlinecourses.nptel.ac.in/noc19_ge22/
2	NPTEL
3	https://news.mit.edu/2013/ewaste-mit

CO - PO – PSO matrices of course

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
MC23313.1	1	2	3	1	-	2	2	2	1	1	1	2	-	2	-
MC23313.2	1	2	3	1	-	2	2	2	1	1	1	2	-	2	-
MC23313.3	-	-	3	1	-	2	3	2	1	-	1	2	-	2	-
MC23313.4	-	1	2	1	1	3	3	2	1	1	1	2	-	2	-
MC23313.5	-	1	2	-	-	2	2	2	1	2	2	2	-	2	-
AVG.	0.4	1.2	2.6	0.8	0.2	2.2	2.4	2	1	1	1.2	2	-	2	-

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High) No correlation: "-"

SEMESTER-IV

Course Code	Course Title (Lab oriented Theory Course)	Category	L	T	P	C
CB23411	INTRODUCTION TO INNOVATION, IP MANAGEMENT AND ENTREPRENEURSHIP	PC	3	0	0	3

Objectives:	
●	To study the fundamentals of technology innovation, intellectual property rights and entrepreneurship.
●	To identify and discover market needs.
●	To create, protect and assetize and commercialize intellectual property.
●	To learn the opportunities and challenges for entrepreneurs.
●	To learn the fundamentals of a business model based on technology innovation.

UNIT-I	INNOVATION	9
	A primer on Innovation, IP Rights and Entrepreneurship - Types of Innovation - incremental, disruptive, Lifecycle of Innovation - idea, literature survey, PoT, PoC, Challenges in Innovation - time, cost, data, infrastructure- Case study.	
UNIT-II	INTELLECTUAL PROPERTY RIGHT	9
	Types of IPR - patents, copyrights, trademarks, Geographical Indication, Lifecycle of IP -creation, protection, assetization, monetization, Balancing IP risks and rewards - Right Access and Right Use of Open Source and 3rd party products, technology transfer and licensing, IP valuation - methods, examples, limitations- Case study.	
UNIT-III	ENTREPRENEURSHIP	9
	Opportunity identification in technology entrepreneurship - customer pain points, competitive context, Market research, segmentation and sizing, Product positioning and pricing, go-to market strategy, Innovation assessment - examples, patentability analysis.	
UNIT-IV	BUSINESS MODELS	9
	Start-up business models - fund raising, market segments, channels, co-innovation and open innovation - academia, start-ups and corporates, Technology innovation – Case study.	
UNIT-V	INNOVATION, INCUBATION and ENTREPRENEURSHIP IN CORPORATE CONTEXT	9
	Innovation, Incubation and Entrepreneurship in Corporate Context, Technology-driven Social Innovation and Entrepreneurship, Manage innovation, IP and Entrepreneurship Programs- Processes, Governance and Tools.	
	Total Contact Hours	: 45

Course Outcomes:	
Upon completion of the course, the students will be able to	
●	Understand the innovation life cycle and types of innovation.
●	Gain knowledge on the importance of intellectual property rights and procedure of filing an IPR.
●	Interpret the market needs and analyze the marketing strategy.
●	Build a business model based on technology innovation
●	Convert an innovative idea into a venture and protect it through intellectual property rights.

	Text Book(s):
1	Tidd, John Bessant, "Managing Innovation: Integrating Technological, Market and Organizational Change", Sixth Edition, John Wiley and Sons Limited, 2018.
2	John Bessant and Joe Tidd, "Innovation and Entrepreneurship", Third Edition, John Wiley and Sons Limited, 2015.
3	Vivien Irish, "Intellectual Property Rights for Engineers", Second Edition, The Institution of Engineering and Technology, 2015.

	Reference Book(s)/Web Links/Online Resources:
1	www.lead-innovation.com
2	www.tatainnovista.com
3	Social Innovation: A Guide to Achieving Corporate and Societal Value (Insight Report, World Economic Forum, 2016)
4	Valuation and Deal making of Technology-Based Intellectual Property: Principles, Methods and Tools, http://razgaitis.com/books/dealmaking/
5	www.wipo.int
6	Indian Patent Act, 1970

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CB23411.1	3	3	3	3	1	3	2	2	1	1	1	1	1	3	2
CB23411.2	2	2	3	3	1	3	2	3	1	1	3	1	1	3	3
CB23411.3	2	3	3	2	1	3	2	2	1	1	3	1	1	3	1
CB23411.4	1	2	2	2	1	3	3	2	1	1	3	1	1	3	3
CB23411.5	2	2	2	2	1	2	2	2	1	1	1	1	1	1	1
Average	2.0	2.4	2.6	2.4	1.0	2.8	2.2	2.2	1.0	1.0	2.2	1.0	1.0	2.6	2.0

Correlation levels 1, 2 or 3 as defined below:
1: Slight (Low)
2: Moderate (Medium)
3: Substantial (High) No correlation: "-"

Course Code	Course Title (Theory Course)	Category	L	T	P	C
BA23412	FUNDAMENTALS OF MANAGEMENT	MS	2	0	0	2

Objectives:

●	The course will cover the management theories, evolution of management over the years and few basic concepts without going into the details.
●	To expose the students to know the functions of management, the organizational design, leadership and ethics in management.

UNIT-I	MANAGEMENT THEORIES	6
Concept and Foundations of Management, Evolution of Management Thoughts [Pre-Scientific Management Era (before 1880), Classical management Era (1880-1930), Neo-classical Management Era (1930-1950), Modern Management era (1950-onward). Contribution of Management Thinkers: Taylor, Fayol, Elton Mayo etc.	

UNIT-II	FUNCTIONS OF MANAGEMENT and LEADERSHIP	6
	Planning, Organizing, Staffing, Directing, Controlling, Leadership - Concept, Nature, Importance, Attributes of a leader, developing leaders across the organization, Leadership Grid.	

UNIT-III	ORGANIZATIONAL DESIGN	6
	Classical, Neoclassical and Contingency approaches to organizational design; Organizational theory and design, Organizational structure (Simple Structure, Functional Structure, Divisional Structure, Matrix Structure).	

UNIT-IV	ORGANIZATION BEHAVIOR	6
	Introduction, Personality, Perception, Learning and Reinforcement, Motivation, Group Dynamics, Power and Influence, Work Stress and Stress Management, Decision Making, Problems in Decision Making, Decision Making, Organizational Culture, Managing Cultural Diversity.	

UNIT-V	MANAGERIAL ETHICS	6
	Ethics and Business, Ethics of Marketing and advertising, Ethics of Finance and Accounting, Decision – making frameworks, Business and Social Responsibility, International Standards, Corporate Governance, Corporate Citizenship, Corporate Social Responsibility.	
	Total Contact Hours :	30

Course Outcomes:

On completion of the course, the students will be able to

●	Understand the theories, concept, and evolution of management.
●	Demonstrate the ability to employ 'the management way of thinking'.
●	Understand how organizations work and find it easier to grasp the intricacies of other management areas such as finance, marketing, strategy etc.
●	Understand the qualities of a leader in the managerial aspect in future terms.
●	Understand the managerial ethics and CSR and its importance.

Text Book (s):

1	Richard L. Daft, "Understanding the Theory and Design of Organization", Eleventh Edition, Cengage Learning India Private Limited, 2020.

Reference Books(s) :

1	Stephen P. Robbins, Timothy A. Judge, Neharika Vohra, Organizational Behavior, Eighteenth Edition, Pearson India,2019.

CO - PO – PSO matrices of course

PO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BA23412.1	2	2	1	-	-	2	2	1	3	-	2	1	3	-	3
BA23412.2	2	2	2	-	-	2	3	1	3	1	2	1	-	2	1
BA23412.3	2	3	1	-	-	1	2	-	3	2	2	3	2	-	-
BA23412.4	3	2	-	-	-	2	2	2	3	2	1	2	1	-	1
BA23412.5	2	1	-	-	-	2	2	3	1	1	2	2	1	-	1
Average	2.2	2	0.8	-	-	1.8	2.2	1.4	2.6	1.2	1.8	1.8	1.4	0.4	1.2

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High) No correlation: "-"

Course Code	Course Title (LAB ORIENTED THEORY COURSE)	Category	L	T	P	C
CB23431	**OPERATING SYSTEM CONCEPTS**	PC	3	0	2	4

	Objectives:
●	Learn basics of operating system and concept of virtual machine
●	Understand the concepts of process, scheduling and synchronization
●	Acquire knowledge about deadlocks and concurrent programming
●	To study about the various memory management schemes
●	Know about the I/O, file, disk management, basics of Linux and Android OS.

UNIT-I	**INTRODUCTION**	**8**

Concept of Operating Systems (OS) - Generations of OS - Types of OS - OS Services - Interrupt handling and System Calls- Basic architectural concepts of an OS- Concept of Virtual Machine - System Boot process, BIOS, Bootstrap loader.

UNIT-II	**PROCESS MANAGEMENT**	**10**

Processes – Concept-Process Scheduling – Threads-Types - Concept of multithreads – CPU Scheduling- – Scheduling algorithms- FCFS - SJF - RR - Multiprocessor scheduling – Real Time scheduling- RM and EDF – Inter-process Communication- Critical Section- Race Conditions- Mutual Exclusion- Hardware Solution- Semaphores- The Producer / Consumer Problem- Classical IPC Problems - Reader's and Writer Problem - Dinning Philosopher Problem - Barber's shop problem.

UNIT-III	**DEADLOCK AND CONCURRENT PROGRAMMING**	**8**

Deadlocks – Necessary and sufficient conditions for Deadlock - Deadlock Prevention - Deadlock Avoidance - Banker's algorithm- Deadlock detection and Recovery – Monitors. Concurrent processes-Concurrent Programming - Concurrent languages – Communicating Sequential Process (CSP).

UNIT-IV	**MEMORY MANAGEMENT**	**9**

Memory Management – Basic concept - Logical and Physical address maps-Contiguous Memory allocation – Internal and External fragmentation and Compaction– Virtual Memory- Basics ofVirtual Memory – Hardware and control structures – Locality of reference- Page allocation- Partitioning- Paging- Page fault- Working Set- Segmentation- Demand paging– Page Replacement algorithms- Optimal- First in First Out (FIFO)-Second Chance (SC)- Not recently used (NRU)- Least Recently used(LRU).

UNIT-V	**FILE AND I/O MANAGEMENT**	**10**

I/O Hardware -I/O devices, Device controllers, Direct Memory Access, Principles of I/O Concept of File - Access methods - File types - File operation - Directory structure - File System structure - Allocation methods (contiguous, linked, indexed) - Free-space management (bit vector, linked list, grouping) - directory implementation (linear list, hash table) - efficiency and performance -Disk structure - Disk scheduling - FCFS - SSTF - SCAN - C-SCAN - Disk reliability - Disk formatting- Case Study: Linux OS and Android OS.

	Contact Hours	**:**	**45**

	LIST OF EXPERIMENTS		
1	Implement shell scripts with filters and pipes (grep, sort, uniq, cut, tr)		
2	Implement shell script for system monitoring with email alert		
3	Implement UNIX/Linux I/O system calls (create, open, close, read, write)		
4	Inter-process communication using shared memory		
5	Scheduling algorithms – FCFS, SJF, Priority and RR		
6	Producer Consumer problem solution using semaphores		
7	Bankers deadlock avoidance algorithm		
8	Contiguous Memory Allocation - First Fit and Best Fit		
9	Page Replacement Algorithms - FIFO and LRU		
10	Implement a character device driver in Unix/Linux		
		Contact Hours :	**30**
		Total Contact Hours :	**75**

COURSE OUTCOMES:
On successful completion of this course, the student will be able to:

•	Grasp the basic concepts of an operating system
•	Thoroughly analyze the various scheduling algorithms
•	Able to do concurrent programming
•	Compare and contrast the various memory management scheme
•	Evaluate various disk scheduling algorithms and understand the basic principles of Linux and Android OS.

TEXT BOOKS:
1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", TenthEdition, Wiley, 2023.

	REFERENCE BOOKS
1	William Stallings, Operating Systems – Internals and Design Principles, Ninth Edition, Pearson, 2018.
2	Charles Patrick Crowley, Operating System: A Design-oriented Approach, First Edition, McGraw Hill Education, 2018.
3	Gary J. Nutt, Operating Systems: A Modern Perspective, Third Edition, Deitel, 2007.
4	Maurice J. Bach, Design of the Unix Operating Systems, First Edition, Pearson, 2015.
5	Daniel Pierre Bovet, Marco Cesati, Understanding the Linux Kernel, Third Edition, O'Reilly, 2006.
6	Wei-Meng Lee, "BEGINNING ANDROID™ 4 APPLICATION DEVELOPMENT ", Ch1 , John Wiley and Sons , 2012

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CB23431.1	2	1	1	1	3	1	1	-	2	1	2	2	3	-	1
CB23431.2	2	2	2	1	3	1	-	-	2	-	2	2	2	3	2
CB23431.3	2	2	2	1	2	1	-	-	1	-	2	2	2	3	2
CB23431.4	2	2	3	1	2	1	-	-	2	-	2	2	2	2	1
CB23431.5	2	1	2	1	2	1	-	-	2	-	1	2	2	-	1
Average	2	1.6	2	1	2.4	1	1	-	1.8	1	1.8	2	2.2	2.8	1.6

Correlation levels 1, 2 or 3 as defined below:

Correlation levels 1, 2 or 3 as defined below:
1: Slight (Low)
2: Moderate (Medium)
3: Substantial (High)
No correlation: "-"

Course Code	Course Title (Lab Oriented Theory Course)	Category	L	T	P	C
CB23432	**SOFTWARE DESIGN WITH UML**	**PC**	**2**	**0**	**2**	**3**

Objectives:	
●	Understand the object-oriented software development process
●	Design suitable pattern to develop software models
●	Analyze requirements to create requirements design model
●	Apply business modelling and modelling languages to design software
●	Develop correct and robust software deployment models

UNIT-I	INTRODUCTION TO OBJECT ORIENTED TECHNOLOGIES	6

Software development process: The Waterfall Model vs. The Spiral Model - The Software Crisis, description of the real world using the Objects Model. - Classes, inheritance and multiple configurations. - Quality software characteristics - Description of the Object-Oriented Analysis process vs. the Structure Analysis Model.

UNIT-II	INTRODUCTION TO THE UML LANGUAGE AND DESIGN PATTERNS	6

Standards - Elements of the language. - General description of various models -The process of Object-Oriented software development. - Description of Design Patterns - Technological Description of Distributed Systems.

UNIT-III	BUSINESS MODEL DIAGRAMS	6

Requirements Analysis Using Case Modeling - Analysis of system requirements - Actor definitions. - Writing a case goal - Use Case Diagrams. - Use Case Relationships. **Dynamic Model: State Diagram / Activity Diagram-** Description of the State Diagram - Events Handling - Description of the Activity Diagram - Exercise in State Machine - Case studies to implement in design lab.

UNIT-IV	THE LOGICAL VIEW DESIGN DIAGRAMS	6

Transfer from Analysis to Design in the Characterization Stage: Interaction Diagrams - Description of goal - Defining UML Method, Operation, Object Interface, Class - Sequence Diagram - Finding objects from Flow of Events - Describing the process of finding objects using a Sequence Diagram - Describing the process of finding objects using a Collaboration Diagram –Mapping use case to sequence diagram - **The Static Structure Diagrams. -** The Class Diagram Model - Attributes descriptions - Operations descriptions - Connections descriptions in the Static Model - Association, Generalization, Aggregation, Dependency, Interfacing, Multiplicity- Case studies to implement in design lab.

UNIT-V	TECHNICAL STACK DIAGRAMS	6

Package Diagram Model - Description of the model. - White box, black box - connections between packagers - Interfaces - Create Package Diagram - Drill Down - **Component Diagram Model -** Physical Aspect - Logical Aspect - Connections and Dependencies - User face - Initial DB design in a UML environment. - **Deployment Model -** Processors
4. Connections - Components - Tasks - Threads
5. Signals and Events. – Mapping class diagram to create skeleton code to implement - Case studies to implement in design lab.

		Contact Hours	:	30

LIST OF EXPERIMENTS	
1	Students should design a mini project and should apply the following experiments

2	Requirements Engineering
	    Writing Problem Statement
	    Writing Requirement Specification
	        a. SRS
	        b. Use Case
	Planning Project with PERT Diagram

	Designing Project			
	Use Case Diagrams			
	Interaction Diagrams			
	State chart Diagrams and Activity Diagrams			
	Class Diagrams			
	Package Diagrams			
	Component Diagrams and Deployment Diagrams			
3	Mapping Design to code			
		Contact Hours	:	30
		Total Contact Hours	:	60

SOFTWARE:
1.	IBM Rational Rose/AGRO UML/STAR UML for Design

Course Outcomes
On completion of the course, students will be able to:
●	To understand how to model object-oriented languages
●	To decide a suitable software model for a project
●	To elicit requirements and design a user interface model
●	To design a project business model
●	To create a deployment model

Text Books:
1.	Bernd Bruegge and Allen H. Dutoit, *"Object-Oriented Software Engineering: using UML, Patterns, and Java"*, Third Edition, Pearson, 2011.

Reference Books:
1.	Erich Gamma, Richard Helm, Ralph Johnson, and John M. Vlissides, Design Patterns: Elements of Reusable Object-Oriented Software, Addison Wesley, 2018.
2	Craig Larman, "Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development", 3rd Edition, Pearson Education, 2015.
3	Simon Bennett, Steve Mc Robb and Ray Farmer, "Object Oriented Systems Analysis and Design Using UML", Fourth Edition, Mc-Graw Hill Education, 2010.
4	Martin Fowler, "UML Distilled: A Brief Guide to the Standard Object Modeling Language", Third edition, Addison Wesley, 2003.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CB23432.1	2	1	1	1	2	2	2	2	2	2	3	1	1	3	-
CB23432.2	-	2	-	1	2	1	-	1	1	1	2	-	1	2	-
CB23432.3	2	3	1	1	1	1	-	-	-	1	1	1	2	2	-
CB23432.4	1	2	3	1	2	2	1	1	1	2	2	1	1	2	-
CB23432.5	1	1	-	1	1	1	1	2	1	1	1	1	2	1	-
Average	1.2	1.8	1.0	1.0	1.6	1.4	0.8	1.2	1.0	1.4	1.8	0.8	1.4	2.0	-

Correlation levels 1, 2 or 3 as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High) No correlation: "-"

Course Code	Course Title (Lab Oriented Theory Course)	Category	L	T	P	C
CB23433	**ANALYSIS OF ALGORITHMS AND DESIGN**	PC	2	1	2	4

Objectives:	
●	Learn and understand the algorithm analysis techniques and complexity notations
●	Become familiar with the different algorithm design techniques for effective problem solving in computing.
●	Learn to apply the design techniques in solving various kinds of problems in an efficient way.
●	Understand the limitations of algorithm power.
●	Solve variety of problems using different design techniques

UNIT-I	**ANALYSIS OF ALGORITHMS**	9
Introduction: Characteristics of Algorithm. Analysis of Algorithm: Performance Measurements of Algorithm, Time and Space Trade-Offs, Asymptotic analysis of Complexity Bounds – Best, Average and Worst-Case behaviour; Analysis of Recursive Algorithms through Recurrence Relations: Substitution Method, Recursion Tree Method and Masters' Theorem.	
UNIT-II	**FUNDAMENTALS OF ALGORITHIMIC STRATEGIES**	9
	Brute-Force, Heuristics, Greedy, Divide and Conquer, Dynamic Programming Methodologies; Illustrations of these techniques for Problem-Solving, Bin Packing, Knapsack, Travelling Salesman Problem.	
UNIT-III	**ALGORITHIMIC STRATEGIES**	9
	Branch and Bound and Backtracking methodologies; Illustrations of these techniques for Problem-Solving , n-Queens Problem , Graph Coloring , Knapsack, Travelling Salesman Problem.	
UNIT-IV	**GRAPH AND TREE ALGORITHMS**	9
	Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.	
UNIT-V	**TRACTABLE, INTRACTABLE PROBLEMS AND ADVANCED TOPICS**	9
	Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques. Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE, Introduction to Quantum Algorithms.	
	Total Contact Hours :	45

	List of Experiments
1	Finding Time Complexity of Algorithms.
2	Design and implement algorithms using Brute Force Technique.
3	Design and implement algorithms using Divide and Conquer Technique.
4	Design and implement algorithms using Greedy Technique.
5	Design and implement algorithms using Dynamic Programming.
6	Design and implement algorithms using Backtracking.
7	Design and implement algorithms using Branch and Bound.
	Contact Hours : **30**
	Total Contact Hours : **75**

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

●	Analyse the time and space complexity of various algorithms and compare algorithms with respect to complexities.
●	Ability to decide and Apply Brute Force and Divide and Conquer design strategies to Synthesize algorithms for appropriate computing problems.
●	Ability to decide and Apply Greedy and Dynamic Programming techniques to Synthesize algorithms for appropriate computing problems.
●	Ability to decide and Apply Backtracking and Branch and Bound techniques to Synthesize algorithms for appropriate computing problems.
●	Ability to identify an algorithm is tractable or intractable.

Text Book (s):

1	E. Horowitz and S. Sahni., "Fundamental of Computer Algorithms", Second Edition, Computer Science Press, 2018.
2	A. Aho, J. Hopcroft and J. Ullman, "The Design and Analysis of Computer Algorithms", Fourth Edition, Pearson India, 2009.

Reference Books(s) :

1	T. H. Cormen, C. E. Leiserson and R. L. Rivest, "Introduction to Algorithms", Third Edition, MIT Press, 2009.
2	S. Baase, "Computer Algorithms: Introduction to Design and Analysis", Third Edition, Pearson, 2000.
3	.D. E. Knuth ,"The Art of Computer Programming, Vol. 1, Vol. 2 and Vol. 3", Third Edition, Mathematical Science Publishers,1997.

CO - PO – PSO matrices of course

PO/PSO \ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CB23433.1	3	-	-	-	-	-	-	-	-	-	-	1	3	2	2
CB23433.2	2	3	2	2	-	-	-	-	-	-	-	1	3	3	1
CB23433.3	2	3	2	2	-	-	-	-	-	-	-	1	3	3	1
CB23433.4	2	3	2	2	-	-	-	-	-	-	-	1	3	3	1
CB23433.5	1	2	2	2	-	-	-	-	-	-	-	1	3	3	1
Average	2	2.75	2	2	-	-	-	-	-	-	-	1	3	2.8	1.2

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)   2: Moderate (Medium) 3: Substantial (High)

No correlation: "-"

Course Code	Course Title	Category	L	T	P	C
MA23437	OPTIMIZATION TECHNIQUES	BS	3	0	2	4
	IV sem. B.Tech. – Computer Science and Business Systems					

Objectives:
● To understand and apply the concept of Linear Programming problems in Engineering.
● To develop formulation skills in transportation and assignment models and finding solutions.
● To acquire skills in analysing queuing models.
● To find the best ways to crash project schedule, shortening total project duration and the ways to save money by adjusting activity durations and optimizing resource requirements.
● To explain the importance of inventory control and inventory control systems.

UNIT-I	INTRODUCTION TO LINEAR PROGRAMMING	9

Origin of OR and its definition- Concept of optimizing performance measure- Types of OR problems: Deterministic vs. Stochastic optimization - Phases of OR problem approach: problem formulation, building mathematical model, deriving solutions, validating model, controlling and implementing solution.
Convex sets, Convex function-Linear Programming: formulation, solution by graphical and simplex methods - Primal-Penalty- Two phase –Principles of duality.

UNIT-II	TRANSPORTATION AND ASSIGNMENT PROBLEMS	9

Transportation Models (Minimising and Maximising Problems) – Balanced and unbalanced Problems – Initial Basic feasible solution by N-W Corner Rule, Least cost and Vogel's approximation methods- Check for optimality: Solution by MODI algorithm - Case of Degeneracy- Assignment Models (Minimising and Maximising Problems) : Balanced and Unbalanced Problems -Solution by Hungarian - Travelling Salesman problem.

UNIT-III	QUEUEING THEORY AND SIMULATION METHOD	9

Markovian queues – Birth and Death processes – Queueing Models - (M/M/1):(GD/∞/∞), (M/M/1):(GD/K/∞), (M/M/C):(GD/∞/∞), (M/M/C):(GD/K/∞), (M/G/1) :(GD/∞/∞).
Definition and steps of simulation - random number, random number generator - Discrete Event System Simulation – clock, event list - Application in Queuing systems.

UNIT-IV	PERT -CPM	9

Project definition, Project scheduling techniques – Gantt chart, PERT and CPM, Determination of critical paths, Estimation of Project time and its variance in PERT using statistical principles -Concept of project crashing/time-cost trade-off- Scheduling using simulation methods.

UNIT-V	INVENTORY CONTROL	9

Functions of inventory and its disadvantages - ABC analysis - Concept of inventory costs - Basics of inventory policy (order, lead time, types) - Fixed order-quantity models – EOQ, POQ and Quantity discount models - EOQ models for discrete units- sensitivity analysis and Robustness - Special cases of EOQ models for safety stock with known/unknown stock out situations, models under prescribed policy - Probabilistic situations – Inventory systems using simulation methods.

Contact Hours: 45

Description of the Experiments (using Python Software)	Contact Hours:30
1. Linear programming-Graphical method	
2. Linear programming-Simplex method	
3. Transportation Problem	
4. Assignment Problem	
5. Monte Carlo simulation	

6.	Simulation of Single server Queuing system
7.	PERT -Analysis
8.	CPM – Analysis
9.	ABC Analysis
10.	Economic order quantity
	Total Contact Hours : 75

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

- Solve Linear Programming problems using different methods.
- Formulate and solve transportation and assignment models arising in the field of engineering and technology.
- Analyse problems involving queuing theory and optimize using simulation techniques.
- Find the best ways to crash project schedule, shortening total project duration and the ways to save money by adjusting activity durations and ooptimizing resource requirements in real life problems.
- Explain the concept of inventory and the importance of inventory management in the supply chain process.

SUGGESTED ACTIVITIES

- Problem solving sessions
- Smart Class room sessions

SUGGESTED EVALUATION METHODS (if Any)

- Problem solving in Tutorial sessions
- Assignment problems
- Quizzes and class test
- Discussion in classroom

Text Book(s):

1.	Hamdy A Taha, "Operations Research: An Introduction", Tenth Edition ,Prentice Hall India, 2019.
2.	Paneerselvam R.," Operations Research", Fourth Print ,Prentice Hall of India, 2008.
3.	G. Srinivasan, "Operations Research – Principles and Applications", Second Edition, Prentice Hall of India, 2011.
4.	F.S. Hiller and G.J. Lieberman, Introduction to Operations Research, Ninth Edition, McGraw-Hill, Year: 2010.

Reference Books(s) / Web links:

1.	Katta G. Murty Linear Programming, John Wiley and Sons, 1983.
2.	G. Hadley, Linear Programming Addison-Wesley Publishing, 1962.
3.	Thomas L. Saaty Elements of Queueing theory with applications, McGraw-Hill, 1983.
4.	Jerome Wiest and F.K. Levy. Management Guide to PERT/CPM, Prentice Hall India, 1970.

CO - PO – PSO matrices of course

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA23437.1	2	2	1	-	-	-	-	-	-	-	-	-	-	1	-
MA23437.2	2	2	1	-	-	-	-	-	-	-	1	-	-	1	-
MA23437.3	2	1	1	-	1	-	-	-	-	-	-	-	-	1	-
MA23437.4	2	2	1	-	-	-	-	-	-	-	2	-	-	1	-
MA23437.5	2	1	1	-	-	-	-	-	-	-	1	-	-	1	-
Average	2	1.6	1	-	1	-	-	-	-	-	1.3	-	-	1	-

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High) No correlation: "-"

Course Code	Course Title	Category	L	T	P	C
HS23421	BUSINESS COMMUNICATION AND VALUE SCIENCE –III	HS	0	0	4	2

IV Sem. B.Tech. – Computer Science and Business Systems

Objectives:

- Introduce students to Self-analysis techniques like SWOT and TOWS
- Expose students to key concepts of Pluralism and cultural spaces, Cross-cultural communication
- Enhance the technical writing skills of the students and help them understand the science of nation building
- Create awareness about Artificial Intelligence and how to communicate with machines
- Inculcate social consciousness among the students and make them realize their responsibility in addressing the social issues

UNIT-I	FRAMEWORK OF ANALYSIS	9

Concepts: Person analysis:SWOT analysis - SWOT and Life Positions –Analysis of others' lives – Analysis of one's own life. - TOWS Analysis:How to turn threat into opportunity – VUCA - Volatility, uncertainty, complexity and ambiguity - Application of analysis in real life scenarios – Maslow's theory of motivation.

Activity:SWOT analysis of awell-known individual's life - Creatingone's own SWOT – TED talk on biomimicry – Group activity - Presentation on strengths identified to survive in the VUCA World – Watching videos of motivation and discussion.

UNIT-II	PLURALISM IN CULTURAL SPACES	9

Concepts:Identifying Pluralism in cultural spaces - uniqueness and differences - Global, Glocal and Translocational cultures – benefits, differences and implications of multi-culture – Gender awareness - Roles and relations of different genders.

Activity:Group activity – Exploring cultures and traditions of different states – Performing Indian dance forms - Debate on Global, Glocal and Translocational impacts – cultural misunderstanding – Group discussion on implications of cross cultural communication –Gender awareness campaign: College, Workplace, Family, Friends.

UNIT-III	ROLE OF SCIENCE IN NATION BUILDING	9

Concepts:Role of science in nation building – Pre and Post Independent scientific inventions and inventors – development of Information Technology – Technical writing – Introduction and application of Technical writing.

Activity:Discussion on the role of scientists and mathematicians – Presentation on eminent scientists and mathematicians – Quiz on Scientists and inventions – Writing a technical article - Explaining something to visually impaired person.

UNIT-IV	ARTIFICIAL INTELLIGENCE	9

Concepts:Artificial Intelligence – Recognizing the importance of AI– Future of AI– Communicating with machines – Technical writing in profession.

Activity: Skit on Voice Assistant in future – Discussion on AI in everyday life – Deliberation on future colleges and workplaces - Watching DrBimal Ray's videos on cryptology–Explaining IOTs		
UNIT-V	**PROJECT CAMPAIGN**	**9**
Concepts:Social consciousness – contributing to society. Activity:Project visit to rural area/ underprivileged parts of city to address some of the local issues; if relevant, suggest a practical technology solution to the issues.		
	Total Contact Hours	**45**

Course Outcomes:	
On completion of the course, students will be able to	
●	Apply andanalyse the basic principles of SWOT and life positions, and understand the power of motivation
●	Identify and respect pluralism and gender differences in cultural spaces.
●	Recognize the role of science in Nation building and also creating technical documents effectively.
●	Understand the importance of Artificial Intelligence in every walk of life andIdentify the best practices of technical writing.
●	Understand the Social issues and suggest technical solutions.

SUGGESTED ACTIVITIES
- SWOT analysis and presentation
- Debate
- Presentation
- Quizzes
- Word Scramble
- Case study

SUGGESTED EVALUATION METHODS
- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Case study

Reference Books / Web links:	
1	L. Ron Hubbard ,"Self-Analysis by Ron Hubbard", Bridge Publications, Inc.2008.
2	Gary N. Powell ,"Managing a Diverse Workforce: Learning Activities", Third Edition, Sage Publication, 2010.
3	M.S. Gore ,Unity in Diversity: The Indian Experience in Nation-building, Rawat Publication,2002.
4	Stuart Russell and Peter Norvig,"Artificial Intelligence A Modern approach", Pearson Education India, 2020.
Web References	
1	Examples of Technical Writing for Students https://freelance-writing.lovetoknow.com/kinds-technical-writing

2	11 Skills of a Good Technical Writer https://clickhelp.com/clickhelp-technical-writing-blog/11-skills-of-a-good-technical-writer/
3	13 benefits and challenges of cultural diversity in the workplace https://www.hult.edu/blog/benefits-challenges-cultural-diversity-workplace/

Online Resources

1	https://youtu.be/CsaTslhSDI
2	https://m.youtube.com/watch?feature=youtu.beandv=IIKvV8_T95M
3	https://m.youtube.com/watch?feature=youtu.beandv=e80BbX05D7Y
4	https://m.youtube.com/watch?v=dT_D68RJ5T8andfeature=youtu.be
5	https://m.youtube.com/watch?v=7sLLEdBgYYYandfeature=youtu.be

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO 12	**PS O1**	**PS O2**	**PSO 3**
HS23421. 1	1	3	-	2	-	2	1	-	3	3	-	1	1	1	1
HS23421. 2	-	-	2	2	1	2	3	3	3	1	-	3	2	-	2
HS23421. 3	-	-	-	1	-	1	1	1	3	3	3	3	1	-	1
HS23421. 4	-	-	1	-	-	2	2	2	2	2	1	1	2	-	1
HS23421. 5	-	-	-	1	-	2	2	-	1	2	3	3	1	1	-
Average	0.2	0.6	0.6	1.2	0.2	1.8	1.8	1.2	2.4	2.2	1.8	2.4	1.4	0.4	1

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

No correlation: "-"

Course Code	Course Title	Category	L	T	P	C
GE23421	Soft Skills-I	EEC	0	0	2	1

Course Objectives:

The major course objectives are:

a. To help students break out of shyness.

b. To build confidence

c. To enhance English communication skills.

d. To encourage students' creative thinking to help them frame their own opinions,

Learning and Teaching Strategy:

The program is completely student centric where the focus is on activities led by students which include role plays, discussions, debates other games as well. These activities would be supplemented by interactive use of technology and brief trainer input.

Week	Activity Name	Description	Objective
1	Introduction	The trainer and the college facilitator talk to the students about the course and in turn the students introduce themselves.	To set expectations about the course and the students are made aware of the rules and regulations involved in this program
2	If I ruled the world	This is a quick and useful game by getting students to form a circle and provide their point of view. Each student then repeats what the other has said and comes up with their own opinion.	The aim of this activity is to for students to get to know each other and also develop their listening skills as well as learning how to agree and disagree politely.
3	Picture Narrating	This activity is based on several sequential pictures. Students are asked to tell the story taking place in the sequential pictures by paying attention to the criteria provided by the teacher as a rubric. Rubrics can include the vocabulary or structures they need to use while narrating.	The aim of this activity is to make the students develop creative way of thinking.
4	Brainstorming	On a given topic, students can produce ideas in a limited time. Depending on the context, either individual or group brainstorming is effective and learners generate ideas quickly	The activity aims at making the students speak freely without the fear of being criticized. It

		and freely. The good characteristics of brainstorming are that the students are not criticized for their ideas so students will be open to sharing new ideas.	also encourages students to come up with their own opinions.
5	Debate	Is competition necessary in regards to the learning process?	The aim of this activity is to develop the students ability to debate and think out of the box
6	Short Talks	Here the students are given topics for which they take one minute to prepare and two minutes to speak. They can write down points but can't read them out they can only use it as a reference.	The activity aims at breaking the students' shyness and encouraging them to standup in front of the class and speak. It also aims at creating awareness that they are restricted for time so they only speak points that are relevant and important.
7	Debate	Will posting students' grades on bulletin boards publicly motivate them to perform better or is it humiliating?	This activity aims at enhancing the students unbiased thought process when it comes to exams and grades as well as develop their skills to debate
8	The Art of diplomacy	The facilitator proceeds to share multiple concepts of conversation and helps the participants to identify the various methods of being diplomatic and how do deal with misinformation.	The aim of the lesson is to provide an opportunity for the participants to learn about body language and choosing the appropriate words for conversation.
9	Debate	Are humans too dependent on computers?	The aim of this activity is to test the students debating skills and thought process with a topic that affects everybody in daily life.
10	Story Completion	The teacher starts to tell a story but after 2 sentences he/she asks students to work in groups to create the rest of the story which includes the plot and the ending.	This activity aims at building their narrating skills as well as their creativity and ability to work in a team.
11	Role play debate	Students scrutinize different points of view or perspectives related to an issue. For example, a debate about the question "Should students be required to wear uniforms at school?" might yield a range of	The aim of this activity is to get students to speak based on other people's perspective instead of their own. The students

		opinions. Those might include views expressed by a student (or perhaps two students – one representing each side of the issue), a parent, a school principal, a police officer, a teacher, the owner of a clothing store, and others.	take the role of various characters and debate accordingly.
12	I Couldn't Disagree More	This is a game where students practice rebuttal techniques where one student provides a thought or an idea and the other students starts with the phrase I couldn't disagree more and continues with his opinion	The aim of this activity is to improve general communication skills and confidence.
	Feedback	At the end of the session in the final week (12) the trainer would provide feedback to the students on best practices for future benefits	The aim is to do both give feedback to students as well as obtain feedback on the course from them.

Course Learning Outcome:

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

1. Be more confident

2. Speak in front of a large audience

3. Be better creative thinkers

4. Be spontaneous

5. Know the importance of communicating in English.

V SEMESTER

Course Code	Course Title (THEORY COURSE)	Category	L	T	P	C
BA23511	**PRINCIPLES OF FINANCIAL MANAGEMENT**	MS	2	0	0	2

Objectives:	
•	Understand the functional distinctions of a Finance Manager.
•	Comprehend the technique of making decisions related to finance function.
•	Understand the techniques involved in deciding upon purchase or sale of securities.
•	An overview and generating investment project proposals.
•	Motives for holding cash and receivables.

UNIT-I	INTRODUCTION	6
	Introduction to Financial Management - Goals of the firm - Financial Environments. Time Value of Money: Simple and Compound Interest Rates, Amortization, Computing more than once a year, Annuity Factor.	
UNIT-II	VALUATION OF SECURITIES	6
	Bond Valuation, Preferred Stock Valuation, Common Stock Valuation, Concept of Yield and YTM. Risk & Return: Defining Risk and Return, Using Probability Distributions to Measure Risk, Attitudes Toward Risk, Risk and Return in a Portfolio Context, Diversification, The Capital Asset Pricing Model (CAPM).	
UNIT-III	CAPITAL BUDGETING	6
	The Capital Budgeting Concept & Process - An Overview, Generating Investment Project Proposals, Estimating Project, After Tax Incremental Operating Cash Flows, Capital Budgeting Techniques, Project Evaluation and Selection - Alternative Methods.	
UNIT-IV	COST OF CAPITAL, OPERATING & FINANCIAL LEVERAGE	6
	Cost of Capital : Concept , Computation of Specific Cost of Capital for Equity - Preference – Debt, Weighted Average Cost of Capital – Factors affecting Cost of Capital 4L. Operating & Financial Leverage: Operating Leverage, Financial Leverage, Total Leverage and Indifference Analysis in leverage study.	
UNIT-V	WORKING CAPITAL MANAGEMENT	6
	Working Capital Management: Overview, Working Capital Issues, Financing Current Assets (Short Term and Long Term- Mix), Combining Liability Structures and Current Asset Decisions, Estimation of Working Capital. Accounts Receivable Management: Credit & Collection Policies, Analyzing the Credit Applicant, Credit References, Selecting optimum Credit period. 4L. Cash Management: Motives for Holding cash, Speeding Up Cash Receipts, Slowing Down Cash Payouts, Electronic Commerce, Outsourcing, Cash Balances to maintain, Factoring.	
	Total Contact Hours :	**30**

Course Outcomes:
On completion of the course, the students will be able to
• Identify the basic concepts of financial management and time value of money.
• Understand the various processes involved in securities market.
• Evaluate and choose the best project from alternatives based on cost-benefit analysis.
• Compute the fundamental concepts of financial management.
• Influence the concept for deciding financial angle of IT projects.

Text Book (s):	
1	Chandra Prasanna, "Financial Management - Theory & Practice", 10th Edition, Tata McGraw Hill, 2019.
2	M.Y.Khanand and P.K.Jain, "Financial management, Text, Problems and Cases",Fifth Edition ,Tata Mc Graw Hill, 2000.
3	I.M.Pandey, "Financial Management", Eight Edition ,Vikas Publishing House Pvt.Ltd., 2007.
4	Aswat Damodaran, "Corporate Finance Theory and Practice", Second Edition ,John Wiley & Sons, 2008.
5	James C.Vanhorne, "Fundamentals of Financial Management", Eleventh Edition ,PHI Learning, 2008.

Reference Books(s) :
Van Horne and Wachowicz, "Fundamentals of Financial Management", Prentice Hall, 13th Edition, 2009.
Brigham and Ehrhardt, "Financial Management Theory and Practice", 11th edition, Cengage Learning, 2011.

CO - PO – PSO matrices of course

PO\PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BA2351 1.1	-	1	1	1	1	1	1	-	1	1	3	2	2	-	2
BA2351 1.2	1	1	1	1	3	1	1	1	1	1	2	2	2	-	2
BA2351 1.3	2	1	1	1	1	1	2	1	1	1	2	2	2	-	2
BA2351 1.4	1	1	1	2	1	1	1	1	1	1	2	1	2	-	2
BA2351 1.5	1	1	2	1	2	2	1	2	1	1	2	2	2	-	2
Average	1	1	1.2	1.2	1.6	1.2	1.2	1	1	1	2.2	1.8	2	-	

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)   2: Moderate (Medium) 3: Substantial

(High) No correlation: "-"

Course Code	Course Title (Lab Oriented Theory Course)	Category	L	T	P	C
CB23531	COMPUTER NETWORK TECHNOLOGY	PC	3	0	2	4

Objectives:	
●	Understand the concepts of computer networks and learn techniques for bandwidth utilization.
●	Be exposed to various addressing schemes and error detection-correction of data.
●	Learn the routing protocols, transport layer, flow control and congestion control algorithms.
●	Be familiar with real-time applications of networking devices and tools.
●	To write different applications using different types of sockets.

