JOY UNIVERSITY

Established vide Tamil Nadu State Pvt. Universities Act 2019

SCHOOL OF COMPUTATIONAL SCIENCE

Outcome Based Curriculum Framework with CBCS

for

BACHELOR OF COMPUTER APPLICATION (CYBER SECURITY)

(BCA Cyber Security)

Students admitted from 2025 -26 onwards

JOY UNIVERSITY
semper paratus

VISION

To create and nurture a multidisciplinary global university with highest academics, research and ethical standards in a creative and innovative environment.

MISSION

To be a premier University of choice for all stakeholders and contribute for academic demographic dividend. To inculcate quality, integrity, team work, compassion, ethics in new generation students for catering to various needs of society.

QUALITY OBJECTIVES

- To disseminate knowledge with skills through teaching, training, seminars, workshops, conferences and symposia in Engineering and Technology, Art and Design, Management and Commerce, Allied Health Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences, Law and Agricultural Sciences to enable students to meet the current needs and trends of industries, business and society.
- To provide technical and scientific solutions to real time problems posed by industries, business and society in all Schools of Joy University.
- To inculcate quality, integrity, team work, compassion, ethics in new generation students for catering to various needs of society.
- To promote the spirit of entrepreneurship in the young generation to help and create more career opportunities in the society by incubating a nurturing technology product idea backed by Technology Business Incubation.
- To identify and nurture leadership and innovate skills in students to become future leaders to enrich society.
- To develop collaborations and partnerships with International global and reputed Universities, research establishments, Government and NGO's, industries and businesses. To support both faculties and students for international exposure.

VISION STATEMENT OF THE SCHOOL

The SOCI envisions a 'cooperatively competitive' academic environment in the thematic areas of the school and relevant research backed by quality education to churn out graduates with professional acumen, exceptional leadership and a humane heart to meet both national and global needs.

MISSION STATEMENT OF THE SCHOOL

The SOCI offers a value-based, technology-oriented education striving to achieve high levels of academic excellence, intellectually competence and exemplary values. The tri-value system of our school is designed to deliver education through three interconnected values: Learning, Transmutation and Transformation

Program Educational Objectives (PEO)

PEO1: Demonstrate analytical and design skills including the ability to generate creative solutions and foster team-oriented, professionalism through effective communication in their careers.

PEO2: Expertise in successful careers based on their understanding of formal and practical methods of application development using the concept of computer programming languages and design principles in national and international level.

PEO3: Pursue advanced education, research and development moreover other creative and innovative efforts in science and technology, as well as other professional careers.

PEO4: Implement their exhibiting critical thinking and problem solving skills in professional practices or tackle social, technical and business challenges.

PEO5: Illustrate effective work conventionalities and be able to adapt as well as accept to the challenges of a dynamic job environment.

Program Outcomes (PO)

PO1: To identify, formulate, review literature and analyze complex engineering problems reaching substantiated conclusions.

PO2: To design solutions for designing system components or processes that meet the specified needs with appropriate consideration for cultural, societal and environmental considerations.

PO3: To use research-based knowledge for analysis and interpretation of data and synthesis of the information to provide valid conclusions.

PO4: To create, select and apply appropriate techniques, resources, and modern automation tools.

PO5: To apply the knowledge of engineering specialization to solve complex problems.

PO6: To convert the real-world problems into computational problem to solve them by using various computational and problem-solving skills.

PROGRAM SPECIFIC OUTCOME (PSO)

PSO1: To develop programming skills, networking skills, learn applications, packages, programming languages and recent techniques in cybersecurity

PSO2: To understand the structure and development methodologies of software systems.

PSO3: To implement the analytical skills, decision making and problem-solving skill in the field of computational studies.