UNIT-I	FUNDAMENTALS AND PHYSICAL LAYER	9
	Introduction: Computer networks and distributed systems, Classifications of computer networks, Preliminaries of layered network structures. Data communication components: Representation of data and its flow, Various connection topology, Protocols and standards, OSI model, Transmission Media. LAN: Wired LAN, Wireless LAN, Virtual LAN. Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division, and Wave division, Concepts on spread spectrum.	
UNIT-II	DATA LINK LAYER AND MEDIUM ACCESS SUB-LAYER	9
	Fundamentals of Error Detection and Error Correction, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go-back–N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD, CDMA/CA.	
UNIT-III	NETWORK LAYER	9
	Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols, OSPF, BGP, Internet Multiplexing.	
UNIT-IV	TRANSPORT LAYER	9
	Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service (QoS), QoS improving techniques - Leaky Bucket and Token Bucket algorithms.	
UNIT-V	APPLICATION LAYER AND SECURITY	9
	Application Layer: DNS, DDNS, TELNET, EMAIL, FTP, WWW, HTTP, SNMP, Bluetooth, Firewalls. Network Security: Electronic mail, directory services and network management, Basic concepts of Cryptography, Network Management Protocols, Network Monitoring Tools, Performance Optimization, Troubleshooting Networks, and Emerging Network Technologies.	
	Total Contact Hours :	45

List of Experiments	
1	Learn to use basic commands
2	Configuration of Network in Linux Environment.
3	Assignment of IP Address to computers.
4	Implementation of Subnet mask in IP addressing.
5	Implementation of setup of a Local Area Network (using Switches) – Minimum 3 nodes and Internet
6	To capture, save, and analyze network traffic on TCP / UDP / IP / HTTP / ARP /DHCP /ICMP /DNS using the Wireshark Tool.
7	Write a socket PING program to test the server connectivity.
8	Study of system administration and network administration
9	Study of socket programming and client-server model using TCP and UDP.

10	Programs using TCP Sockets (like date and time server & client, echo server & client, chat etc.)		
11	Programs using UDP Sockets (like echo server, chat, simple DNS).		
12	Simulation of the sliding window.		
13	Implementation of ARP.		
14	Configuring RIP		
15	Configuring a Cisco Router as a DHCP Server		
	Contact Hours	:	**30**
	Total Contact Hours	:	**75**

Course Outcomes:
On completion of the course, the students will be able to
- Choose the required functionality at each layer for given application.
- Trace the flow of information from one node to another node in the network.
- Apply the knowledge of addressing scheme and various routing protocols in data communication to select optimal path.
- Monitor the traffic within the network and analyse the transfer of packets.
- Develop real time applications of networks using socket programming.

Text Book (s):

1	Andrew S. Tanenbaum and David J. Wetherall, "Computer Networks", 6th edition, Pearson education, 2022.
2	William Stallings, "Data and Computer Communication", 10th edition, Pearson education, 2017.

Reference Books(s) / Web links:

1	Kaufman, R. Perlman and M. Speciner, "Network Security", Pearson education, 2017.
2	W. Richard Stevens, "UNIX Network Programming, Vol. 1,2 & 3", Prentice-Hall of India, 2004.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CB23531.01	1	0	0	0	0	0	0	0	0	1	1	0	2	1	3
CB23531.02	1	0	1	0	1	0	0	0	0	0	0	0	2	1	2
CB23531.03	0	1	1	1	1	0	0	0	1	0	0	1	1	2	1
CB23531.04	2	1	2	1	1	0	0	0	1	1	1	1	2	3	2
CB23531.05	2	2	3	1	1	0	0	0	2	2	1	1	3	3	3
Average Mapping	1	1	1	1	1	0	0	0	1	1	1	1	2	2	2

Correlation levels 1, 2 or 3 are as defined below:1: Slight (Low)
2: Moderate (Medium)
3: Substantial (High) No correlation: "-"

Department of CSBS, REC

Course Code	Course Title (Lab Oriented Theory Course)	Category	L	T	P	C
CB23532	**ARTIFICIAL INTELLIGENCE**	PC	3	0	2	4

Objectives:	
☐	To understand the intelligent agents and formulate a problem in search space.
☐	To analyze the problem and learn the different search techniques.
☐	To learn the constraint satisfaction problem and game theory.
☐	To study the system of knowledge representation using rules and reasoning.
☐	To gain knowledge on learning and applications of AI

UNIT-I	**INTRODUCTION TO AI AND PROBLEM-SOLVING**	**9**

Introduction - Intelligent agents, agents & environment, concept of rationality - nature of environment, structure of agents, goal-based agents, utility-basedagents, learning agents. Problems of AI, AI technique, Tic - Tac - Toe problem.

UNIT-II	**SEARCH TECHNIQUES**	**9**

Problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. Heuristic search strategies - Greedy best-first search, A* search, AO* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search.

UNIT-III	**CONSTRAINT SATISFACTION PROBLEMS AND GAME THEORY**	**9**

Adversarial search, Games, optimal decisions & strategies in games,minimax search procedure, alpha-beta pruning, constraint satisfaction problems.

UNIT-IV	**KNOWLEDGE AND REASONING**	**9**

Knowledge based agents – Propositional Logic – First Order Logic – Syntax and Semantics – Propositional Vs. First Order Inference – Unification – Forward and Backward Chaining – Resolution -
Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory.

UNIT-V	**LEARNING AND APPLICATIONS**	**9**

Forms of Learning – Supervised Learning –Ensemble Learning – Explanation based Learning – Learning Using Relevance Information – Statistical Learning – Reinforcement Learning - AI applications – Language Models – Natural Language Processing – Computer vision – Detecting objects – Robotics – Planning and Control.

	Total Contact Hours	**:**	**45**

List of Experiments	
1	Programs on Problem Solving a. Write a program to solve Tic-Tac-Toe game b. Solve any problem using depth first search c. Implement MINIMAX algorithm d. Implement A* algorithm e. Implement local search strategies such as hill climbing to solve 8-Queens problem.
2	Programs on Decision Making and Knowledge Representation a. Introduction to PROLOG b. Implementation of Unification and Resolution Algorithm. c. Implementation of Backward Chaining
3	Programs on Learning and AI applications a. Implement an algorithm on Ensemble Learning (Random Forest Algorithm) b. Write a program to preprocess the given text for normalizing and tokenizing.

	Contact Hours	**:**	**30**
	Total Contact Hours	**:**	**75**

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	Course Outcomes:
	On completion of the course, the students will be able to
☐	Formulate a problem and build intelligent agents.
☐	Build systems to analyze a problem and make decisions using suitable search techniques.
☐	Understand the constraint satisfaction problem and game theory.
☐	Apply reasoning and rules on knowledge representation.
☐	Apply learning methods in AI applications.

Text Book (s):	
1	Stuart J. Russell, Peter Norvig , "Artificial Intelligence –A Modern approach", Fourth Edition, Pearson Education, 2022.
2	Kevin Knight, Elaine Rich & Shivashankar Nair, "Artificial Intelligence", Third Edition, Tata McGraw Hill, 2017.

Reference Books(s) :	
1	Sutton R.S. and Barto, A.G., "Reinforcement Learning: An Introduction", 2nd Edition MIT Press, 2018.
2	Patterson, "Introduction to Artificial Intelligence & Expert Systems", First Edition, Pearson, 2015.
3	Saroj Kaushik, "Logic & Prolog Programming", First Edition, New Age International, 2008.
4	Ronald Brachman and Hectar Levesque,, "Knowledge Representation and Reasoning", Morgan Kaufmann, 2022.

CO - PO – PSO matrices of course

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CB23532.01	3	3	1	0	2	1	1	1	1	0	2	1	2	1	1
CB23532.02	2	2	1	0	2	1	2	0	0	0	2	2	1	1	1
CB23532.03	3	3	1	0	3	0	1	0	0	0	3	1	2	3	2
CB23532.04	2	3	0	0	2	1	1	1	0	0	2	2	2	2	3
CB23532.05	2	2	2	2	3	0	1	2	0	0	3	3	3	3	3
Average Mapping	2.4	2.4	1.0	2.0	2.4	0.6	1.2	0.8	0.2	0.0	2.0	1.8	2.0	2.0	2.0

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)
2: Moderate (Medium)
3: Substantial (High)
No correlation: "-"

Course Code	Course Title	Category	L	T	P	C
GE23627	DESIGN THINKING AND INNOVATION (Type - Project based learning)	EEC	0	0	4	2

Objectives:
● To understand the design thinking concepts and deep understanding of user needs and experiences.
● To find the problem statement and to develop innovative design solutions that address identified user challenges
● To master the process of prototyping and iterating on designs.
● To conduct thorough market analysis and financial planning
● To effectively communicate design concepts and findings.

Unit-I: Introduction to Design Thinking: The design thinking concepts - Different design thinking models - Details of Stanford Design thinking process: Empathize, Define, Ideate, Prototype, Test
Activities:
- Case studies of successful domain-based Design Thinking and Innovative projects
- Group discussions on design thinking

Unit 2: Empathize and Define: User research methods (interviews, surveys, observation, contextual inquiry) - Persona development- Journey mapping – Brainstorming Defining the design problem statement
Activities:
- Conducting user interviews and surveys
- Creating user personas and journey maps
- Identifying key user needs and pain points
- Analyze the user needs and brainstorming to define problem statement

Unit 3: Ideate and Create: Brainstorming techniques (e.g., mind mapping, SCAMPER) - Ideation tools (e.g., design thinking tools, concept sketching) - Concept generation and evaluation (e.g. Brainstorming)
Activities:
- Group brainstorming sessions to select the best idea
- Creating concept sketches and prototypes
- Evaluating ideas based on user needs and feasibility

Unit 4: Prototype and Test: Low, Medium and high-level fidelity for prototyping-Usability testing -Iterative design
Activities:
- Building low-fidelity prototypes (e.g., paper prototypes)
- Conducting usability tests with users
- Iterating on designs based on feedback

Unit 5: Market Analysis and Implementation: Market research and analysis - Business model development- Financial Planning-Implementation strategies
Activities:
- Conducting market research
- Developing a business model canvas
- Creating a financial projection
- Developing an implementation plan

Total Hours: 60

Course Outcomes: On completion of the course, the students will be able to	
CO1	Construct design challenge and reframe the design challenge into design opportunity.
CO2	Interview the user, and know the feelings of users to foster deep user understanding and be able to uncover the deep user insights and needs.
CO3	Develop ideas and prototypes by brainstorming.
CO4	Organize the user walkthrough experience to test prototype
CO5	Develop smart strategies and implementation plan that will deliver/achieve the idea/solution deduced from earlier phases.

Assessment:
- Encourage students to work on real-world design challenges based on the user needs
- Group presentations
- Quizzes and exams
- Evaluation of Project report and viva and also encourage the students for filing patent/ copyright / presenting in conference / publishing in journal

Text Book(s):	
1	Christian Müller-Roterberg ,"Handbook of Design Thinking", Kindle Direct Publishing, 2018.
2	E Balagurusamy, Bindu Vijakumar ,"Design Thinking – A Beginner's Perspective", MC Graw Hill, 2024
Reference Books:	
1	Design Thinking for Entrepreneurs and Small Businesses: Putting the Power of Design to Work – by Beverly Rudkin Ingle, Apress; 1st ed. Edition, 2013
2	Design Thinking: Understanding How Designers Think and Work by Nigel Cross, Bloomsbury Visual Arts; 2 edition 2023

Web links	
1	Design thinking Guide https://www.rcsc.gov.bt/wp-content/uploads/2017/07/dt-guide-book-master-copy.pdf
2	NPTEL Course on Design Thinking and Innovation By Ravi Poovaiah ; https://onlinecourses.swayam2.ac.in/aic23_ge17/preview
3	IITB Design course tools and Resources https://www.dsource.in/

CO-PO Mapping

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	3	2	2	3	3	3	3	3
CO2	3	2	3	3	3	2	2	3	3	3	3	3
CO3	3	2	3	3	3	2	2	3	3	3	3	3
CO4	3	2	3	3	3	2	2	3	3	3	3	3
CO5	3	2	3	3	3	2	2	3	3	3	3	3
Average	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**3**

1-Slight (Low), 2- Moderate (Medium), 3- Substantial (High), "-"No correlation

Course Code	Course Title	Category	L	T	P	C
GE23521	Soft Skills-II	EEC	0	0	2	1

Course Objectives:

The major course objectives are:

e. To help students break out of shyness.

f. To build confidence

g. To enhance English communication skills.

h. To encourage students' creative thinking to help them frame their own opinions,

Learning and Teaching Strategy:

The program is completely student centric where the focus is on activities led by students which include role plays, discussions, debates other games as well. These activities would be supplemented by interactive use of technology and brief trainer input.

Week	Activity Name	Description	Objective
1	The News hour	Students are made to read news articles from the English newspapers. The students also have to find words and their meaning from the article they have not come across before and share it with the group. They then use these words in sentences of their own	The aim of this activity is not only to get the students to read the newspaper but also aims at enhancing the students' vocabulary.
2	Court Case	The facilitator provides the participants the premise of a story and proceeds to convert the story into a court case. The students are required, department-wise to debate and provide their points to win the case for their clients.	The aim of the lesson is to encourage creative and out-of-the -box thinking to ensure a good debate and defense skills.
3	The ultimate weekend	The students design activities they are going to do over the weekend and they have to invite their classmates to join in the activity. The students move around the class and talk to other students and invite them.	The aim of this activity is to develop the art of conversation among students. It also aims at practicing the grammatical structures of "going to" "have to" and asking questions.
4	The Four Corners	This is a debate game that uses four corners of the classroom to get students moving. The following is written on the 4 corners of the room "Strongly Agree, Somewhat Agree, Somewhat Disagree and Strongly Disagree". The topics are then given to the class and students move	This activity aims at getting students to come up with their own opinions and stand by it instead of being overshadowed by others and forcing themselves to change based on others opinions.

		to the corner that they feel best explains their opinions	
5	Debate	Boarding school or day school? Which is more beneficial for a student?	The aim of this activity is to encourage students to draw up feasible points on the advantages and benefits of both. And enhance their debating ability
6	Grand Master	The facilitator starts the session by keeping an individual in mind, upon which the students guess it only through "Yes or No" questions. Post few trials the students are given same opportunity to do the same with the crowd.	The aim of the lesson is designed to teach the art of questioning. It also helps to enhance the students' speaking and listening skills.
7	Debate	Does violence on the TV and Video games influence children negatively?	This activity aims at encouraging the students to debate on real life scenarios that most students spend a lot of time on.
8	Turn Tables	This is a speaking activity where the students need to speak for and against the given topics when the facilitator shouts out 'Turn Table'.	The aim of this activity is to make the participants become spontaneous and have good presence of mind.
9	Debate	Do marks define the capabilities of a student?	This debate activity aims at allowing the students to argue on this worrisome adage of marks.
10	FictionAD	The Participants are asked to create an Ad for a challenging topic only using fictional characters.	The activity aims at developing their creativity and presentation skills.
11	Debate	Are social networking sites effective, or are they just a sophisticated means for stalking people?	This activity aims at refining the students debating skills on a very real life situation
12	Talent Hunt	Talent Hunt is a fun activity where the students are selected at random and supported to present any of their own skills.	The aim of this activity is designed to evoke their inner talents and break the shyness and the fear of participating in front of a crowd
	Feedback	At the end of the session in the final week (12) the trainer would provide feedback to the students on best practices for future benefits.	The aim is to do both give feedback to students as well as obtain feedback on the course from them.

Course Learning Outcome:

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

6. Be more confident

7. Speak in front of a large audience without hesitation

8. Think creatively

9. Speak impromptu

10. Communicate in English

VI SEMESTER

Course Code	Course Title (Theory Course)	Category	L	T	P	C
BA23611	FINANCIAL AND COST ACCOUNTING	MS	2	0	0	2

Objectives:	
•	To create an awareness about the importance and usefulness of the accounting concepts and their managerial implications.
•	To develop an understanding of the financial statements and the underlying principles and learn to interpret financial statements.
•	To create awareness about cost accounting, different types of costing and cost management.
•	Understand how financial statement information can help solve business problems and increase the ability to read and understand financial statements and related information

UNIT-I	ACCOUNTING CONCEPT	6
Introduction, Techniques and Conventions, Financial Statements- Understanding & Interpreting Financial Statements. Company Accounts and Annual Reports- Audit Reports and Statutory Requirements, Directors Report, Notes to Accounts, Pitfalls.		
UNIT-II	ACCOUNTING PROCESS	6
Book Keeping and Record Maintenance, Fundamental Principles and Double Entry, Journal, Ledger, Trial Balance, Balance Sheet, Final Accounts, Cash Book and Subsidiary Books, Rectification of Errors.		
UNIT-III	FINANCIAL STATEMENTS	6
Form and Contents of Financial Statements, Analyzing and Interpreting Financial Statements, Accounting Standards. **Class Discussion:** Corporate Accounting Fraud- A Case Study of Satyam.		
UNIT-IV	CASH FLOW AND FUND FLOW TECHNIQUES	6
Introduction, How to prepare – Cash flow and Fund flow, Difference between them.		
UNIT-V	COSTING SYSTEMS	6
Elements of Cost, Cost Behavior, Cost Allocation, Overhead Allocation, Unit Costing, Process Costing, Job Costing, Absorption Costing, Marginal Costing, Cost Volume Profit Analysis, Budgets, ABC Analysis. **Class Discussion:** Application of costing concepts in the Service Sector.		
	Contact Hours :	30

Course Outcomes:	
On completion of the course, the students will be able to	
•	Understand the theories, concept, and evolution of management.
•	Demonstrate the ability to employ the management way of thinking.
•	Understand how organizations work and find it easier to grasp the intricacies of other management areas such as finance, marketing, strategy etc.
•	Understand the qualities of a leader in the managerial aspect in future terms.
•	Understand the managerial ethics and CSR and its importance.

Text Book (s):	
1	Robert N Anthony, David Hawkins, Kenneth Marchant, "Accounting: Texts and Cases", Thirteenth Edition, McGraw-Hill, 2017.
2	M.Y.Khan & P.K.Jain, "Management Accounting", Tata McGraw Hill, 2011.
3	R.Narayanaswamy, "Financial Accounting – A managerial perspective", Seventh Edition , PHI Learning, New Delhi, 2022.

Reference Books(s) :	
1	Jan Williams, "Financial and Managerial Accounting – The basis for business Decisions", Fifteenth Edition, Tata McGraw Hill Publishers, 2010.

2	Horngren, Surdem, Stratton, Burgstahler, Schatzberg, "Introduction to Management Accounting", Sixteenth Edition, PHI Learning, 2014.
3	Stice & Stice," Financial Accounting Reporting and Analysis", Eight Edition, Cengage Learning, 2010.
4	Singhvi Bodhanwala, "Management Accounting -Text and cases", Third Edition, PHI Learning, 2018.
5	Ashish K. Battacharya, Introduction to Financial Statement Analysis, Elsevier, 2009.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BA23611.1	2	2	1	-	-	2	2	-	-	-	2	1	3	-	3
BA23611.2	2	2	2	-	-	2	3	-	-	-	2-	1	3	-	3
BA23611.3	2	3	1	-	-	1	2	-	-	-	2	3	3	-	3
BA23611.4	3	2	-	-	-	2	2	-	-	-	1	2	3	-	3
BA23611.5	2	1	-	-	-	2	2	-	-	-	2	2	3	-	3
Average	2.2	2.0	1.3	-	-	1.8	2.2	-	-	-	1.8	1.8	3	-	3

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High) No correlation: "-"

Course Code	Course Title (Theory Course)	Category	L	T	P	C
BA23612	BUSINESS STRATEGY	MS	2	0	0	2

Objectives:

☐	The course will cover the determination of the concept and process of strategic management.
☐	Expose the students to analyze the internal and external environment.
☐	The insights of creating and formulation of strategies, implementation and evaluation of strategies.
☐	The course will cover case studies and latest business events.

UNIT-I	INTRODUCTION TO STRATEGIC MANAGEMENT	6
Importance of Strategic Management-Vision and Objectives - Schools of thought in Strategic Management- Strategy Content, Process, and Practice - Fit Concept and Configuration Perspective in Strategic Management.		
UNIT-II	**INTERNAL ENVIRONMENT OF FIRM**	**6**
Recognizing a Firm's Intellectual Assets - Core Competence as the Root of Competitive Advantage - Sources of Sustained Competitive Advantage -Business Processes and Capabilities-based approach to Strategy.		
UNIT-III	**EXTERNAL ENVIRONMENTS OF FIRM**	**6**
Competitive Strategy - Five Forces of Industry Attractiveness that Shape Strategy- The concept of Strategic Groups, and Industry Life Cycle - Generic Strategies, Generic Strategies and the Value Chain.		
UNIT-IV	**CORPORATE STRATEGY AND GROWTH STRATEGIES**	**6**
The Motive for Diversification - Related and Unrelated Diversification- Business Portfolio Analysis - Expansion, Integration and Diversification - Strategic Alliances, Joint Ventures and Mergers & Acquisitions – case studies.		
UNIT-V	**STRATEGY IMPLEMENTATION**	**6**
Structure and Systems - The 7S Framework - Strategic Control and Corporate Governance.		
	Total Contact Hours :	**30**

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

☐	Become familiar with both internal and external environment. They would also become familiar with corporate and growth strategies, appreciate implementation of such strategies.
☐	Learn the fundamental concepts of strategic management to analyse business situations and apply these concepts to solve business problems.
☐	Understand the fundamental principles of and interrelationships among business functions such as: R&D, production, marketing, finance, and HR and information technology.
☐	Apply the inter-relationships of business to individuals, other organizations, government and society.
☐	Analyze complex, unstructured qualitative and quantitative problems, using appropriate tools.

Text Book (s):

1	Robert M. Grant, "Contemporary Strategic Management", Seventh Edition, Blackwell,2012.
2	D N Dwivedi, "Managerial Economics", Eighth Edition, Vikas Publishing House, 2018.
3	Kazmi, Azhar, "Business Policy and Strategic Management", Third Edition, Tata McGrawhill, New Delhi, 2008.
4	Upendra Kachru,"Strategic Management Concepts and Cases", First Edition, Excel Publications, 2005.

	Reference Books(s) / Web links:
1	M.E. Porter, Competitive Strategy, The Free Press, New York, 1980.https://doi.org/10.1002/smj.4250020110
2	Michael E.Porter, Competitive Advantage, The Free Press, New York, 1985.
3	Richard Rumelt , Good Strategy Bad Strategy: The Difference and Why It Matters. Profile Books, Fourth edition, 2011.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BA23612.1	1	2	1	1	1	2	1	1	1	1	2	1	2	1	1
BA23612.2	2	1	1	1	1	1	2	1	1	1	2	1	2	1	1
BA23612.3	2	1	1	1	1	2	1	1	1	1	2	1	1	1	1
BA23612.4	2	1	1	1	1	2	1	1	1	1	2	1	2	1	1
BA23612.5	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Average	1.8	1.2	1	1	1	1.6	1	1	1	1	1.8	1	2	1	1

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High) No correlation: "-"

Course Code	Course Title (Lab oriented Theory Course)	Category	L	T	P	C
CB23631	MACHINE LEARNING	PE	2	1	2	4

Objectives:	
•	Have a thorough understanding of the existing machine learning techniques.
•	Know the basic concepts of supervised learning techniques.
•	Study the working of neural networks and similar models.
•	Familiarize with unsupervised learning algorithms.
•	Understand the concepts of Reinforcement Learning with various methods.

UNIT-I	INTRODUCTION TO MACHINE LEARNING	9
	Introduction to Machine Learning (ML); Relationship between ML and human learning; A quick survey of major models of how machines learn; Example applications of ML.	
UNIT-II	SUPERVISED LEARNING ALGORITHMS	9
	Basics of Classification: Statistical decision theory including discriminant functions and decision surfaces; **Classifications:** Bayesian networks; Decision Tree Hidden Markov Model with forward-backward and Viterbi algorithms; Sequence classification using HMM; Conditional random fields. and k-Nearest Neighbour classification; Support Vector Machines, Ensembles of classifiers including bagging and boosting. Random Forests; Artificial neural networks including back propagation; Applications of classifications; **Model Evaluation Metrics:** Precision, recall, F1-measure, accuracy, area under curve, ROC, Kappa value, Confusion Matrix.	
UNIT-III	LINEAR AND NON-LINEAR MODELS	9
	Simple Linear Regression: Regression and Model building, Simple Linear Regression, Least Squares Estimation of Parameters, Multiple Regression Models, Estimation of Model Parameters, Hypothesis testing in Multiple Linear Regression, Confidence intervals in multiple regression. **Generalized Linear Model:** Logistic Regression - Models with binary response variable, parameter estimation, parameter estimation, statistical inference on model parameter **Non-linear Model**: Polynomial Regression - Basic principles, piecewise polynomial fitting (splines), polynomial and trigonometric terms. Nonparametric regression - Kernel Regression, Locally weighted Regression (Loess), polynomial models on two or more variables.	
UNIT-IV	UNSUPERVISED LEARNING ALGORITHMS	9
	Types of Linkages Single linkage, complete linkage and Average linkage. **Types of clustering**: centroid based clustering - K-Means algorithm, Density based Clustering - DBSCAN algorithm, Hierarchical clustering - BIRCH, Minimum spanning tree clustering, CURE algorithm	
UNIT-V	REINFORCEMENT LEARNING	9
	Reinforcement Learning: Introduction, Evaluative Feedback – An n-armed Bandit Problem, Action-Value Method, Softmax Action Selection, Evaluation vs instruction, incremental Implementation, tracking non-stationary problem, optimistic initial values, Reinforcement comparison. Elementary Methods: Monte Carlo Methods, Temporal Difference Learning	
	Contact Hours	:	45

	List of Experiments
1	For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate- Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
2	Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file. A python program to implement decision tree
3	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
4	Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Python ML libraries.
5	Apply HMM model to find the PoS tagging of a sentence.
6	Assuming a set of documents that need to be classified, use the support vector Classifier model to perform this task. Python can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
7	Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Python ML libraries can be used for this problem.
8	Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
9	Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.
10	Apply Q Learning with epsilon-greedy action selection using Reinforcement Learning.
11	Implementation of a mini project – Stock prices predictor/ Sports predictor/ Sentiment analyzer/ Healthcare predictor.
	Contact Hours: 30
	Total Contact Hours: 75

Course Outcomes:
On completion of the course, the students will be able to
• Distinguish between, supervised, unsupervised and semi-supervised learning.
• Modify existing machine learning algorithms to improve classification efficiency.
• Build a basic neural network for real-time data.
• Use unsupervised models for clustering data.
• Design a system that uses the reinforcement learning models..

	Text Books
1	R.O. Duda, P.E. Hart, D.G. Stork, "Pattern Classification", Second Edition, Wiley, 2001.
2	Hastie, Trevor, Robert Tibshirani, Jerome Friedman, and James Franklin. "The elements of statistical learning: data mining, inference and prediction, Springer Series in Statistics, Second Edition.,2009
	Reference Books
1	C. Bishop,"Pattern Recognition and Machine Learning", Springer, 2007.
2	E. Alpaydin, "Introduction to Machine Learning", Third Edition, Prentice-Hall, 2014.
3	A. Rostamizadeh, A. Talwalkar, M. Mohri, "Foundations of Machine Learning", MIT Press.
4	A. Webb, "Statistical Pattern Recognition", Third Edition, Wiley, 2011.
5	R. S. Sutton and A. G. Barto. Reinforcement Learning - An Introduction. MIT Press. 1998.
6	Introduction to Linear Regression Analysis, Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining, Wiley Editorial Team, 6ed, An Indian Adaptation

CO - PO – PSO matrices of course

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CB19P43.01	3	3	1	0	2	1	1	1	1	0	2.2	1	2	1	1
CB19P43.02	2	2	1	0	2	1	2	0	0	0	2	2	1	1	1
CB19P43.03	3	3	1	0	3	0	1	0	0	0	3	1	2	3	2
CB19P43.04	2	3	0	0	2	1	1	1	0	0	2	2	2	2	3
CB19P43.05	2	2	2	2	3	0	1	2	0	0	3	3	3	3	3
Average Mapping	2.4	2.4	1.0	2.0	2.4	0.6	1.2	0.8	0.2	0.0	2.0	1.8	2.0	2.0	2.0

Note: Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High) If there is no correlation, put "-"

Course Code	Course Title (Lab Oriented Theory Course)	Category	L	T	P	C
CB23632	CLOUD, MICROSERVICES AND APPLICATION	PE	2	1	2	4

Objectives:	
☐	To know basic components and fundamentals of cloud computing.
☐	To develop an application using various services in cloud.
☐	Understand how to design the web application development in cloud.
☐	To learn the basic and important concepts of python to implement in an application.
☐	Understand the issues and solutions for cloud security and cloud monitoring.

UNIT-I	INTRODUCTION	9
	Cloud Fundamentals-Cloud Service Components-Cloud Service, Deployment Models-Cloud components-Guiding principle with respect to utilization, Security, Pricing- Application of Cloud Computing. Case Study: Design and Implementation of Public and Private Cloud Environments – Open Stack and AWS.	
UNIT-II	CLOUD BASED APPLICATIONS DEVELOPMENT	9
	Application Architectures-Monolithic & Distributed, Microservice Fundamental and Design Approach-Cloud Native Applications-12 Factors App-Application Integration Process and APIfication Process- API Fundamental-Microservice and API Management- Spring Boot Fundamental and Design of Microservice - API Tools - Developer Portal-Applications of Microservice and APIfication.	
UNIT-III	WEB DEVELOPMENT TECHNIQUES	9
	Devops fundamentals - Devops Role and Responsibility-Tools and Applications- Containerization Process and Application-Evolution of APP Deployment- Docker Fundamentals - Docker Architecture- Docker Commands. Case study Orchestration, Kubernetes, Docker Container.	
UNIT-IV	CLOUD SECURITY AND MONITORING TOOL	9
	Cloud Security-Cloud Security Shared Responsibility Architecture-Security By Design Principles-Identity And Access Management-Cloud Security Layers Illustration-Cloud Network, Host And Data Security Concepts-Security Operations and Major Cloud Service Provider Tools-Security Compliance and Regulations-Cloud Monitoring-Benefits of Cloud Monitoring-Overview of Cloud Monitoring Tools.	
UNIT-V	BUILDING AN APPLICATION USING PYTHON	9
	Developing and Deploying an Application in the Cloud- Building a python project based on Design-Development-Testing-Deployment of an application in the cloud using a development framework and deployment platform. Case Study: Python Use case and Python Framework.	
	Contact Hours :	45

List of Experiments	
1	Find procedure to run the virtual machine of different configuration using virtual-manager.
2	Virtualize a machine and check how many virtual machines can be utilized at a particular time.
3	Create a VM Clone and attach virtual block to the cloned virtual machine and check whether it holds the data even after the release of the virtual machine.
4	Create a Snapshot of a VM at a given point in time and test the snapshot by restoring the VM to that time. (Note: Testing can be done by installing an application and then restore it.)
5	Develop a simple application to understand the concept of PAAS using GAE/Amazon Elastic Beanstalk/IBM Blue Mix and launch it.
6	Test how a SaaS applications scales in response to demand.
7	Find the procedure to launch a Cloud instance using a Public IaaS cloud like AWS/GCP.
8	Setup a Private Cloud by performing the procedure using a Single node OPENSTACK implementation.
9	Find the procedure to develop a DevSecOps – Cloud (AWS, GCP, Azure).
10	Find the procedure to develop a DevSecOps – Cluster (Kubernetes).
11	Find the procedure to develop a Container (Docker).
12	To Build and Test Your Docker Images in the Cloud with Docker commands.
13	Perform the installation steps and configure Google App Engine.
14	Find the Procedure to develop a SalesForce application in cloud.
15	Create an Application in SalesForce.com using Apex programming Language.
	Contact Hours : 30
	Total Contact Hours : 75

	Course Outcomes:
	On completion of the course, the students will be able to
•	Demonstrate the main concepts of cloud, its characteristics, advantages, key technologies and its various delivery and deployment models.
•	Develop and design an application using various tools in a cloud environment.
•	Acquire the basic and important design concepts and issues of web application development techniques in cloud.
•	Structure a simple python program for developing an application in the cloud.
•	Analyze the issue of cloud such as security, energy efficiency and interoperability, and provide an insight into future prospects of computing in the cloud monitoring.

	Text Books
1	Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, "Cloud Computing Concepts, Technology & Architecture", Prentice Hall Second Edition, 2023.
2	Guo Ning Liu, Qiang Guo Tong, Harm Sluiman, Alex Amies, "Developing and Hosting Applications on the Cloud", IBM Press, 2012.
3	Kai Hwang, Geoffery C. Fox and Jack J. Dongarra, "Distributed and Cloud Computing: Clusters, Grids, Clouds and the Future of Internet", First Edition, Morgan Kaufman Publisher, an Imprint of Elsevier, 2013.
4	Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, "Cloud Computing: Principles and Paradigms", Wiley, 2011.

	Reference Books
1	Michael J. Kavis "Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS)", 1st Edition, Wiley, 2014.
2	https://www.techrepublic.com/blog/the enterprise cloud/mini glossary cloud computing terms you should know/
3	Azure Virtual Machines https://docs.microsoft.com/en us/azure/virtual machines/
4	Google App Engine https://cloud.google.com/appengine#all features
5	Google Kubernetes Engine https://cloud.google.com/kubernetes engine#all features
6	Docker Tutorial : https://docker curriculum.com
7	Google Cloud Infrastructure security setup overview: https://cloud.google.com/security/infrastructure/design

CO - PO – PSO Matrices of Course

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CB23632.01	3	3	3	3	3	2	-	2	-	3	1	3	3	3	2
CB23632.02	2	2	3	3	3	2	1	2	2	2	1	1	3	3	2
CB23632.03	-	2	3	3	2	2	1	2	2	3	2	2	3	2	2
CB23632.04	3	3	3	3	3	2	2	2	2	2	3	3	3	3	2
CB23632.05	2	3	3	3	3	2	2	2	2	3	3	3	3	3	2
Average Mapping	2	2.2	3	3	3	2	1.2	2	1.6	2.6	2	2.4	3	2.8	2

Note: Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low)   2: Moderate (Medium) 3: Substantial (High)

 If there is no correlation, put "-

Course Code	Course Title (Lab Oriented Theory Course)	Category	L	T	P	C
CB23633	USABILITY DESIGN OF SOFTWARE APPLICATIONS	PC	2	0	2	3

Objectives:	
●	To learn the fundamentals of User-Centered Design, their relevance and their contribution to businesses.
●	To study the principles of heuristic evaluation for interactive design.
●	To understand the appreciation of user research, solution conceptualization, and validation as interwoven activities in the design and development lifecycle.
●	To familiarize the facets of User Experience (UX) Design, particularly as applied to the digital artifacts.
●	To implement complex mobile/web applications.

UNIT-I	INTRODUCTION TO USER CENTRED DESIGN	6
	Basics of User-Centered Design-Elements-Models and approaches-User Centered Design Principles-Usability-UCD Process-Analysis tools: personas, scenarios, and essential use cases with examples- User-Centred Design and Agile aspects of User-Centered Design.	
UNIT-II	INTERACTIVE DESIGN EVALUATION	6
	Introduction to Interactive Design process – Interactive design in practice – Introducing evaluation – Evaluation: Inspection, Analysis and Models – Inspection: Heuristic Evaluation: 10 Heuristic Principles, Examples – Case study: A Heuristic Evaluation of Iraq E-Portal.	
UNIT-III	DEVELOPMENT OF APPLICATION	6
	Case Study: Development of any application mobile or web-based on User-Centered Design – Design lifecycle: Establishing Requirements, Design, Prototyping, and Construction.	
UNIT-IV	UX RESEARCH	6
	Basics of UX design Process-Elements of UX-Design Thinking Techniques: Scenarios, Brainstorming, Design Tools, User Interviews, Competitive Analysis for UX, Wire-Framing and Prototyping Techniques Understanding users, their goals, context of use, and environment of use. Research Techniques: Contextual Enquiry, User Interviews, Competitive Analysis for UX.	
UNIT-V	ITERATIVE PRODUCT DEVELOPMENT	6
	The Problem with Complexity - Iterative Product Development - Scenarios and Persona Technique, Design Thinking Technique: Discovery and brainstorming - Concept Development - Prototyping Techniques: Paper, Electronic, Prototyping Tools – Review and feedback	
	Total Contact Hours	**: 30**

	List of Experiments
1	Product Appreciation Assignment – Evaluating the product from User Centred Design aspects such as functionality, ease of use, ergonomics, and aesthetics.
2	Heuristic Evaluation: Group Assignment initiation (Website and App) Evaluation for key tasks of the app or website for heuristic principles, severity, recommendations.
3	Students will identify a project in the given domain (Healthcare, E-Commerce, Online Learning Platforms, Gaming, Point-of-Sale, Smart Things) and its related website or mobile app to redesign. They will take this redesign project through the design lifecycle: Discovery, Define, Design, Implement (Design Prototype) Usability, Testing The below design methods and techniques will be imparted with respect to the group project selected by the students.
4	Presentation of Persona for the group project
5	Task flow detailing for the project
6	Project Prototyping Iteration 1
7	Project Prototyping Iteration 2
8	Pick your favorite design agency. Redesign their contact page in a more user-friendly way.
9	Final Product Demo (Mobile or Web Application) Eg: Swiggy application.
	Contact Hours : 30
	Total Contact Hours : 60

Course Outcomes:
On completion of the course, the students will be able to
● Understand the fundamentals and importance of User-Centered design.
● Perform design evaluation by applying the heuristic principles.
● Develop an application focusing on the design aspects.
● Do research on understanding user requirement.
● Perform iterative product development using prototyping technique.

Text Book (s):	
1	Jenny Preece, Helen Sharp and Yvonne Rogers, "Interaction Design: Beyond Human-Computer Interaction", 6th Edition, Wiely, 2023.
2	Jonny Schneider, "Understanding Design Thinking, Lean, and Agile", 1st Edition, O'Reilly,2020.

Reference Books(s) :	
1	Alan Cooper and Robert Reimann, "About Face", 4th Edition John Wiley, 2014.
2	Elizabeth Goodman, Mike Kuniavsky, Andrea Moed, "Observing the User Experience: A Practitioner's Guide to User Research", 2nd Edition, Peason, 2012.
3	Jesse James Garrett, The Elements of User Experience: User-Centered Design for the Web and Beyond, 3nd Edition, Berkeley, CA: New Riders,2011.

CO - PO – PSO matrices of course

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CB23633.1	2	2	2	-	-	-	-	-	1	-	-	2	2	-	-
CB23633.2	2	2	3	1	-	-	-	-	1	-	-	2	2	-	-
CB23633.3	2	2	3	2	2	2	2	2	1	-	-	2	2	2	-
CB23633.4	2	3	3	2	2	1	2	2	1	2	1	2	2	-	-
CB23633.5	2	2	3	3	3	1	2	1	3	2	3	2	2	2	2
Average	2	2.2	2.8	1.6	1.4	0.8	1.2	1	1.4	0.8	0.8	2	2	0.8	0.4

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

No correlation: "-"

Course Code	Course Title	Category	L	T	P	C
HS23621	**BUSINESS COMMUNICATION AND VALUE SCIENCE – IV**	HS	0	0	4	2

Objectives:
• To recognize the best practices of communicative writing
• To understand the importance of emotional intelligence in personal and professional lives
• To understand how stress impacts life and work
• To use the best practices to manage stress
• To understand how to make start-ups and public speaking

UNIT-I	**COMMUNICATIVE WRITING**	**12**

Concepts: Principles of Communicative writing – Formal Business letters – Writing Proposals – Use of charts in communicative writing – use of business idioms – corporate terms

Activity: Group business proposals – presentation of proposal – Story telling using charts and graphs (demonstrative speech)

UNIT-II	**EMOTIONAL INTELLIGENCE**	**12**

Concepts: Concepts of emotional intelligence – its importance in human life and professional life – difference between Emotional quotient and Intelligent quotient – Corporate etiquette

Activity: Any two Anubhaav activities – 10 ways to build Emotional Intelligence by Daniel Goleman – Mock interview

UNIT-III	**CONFLICT MANAGEMENT**	**12**

Concepts: Conflicts – Corporate and workplace conflicts – reason and impacts of conflicts – guidelines to manage conflicts. Teams - role of team player – stress – stress management – importance of feedbacks – Time Management.

Activity: Creating posters with stress management tips – open house discussion on challenges of time management – Tracking time activity

UNIT-IV	**CORPORATE SOCIAL RESPONSIBILITY**	**12**

Concepts: Corporate Social Responsibility - Social responsibilities of companies - Diversity in workplace – Individual social responsibility – Social connect – life skills - empathy

Activity: Discussion & Role play in diversity – Ubuntu story of social responsibility – creating audio embedded ppt on the concept of social responsibility

UNIT-V	**DESIGN THINKING & PUBLIC SPEAKING**	**12**

Concepts: Design thinking – importance of start-ups – Proof of concept for start-ups – Best practices – Art of Public speaking

Activity: Pitch in start-up idea – watching videos of public speaking – Finding similarities among world famous speeches – watching videos of Sw. Vivekananda's speech – Martin Luther King's My Dream speech, etc.,		
	Total Contact Hours	**60**

Course Outcomes:	
On completion of the course, students will be able to	
●	Recognize the best practice of Communicative writing
●	Apply emotional intelligence in real life scenarios
●	Identify the best practices of stress management
●	Recognize the attributes needed to function and grow in a corporate environment
●	Apply the best practices of public speaking

SUGGESTED ACTIVITIES
● Proposal Writing
● Mock Interview
● Poster presentation
● Group discussion
● Role play
SUGGESTED EVALUATION METHODS
● Assignment topics
● Quizzes
● Class Presentation/Discussion
● Case study

Reference Books / Web links:	
1	Daniel Goleman, "Emotional Intelligence: Why it Can Matter More Than IQ", 25th Anniversary Edition ,Bloomsbury Publishing, published in 2020
2	David Ryback, Putting "Emotional Intelligence To Work, Routledge, First Edition, Routledge, published on October 20, 1997.
3	Dale Carnegie, "How to Develop Self Confidence and Improve Public Speaking - Time - Tested Methods of Persuasion", Vermilion, published on October 2, 1998.
4	Chris Anderson, "TED Talks:The official TED guide to public speaking: Tips and tricks for giving unforgettable speeches and presentations", Houghton Mifflin Harcourt, published on May 3, 2016
Web References	
1	https://www.tata.com/about-us/tata-group-our-heritage

2	https://economictimes.indiatimes.com/tata-success-story-is-based-on-humanity-philanthropy-and-ethics/articleshow/41766592.cms
Online Resources	
1	https://youtu.be/reu8rzD6ZAE
2	https://youtu.be/Wx9v_J34Fyo
3	https://youtu.be/F2hc2FLOdhI
4	https://youtu.be/wHGqp8lz36c
5	https://youtu.be/hxS5He3KVEM

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	-	-	1	-	1	3	1	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	1	-	-	1	-	1	2	1	-	-	-	1
CO4	-	-	-	-	-	-	-	-	1	2	1	-	-	-	1
CO5	-	-	-	-	-	-	1	-	-	2	-	-	1	-	1
Average	-	-	-	1	-	-	1	-	1	2.25	1	-	1	-	1

Note: Enter correlation levels 1, 2 or 3 as defined below:
    1: Slight (Low)
    2: Moderate (Medium)
    3: Substantial (High)
    If there is no correlation, put "-"

Course Code	Course Title	Category	L	T	P	C
GE231621	**PROBLEM-SOLVING TECHNIQUES**	**EEC**	**0**	**0**	**2**	**1**

Course Objectives:
- To improve the numerical ability
- To improve problem-solving skills.

Course topics:

S.No.	Topics
1	Numbers system
2	Reading comprehension
3	Data arrangements and Blood relations
4	Time and Work
5	Sentence correction
6	Coding & Decoding, Series, Analogy, Odd man out and Visual reasoning
7	Percentages, Simple interest and Compound interest
8	Sentence completion and Para-jumbles
9	Profit and Loss, Partnerships and Averages
10	Permutation, Combination and Probability
11	Data interpretation and Data sufficiency
12	Logarithms, Progressions, Geometry and Quadratic equations.
13	Time, Speed and Distance

Course Outcome:
On successful completion of the course, students should be able to:
1. Have mental alertness

2. Have numerical ability

3. Solve quantitative aptitude problems with more confident

CO - PO – PSO Matrices Of Course

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	1	1	1	2	3	2	1	3	2	1
CO2	3	3	3	2	1	1	1	1	2	2	2	1	3	3	2
CO3	3	3	3	3	2	1	1	1	3	3	2	2	3	3	2

SEMESTER VII

Course Code	Course Title (Lab Oriented Theory Course)	Category	L	T	P	C
CB23731	DATA VISUALIZATION TECHNIQUES	PC	2	0	2	3

Course Objectives (CO):
CO1: Analyze various data analysis frameworks (CRISP-DM, SEMMA, KDD) for their applications and effectiveness
CO2: Evaluate different exploratory data analysis (EDA) techniques in Python for handling and cleaning diverse datasets.
CO3: Analyze relationships and correlations within datasets using advanced visualizations with Python libraries like Matplotlib.
CO4: Evaluate the functionalities and features of Power BI for designing and developing comprehensive data visualizations and interactive reports.
CO5: Analyze and compare various advanced visualization techniques in Tableau to create insightful dashboards and stories that effectively communicate data-driven insights.

Unit – I	Introduction to data analytics and Framework	6
Overview of Data Analytics-Importance and Applications-Data Types and Sources- Overview of Data Analysis Frameworks-CRISP-DM (Cross-Industry Standard Process for Data Mining)-SEMMA (Sample, Explore, Modify, Model, Assess)-KDD (Knowledge Discovery in Databases)		
UNIT-II	**EDA using Python**	6
Introduction to EDA -Types of EDA-EDA Tools-EDA using Python : Data Frame Operations- Key Data Structures: Series and Data Frame-Creating and Loading Data Frames from Various Sources (e.g., CSV, Excel, SQL)- Viewing and Inspecting Data Frames-Filtering and Subsetting Data using Conditions-Data Cleaning with Pandas- Handling Missing Data-Detection, Filling, and Dropping-Removing Duplicates and Unnecessary Data-Data Type Conversion and Ensuring Consistency		
UNIT-III	**Visualization in Python**	6
Importance of data visualization in EDA- Types of data visualizations- Python Libraries for Data Visualization- Basic Plotting with Matplotlib - Visualization for Descriptive Statistics-Visualizing central tendency and dispersion-Box plots and whisker plots-Correlation and Relationship Analysis-Scatter plot matrix-Correlation heatmaps.		
UNIT-IV	**Visualization using Power BI**	6
What is Power BI? - Features of Power BI -Getting Started with Data Importing-Data Modelling- Report Design : Adding Visualization to the Report, Style Manipulations on a Report, Setting Colours and Background-,Exploring charts - Introduction to DAX Measures and Columns -Editing Interactions-Filters: Types of Filters- Visual Level, Page and Report Level, Include and Exclude,Using Slicer as a Filter-Adding Reports and Data Sets in Workspace -Converting Published Reports into Dashboards		
UNIT-IV	**Visualization using Tableau tool**	6
Introduction to Tableau-Overview of Tableau-Tableau Interface-Connecting to Data-Connecting to various data sources (Excel, CSV, SQL databases-Data Preparation-Data cleaning and transformation within Tableau-Basic Visualizations in Tableau -Bar charts, line charts, and pie charts-Tables and cross-tabs-Formatting and styling visualizations- Filters and Parameters-Adding filters to visualization-		

Calculated Fields and Analytics-Advanced Visualizations in Tableau-Heatmaps, tree maps, and bubble charts-Creating maps- Dashboards and Stories	
	Contact Hours: **30**

Description of the Experiments	**Contact Hours:** **30**
Setting up the Python environment and libraries-Juypter Notebook	

- **EDA-**Data Import and Export
- Importing data from CSV, Excel, SQL databases, and web scraping
- Handling different data formats
- Export a DataFrame to an Excel file.

- **EDA-**Data Cleaning
- Handling missing values: detection, filling, and dropping
- Removing duplicates and unnecessary data
- Data type conversion and ensuring consistency
- Normalize data (e.g., standardization, min-max scaling).

- **EDA-**Data Inspection and Analysis
- Viewing and inspecting Data Frames
- Filtering and subsetting data using conditions
- Descriptive statistics: measures of central tendency (mean, median, mode) and measures of dispersion (range, variance, standard deviation)

Data Visualization Using PowerBi
- Learning the Power BI Interface
- Connecting to various data sources (Excel, CSV, SQL databases)
- Creating basic visualizations: bar charts, line charts, pie charts
- Creating Calculated Columns and Measures
- Building Dashboards

Data Visualization Using Tableau
- Introduction to Tableau and its interface
- Connecting to various data sources (Excel, CSV, SQL databases)
- Creating basic visualizations: bar charts, line charts, pie charts
- Creating calculated fields
- Building dashboards and stories in Tableau

Case Studies
- Healthcare Data Analytics
- Financial Data Analytics
- Social Media Data Analytics
- Sports analytics
- Tourism Analytics

Course Outcomes:
The students will be able to

- **Critically analyze** different data analysis frameworks (CRISP-DM, SEMMA, KDD) and **determine** their suitability for various data analytics projects and real-world applications.
- **Evaluate** and **apply** appropriate exploratory data analysis (EDA) techniques in Python to clean, transform, and prepare datasets for further analysis, ensuring data quality and integrity.
- A**nalyze** complex datasets by creating advanced visualizations using Python libraries (Matplotlib) and **interpret** the visual representations to extract meaningful insights and identify patterns.
- E**valuate** the capabilities of Power BI and **develop** interactive and dynamic data visualizations and reports, effectively communicating data insights to stakeholders.
- Analyze and compare advanced visualization techniques in Tableau, creating comprehensive dashboards and stories that effectively present data insights and support data-driven decision-making.

SUGGESTED ACTIVITIES (UNIT/ Module Wise) –

Case Study Analysis: Analyze case studies that implement CRISP-DM, SEMMA, and KDD frameworks. Discuss the strengths and weaknesses of each framework in various scenarios.

Data Cleaning Challenge: Provide a raw dataset and have students clean and prepare the data using Python, focusing on handling missing values, removing duplicates, and ensuring data consistency.

Peer Review: Students conduct EDA on different datasets and then peer-review each other's work, providing feedback on data cleaning and transformation techniques used.

Power BI Project: Assign a project where students import data, create data models, and design interactive reports and dashboards in Power BI, showcasing their ability to manipulate and visualize data.

Tableau Dashboards Project: Have students create comprehensive dashboards using Tableau, incorporating various visualization types (bar charts, line charts, maps) and data sources.

Data Storytelling Assignment: Students design and present data stories using Tableau, focusing on effectively communicating insights through well-structured visual narratives.

Tableau Hackathon: Organize a hackathon where students work in teams to solve real-world data problems using Tableau, presenting their findings and visualizations at the end.

Text Book(s):
1. Wes McKinney, "Python for Data Analysis", O'Reilly Media , 3rd edition.2022
2. Wes McKinney, "Python for Data Analysis - Data wrangling with pandas, Numpy, and ipython", Second Edition, O'ReillyMedia Inc, 2017.
3. Stefanie Molin, "Hands-On Data Analysis with Pandas: Efficiently perform data collection, wrangling, analysis, and visualization using Python" Packt Publishing, 2019.

4. Joshua N. Milligan, "Learning Tableau 2022: Create effective data visualizations, build interactive visual analytics, and transform your organization", Fifth Edition, PacktPublishing ,2022.

5. Nokolai Schuler, "Microsoft Power BI - The Complete Masterclass [2023 EDITION]", Packt Publishing, 2023.

Reference Books(s) / Web links:
- https://www.datacamp.com/courses/statistical-thinking-in-python-part-1

CO - PO – PSO MAPPING

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CB23731.1	3	2	2	-	2	-	-	1	-	1	-	-	2	2	–
CB23731.2	3	3	2	2	3	2	1	1	1	2	1	2	3	3	3
CB23731.3	3	3	2	2	3	2	2	2	2	1	3	3	3	3	3
CB23731.4	3	3	3	2	3	2	2	2	2	3	3	3	3	3	3
CB23731.5	3	3	3	2	3	2	2	2	2	3	3	3	3	3	3
Average	3	2.8	2.8	3	3	2	1.75	1.6	1.75	2.2	2.5	2.75	2. 6	2.8	3

Scale: 1 – Slight (Low),
    2 – Moderate (Medium),
    3 – Substantial (High), No correlation: "-"

Course Code	Course Title (LAB ORIENTED THEORY COURSE)	Category	L	T	P	C
CB23732	IT PROJECT MANAGEMENT	PC	2	0	2	3

Objectives:	
☐	Gain knowledge on fundamental concepts of project and project scheduling.
☐	Understand Project Cost Control, Scheduling and Management Features.
☐	Obtain knowledge on Agile Project Management.
☐	Know about the Scrum framework in detail.
☐	Obtain knowledge on Extreme Programming and Kanban

UNIT-I	PROJECT OVERVIEW AND PROJECT SCHEDULING	6
	Project Overview and Feasibility Studies: Identification, Market and Demand Analysis, Project Cost Estimate, Financial Appraisal- Project Scheduling: Project Scheduling, Introduction to PERT and CPM, Critical Path Calculation, Precedence Relationship, Difference between PERT and CPM, Float Calculation and its importance, Cost reduction by Crashing of activity.	
UNIT-II	COST CONTROL, SCHEDULING AND MANAGEMENT FEATURES	6
	Cost Control and Scheduling: Project Cost Control (PERT/Cost), Resource Scheduling & Resource Leveling - Project Management Features: Risk Analysis, Project Control, Project Audit and Project Termination.	
UNIT-III	AGILE PROJECT MANAGEMENT	6
	Agile Project Management: Introduction, Agile Principles, Agile methodologies, Relationship between Agile Scrum, Lean, DevOps and IT Service Management (ITIL). Other Agile Methodologies: Introduction to XP, FDD, DSDM, Crystal.	
UNIT-IV	SCRUM	6
	Scrum: Various terminologies used in Scrum (Sprint, product backlog, sprint backlog, sprint review, retro perspective), various roles (Roles in Scrum), Best practices of Scrum, Case Study.	
UNIT-V	EXTREME PROGRAMMING AND KANBAN	6
	XP and Embracing change, the primary practices of XP, Simplicity, code and design, Incremental Design and the Holistic XP Practices; Kanban-The Principles of Kanban - Improving Your Process with Kanban - Measure and Manage Flow - Emergent Behavior with Kanban	
	Total Contact Hours :	30

List of Experiments	
A mini-project to be identified in the given domain (Crowd Source System, Day Book, Smart Transport System, Resume Builder, E-Commerce, Expert System, Puzzle Corner) to apply the IT Project Management Principles.	
1	Estimation of project cost and control activity using open-source tools.
2	Scheduling of project with PERT and CPM techniques to estimate the completion time.
3	Assessment of IT Project Risk Analysis using open-source tools.
4	Perform IT Project Audit and generate a report using open-source tools.
5	Study of Agile project management tools.
6	Application of Scrum practices in the project.
7	Design and perform automated testing.

	Contact Hours	:	30
	Total Contact Hours	:	60

Course Outcomes:
On completion of the course, the students will be able to
• Learn to effectively plan, and schedule projects within time and cost targets.
• Have Knowledge in Cost Control, Scheduling and Management Features.
• Be aware of different Agile Project Methodologies.
• Know in detail about Scrum.
• Obtain good knowledge in Extreme Programming and Kanban

Text Book (s):	
1	Bob Hughes, Mike Cotterell, Rajib Mall, "Software Project Management , Sixth edition, McGraw-Hill Education 2017
2	Craig Larman, Bas Vodde, Large-Scale Scrum: More with LeSS, First Edition, Addison-Wesley Signature Series , 2016.

Reference Books(s) :	
1	Roman Pichler, "Agile Product Management with Scrum", Addison-Wesley publisher, 1st Edition, 2010.
2	Andrew Stellman & Jennifer Greene , "Learning Agile: Understanding Scrum, XP, Lean, and Kanban" Oreillymedia publications , 2014

CO - PO – PSO matrices of course

PO/PSO \ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CB23732.1	2	2	2	1	0	0	0	0	3	2	0	0	1	2	0
CB23732.2	1	2	2	2	3	2	2	2	3	3	3	1	3	2	2
CB23732.3	1	2	2	2	3	2	2	2	3	3	2	1	2	2	2
CB23732.4	1	2	2	2	3	2	2	2	3	3	2	1	2	2	2
CB23732.5	1	1	2	2	2	2	2	2	3	3	2	1	2	2	2
Average	1.2	1.8	2	1.8	2.2	1.6	1.6	1.6	3	2.8	1.8	0.8	2	2	1.6

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

No correlation: "-"

Course Code	Course Title	Category	L	T	P	C
CB23721	**PROJECT EVALUATION I**	**EEC**	**0**	**0**	**4**	**2**

Objectives:	
☐	To identify a problem statement of societal importance
☐	To analyze a problem and find out requirements
☐	To plan, design, and execute a project solution effectively within specified timelines and resources
☐	To develop technical expertise in using contemporary tools, technologies, and methodologies for the project.
☐	To test and document a project

1	**Project Proposal and Initial Planning**
	Problem Understanding and Objective, Feasibility and Innovation, Proposed Methodology, Team Structure and Role Distribution
2	**Proof of Concept**
	Literature Review and Background Research.
3	**Design Development Evaluation**
	Data Collection and Preprocessing / Components Identification and Collection, Data Organization, Technical Skills and Development, Collaboration and Teamwork
4	**Initial Implementation**
	Technical Execution, Conceptual Clarity and Progress, Core Functionality
5	**Phase I Project Demonstration**
	Innovation and Creativity, Data Quality Assessment, Data Preprocessing Output, Presentation Clarity
	Contact Hours : 60

Course Outcomes:	
On completion of the course, the students will be able to	
☐	Apply the concepts of computer science to real-world problems and understand Ethical and societal implications.
☐	Take in any difficult sensible issues and propose solution through formulating right methodology.
☐	Attain a hands-on experience in changing a small novel idea / method right into an operating model / prototype related to multi-disciplinary abilities and / or understanding and operating in at team.
☐	Interpret the outcome of their project. Students will take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.
☐	Publish or release the project outcome to the society.

CO-PO-PSO Mapping Table

POs-Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CB23721.1	3	3	2	2	2	3	3	3	-	2	1	2	3	2	2
CB23721.2	3	3	3	3	2	2	2	-	-	2	2	3	2	3	3
CB23721.3	3	2	3	3	3	2	2	-	3	3	3	3	2	3	3
CB23721.4	2	3	2	3	2	1	-	-	3	3	3	3	2	2	3
CB23721.5	3	2	3	2	2	3	3	3	3	2	3	3	3	3	3

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

No correlation: "-"

SEMESTER VIII

Course Code	Course Title	Category	L	T	P	C
CB23821	PROJECT EVALUATION II	EEC	0	0	16	8

Objectives:	
☐	To identify a problem statement of societal importance
☐	To analyze a problem and find out requirements
☐	To plan, design, and execute a project solution effectively within specified timelines and resources
☐	To develop technical expertise in using contemporary tools, technologies, and methodologies for the project.
☐	To test and document a project

1	**Model Selection Process**
	Model Exploration, Justification for Model Selection, Alignment with Data, Scalability and Adaptability
2	**One-Thirds Project Implementation Progress**
	Progress and Milestones, Depth of technology, Adherence to Objectives, Quality of Implementation
3	**Two-Thirds Project Implementation Progress**
	Completeness of Implementation, Technical Complexity, Testing and Debugging, Code Quality and Optimization
4	**Full Project Demonstration**
	Final Implementation, Quality and Innovation of the Developed Model, Project Presentation & Demonstration, Documentation and Reporting
5	**Viva-Voce**
	Demonstration of the project work and Viva-Voce by panel of experts
	Contact Hours : 90

Course Outcomes:	
☐	On completion of the course, the students will be able to apply the concepts of computer science to real-world problems and understand Ethical and societal implications.
☐	On completion of the project work students could be in a role to take in any difficult sensible issues and propose solution through formulating right methodology.
☐	Students will attain a hands-on experience in changing a small novel idea / method right into an operating model / prototype related to multi-disciplinary abilities and / or understanding and operating in at team.
☐	Students will be able to interpret the outcome of their project. Students will take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.
☐	Students will be able to publish or release the project outcome to the society.

CO-PO-PSO Mapping Table

COs-POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CB23821.1	3	3	2	2	2	3	3	3	-	2	1	2	3	3	2
CB23821.2	3	3	3	3	2	2	2	-	-	2	2	3	2	3	3
CB23821.3	3	2	3	3	3	2	2	-	3	3	3	3	2	3	3
CB23821.4	2	3	2	3	2	1	-	-	3	3	3	3	2	2	3
CB23821.5	3	2	3	2	2	3	3	3	3	2	3	3	3	3	3

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)   2: Moderate

(Medium) 3: Substantial (High)

No correlation: "-"

PROFESSIONAL ELECTIVES

Course Code	Course Title (Theory Course)	L	T	P	C
MCB2301	**FUNDAMENTALS OF BUSINESS STATISTICS**	3	0	0	3

Objectives:
● To gain the basic knowledge on statistics.
● To understand the relation among the data and selecting the highly influential data for the
● To learn the role, need and selection approaches of the factors.
● To explore the various types of possible errors and error reduction approaches.
● To analyze the time series data with statistical models.

UNIT-I	DATA PROJECTION, LINEAR REGRESSION AND CORRELATION	9
	Graphical representation - histogram, boxplots, and scatterplots, Numerical data: Mean, Median, Quantiles, Variance and standard deviation, Normal Distribution. Categorical data: Two-way tables, bar graphs, segmented bar graphs. Linear regression: Least Squares, residuals, outliers and influential observations, extrapolation. Inference in Linear Regression: Confidence intervals for intercept and slope, significance test, mean response and predication intervals. Correlation: Correlation coefficient, Rank correlation. Multiple Linear Regression: Confidence intervals, test of significance, squared multiple correlation, ANOVA: Analysis of variance for simple and multiple regression, F statistics.	
UNIT-II	PRINCIPAL COMPONENT ANALYSIS	9
	Principal components, Algorithm for conducting principal component analysis: Data standardization, covariance matrix evaluation, Eigen vector and Eigen value calculation, deciding on how many principal components to retain, H-plot.	
UNIT-III	FACTOR ANALYSIS	9
	Factor Analysis: Definition, exploratory factor analysis and confirmatory factor analysis. Factor analysis model, Extracting common factors, determining number of factors, Transformation of factor analysis solutions, Factor scores.	
UNIT-IV	ERROR ANALYSIS	9
	Introduction, Accuracy vs Precision, Types of Errors / Uncertainties: Random errors, Systematic errors. Type I error (false positive), Type II error (false negative), Bias, Regression Error, Standard Error, Sampling and Non-Sampling error.	
UNIT-V	ANALYSIS & FORECASTING ON TIME SERIES DATA	9
	Stationary, ARIMA Models: Identification, Estimation and Forecasting.	
Contact Hours :		**45**

Course Outcomes:
On completion of the course, students will be able to
● Gain the basics of statistics knowledge
● Expertise in analyzing and selecting the highly influential features.
● Understand the factors' role for further analysis.
● Proficiency in finding and optimizing the errors to improve the model performance.
● Able to construct an optimal model on time series data for the required analysis.

Text Books:

1.	Bruce, Peter, Andrew Bruce, and Peter Gedeck,"Practical statistics for data scientists: 50+ essential concepts using R and Python", O'Reilly Media, 2020.
2.	Johnson, Richard A., Irwin Miller, and John E. Freund, "Miller & Freund's Probability and Statistics for Engineers", Eighth Edition, University of Wisconsin - Madison, 2011.
3.	Cowpertwait, Paul SP, and Andrew V. Metcalfe,"Introductory time series with R", Springer Science & Business Media, 2009.

Reference Books / Web links:	
1.	Montgomery, Douglas C., Elizabeth A. Peck, and G. Geoffrey Vining, "Introduction to linear regression analysis", John Wiley & Sons, 2021.
2.	Mood, A. M., Franklin A. Graybill, and D. C. Boes. "Introduction to the theory of statistics", McGraw-Hill series in probability and statistics, 1974.
3.	Draper, Norman R., and Harry Smith, "Applied regression analysis",Vol. 326. John Wiley & Sons, 1998.
4.	Goon, A. M., M. K. Gupta, and B. Dasgupta, "Fundamentals of Statistics, Vol. I & II." 2002.
5.	Chatfield, Chris, "The analysis of time series: an introduction", Chapman and Hall, CRC, 2003.
6.	http://www.stat.yale.edu/Courses/1997-98/101/stat101.htm
7.	https://journals.physiology.org/doi/pdf/10.1152/ajpendo.00484.2003

CO - PO – PSO matrices of course

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MCB2301.1	3	2	3	3	2	1	-	-	-	2	2	-	2	2	2
MCB2301.2	3	3	2	3	2	1	-	-	-	1	2	-	2	2	2
MCB2301.3	3	3	2	3	3	1	-	-	-	1	2	-	2	3	2
MCB2301.4	3	3	2	3	3	2	-	-	-	2	2	-	2	3	3
MCB2301.5	3	3	2	3	3	2	-	-	-	2	2	-	2	3	3
Average	3	2.8	2.2	3	2.6	1.4	-	-	-	1.6	2	-	2	2.6	2.4

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)   2: Moderate

(Medium) 3: Substantial (High)

No correlation: "-"

Course Code	Course Title (Theory Course)	L	T	P	C
MCB2302	**DIGITAL MARKETING AND WEB ANALYTICS**	**3**	**0**	**0**	**3**

Objectives:
● To gain marketing advantage by learning digital marketing fundamentals to achieve better user.
● To increase brand awareness and visibility.
● To develop customer engagement and loyalty.
● To perform quantitative and qualitative analysis to give business that extra advantage.
● Improve website usability and increase website traffic.

UNIT-I	ONLINE MARKET SPACE	9

Digital Marketing Strategy- Components -Opportunities for building Brand Website - Planning and Creation- Content Marketing.

Case study: Build a digital branding strategy for a multinational apparel shop to help the brand establish itself as a new product in the market.

UNIT-II	TERMINOLOGY USED IN DIGITAL MARKETING	9

PPC and online marketing through social media, Social Media Marketing, SEO techniques, Keyword advertising, Google web-master and analytics overview, Affiliate Marketing, Email Marketing, Mobile Marketing.

Case study: Social media marketing using Facebook Ads Manager.

UNIT-III	DIGITAL MARKETING TECHNOLOGY	9

Technology behind digital marketing - Evolution of digital marketing- Digital Marketing Strategy-10Ps of digital marketing-Choosing web designer / developer- Trust in Internet Marketing- Ethical and Legal Issues- Future of digital marketing.

Case study: Application of Google Ads Manager in any Healthcare, Finance or Banking tracks.

UNIT-IV	WEB ANALYTICS	9

Present and Future, Data Collection - Importance and Options, Overview of Qualitative Analysis, Business Analysis, KPI and Planning, Critical Components of a Successful Web Analytics Strategy, Web Analytics Fundamentals, Concepts, Proposals & Reports, Web Data Analysis.

Case study: Application of Google Analytics in E-commerce track.

UNIT-V	SEARCH ANALYTICS	9

Search engine optimization (SEO), non-linear media consumption, user engagement, user generated content, web traffic analysis, navigation, usability, eye tracking, online security, online ethics, content management system, data visualization, RSS feeds, Mobile platforms, User centered design, Understanding search behaviors.

Contact Hours :	45

Course Outcomes:
On completion of the course, students will be able to
● Know how to improve website visits and sales.
● Develop a mass strategy and guide campaigns to increase sales and revenue.
● Apply digital marketing strategy to increase customer lifetime value.
● Perform web analytics process for better optimization.
● Effectively use the search analytics insights to support brand recognition and ROI

Text Books:	
1.	Ryan Deiss & Russ Henneberry, "Digital Marketing for Dummies, 2, illustrated Edition,John Wiley Sons, 2020
2.	Dave Chaffey & Fiona Ellis-Chadwick, "Digital Marketing: Strategy, Implementation & Practice", Sixth Edition, Pearson, 2016.
3.	Dr.Anil Maheshwari, "Data Analytics Made Accessible", Kindle Edition, 2023.

Reference Books / Web links:	
1.	K. M. Shrivastava, "Social Media in Business and Governance", Sterling
2.	Christian Fuchs, "Social Media a Critical Introduction", SAGE Publications
3.	Bittu Kumar, "Social Networking", V & S Publishers, 2013.
4.	Avinash Kaushik, "Web Analytics - An Hour a Day", Wiley Publishing,
5.	T. Peterson, "Web Analytics Demystified", Celilo Group Media and Café
6.	TakeshiMoriguchi, "Web Analytics Consultant Official Textbook", 7th

CO - PO – PSO matrices of course

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MCB2302.1	3	2	-	3	3	1	-	-	-	-	2	3	3	2	2
MCB2302.2	3	3	2	3	3	1	-	-	-	1	2	3	3	3	2
MCB2302.3	3	3	3	3	3	-	-	-	-	1	2	3	3	3	3
MCB2302.4	3	3	3	3	3	-	-	-	-	2	3	3	3	3	3
MCB2302.5	3	2	3	3	3	1	-	-	-	3	2	3	3	3	2
Average Mapping	3	2	3	3	3	1	-	-	-	3	2	3	3	3	2

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)   2: Moderate

(Medium) 3: Substantial (High)

No correlation: "-"

Course Code	Course Title (Theory Course)	L	T	P	C
MCB2303	**OPERATIONS AND SUPPLY CHAIN ANALYTICS**	3	0	0	3

Objectives:	
•	To familiarize the fundamentals of operations and supply chain.
•	To learn techniques to optimize inventory levels and minimize waste.
•	To learn to create a responsive supply chain by reducing lead times.
•	To enhance decision-making capabilities by providing better data-driven insights through fundamentals of supply chain analytics with analytical
•	To estimate possible outcomes which reduce costs associated with the

UNIT-I	INTRODUCTION	9

Introduction to Operations management, Introduction to Demand Forecasting - Demand & Planning: Matching demand & supply, Inventory management Models. Role of analytics in supply chain, Supply chain strategies, Tools/Drivers for supply chain management, Framework for structuring Drivers.

UNIT-II	LOGISTICS & GLOBAL SUPPLY CHAIN MANAGEMENT	9

Freight transportation: Selection & its impact on inventory, Warehousing: Design, Operations heuristics, Material handling, Customs, Duties, Tariffs, INCO terms, Rules of origin, Letter of credit etc. International transportation, Trading blocks, Trade zones, Bonded warehouses, Currency fluctuations, Exchange rate risks, Transfer pricing, Permanent establishment.

UNIT-III	SUPPLY CHAIN PERFORMANCE	9

Lack of supply Chain Coordination and BULLWHIP, Managing uncertainties in a supply chain, Cycle Service Level, Monte Carlo Simulation, Tools and methods in supply chain risk management.

UNIT-IV	SUPPLY CHAIN ANALYTICS	9

Introduction to analytics – descriptive, predictive and prescriptive analytics, Data Driven Supply Chains – Basics, transforming supply chains, Barriers to implementation, Road Map.

UNIT-V	MCDM MODELS	9

Analytic Hierarchy Process (AHP), Data Envelopment Analysis (DEA), Fuzzy Logic and Techniques, the analytical network process (ANP), TOPSIS-Application in SCM.

Contact Hours :	45

Course Outcomes:	
On completion of the course, students will be able to	
•	Understand supply chain fundamentals which improve customer service and satisfaction.
•	Enhance supply chain performance which increases profitability and cost savings.
•	Analyze models and strategies in inventory management which improves supplier relationships and better collaboration.
•	Reduce inventory costs and improve inventory management through analytics.
• •	Make decision using multi-criteria in applications of SCM for better visibility and control of supply chain activities.

Text Books:	
1.	B. Mahadevan , "Operations Management Theory & Practice", Third Edition , Pearson,2022.
2.	Sunil Chopra and Peter Meindl, "Supply Chain Management: Strategy, Planning, and Operation", Pearson Education, 2019.

3.	Nada R. Sanders, "Big Data Driven Supply Chain Management: A Framework for Implementing Analytics and Turning Information Into Intelligence",Seventh Edition ,Pearson, 2019.
4.	Muthu Mathirajan, Chandrasekharan Rajendran, Sowmyanarayanan Sadagopan, Arunachalam Ravindran, Parasuram Balasubramanian, "Analytics in Operations/Supply Chain Management" , I.K. International Publishing House Pvt. Ltd., 2016.

	Reference Books(s) / Web links:
1	Nada R. Sanders, "Big data driven supply chain management: A framework for implementing analytics and turning information into intelligence", Pearson Education, 2014.
2	Michael Watson, Sara Lewis, Peter Cacioppi, Jay Jayaraman, "Supply Chain Network Design: Applying Optimization and Analytics to the Global Supply Chain", Pearson Education, 2013.
3	Anna Nagurney, Min Yu, Amir H. Masoumi, Ladimer S. Nagurney,"Networks Against Time: Supply Chain Analytics for Perishable Products", Springer, 2013.
4	Muthu Mathirajan, Chandrasekharan Rajendran, Sowmyanarayanan Sadagopan, Arunachalam Ravindran, Parasuram Balasubramanian, "Analytics in Operations/Supply Chain Management" , I.K. International Publishing House Pvt. Ltd., 2016.
5	Gerhard J. Plenert, "Supply Chain Optimization through Segmentation and Analytics", CRC Press, Taylor & Francis Group, 2014.

CO - PO – PSO matrices of course

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
MCB2303.1	3	3	3	2	3	2	2	-	-	2	2	3	3	3	3
MCB2303.2	3	3	3	3	3	2	2	-	-	2	3	3	3	3	3
MCB2303.3	3	3	3	3	3	2	2	-	-	2	3	3	3	3	3
MCB2303.4	3	3	3	3	3	2	2	-	-	2	3	3	3	3	3
MCB2303.5	3	3	3	3	3	2	2	-	-	2	3	3	3	3	3
Average Mapping	3	3	3	2.8	3	2	2	-	-	2	2.8	3	3	3	3

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

No correlation: "-"

Course Code	Course Title (Lab Oriented Theory Course)	Category	L	T	P	C
CB23A11	ENTERPRISE RESOURCE PLANNING AND DEVELOPMENT	PC	2	0	2	3

Objectives:	
☐	To understand the basic concept of ERP systems
☐	To study the steps and activities in the ERP life cycle
☐	To develop a process driven thinking towards business processes

UNIT-I	Introduction to ERP	6

Evolution of ERP, what is ERP, Reasons for the Growth of ERP, Scenario and Justification of ERP in India, Evaluation of ERP, Various Modules of ERP, Advantage of ERP.

UNIT-II	An Overview of Enterprise	6

An Overview of Enterprise, Integrated Management Information, Business Modeling, ERP for Small Business, ERP for Make to Order Companies, Business Process Mapping for ERP Module Design, Hardware Environment and its Selection for ERP Implementation.

UNIT-III	ERP and Related Technologies	6

ERP and Related Technologies, Business Process Reengineering (BPR), Management Information System (MIS), Executive Information System (EIS), Decision support System (DSS), Supply Chain Management (SCM),

UNIT-IV	ERP Implementation Lifecycle	6

Issues in Implementing ERP Packages, Pre-evaluation Screening, Package Evaluation, Project Planning Phase; Gap Analysis; Reengineering; Configuration; Implementation; Team Training; Testing; Going Live; End-User Training; Post Implementation (Maintenance Mode)

UNIT-V	Selection of ERP Vendors and Future Directions in ERP	6

Vendors, Consultants and Users, In-House Implementation - Pros and Cons, Vendors; Consultants; End User, New Markets, New Channels, Faster Implementation Methodologies.

		Total Contact Hours	:	30

	List of Experiments
1	Install and explore a popular Odoo and ERP next, Identify and document the modules available in the ERP system.
2	Using Dolibarr or Microsoft dyanamics365, simulate basic transactions like creating a sales order, generating invoices, and processing payments.
3	Create a simple business model that represents an organization's functions.
4	Simulate the implementation of an ERP system for a small business scenario, input basic data such as customer details, products, and sales orders
5	Simulate an end-to-end supply chain process. Track the flow of materials from procurement to delivery.
6	Create a gap analysis report to show the required changes to align the ERP system with business needs.
7	Configure basic ERP modules like finance or inventory according to a business's requirements. Test the configurations by running a few transactions
8	Simulate how cloud-based ERP might be implemented for an organization.
9	Configure ERP system access for mobile devices, simulate field sales representatives using mobile ERP to access inventory, create orders, or view customer data.
10	Customize dashboards in to display the most critical metrics and KPIs relevant to different roles within the organization
	Contact Hours :	30
	Total Contact Hours :	60

Course Outcomes:

On completion of the course, the students will be able to

☐	Demonstrate a good understanding of the basic issues in ERP systems
☐	Analyse the strategic options for ERP identification and adoption
☐	Design the ERP implementation strategies
☐	Understand the need of Business Systems and Processes through strategic analysis of ERP systems
☐	Evaluate the Business systems and enhance with future with Faster Implementation Methodologies

Text Book (s):

1	James A. Hall ,"Successfully Implementing ERP: A Practical Guide to ERP Implementation",Third Edition, Pearson, 2023.
2	Khalid Sheikh," Manufacturing Resource Planning (MRP II) with Introduction to ERP; SCM; an CRM", McGraw-Hill, 2003.
3	K.B. Hendricks; V.R. Singhal; and J.K. Stratman, "The Impact of Enterprise Systems on Corporate Performance: A study of ERP, SCM, and CRM System Implementations [An article from: Journal of Operations Management], Elsevier, 2007.

Reference Books(s) / Web links:

1	Christian N. Madu, "ERP and Supply Chain Management", CHI Publishers, 2005.
2	Glynn C. Williams,"Implementing SAP ERP Sales & Distribution", McGraw-Hill, 2008.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CB23A11.01	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CB23A11.02	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CB23A11.03	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CB23A11.04	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CB23A11.05	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Average Mapping	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial

Course Code	Course Title (Lab Oriented Theory Course)	L	T	P	C
MCB2341	DATA SCIENCE FOR BUSINESS ANALYTICS	3	0	2	4

Objectives:
- To understand the basic concept, process, and practice of data analytics and how it helps to develop asolution for decision-making.
- To understand various methods and models for the evaluation of business problems.
- To learn various model fitting and machine learning of overfitting and underfitting techniques for accurate prediction.
- To design an analytical solution based on the available data, tools, and frameworks.
- To learn data visualization and various types of visual charts and techniques used in real-time problem-solving with case studies.

UNIT-I	Introduction to Business Analytics	9

Introduction to Data Science - Business Analytics-The science of data-driven decision making-Descriptive, Predictive and Prescriptive Analytics Techniques-Big Data Analytics-Framework for Data-Driven decision making-Analytics capability building-Roadmap for Analytics Capability Building-Challenges in Data-Driven Decision Making.

UNIT-II	Business Problems and Model Building	9

From business problems to data mining tasks – Supervised vs Unsupervised methods-The data mining process-Business understanding – Data understanding- Data preparation - Preprocessing - Modeling-Evaluation-Deployment-Implications for managing the data science team-Other analytics techniques and technologies-Predictive model building- Models, Induction and Prediction-Supervised Segmentation-Clustering as similarity based segmentation-Nearest Neighbor Reasoning-Hierarchical Clustering-Visualizing segmentation-Trees as a set of rules-Probability Estimation.

UNIT-III	Model fitting and Overfitting	9

Finding optimal model parameters based on data-Classification via mathematical functions Regression via mathematical functions-Class probability estimation and Logistic Regression-Nonlinear Functions, Support Vector Machines and Neural Networks-Overfitting Examined-Overfitting avoidance and complexity control.

UNIT-IV	Decision Analytic Thinking	9

Key evaluation framework – Evaluating classifiers- Key analytical framework – Evaluation, Baseline performanceand implications for investments in Data – Visualizing model performance – Techniques – Profit curves – Cumulative Response Curves – Lift curves – ROC curves - Co-occurrences and Associations-Measuring Surprise- Profiling: Finding Typical Behavior- Link Prediction and Social Recommendation-Data Reduction, Latent Information, and Movie Recommendation- Bias, Variance, and Ensemble Methods.

UNIT-V	Data Visualization Tools and Techniques	9

Access, merge, and transform all of your data-Make sense of your data with the tools - Support enterprise-wide data science practices-Leverage insights gained from your data - Visualization Basics- Data Visualization with Analytics– Histogram-Bar Chart-Pie Chart-Scatter Plot-Coxcomb Chart-Box Plot (or Box and Whisker Plot) - Treemap - Business Case Studies: Sales Forecasting - Customer Segmentation-Fraud Detection- Inventory Management- Stock Market Analysis.

		Contact Hours	:	45

	List of Experiments
1	Build a predictive model for a data set and predict the result. Read the training data from a .CSV file.
2	For a given set of training data examples stored in a .CSV file, implement and demonstrate the clustering algorithm to output similarities.
3	Write a program to demonstrate the working of the decision tree technique. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
4	Write a program and implement a regression technique for predicting the sales revenue of a company based on data such as the previous sales of the company.
5	Write a program to build an effective email spam classification
6	Implement a program for analyzing goodness of Fit (Overfit or Underfit) for a given data set.
7	Write a program to compare Cumulative Response and Lift Curves of Classifiers built on given data set.
8	Implement and apply a variety of link prediction methods to each of the ego networks contained within the SNAP Facebook dataset and SNAP Twitter dataset.
9	For a given data set access, blend, analyze, and visualize data using KNIME analytics platform open source software.
10	Implement the data visualization for a given data set a. Find the data distributions using box and scatter plot. b. Find the outliers using plot. c. Plot the histogram, bar chart and pie chart on sample data.

	Contact Hours	**:**	**30**
	Total Hours	**:**	**75**

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

- Understand the basic concept, process, and practice of data Analytics and how it helps to develop a solution for decision-making.
- Understand various methods and models for the evaluation of business problems.
- Learn various model fitting and machine learning of overfitting and underfitting techniques for accurate prediction.
- Design an analytical solution based on the available data, tools, and frameworks.
- Learn various tools and techniques used in real-time problem-solving with case studies.

	Text Books:
1.	U Dinesh Kumar, "Business Analytics The Science of Data-driven Decision Making", First Edition, Wiley Publishers, 2017.
2.	Foster Provost and Tom Fawcett, "Data Science for Business" First Edition, O'Reilly Media, 2013.

	Reference Books / Web links:
3.	R.N.Prasad, Seema Acharya, "Fundamentals of Business Analytics", Second Edition, Wiley Publishers, 2016.
4.	Regi Mathew, "Business Analytics for Decision Making", First Edition, Pearson India, 2020.
5.	Jeffrey D Camm, James J.Cochran, Michael J.Fry, Jeffrey W.Ohlmann, David R.Anderson, Dennis J.Sweeney, "Essentials of Business Analytics", First Edition, Cengage Learning, 2015.
6.	https://www.kaggle.com/datasets
7.	https://archive.ics.uci.edu/ml/index.php
8.	https://data.gov/

9.	https://aws.amazon.com/marketplace/solutions/data-analytics/data-sets#

CO – PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
MCB2341.1	3	2	-	3	3	1	-	-	-	-	2	3	3	2	2
MCB2341.2	3	3	2	3	3	1	-	-	-	1	2	3	3	3	2
MCB2341.3	3	3	3	3	3	-	-	-	-	1	2	3	3	3	3
MCB2341.4	3	3	3	3	3	-	-	-	-	2	3	3	3	3	3
MCB2341.5	3	2	3	3	3	1	-	-	-	3	2	3	3	3	2
Average Mapping	**3**	**2**	**3**	**3**	**3**	**1**	**-**	**-**	**-**	**3**	**2**	**3**	**3**	**3**	**2**

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial

Course Code	Course Title (Lab Oriented Theory Course)	L	T	P	C
MCB2342	PROGRAMMING FOR DATA ANALYTICS	2	0	4	4

Objectives:
• To learn the basics of python programming and File Formats.
• To Understand about the Arrays and Objects Using Python Packages.
• To Understand the basic concepts of Data Processing and Visualization.
• To learn the basics of R programming structures.
• To learn the exploratory data analysis using R.