Summary of Credits/Program and Contact Hrs./Week

Semester	I	II	III	IV	V	VI	Total
Credits	16	21	19	26	26	22	130
Contact Hrs./Week	20	25	21	27	26	8	127

SEMESTER WISE CREDIT STRUCTURE

Sl. No.	Category of Courses	1st Year		2nd Year		3rd Year		Total
		Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	
1.	Departmental Core	08	11	19	21	18	07	83
2.	Program Specific Electives (DSE)	–	–	-	03	03	-	06
3.	Open Elective	-	-	-	-	03	-	03
4.	Applied Sciences	04	07	–	–	–	–	11
5.	Internships/ Field Visits	–	–	–	02	02	–	04
6.	Project	–	–	-			15	15
7.	Skill Enhancement Course	–	-	–	-	-	–	-
8.	Ability Enhancement Courses (AECC)	03	–	–	–	–	–	03
9.	Value-Added Course	01	03	-	–	-	–	04
Total		16	21	19	26	26	22	130

School of Computational Intelligence

Bachelor of Computer Application (Cyber Security)

Semester – I							
Sl. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**CONTACT HRS / WK**	**Credits**
1.	25BCCY111	**Core Course** Fundamentals of Computing	3	0	0	3	3
2.	25BCCY112	**Core Course** Introduction to Programming	3	0	0	3	3
3.	25BCCY113	**Applied Science** Mathematics I	3	1	0	4	4
4.	25AEEN911	**Ability Enhancement Compulsory Course (AECC)** - Effective Communication	3	0	0	3	3
5.	25BCCY911	**Value-Added Course** Performing Arts/Sports (Graded)	3	0	0	3	1
6.	25BCCY211	**Core Course** Fundamentals of Computing Lab	0	0	2	2	1
7.	25BCCY212	**Core Course** Introduction to Programming Lab	0	0	2	2	1
		TOTAL	**15**	**1**	**4**	**20**	**16**

Semester - II							
Sl. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**CONTACT HRS / WK**	**Credits**
1.	25BCCY121	**Core Course** Python Programming	3	0	0	3	3
2.	25BCCY122	**Applied Science** Probability, Statistics and Stochastic Processes	3	0	0	3	3
3.	25BCCY123	**Applied Science** Mathematics II	3	1	0	4	4
4.	25BCCY124	**Core Course** Office Automation Tools	3	0	0	3	3
5.	25BCCY125	**Core Course** Discrete Structures for Computer Science	3	0	0	3	3
6.	25EVST921	**Value Added Course** Environmental Science	2	0	0	2	2
7	25BCCY221	**Core Course** Python Programming Lab	0	0	2	2	1
8	25BCCY222	**Core Course** Office Automation Tools Lab	0	0	2	2	1
9	25BCCY223	**Value Added Course** Extended Reality and its applications	0	1	2	3	1
		TOTAL	**17**	**2**	**6**	**25**	**21**

Semester III							
Sl. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**CONTACT HRS / WK**	**Credits**
1.	25BCCY131	**Core Course** Fundamentals of Information and Data Security	3	0	0	3	3
2.	25BCCY132	**Core Course** Data Structure and Algorithms	3	0	0	3	3
3.	25BCCY133	**Core Course** Object Oriented Programming	3	0	0	3	3
4.	25BCCY134	**Core Course** Computer Networks	3	0	0	3	3
5.	25BCCY135	**Core Course** AI in Cyber Security	3	1	0	3	4
5	25BCCY231	**Core Course** Computer Networks Lab	0	0	2	2	1
6	25BCCY232	**Core Course** Data Structure and Algorithms Lab	0	0	2	2	1
7	25BCCY233	**Core Course** Object Oriented Programming Lab	0	0	2	2	1
		TOTAL	**15**	**1**	**6**	**21**	**19**

Semester IV							
Sl. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**CONTACT HRS / WK**	**Credits**
1.	25BCCY141	**Core Course** Cryptography and Network Security	3	0	0	3	3
2.	25BCCY142	**Core Course** Database Management Systems	3	0	0	3	3
3.	25BCCY143	**Core Course** Ethical Hacking and Penetration Testing	3	0	0	3	3
4.	25BCCY144	**Core Course** Computer Organization and Architecture	3	0	0	3	3
5.	25BCCY145	**Core Course** Operating Systems	3	0	0	3	3
6.	25BCCY146	**Core Course** Data Mining and Data Warehousing	3	0	0	3	3
7.	25BCCY241	**Core Course** Cryptography and Network Security Lab	0	0	2	2	1
8.	25BCCY242	**Core Course** Database Management Systems Lab	0	0	2	2	1
9.	25BCCY243	**Core Course** Ethical Hacking and Penetration Testing Lab	0	0	2	2	1
10.	25BCCY341 25BCCY342 25BCCY343	**Discipline Specific Elective I:** Full Stack Developments Number Theory in Cryptography Social Network Analysis	0	3	0	3	3
11	25BCCY441	Industrial Internship	0	0	0	0	2
		TOTAL	**18**	**3**	**6**	**27**	**26**