UNIT-I	Introduction to Python Programming	6
Python Concepts, Data Structures, Classes: Interpreter, Program Execution, Statements, Expressions, Flow Controls, Functions, Numeric Types, Sequences and Class Definition, Files and Operating Systems, Text & Binary Files - Reading and Writing-Data Loading and Storing File Formats.		
UNIT-II	Arrays and Objects in Python	6
Understanding Data Types in Python-The Basics of NumPy Arrays-Computation of NumPy Arrays, - vectorized Computation-Introducing Pandas Data Structures: Essential functionality, Summarizing and Computing descriptive Statistics, Data Indexing and Selection, Operating on Data in pandas		
UNIT-III	Data Processing and Visualization	6
Data Wrangling: Combining and Merging Datasets, Reshaping and Pivoting, Data Transformation, String Manipulation, Regular Expressions-Data Aggregation, Group Operations, Time series: GoupBy Mechanics, Data Aggregation, Groupwise Operations and Transformations, Pivot Tables and Cross Tabulations, Time Series Basics, Data Ranges, Frequencies and Shifting- Visualization in Python: Matplotlib package, Plotting Graphs, Controlling Graph, Adding Text, More Graph Types, Getting and setting values, Patches.		
UNIT-IV	Introduction to R programming	6
Overview – Data Types, Variables, Operators, Decision Making, Loops, Functions, Strings, Vector, List, Matrices, Arrays, Factors, Data Frames, Packages- Data Interfaces – Reading and writing of CSVfiles.		
UNIT-V	R programming for Data Analytics	6
Data Wrangling - The Jupyter and PyDev development environments- Exploratory Data Analysis using R– Association – Classification – Clustering – Time series Analysis – Prediction Models- DataVisualization.		
`	Contact Hours :	30

	List of Experiments
1	To perform operations using Operators and Flow Controls in python.
2	Demonstrate the Built -in and User defined functions in the following using python. a) Strings b) Lists c) Tuples
3	File Operation using python d) To read and write operations on a file. e) To copy the contents of a file to another file. f) To count the frequency of characters in a given file. g) To print each line of a file in reverse order.
4	To perform arrays and vectored computation using NumPy.
5	Implementation of data loading, storage and file formats of CSV, XLS and JSON using pandas.
6	To perform data wrangling operations using pandas. a) Merging b) Grouping c) Concatenating

7	Read and write different types of datasets in R.	
	a) Reading different types of data sets (.txt, .csv) from web and disk and writing in file in specific disk location.	
	b) Reading Excel data sheet.	
	c) Reading XML dataset.	
8	Implementation of vector data object operation using R.	
9	Implementation and use of data frames in R.	
	a) To select the rows where the score is missing, i.e. is NaN.	
	b) To select the rows where the number of attempts in the examination is less than 2 and score greater than 15.	
	c) To calculate the mean score for each different student in the Data Frame.	
	d) To sort the Data Frame first by 'name' in descending order, then by 'score' in ascending order.	
	e) To count the city wise number of students from a given data set (city, name of the student).	
10	Descriptive Statistics in R	
	a) To find basic descriptive statistics using summary, str, quartile function on mtcars & cars datasets.	
	b) To find subset of dataset by using subset (), aggregate () functions on iris dataset.	
11	Build a regression model for the following.	
	a) Financial forecasting (like house price estimates or stock prices, Beta and CAPM).	
	b) Weather analysis and prediction.	
	c) Time series forecasting.	
12	Implementation of the clustering algorithms for the following.	
	a) Fraud Detection.	
	b) Website Recommendation.	
	c) Market Basket Analysis.	
13	Implementation of data visualization with ggplot2.	
	a) Data Layer	
	b) Aesthetic Layer	
	c) Geometric Layer	
	d) Facet Layer	
	e) Statistics Layer	
	f) Coordinates Layer	

	Contact Hours	**:**	**60**
	Total Hours	**:**	**90**

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

●	Learn the basics of python programming and File Formats.
●	Understand about the Arrays and Objects Using Python Packages.
●	Understand the basic concepts of Data Processing and Visualization.
●	Apply programming for Data Wrangling and learn the basics of Visualization Concepts
●	learn the basics of R programming and implement Data Science algorithms using R

Text Books:

1	Wes Mckinney "Python for Data Analysis", Third Edition, O'Reilly Media, 2022.
2	Hadley Wickham & Garrett Grolemund, "R for DataScience", Second Edition, O'Reilly Media, 2017.
3	Jake Vendor plus,"Python Data Science Handbook", First Edition, Jake VanderPlas,2016.

Reference Books:

1	Frank kane, "Hands on Data Science and Python Machine Learning", Second Edition, Packt Publishing, 2017.
2	David Taieb," Data Analysis with Python: A Modern Approach ", First Edition, Packt Publishing, 2018.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
MCB2342.1	3	2	-	2	3	-	-	-	-	-	2	3	3	2	2
MCB2342.2	3	3	2	3	3	-	-	-	-	-	2	3	3	3	2
MCB2342.3	3	3	3	3	3	1	-	-	-	1	2	3	3	3	3
MCB2342.4	3	2	2	2	3	-	-	-	-	1	2	3	3	3	2
MCB2342.5	3	3	3	3	3	1	-	-	-	1	2	3	3	3	3
Average Mapping	3	2.6	2.5	2.6	3	1	-	-	-	1	2	3	3	2.8	2.4

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)
2: Moderate (Medium)
3: Substantial

Course Code	Course Title (THEORY COURSE)	Category	L	T	P	C
BA23B11	BEHAVIORAL ECONOMICS	PE	3	0	0	3

Objectives:	
☐	To understand the concept and theory of economics.
☐	To acquire knowledge on the choices and behavior of firms, households and other economics entities.
☐	To learn the behavioral science perspective in economics.
☐	To know the current ideas and concepts regarding decision making in economics.
☐	To study the intertemporal choice in economics.

UNIT-I	INTRODUCTION	9

The neoclassical/standard model and behavioral economics in contrast; historical background; behavioral economics and other social sciences; theory and evidence in the social sciences and in behavioral economics; applications – gains and losses, money illusion, charitable donation.

UNIT-II	BASICS OF CHOICE THEORY	10

Revisiting the neoclassical model; utility in economics and psychology; models of rationality; connections with evolutionary biology and cognitive neuroscience; policy analysis – consumption and addiction, environmental protection, retail therapy; applications – pricing, valuation, public goods, choice anomalies.

UNIT-III	BELIEFS, HEURISTICS AND BIASES	8

Revisiting rationality; causal aspects of irrationality; different kinds of biases and beliefs; self-evaluation and self-projection; inconsistent and biased beliefs; probability estimation; trading applications – trade in counterfeit goods, financial trading behavior, trade in memorabilia, policy analysis – norms and markets, labor markets, market clearing, public goods; applications – logic and knowledge, voluntary contribution, compensation design.

UNIT-IV	CHOICE UNDER UNCERTAINTY	9

Background and expected utility theory; prospect theory and other theories; reference points; loss aversion; marginal utility; decision and probability weighting; applications – ownership and trade, income and consumption, performance in sports. Strategic choice-Review of game theory and Nash equilibrium – strategies, information, equilibrium in pure and mixed strategies, iterated games, bargaining, signaling, learning; applications – competitive sports, bargaining and negotiation, monopoly and market entry.

UNIT-V	INTERTEMPORAL CHOICE	9

Geometric discounting; preferences over time; anomalies of inter-temporal decisions; hyperbolic discounting; instantaneous utility; alternative concepts – future projection, mental accounts, heterogeneous selves, proceduralchoice; policy analysis – mobile calls, credit cards, organization of government; applications – consumption and savings, clubs and membership, consumption planning.

Individual preferences; choice anomalies and inconsistencies; social preferences; altruism; fairness; reciprocity; trust; learning; communication; intention; demographic and cultural aspects; social norms; compliance and punishment; inequity aversion.

		Total Contact Hours	:	45

Course Outcomes:	
On completion of the course, the students will be able to	
☐	Understand and apply various concepts in traditional and modern Microeconomics.
☐	Focus on decision making, and develop a holistic understanding of these concepts and their interconnections.
☐	Explore the knowledge on behavioural science perspective in Economics.
☐	Understand current ideas and concepts regarding decision making in Economics.
☐	Students will be able to understand the intertemporal choice in Economics.

Text Book (s):	
1	N. Wilkinson and M. Klaes , "An Introduction to Behavioral Economics", Third Edition, Palgrave Macmillan 2017.
2	Paul A. Samuelson, William D. Nordhaus, Sudip Chaudhuri and AnindyaSen, "Economics", Ninth Edition, TataMcGraw Hill, 2010.
3	M.L.Trivedi, "Managerial Economics: Theory & Applications", Fourth Edition , Tata McGraw-Hill Education, 2002.
4	Robert H. Frank, 2014, "Microeconomics and Behaviour", Ninth Edition ,McGraw-Hill, 2014.
5	Philip Corr, Anke Plagnol, "Behavioral Economics: The Basic",First Edition,Routledge, 2018.

Reference Books(s) :	
1	William Boyes and Michael Melvin, "Textbook of Economics", DTECH, 6th Edition, 2004.
2	N. Gregory Mankiw, "Principles of Economics", Thomson learning, 3rd Edition, 2003.
3	Richard Lipsey and Alec Charystal, "Economics", Oxford, University Press, 12th Edition, 2011.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BA23B11.1	2	1	3	2	3	1	3	3	2	2	2	3	-	1	2
BA23B11.2	2	1	2	2	2	1	2	1	2	2	3	3	-	1	2
BA23B11.3	1	2	1	2	2	2	3	3	3	3	2	3	-	1	2
BA23B11.4	2	2	3	3	3	2	3	3	1	1	2	2	-	1	2
BA23B11.5	1	2	3	3	3	3	2	3	2	2	2	2	-	1	2
Average	1.6	1.6	2.4	2.4	2.6	1.8	2.6	2.6	2	2	2.2	2.6	-	1	2

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)   2: Moderate (Medium) 3: Substantial (High) No

correlation: "-"

Course Code	Course Title (THEORY COURSE)	Category	L	T	P	C
BA23B31	**COMPUTATIONAL FINANCE AND MODELING**	**PE**	**3**	**0**	**0**	**3**

Objectives:	
☐	To make the students to understand how the techniques in computational finance applied in risk hedging and pricing of options.

UNIT-I	NUMERICAL METHODS AND MODELS	9
	Numerical methods relevant to integration, differentiation and solving the partial differential equations of mathematical finance- examples of exact solutions including Black Scholes and its relatives. Finite difference methods including algorithms and question of stability and convergence. Treatment of near and far boundary conditions-the connection with binomial models- interest rate model- early exercise- the corresponding free boundary problems. Introduction to numerical methods for solving multi-factor models.	
UNIT-II	**BLACK-SCHOLES FRAMEWORK**	**9**
	Black-Scholes PDE: simple European calls and puts; put-call parity. The PDE for pricing commodity and currency options. Discontinuous payoffs - Binary and Digital options. Option Greeks and their role in hedging. The mathematics of early exercise - American options: perpetual calls and puts; optimal exercise strategy and the smooth pasting condition. Volatility considerations - actual, historical, and implied volatility; local volatility surfaces.	
	Simulation including random variable generation, variance reduction methods and statistical analysis of simulation output. Pseudo random numbers, Linear congruential generator, Mersenne twister RNG. The use of Monte Carlo simulation in solving applied problems on derivative pricing discussed in the current finance literature. The technical topics addressed include importance sampling, Monte Carlo integration, Simulation of Random walk and approximations to diffusion processes, martingale control variables, stratification, and the estimation of the "Greeks."	
UNIT-III	**FINANCIAL PRODUCTS AND MARKETS**	**9**
	Introduction to the financial markets and the products which are traded in them: Equities, indices, foreign exchange, and commodities. Options contracts and strategies for speculation and hedging.	
UNIT-IV	**APPLICATION AREAS**	**9**
	The pricing of American options- pricing interest rate dependent claims, and credit risk. The use of importance of sampling for Monte Carlo simulation of VaR for portfolios of options.	
UNIT-V	**STATISTICAL ANALYSIS OF FINANCIAL RETURNS**	**9**
	Fat-tailed and skewed distributions, outliers, stylized facts of volatility, implied volatility surface, and volatility estimation using high frequency data. Copulas, Hedging in incomplete markets, American Options, Exotic options, Electronic trading, Jump Diffusion Processes, High-dimensional covariance matrices, Extreme value theory, Statistical Arbitrage.	
	Total Contact Hours :	**45**

Course Outcomes:	
On completion of the course, the students will be able to	
☐	Understand existing financial models in a quantitative and mathematical way.
☐	Apply these quantitative tools to solve complex problems in the areas of portfolio management, risk management and financial engineering.
☐	Explain the approaches required to calculate the price of options.
☐	Identify the methods required to analyse information from financial data and trading systems.
☐	Understand the various statistical methods to analyse the financial data.

Text Books	
1	R. Seydel, "Tools for Computational Finance", Second Edition, Springer-Verlag, New York, published in 2017.
2	P. Glasserman, "Monte Carlo Methods in Financial Engineering", Springer-Verlag, New York, 2004.
3	W. Press, S. Teukolsky, W. Vetterling and B. Flannery, "Numerical Recipes in C: The Art of Scientific Computing", Third Edition,Cambridge, Cambridge University Press,2007.
4	A. Lewis, " Option Valuation under Stochastic Volatility", Finance Press, Newport Beach, California, 2000
5	A. Pelsser, "Efficient Methods for Valuing Interest Rate Derivatives", Springer-Verlag, New York, 2000.

CO - PO – PSO matrices of course

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BA23B31.1	3	1	2	3	2	0	2	2	-	-	-	-	1	-	2
BA23B31.2	3	3	3	3	2	1	2	3	-	-	-	-	1	-	2
BA23B31.3	2	3	2	3	2	2	1	3	-	-	-	-	1	-	2
BA23B31.4	3	2	2	3	1	2	2	3	-	-	-	-	1	-	2
BA23B31.5	1	2	1	2	3	3	2	3	-	-	-	-	1	-	2
Average	2.4	2.2	2	2.8	2	1.6	1.8	2.8	-	-	-	-	1	-	2

Note: Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)If there is no correlation, put "-"

Course Code	Course Title (THEORY COURSE)	Category	L	T	P	C
BA23B12	INDUSTRIAL PSYCHOLOGY	PE	3	0	0	3

Objectives:	
☐	Introduces students to the content areas of industrial psychology and the application of psychological theory to organizational issues. Topics include employment law, job analysis, recruitment and selection, training, performance appraisal and discipline, employee motivation, and workplace safety. Using an applied approach, this course will help prepare students for their roles as employees and managers.

UNIT-I		10
Industrial/Organizational Psychology: Research Methods, Statistics, and Evidence-based Practice, Introduction & Legal Context of Industrial Psychology, Job Analysis & Competency Modeling, Job Evaluation & Compensation, Job Design & Employee Well-Being, Recruitment.		
UNIT-II		8
Identifying Criteria & Validating Tests and Measures, Screening Methods, Intensive Methods.		
UNIT-III		9
Performance Goals and Feedback, Performance Coaching and Evaluation, Evaluating Employee Performance.		
UNIT-IV		8
Employee Motivation, Satisfaction and Commitment, Fairness and Diversity.		
UNIT-V		10
Leadership, Organizational Climate, Culture, and Development, Teams in Organizations, The Organization of Work Behavior, Stress Management: Demands of Life and Work.		
	Total Contact Hours :	45

Course Outcomes:	
On completion of the course, the students will be able to	
☐	Become conversant about the major content areas of Industrial Psychology.
☐	Gain further comfort with statistical concepts in the context of making personnel decisions.
☐	Gain practical experience by completing a series of hands-on projects involving job analysis, selection decisions, training programs, and employee well-being.
☐	Deepen your understanding of tests and measurements so that you can collect accurate information and make sound data-based decisions.
☐	Prepare for other focused seminar courses in Industrial/Organizational Psychology or Human Resource Management.

Text Books	
1	Stephen Robbins, Tim Judge, Neharika Vohra, "Organizational Behaviour", Eighteenth Edition, Pearson, 2019.
2	Elmes, D., Kantowitz, B., & Roediger, H, "Research methods in psychology", Ninth Edition , Cengage Learning, 2011.
3	Landy, F. J. and Conte, J. M, "Work in the 21st Century", Fourth Edition , Oxford: Blackwell Publishing, 2013.
4	TV.Rao, "Performance Management towards Organizational Excellence", Second Edition, Sage, 2016.
5	Pratibha Goyal , Alok Chakrawal , "Stress Management", First Edition ,Studera Press, 2016.

Reference Books	
1	Breakwell, G.M., Smith, J.A., &Wright, D.B, "Research methods in psychology", Sage, 4th Edition, 2012.

CO - PO – PSO matrices of course

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BA23B12.1	0	1	-	-	-	-	1	3	2	0	0	0	0	1	-
BA23B12.2	1	2	-	-	-	-	2	3	2	0	0	0	1	2	-
BA23B12.3	0	3	-	-	-	-	2	3	2	0	0	0	0	3	-
BA23B12.4	1	1	-	-	-	-	1	2	2	0	0	0	1	1	-
BA23B12.5	0	1	-	-	-	-	1	1	1	0	0	0	0	1	-
Average	0.4	1.6	-	-	-	-	1.4	2.4	1.8	0	0	0	0.4	1.6	-

Note: Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)If there is no correlation, put "-"

Course Code	Course Title (THEORY COURSE)	Category	L	T	P	C
BA23B13	ADVANCE FINANCE	PE	3	0	0	3

Objectives:	
☐	Imbibe knowledge about the decisions and decision variables in Finance.
☐	Comprehend the technique of making decisions related to finance function.

UNIT-I	SOURCES OF FUNDS	9
Sources of Funds (including regulatory framework) Types of securities- Issuing the capital in market- Pricing of issue - Valuation of Stocks and bonds Dividend Decisions: Traditional Approach, Dividend Relevance Model, Miller and Modigliani Model, Stability of Dividends, Forms of Dividends, Issue of bonus shares, Stock Split.	
UNIT-II	EVALUATION OF LEASE CONTRACTS	9
	Evaluation of Lease Contracts- Corporate Restructuring -Mergers and Acquisitions- Types of Mergers, Evaluation of Merger Proposal-Take-over-Amalgamation-Leverage buy-out-Management buy-out-Corporate Failure and Liquidation.	
UNIT-III	FINANCIAL RESTRUCTURING	9
	Share Split – Consolidation -Cancellation of Paid-up Capital -Other Mechanisms.	
UNIT-IV	WORKING CAPITAL MANAGEMENT	9
	Working Capital Planning- Monitoring and Control of Working Capital-Working Capital Financing -Managing the Components of Working Capital- Cash Management- Receivable Management -Inventory Management.	
UNIT-V	INTRODUCTION TO DERIVATIVES	9
	Basics of Futures, Forwards, Options, Swaps -Interest rate Payoff Diagrams, Pricing of Futures, Put Call Parity, Option Pricing using Binomial Model and Black Scholes Model -Use of Derivatives for Risk-Return Management- Credit Default Swaps	
	Contact Hours :	45

Course Outcomes:	
On completion of the course, the students will be able to
☐	Understand the sources of funds including regulatory framework.
☐	Understand the Corporate Restructuring.
☐	Develop skills for the interpretation of business information and application of financial theory in corporate investment decisions.
☐	Predict the working capital requirements of a concern.
☐	Understand Basics of Derivatives.

Text Books	
1	John.C.Hull, Options, "Futures and other Derivative Securities", 10th Edition , PHI Learning, , 2017.
2	Fred Weston, Kwang S Chung, Susan E Hoag Mergers, "Restructuring And Corporate Control", 4th Edition. Pearson Education,2018.
3	I.M.Pandey, "Financial Management", 9th Edition ,Vikas Publishing House Pvt. Ltd., 2014.

Reference Books	
1	Stulz, "Risk Management and Derivatives", Cengage Learning, 2nd Edition, 2011.
2	Rajinder S. Aurora, Kavita Shetty and Sharad R. Kale, "Mergers and Acquisitions", Oxford University Press, 2011.
3	M.Y.Khan and P.K.Jain, "Financial Management, Text, Problems and Cases", Tata McGrawHill, 5th edition, 2008.

CO - PO – PSO matrices of course

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	3	2	2	2	1	2	3	2	3	3	2	1
CO2	2	1	2	3	1	2	1	2	2	3	2	2	2	1	3
CO3	1	1	2	2	3	2	2	2	1	2	2	1	3	2	1
CO4	2	1	2	2	3	2	2	2	2	2	2	2	3	3	3
CO5	3	2	2	2	1	2	2	2	3	2	2	3	2	2	2
Average	2	1.4	2	2.4	2	2	1.8	1.8	2	2.4	2	2.2	2.6	2	2

Note: Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

If there is no correlation, put "-"

Course Code	Course Title (THEORY COURSE)	Category	L	T	P	C
BA23B14	**ESSENTIALS OF HUMAN RESOURCES MANAGEMENT**	MS	3	0	0	3

Objectives:	
☐	Facilitate student to imbibe knowledge about understanding the basic concepts and importance of Human Resources Management, Recruitment, Training, Communications, Employee Empowerment, Employee Interaction, Various Human Resources Applications and Practices, Managerial functions etc.

UNIT-I	HUMAN RESOURCES MANAGEMENT	9
Concept and Challenges, HR Philosophy, Policies, Procedures and Practices.		

UNIT-II	HUMAN RESOURCE SYSTEM DESIGN	9
HR Profession and HR Department, Line Management Responsibility in HRM, Measuring HR, Human Resources Accounting and Audit, Human Resource Information system.		

UNIT-III	FUNCTIONAL AREAS OF HRM	9
Recruitment and Staffing, benefits, compensation, Employee Relations, HR Compliance, Organizational Design, Training and Development, Human Resources Information systems (HRIS) and Payroll.		

UNIT-IV	HUMAN RESOURCES PLANNING	9
Demand Forecasting, Action Plans – Retention, Training, Redeployment and staffing, succession Planning.		

UNIT-V	STRATEGIC MANAGEMENT OF HUMAN RESOURCES	9
SHRM, relationship between HR strategy and overall Corporate Strategy, HR as a Factor of Competitive Advantage, Managing Diversity in the Workplace.		
	Total Contact Hours :	**45**

Course Outcomes:	
On completion of the course, the students will be able to	
☐	Be aware of the basic principles of Human Resource Management.
☐	Be familiarize with the system design of Human Resource Management.
☐	Know the concepts, roles, functional areas and activities of HR.
☐	Understand organization's employee, their interest, motivation, satisfaction belief of fair treatment.
☐	Get awareness on actual impact of the firm's current performance and sustainability in the long run.

Text Book (s):	
1	Prof. Gary Dessler , Human Resources Management, Sixteen Edition ,Pearson,2020.
2	Prof.John M.Ivancevich, "Human Resource Management", Twelfth Edition, Tata McGraw Hill Publication, 2003.
3	Prof.Aswathappa, "Human Resource Management and Personnel Management", Third Edition, Tata McGraw Hill,2002.

Reference Books(s) / Web links:	
1	Dr.C.B.Gupta, "Human Resource Management ", Sultan Chand & Sons, New Delhi, 1st Edition, 2018.
2	Prof.S.S.Khanka, "Human Resource Management", Chand & Company, New Delhi, 2019.
3	Dr.S.Seetharaman et al., "Human Resource Management", SciTech Publications Pvt Ltd. Chennai,2012.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BA23B14.1	2	2	2	3	2	2	2	1	2	3	2	3	3	2	1
BA23B14.2	1	2	2	3	1	1	2	2	2	3	2	2	2	1	3
BA23B14.3	1	1	2	2	3	2	2	2	1	2	2	3	1	2	1
BA23B14.4	1	2	2	2	3	2	2	2	2	2	2	3	2	3	3
BA23B14.5	2	3	2	2	1	2	2	2	3	2	2	2	3	2	2
Average	1.4	2	2	2.4	2	1.8	2	1.8	2	2.4	2	2.6	2.2	2	2

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High) Nocorrelation: "-"

Course Code	Course Title (THEORY COURSE)	Category	L	T	P	C
BA23B15	MARKETING RESEARCH AND MARKETINGMANAGEMENT	MS	3	0	0	3

Objectives:	
☐	The course will enable in understanding the concepts of marketing with respect to the changing business environment. It will also provide a balance of the theoretical and practical aspects of marketing research and encourage the students to take up a critical and analytical thinking through research.

UNIT-I	MARKETING CONCEPTS	9

Introduction to marketing —Core concepts — Marketing of Services ; importance of marketing in service sector — Marketing planning and Environment ; Elements of marketing mix; analyzing the needs and trends in Environment- Macro, Economical, Political, Technical and Social — Understanding the Consumers – Determinants and factors - Market Segmentation – Meaning and concept; Basis of segmentation, selection of segments, Segmentation strategies, Target marketing, target Positioning.

UNIT-II	PRODUCT MANAGEMENT	9

Product Life cycle concept, New Product development & strategy, Stages in New Product development, Product decision and strategies, Branding & packaging.

UNIT-III	PRICING, PROMOTION AND DISTRIBUTION STRATEGY	9

Policies & Practices – Pricing Methods & Price determination Policies. Marketing Communication – The promotion mix, Advertising & Publicity, 5 M's of Advertising Management. Marketing Channels, Retailing, Marketing Communication, Advertising.

UNIT-IV	MARKETING RESEARCH	9

Introduction, Type of Market Research, Scope, Objectives & Limitations - Marketing Research Techniques, Survey Questionnaire design & drafting, Pricing Research, Media Research, Qualitative Research.
Data Analysis: Use of various statistical tools – Descriptive & Inference Statistics, Statistical Hypothesis Testing, Multivariate Analysis - Discriminant Analysis, Cluster Analysis, Segmenting and Positioning, Factor Analysis.

UNIT-V	INTERNET MARKETING	9

Introduction to Internet Marketing. Mapping fundamental concepts of Marketing (7Ps, STP); Strategy and Planning for Internet Marketing. **Business to Business Marketing:** Fundamental of business markets. Organizational buying process. Business buyer needs. Market and sales potential. Product in business markets. Price in business markets. Place in business markets. Promotion in business markets. Relationship, networks and customer relationship management. Business to Business marketing strategy

	Total Contact Hours	:	45

Course Outcomes:	
On completion of the course, the students will be able to	
☐	Understand the basic marketing concepts.
☐	Comprehend the dynamics of marketing and analyze how various components interact with each other in the real world.
☐	Leverage marketing concepts for effective decision making.
☐	Understand the basic concepts and the application of statistical tools in marketing research.
☐	Understand internet marketing, Business to Business marketing, Promotion in business markets, CRM and Strategies adopted in B2B markets.

Text Book (s):	
1	Donald R. Cooper, Pamela S. Schindler and J K Sharma, "Business Research Methods", Eleventh Edition, TataMcGraw Hill, New Delhi,2019.
2	Philip Kotler and Kevin Lane Keller, "Marketing Management", Fifteenth Edition, PHI, 2016.
3	Uma Sekaran and Roger Bougie, "Research methods for Business", 5th Edition, Wiley India, New Delhi, 2012.
4	KS Chandrasekar, "Marketing management-Text and Cases", First edition, Tata McGraw Hillm, 2010.

Reference Books(s) :	
1	Paul Baines, Chris Fill and Kelly Page, "Marketing", Oxford University Press, 2nd Edition, 2011.
2	William G Zikmund, Barry J Babin, Jon C.Carr, Atanu Adhikari,Mitch Griffin, "Business Research methods, A South Asian Perspective", 8th Edition, Cengage Learning, New Delhi, 2012.

CO - PO – PSO matrices of course

PO/PSO CO	PO1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BA23B15.1	2	1	1	-	-	2	1	-	1	-	2	2	2	2	2
BA23B15.2	2	1	1	-	-	2	1	-	1	-	2-	2	2	2	2
BA23B15.3	2	1	-	-	-	2	1	-	1	-	2	2	1	1	1
BA23B15.4	2	1	-	-	-	2	1	-	1	-	2	2	1	1	1
BA23B15.5	2	1	-	-	-	2	1	-	1	-	2	2	2	2	2
Average	2	1	1	-	-	2	1	-	1	-	2	2	2	2	2

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)
2: Moderate (Medium)
3: Substantial (High) Nocorrelation: "-"

Course Code	Course Title (Theory course)	Category	L	T	P	C
BA23P12	**FINTECH AND BLOCKCHAIN APPLICATIONS IN FINANCE**	PE	3	0	0	3

Course Objectives:
●	To provide a broad introduction to the field of Fintech and Blockchain and its application in the field of financial sector.
●	To get insight into the Fintech landscape and get proficiency in Block chain technology for integration and implementation in financial system.
●	To develop strategic insights for leveraging Fintech and Blockchain in Business models

UNIT-I	**INTRODUCTION TO FINTECH**	9

Overview of Fintech and its impact on traditional financial services, -, Historical development and evolution of Fintech and Regulatory landscape and challenges in the Fintech and Blockchain space- Examination of regulatory challenges and opportunities, Compliance considerations in Fintech.

UNIT-II	**FINTECH APPLICATIONS IN FINANCE**	9

Digital banking and online payments, Robo-advisors and algorithmic trading, Insurtech and digital insurance, Peer-to-peer lending and crowdfunding. **Fintech Innovations- API** (Application Programming Interface), BIG data - IOT -other technologies and their impact on Finance Overview of cutting-edge Fintech solutions, Robotic Process Automation (RPA), Artificial Intelligence (AI), and machine learning in finance. **Decentralized Finance (DeFi) -** Understanding the rise of DeFi platforms, Smart contracts for lending, borrowing, and decentralized exchanges. Case studies on successful Fintech implementations.

UNIT-III	**BLOCKCHAIN BASICS**	9

Understanding the basics of Blockchain: blocks, nodes, and consensus mechanisms, Decentralization, distributed ledgers, and smart contracts and their applications in finance, - Cryptocurrencies and their role in the financial ecosystem. **Cryptocurrencies and Digital Assets-**Exploration of popular cryptocurrencies (e.g., Bitcoin, Ethereum) Analysis of digital assets and their role in the financial landscape.

UNIT-IV	**FINTECH & BLOCKCHAIN APPLICATIONS IN FINANCE SECTOR**	9

The impact of Fintech on traditional banking operations- Blockchain applications in improving banking processes, - Central bank digital currencies (CBDCs) and their implications, Cross-border payments(SWIFT), remittances, Real-time Settlements, Identity verification-KYC, e-KYC,PMLA reducing fraud. Case studies on how banks are adopting Fintech and Blockchain solutions.

UNIT-V	**CHALLENGES AND FUTURE TRENDS**	9

Regulatory challenges and legal considerations in Fintech and Blockchain, Regtech in India - Ethical considerations in the use of Fintech and Blockchain, Block chain security- cybersecurity in Blockchain applications, Addressing potential risks and mitigating vulnerabilities- Future trends and emerging technologies in Fintech - The role of artificial intelligence in shaping the future of finance.

	Total Hours	:	45

Course Outcomes: On successful completion of the course students will be able to:	
CO1: Identify and apply the Knowledge in Fintech Landscape and Blockchain technology.	
CO2: Explain the application of Fintech in the areas of finance.	
CO3: Understand the basics of Blockchain technology and their role in financial system.	
CO4: Demonstrate the application of Blockchain and Fintech in traditional banking system.	
CO5: Explore the regulatory, ethical challenges and future trends in the area of Fintech & Blockchain technology in finance.	

SUGGESTED ACTIVITIES

Case studies that highlight real-world applications of Fintech and Blockchain in finance. Discuss the challenges, benefits, and potential implications of each case.

Cryptocurrency Trading Game

Regulatory Compliance Exercise- To explore the regulatory landscape

Pitch Sessions

Industry reports on application of Fintech & Blockchain technology.

Class discussion on ethical dilemma.

	Textbook(s):
1	Peter Borovykh, "Block Chain Applications in Finance", 2nd edition, Kindle Edition, 2018.
2	Jaspal Singh, "Financial Technology (Fintech) and Digital Banking in India", New Century Publications, 2022.

SUGGESTED EVALUATION METHODS

Case study Method

Gaming

Pitch sessions

Class discussion

Report

	Reference Books
1	Daniel Drescher, Blockchain Basics: A Non-Technical Introduction in 25 Steps Paperback – APresser publication – 2017
2	Jacob William "Fintech: The Beginner's Guide to Financial Technology" Paperback - CreateSpace Independent Publishing Platform, 2016
3	Geetika Madaan, "Applications of Blockchain Technology in Finance" - IGI Global Publishing, 2023
4	S.L.Gupta,Pooja Kansra, Gagan Kukreja,"Applications, Challenges, and Opportunities of Blockchain Technology in Banking and Insurance", IGI Global Publishing, 2022
5	Manoj Kumar, Annappa B, Likewin Thomas, "Blockchain Technology and Applications", Roultedge, Taylor & Francis,2023

	Web links	
1	Real world Fintech case studies	**https://upplabs.com/blog/4-real-world-Fintech-case-studies-by-upplabs/**
2	India: Case Study on the Power of Fintech Innovation	**https://insights.flagshipadvisorypartners.com/insights/india-case-study-on-the-power-of-Fintech-innovation**
3	Case study of a Bank's strategic planning for an investment in a Fintech company	https://jfin-swufe.springeropen.com/articles/10.1186/s40854-016-0037-6
4	Block chain uses for banks cases	https://theblockchaintest.com/uploads/resources/file-265154939225.pdf
5	Blockchain Application in Banking System	**https://www.scirp.org/journal/paperinformation.aspx?paperid=110541**
6	Ethics of Fintech	https://magazine.Fintechweekly.com/articles/what-about-the-ethics-of-Fintech

CO- PO Mapping:

PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BA23P12.1	2	2	2	1	2	3	3	3	2	2	2	2	3	3	3
BA23P12.2	2	2	2	2	2	3	3	2	2	3	2	2	3	3	3
BA23P12.3	2	1	2	3	2	3	3	3	2	3	2	2	3	3	3
BA23P12.4	1	2	2	3	2	3	2	2	2	3	3	3	3	3	3
BA23P12.5	2	2	2	3	2	3	1	1	3	3	3	3	3	3	3
Average	2.2	1.8	2	2.4	2	3	2.4	2.2	2.2	2.8	2.4	2.4	3	3	3

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)
2: Moderate (Medium)
3: Substantial (High) Nocorrelation: "-"

Course Code	Course Title (THEORY COURSE)	Category	L	T	P	C
BA23B16	SERVICES SCIENCE AND SERVICE OPERATIONAL MANAGEMENT	MS	3	0	0	3

Objectives:	
☐	Understand the services and service operations management concepts.
☐	Comprehend the techniques of service operations.
☐	Understand the service quality and service design aspects.
☐	Understand the service innovation aspects.
☐	To analyze how services are different from products by its characteristics.

UNIT-I	INTRODUCTION	9

Introduction to the course, Introduction to service operations, Role of service in economy and society, Introduction to Indian service sector. Nature of Services and Service Encounters: Differences between services and operations, Service package, characteristics, various frameworks to design service operation system, Kind of service encounter, importance of encounters. Service-Dominant Logic: From Goods-Dominant logic to Service-Dominant logic, Value co-creation.

UNIT-II	SERVICE STRATEGY AND COMPETITIVENESS	10

Development of Strategic Service Vision (SSV), Data Envelopment Analysis-New Service Development: NSD cycle, Service Blueprinting, Elements of service delivery system - Service Design: Customer Journey and Service Design, Design Thinking methods to aid Service Design Locating facilities and designing their layout: models of facility locations (Huff's retail model), Role of service-scape in layout design - Service Quality: SERVQUAL, Walk through Audit, Dimensions of Service quality & other quality tools.

UNIT-III	SERVICE GUARANTEE & SERVICE RECOVERY	8

Service quality GAP analysis, Service guarantee-Service encounter-service profit chain.

UNIT-IV	FORECASTING DEMAND FOR SERVICES	9

Types of demand forecasting methods for Managing Capacity and Demand: Strategies for matching capacity and demand, managing waiting line in services. Managing Facilitating Goods: inventory models, Role of inventory in services - Managing service supply relationship: Understanding the supply chain, Strategies for managing suppliers of service - Vehicle Routing Problem: understanding services that involve transportation of people and vehicle.

UNIT-V	SERVICE INNOVATION	9

Services Productivity, Need for Services Innovation, service innovation in different service sector – educational, health and hospitality sectors.

	Total Contact Hours	:	45

Course Outcomes:	
On completion of the course, the students will be able to	
☐	Understand concepts about services and distinguish it from goods.
☐	Able to identify characteristics and nature of services.
☐	Comprehend ways to design services and evaluate them using service qualities.
☐	Understand how various methods can be used to operate and manage service businesses.
☐	Understand how innovation can be approached from services point of view.

Text Book (s):	
1	Fitzsimmons & Fitzsimmons, "Service Management: Operations, Strategy, Information Technology", 7th Edition ,McGrawHill publications, 2017.
2	Christopher H.Lovelock and JochenWirtz, "Services Marketing", 7th Edition ,Pearson Education, New Delhi, 2011.
3	Richard Metters, Karthryn King-Metters, Madeleine pullman, Steve Walton, "Successful Service Operations Management", 2nd Edition ,South-Western, Cengage Learning, 2008.
4	Cengiz Haksever, Barry Render, Roberta S Russell, Pobert G Mirdick, "Service Management and Operations", 2nd Edition, Pearson Education, 2000.

	Reference Books(s) :
1	Wilson, A., Zeithaml, V. A., Bitner, M. J., & Gremler, D. D., " Services marketing: Integrating customer focus across the firm", McGraw Hill, 2012
2	Lovelock, C,Services, " Marketing", Pearson Education India, 7th Edition ,2011.
3	Robert Johnson, Graham clark, "Service Operations Management", Pearson Education, 2nd Edition, 2005.
4	Reason, Ben, and Lovlie, Lavrans, "Service Design for Business: A Practical Guide to Optimizing the Customer Experience", Pan Macmillan India, 2016.
5	Chesbrough, H, "Open Services Innovation: Rethinking Your Business To Grow and Compete in a New Era". John Wiley & Sons, 2010.

CO - PO – PSO matrices of course

PO-PSO \ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BA23B16.1	-	1	1	1	1	1	1	-	1	1	3	2	2	-	3
BA23B16.2	1	1	1	1	3	1	1	1	1	1	2	2	2	-	3
BA23B16.3	2	1	1	1	1	1	2	1	1	1	2	2	2	-	3
BA23B16.4	1	1	1	2	1	1	1	1	1	1	2	1	2	-	3
BA23B16.5	1	1	2	1	2	2	1	2	1	1	2	2	2	-	3
Average	1	1	1.2	1.2	1.6	1.2	1.2	1	1	1	2.2	1.8	2	-	3

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)
2: Moderate (Medium)
3: Substantial (High) Nocorrelation: "-"

Course Code	Course Title (LAB ORIENTED THEORY COURSE)	Category	L	T	P	C
CB23C11	COGNITIVE SCIENCE AND ANALYTICS	PE	3	0	0	3

Objectives:
• Introduction to cognitive science, psychology, nervous system and brain.
• Understand brain and sensory motor information, representation of sensory information.
• Analyze from sensation to cognition; Roots of cognitive science.
• Develop language and embodiment.
• Implement affordances in biological and artificial systems, cognitive development.

UNIT-I	INTRODUCTION TO THE STUDY OF COGNITIVE SCIENCES	9

Introduction to the study of cognitive sciences - A brief history of cognitive science - Methodological concerns in philosophy - Artificial intelligence and psychology - Structure and constituents of the brain - Brief history of neuroscience - Mathematical models - Looking at brain signals - Processing of sensory information in the brain.

UNIT-II	COGNITIVE MODELS	9

Brain Imaging - FMRI, MEG - PET, EEG - Multisensory integration in cortex - Information fusion - From sensation to cognition – Cybernetics - From physics to meaning, Analog vs. Digital: Code duality.

UNIT-III	LINGUISTIC KNOWLEDGE	9

Linguistic knowledge: Syntax, semantics, (and pragmatics) - Generative linguistic - Brain and language - Language disorders – Lateralization - The great past tense debate - Cognitivist and emergent stand points - A robotic perspective.

UNIT-IV	AFFORDANCES	9

Direct perception - Ecological Psychology - Affordance learning in robotics - Child and robotic development - Attention and related concepts - Human visual attention - Computational models of attention - Applications of computational models of attention.

UNIT-V	CATEGORIES AND CONCEPTS	9

Logic; Machine learning - Constructing memories - Explicit vs. implicit memory - Information processing (three-boxes) model of memory - Sensory memory; Short term memory – Long term memory; Rationality - Bounded rationality; Prospect theory; Heuristics and biases - Reasoning in computers - Key points in social cognition - Context and social judgment; Schemas; Social signals.

		Total Contact Hours	:	45

Course Outcomes:
On completion of the course, the students will be able to
☐   Know introduction to cognitive science, psychology, nervous system and brain.
☐   Understand brain and sensory motor information, representation of sensory information.
☐   Analyse from sensation to cognition; Roots of Cognitive Science.
☐   Implement affordances in biological and artificial systems, cognitive development.
☐   Make attention, learning, memory, reasoning, social cognition.

Text Book (s):	
1	Pradeep Kumar Mallick, Samarjeet Borah," Emerging Trends and Applications in Cognitive Computing", IGI Global Publishers, 2019.

Reference Books(s) :	
1	Jose Luis Bermudez, "Cognitive Science: An Introduction to the Science of the Mind", Cambridge University Press, New York, 2020.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CB23C11.1	3	3	1	0	2	1	1	1	1	0	2.2	1	2	1	1
CB23C11.2	2	2	1	0	2	1	2	0	0	0	2	2	1	1	1
CB23C11.3	3	3	1	0	3	0	1	0	0	0	3	1	2	3	2
CB23C11.4	2	3	0	0	2	1	1	1	0	0	2	2	2	2	3
CB23C11.5	2	2	2	2	3	0	1	2	0	0	3	3	3	3	3
Average	2.4	2.4	1.0	2.0	2.4	0.6	1.2	0.8	0.2	0.0	2.0	1.8	2.0	2.0	2.0

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High) Nocorrelation: "-"

Course Code	Course Title (LAB ORIENTED THEORY COURSE)	Category	L	T	P	C
CB23C31	IMAGE PROCESSING AND PATTERN RECOGNITION	PE	2	0	2	3

Objectives:	
▢	To learn the fundamentals of image formation and formats.
▢	To understand the intensity transformations and filtering techniques.
▢	To acquire knowledge on image segmentation operations.
▢	To learn the feature extraction and image registration process.
▢	To understand the components of colour image processing.

UNIT-I	INTRODUCTION AND IMAGE FORMATION	6
Introduction - Image processing systems and its applications - Basic image file formats. **Image formation:** Geometric and photometric models; Digitization - sampling, quantization; Image definition and its representation, neighborhood metrics.		
UNIT-II	**INTENSITY TRANSFORMATIONS AND SPATIAL FILTERING**	**6**
Enhancement, contrast stretching, histogram specification, local contrast enhancement; Smoothing, linear and order statistic filtering, sharpening, spatial convolution, Gaussian smoothing, DoG, LoG- Morphological Filtering Basics - Dilation and Erosion Operators, Top Hat Filters.		
UNIT-III	**IMAGE SEGMENTATION**	**6**
Pixel classification; Grey level thresholding, global/local thresholding; Optimum thresholding - Bayes analysis, Otsu method; Derivative based edge detection operators, edge detection/linking, Canny edge detector; Region growing, split/merge techniques, line detection, Hough transform.		
UNIT-IV	**FEATURE EXTRACTION AND IMAGE REGISTRATION**	**6**
Textural features - gray level co-occurrence matrix; Moments; Connected component analysis; Convex hull; Distance transform, medial axis transform, skeletonization/thinning, shape properties. Mono-modal/multimodal image registration; Global/local registration; Transform and similarity measures for registration; Intensity/pixel interpolation.		
UNIT-V	**COLOUR IMAGE PROCESSING**	**6**
Fundamentals of different Colour models - RGB, CMY, HSI, YCbCr, Lab; False Colour; Pseudo Colour; Enhancement.		

	Total Contact Hours	:	30

List of Experiments	
1	In a security system, images captured in low-light conditions often lack sufficient contrast, making it challenging to identify individuals or objects. Process these images to improve their visibility and uniformity by applying Histogram Equalization to enhance the contrast of a low-light image and perform Histogram Mapping ensuring uniform appearance across the image set.
2	You are working on an image processing application for a surveillance system. Images captured by the system are often noisy due to environmental factors like low light or weather conditions. Enhance the quality of these images by smoothing to reduce noise and sharpening to enhance the details and edges to highlight key features like faces, objects, or text.
3	You are working on a document scanning and processing application. The scanned documents often have noise, broken characters, or extra small dots. Clean up the binary images by performing morphological operations such as erosion, dilation, opening, and closing.
4	You are developing an image processing module for a smart traffic monitoring system. The module needs to identify the edges of vehicles, roads, and obstacles from images captured by cameras to assist in object detection and boundary recognition. Perform edge detection using the Sobel, Prewitt and Roberts gradient-based operators

5	You are working on an autonomous vehicle navigation system. The system uses cameras to capture real-time images of the road and its surroundings. To ensure accurate object detection, you need to implement an edge detection algorithm to identify clear boundaries of objects such as lanes, vehicles, and pedestrians. Apply the Canny Edge Detection technique to detect object boundaries
6	You are developing an application for texture analysis in medical imaging, where accurate characterization of textures is critical for diagnosing diseases. For instance, detecting patterns in MRI or CT scan images can help identify tumors or abnormalities. To achieve this, calculate the Gray-Level Co-occurrence Matrix (GLCM) of the given image to extract texture features like contrast, energy, homogeneity, and correlation.
7	You are working on a satellite imaging project where images of the same geographical area are captured at different times or angles. Due to variations in camera orientation, scale, or movement, the images may not align properly. To analyze these images effectively perform image registration to align them accurately.
8	You are developing an application for digital image editing, where users can manipulate images for various purposes like artistic effects, analysis, or optimization. To provide functionality for color adjustments, convert the image between different color models (e.g., RGB, HSV, LAB, and Grayscale) so that users can work with their preferred color space for specific tasks, such as brightness adjustment, hue manipulation, or edge detection. Convert the image from RGB to Grayscale, HSV (Hue, Saturation, Value), LAB (Luminance, A, B).
9	You are working on an image processing application for analyzing scientific images, such as medical scans or thermal images, where the original images are in grayscale. The grayscale images may lack sufficient contrast, making it difficult to distinguish key features or anomalies. To enhance visual interpretation, apply pseudo-coloring to the grayscale images, mapping intensity values to color scales, thus improving the visual representation of different regions in the image.
10	You are working on an image enhancement application for analyzing satellite images, where specific features such as water bodies, forests, or urban areas need to be highlighted. In such images, the intensity values of different regions can vary significantly. To enhance the visibility of specific regions of interest, apply the Intensity Slicing technique to slice the intensity levels of the image, mapping certain intensity ranges to specific grayscale or color values for better feature identification
11	You are developing a wildlife monitoring system using camera traps to capture images of animals in their natural habitat. The system needs to automatically detect the faces of animals in these images and classify the type of animal based on facial features. Perform face detection on each image to locate the animal's face using a suitable face detection algorithm

		Contact Hours	:	**30**
		Total Contact Hours	:	**60**

Course Outcomes:	
On completion of the course, the students will be able to	
☐	Be familiar with the fundamentals of image formation and formats.
☐	Perform image transformation functions and filtering operations.
☐	Apply the segmentation techniques on the images.
☐	Extract the features of an image and perform image registration.
☐	Able to do colour image processing and conversion operations.

Text Books	
1	R. C. Gonzalez and R. E. Woods, "Digital Image Processing",4th Edition, Pearson,2018.
2	Maria Petrou and Panagiota Bosdogianni, "Image Processing: The Fundamentals ",Second Edition, John Wiley & Sons, Ltd,2010.
3	K. R. Castleman, "Digital Image Processing", First Edition ,Prentice Hall, Englewood Cliffs,1995.

Reference Books	
1	A. Blake and A. Zisserman, "Visual Reconstruction", MIT Press, Cambridge. https://doi.org/10.7551/mitpress/7132.001.0001
2	A. N. Netravali and B. G. Haskell, "Digital Pictures", Plenum Press, 2nd Edition, 1995
3	A. B. Watson, "Digital Images and Human Vision", MIT Press, Cambridge, 1993.

CO - PO – PSO matrices of course

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CB23C31.1	1	1	1	1	1	-	-	-	-	-	-	1	2	2	-
CB23C31.2	3	3	3	3	3	1	1	1	-	-	-	1	3	3	-
CB23C31.3	3	3	3	3	3	1	1	1	-	-	-	1	3	3	-
CB23C31.4	3	3	3	3	3	1	1	1	-	-	-	1	3	3	-
CB23C31.5	3	3	3	3	3	1	1	1	-	-	-	1	3	3	-
Average	2.6	2.6	2.6	2.6	2.6	0.8	0.8	0.8	-	-	-	1	2.8	2.8	-

Note: Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)If there is no correlation, put "-"

Course Code	Course Title (THEORY COURSE)	Category	L	T	P	C
CB23C12	**GENERATIVE ARTIFICIAL INTELLIGENCE**	PE	3	0	0	3

Objectives:	
●	Understand the basics of Generative AI.
●	Know the basics of Text Generation.
●	Understand the process of generating videos.
●	Know about GAN and its variants.
●	Understand and Apply Gen AI tools.

UNIT-I	**INTRODUCTION TO GENERATIVE AI**	9

Historical Overview of Generative modeling - Difference between Gen AI and Discriminative Modeling – Importance of generative models in AI and Machine Learning – Types of Generative models – GANs, VAEs, autoregressive models and Vector quantized Diffusion models - Understanding if probabilistic modeling and generative process - Challenges of Generative Modeling – Future of Gen AI – Ethical Aspects of AI – Responsible AI – Use Cases.

UNIT-II	**GENERATIVE MODELS: TEXT**	9

Language Models Basics – Building blocks of Language models - Transformer Architecture – Encoder and Decoder – Attention mechanisms - Generation of Text – Models like BERT and GPT models – Generation of Text - Autoencoding – Regression Models – Exploring ChatGPT – Prompt Engineering – Designing Prompts– Revising Prompts using Reinforcement Learning from Human Feedback (RLHF) - Retrieval Augmented Generation – Multimodal LLM – Issues of LLM like hallucination.

UNIT-III	**GENERATION OF IMAGES**	9

Introduction to Generative Adversarial Networks – Adversarial Training Process – Nash Equilibrium – Variational Autoencoders – Encoder-Decoder Architectures - Stable Diffusion Models – Introduction to Transformer-based Image Generation – CLIP – Visual Transformers ViT- Dall-E2 and Dall-E3, GPT-4V – Issues of Image Generation models like Mode Collapse and Stability.

UNIT-IV	**GENERATION OF PAINTING, MUSIC, AND PLAY**	9

Variants of GAN – Types of GAN - Cyclic GAN – Using Cyclic GAN to Generate Paintings – Neural Style Transfer – Style Transfer - Music Generating RNN – MuseGAN – Autonomous agents – Deep Q Algorithm – Actor-critic Network.

UNIT-V	**OPEN-SOURCE MODELS AND PROGRAMMING FRAMEWORKS**	9

Training and Fine tuning of Generative models – GPT4All - Transfer learning and Pretrained models - Training vision models – Google Copilot - Programming LLM – LangChain – Open Source Models – Llama - Programming for TimeSformer – Deployment – Hugging Face.

Total Contact Hours	:	45

Activities

- Comparing Generative and Discriminative Models
- Fine-Tuning GPT for Custom Text Generation
- Prompt Engineering with ChatGPT
- Image Generation using GAN
- Exploring DALL-E for Image Generation
- Neural Style Transfer for Artistic Image Generation
- Music Generation Using MuseGAN
- Fine-Tuning GPT-4All for Domain-Specific Text Generation
- Deploying a Generative AI Model Using Hugging Face

Course Outcomes:	
On completion of the course, the students will be able to	
•	Understand the concepts of Generative Modelling.
•	Apply Gen AI to Generate Texts.
•	Understand and Apply Gen AI for generating video.
•	Understand and Apply Gen AI for generating video.
•	Apply Open Source Tools for solving problems using Gen AI.

Text Book (s):	
1	Denis Rothman, "Transformers for Natural Language Processing and Computer Vision", Third Edition , Packt Books024.
2	David Foster,"Generative Deep Learning",Second Edition, O'Reily Books, 2024.

Reference Books(s):	
1	J. D. Garofolo, Practical AI with Generative AI: Creating Intelligent Solutions with Machine Learning, 1st Edition, Packt Publishing, 2023.

CO - PO – PSO matrices of course

COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CB23C12.1	3	3	3	1	2	2	-	1	2	-	-	2	3	3	3
CB23C12.2	3	3	3	1	2	2	-	1	2	-	-	2	3	3	3
CB23C12.3	3	3	3	1	2	2	-	1	2	-	-	2	3	3	3
CB23C12.4	3	3	3	1	2	2	-	1	2	-	-	2	3	3	3
CB23C12.5	3	3	3	1	2	2	-	1	2	-	-	2	3	3	3
AVG	3	3	3	1	2	2	-	1	2	-	-	2	3	3	3

Note: Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)If there is no correlation, put "-".

Course Code	Course Title (Lab Oriented Theory Course)	Category	L	T	P	C
CB23C32	CONVERSATIONAL SYSTEMS	PE	2	0	2	3

Objectives:	
☐	To be familiar with the basic knowledge about conversational systems.
☐	To understand the different techniques of natural language processing
☐	To learn the working knowledge of a chatbot and the prerequisite knowledge.
☐	Study the fundamental role of machine learning in building conversational systems.
☐	To know the various applications of conversational systems and its future developments.

UNIT-I	FUNDAMENTALS OF CONVERSATIONAL SYSTEMS	6
Overview, Explanation about different modes of engagement for a human being, History and impact of AI - Underlying technologies: Natural Language Processing, Artificial Intelligence and Machine Learning, Natural Language Generation, Speech-To-Text, Text-To-Speech, Computer Vision. Introduction to Top players in Current Market –Messaging Platforms. Ethical and Legal Considerations in AI Overview.		
UNIT-II	NATURAL LANGUAGE PROCESSING	6
Introduction: Brief history, Basic Concepts, Phases of NLP, Application of chatbots. General chatbot architecture, Basic concepts in chatbots: Intents, Entities, Utterances, Variables and Slots, Fulfilment. Lexical Knowledge Networks(WordNet, Verbnet, PropBank, etc). Lexical Analysis, Part-of-Speech Tagging, Parsing/Syntactic analysis, Semantic Analysis, Word Sense Disambiguation. Information Extraction, Sentiment Analysis.		
UNIT-III	BUILDING A CHATBOT/CONVERSATIONAL AI SYSTEMS	6
Fundamentals of Conversational Systems (NLU, DM and NLG) - Chatbot framework & Architecture, ConversationalFlow & Design, Intent Classification (ML and DL based techniques), Dialogue Management Strategies, NaturalLanguage Generation - UX design, APIs and SDKs, Usage of Conversational Design Tools - Introduction to popularchatbot frameworks – Google Dialog flow, Microsoft Bot - Framework, Amazon Lex, RASA Channels: FacebookMessenger, Google Home, Alexa, WhatsApp, Custom Apps - Overview of CE Testing techniques, A/B Testing,Introduction to Testing Frameworks - Botium /Mocha ,Chai Security & Compliance – Data Management, Storage, GDPR, PCI.		
UNIT-IV	ROLE OF ML/AI IN CONVERSATIONAL TECHNOLOGIES	6
Understanding on how conversational systems uses ML technologies in ASR, NLP - Advanced Dialog management - Language Translation - Emotion/Sentiment Analysis - Information extraction to effectively converse.		
UNIT-V	CONVERSATIONAL ANALYTICS AND THE FUTURE OF COVERSATIONAL SYSTEMS	6
Introduction to contact centers – Impact & Terminologies - Case studies & Trends, How does a Virtual Agent/Assistant fit in here? - Conversation Analytics: The need of it. Introduction to Conversational Metrics - Summary, Robots and Sensory Applications overview - XR Technologies in Conversational Systems , XR-Commerce - What to expect next? –Future technologies and market innovations overview.		
	Contact Hours	:	30

List of Experiments	
1	A python program to identify morphological features of a word by analyzing it.
2	A python program to generate word forms from root and suffix information.
3	A python program to perform morphological analysis of a word by the use of Add-Delete table.
4	A python program to calculate the bigrams from a given corpus and calculate probability of a sentence.

5	A python program to do sentiment analysis for the given dataset and to classify sentences based on their categories.
6	A python program to find Parts – Of - Speech tags of words in a sentence.
7	A python program to know the importance of context and size of training corpus in learning Parts of Speech and understand the concept of chunking and get familiar with the basic chunk tagset.
8	A python program to detect the entities from the dataset and tag them based on their categories.
9	A python program to build a Neural Network to recognize handwritten digits using MNIST dataset.
10	A python program to build a Recurrent Neural Model with Keras.
11	Formulate a problem statement for mini-project to build a chatbot for an application that proves its importance from a social perspective.

	Contact Hours	:	30
	Total Contact Hours	:	75

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

☐	Will be familiar with the basic technologies required for building a conversational system.
☐	Will be familiar with the NLTK tool kit and the pre-processing techniques of natural language processing.
☐	Build a chatbot for any application and deploy it.
☐	Involve AI in building conversational system and build advanced systems that can be cognitively inclined towards human behaviour.
☐	Will be able build a real time working conversational system for social domain that can intelligently process inputs and generate relevant replies.

Reference Books

1	Michael McTear, "Conversational AI: Dialogue Systems, Conversational Agents, and Chatbots", Second Edition, Moran and Claypool Publishers, 2020.
2	Cathy Pearl, "Designing Voice User Interfaces: Principles of Conversational Experiences", O'REILLY, 2016.

CO - PO – PSO Matrices of Course

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CB23C32.1	3	3	1	0	2	1	1	1	1	0	2.2	1	2	1	1
CB23C32.2	2	2	1	0	2	1	2	0	0	0	2	2	1	1	1
CB23C32.3	3	3	1	0	3	0	1	0	0	0	3	1	2	3	2
CB23C32.4	2	3	0	0	2	1	1	1	0	0	2	2	2	2	3
CB23C32.5	2	2	2	2	3	0	1	2	0	0	3	3	3	3	3
Average Mapping	2.4	2.4	1.0	2.0	2.4	0.6	1.2	0.8	0.2	0.0	2.0	1.8	2.0	2.0	2.0

Note: Enter correlation levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)If there is no correlation, put "-"

Course Code	Course Title	Category	L	T	P	C
CB23C33	**ALGORITHMIC BUSINESS THINKING**	**PE**	**3**	**0**	**0**	**3**

Objectives:
• To equip students with the knowledge and skills necessary for analyzing and solving business problems using algorithmic approaches.
• To familiarize students with machine learning techniques and their applications in predictive modeling and business analytics.
• To familiarize students with optimization algorithms and their applications in resource allocation, scheduling, and logistics.
• To provide students with practical knowledge and skills in modeling and analyzing business processes.
• To foster critical thinking and ethical awareness in the application of algorithmic techniques in business contexts.

Unit -1 Foundations of Algorithmic Business Thinking	**9**
Introduction to Algorithmic Business Thinking-Overview of algorithms-Understanding computational complexity-Introduction to data structures-Algorithm Design Techniques.	
Unit-2 Data Analytics and Decision-Making	**9**
Data Analytics Fundamentals-Statistical Analysis for Decision Making-Machine Learning Fundamentals-Business Applications of Data Analytics-Ethical Considerations in Data Analytics.	
Unit-3 Optimization Techniques	**9**
Linear Programming-Integer Programming-Optimization Algorithms.	
Unit 4: Business Process Modelling	**9**
Process Simulation Techniques-Business Process Automation-Business Process Reengineering-Agile Business Process Management	
Unit 5: Algorithmic Strategy and Ethical Implications	**9**
Algorithmic Decision-Making in Finance-Algorithmic Bias and Fairness-Algorithmic Accountability and Transparency-Social Impacts of Algorithmic Systems.	
Total Contact Hours:45	

Course Outcomes:
On completion of the course students will be able to
• Develop the ability to model and optimize business processes using algorithmic techniques.
• Apply statistical methods and machine learning algorithms to extract actionable insights from data.
• Gain proficiency in implementing and analyzing optimization algorithms to optimize business processes.
• Able to analyze and optimize business processes using algorithmic approaches and simulation techniques.
• Gain insights into the strategic use of algorithms in business decision-making through case studies and discussions.

Text Books:
1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein "Introduction to Algorithms", 4th Edition, Peason,2022.
2. Foster Provost and Tom Fawcett,"Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking" O Reilly, 2013.
3. Frederick S. Hillier and Gerald J. Lieberman, "Introduction to Operations Research", Eleventh Edition, Stanford University,2019.
4. Manuel Laguna and Johan Markland,"Business Process Modeling, Simulation and Design", Third Edition, Peason,2018.
5. Kord Davis and Doug Patterson, "Ethics of Big Data: Balancing Risk and Innovation", O'Reilly, 2013.

Reference Books:
1. Peter Bruce, Andrew Bruce, Peter Gedeck,"Practical Statistics for Data Scientists", 2nd Edition, O'Reilly, 2020.
2. Marlon Dumas, Marcello La Rosa, Jan Mendling, Hajo A. Reijers,"Fundamentals of Business Process Management", Springer Berlin Heidelberg, 2013.
3. Barry Johnson,"Algorithmic Trading and DMA: An introduction to direct access trading strategies", 2010.

CO – PO – PSO matrices of course

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High) If there is no correlation, put "- "

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CB23C33.1	3	-	-	-	-	-	-	-	-	-	-	1	3	2	2
CB23C33.2	2	3	2	2	-	-	-	2	-	-	-	1	3	3	1
CB23C33.3	2	3	2	2	-	-	-	-	-	-	-	1	3	3	1
CB23C33.4	2	3	2	2	-	-	-	-	-	-	-	1	3	3	1
CB23C33.5	1	2	2	2	-	-	-	2	-	-	1	1	3	3	1
Average	2	2.75	2	2	-	-	-	2	-	-	1	1	3	2.8	1.2

Course Code	Course Name (Lab oriented Theory Courses)	Category	L	T	P	C
AI23632	NATURAL LANGUAGE PROCESSING	PE	3	0	2	4

Objectives:

•	To introduce the fundamental concepts of Natural Language Processing (NLP for analysing words based on statistical measures and CORPUS.
•	To understand the principles of morphological analysis and language modeling using finite state machines and n-gram models.
•	To explore vector semantics and learn how to represent words and their relationships through embeddings and similarity measures.
•	To analyze and implement Hidden Markov Models (HMMs) and their applications in Part-Of-Speech (POS) tagging
•	To study the architecture of transformers and large language models, including pre-training and evaluation techniques.

UNIT-I	INTRODUCTION TO NATURAL LANGUAGE PROCESSING	9

Introduction to NLP - Various stages of NLP –NLP Pipeline, The Ambiguity of Language: Parts of Speech, Phrase Structure. Statistics Essential Information Theory: Entropy, perplexity, The relation to language: Cross entropy, Text Prepossessing: Character Encoding, Word Segmentation, Sentence Segmentation, Introduction to Corpora, Corpora Analysis

UNIT-II	MORPHOLOGY AND LANGUAGE MODELLING	9

Inflectional and Derivation Morphology, Morphological analysis and generation using Finite State Automata and Finite State transducer.Bag of words, skip-gram, Continuous Bag-Of-Words, N gram model, n -gram Models over Sparse Data: Bins: Forming Equivalence Classes- - Statistical Estimators- Combining Estimators

UNIT-III	VECTOR SEMANTICS AND EMBEDDINGS	9

Lexical Semantics-Vector Semantics-Words and Vectors-Cosine for measuring similarity- TF-IDF: Weighing terms in the vector- Pointwise Mutual Information (PMI) -Applications of the TF-IDF or PPMI vector models- Word2vec -Visualizing Embeddings-Semantic properties of embeddings-Bias and Embeddings-Evaluating Vector Models

UNIT-IV	MARKOV MODEL AND POS TAGGING	9

Markov Model: Hidden Markov model, Three Fundamental questions of HMM, Implementation properties, and Variants of HMMs, Multiple input observation. **POS**: The Information Sources in Tagging: Markov model taggers, Viterbi algorithm, Applying HMMs to POS tagging, Applications of Tagging.

UNIT-V	TRANSFORMERS AND LARGE LANGUAGE MODELS	9

The Transformer - Attention-Transformer Blocks- Parallelizing computation using a single matrix X , The input: embeddings for token and position-The Language Modeling Head - Large Language Models : Large Language Models with Transformers -Sampling for LLM Generation -Pretraining Large Language Models -Evaluating Large Language Models

		Contact Hours	:	45

	List of Experiments
1.	Develop a morphological analyzer to process and analyze various sentence structures, including interrogative, declarative, and complex sentences with conjunctions. Perform word segmentation and sentence segmentation as part of the analysis. **Suggested Dataset/Corpus: Universal Dependencies (UD) English Treebank**
2.	Design a basic NLP pipeline to preprocess raw text data by performing tokenization, sentence segmentation, and part-of-speech (POS) tagging. Automate the pipeline to process large-scale text efficiently. **Suggested Dataset/Corpus: Universal Dependencies (UD) English Treebank**
3.	Implement a Named Entity Recognition (NER) system using Python libraries such as spaCy or NLTK. Utilize a pre-trained model to extract named entities, including people, organizations, and locations, from a text corpus. **Suggested Dataset/Corpus**: **CoNLL-2003 NER Dataset**
4.	Construct unigram, bigram, and trigram models to analyze their performance on sparse data. Compare the language models based on perplexity and their effectiveness in predicting word sequences. **Suggested Dataset/Corpus**: **The Brown Corpus**
5.	Implement n-gram language models (unigram, bigram, trigram, etc.) and apply smoothing techniques like Laplace smoothing to address data sparsity. Evaluate the models on a large text corpus for accuracy and perplexity. **Suggested Dataset/Corpus**: **Google Ngram Dataset**
6.	Design a spelling correction model using a combination of morphological rules and n-gram probabilities. Test the model on a dataset containing deliberately misspelled words and compare it to established spell-check systems. **Suggested Dataset/Corpus**: **Birkbeck Spelling Error Corpus**
7.	Implement the Term Frequency-Inverse Document Frequency (TF-IDF) model and use cosine similarity to compare the similarity between documents in a given corpus. Visualize the similarity matrix for better insight. **Suggested Dataset/Corpus**: **20 Newsgroups Dataset**
8.	Train a Word2Vec model on a given text corpus and visualize the resulting word embeddings using dimensionality reduction techniques like t-SNE or PCA. Analyze the semantic relationships between words in the embeddings. **Suggested Dataset/Corpus**: **Text8 Dataset**
9.	Build a Hidden Markov Model (HMM) for part-of-speech (POS) tagging. Train the model on a tagged corpus and evaluate its accuracy on a test dataset. **Suggested Dataset/Corpus**: **Universal Dependencies (UD) Treebank**
10.	Use a pre-trained Transformer model (e.g., BERT) to build a sentiment analysis model. Fine-tune the model on a dataset of tweets, classify sentiment (positive, neutral, negative), and evaluate its performance using accuracy and F1-score. **Suggested Dataset/Corpus**: **Sentiment140 Dataset**
11	Use a pre-trained language model to perform sentiment analysis or keyword extraction on a dataset of WhatsApp chat data. Analyze the conversational patterns, emotions, and key topics discussed in the chats. **Suggested Dataset/Corpus**: **WhatsApp Chat Export (User-Generated Data)**
12	Implement a question-answering system using a pre-trained BERT model. Input a passage and a question, and use the model to extract the correct answer from the passage. Evaluate the system

	on accuracy and relevance of the answers. **Suggested Dataset/Corpus**: SQuAD (Stanford Question Answering Dataset)
13	**Mini Project** • Choose a Topic: Identify a deep learning problem of interest, such as image classification, text generation, or anomaly detection. • Research related works using platforms like Google Scholar. • Dataset Selection: Find or collect a suitable dataset from sources like Kaggle or UCI. Ensure it is relevant, well-sized, and consider preprocessing requirements. • Develop Methodology: Start with baseline models, then experiment with advanced architectures (e.g., CNNs, Transformers). Use frameworks like TensorFlow or PyTorch. • Implementation & Evaluation: Train models and evaluate performance using appropriate metrics (e.g., accuracy, F1-score). Document findings systematically. • Discuss & Present: Analyze results, highlight challenges, and present your work with clear insights and future directions.

	Contact Hours	:	**30**
	Total Contact Hours	:	**75**

•	Analyze the different stages in the NLP pipeline and perform statistical analysis on the data.
•	Apply morphological analysis techniques and construct n-gram models for language processing.
•	Evaluate the effectiveness of word embeddings and semantic vector models
•	Implement and analyze Hidden Markov Models (HMMs) for Part-Of-Speech (POS) tagging and compare their effectiveness..
•	Design and evaluate transformer-based large language models for text generation and other NLP applications

Textbooks:	
1	Daniel Jurafsky and James H. Martin "Speech and Language Processing", Third Edition, Prentice Hall, 2024
2	T V Geetha ,"Understanding Natural Language Processing" (Machine Learning and Deep Learning Perspectives),First Edition, Pearson,2024

Reference Books:	
1	Christopher D. Manning and HinrichSchutze, "Foundations of Natural Language Processing", 6th Edition, The MIT Press Cambridge, Massachusetts London, England, 2003 2009.
2	Nitin Indurkhya, Fred J. Damerau "Handbook of Natural Language Processing", Second Edition, CRC Press, 2010.
3	James Allen "Natural Language Understanding", Pearson Publication, 8th Edition. 2012
4	Hobson lane, Cole Howard, Hannes Hapke, "Natural language processing in action" MANNING Publications, 2nd edition, 2019.
5	Alexander Clark, Chris Fox, Shalom Lappin, "The Handbook of Computational Linguistics and Natural Language Processing", Wiley-Blackwell, 2016
6	Rajesh Arumugam, Rajalingappa Shanmugamani "Hands-on natural language processing with python: A practical guide to applying deep learning architectures to your NLP application". PACKT publisher, 2018.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
AI23632.1	3	3	2	2	3	2	1	2	2	2	2	3	3	2	2
AI23632.2	3	3	2	2	3	2	1	1	2	2	2	3	3	2	3
AI23632.3	3	3	3	2	3	2	1	2	2	2	2	3	3	3	3
AI23632.4	3	3	3	2	3	2	1	2	2	2	2	3	3	3	2
AI23632.5	3	3	3	3	3	2	1	2	3	3	3	3	3	3	3
Average	3	3	2.6	2	2.2	1	1	1.8	1	1	-	1	3	3	2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low)
2: Moderate (Medium)
3: Substantial (High)
No correlation: "-

Course Code	Course Name (Lab Oriented Theory Course)	Category	L	T	P	C
IT23531	COMPUTER VISION (Common to IT, CSBS, AIML)	PE	3	0	2	4

Objectives:
• Understand the basics of computer vision and its applications
• Understand the basic image processing operations to enhance the image quality
• Develop skills to extract and analyze significant features from images
• Apply various segmentation algorithm to segment images into multiple regions
• Latest advancements and future trends in computer vision are explored for real time applications

UNIT-I	Overview of Computer Vision	9

Image Formation and Representation: Imaging geometry, radiometry, digitization, cameras and Projections, rigid and affine transformation, Computer Vision and its Applications

UNIT-II	Digital Image Processing	9

Pixel transforms, color transforms, histogram processing, histogram equalization, filtering, convolution, Fourier transformation and its applications in sharpening, blurring and noise removal

UNIT-III	Feature Detection	9

Edge detection, corner detection, line and curve detection, active contours, SIFT and HOG descriptors, shape context descriptors, Morphological operations .

UNIT-IV	Segmentation	9

Active contours, split & merge, watershed, region splitting, region merging, graph-based segmentation, mean shift and model finding, Normalized Cut.

UNIT-V	Motion Analysis	9

Background Subtraction and Modeling, Optical Flow, KLT, Spatio Temporal Analysis, Dynamic Stereo, Motion parameter estimation

Total Contact Hours: 45

List of Experiments:
1. Implementing various basic image processing operations Reading image, writing image and conversion of images
2. Implement contrast adjustment of an image.
3. Implement Histogram processing and Equalization.

4. Implement the various low pass and high pass filtering mechanisms
5. Use of Fourier transform for filtering the image.
6. Utilization of SIFT and HOG features for image analysis
7. Implement various image segmentation algorithm
8. Implement optical flow computation algorithm.
9. Face Detection on available online human face image datasets
10. Object Recognition on available online image datasets

Contact Hours : 30
Total Contact Hours :75

Course Outcomes: Students will be able to
• Learn fundamentals of computer vision and its applications
• Understand techniques are available to process the image.
• Understand how to analyze the image and extract required features
• Apply different segmentation techniques to different images
• Understand how computer vision solves real world problems

SUGGESTED EVALUATION METHODS
• Continuous Assessment Test • Online Quiz Assignments • Offline Assignments • Experiment based VIVA

Text Book(s):
1. Rafael C. Gonzalez and Richard E. Woods ,"Digital Image Processing", Fourth Edition, Pearson, 2019.
2. Richard Szeliski , "Computer Vision: Algorithms and Applications", Second Edition, Springer, 2022.
3. "Computer Vision: A Modern Approach", 2nd Edition, Pearson Education, Paperback – 1 January 2015.

Reference Books(s):
1. B Cyganek, "An Introduction to 3D Computer Vision Techniques and Algorithms", 1st edition , John Wiley & Sons , 2009
2. V Kishore Ayyadevara & Yeshwanth Reddy, "Modern Computer Vision with PyTorch", Packt Publishing, 2020.

CO-PO-PSO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IT23531.1	3	–	3	–	3	–	–	–	–	2	–	–	–	–	2
IT23531.2	3	3	3	–	3	2	–	–	–	–	–	3	–	3	2
IT23531.3	3	3	3	–	3	2	–	–	–	2	–	3	–	3	2
IT23531.4	2	3	3	3	3	2	–	1	2	2	–	3	3	3	3
IT23531. 5	3	3	3	3	3	2	2	1	2	2	3	3	3	3	3
Average	2.8	3	3	3	3	2	2	1	2	2	3	3	3	3	2. 4

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

No correlation: "-"

Code	Course Title (Lab oriented Theory Course)	Category	L	T	P	C
CB23D31	**DATA MINING AND ANALYTICS**	PE	3	0	2	4

Objectives:	
•	To introduce the fundamental concept of data mining along with data preprocessing and attribute-oriented analysis
•	To understand the association rules, classification and prediction algorithms
•	To explore and apply the linear models of data analysis
•	To understand and implement non-linear modeling techniques for data analysis
•	To understand the time series analysis and aspects of prescriptive analysis☐

UNIT-I	INTRODUCTION, KNOWLEDGE REPRESENTATION AND DATA PREPROCESSING	9

Introduction: Evolution of Information Technology, Stages of the Data Mining Process, Data Mining Techniques, Knowledge Representation Methods, Applications.
Types of Data Analytics: Descriptive Analytics, Diagnosis Analytics, Predictive Analytics, Prescriptive Analytics and Adaptive/Autonomous Analytics.
Data preprocessing: Data cleaning, Data transformation, Data reduction, Discretization and generating concept hierarchies. Attribute-oriented analysis: Attribute generalization, Attribute relevance, Class comparison, Statistical measures

UNIT-II	ASSOCIATION RULE MINING, CLASSIFICATION AND PREDICTION	9

Association rules: Motivation and terminology, Basic idea: item sets, generating item sets and rules efficiently, Apriori Algorithm, FP Growth Algorithm. Correlation analysis.
Classification: Basic learning/mining tasks, inferring rudimentary rules: 1R algorithm, Decision trees, covering rules.
Prediction: The prediction task, Statistical (Bayesian) classification, Bayesian networks, Instance based methods (nearest neighbor), linear models

UNIT-III	LINEAR MODELS	9

Forecasting models: Heuristic methods, predictive modelling and pattern discovery
Logistic Regression: Logit transform, ML estimation, Tests of hypotheses, Wald test, LR test, score test, test for overall regression, multiple logistic regression, forward, backward method, interpretation of parameters, relation with categorical data analysis. Interpreting Regression Models, Implementing Predictive Models.

UNIT-IV	NON-LINEAR MODELS	9

Non-Linear Regression: Linearization transforms, their uses & limitations, examination of non-linearity, initial estimates, iterative procedures for NLS. Introduction to semiparametric regression models, additive regression models. Introduction to nonparametric regression methods

UNIT-V	TIME SERIES ANALYSIS, LINEAR TIME SERIES MODELS AND PRESCRIPTIVE ANALYTICS	9

Time Series Analysis: Exploratory time series analysis, Test for trend and seasonality, Exponential and moving average smoothing, Holt – Winter smoothing, forecasting based on smoothing.

Linear time series models: Autoregressive, Moving Average, Autoregressive Moving Average and Autoregressive Integrated Moving Average models; Estimation of ARIMA models such as Yule-Walker estimation for AR Processes, Maximum likelihood and least squares estimation for ARIMA Processes, Forecasting using ARIMA models.

Prescriptive Analytics: Mathematical optimization, Networks modeling-Multi-objective optimization-Stochastic modeling, Decision and Risk analysis, Decision trees

	Contact Hours	:	45

List of Experiments	
1	**Data Preprocessing:** Apply various data pre-processing tasks on a dataset from a real domain (Medical/Retail/Banking) using R Analytical tool. Compare the original data with the pre-processed data using Table representation.
2	**Association Rule Mining**: Apply Apriori and FP Growth Association Rule mining algorithms for an appropriate dataset. Visualize the outcome in R
3	**Descriptive Analytics** Analyze the central tendency and dispersion of a dataset (mean, median, variance, etc.). Create visualizations such as histograms, boxplots, and scatterplots for exploratory data analysis (EDA).
4	**Classification** Build the classifiers - Decision Tree, Naïve Bayesian Classifier, NN classifier and SVM. Compare the performance metrics of the above classifiers using a Table.
5	**Predictive Modeling** Use logistic regression to classify binary outcomes (e.g., spam vs. non-spam emails). Implement decision tree algorithms for classification or regression tasks.
6	**Linear Models** (House Price Prediction/Salary Estimation/Stock Market Analysis) Build a linear regression model to predict house prices / employee salaries / stock prices using the given features. Evaluate model fit using metrics like R^2 and mean squared error (MSE).
7	**Non-Linear Models** (Predicting Disease Progression / Customer Purchase Behavior / Fraud Detection in Financial Transactions) Build a non-linear model to predict the disease progression / customer purchase behaviour / fraud in financial transactions using the given features.Evaluate the model using kappa value and ROC-AUC.
8	**Cross-Validation and Model Tuning** Perform k-fold cross-validation for model performance evaluation with hyperparameters tuning. Use R's caret package to automate the process of model selection and optimization.
9	**Opinion Mining on Social Media** Perform opinion mining on customer reviews from e-commerce datasets. Visualize the polarity of sentiments using pie charts or bar plots.
10	**Time Series Analysis** Use the AirPassengers dataset. Decompose the time series into trend, seasonality, and residual components. Fit an ARIMA model to forecast the next 12 months.

Visualize the original and forecasted series.			
	Contact Hours	:	30
	Total Contact Hours	:	75

Course Outcomes:
On completion of the course, the students will be able to
• Understand the fundamentals of data mining, data representation and data preprocessing.
• Perform the association rules, classifications and prediction algorithms.
• Apply linear models for the data sets.
• Build data models using non-linear regression techniques.
• Gain knowledge on time series analysis and prescriptive analysis.

Text Books	
1	Jiawei Han, Micheline Kamber, "Data Mining: Concepts and Techniques", Morgan Kaufmann ,2023
2	Galit Shmueli, Peter C. Bruce, Nitin R. Patel, Kenneth C. Lichtendahl Jr.," Data Mining for Business Analytics: Concepts, Techniques, and Applications with XLMiner",4th Edition ,Wiley 2023..
3	Lior Rokach and Oded Maimon, "Data Mining and Knowledge Discovery Handbook", Second Edition,Springer, 2010.
4	Ian H. Witten, Eibe Frank and Mark A. Hall "Data Mining: Practical Machine Learning Tools and Techniques", Fourth Edition, Elsevier, 2017

Reference Books	
1	Draper, N. R. and Smith, H., "Applied Regression Analysis", Third Edition, John Wiley, 1998.
2	Hosmer, D. W. and Lemeshow, S., "Applied Logistic Regression", Third Edition, Wiley, 2003.
3	Daniel T.Larose, "Data Mining Methods and Models", Wiley-Interscience, 2006.
4	Jason Brownlee "Machine Learning Mastery with Weka" ,2020.
5	http://garfield.library.upenn.edu/classics1989/A1989AV48500001.pdf

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CB23D31.1	3	3	1	0	2	1	1	1	1	0	2.2	1	2	1	1
CB23D31.2	2	2	1	0	2	1	2	0	0	0	2	2	1	1	1
CB23D31.3	3	3	1	0	3	0	1	0	0	0	3	1	2	3	2
CB23D31.4	2	3	0	0	2	1	1	1	0	0	2	2	2	2	3
CB23D31.5	2	2	2	2	3	0	1	2	0	0	3	3	3	3	3
Average Mapping	2.4	2.4	1.0	2.0	2.4	0.6	1.2	0.8	0.2	0.0	2.0	1.8	2.0	2.0	2.0

Note: Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) If there is no correlation, put "-"

Course Code	Course Title	Category	L	T	P	C
CB23D32	DECISION SUPPORT SYSTEMS	PE	3	0	2	4

Objectives:
• To learn about foundations, various phases and technologies of decision making.
• To learn the models of decision making and expert systems.
• To learn in detail about knowledge management systems in DSS.
• To identify the use of DSS using AI in Intelligent decision support systems.
• To understand various tools used in the development of DSS and its applications.

UNIT-I	DECISION MAKING AND ANALYTICS	9

Foundations and Technologies for Decision Making – Introduction – Phases of Decision-Making Process – The Intelligence phase– Design Phase – Choice Phase – Implementation Phase – Decision Support System Capabilities – Classification – Components of Decision Support System.

UNIT-II	DECISION-MAKING MODELING AND AUTOMATED DECISION SYSTEMS	9

Model based decision making – DSS modeling – Structure – Certainty, Uncertainty and Risk –Fuzzy logic-Decision modeling with spreadsheets – Decision analysis with decision tables and trees – Automated Decision Systems and Expert Systems – Basic concepts of expert systems – Structure of expert systems – Knowledge engineering – Development of Expert system.

UNIT-III	KNOWLEDGE MANAGEMENT SYSTEMS IN DSS	9

Introduction to Knowledge Management- Knowledge Management Concepts and Definitions-Approaches to Knowledge Management-The Process Approach to Knowledge Management-The Practice Approach to Knowledge Management-Hybrid Approaches to Knowledge Management-Information Technology (IT) in Knowledge Management-The KMS Cyder, Components of KMS, Technologies That Support Knowledge Management, Knowledge Making Decisions in Groups: Characteristics, Process, Benefits, and Dysfunctions, Characteristics of Groupwork-The Group Decision-Making Process, The Benefits and Limitations of Groupwork.

UNIT-IV	INTELLIGENT DECISION SUPPORT SYSTEMS	9

Artificial Intelligence -AI Paradigms; IDSS Typology-Classification of IDSS. Model-Driven IDSSs, Data-Driven IDSSs. Conceptual Components of an IDSS-Considerations and Requirements of an IDSS-IDSS Architecture-IDSS Analysis, Design, and Development-IDSS Evaluation-Development of an IDSS: Case Study.

UNIT-V	DEVELOPMENT AND APPLICATION OF IDSS	9

Tools for IDSS Development-Introduction-Tools for Data-Driven Methods -Tools for Model-Driven Techniques- Agent-Based Simulation Tools, Expert-Based Model Tools, Model-Based Reasoning Tools, Qualitative Reasoning Tools; General Development Environments.