Semester V							
Sl. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**CONTACT HRS / WK**	**Credits**
1.	25BCCY151	**Core Course** Introduction to Blockchain and Cryptocurrency	3	0	0	3	3
2.	25BCCY152	**Core Course** Malware Analysis	3	0	0	3	3
3.	25BCCY153	**Core Course** Theory of Computation	3	1	0	4	4
4.	25BCCY154	**Core Course** Software Engineering	3	0	0	3	3
5.	25BCCY155	**Core Course** Criminology and Cyber Crimes	3	0	0	3	3
6.	25BCCY251	**Core Course** Introduction to Blockchain and Cryptocurrency Lab	0	0	2	2	1
7.	25BCCY252	**Core Course** Malware Analysis Lab	0	0	2	2	1
8.	25BCCY351 25BCCY352 25BCCY353 25BCCY354	**Discipline Specific Elective** Cloud Security Cloud Computing Fuzzy logic and Computing Introduction to Machine Learning	3	0	0	3	3
9.	25BCCY451	Industrial Internship	0	0	0	0	2
10.	25BCCYO51 25BCCY052 25BCCY053	**Open Electives** Artificial Intelligence Python Programming Computed Networks	3	0	0	3	3
		TOTAL	**21**	**1**	**4**	**26**	**26**

Semester VI							
Sl. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**CONTACT HRS / WK**	**Credits**
1.	25BCCY161	**Core Course** Natural Language Processing	3	0	0	3	3
2.	25BCCY162	**Core Course** Cyber Threat Intelligence	3	0	0	3	3
3.	25BCCY261	**Core Course** Natural Language Processing Lab	0	0	2	2	1
4.	25BCCY561	**Project** Capstone Project	0	0	0	0	15
		TOTAL	**6**	**0**	**2**	**8**	**22**

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY111	Number of Hours/Week	45/3		
Semester	I	Max. Marks	100		
Course Category	Core	Credits	3		
Course Title	FUNDAMENTALS OF COMPUTING		L	T	P
			3	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To have a comprehensive understanding of a foundational understanding of computer systems.
- To learn about various number systems including decimal, binary, octal, and hexadecimal
- To develop a comprehensive grasp of how computers function, the types of software used and the significance of networking in today's digital world.

UNIT	TOPICS	HOURS
I	**Introduction to Computer:** Evolution of Computers, Generations of Computers, Classification of Computers, The Computer System, Computing Concepts, Applications of Computers. **Memory and storage systems:** Computer Software and Hardware components and its requirements- Storage Devices, **Computer Viruses:** Types Of Viruses – Spreading of Virus, Prevention of Computer Virus, Virus Detection, Computer Security, Maintenance, Desktop functions, Dialog boxes, Single Document Interface (SDI), Multiple Document Interface (MDI), Windows Controls, Main Menu Display, Categories of Menus, Main and Context Sensitive Menus, Booting/Shutting Down.	9
II	**Microsoft software**: MS DOS, MS Word System, MS Excel System, MS Power Point System, MS Access System, MS Publisher. **Number System:** Decimal Number System, Binary Number System, Octal Number System, Hexadecimal Number System, BCD, XS,3, Gray Code, Alphanumeric Codes,(ASCII, EBCDIC).	9
III	**Computer Software:** Machine language, Mnemonics, High level Language, Assembler, Compiler, Interpreter, System Development Programs, System Management Programs, Standard Application Programs, Unique Application Programs, Problem Solving, Structuring the Logic.	9
IV	**Memory management:** Introduction, History, Functions, Process, Memory File, Management Device, Security Management, Types of Operating Systems, Providing User Interface, Popular Operating Systems.	9
V	**The Internet And World Wide Web :** History of the Internet-The Internet Applications-Understanding World Wide Web-Web Browsers-Browsing the Internet-Using a Search Engine-Email Service-Protocols used in the Internet. **Data Communications and Networks**: Introduction-Data Communication Using Modem-Computer Networks-Network Topologies-Network Protocols and Software-Applications of Network.	9