	Total Contact Hours	:	45

Course Outcomes:

On completion of the course, the students will have the ability to

•	Understand foundations, various phases and technologies for decision making.
•	Build models for decision making and expert systems.
•	Apply decision making in knowledge management systems.
•	Analyze the use of DSS in Intelligent decision support systems.
•	Apply various types of tools in applications of DSS.

List of Experiments	
1	Installation of IDSS Development Tools (RapidMiner).
2	Implement a Data Driven DSS to predict future events for sales systems.
3	Implementation of decision tree and decision table using given dataset.
4	Build a model for a scheduling software in decision support systems.
5	Predict consumer decisions with Choice-Based Conjoint experiments.
6	Implement decision making support systems to visualize the below data from supply chain dataset. i)Total Expenditure of month. ii)Category Expenditure. iii)Supplier Performance. iv)Contracted and Non-Contracted supplier ratio.
7	Analyse clinical data using decision support systems to diagnose and plan treatment for patients.
8	Implement spatial decision support system using GIS.
9	Neuro-Fuzzy decision support system to predict best suitable crop on basis of soil and weather parameters using R.
10	Development of a prototype web-based decision support system for watershed management using SWAT (Soil and Water Assessment Tool).
	Contact Hours : 30
	Total Contact Hours : 75

Text Book (s):	
1	Miquel Sànchez-Marrè , "Intelligent Decision Support Systems", Springer,2022.
2	Ramesh Sharda, Dursun Delen, Efraim Turban, "Business Intelligence and Analytics Systems for Decision Support",10th Edition, Pearson Education, 2018.

Reference Books(s) / Web links:	
1	Marakas,"Decision Support Systems: In the 21st Century", Prentice Hall, 2013.
2	Efraim Turban, "Decision Support Systems and Intelligent System", Seventh Edition, PHI, 2007.
3	Daniel P Loucks and Joao R da Costa, "Decision Support Systems: Water Resources Planning", Springer Science & Business Media, 2013.

CO-PO-PSO Matrices of Course

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CB23D32.1	3	3	2	1	2	2	1	1	2	2	2	3	2	1	1
CB23D32.2	3	3	3	2	3	1	1	2	2	2	2	2	2	2	2
CB23D32.3	3	2	2	2	3	1	2	1	2	3	3	2	1	2	2
CB23D32.4	2	3	2	3	3	3	2	2	2	2	2	2	2	2	2
CB23D32.5	2	2	2	2	3	1	2	2	2	2	2	3	1	2	3
Average Mapping	2.6	2.6	2.2	2	2.8	1.6	1.6	1.6	2	2.2	2.2	2.4	1.6	1.8	2

Note: Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low)
2: Moderate (Medium)
3: Substantial (High) If there is no correlation, put "-"

Course Code	Course Title (LAB ORIENTED THEORY COURSE)	Category	L	T	P	C
CB23D33	**ADVANCED SOCIAL, TEXT AND MEDIA ANALYTICS**	PE	3	0	2	4

Objectives:	
☐	To learn the fundamentals of text mining analysis.
☐	To be able to use various tools for text mining and carry out pattern discovery, predictive modeling.
☐	Explore the use of social network analysis to understand the growing connectivity and complexity.
☐	Perform social network analysis to identify important network properties in social media sites.
☐	Analysing interactions between people, and determine structural patterns in such interactions in real timeapplication.

UNIT-I	**INTRODUCTION TO TEXT MINING**	**9**

Introduction- Defining text mining, general architecture of text mining systems. Core text mining operations- Using background knowledge for text mining, Text mining query languages. Pre-processing techniques-Task oriented approaches. Categorization-Applications of text categorizations, Definition of the problem, Document representations, Knowledge engineering approach to TC, Machine learning approach to TC, Using unlabeled evaluation of text classifiers.

UNIT-II	**CLUSTERING AND INFORMATION EXTRACTION**	**9**

Information extraction –Introduction, Historical evolution, Examples, Architecture of IE systems, AnaphoraResolution,Inductive algorithms, Structural IE.
Probabilistic models for information extraction- Hidden Markov Models, Stochastic Context Free Grammars, Maximalentropy 138odeling, Maximal entropy Markov Models, Conditional Random Fields.
Text mining applications.

UNIT-III	**TEXT MINING METHODS & APPROACHES**	**9**

Content Analysis; Natural Language Processing; Clustering & Topic Detection; Simple Predictive Modelling;Sentiment Analysis; Sentiment Prediction.

UNIT-IV	**WEB ANALYTICS**	**9**

Web analytics tools, Clickstream analysis, A/B testing, online surveys; Web search and retrieval, Search engineoptimization, Web crawling and Indexing, Ranking algorithms, Web traffic models.

UNIT-V	**SOCIAL MEDIA ANALYTICS**	**9**

Social network and web data and methods. Graphs and Matrices-Why Graphs? Graphs, Directed Graphs, Signed Graphs, Valued Graphs, Multigraphs, Hypergraphs, Relations, Matrices. Basic measures for individuals and networks. Information visualization: Architectural considerations, common visualization approaches for text mining, visualization
technique in link analysis; Making connections: Link analysis. Random graphs and network evolution. Social contexts: Affiliation and identity; Social network analysis.

	Total Contact Hours	**:**	**45**

List of Experiments	
1	Installation of NLTK and perform simple tokenize on any web page.

2	Find the frequency distribution of words for the given web page.			
3	Perform word stemming using NLTK.			
4	Perform an experiment for text summarization applying Deep Learning.			
4	Collect the Tweets of a particular Movie and interpret the influence of the Movie providing thePositive/NegativeComments.			
5	Analyse emoticons feedbacks of consumable product and conclude whether to buy a product or not from e-newspaper.			
6	Based upon the counts of share, like, comments for a post in Facebook, analyse and comment the Post.			
7	Consider the role of a marketing manager for an apparel software company and develop a campaign forLinkedIn target audience.			
8	Use Tableau to derive decision for knowledge worker from available previous data sets.			
9	In a video frame sequence use snapchat to raise trigger to skip horror frames by analysing the video.			
10	Create an ontology for news article in English contents that are good/bad to the country.			
		Contact Hours	**:**	**30**
		Total Contact Hours	**:**	**75**

Course Outcomes:
On completion of the course, the students will be able to
- Perceive the trends in recent years on online social networks.
- Draw the graphical relation between the communities.
- Know various social network algorithms related to predictive modelling and pattern discovery.
- Determine the relation between the participants of various social media.
- Understand Social Network Mining Tools and apply in real time problems.

Text Book (s):

1	Ronen Feldman and James Sanger, "The Text Mining Handbook: Advanced Approaches in AnalyzingUnstructured Data", Cambridge University Press, 2006.
2	Hansen, Derek, Ben Sheiderman, Marc Smith, "Analyzing Social Media Networks with NodeXL: Insights froma Connected World", Morgan Kaufmann, 2011.
3	Avinash Kaushik, "Web Analytics 2.0: The Art of Online Accountability",Wiley, 2009.
4	Hanneman, Robert and Mark Riddle, "Introduction to Social Network Method", University of California,2005.
5	Ronen Feldman and James Sanger, "The Text Mining Handbook: Advanced Approaches in AnalyzingUnstructured Data", Cambridge University Press, 2006.

Reference Books(s) :

1	Wasserman, S. & Faust, K.. "Social Network Analysis: Methods and Applications", New York: CambridgeUniversity Press, 1994.
2	Monge, P. R. & Contractor, N. S., "Theories of Communication Networks", New York: Oxford UniversityPress, 2003. http://nosh.northwestern.edu/vita.html

CO-PO-PSO Matrices of Course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CB23D33.1	2	2	3	2	2	2	2	-	-	-	-	1	3	2	3
CB23D33.2	2	2	3	2	2	2	2	2	-	-	-	1	3	2	3
CB23D33.3	3	3	3	2	2	2	2	-	-	-	2	1	3	2	3
CB23D33.4	2	2	3	2	2	2	2	2	-	-	-	1	3	2	3
CB23D33.5	3	3	3	2	2	2	2	-	-	-	-	1	3	2	3
Average	2.4	2.4	3	2	2	2	2	0.8	-	-	0.4	1	3	2	2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low)
2: Moderate (Medium)
3: Substantial (High) Nocorrelation: "-"

Course Code	Course Name (Lab oriented Theory Courses)	Category	L	T	P	C
AI23531	DEEP LEARNING	PE	3	0	2	4

Objectives:
• To introduce the foundational concepts of neural networks and enable students to implement a basic three-layer neural network for handwritten digit recognition.
• To impart knowledge on various training techniques including optimization algorithms and hyperparameter tuning.
• To familiarize students with convolutional neural networks (CNNs) and guide them through building and experimenting with CNN architectures.
• To explore recurrent neural networks (RNNs) and their applications in natural language processing, image generation, and autoencoders.
• To understand generative models, including variational autoencoders (VAE) and generative adversarial networks (GANs), and to discuss best practices for model optimization and scaling.

UNIT-I	INTRODUCTION TO DEEP LEARNING	9
Neural Networks – Biological Motivation- Perceptron – Multi-layer Perceptron – Feed Forward Network – BackPropagation -Activation and Loss Functions – Implementing three layer Neural Network - Handwritten Digit Recognition		
UNIT-II	TRAINING TECHNIQUES	9
Numerical Differentiation – Gradient – Implementing a Training Algorithm - Stochastic Gradient Descent – Momentum – AdaGrad – Adam – Initial Weight Values – Regularization – Hyperparameter optimization - Validating Hyper parameters- - Model ensembling - Scaling up model training.		
UNIT-III	CONVOLUTIONAL NEURAL NETWORKS	9
Overall Architecture – The convolution layer – The pooling layer – Implementing a CNN- LeNet - ImageNet –AlexNet - VGG – GoogLeNet – ResNet		
UNIT-IV	RECURRENT NEURAL NETWORKS	9
Recursive Neural Networks – Bidirectional RNNs – Deep Recurrent Networks – Applications: Image Generation, Image Compression, Natural Language Processing. Auto encoder -Complete Auto encoder, Regularized Autoencoder-LSTM		
UNIT-V	GENERATIVE DEEP LEARNING	9
Generative deep learning: Text generation – Deep dream – Neural style transfer – Generating images with variational autoencoders – Introduction to Generative Adversarial Networks.		
	Contact Hours	:	45

	List of Experiments
1.	Design and implement a three-layer neural network from scratch using Python. Train the network using the backpropagation algorithm with appropriate activation and loss functions. Apply the model to recognize handwritten digits. Suggested Dataset: MNIST Dataset
2.	Develop a multi-layer perceptron (MLP) for a simple classification task. Experiment with different numbers of hidden layers and activation functions, and evaluate the model's performance using accuracy and loss.Suggested Dataset: Iris Dataset.
3.	Implement a training algorithm using stochastic gradient descent (SGD) with momentum and compare it with the Adam optimizer. Train both models on a dataset and compare their convergence rates and performance. Suggested Dataset: CIFAR-10 Dataset.
4.	Implement a Convolutional Neural Network (CNN) from scratch to classify images. Train the network using a dataset of labeled images and evaluate its performance. Visualize the learned filters in the convolution layersuggested Dataset: CIFAR-10 Dataset
5.	Implement and compare the performance of three popular CNN architectures: VGG, ResNet, and GoogLeNet for classification using Dogs vs. Cats dataset.Suggested Dataset: Dogs vs. Cats dataset.
6.	Implement a bidirectional recurrent neural network (RNN) to predict sequences in time-series data. Train the RNN and compare its performance with a traditional feed-forward neural network for sequence-basedtasks. Suggested Dataset: Airline Passenger Dataset
7.	Build a deep recurrent neural network (RNN) to generate image captions. Combine CNN for image feature extraction with RNN for sequence generation. Suggested Dataset: MS COCO Dataset
8.	Implement a variational autoencoder (VAE) to generate new images from a given dataset. Train the VAE to learn the latent representation of images and generate new samples from the learned distribution.Suggested Dataset: CelebA Dataset
9.	Build a text generation model using Long Short-Term Memory (LSTM) networks. Train the model on a text corpus to generate coherent sequences of text and evaluate the generated text for fluency and coherence. Suggested Dataset: Shakespeare Corpus
10.	Train a Generative Adversarial Network (GAN) to generate new images from a dataset. Evaluate the quality of the images generated using visual inspection and a quantitative metric like the Inception Score (IS) or Fréchet Inception Distance (FID). Suggested Dataset: LSUN Dataset
11.	Mini Project • **Choose a Topic**: Identify a deep learning problem of interest, such as image classification, text generation, or anomaly detection. Research related work using platforms like Google Scholar. • **Dataset Selection**: Find or collect a suitable dataset from sources like Kaggle or UCI. Ensure it is relevant, well-sized, and consider preprocessing requirements. • **Develop Methodology**: Start with baseline models, then experiment with advanced architectures (e.g., CNNs, Transformers). Use frameworks like TensorFlow or PyTorch. • **Implementation & Evaluation**: Train models and evaluate performance using appropriate metrics (e.g., accuracy, F1-score). Document findings systematically. • **Discuss & Present**: Analyze results, highlight challenges, and present your work with clear insights and future directions.
	Contact Hours : 30

Total Contact Hours	:	75

Course Outcomes:	
On completion of the course, the students will be able to	
•	Define the architecture of a neural network and implement a three-layer neural network
•	Analyze and apply various training techniques to optimize neural network performance
•	Design and evaluate convolutional neural networks (CNNs) by building models for image classification tasks
•	Illustrate the working of recurrent neural networks (RNNs) and apply autoencoders for various applications
•	Construct deep generative model for various applications.

Text Books:	
1	Koki Saitoh, "Deep Learning from the Basics - Python and Deep Learning: Theory and Implementation", 1st edition, Packt Publishing,2021.
2	Ian Goodfellow, Yoshua Bengio and Aaron Courville," Deep Learning ",1st edition ,MIT Press,2016.

Reference Books:	
1	Duda, Richard, Peter Hart, and David Stork. Pattern Classification. 2nd ed. New York, NY: Wiley-Interscience, 2nd edition ,2007.
2	François Chollet, "Deep Learning with Python", Second Edition, Manning, 2021.
3	Charu C. Aggarwal, "Neural Networks and Deep Learning: A Textbook", First Edition, Springer International Publishing AG ,2018.

Web link:
1. **https://www.manning.com/books/deep-learning-with-python-second-edition**
CO - PO – PSO Mapping

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI23531.1	3	3	2	2	1	-	-	1	-	-	-	1	3	3	1
AI23531.2	3	3	2	2	2	-	-	2	-	-	-	1	3	3	2
AI23531.3	3	3	3	2	2	-	-	2	-	-	-	1	3	3	1
AI23531.4	3	3	3	2	3	1	1	2	1	1	-	1	3	3	3
AI23531.5	3	3	3	2	3	1	1	2	1	1	-	1	3	3	3
Average	3	3	2.6	2	2.2	1	1	1.8	1	1	-	1	3	3	2

Correlation levels 1, 2 or 3 are as defined below:
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2: Moderate (Medium)
3: Substantial (High)
No correlation: "-"

Course Code	Course Name (Lab oriented Theory Courses)	Category	L	T	P	C
AI23A36	BIG DATA ANALYTICS	PE	2	0	2	3

Objectives:
• To understand the basic concepts of big data and Hadoop.
• To have knowledge on accessing , storing and manipulating the huge data from different sources.
• To implement Map-Reduce programs for processing big data.
• To realize storage and processing of big data using MongoDB, Pig, Hive and Spark.
• To analyze big data using machine learning techniques.

UNIT-I	Introduction To Big Data	6
	Classification of data, Characteristics, Evolution and definition of Big data, What is Big data, Why Big data, Traditional Business Intelligence Vs Big Data,Typical data warehouse and Hadoop environment. **Big Data Analytics:** Classification of Analytics, Importance of Big Data Analytics, Technologies used in Big data Environments, Few Top Analytical Tools, NoSQL, Hadoop.	
UNIT-II	Hadoop And Map Reduce	6
	Introduction to Hadoop: Introducing hadoop, Why hadoop, Why not RDBMS, RDBMS Vs Hadoop, History of Hadoop, Hadoop overview, Use case of Hadoop, HDFS (Hadoop Distributed File System),Processing data with Hadoop, Managing resources and applications with Hadoop YARN(Yet Another Resource Negotiator). **Introduction to Map Reduce Programming:** Introduction, Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression.	
UNIT-III	MongoDB	6
	Introduction to MongoDB: What is MongoDB, Why MongoDB, Terms used in RDBMS and MongoDB, Data Types in MongoDB, MongoDB Query Language.	
UNIT-IV	FUNDAMENTALS OF APACHE PIG, HIVE	6
	Introduction to Hive: What is Hive, Hive Architecture, Hive data types, Hive file formats, Hive Query Language (HQL), RC File implementation, User Defined Function (UDF). **Introduction to Pig:** What is Pig, Anatomy of Pig, Pig on Hadoop, Pig Philosophy, Use case for Pig, Pig Latin Overview, Data types in Pig, Running Pig, Execution Modes of Pig, HDFS Commands, Relational Operators, Eval Function, Complex Data Types, Piggy Bank, User Defined Function, Pig Vs Hive.	
UNIT-V	Spark And Data Analysis	6
	Spark and Big Data Analytics: Spark, Introduction to Data Analysis with Spark. **Text, Web Content and Link Analytics:** Introduction, Text Mining, Web Mining, Web Content and Web Usage Analytics, Page Rank, Structure of Web and Analyzing a Web Graph	
	Contact Hours :	30

List of Experiments	
1.	Install Hadoop and Implement the following file management tasks in Hadoop: Adding files and directories Retrieving files Deleting files and directories. **Note:** A typical Hadoop workflow creates data files (such as log files) elsewhere and copies them into HDFS using one of the above command line utilities.
2.	Develop a MapReduce program to implement Matrix MultiplicationSuggested Dataset: Iris Dataset
3.	Develop a Map Reduce program that mines weather data and displays appropriate messages indicating the weather conditions of the day.

4.	Develop a MapReduce program to find the tags associated with each movie by analyzing movie lens data.
5.	Implement Functions: Count – Sort – Limit – Skip – Aggregate using MongoDB
6.	Pig Latin scripts to sort, group, join, project, and filter the data
7.	Use Hive to create, alter, and drop databases, tables, views, functions, and indexes.
8.	Implement a word count program in Hadoop and Spark.
9.	Use CDH (Cloudera Distribution for Hadoop) and HUE (Hadoop User Interface) to analyse data and generate reports for sample dataset

		Contact Hours	:	30
		Total Contact Hours	:	60

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

- Identify and list various Big Data concepts, tools and applications.

- Develop programs using HADOOP framework.

- Learn the working principles of big data management using MongoDB

- Use Hadoop Cluster to deploy Map Reduce jobs, PIG,HIVE and Spark programs

- Analyse the given data set and identify deep insights from the data set.

Text Books:

1	Seema Acharya and Subhashini Chellappan "Big data and Analytics" ,Second Edition ,Wiley India Publishers, 2019.
2	Rajkamal and Preeti Saxena, "Big Data Analytics, Introduction to Hadoop, Spark and Machine Learning", McGraw Hill Publication 2019.

Reference Books:

1	Tom White, "Hadoop: The Definitive Guide" 4th Edition, O'reilly Media, 2015.
2	Thomas Erl, Wajid Khattak, and Paul Buhler, Big Data Fundamentals: Concepts, Drivers & Techniques, Pearson India Education Service Pvt. Ltd., 1st Edition, 2016.
3	John D. Kelleher, Brian Mac Namee, Aoife D'Arcy -Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, MIT Press 2020, 2nd Edition
4	Mohammed Guller, "Big Data Analytics with Spark", Apress, 2015

Web links and Video Lectures (e-Resources):
- **https://www.kaggle.com/datasets/grouplens/movielens-20m-dataset**

- **https://www.youtube.com/watch?v=bAyrObl7TYE&list=PLEiEAq2VkUUJqp1k-g5W1mo37urJQOdCZ**

- **https://www.youtube.com/watch?v=VmO0QgPCbZY&list=PLEiEAq2VkUUJqp1kg5W1mo37urJQOdCZ&index=4**

- **https://www.youtube.com/watch?v=GG-VRm6XnNk https://www.youtube.com/watch?v=JglO2Nv_92A**

CO - PO – PSO Mapping

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI23A36.1	3	3	2	2	1	-	-	1	-	-	-	1	3	3	1
AI23A36.2	3	3	2	2	2	-	-	2	-	-	-	1	3	3	2
AI23531.3	3	3	3	2	2	-	-	2	-	-	-	1	3	3	1
AI23A36.4	3	3	3	2	3	1	1	2	1	1	-	1	3	3	3
AI23A36.5	3	3	3	2	3	1	1	2	1	1	-	1	3	3	3
Average	3	3	2.6	2	2.2	1	1	1.8	1	1	-	1	3	3	2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low)
2: Moderate (Medium)
3: Substantial (High)
No correlation: "-"

Course Code	Course Title (LAB ORIENTED THEORY COURSE)	Category	L	T	P	C
AD23A35	HEALTHCARE ANALYTICS	PE	2	0	2	3

Objectives:
• To Introduce Predictive Modeling
• To familiarize Regression and Classification Techniques.
• To impart knowledge on the concepts of Support vector machines and Neural Networks.
• To explore tree-based classifiers and ensemble methods
• To introduce Topic modeling

UNIT-I	INTRODUCTION TO HEALTHCARE DATA ANALYTICS	6
Introduction, Healthcare Data Sources and Basic Analytics, Advanced Data Analytics for Healthcare, Applications and Practical Systems for Healthcare, Resources for Healthcare Data Analytics.		
INIT-II	**HEALTH CARE DATA SOURCES AND BASIC ANALYTICS**	6
Health Law, Big Data Analytics & AI in healthcare, History of EHR, Components of EHR, Coding Systems, Benefits of EHR, Barriers to Adopting EHR, Challenges of Using EHR Data, Phenotyping Algorithms.		
UNIT-III	**ARTIFICIAL INTELLIGENCE IN HEALTH CARE**	6
Big Data Analtyics and Artificial Intelligence in Health care, Biomedical Imaging Modalities, Object Detection, Image Segmentation, Image Registration, Feature Extraction, Digital Health Informatics, Health Informatics Databases.		
UNIT-IV	**HEALTH INFORMATICS & MINING OF SENSOR DATA IN HEALTHCARE**	6
Digitizing Medical Records, Health Record Content and Documentation, Clinical Terminologies, Classifications and Code Systems, Mining Sensor Data in Medical Informatics: Scope and Challenges, Challenges in Healthcare Data Analysis, Sensor Data Mining Applications, Nonclinical Healthcare Applications.		
UNIT-V	**ADVANCED DATA ANALYTICS IN HEALTHCARE**	6
Public Health Informatics, Security and Privacy Issues, Healthcare Statistics, Statistical Prediction Models, Survival Models, Evaluation and Validation.		
	Total Contact Hours :	30

	List of Experiments
1	Perform EDA on a publicly available healthcare dataset to identify trends, patterns, and outliers. Dataset: Kaggle Health Data.
2	Analyze a dataset containing EHRs to understand components, coding systems, and barriers to adoption. Dataset: MIMIC-III Clinical Database
3	Implement a classification algorithm to predict diseases using patient demographics and clinical data. Dataset: UCI Machine Learning Repository - Heart Disease
4	Apply image processing techniques for object detection and segmentation in biomedical images. Dataset: The Cancer Imaging Archive (TCIA)
5	Extract features from medical images and build a predictive model for diagnosis. Dataset: Chest X-ray Images (Pneumonia)
6	Design a basic application using health informatics principles to analyze patient data and visualize results. Dataset: Health and Nutrition Examination Survey (NHANES)
7	Develop statistical models to predict health outcomes based on historical data. Dataset: World Health Organization (WHO) Data
8	Analyze a dataset for privacy concerns and develop recommendations for securing health data. Dataset: Healthcare Cost and Utilization Project (HCUP).
9	Mini Project a. Predictive Analytics for Diabetes Management: A Machine Learning Approach

Objective: Utilize machine learning algorithms to predict the likelihood of diabetes in patients based on clinical and demographic data.

a. Analyze the factors influencing diabetes risk and visualize the results for   healthcare professionals.

b. Development of an EHR Dashboard: Insights from Electronic Health Records

Objective: Create a dashboard that aggregates and visualizes key metrics from electronic health records (EHRs) to help healthcare providers monitor patient outcomes, identify trends, and improve decision-making.

c.Image Segmentation for Tumor Detection in Medical Imaging

Objective: Implement image segmentation techniques using deep learning to identify and delineate tumors in MRI or CT scan images. Evaluate the effectiveness of various segmentation algorithms and their potential in clinical settings.

d.Mining Sensor Data for Predictive Health Monitoring in Wearable Devices

Objective: Analyze data collected from wearable health devices (e.g., heart rate monitors) to predict potential health issues. Develop a model to classify activity levels and assess how these correlate with user health metrics.

e.Evaluating Public Health Trends Using Statistical Models and Health Informatics

Objective: Utilize statistical models to analyze public health data and identify trends in health outcomes related to specific demographics. Provide recommendations for interventions based on the findings.

Considerations for Implementation

Data Sources: For each project, identify appropriate datasets (as suggested in the previous message) to support your analysis.

Tools and Technologies: Use relevant programming languages and libraries (e.g., Python, R, TensorFlow, Pandas) based on the project requirements.

Documentation: Ensure thorough documentation of project objectives, methodologies, results, and conclusions to facilitate understanding and potential future work in the field.

Contact Hours	:	30
Total Contact Hours	:	60

Course Outcomes:
At the end of the course the student will be able to:

- Understand and apply basic and advanced data analytics techniques to healthcare datasets, enabling data-driven decision-making in healthcare environments.
- Develop predictive models using regression, classification techniques, and support vector machines to analyze and interpret healthcare data effectively.
- Implement and evaluate various machine learning algorithms, including tree-based classifiers and ensemble methods, to address complex healthcare problems.
- Analyze biomedical images and signals using techniques such as segmentation, registration, and feature extraction to enhance diagnostic accuracy.
- Explore and apply sensor data mining techniques in healthcare to develop non-clinical applications and address challenges in medical informatics.

Text Book (s):

1	Leming Zhou, "Introduction to Healthcare Informatics", Third Edition,American Health Information Management Association Publication,March 2023.
2	Phillip Olla,Joseph Tan, "Digital Health Care: Perspectives, Applications, and Cases: Perspectives, Applications, and Cases", Jones & Bartlett Learning, May 2022.
3	Chandan K. Reddy, Charu C. Aggarwal, "Healthcare Data Analytics", First Edition ,Chapman and Hall/CRC, June 2020.
4	Susan White, "A Practical Approach to Analyzing Healthcare Data", Fourth Edition,Ahima Publications, March 2021.

Reference Books(s) / Web links:

1	Oachs, Watters, "Health Information Management: Concepts, Principles, and Practice", AHIMA Press Publications, Sixth Edition, February 2020.
2	Nalin Johri PhD MPH, "Health Services Research and Analytics Using Excel", Springer Publishing Company, First Edition, February 2020.

CO - PO – PSO matrices of course

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
AD23A35.1	3	3	2	2	2	1	1	1	1	2	1	2	3	2	2
AD23A35.2	3	3	2	3	3	1	1	1	1	2	2	2	3	2	2
AD23A35.3	3	3	2	3	3	1	1	1	2	2	2	2	3	3	2
AD23A35.4	3	3	2	3	3	1	2	1	2	2	2	2	3	3	2
AD23A35.5	3	3	2	3	3	1	2	1	2	2	2	2	3	3	2
Average	3	3	2	2.5	2.5	1	1.5	1	1.5	2	2	2	3	2.5	2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low)
2: Moderate (Medium)
3: Substantial (High)
No correlation: "-"

Course Code	Course Title (Lab Oriented Theory Course)	Category	L	T	P	C
CB23E31	**INFORMATION SECURITY**	**PE**	**3**	**0**	**2**	**4**

Objectives:	
☐	To understand the overview of computer security.
☐	To understand the information security policy and system design.
☐	To understand techniques of system security.
☐	To learn about various applications of system security.
☐	To learn about operating system and database security.

UNIT-I	OVERVIEW OF COMPUTER SECURITY	9

The Basic Components- Confidentiality, integrity and availability; Security policy and procedure; Assumptions and Trust; Security Assurance, Implementation and operational issues; Security Life Cycle -Access Control Models: Role based Model.

UNIT-II	SECURITY POLICIES AND SYSTEM DESIGN	10

Types of Security Policies-Confidentiality policies: Goals of Confidentiality Policies, The Bell-LaPadula Model- Integrity policies: Biba Integrity Model, Clark-Wilson Integrity Model -Hybrid policies: Chinese Wall Model, Clinical Information Systems Security Policy. Access Control Mechanisms: Access Control Lists- Information Flow:
Compiler-Based Mechanisms, Execution-Based Mechanisms- Confinement Problem: Isolation, Covert Channels- Assurance: Building Secure and Trusted Systems- Evaluating Systems: Goals of Formal Evaluation.

UNIT-III	SYSTEM SECURITY	10

Malicious Logic: Trojan Horses, Computer Viruses, Computer Worms- Vulnerability Analysis: Penetration Studies,Vulnerability Classification-Auditing: Anatomy of an Auditing System, Auditing Mechanisms, Audit Browsing-Intrusion Detection: Architecture, Organization of Intrusion Detection Systems- Design Principles- Representing Identity: Files and Objects, Users, Groups and Roles, Naming and Certificates.

UNIT-IV	APPLICATIONS	10

Network Security: Policy Development, Network Organization- System Security: Policy- User Security: Policy, Access, Files and Devices- Program Security: Requirements and Policy, Design, Case Study: Common Security-
Related Programming Problems.

UNIT-V	OPERATING SYSTEM AND DATABASE SECURITY	6

Operating System Security: Security Architecture, Analysis of Security in Linux/Windows-Database Security: SecurityArchitecture, Database Auditing-Case Study: Discretionary Access Control.

		Contact Hours	:	45

LIST OF EXPERIMENTS	
1	Analysis of security in Unix/Linux.
2	Administration of users, password policies, privileges and roles.
3	Implementation of discretionary access control and mandatory access control.
4	Demonstrate intrusion detection system (ids) using any tool Eg. Snort or any other software.
5	Implementation of IT audit, malware analysis and vulnerability assessment and generate the report.

6	Implementation of mobile audit and generate the report of the existing artifacts.
7	Implementation of OS hardening and RAM dump analysis to collect the artifacts and other information.
8	Implementation of digital forensics tools for disk imaging, data acquisition, data extraction and data analysis andrecovery.
9	Perform mobile analysis in the form of retrieving call logs, SMS log, and all contacts list using the forensics tool likeSAFT.
10	Implementation to identify web vulnerabilities, using OWASP project.

	Contact Hours	:	30
	Total Hours	:	75

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

☐	Discuss the basics of information security and international standards.
☐	Analyse information security policy and system design.
☐	Comprehend system level security.
☐	Apply system level security in various environments.
☐	Analyze the operating system and database security methods.

Text Book(s):

1	Ross Anderson, "Security Engineering: A Guide to Building Dependable Distributed Systems", Third Edition, Wiley, 2021.
2	M. Bishop, "Computer Security: Art and Science", Second Edition, Pearson Education, 2019.
3	M. Stamp, "Information Security: Principles and Practice", Second Edition, Wiley, 2011.

Reference Books(s) /Web Resources :

1	C.P. Pfleeger, S.L. Pfleeger, J. Margulies, "Security in Computing", 5th Edition, Prentice Hall, 2015.
2	David Wheeler, "Secure Programming HOW TO", v3.010 Edition, 2003.
3	Michael Zalewski, "Browser Security Handbook", Google Inc., 2009.
4	M. Gertz, S. Jajodia, "Handbook of Database Security", Springer, 2008.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CB23E31.1	3	1	1	1	1	2	-	3	-	-	-	2	2	1	1
CB23E31.2	3	2	3	3	3	2	2	2	-	-	-	-	2	1	3
CB23E31.3	3	3	2	2	2	2	2	2	-	-	-	2	3	1	2
CB23E31.4	3	3	3	3	3	2	3	2	-	-	-	2	3	2	3
CB23E31.5	3	3	2	2	3	2	2	1	-	-	-	2	3	1	2
Average Mapping	3	1	1	1	1	2	-	3	-	-	-	2	2	1	1

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)No correlation: "-"

Course Code	Course Title (LAB ORIENTED THEORY COURSE)	Category	L	T	P	C
CB23E32	FUNDAMENTALS OF IOT	PE	2	1	2	4

Objectives:	
☐	To understand about the fundamentals of Internet of Things and its building blocks along with their characteristics.
☐	To gain knowledge about IoT Architecture.
☐	To understand and learn about Sensors and industrial systems.
☐	To understand the other associated technologies like networking and communication in the domain of IoT.
☐	To understand the data processing and standards designed for IoT and the current research on it.

UNIT-I	INTRODUCTION TO IOT AND USE CASES	9
	Understanding basic concepts of IoT, Consumer IoT vs Industrial Internet, Fundamental building blocks, Use Cases ofIoT in various industry domains.	
UNIT-II	ARCHITECTURE	9
	IoT reference architectures, Industrial Internet Reference Architecture, Edge Computing, IoT Gateways, Data Ingestionand Data Processing Pipelines, Data Stream Processing.	
UNIT-III	SENSORS AND INDUSTRIAL SYSTEMS	9
	Introduction to sensors and transducers, integrating sensors to sensor processing boards, introduction to industrial data acquisition systems, industrial control systems and their functions.	
UNIT-IV	NETWORKING AND COMMUNICATION FOR IOT	9
	Recap of OSI 7 layer architecture and mapping to IoT architecture, Introduction to proximity networking technologies (ZigBee, Bluetooth, Serial Communication), Industrial network protocols (Modbus, CANbus), Communicating with cloud applications - web services, REST, TCP/IP and UDP/IP sockets, MQTT, WebSockets, protocols. Messageencoding (JSON, Protocol Buffers).	
UNIT-V	IOT DATA PROCESSING AND STORAGE	9
	Time series data and their characteristics, time series databases, basic time series analytics, data summarization andsketching, dealing with noisy and missing data, anomaly and outlier detection.	
	Total Contact Hours :	45

List of Experiments	
1	Setting up the Arduino development environment, connecting analog sensors to an Arduino board and readinganalog sensor data.
2	Digital input and output reading using an Arduino board and Arduino development environment.
3	Integrate an Arduino board to a Raspberry Pi computer and send sensor data from Arduino to the R Pi.
4	Setup Python on the R Pi and run sample R Pi programs on the R Pi. Read the data from Arduino usingPython language.
5	Connect a R Pi Camera module to the Raspberry Pi and using Python programming capture still images andvideo.
6	Set up TCP/IP socket server on a PC. Send a message from the R Pi to the PC using socket communication.
7	Set up a MQTT broker on the PC. Send data from R Pi to PC using MQTT protocol. Receive data from PC toR Pi using MQTT protocol.
8	Connect LED lights to an Arduino. Connect the Arduino to the R Pi. Send Message from PC to R Pi viaMQTT protocol. On receipt of the message, toggle the LED lights on the Arduino.
9	Set up an account in a cloud service (such as Google / AWS or Azure). Set up a simple Http server using a language of your choice. Push the image captured from the R Pi camera to this web service. On receiving the image, store the image in a database or file.
10	Develop a mobile application to view the images captured by the R Pi camera.
	Contact Hours : 30
	Total Contact Hours : 75

	Course Outcomes:
	On completion of the course, the students will be able to
☐	Understand basic principles and concepts of Internet-of-Things use cases, applications, architecture and technologies.
☐	Get an overview of an end to end IoT system encompassing the edge, cloud and application tiers.
☐	Build upon the foundations created in the pre-requisite courses and will equip the students to architect a complete IoT application on their own.
☐	Lead to building an IoT end-to-end application.
☐	Apply the concept to do research.

	Text Book (s):
1	Samuel Greengard, "The Internet of Things-Essential Knowledge Series", First s, 2015.

	Reference Books(s) :
1	Industrial Internet Reference Architecture - http://www.iiconsortium.org/IIRA.htm,2022.
2	World Economic Forum Report on Industrial Internet of Things - https://www.weforum.org/reports/industrial-internet-things
3	50 Sensor Applications for a Smarter World - http://www.libelium.com/resources/top_50_iot_sensor_applications_ranking/
4	Ben Fry, "Visualizing Data-Exploring and Explaining Data with the Processing Environment", O'Reilly Media, 2007.
5	Andrew K Dennis, "Raspberry Pi Computer Architecture Essentials", 2016.
6	M. Banzi, "Getting Started with Arduino", O Reilly Media.
7	GSMA IoT Security Guidelines & Assessment - https://www.gsma.com/iot/future-iot-networks/iot-security-guidelines/

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CB23E32.1	3	2	3	3	3	3	3	2	2	2	2	2	2	2	3
CB23E32.2	3	2	3	3	3	3	2	2	3	2	3	3	3	2	3
CB23E32.3	3	2	3	3	2	3	2	2	2	2	2	2	3	2	2
CB23E32.4	3	2	3	3	2	2	3	2	2	3	3	3	3	3	3
CB23E32.5	2	2	2	3	3	3	3	2	3	3	3	3	2	3	2
Average	2.8	2	2.8	3	2.6	2.8	2.6	2	2.4	2.4	2.6	2.6	2.6	2.4	2.6

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)   2: Moderate (Medium) 3: Substantial (High) Nocorrelation: "-"

Course Code	Course Title (LAB ORIENTED THEORY COURSE)	Category	L	T	P	C
CB23E33	MOBILE COMPUTING	PE	2	0	2	3

Objectives:	
☐	To learn about the mobile infrastructure, radio resource management, overview of generation 1G to 5G.
☐	To illustrate the location management involved in GSM, Mobile IP.
☐	To illustrate the transmission, transaction technology involved in mobile.
☐	To explore the wireless network in mobile.
☐	To discover the cognitive radio networks in mobile.

UNIT-I	INTRODUCTION	6

Overview of wireless and mobile infrastructure, Preliminary concepts on cellular architecture, Design objectives and performance issues, Radio resource management and interface, Propagation and path loss models, Channel interference and frequency reuse, Cell splitting, Channel assignment strategies, Overview of generations: - 1G to 5G.

UNIT-II	LOCATION AND HANDOFF MANAGEMENT	6

Introduction to location management (HLR and VLR), Mobility models characterizing individual node movement (Random walk, Fluid flow, Markovian, Activity based), Mobility models characterizing the movement of groups of nodes (Reference point based group mobility model, Community based group mobility model), Static (Always vs. Never update, Reporting Cells, Location Areas) and Dynamic location management schemes (Time, Movement, Distance, Profile Based), Terminal Paging (Simultaneous paging, Sequential paging), Location management and
Mobile IP, Overview of handoff process, Factors affecting handoffs and performance evaluation metrics, Handoff strategies, Different types of handoffs (soft, hard, horizontal, vertical).

UNIT-III	WIRELESS TRANSMISSION FUNDAMENTALS	6

Introduction to narrow and wideband systems, Spread spectrum, Frequency hopping, Introduction to MIMO, MIMO Channel Capacity and diversity gain, Introduction to OFDM, MIMO-OFDM system, Multiple access control (FDMA, TDMA, CDMA, SDMA), Wireless local area network, Wireless personal area network (Bluetooth and zigbee).

UNIT-IV	WIRELESS NETWORK	6

Mobile Ad-hoc networks - Characteristics and applications; Coverage and connectivity problems, Routing in MANETs, Wireless sensor networks - Concepts, basic architecture, design objectives and applications; Sensing and communication range, Coverage and connectivity, Sensor placement, Data relaying and aggregation, Energy consumption, Clustering of sensors, Energy efficient Routing (LEACH).

UNIT-V	COGNITIVE RADIO NETWORKS	6

Fixed and dynamic spectrum access, Direct and indirect spectrum sensing, Spectrum sharing, Interoperability and co-existence issues, Applications of cognitive radio networks, Introduction to D2D communications-High level requirements for 5G architecture, Introduction to the radio resource management, power control and mode selection problems, Millimeter wave communication in 5G.

	Total Contact Hours	:	30

List of Experiments			
Design and Development of different wireless network protocols using network simulators such as NS-3/ OMNET++			
1.	MAC Protocol		
2.	Routing Protocol		
3.	Transport Protocol		
4.	Congestion Control Protocol		
5.	Application Protocol		
6.	Security Protocol		
	Contact Hours	:	30
	Total Contact Hours	:	60

Course Outcomes:
On completion of the course, the students will be able to
☐ Understand and apply the various concepts of Basics of Number Theory
☐ Secure a message over an insecure channel by numerous symmetric key cryptosystem
☐ Apply diverse Public Key Cryptosystem & Authentication
☐ Implement varied Security Applications
☐ Understand the implications of quantum computing on cryptography and security

Text Book (s):	
1	Petri Ahokangas and Annabeth Aagaard, "The Changing World of Mobile Communications: 5G, 6G and the Future of Digital Services",Springer Nature, 2023.
2	Jochen Schiller, "Mobile Communications", Second Edition, Pearson, 2008.
3	Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005.

Reference Books(s) :	
1	Theodore Rappaport, "Wireless Communications: Principles and Practice", Pearson Education, 2014.
2	Ezio Biglieri, MIMO, "Wireless Communications", Cambridge University Press, 2009.
3	Ivan Stojmenovic, "Handbook of Wireless Networking and Mobile Computin", Wiley, 2002.
4	James Cowling, "Dynamic Location Management in Heterogeneous Cellular Networks", 2004.
5	MIT Thesis. http://people.csail.mit.edu/cowling/hons/jcowling-dynamic-Nov 2004.pdf
6	Travis Keshav, Location Management in Wireless Cellular Networks. 2006. https://www.cse.wustl.edu/~jain/cse574-06/ftp/cellular_location.pdf.
7	Fahd A. Batayneh, Location Management in Wireless Data Networks. 2006 https://www.cse. wustl.edu/~jain/cse574-06/ftp/wireless_location.pdf.
8	Lingyang Song, Dusit Niyato, Zhu Han, and Ekram Hossain, "Principles of Mobile Communication", Springer, 2017.
9	Ezio Biglieri, Andrea J. Goldsmith, Larry J. Greenstein, Narayan Mandayam and H. Vincent Poor, "Principles of Cognitive Radio", Cambridge University Press, 2012.
10	Edgar H. Callaway, Jr. and Edgar H. Callaway, "Wireless Sensor Networks: Architectures and Protocols", CRC Press, 2003.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CB23E33.1	3	3	3	3	3	3	3	2	3	-	1	3	3	3	2
CB23E33.2	2	3	3	3	3	-	-	-	-	-	1	1	3	3	2
CB23E33.3	-	2	3	3	3	-	2	2	2	-	2	2	3	2	3
CB23E33.4	3	3	3	3	3	-	-	-	2	2	2	3	3	3	3
CB23E33.5	2	3	3	3	3	3	-	2	-	-	3	3	3	3	3
Average	2	2.8	3	3	3	1.2	1	1.2	1.4	0.4	1.8	2.1	3	2.8	2.4

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) , 2: Moderate (Medium) ,3: Substantial (High) Nocorrelation: "-

Course Code	Course Title	Category	L	T	P	C
CB23E34	**CYBER SECURITY FOR BUSINESS**	PE	2	0	2	3

Objectives:
☐ To understand various types of cyber-attacks and cyber-crimes
☐ To learn threats and risks within context of the cyber security
☐ To have an overview of the cyber laws & concepts of cyber forensics
☐ To study the defensive techniques against these attacks

UNIT-I	**Introduction to Cyber Security**	**6**
Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.		
UNIT-II	**Cyberspace and the Law & Cyber Forensics**	**6**
Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy. Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics		
UNIT-III	**Cybercrime: Mobile and Wireless Devices**	**6**
Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Organizational security Policies and Measures in Mobile Computing Era, Laptops.		
UNIT-IV	**Cyber Security: Organizational Implications:**	**6**
Introduction, cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing and the associated challenges for organizations.		
UNIT-V	**Privacy Issues:**	**6**
Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Data linking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains- medical, financial, etc **Cybercrime: Examples and Mini-Cases** **Examples:** Official Website of Maharashtra Government Hacked, Indian Banks Lose Millions of Rupees, Parliament Attack, Pune City Police Bust Nigerian Racket, e-mail spoofing instances. **Mini- Cases:** The Indian Case of online Gambling, An Indian Case of Intellectual Property Crime, Financial Frauds in Cyber Domain.		
	Contact Hours :	**30**

Course Outcome:
On completion of the course, the students will be able to
• Get the skill to identify cyber threats/attacks.
• Get the knowledge to solve security issues in day-to-day life.
• Able to use Autopsy tools
• Perform Memory capture and analysis
• Demonstrate Network analysis using Network miner tools

	List of Experiments
1	Perform an Experiment for port scanning with nmap
2	Set Up a honeypot and monitor the honeypot on the network
3	Install Jscript/Cryptool tool (or any other equivalent) and demonstrate Asymmetric, Symmetric crypto algorithm, Hash and Digital/PKI signatures.
4	Generate minimum 10 passwords of length 12 characters using open SSL command
5	Perform practical approach to implement Footprinting-Gathering target information using Dmitry-Dmagic, UAtester
6	Working with sniffers for monitoring network communication (Wireshark).
7	Using Snort, perform real time traffic analysis and packet logging.
8	Perform email analysis using the Autopsy tool.
9	Perform Registry analysis and get boot time logging using process monitor tool
10	Perform File type detection using Autopsy tool
11	Perform Memory capture and analysis using FTK imager tool
12	Perform Network analysis using the Network Miner tool

	Contact Hours	:	30
	Total Contact Hours	:	60

Course Outcomes:	
On completion of the course, students will be able to	
☐	Understand the various tools and methods used in cybercrime.
☐	Identify risk management processes, risk treatment methods, organization of information security.
☐	Classify cyber security solutions and information assurance.
☐	Examine software vulnerabilities and security solutions to reduce the risk of exploitation.
☐	Analyze the cyber security needs of an organization.

Text Books:	
1	B.B. Gupta, D.P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, First Edition,CRC Press, 2018.
2	Nina Godbole and Sunit Belpure, " Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley, 2011.
3	E. P. Dorothy,"Real Digital Forensics for Handheld Devices", Auerback Publications, 2013.
4	J.Sammons, "The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics", Syngress Publishing, 2012.

Reference Books:	
1	James Graham, Richard Howard and Ryan Otson, "Cyber Security Essentials", CRC Press, 2010.
2	Chwan-Hwa(john) Wu,J. David Irwin, "Introduction to Cyber Security", CRC Press T&F Group, 2013.
3	E. Casey, "Handbook of Digital Forensics and Investigation", Academic Press, 2010.
4	C. H.Malin, E. Casey and J. M. Aquilina, "Malware Forensics Field Guide for Windows Systems: Digital Forensics Field Guides", Syngress Publishing, 2012.
5	J. Wiles and A. Reyes,"The Best Damn Cybercrime and Digital Forensics Book Period", Syngress, 2007.

CO - PO – PSO MATRICES OF THE COURSE

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CB23E34.1	2	2	1	1	3	3	1	3	0	1	0	3	0	2
CB23E34.2	2	2	1	1	0	3	2	3	0	1	0	3	0	3
CB23E34.3	2	2	1	1	0	3	1	3	0	1	0	3	0	3
CB23E34.4	2	2	1	1	3	3	1	3	0	1	0	3	0	2
CB23E34.5	2	2	1	1	0	3	1	3	0	1	0	3	0	3
Avg	**2**	**2**	**1**	**1**	**1**	**3**	**1**	**3**	**0**	**1**	**0**	**3**	**0**	**3**

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High) No correlation: "-"

Course Code	Course Title (LAB ORIENTED THEORY COURSE)	Category	L	T	P	C
CB23E35	ENTERPRISE SYSTEMS	PE	2	0	2	3

Objectives:	
☐	Understand the concept of Simple Web Applications using MVC.
☐	Be exposed to different models in SOA and ERP.
☐	Be exposed to CRM models.
☐	Be exposed to interactive networks and applications.
☐	Be familiar with configuration of networking.

UNIT-I	WEB APPLICATIONS USING MVC	6
	Overview of Database Management Systems; PHP- Model View Controller and Object-Oriented Programming in PHP- Building Web Applications in PHP, Creating an MVC Framework using PHP, Angular JS- Introduction, Expressions and data binding, Building single page application, Server communication and testing.	
UNIT-II	SOA AND ERP MODELS	6
	Service Oriented Architecture (SOA); Principles of loose coupling, encapsulation; Inter-operability; Web Services as the implementation vehicle protocols, usage; Enterprise Resource Planning (ERP); systems and their architecture; Overview of SAP and Oracle Applications; Generic ERP Modules : Finance; HR; Materials Management; Investment, etc. ; Examples of Domain Specific Modules.	
UNIT-III	CRM MODELS	6
	Electronic Data Exchange; Customer Relationship Management (CRM); Customer Relationship Management (CRM); Supplier Relationship Management (SRM) ; Security Issues - Authentication, Authorisation, Access control ; Roles; single-sign-on ; Directory servers, Audit trails; Digital signatures; Encryption: review of IPSec, SSL and other technologies; Simple Applications Demo; Case study.	
UNIT-IV	INTERACTIVE NETWORK AND APPLICATION	6
	Overview of : MPLS ; Virtual Private Networks (VPN) ; Firewalls ; Network monitoring and enforcement of policies ; Software Acquisition Process ; Tendering; conditions of contract ; Commercial off the shelf software (COTS) versus Bespoke Implementations; Total cost of ownership; Issues on using Open source software or free software; Licensed software; Case study.	
UNIT-V	CONFIGURATION OF NETWORKING	6
	Hardware Architectures for Enterprise Systems; Servers; Clustering; Storage area networks; Storage units; Back-up strategies; Local Area Network (LAN) technologies and products; Data Centres; Disaster recovery site design and implementation issues; Hardware Acquisition Issues; Case study.	
	Total Contact Hours :	30

List of Experiments	
1	Create a Movie Database Application using MVC.
2	Creating an ASP.NET MVC Web Application Project.
3	Explore the client/server architecture of SAP. Learn how to use the user interface.
4	Create customer, material master data. Execute the sales process in SAP.
5	Create vendor, material master data for purchasing. Execute the Purchasing process in SAP.
6	A model of customer relationship management and business intelligence systems for catalogue and online retailers.
7	A model of customer relationship management and business intelligence systems for catalogue and online retailers with access control.
8	Configure firewall settings for an interactive network.
9	Configure and Implement a COTS.
10	Mini project.
	Contact Hours : 30
	Total Contact Hours : 60

Course Outcomes:
On completion of the course, the students will be able to
• Design and deploy Simple Web Applications using MVC.
• Design SOA and ERP models.
• Design of CRM models.
• Design interactive network and application.
• Manage, Maintain and configuration of Networking

Text Books	
1	Alexis Leon, "Enterprise Resource Planning",3rd Edition , Tata McGraw Hill, 2017.
2	Alexis Leon, "Enterprise Resource Planning – Diversified",2nd Edition.,TMH,2008.

Reference Books	
1	Ravi Shankar & S. Jaiswal, Galgotia, "Enterprise Resource Planning", 1st Edition, 1999.
2	Dr. Ravi Kalakota, "E-Business Network Resource planning using SAP R/3 Baan and Peoples soft: A Practical Roadmap For Success", Pearson, 2nd Edition, 2001.

CO – PO – PSO matrices of course

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CB23E35.1	1	2	1	1	1	0	0	0	1	2	2	1	2	2	3
CB23E35.2	1	1	1	0	1	0	0	0	0	1	1	0	1	1	3
CB23E35.3	1	1	0	0	1	0	0	0	1	0	0	1	1	2	2
CB23E35.4	1	1	0	0	1	0	0	0	1	0	0	1	2	2	3
CB23E35.5	2	2	2	1	1	0	0	0	1	1	0	1	2	2	3
Average	1	1	1	1	1	0	0	0	1	1	2	1	2	2	3

Note: Enter correlation levels 1, 2 or 3 as defined below:1: Slight (Low)   2: Moderate (Medium) 3: Substantial

(High)If there is no correlation, put "-"

Course Code	Course Name (Lab Oriented Theory Course)	Category	L	T	P	C
CR23A34	**SECURITY AND PRIVACY IN CLOUD**	PE	2	0	2	3

Objectives:	
•	To learn the fundamentals of Cloud Computing.
•	To learn the infrastructure security in cloud environment.
•	To learn the cloud application.
•	To learn the data life cycle and privacy in cloud.
•	To learn the cloud privacy and risk management.

UNIT-I	**FUNDAMENTALS OF CLOUD CONCEPTS**	6
Cloud Computing-Cloud computing technology components, Cloud services delivery, Cloud Deployment Model, Key drivers for adopting the cloud.		
UNIT-II	**INFRASTRUCTURE SECURITY**	6
Infrastructure Security: The Host Level-The Network Level, Ensuring Data Confidentiality and Integrity, Ensuring Proper Access Control, SaaS and PaaS Host Security, IaaS Host Security, Virtualization Software Security, Threats to the hypervisor, Virtual Server Security, Securing virtual servers.		
UNIT-III	**CLOUD APPLICATION**	6
Application-Level Security Threats, DoS and EDoS, End User Security, End User Security, PaaS Application Security, Customer-Deployed Application Security, IaaS Application Security, Public Cloud Security Limitations.		
UNIT-IV	**CLOUD PRIVACY**	6
Privacy: Data Life Cycle, Key Privacy Concerns in the Cloud, Protecting Privacy.		
UNIT-V	**CLOUD PRIVACY RISK MANAGEMENT**	6
Privacy Risk Management: Collection Limitation Principle, Use Limitation Principle, Security Principle, Transfer Principle, Accountability Principle, Legal and Regulatory Implications.		
	Contact Hours :	30

List of Experiments		
1.	**Private Cloud**	
a	Setup a Private Cloud by performing the procedure using a Single node OPENSTACK implementation.	
b	Perform Creation, Management and Termination of a CirrOS instance in OPENSTACK.	
c	Show the virtual machine migration based on certain conditions from one node to the other.	
2	**Public Cloud**	
a	Develop a simple application to understand the concept of PAAS using GAE/Amazon Elastic Beanstalk/IBM Blue Mix/GCC and launch it.	
b	Test how a SaaS applications scales in response to demand.	
c	Find the procedure to launch a Cloud instance using a Public IaaS cloud like AWS/GCP.	
3	**Data Encryption**	
a	Encrypt data both in transit and at rest using robust encryption algorithms.	
b	Implement Transport Layer Security (TLS) for securing communication channels.	
c	Use disk encryption to protect data stored on physical or virtual disks.	
4	**Access Control Policies**	
a	Develop access control policies defining who can access what resources.	
b	Implement role-based access control (RBAC) to assign permissions based on roles.	
5	**Identity Access Management**	
a	Capture all the flags in AWS bigiam challenges that consists of common misconfigurations in IAM.	

	Contact Hours	:	30
	Total Contact Hours	:	60

Course Outcomes:
On completion of the course, the students will be able to
• Understand the cloud concepts and fundamentals.
• Explain the infrastructure security in cloud
• Define cloud application.
• Understand various privacy in the cloud.
• Define the various privacy risk management.

Text Book(s):	
1	Eyal Estrin, "Cloud Security Handbook", First Edition, Packt, 2022.
2	Tim Mather, Subra Kumaraswamy, and Shahed Latif "Cloud Security and Privacy", First Edition ,O'Reilly,2009.

Reference Book(s) / Web link(s):	
1	Michael J. Kavis "Architecting the Cloud: Design Decisions for Cloud Computing Service Models(SaaS, PaaS, and IaaS)", First Edition, Wiley,2014.
2	Tom White, "Hadoop: The Definitive Guid". Yahoo Press, 2014.
3	Rajkumar Buyya, Christain Vecchiola, and Thamarai Selvi, "Mastering Cloud Computing", Tata McGraw Hill, 2013.
4	John W. Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
5	Thomas Erl, Zaigham Mahood, Ricardo Puttini- "Cloud Computing, Concept, Technology and Architecturel", Prentice Hall, First Edition, 2013.
6	Kai Hwang, Geoffery C, Fox and Jack J, Dongarra," Distributed and Cloud Computing: Clusters, Grids, Clouds and the Future of Internet", First Edition, Morgan Kaufman Publisher, an Inprint of Elsevier, 2012.
7	https://www.itu.int/dms_pub/itu-t/oth/23/01/T23010000160001PDFE.pdf
8	https://www.youtube.com/watch?v=dmEe6dHBKYc
9	https://www.youtube.com/watch?v=zd4LWt5Phac
10	https://www.youtube.com/watch?v=qTRmgP3oaqk

CO-PO-PSO Matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CR23A34.1	3	2	1	-	2	-	-	-	-	1	-	2	2	1	-
CR23A34.2	2	3	2	2	3	1	-	2	-	-	1	2	3	2	-
CR23A34.3	2	2	3	-	3	-	-	1	1	-	-	1	2	2	-
CR23A34.4	2	2	1	-	2	2	1	3	-	1	-	1	2	1	1
CR23A34.5	2	3	2	1	2	2	1	3	-	1	2	1	2	1	2
Average	2.2	2.4	1.8	1.5	2.4	1.6	1	2.25	1	1	1.5	1.4	2.2	1.4	1.5

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (low)
2: Moderate (Medium)
3: Substantial (High) No correlation:"-"

Course Code	Course Name (LAB ORIENTED THEORY COURSE)	Category	L	T	P	C
CB23E36	**CRYPTOLOGY**	PE	2	1	2	4

Objectives:

●	To understand the Basics of Number Theory.
●	To be able to secure a message over an insecure channel by various means.
●	To use a variety of public key cryptosystems and authentication methods.
●	To gain a better understanding of the different security applications.
●	To acquire a deeper insight of quantum computing on cryptography and security.

UNIT-I	**INTRODUCTION**	9
Introduction to Cryptography: Elementary number theory, Pseudo-random bit generation, Elementary cryptosystems. Basic security services: confidentiality, integrity, availability, non-repudiation, privacy.	
UNIT-II	**SYMMETRIC KEY CRYPTOSYSTEMS**	10
	Stream Cipher: Basic Ideas, Hardware and Software Implementations, Examples with some prominent ciphers: A5/1, Grain family, RC4, Salsa and ChaCha, HC128, SNOW family, ZUC; Block Ciphers: DES, AES and Modes of Operation.	
UNIT-III	**PUBLIC KEY CRYPTOSYSTEM & AUTHENTICATION**	8
	Public Key Cryptosystems: RSA, ECC; Digital signatures; Hash Functions; Authentication.	
UNIT-IV	**SECURITY APPLICATIONS**	9
	Electronic commerce (anonymous cash, micro-payments), Key management, Zero-knowledge protocols, Cryptology in Contact Tracing Applications.	
UNIT-V	**QUANTUM CRYPTANALYSIS & POST-QUANTUM CRYPTOGRAPHY**	9
	Quantum cryptography, quantum encryption, Issues related to Quantum Cryptanalysis. Post-Quantum Cryptography: Lattice-based cryptography : NTRU, Hash-based cryptography :SPHINCS, Multivariate cryptography: Rainbow.	
	**Total Contact Hours : **	**45**

List of Experiments	
1	Implement the following Substitution and Transposition Techniques: a) Caesar Cipher b) Playfair Cipher c) Hill Cipher d) Vigenere Cipher e) Rail fence – row & Column Transformation f) Affine Cipher
2	Implement the following algorithms a) DES b) RSA Algorithm c) MD5 d) SHA-1
3	Implement the Digital Signature Algorithm (DSA).
4	Implement Linux Privilege Escalation Checker.
5	Implement a Keylogger to record the keystrokes.
6	Set Up a honey pot and monitor the honeypot on network (Pentbox or Honeyd or any other equivalent s/w).
7	Demonstrate Intrusion Detection System using any tool (snort or any other equivalent s/w).
8	Demonstrate various exploits of Windows OS using Metasploit framework.
9	Install and Configure Firewalls for a variety of options (iptables or pfsense).
10	Demonstrate simple MITM attack (ettercap).
	Contact Hours : 30
	Total Contact Hours : 75

Course Outcomes:
On completion of the course, the students will be able to
● Understand and apply the various concepts of basics of Number Theory.
● Secure a message over an insecure channel by numerous symmetric key cryptosystem.
● Apply diverse Public Key Cryptosystem & Authentication.
● Implement varied security applications.
● Understand the implications of quantum computing on cryptography and security.

Text Book (s):	
1	Douglas R. Stinson, "Cryptography, Theory and Practice", CRC Press, 3rd Edition, 2018.
2	A. Menezes, P. Van Oorschot and S. Vanstone, "Handbook of Applied Cryptography", CRC Press, 5th printing, 2001.
3	Stallings William, "Cryptography and Network Security - Principles and Practice", Pearson, Seventh Edition, 2017.

Reference Books(s) :	
1	Neal Koblitz, "A course in number theory and cryptography", GTM, Springer.
2	Ross Anderson, "Security Engineering", Wiley, 3rd Edition, 2020.
3	http://theory.caltech.edu/~preskill/ph229/

CO - PO – PSO matrices of course

PO/PSO \ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CB23E36.1	3	2	2	2	2	-	-	-	-	-	1	1	3	2	-
CB23E36.2	2	2	2	2	2	-	-	-	1	-	1	1	3	2	-
CB23E36.3	2	2	2	2	2	-	-	-	1	-	1	1	3	2	-
CB23E36.4	2	2	2	2	2	-	-	-	1	-	1	1	3	2	-
CB23E36.5	2	2	2	2	2	-	-	-	-	-	1	1	3	2	-
Average	3	2	2	2	2	-	-	-	-	-	1	1	3	2	-

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)   2: Moderate (Medium) 3: Substantial (High) No

correlation: "-"

Course Code	Course Title (Lab oriented Theory Course)	Category	L	T	P	C
CB23F31	**MODERN WEB APPLICATIONS**	**PE**	**2**	**0**	**2**	**3**

Objectives:	
☐	To understand different internet technologies.
☐	Know the importance of object-oriented aspects of scripting.
☐	Understand creating database connectivity using PHP and MySQL.

UNIT-I	INTRODUCTION TO INTERNET & WORLD WIDE WEB	6
History of the Internet & World- Wide Web, Web Browsers, Web Servers, Uniform Resource Locator, Tools and Web Programming Languages. Web Standards, Categories of Web Applications, Characteristics of Web Applications, Tiered Architecture.	
UNIT-II	HYPERTEXT MARKUP LANGUAGE (HTML) AND CASCADING STYLE SHEETS (CSS)	6
	HTML: Basic HTML page, Text Formatting, Table, Headers, Linking, Images, List, Meta Elements. CSS: Inline, Internal and External Style Sheet, Bootstrap-CSS Text, CSS forms, CSS components drop down.	
UNIT-III	JAVASCRIPT AND EXTENSIBLE MARKUP LANGUAGE(XML)	6
	JavaScript: Introduction to Java Scripts, Objects in Java Script, Dynamic HTML with Java Script, Bootstrap- JS Alert, JS Button, JS popover. **XML:** Introduction, Structuring Data, Document Type Definition, XML Vocabularies, Document Object Model (DOM) with JavaScript, Extensible Stylesheet Language Transforms (XSL).	
UNIT-IV	PHP BASICS	6
	Writing Basic PHP Programs: Creating PHP Programs, Numbers and Strings, Literals and Variables, Operators and Functions. **Form & PHP:** Creating Form Controls, Using Values Returned From, Forms Using PHP	
UNIT-V	PHP DATABASE CONNECTIVITY	6
	PHP Database Connectivity: Connecting to MySQL Server, Selecting Databases, Checking for Errors, Closing the MySQL Server Connection. **Manipulating Data in MySQL Using PHP:** Inserting, Viewing, Updating and Deleting Records, Manipulating joined tables. **User Authentication:** Creating Session, Authorization Level.	

		Contact Hours	:	30

	List of Experiments
1	Create a HTML page with frames, links, tables and other tags for highlighting the facilities in the Department in your College. State the assumptions you make (business logic you are taking into consideration).
2	Create a web page with the following using HTML: a. To embed a map in a web page. b. To fix the hot spots in that map. c. Show all the related information when the hot spots are clicked. Embed an image map picture (India map) on a Web page that provides different links to other Web pages (different states) and show the all the related information depending on where a user clicks on the image. Create a webpage to embed a human body image, identify and display all the related information about the human body parts (head, eye, nose, finger etc.) based on the user clicks on the human body image map.
3	Create a web page with the following: a. Cascading style sheets. b. Embedded style sheets. c. Inline style sheets. d. Use your college information for the web pages.

4	Create a User Registration form with First Name, Last name, Address, City, State, Country, Pincode, Username and Password fields for a General login webpage and satisfy the following criteria:
	   a. Create a validate() function that does the following:
	   b. Checks that the First Name, Last Name, City, Country, Username, and Password fields are filled out.
	   c. Checks that the Pincode is exactly 6 numeric.
	   d. Checks that the state is exactly two characters.
	   e. Checks that the email is a valid email address.
	   • false if email has fewer than 6 characters
	   • false if email does not contain an @ symbol
	   • false if email does not contain a period (.)
	   • true otherwise

5	Write a DTD for a XML document that declares an address book containing contacts. Each contact has a name and address. An address should contain attributes for street name, state and phone number. Write a XML document and validate it against this DTD.
6	Create and save a XML document at the server, which contains 10 users information. Write a Program, which takes user Id as an input and returns the user details by taking the user information from the XML document.
7	Create a XML to represent the BOOKS catalog that has the following elements (TITLE, ISBN NO, AUTHOR, PUBLISHER, and PRICE). Display the book details styled with XSLT.
8	Create an Extensible markup language to represent the students mark information of a class. Create a webpage to display all the students consolidated mark statement with pass (green color) or fail (red color) using XSLT.

9	Write programs in PHP to create three-tier applications:
	           a. for conducting on-line examination.
	  b. for displaying student mark list. Assume that student information is available in a database which has been stored in a database server.

10	Session tracking using hidden form fields and Session tracking for a hit count.
11	Convert the static webpages of programs 1 to 4 into dynamic web pages using PHP and cookies. Hint: Users information (user id, password, credit card number) would be stored in web.xml.
12	Write a PHP program for Employee Details which includes EmpID, Name, Designation, Salary, DOJ, etc., to connect with the database and execute queries to retrieve and update data. Prepare the report for single and group of employees based on the end user needs.
13	Consider a Library Management System. Develop a JavaScript program that will validate the controls in the forms you have created for the application. State the assumptions you make (business logic you are taking into consideration). Note: Your application must access a database using PHP.

	Contact Hours	:	30
	Total Contact Hours	:	60

Course Outcomes:
On completion of the course, the students will be able to
☐ Construct a basic website using HTML and Cascading Style Sheets.
☐ Build dynamic web page with validation using Java Script objects and by applying different event handling mechanisms.
☐ Construct simple web pages in PHP and to represent data in XML format.
☐ Design and implement server side programs using PHP.
☐ Do database manipulation using MySQL and authenticate data.

	Text Books:
1	Brian Ding, "Building Modern Web Applications with ASP.NET Core Blazor", BPB Publications,2023.
2	Deitel P. J., Deitel H. M. and Deitel A., "Internet and World Wide Web: How to Program", Fifth Edition, Pearson Prentice Hall, 2012.
3	Jon Duckett, "HTML & CSS: Design and Build Websites", First Edition, John Wiley & Sons, 2011.
4	Naramore E., Gerner J., Scouarnec Y.L., et al., "Beginning PHP5, Apache, MySQL Web Development: Programmer to Programmer", John Wiley & Sons Inc., 2005.

	Reference Books
1	Sebesta R. W.," Programming the World Wide Web", Eight Edition, Pearson, 2014.
2	Pressman R. and Lowe D.," Web Engineering: a practitioner's approach", First Edition, Mc GrawHill, 2008.
3	Kappel G., et al.," Web Engineering: The Discipline of systematic Development of Web Applications", First Edition, John Wiley & Sons, 2006.
4	Suh W., "Web Engineering: Principles and Techniques", Idea Group Inc., 2005.
5	Ullman L ," PHP for the Web: Visual Quick Start Guide", Fifth Edition, Peach pit Press, 2016.

CO - PO – PSO matrices of course

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CB23F31.1	3	3	3	3	3	3	2	2	3	-	1	3	3	3	1
CB23F31.2	3	3	3	3	3	3	-	-	-	-	1	1	3	3	1
CB23F31.3	3	3	3	3	3	-	-	2	2	-	2	2	3	3	1
CB23F31.4	3	3	3	3	3	-	-	-	2	2	2	3	3	3	1
CB23F31.5	3	3	3	3	3	3	2	2	-	-	3	3	3	3	1
Average Mapping	3	3	3	3	3	1.8	1	1.2	1.4	0.4	1.8	2.1	3	3	1

Note: Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low)   2: Moderate (Medium) 3: Substantial

(High)If there is no correlation, put "-"

Course Code	Course Title (LAB ORIENTED THEORY COURSE)	Category	L	T	P	C
CB23F32	SCRIPTING LANGUAGES	PE	2	0	2	3

Objectives:
- To know the basics of scripting language.
- To understand server-side programs and develop simple programs in PHP.
- To know about Python and Ruby.
- To learn the features and event driven programs in TCL.
- To learn the concept of shell environment.

UNIT-I	Introduction to scripting languages	6

Scripts and Programs, Origin of Scripting, Scripting Today, Characteristics of Scripting Languages, Users for Scripting Languages, Web Scripting, and the universe of Scripting Languages.

UNIT-II	Server-side processing and PHP	6

PHP – Working principle of PHP – PHP Variables – Constants – Operators – Flow Control and Looping – Arrays – Strings – Functions – File Handling – forms using PHP – Email Basics – Email with attachments – PHP and HTML – Simple PHP scripts-databases with PHP.

UNIT-III	Python & Ruby	6

Introduction to python- Variables-Data Types-Sequence- Selection- Repetition- Data Types- Decision Making-Iteration-Classes & Objects-Functions-Files- applications of Python Scripting-Illustrative programs-Ruby-Rails- the structure and execution of Ruby Programs, -Package Management with RUBYGEMS- Ruby and web: Writing CGI scripts- cookies- Choice of Web servers, SOAP and web services.

UNIT-IV	TCL	6

TCL Structure, syntax, Variables and Data in TCL, Control Flow, Data Structures, input/output, procedures, strings, patterns, files, Advance TCL- source, exec and up level commands, Name spaces, trapping errors, event driven programs, making applications internet aware, Nuts and Bolts Internet Programming, Security Issues.

UNIT-V	Shell Script	6

Introduction to Shell script- Types of Shell- Shell prompt- Shell Comments- Escape characters-Extended shell scripts- Variable types- Command-Line Arguments-Shell Array –Shell basic operators-Shell decision making and Loop types-Shell functions and its types-Files-Simple Shell programming.

		Contact Hours	:	30

List of Experiments

1	Create a web page to embed a map along with hot spot, frames & links.
2	Create a web page using an embedded, external and inline CSS file.
3	Create an online job registration page along with java script validations.
4	Get the name of the user from a form and show greeting text using PHP.
5	Develop a simple application using PHP to- a) Enter data into database b) Retrieve and present data from database
6	Write a PHP program for Employee Details, which includes EmpID, Name, Designation, Salary, DOJ, etc., to connect with the database and execute queries to retrieve and update data. Also, prepare the report for single and group of employees based on the end user needs.
7	Write a Ruby program to retrieve the total marks where Course Title and marks of a student stored in a hash.
8	Write a Ruby script to print the elements of a given array.
9	Write a PERL program to implement the following list of manipulating functions: a)Shift b)Unshift c)Push
10	Write a PERL script to validate IP address and email address.

	Contact Hours	30
	Total Contact Hours	60

Course Outcomes:	
On completion of the course, the students will be able to	
●	Identify the differences between typical scripting languages and typical system and application programming languages
●	Construct a basic website using HTML and Cascading Style Sheets and build dynamic web page with validation using Java Script objects and by applying different event handling mechanisms.
●	Design and implement server-side programs using PHP
●	Demonstrate the strength of Ruby to speed up the development of a project.
●	Learn and solve typical problems using PERL.

Text Books	
1	David Barron, "The World of Scripting Languages", Wiley Publications, 2020.
2	Robin Nixon, "Learning PHP, MySQL, JavaScript, CSS & HTML5", Third Edition, O'Reilly Publishers, 2014.
3	David Flanagan and Yukihiro Matsumoto,"Ruby Programming language", O'Reilly, 2008.
4	E. Quigley, "Perl by Example", Fifth Edition,Pearson Education, 2014.

Reference Books	
1	J. Lee and B. Ware, "Open-Source Web Development with LAMP using Linux Apache, MySQL, Perl and PHP", Pearson Education, 2003.
2	Larry Wall, T. Christiansen and J. Orwant, "Programming Perl", O'Reilly, 2012.
3	J. P. Flynt, "Perl Power", Cengage Learning, 2006.
4	Dabve Thomas, "Programming Rub - The Pramatic Progammers Guide", Second Edition, 2004.
5	Steven Holzner, "The PHP Complete Reference", McGrawHill Education, 2007.

CO - PO – PSO matrices of course

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CB23F32.1	3	2	2	2	-	3	2	2	-	-	-	3	3	3	1
CB23F32.2	3	3	3	3	3	2	2	2	2	2	2	1	3	3	1
CB23F32.3	3	3	3	3	3	2	2	2	2	2	2	2	3	3	1
CB23F32.4	3	3	3	3	3	2	2	2	2	2	2	3	3	3	1
CB23F32.5	3	3	3	3	3	3	2	2	2	2	2	3	3	3	1
Average Mapping	3	2.8	2.8	2.8	2.4	2.4	2.0	2.0	1.6	1.6	1.6	2.1	3	3	1

Note: Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High) If there is no correlation, put "-"

Course Code	Course Name (Lab Oriented Theory Course)	Category	L	T	P	C
IT23B31	C# AND .NET PROGRAMMING (Common to IT, AIML, AIDS, CSE, CSBS, CSE CS)	PE	2	0	2	3

Objectives:
• To learn basic programming in C# and the object-oriented programming concepts.
• To study the advance programming concepts in C#.
• To understand the working of base class libraries, their operations and manipulation of data using XML.
• To update and enhance skills in writing Windows application, WPF, WCF and WWF with C# and .NET.
• To implement mobile applications using .Net compact framework.

UNIT-I	C# LANGUAGE BASICS	6
.Net Architecture – Core C#– Objects and Types- – Inheritance- Generics – Arrays and Tuples – Operators and Casts.		
UNIT-II	C# ADVANCED FEATURES	6
Delegates – Lambdas – Events– Strings and Regular Expressions – Collections –Asynchronous Programming-Memory Management and Pointers – Errors and Exceptions – Reflection.		
UNIT-III	BASE CLASS LIBRARIES AND DATA MANIPULATION	6
Diagnostics -Tasks, Threads and Synchronization – Manipulating XML–ADO.NET- Peer-to-Peer Networking –Core Windows Presentation Foundation (WPF).		
UNIT-IV	WINDOW BASED APPLICATIONS, WCF AND WWF	6
Core ASP.NET- ASP.NET Web forms -Windows Communication Foundation (WCF)– Introduction to Web Services –.Net Remoting -Windows Service – Windows Workflow Foundation (WWF)		
UNIT-V	.NET FRAMEWORK AND COMPACT FRAMEWORK	6
Assemblies – Custom Hosting with CLR Objects – Core XAML – .Net Compact Framework – Compact Edition Data Stores – Errors, Testing and Debugging – Optimizing performance .		
		Contact Hours: 30

	List of Experiments
1	Write a console application that obtains four int values from the user and displays the product. Hint: you may recall that the Convert.ToDouble() command was used to convert the input from the console to a double; the equivalent command to convert from a string to an int is Convert.ToInt32().
2	Write an application that receives the following information from a set of students: Student Id: Student Name: Course Name: Date of Birth: The application should also display the information of all the students once the data is Entered. Implement this using an Array of Structures.
3	Write a program to declare a class "staff" having data members as name and post. Accept this data 5 for 5 staffs and display names of staff who are HOD.
4	Write a program to implement multilevel inheritance from following figure. Accept and display data for one student.
5	Write a program to create a delegate called TrafficDel and a class called TrafficSignal with the following delegate methods. Public static void Yellow(){ Console.WriteLine("Yellow Light Signal To Get Ready"); } Public static void Green(){ Console.WriteLine("Green Light Signal To Go"); } Public static void Red(){ Console.WriteLine("Red Light Signal To Stop"); } Also include a method IdentifySignal() to initialize an array of delegate with the above methods and a method show() to invoke members of the above array.
6	Write a program to accept a number from the user and throw an exception if the number is not an even number.
7	Create an application that allows the user to enter a number in the textbox named "getnum". Check whether the number in the textbox "getnum" is palindrome or not. Print the message accordingly in the label control named lbldisplay when the user clicks on the button "check".
8	Create a project that calculates the total of fat, carbohydrate and protein. Allow the user to enter into text boxes. The grams of fat, grams of carbohydrate and grams of protein. Each gram of fat is 9 calories and protein or carbohydrate is 4 calories. Display the total calories of the current food item in a label. Use to other labels to display and accumulated some of calories and the count of items entered. The form food have 3 text boxes for the user to enter the grams for each category include label next to each text box indicating what the user is enter.
9	Database programs with ASP.NET and ADO.NET. Create a Web App to display all the Empname and Deptid of the employee from the database using SQL source control and bind it to GridView . Database fields are(DeptId, DeptName, EmpName, Salary).
10	Programs using ASP.NET Server controls. Create the application that accepts name, password, age, email id, and user id. All the information entry is compulsory. Password should be reconfirmed. Age should be within 21 to 30. Email id should be valid. User id should have at least a capital letter and digit as well as length should be between 7 and 20 characters.

		Contact Hours	:	30
		Total Contact Hours	:	60

Course Outcomes:

On completion of the course, the students will be able to

- Write various applications using C# Language.

•	Write various applications using advanced C# concepts.
•	Create window services, libraries and manipulating data using XML.
•	Develop distributed applications using .NET Framework.
•	Create mobile applications using .NET compact Framework.

Text Books(s)

1. Christian Nagel, Bill Evjen, Jay Glynn, Karli Watson, Morgan Skinner, "Professional C# 2012 and .NET 4", Wiley, 2012.
2. Andy Wigley, Daniel Moth, Peter Foot, "Mobile Development Handbook", Microsoft Press, 2007.

Reference Books

1. Ian Gariffiths, Mathew Adams, Jesse Liberty, "Programming C# 4.0‖:,OReilly, Fourth Edition, 2010.
2. D Andrew Troelsen, "Pro C# 5.0 and the .NET 4.5 Framework", Apress publication, 2012.

CO-PO-PSO Mapping

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low)
2: Moderate (Medium)
3: Substantial (High)   No correlation: "-"

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IT23B31.1	2	2	1	1	1	-	-	-	1	-	-	1	2	1	-
IT23B31.2	2	2	1	2	1	-	-	-	1	-	2	2	2	2	-
IT23B31.3	2	2	2	1	1	-	-	-	1	-	-	1	2	1	-
IT23B31.4	2	2	2	2	2	-	-	-	2	-	2	2	2	2	2
IT23B31.5	3	2	2	2	3	-	-	-	3	-	2	2	2	2	2
Average	2.2	2.0	1.6	1.6	1.6	-	-	-	1.6	-	2.0	1.6	2.0	1.6	2.0

Course Code	Course Name (Lab oriented Theory Course)	Category	L	T	P	C
IT23C31	SOFTWARE TESTING (COMMON TO IT, CSE, CSE CS, AIML, AIDS, CSBS, CSD)	PE	2	0	2	3

Objectives:

- To learn the criteria for test cases

- To learn the design of test cases.

- To understand test management and test automation techniques

- To understand test management and test structure group

- To apply test metrics and measurements

UNIT-I	INTRODUCTION	6
Testing as an Engineering Activity – Testing as a Process – Testing Maturity Model- Testing axioms – Basic definitions – Software Testing Principles – The Tester's Role in a Software Development Organization – Origins of Defects – Cost of defects – Defect Classes – The Defect Repository and Test Design		
UNIT-II	**TEST CASE DESIGN STRATEGIES**	**6**
Test case Design Strategies – Using Black Box Approach to Test Case Design – Using White Box Approach to Test design – Test Adequacy Criteria – static testing vs. structural testing – code functional testing – Coverage and Control Flow Graphs – Covering Code Logic – Paths – Secured Code Writing – code complexity testing		
UNIT-III	**LEVELS OF TESTING**	**6**
The need for Levels of Testing – Unit Test – Unit Test Planning – Designing the Unit Tests –Running the Unit tests and Recording results – Integration tests – Designing Integration Tests – Integration Test Planning – Scenario testing – Defect bash elimination System Testing – Acceptance testing – Performance testing – Regression Testing – Internationalization testing – Ad-hoc testing – Alpha, Beta Tests – Testing OO systems – Usability and Accessibility testing – Configuration testing – Compatibility testing .		
UNIT-IV	**TEST MANAGEMENT**	**6**
People and organizational issues in testing – Organization structures for testing teams – testing services – Test Planning – Test Plan Components – Test Plan Attachments – Locating Test Items – test management – test process – Reporting Test Results – Introducing the test specialist – Skills needed by a test specialist – Building a Testing Group- The Structure of Testing Group.		
UNIT-V	**TEST AUTOMATION**	**6**
Software test automation – skills needed for automation – scope of automation – design and architecture for automation – requirements for a test tool – challenges in automation – Test metrics and measurements – project, progress and productivity metrics		
	Total Contact Hours: 30	

Description of the Experiments	Total Contact Hours: 30

1. Demonstrate the working of the following a. constructs: i) do...while   ii) while….do   iii) if…else iv) switch v) for
2. Take any system (e.g. ATM system) and study its system specifications and report the various bug
3. Write the test cases for any known application (e.g. Banking application)
4. Create a test plan document for any application (e.g. Library Management System)
5. Study of any testing tool (e.g. Win runner)
6. Study of any web testing tool (e.g. Selenium)
7. Study of any bug tracking tool (e.g. Bugzilla, bugbit)
8. Study of any test management tool (e.g. Test Director)
9. Study of any open source-testing tool (e.g. Test Link)

Course Outcomes:

At the end of the course the students will be able to

- Design test cases suitable for a software development for different domains

- Identify suitable tests to be carried out

- Prepare test planning based on the document

- Document test plans and test cases designed

- Use automatic testing tools and Develop and validate a test plan

SUGGESTED ACTIVITIES (if any)

- Survey on various Testing technologies
- Activity Based Learning

SUGGESTED EVALUATION METHODS (if Any)

- Assignment problems
- Quizzes
- Class Presentation/Discussion

Text Book(s):

1. Andreas Spillner, Tilo Linz, "Software Testing Foundations", 5th Edition, O'Reilly Publisher, 2021.

2. Arnon Axelrod, "Complete Guide to Test Automation: Techniques, Practices, and Patterns for Building and Maintaining Effective Software Projects ", 1st Edition , Apress Publisher, September 2018

Reference Books(s) / Web links:

1. Ilene Burnstein, "Practical Software Testing: A Process Oriented Approach", Springer International Edition, December 2010.

2. James Whittaker , Jason Arbon , Jeff Carollo , "How Google Tests Software", 1st Edition, Addision Wesley, 2012

3. Rex Black Erik van Veenendaal, Dorothy Graham , "Foundations of Software Testing ISTQB Certification" , 3rd Edition, Cengage Publications, 2015

CO-PO-PSO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IT23C31.1	3	2	3	-	1	-	-	1	2	2	3	3	2	2	2
IT23C31.2	3	2	3	-	2	-	-	-	1	2	2	2	3	2	2
IT23C31.3	3	2	3	-	1	-	-	1	-	2	2	2	2	2	2
IT23C31.4	3	2	3	-	2	-	-	-	1	2	1	1	3	1	2
IT23C31. 5	3	2	3	-	1	-	-	1	-	2	2	1	2	1	2
Average	3	2	3	-	1.4	-	-	1	1.3	2	2	1.8	2.4	1.7	2

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)   No correlation: "-"

Course Code	Course Name (Lab Oriented Theory Course)	Category	L	T	P	C
IT23B33	**DEVOPS** (Common to IT, AIML,AIDS,CSE, CSE CS,CSD,CSBS)	PE	2	0	2	3

Objectives:
• Understand the principles and practices of DevOps.
• Gain proficiency in using DevOps tools like Git, Jenkins, Docker, Kubernetes, and Helm.
• Learn to implement CI/CD pipelines for automation and efficiency.
• Explore advanced topics like DevSecOps, security testing, and reducing deployment downtime.
• Apply DevOps concepts to real-world applications and projects.