Text Books:

1. Fundamentals of Computers, E. Balagurusamy, Tata McGraw Hill Education Private Limited, 2009.

Reference Books:

1. Introduction to Computer Fundamentals, Bright Siaw Afriyie, Second edition, Trafford Publishing, Canada, 2003-2006.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1	Understand the basic concepts of computers.	K2
CO2	Analyze the basics of number systems.	K4
CO3	Apply system development programs to create and manage simple software projects.	K3
CO4	Analyze the performance of different memory management techniques and their impact on system efficiency.	K4
CO5	Evaluate the knowledge of Internet history to understand current Internet technologies and to solve problems in communication and information access.	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	0	3	0	0	2	3	1
CO2	3	3	3	2	3	2	2	2	1
CO3	3	3	2	3	2	2	3	2	3
CO4	3	2	2	3	1	1	3	1	1
CO5	3	2	2	2	1	3	2	1	1
Total	15	12	9	13	7	8	12	9	7

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY112	Number of Hours/Week	3		
Semester	I	Max. Marks	100		
Course Category	Core	Credits	3		
Course Title	INTRODUCTION TO PROGRAMMING		L	T	P
			3	0	0

COURSE OBJECTIVES

The main aim of this course is to prepare the students for:

- To learn the fundamental concepts of programming, including algorithms, flowcharts, and the logical approach to problem solving that is applicable to any programming language.
- To acquire comprehensive understanding of the syntax, semantics and the basic constructs of C language
- Learn to use of pointers, Arrays, and dynamic memory allocation which are key to understanding data structure, memory management.

UNIT	TOPICS	HOURS
I	**Introduction to programming** Algorithm, Formalism, Flow chart, Assembly language, Introduction to program, Program components, structure, Execution path, Programming paradigms introdution, Syntax and Semantics	9
II	**Introduction to C language** History of C, Prerequisites of C, Features and its applications, Structure of C, Preprocessor directives, Data types and constants, variables and its types, Tokens, Identifiers and format specifiers, Operators and Enums, Data I/O, Decision making and Branching, Loop Introdcution, programs with looping structure, Control Flow programs with control flow	9
III	**Array and Strings** Introduction to Array, Initialization, Single dimensional array, Multidimensional array, String, Functions with string: Read, Display string and string functions, String Arrays.	9
IV	**Functions and Pointers** Function Introduction, Function calling, Return type, Function types, Recursion, Types of Recursion, Introduction to Pointers, Types Pointers, Programming exercises with pointers.	9
V	**Structures and Unions** Introduction to structure and simple program using structure concepts, Introduction to Union and programs with union, Storage Classes-Introduction to DMA, Introdcution to Pre-processor	9

Text Book

1. Introduction to Programming Languages 1st Edition by Arvind Kumar Bansal, CRC Press, Taylor and Francis group, 2014.
2. C Programming Language by Brian Kernighan and Dennis Ritchie, Prentice Hall Software, 1988.
3. Programming with C 2 nd Edition Byron Gottfried Schaum's outlines, Tata McGraw-Hill publishers, 1998.

Reference Books

1. E. Balagurusamy, 'Programming in ANSI C', 3rd edition, Tata McGraw Hill Publishers,2004.
2. Eric C.R.Hehner, 'The Logic of Programming', Prentice hall of India, 1991.
3. C: Herbert Schildt, 'The Complete Reference', McGraw Hill, 4th edition , 2017