UNIT – I	**Introduction to DevOps**	6
What is Devop- DevOps Roots and Origin- Why Is DevOps Required- The DevOps Lifecycle and Workflow- DevOps Practices- DevOps Tools		
UNIT-II	**DevOps CI/CD Pipeline**	6
Managing Your Source Code with Git - Overviewing Git and its principal command lines- Understanding the Git process and Gitflow pattern- Continuous Integration and Continuous Delivery- CI/CD principles- Creating a CD pipeline – the release- Using GitLab CI- Using Jenkins for CI/CD implementation- Deploying Infrastructure as Code with CI/CD Pipelines-		
UNIT-III	**Microservices with Docker and Kubernetes**	6
Containerizing Your Application with Docker- Installing Docker- An overview of Docker's elements- Building and running a container on a local machine- Using Docker for running command-line tools- Docker Compose- Installing Kubernetes- Installing the Kubernetes dashboard- Using Helm as a package manager- Creating a CI/CD pipeline for Kubernetes with Azure Pipelines		
UNIT-IV	**More on DevOps**	6
Security in the DevOps Process with DevSecOps- Testing Azure infrastructure- Writing InSpec tests- Reducing Deployment Downtime- Blue-green deployment concepts and patterns- DevOps for Open Source Projects- pull requests- Sharing binaries- GitHub Actions- Analyzing code with SonarCloud		
UNIT-IV	**DevOps Best Practices**	6
Choosing the right tool- Writing all your configuration in code- Designing the system architecture- Building a good CI/CD pipeline- Shifting security left with DevSecOp- Applying web security and penetration testing with ZAP- Running performance tests with Postman		
	Contact Hours:	**30**

List of Experiments	
1.	Exploring Git Commands through Collaborative Coding.
2.	Implement GitHub Operations
3.	Exploring Git Commands through Collaborative Coding.
4.	Implement GitHub Operations

5.	Applying CI/CD Principles to Web Development Using Jenkins, Git, and Local HTTP Server
6.	Exploring Containerization and Application Deployment with Docker
7.	Applying CI/CD Principles to Web Development Using Jenkins, Git, using Docker Containers
8.	Demonstrate Container Orchestration using Kubernets.
9.	Create the GitHub Account to demonstrate CI/CD pipeline using Cloud Platform.
10.	Reduce the Downtown using Blue-Green Deployment
11.	Testing Project with ZAP and Postmen

	Contact Hours : 30
	Total Contact Hours : 60

Course Outcomes: Students will be able to
- Apply DevOps principles and lifecycle workflows to software development.
- Build and manage CI/CD pipelines for application development and deployment.
- Utilize tools like Docker and Kubernetes for containerization and orchestration.
- Implement DevSecOps practices for secure and reliable deployments.
- Demonstrate advanced DevOps practices such as blue-green deployment and testing.

SUGGESTED EVALUATION METHODS (if Any) (UNIT/ Module Wise) – could suggest topic
- Lab assessment:
- Quizzes and Assignments
- Group project

SUGGESTED ACTIVITIES
Case Study:
- Evolution of DevOps in industry-leading companies. Group discussion on the DevOps lifecycle and workflow.

- Code walkthrough:
  Implementing a blue-green deployment strategy. Conducting security analysis using SonarCloud and GitHub Actions and walkthrough the code to the group.

Text Book(s):

1. Mark Reed, " DevOps The ultimate beginners guide to learn DevOps step by-step", Amazon,2019.

2. Craig Berg , "DevOps For Beginners: A Complete Guide To DevOps Best Practices, Second Edition, Amazon , 2020.

. 3. Mikael Krief, "Learning Devops" , Second Edition, Packt Publisher, 2022.

Reference Books(s) / Web links:
1. DevOps Tutorial	Microsoft Azure
2. DevOps Fundamentals- Defining DevOps Principles - GitHub - GitHub Resources

CO-PO-PSO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IT23B33.1	3	2	2	–	3	–	–	2	3	2	–	–	2	2	–
IT23B33.2	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
IT23B33.3	3	3	3	3	3	2	3	3	3	3	2	3	3	3	3
IT23B33.4	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
IT23B33. 5	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
Average	3	2.8	2.8	3	3	2	3	2.8	3	2.8	2.75	2.8	2. 6	2.8	3

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low)
2: Moderate (Medium)
3: Substantial (High)   No correlation: "-"

Course Code	Course Title (LAB ORIENTED THEORY COURSE)	Category	L	T	P	C
CB23F33	IT WORKSHOP	PC	2	0	2	3

Objectives:	
☐	To introduce the students with the basic features of MATLAB for problem solving.
☐	To introduce the students about the Mathematical functions like matrix generation and Plotting with
☐	multiple data sets, line styles and colors.
☐	To introduce the students about the Array operations and solving Linear equations in MATLAB.
☐	To introduce the students about the control flow and operators using if-end structures and loops.

UNIT-I	INTRODUCTION TO MATLAB	6

Introduction to MATLAB: History, basic features, strengths and weaknesses, good programming practices and plan your code.Working with variables, workspace and miscellaneous commands: Creating MATLAB variables, overwriting variable,error messages, making corrections, controlling the hierarchy of operations or precedence, controlling the appearance of floating-point number, managing the workspace, keeping track of your work session, entering multiple statements per line, miscellaneous commands.

UNIT-II	MATRIX, ARRAY AND BASIC MATHEMATICAL FUNCTIONS	6

Matrix generation, entering a vector, entering a matrix, matrix indexing, colon operator, linear spacing, creating a sub-matrix, dimension, matrix operations and functions matrix generators, special matrices, array and array operations, solving linear equations, other mathematical functions.

UNIT-III	BASIC PLOTTING	6

Overview, creating simple plots, adding titles, axis labels, and annotations, multiple data sets in one plot, specifyingline styles and colours.

UNIT-IV	INTRODUCTION TO PROGRAMMING	6

Introduction to programming: Introduction, M-File Scripts, script side-effects, M-File functions, anatomy of a M-File function, input and output arguments, input to a script file, output commands.
Control flow and operators: "if ... end" structure, relational and logical operators, "for ... end" loop, "while ... end"loop, other flow structures, operator precedence, saving output to a file.

UNIT-V	DEBUGGING M-FILES	6

Debugging process, preparing for debugging, setting breakpoints, running with breakpoints, examining values,correcting and ending debugging, correcting an M-file.

	Total Contact Hours	:	30

List of Experiments	
1	Programs using mathematical, relational expressions and the operators.
2	Vectors and Matrices: Programs using array operations and matrix operations (such as matrix multiplication).
3	Programs on input and output of values.
4	Selection Statements: Experiments on if statements, with else and elseif clauses and switch statements.
5	Loop Statements and Vectorizing Code: Programs based on the concepts of counted (for) and conditional (while) loops.
6	Programs based on scripts and user-defined functions.
7	Programs on Built-in text manipulation functions and conversion between string and number types.
8	Programs based on two main data structures: cell arrays and structures.
9	Programs based on Data Transfer
10	Programs based on Advanced Functions.
11	Introduction to Object-Oriented Programming and Graphics.

12	Programs based on Advanced Plotting Techniques.		
13	Programs based on sound files and image processing.		
14	Programs based on Advanced Mathematics.		
		Contact Hours	:	30
		Total Contact Hours	:	60

Course Outcomes:

On completion of the course, the students will be able to

☐	Write fundamental programs in MATLAB, creating variables and mathematical functions.
☐	Understand how to program matrix operations, array operations and how to solve the system of linear equations.
☐	Program the fundamentals concepts of basic Plotting consisting of simple and multiple data sets in one plot.
☐	Understand how to program M-file scripts, M- file functions, Input –output Arguments and program control flow operators, loops, flow structures.
☐	Use the debugging process and debugging M-files.

Text Book (s):

| 1 | Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, "Digital Image Processing using MATLAB", Third Edition, Gatesmark Publishing,2020. |
| 2 | Stormy Attaway, Butterworth-Heinemann, "MATLAB: A Practical Introduction to Programming and Problem Solving", 5th Edition, Boston : Butterworth-Heinemann is an imprint of Elsevier, 2018. |

Reference Books(s) :

| 1 | https://www.mathworks.com/content/dam/mathworks/mathworks-dot com/moler/exm/book.pdf |
| 2 | https://www.mathworks.com/help/releases/R2014b/pdf_doc/matlab/getstart.pdf |

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CB23F33.1	3	3	3	1	1	2	1	2	1	2	2	2	3	2	3
CB23F33.2	3	3	3	1	3	2	1	2	1	2	3	2	3	2	3
CB23F33.3	3	3	3	3	2	1	2	2	2	2	3	2	3	2	3
CB23F33.4	3	3	3	3	2	1	2	2	2	2	3	2	3	2	3
CB23F33.5	3	3	3	3	2	1	2	2	2	2	2	2	3	2	3
Average	3	3	3	2.2	2	1.4	1.6	2	1.6	2	2.6	2	3	2	3

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation: "-"

Course Code	Course Title (Lab Oriented Theory Course)	Category	L	T	P	C
CB23F34	**COMPILER DESIGN TECHNIQUES**	PE	2	1	2	4

Objectives:
☐ Learn the various phases of a Compiler.
☐ Analyze the various parsing techniques and different levels of translation.
☐ Understand Semantic analysis and run-time environment.
☐ Understand intermediate code generation and optimization.
☐ Learn how about code improvement and type systems.

UNIT-I	INTRODUCTION TO COMPILERS	9
Phases of compilation and overview. Lexical Analysis (scanner): Regular languages, finite automata, regular expressions, relating regular expressions and finite automata, scanner generator (lex, flex).		
UNIT-II	**SYNTAX ANALYSIS**	**9**
Context-free languages and grammars, push-down automata, LL(1) grammars and top-down parsing, operator grammars, LR(O), SLR(1), LR(1), LALR(1) grammars and bottom-up parsing, ambiguity and LR parsing, LALR(1) parser generator (yacc, bison).		
UNIT-III	**SEMANTIC ANALYSIS**	**9**
Attribute grammars, syntax directed definition, evaluation and flow of attribute in a syntax tree. Basic structure, symbol attributes and management. Run-time environment: Procedure activation, parameter passing, value return, memory location, scope.		
UNIT-IV	**INTERMEDIATE CODE GENERATION AND CODE OPTIMIZATION**	**9**
Translation of different language features, different types of intermediate forms. Control-flow, data-flow dependence local optimization, global optimization, loop optimization, peep-hole optimization.		
UNIT-V	**ARCHITECTURE DEPENDENT CODE IMPROVEMENT**	**9**
Register allocation and target code generation. Type systems, data abstraction, compilation of object oriented features and non-imperative programming languages, Instruction scheduling (for pipeline), loop optimization (for cache memory) – RISC architecture.		
	Contact Hours :	**45**

	List of Experiments
1	Implement a lexical analyzer to recognize tokens in C. (Ex. identifiers, constants, operators, keywords etc.).
2	Design a Calculator using LEX.
3	Identify an arithmetic expression using LEX and YACC.
4	Evaluate expression that takes digits, *, + using YACC.
5	Generate Three address codes for a given expression (arithmetic expression, flow of control).
6	Implement Code Optimization Techniques like copy propagation, dead code elimination, common sub expression elimination.
7	Generate Target Code (Assembly language) for the given set of Three Address Code.
	Contact Hours : **30**
	Total Contact Hours : **75**

Course Outcomes:
On completion of the course, the students will be able to
☐ Demonstrate the functioning of a Compiler.
☐ Develop language specifications using context free grammars (CFG).
☐ Develop syntax tree and demonstrate the memory management process.
☐ Apply the various optimization techniques.
☐ Generate a target code.

Text Books:	
1	Santanu Chattopadhyay, Compiler Design, Second Edition, PHI Learning Pvt. Ltd., 2022.
2	Torben Ægidius Mogensen , "Introduction to Compiler Design",Springer,2023
3	Alfred V Aho, Monica S. Lam, Ravi Sethi and Jeffrey D Ullman, "Compilers – Principles, Techniques and Tools", Second Edition, Pearson Education, 2007.

Reference Books	
1	Randy Allen, Ken Kennedy, "Optimizing Compilers for Modern Architectures: A Dependence-based Approach", First Edition, Morgan Kaufmann Publishers, 2002.
2	Steven S. Muchnick, "Advanced Compiler Design and Implementation", First Edition, Morgan Kaufmann publishers, 2003.
3	D. Grune, H.E. Bal, C.J.H. Jacobs, K.G. Langendoen, "Modern Compiler Design", Wiley, 2008
4	Allen I. Holub, "Compiler Design in C", Prentice Hall of India, 2003.

CO - PO – PSO matrices of course

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CB23F34.1	3	3	3	3	2	-	-	-	2	-	1	1	3	2	-
CB23F34.2	3	3	3	3	2	-	-	-	2	-	1	1	3	3	-
CB23F34.3	3	3	3	3	2	-	-	-	2	-	1	1	3	3	-
CB23F34.4	3	3	3	3	2	-	-	-	2	-	1	1	3	3	-
CB23F34.5	3	3	3	3	2	-	-	-	2	-	1	1	3	3	-
Average Mapping	3	3	3	3	2	-	-	-	2	-	1	1	3	2.8	-

Note: Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)If there is no correlation, put "-"

Course Code	Course Title (THEORY COURSE)	Category	L	T	P	C
CB23G11	QUANTUM COMPUTATION AND QUANTUM INFORMATION	PE	3	0	0	3

Objectives:	
☐	To learn about Quantum information.
☐	To gain knowledge about Quantum algorithms.
☐	To understand and learn about Quantum random number generators.
☐	To study the basis of post-Quantum cryptography.

UNIT-I	INTRODUCTION TO QUANTUM INFORMATION	9
	States, Operators, Measurements, Quantum Entanglement: Quantum Teleportation, Super-dense coding, CHSH Game, Quantum gates and circuits.	
UNIT-II	QUANTUM ALGORITHMS	9
	Deutsch-Jozsa, Simon, Grover, Shor, Implication of Grover's and Simon's algorithms towards classical symmetric key cryptosystems, Implication of Shor's algorithm towards factorization and Discrete Logarithm based classical public key cryptosystems.	
UNIT-III	QUANTUM TRUE RANDOM NUMBER GENERATORS	9
	Detailed design and issues of quantum Ness, Commercial products and applications.	
UNIT-IV	QUANTUM KEY DISTRIBUTION	9
	BB84, Ekert, Semi-Quantum QKD protocols and their variations, Issues of Device Independence, Commercial products.	
UNIT-V	INTRODUCTORY TOPICS IN POST-QUANTUM CRYPTOGRAPHY	9
	API-Public-key Signatures, Key Encapsulation Mechanism (KEM), Digital Signature standard, Pair-Wise Key Establishment-Discrete Logarithm Cryptography, Integer Factorization Cryptography.	
	Total Contact Hours :	45

Course Outcomes:	
On completion of the course, the students will be able to	
☐	Apply quantum gates and circuits using quantum information.
☐	Apply quantum algorithms in cryptosystems.
☐	Understand the importance of Quantum random number generator.
☐	Understand the importance of Quantum key distribution.
☐	Apply the concept of post-quantum cryptography.

Text Book (s):	
1	Chris Bernhardt, "Quantum Computing for Everyone", The MIT Press, 2019.
2	M. A. Nielsen and I. L. Chuang, "Quantum Computation and Quantum Information", 10th Edition ,Cambridge UniversityPress, 2010.
3	Presskil Lecture notes: Available online: http://www.theory.caltech.edu/~preskill/ph229/

Reference Books(s) :	
1	P. Kaye, R. Laflamme, and M. Mosca, "An Introduction to Quantum Computing". Oxford University Press, New York, 2006.
2	N. David Mermin, "Quantum Computer Science", Cambridge University Press, 2007.
3	Quantum Cryptography. D. Unruh:, Available online: https://courses.cs.ut.ee/all/MTAT.07.024/2017_fall/uploads/
4	SAPV Tharrmashastha, D. Bera, A. Maitra and S. Maitra, "Quantum Algorithms for Cryptographically Significant Boolean Functions - An IBMQ Experience", Springer, 2020.
5	Quantum Algorithm Zoo. https://quantumalgorithmzoo.org/
6	A. J. Menezes, P. C. van Oorschot, and S. A. Vanstone, "Handbook of Applied Cryptography", CRC Press,2018.

CO - PO – PSO matrices of course

PO/PSO ⟍ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CB23G11.1	3	3	3	3	3	2	-	-	-	-	2	2	3	3	1
CB23G11.2	3	3	3	3	2	1	-	-	-	-	2	2	3	3	1
CB23G11.3	3	3	2	2	2	1	-	-	-	-	1	1	3	3	1
CB23G11.4	3	3	2	3	2	1	-	-	-	-	1	1	3	3	1
CB23G11.5	3	3	2	2	2	1	-	-	-	-	1	1	3	3	1
Average	3.0	3.0	2.4	2.6	2.2	1.2	-	-	-	-	1.4	1.4	3.0	3.0	1.0

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High) Nocorrelation: "-"

Course Code	Course Title (Lab Oriented Theory course)	Category	L	T	P	C
CB23G31	**ROBOTICS AND EMBEDDED SYSTEMS**	PE	2	0	2	3

Objectives:
☐ To understand the concept of Industry 4.0 and technologies for cognitive robotics
☐ To understand the fundamentals of robotics operating systems
☐ To understand the role of AI in cognitive robotics
☐ To understand and demonstrate the role of Data Science and their working principles in robotics
☐ To demonstrate the concepts of cloud computing with robot on various real time applications

UNIT-I	**INTRODUCTION TO MODERN DAY ROBOTICS AND THEIR INDUSTRIAL APPLICATIONS**	**6**
Industry 4.0 Concept: Background and Overview-Industry 4.0 technologies: implementation patterns in manufacturing companies-Evolution of Industrial Robots and their Applications-Advancements in Robotics and Its Future Uses-Types of robotics in various fields for applications **Technologies essential for Cognitive Robotics:** Computer systems and Technologies relevant to modern day robotics-Robotic Process Automation: Overview of RPA and its applications-RPA, AI, and Cognitive Technologies for Leaders-Introduction to Robotics: Analysis, Control, Applications	
UNIT-II	**BASICS OF ROBOTIC OPERATING SYSTEM**	**6**
	Basics of Robotic operating System: ROS for beginners an overview- Introduction to the Robot Operating System (ROS) Middleware - Secure communication for the Robot Operating System - An Introduction to Robot Operating System: The Ultimate Robot Application Framework by Adnan Quality of Service and Cybersecurity Communication Protocols -Analysis for the Robot Operating System Robotics systems communication- Threat modelling using ROS **Towards cloud robotic system:** A case study of online co-localization for fair resource competence-A Case Study on Model-Based Development of Robotic Systems using Monti Arc with Embedded Automata	
UNIT-III	**AI IN THE CONTEXT OF COGNITIVE ROBOTICS AND ROLE OF AI IN ROBOTICS**	**6**
	Foundation for Advanced Robotics and AI- A Concept for a Practical Robot Design Process- Demo to train A Robot Using AI - Deep learning core applications-Deep learning business applications **Introduction to computer vision and application of Vision Systems in Robotics:** Concepts of computer vision and the how vision systems are becoming essential part of Robotics-Computer Vision: Models, Learning, and Inference - Mastering Computer Vision with TensorFlow 2.x: Build advanced computer vision applications using machine learning and deep learning techniques- Machine Vision Applications- Application areas for vision systems-Robot inspection case study-Autonomous driving using 3D imaging case study.	
UNIT-IV	**DATA SCIENCE AND BIG DATA IN THE CONTEXT OF COGNITIVE ROBOTICS**	**6**
	Cognitive Technologies: The Next Step Up for Data and Analytics in robotics-Cognitive Deep Learning Technology for Big Data Cognitive Assistant Robots for Reducing Variability in Industrial Human-Robot Activities **Introduction to Python and R Programming in the context of Robotics:** Introduction to Python - Python Functions for Data Science-Basic ROS Learning Python for robotics- An introduction to R -The R in Robotics rosR: A New Language Extension for the Robot Operating System **Artificial Intelligence and Robotics** - The Review of Reliability Factors Related to Industrial Robots -Failure analysis of mature robots in automated production- Data Analytics for Predictive Maintenance of Industrial Robots - Failure Is an Option: How the Severity of Robot Errors Affects Human-Robot Interaction	
UNIT-V	**CONCEPTS OF CLOUD COMPUTING, CLOUD PLATFORMS AND IT APPLICATIONS IN ROBOTICS**	**6**
	Learning Cloud Computing: Core Concepts - Cloud Computing: Private Cloud Platforms -Robot as a Service in Cloud Computing -Cloud Computing Technology and Its Application in Robot Control - A Comprehensive Survey of Recent Trends in Cloud **Robotics Architectures and Applications** - Google's cloud robotics and high computing needs of industrial automation and systems-The role of cloud and opensource software in the future of robotics-The Power of Cloud Robotics by Robotics Industry Association	
	Contact Hours	**: 30**

	List of Experiments
1	Build a Self-Driving Robot that can automatically follow a line
2	Build a basic obstacle-avoiding robot and improve the design to help it avoid getting stuck
3	Build a Humanoid Robot
4	Autonomous Robot Navigation using Computer Vision for exhaustive path-finding
5	A Mobile Autonomous Chemical Detecting Robot
6	Build a voice controlled robot
7	Web-Controlled Mobile Video-Enabled Robotic Litter Collection Device
8	Utilizing Artificial Neural Networks to Create a Learning Robot
9	Hospital Sanitizing Robot
10	Autonomous Robotic Vehicle: Saving lives, preventing accidents one at a time
11	Build a robot with Python and 3D Printed Robotic Arm
12	Build an Intelligent Irrigation Control System
13	AI-powered Hearing Aid
14	Fire Extinguishing Robot
15	Remote Operated Spy Robot Circuit

Contact Hours	:	30
Total Contact Hours	:	60

Course Outcomes:
- Develop skills of using advanced software for solving practical problems in robotics pertaining to various industries
- Understand the basics of Robotic operating systems and communication system
- Understand basic concepts and technological advancements in AI and robotics
- Understand and apply several statistical analysis techniques, business analytics for cognitive robotics and programming of robots using python and R languages
- Understand and apply the cloud computing concepts in robotics

Text Book (s):
1. Saeed Benjamin Niku, "Introduction to Robotics: Analysis, Control, Applications", Third Edition Wiley Publishers, 2019..
2. Simon J. D. Prince, "Computer Vision: Models, Learning, and Inference", Cambridge University Press, 2012.
3. Francis X. Govers," Artificial Intelligence for Robotics: Build Intelligent Robots that Perform Human Tasks Using AI Techniques", Packt publishing, 2018.

Reference Books(s) / Web links:
1. Krishnendu Kar, "Mastering Computer Vision with TensorFlow 2.x: Build Advanced Computer Vision Applications Using Machine Learning and Deep Learning Techniques", Packt publishing, 2020.
2. Armando Vieira, Bernardete Ribeiro," Introduction to Deep Learning Business Applications for Developers from Conversational Bots in Customer Service to Medical Image processing",Apress, 2018.
3. Steve Heath, "Embedded System Design 2nd Edition", EDN Series for Design Engineers, 2003

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CB23G31.1	3	3	3	2	3	3	2	2	2	2	3	3	2	3	3
CB23G31.2	3	2	2	3	2	2	2	2	2	2	2	2	2	3	2
CB23G31.3	3	3	3	3	3	3	2	2	3	2	3	3	2	3	3
CB23G31.4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CB23G31.5	3	3	3	2	3	3	3	3	2	3	3	3	2	3	3
Average	3	2.8	2.8	2.6	2.8	2.8	2.4	2.4	2.4	2.4	2.8	2.8	2.2	3	2.8

Note: Enter correlation levels 1, 2 or 3 as defined below:
1: Slight (Low)
2: Moderate (Medium)
3: Substantial (High)
If there is no correlation, put "-"

Course Code	Course Name	Category	L	T	P	C
CS23A32	ROBOTIC PROCESS AUTOMATION	PE	1	0	4	3

Objectives:
● Prepare to become Junior RPA Developers.
● Learn the basic concepts of Robotic Process Automation.
● Develop familiarity and deep understanding of UiPath tools.
● Develop the ability to design and create robots for business processes independently.
● Develop skills required to pass UiPath Automation Developer Associate v1.0.

	List of Experiments
1.	Downloading and Installing UiPath Academic Alliance and connect to Orchestrator.
2.	Installing UiPath Extension in Browsers.
3.	Installing Activity Packages in UiPath Studio - Manage Packages feature to find, install, update and remove packages.
4.	Experiments based on variables and arguments.
5.	Algorithmic Approach: Selection control structures.
6.	Algorithmic Approach: Iteration control structures.
7.	Debugging - Debug modes, debug actions and the debug ribbon option to debug a file or the entire Project and simple and conditional breakpoints and simple and conditional trace points.
8.	Exception Handling - Try Catch, Throw, Rethrow and Retry Scope.
9.	Logging - Apply logging best practices during development.
10.	UI Automation – Modern Recorder, Modern UI Automation Input Activities and Input Methods, Modern UI Automation Output Activities and Output Methods, UI Synchronization with activities available in the Modern Design Experience, static and dynamic Descriptors.
11.	Excel Automation.
12.	Email Automation.
13.	PDF Automation.
14.	Working with Files and Folders.
15.	Data Manipulation.
16.	Version Control Integration.
17.	Libraries and Templates.
18.	Workflow Analyzer
19.	Orchestrator: Invoice Processing – Dispatcher.
20.	Orchestrator: Invoice Processing – Performer.

		Contact Hours	:	45

Course Outcomes: On completion of the course, students will be able to:
● Start working as Junior RPA Developers.
● Understand the fundamental principles of robotic process automation.
● Become familiar with and gain a thorough knowledge of UiPath's software tools.
● Design and build automation robots for business tasks on their own.
● Successfully pass the UiPath Automation Developer Associate v1.0 certification exam.

	Text Books:
1.	Niyaz Ahmed, Lahiru Fernando, Rajaneesh Balakrishnan ,"UiPath Associate Certification Guide: The go-to guide to acing your Associate certification exam with the help of mock tests and quizzes", Packt Publishing Limited, 2022.
2.	Alok Mani Tripathi ,"Learning Robotic Process Automation: Create Software Robots and Automate Business Processes with the Leading RPA Tool – UiPath", Packt Publishing Limited, 2018.

	Reference Books:
1.	Robotic Process Automation Projects: Build real-world RPA solutions using UiPath and Automation Anywhere, Nandan Mullakara, Arun Kumar Asokan, Packt Publishing Ltd., 2020.
2.	The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems, Tom Taulli, Apress, 2020.
3.	Democratizing Artificial Intelligence with UiPath: Expand automation in your organization to achieve operational efficiency and high performance, Fanny IP, Jeremiah Crowley, Packt Publishing Limited, 2022.
4.	UiPath Administration and Support Guide: Learn industry-standard practices for UiPath program support and administration activities, Arun Kumar Asokan, Packt Publishing, 2022.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CS23A32.1	3	2	2	1	3	-	-	-	1	3	3	2	2	2	1
CS23A32.2	1	1	2	3	3	-	-	-	1	2	3	1	3	2	1
CS23A32.3	2	3	2	3	3	-	-	-	2	3	1	1	3	3	3
CS23A32.4	1	2	1	2	2	-	-	-	1	2	1	3	3	3	2
CS23A32.5	3	3	3	3	3	-	-	-	3	1	1	1	3	2	1
Average	2	2.2	2	2.4	2.8	-	-	-	1.6	2.2	1.8	1.6	2.8	2.4	1.6

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low)
2: Moderate (Medium)
3:Substantial (High) No

Course Code	Course Name (Theory course)	Category	L	T	P	C
CR23A33	**CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES**	**PE**	**2**	**0**	**2**	**3**

Objectives:
• To understand how blockchain operates and its potential applications beyond cryptocurrency
• To understand various types of cryptocurrencies, mining processes, wallets, and their economic Principles
• To understand how smart contracts and decentralized applications transform the Ethereum
• To understand common security challenges in cryptocurrencies and blockchain
• Explore in setting up a cryptocurrency wallet, interacting with blockchain platforms, and exploring dApps for diverse applications.

UNIT I	INTRODUCTION	6
Overview, distributed ledger, how it works, and its key components like blocks, hashing functions, and consensus mechanisms (Proof of Work, Proof of Stake). Blockchain operation and its potential to revolutionize various industries beyond just cryptocurrency.

UNIT II	CRYPTOCURRENCIES	6
Overview of history and evolution of leading cryptocurrencies like Bitcoin and Ethereum, different types of cryptocurrencies available, the mining process that creates new coins, how to securely store them in wallets, and the economic principles that govern their value.

UNIT-III	SMART CONTRACTS AND DAPPS	6
Overview of smart contracts and decentralized applications (dApps), Smart contracts functionalities, limitations, and real-world applications, dApp platforms like Ethereum and how these applications are transforming industries such as finance, supply chain management, and even voting systems.

UNIT IV	BLOCKCHAIN SECURITY, REGULATION, AND FUTURE APPLICATIONS	6
Overview on common security challenges associated with cryptocurrencies and blockchain platforms, like hacking attempts and fraudulent activities, explore the current regulations and potential future frameworks being developed globally, Future applications of blockchain technology across different sectors like healthcare, data management, and the Internet of Things (IoT).

UNIT-V	BLOCKCHAIN IN PRACTICE	6
Provide practical experience with blockchain and cryptocurrency tools, Set up a cryptocurrency wallet, interact with a blockchain platform like Ethereum or another chosen platform, or explore dApps for different purposes (e.g., decentralized finance applications or NFT marketplaces).

	Total Contact Hours	**:**	**30**

	List of Experiments
1	Simulate a Simple Blockchain creation
2	Simple implementation of Proof of Work
3	Simulate Bitcoin Mining
4	Creating a Crypto-currency Wallet
5	Creating and Deploying a Simple Smart Contract on Ethereum (Remix)
6	Developing a Simple dApp with Web3 and Python
7	Writing a Simple Smart Contract with Python or Solidity
8	Public and Private key generation and basic encryption for Wallet security
9	Creating a cryptocurrency wallet on a platform like MetaMask or Trust Wallet, and perform transactions on a testnet
10	Exploring and Interacting with a Decentralized Finance (DeFi) Application or NFT Marketplace

	Contact Hours :	30
	Total Contact Hours :	**60**

Course Outcomes:

On completion of course you will be able to

- Develop knowledge in the core concepts of blockchain technology, including distributed ledgers, hashing functions, and consensus mechanism
- Focus on understanding history and evolution of cryptocurrencies, such as Bitcoin and Ethereum
- Understand the concept of smart contracts and their functionalities on a blockchain platform
- Understand the potential future applications of blockchain technology across various industries
- Demonstrate practical skills through hands-on activities, such as setting up a cryptocurrency wallet or interacting with a blockchain platform

Suggested Activities:

- Problem solving sessions
- Mini projects

Course Outcomes:

On completion of course you will be able to

- Tutorial problems.
- Assignment problems.
- Quizzes
- Class presentation/Discussion

Reference Books (s)/Web links:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. "Bitcoin and cryptocurrency technologies: a comprehensive introduction", Princeton University Press, 2016
2. Don and Tapscott, Alex, "Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies is Changing the World", Penguin, 2018.
3. Bashir and Imran, "Mastering Blockchain: Deeper insights into decentralization, cryptography,

	Bitcoin, and popular Blockchain frameworks", Packt,2017	
4.	Ritesh Modi, "Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain", Packt Publishing, 2018	

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CR23A33. 1	3	2	3	-	1	-	-	-	1	-	1	2	2	1	2
CR23A33. 2	2	2	2	-	1	-	-	-	1	-	1	2	2	1	2
CR23A33. 3	2	2	3	-	2	-	-	-	1	-	1	2	2	1	2
CR23A33. 4	2	2	2	-	2	-	-	-	1	-	1	2	2	1	2
CR23A33. 5	2	2	2	-	2	-	-	-	1	-	1	2	2	1	2
Average	2.2	2	2.6	-	1.6	-	-	-	1	-	1	2	2	1	2

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High) No correlation: "-"

Course Code	Course Name (Theory course)	Category	L	T	P	C
CS23B31	INTRODUCTION TO METAVERSE	PE	3	0	0	3

Objectives:
• To learn the basics of Metaverse characteristics, concepts and layers.
• To understand and analyze Metaverse technologies, tools and platforms.
• To discuss design theories and practices relevant to the Metaverse.
• To explore cybersecurity and cybercrime in the Metaverse.
• To explore metaverse applications and examine open challenges in the Metaverse.

UNIT-I	Metaverse fundamentals	9

Metaverse evolution-Metaverse importance and characteristics-The interdisciplinary nature of the Metaverse-Metaverse opportunities and risks- Computer-mediated communication -Avatar-mediated communication-layers of Metaverse: Experience-Discovery-Creator economy- Spatial computing- Decentralization - Human interface-Infrastructure

UNIT-II	Metaverse technologies, tools and platforms	9

Metaverse Technologies: AR/VR/MR/XR - 3D reconstruction - Game engines - Smart glasses- wearables, haptic devices, headsets and headwear -Blockchain, smart contracts, tokens, NFTs - Cryptography - Artificial Intelligence (AI) - Internet of Things (IoT) - Edge computing and 5G, 6G
Tools and technologies for Metaverse UX and UI: Tools and services for avatar systems - Spatial user interface design - Cross-platform user experience design - Multimodal user interface- Technologies and devices for human computer interaction in Metaverse
Metaverse Platforms: Decentraland, SANDBOX - Roblox, Axie Infinity- uHive, Hyper Nation - Nakamoto (NAKA), Metahero (HERO), Star Atlas (ATLAS)- Bloktopia (BLOK), Stageverse - Spatial, PalkaCity, Viverse -Sorare, Illuvium, Upland - Second Life, Sansar, Sensorium Galaxy

UNIT-III	Design theories and practices	9

Social presence and co-presence - Motion sickness and cybersickness- Uncanny valley - Sense of self- location, sense of agency and sense of body ownership-Universal simulation principle- Prototyping- Evaluation techniques

UNIT-IV	Cybersecurity and Cybercrime in the Metaverse	9

Metaverse and cybersecurity: Cybersecurity concerns in Metaverse: social engineering attacks, Data theft, Decentralization vs vulnerabilities - Cybersecurity risks in Metaverse: process, people, technology - Best practices for preventing cyberattacks in Metaverse: Risk assessment and mitigation, Physical security, Data encryption, Controlled access, Protect outbound data - Implementing cybersecurity in the Metaverse: Platform owners, Property owners/renters, Consumers/users
Metaverse and cybercrime: Scam and theft- Rug pull- Money manipulation and wash trading- Money laundering

UNIT-V	Metaverse applications, challenges and open issues	9

Metaverse applications: Gaming and entertainment- Travel and tourism - Education and learning- Real estate -Banking and Finance- Healthcare- Social media- Fashion
Metaverse challenges and open issues: Persistency - Interoperability and scalability- Maturity- Regulation- Usefulness and ease-of-use - Privacy and data security- Content creation- NFTs and creator economy - Social, legal and ethical issues in the Metaverse

	Contact Hours	:	45

Course Outcomes: On completion of the course, the students will be able to
• Understand the characteristics, and interdisciplinary nature of the Metaverse, the opportunities and risks it presents.
• Analyze Metaverse layers, the technologies used in creating them, as well as design theories and practices for Metaverse.
• Examine and discuss Metaverse platforms, applications and the latest technological developments in this area

•	Identify cybersecurity issues, understand cybercrime in the Metaverse
•	Discuss various applications and the open challenges in Metaverse

Text Books:

1	Terry Winters ,"The Metaverse : Prepare Now For the Next Big Thing! ", Independently published, 2021.

Reference Books:

1.	Ball, M., 2022, "The Metaverse and How It Will Revolutionize Everything ", Liveright, ISBN: 978-1324092032
2.	Christodoulou, K. Katelaris, L., Themistocleous, M, Christoudoulou P. and Iosif E, 2022, "NFTs and the Metaverse Revolution: Research Perspectives and Open Challenges", Blockchains and the Token Economy: Theory and Practice, Eds: Lacity M., Treiblmaier H., (2022), Palgrave Macmillan, Cham, pp. 139-178
3.	Damar, M. (2021). Metaverse shape of your life for future: A bibliometric snapshot. Journal of Metaverse, 1(1), 1–8.
4	Day, J. (2022) Metaverse will see cyberwarfare attacks unlike anything before: 'Massively elevated', February 28, https://www.express.co.uk/news/science/1570844/metaverse-news-cyberwarfare-attacks-virtual-worlds-russia-china-spt.
5	Davis, A., Khazanchi, D., Murphy, J., Zigurs Ilze, & Owens, D. (2009). Avatars, people, and virtual worlds: Foundations for research in metaverses. Journal of the Association for Information Systems, 10(2), 90–117. https://doi.org/10.17705/1jais.00183

Learning Activities and Teaching Methods:

- Faculty Lectures
- Guest-Lectures Seminars
- Directed and Background Reading
- Case Study Analysis
- Academic Paper Discussion
- Simulations
- Student-led Presentations
- In-Class Exercises

Assessment Methods:

- Interactive Activities
- Assignments / Project
- Quiz
- CAT & Final Exams

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CS23B31.1	3	2	2	2	3	1	2	1	2	1	2	1	3	2	2
CS23B31.2	3	3	3	3	3	1	2	1	2	2	2	1	3	3	3
CS23B31.3	3	3	3	3	3	2	2	1	2	2	2	1	3	3	3
CS23B31.4	3	2	2	3	3	3	3	2	2	1	2	2	2	3	2
CS23B31.5	3	3	3	3	3	2	2	1	2	2	2	1	3	2	3
Average	3	2.6	2.6	2.8	3	1.8	2.2	1.2	2	1.6	2	1.2	2.8	2.6	2.6

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low)
2: Moderate (Medium)
3: Substantial (High) No correlation: "-"

Course Code	Course Name (Lab Oriented Theory Course)	Category	L	T	P	C
CS23A39	GAME DEVELOPMENT	PE	2	0	2	3

Objectives:

- To understand the history and overview of game design
- To develop the Game design document
- To apply the concepts of game loop, collision detection and Cameras
- To understand the concepts of graphics in game design
- To be able to incorporate various Mechanics in Developing game

UNIT-I	Introduction to Game Development	6
	Games Overview; History of Games.Lecture: History and Generations of Video Games-Overview of Game Platforms-the Elements of Gameplay-Maths behind Game Development-Generic Programming	
UNIT-II	Game Design Document	6
	Platforms-Input Devices-Game Genres-Game Design-Characters-Storyline-Levels and Environments-Game Play-Graphic Style and Art-Sound and Music-Game Controls-Accessibility-Marketing.	
UNIT-III	Concepts of Game Design	6
	Game Loop-Collision Detection and Reaction-Common Issues with Collision Detection-Cameras-Screen Space Vs Game Space-Hybrid Approaches-Game Design-Game Mechanics-Rewarding the Player-Tips and Tricks-Virtual Resolution-Layering the Graphics-Palette Swapping	
UNIT-IV	Graphic Design for Game Development	6
	Sound and Music-Digital Sound Processing-Fonts-Shaders-Patterns, containers and Classes-Design Pattern-Resource Manager-Ai in Video Games-Useful Algorithms	
UNIT-V	Mechanics in Developing in Game Design	6
	Game Mechanics-I Frames-2D mechanics-RPG Like Games-Rhythm Games-Matchx Games-Cut Scenes-Testing your Game-Balancing your Game-No BS Principle-Managing Hype-Digital Rights Management-Game Jams	
		Contact Hours: 30

	List of Experiments	
1	Create a simple sprite animation using an open source tool.	
2	Narrate a simple game using scratch 2.0 (Character narration).	
3	Implement a scoring mechanism, such as collecting items or reaching certain milestones.	
4	Enhance the visual appeal of the game by adding animated sprites for player movement and other game elements.	
5	Implement basic AI behaviors, such as following the player when in range or patrolling between predefined points.	
6	Implement level transitions and progression.	
7	Incorporate sound effects for player movement, jumping, and interactions.	
8	Create menu screens for starting the game, pausing/resuming, and displaying game over information	
9	Optimize game performance, fix bugs, and polish game elements to improve the overall quality.	
	Contact Hours:	30
	Total Contact Hours:	60

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

- Understand the history and overview of game design

●	Understand and develop the game design document
●	Understand the collision mechanism, cameras and game loops
●	Analyse and apply graphic design approaches for designing an game
●	Choose efficient mechanic in developing and rolling out a game

Text Book(s):	
1	Daniele Penazzo ,"2D Game Development: From Zero to Hero", Python Edition, 2020
2	John P. Doran, Matt Casanova ,"Game Development Patterns and Best Practices", Packt Publishing, 2017.

Reference Book(s) / Web link(s):	
1	"Game Development with Unity", Michelle Minard Course Technology, 2012.
2	Game Development using Python",James R Parker, Mercury Learning and Information, 2021.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CS23A39.1	3	2	2	1	2	-	-	-	-	-	-	-	2	2	2
CS23A39.2	1	2	2	1	2	-	-	-	-	-	-	-	2	2	1
CS23A39.3	1	1	1	2	1	-	-	-	-	-	-	-	2	2	2
CS23A39.4	3	3	1	3	3	-	-	-	-	-	-	-	2	2	3
CS23A39.5	3	3	2	1	3	-	-	-	-	-	-	-	2	2	3
Average	2.2	2.2	1.6	1.6	2.2	-	-	-	-	-	-	-	2	2	2.2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation: "-"