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Acquiring foundational knowledge of programming including Algorithm, Flowcharts, assembly language basics, Program structure.	K2
CO2 :	Understanding C language fundamentals	K2,K4
CO3 :	Applying various types of arrays and string manipulation technique to manage and process data in programming scenarios	K3
CO4 :	Analyze and experiment with functions, develop recursive solutions, and apply pointers to solve complex problems.	K4
CO5 :	Develop modular programs using control structures, unions	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	2	2	3	1
CO2	3	3	3	2	3	2	2	2	1
CO3	3	3	2	3	2	2	3	2	3
CO4	3	2	2	3	1	2	3	2	1
CO5	3	2	3	2	1	2	3	3	1

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY113	Number of Hours/Week	4		
Semester	I	Max. Marks	100		
Course category	Applied Science	Credits	4		
Course Title	MATHEMATICS-I		L	T	P
			3	1	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To recall and remember basics of matrices, complex numbers, and differential calculus.
- To understand the concepts of basic mathematical methods for matrices, complex numbers and differential calculus.
- To apply methods to solve engineering problems.
- To analyze engineering problems and evaluate.
- To solve and evaluate the problems using matrices, complex numbers, and differential calculus.

UNIT	TOPICS	HOURS
I	**Introduction to Differentiation and its applications:** Fundamentals of Differentiation, Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin's theorems with remainders, Indeterminate forms and L'Hopital's rule, Maxima and Minima	10
II	**Integration and its applications:** Double integral, Triple integral, Change of order of integration, Change of variables, Beta and Gamma functions and their properties, Dirichlet's integral and its applications to area and volume, Liouville's extensions of Dirichlet's integral.	12
III	**Sequence:** Real number system, Convergence of sequence and series, Tests for convergence	8
IV	**Series:** Power series, Taylor's series, Series for exponential, trigonometric and logarithm functions, Fourier series: Half range sine and cosine series, Parseval's theorem.	8
V	**Advanced Multivariable Calculus:** Limit, continuity and Course Categoryial derivatives, Directional derivatives, Total derivative, Tangent plane and normal line, Maxima, minima and saddle points, Method of Lagrange multipliers, Gradient,curl and divergence	10
VI	**Advanced Matrix Theory**: Introduction, types of matrices-symmetric, skew-symmetric, Hermitian, skew-Hermitian, orthogonal, unitary matrices, Rank of a matrix - echelon form, normal form, consistency of system of linear equations (Homogeneous and Non-Homogeneous).Inverse and rank of a matrix, rank-nullity theorem	12

Text Books

1: Advanced Engineering Mathematics, 10th Edition, Erwin Kreyszig

2: Calculus and Analytical Geometry, Thomas and Finney

3: Veerarajan T., Engineering Mathematics-I, Tata McGraw-Hill, New Delhi, 2008.

4: Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

Reference Books

1: B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

2: Principles of Mathematical Analysis, W. Rudin

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Understand the concepts of mean value theorems, higher order derivative, series expansion and associated problems	**K2**
CO2 :	Acquire problem solving skills for finding area and volume using multiple integrals	**K3**
CO3 :	Analyze sequences and series, including Fourier series	**K4**
CO4 :	Apply the differentiation of functions of two variables for maximization and minimization	**K3**
CO5 :	Evaluate basic matrix operations, linear systems of equations	**K5**

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	2	2	1	0	0	0	1	0	0
CO2	2	2	0	0	0	0	2	1	1
CO3	1	2	1	0	0	0	1	2	1
CO4	2	2	2	0	1	0	1	1	2
CO5	3	3	1	0	0	0	2	2	0

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	23AEEN911	Number of Hours/Week	3		
Semester	I	Max. Marks	100		
Course Category	Ability Enhancement Compulsory Course	Credits	3		
Course Title	EFFECTIVE COMMUNICATION		L	T	P
			3	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students to:

- To define and explain the fundamental concepts, types, and processes of communication.
- To develop active listening and effective speaking skills to enhance interpersonal
- To improve reading comprehension skills through different techniques.
- To apply grammar and vocabulary rules and public communication for accurate sentence structure and effective written communication.
- To prepare and deliver effective presentations by planning, structuring, and overcoming stage fright.

UNIT	TOPICS	HOURS
I	**Introduction to Communication** Definition of Communication, Types of Communication: Formal, Informal, Oral, Written, Verbal, non-verbal, interpersonal, intrapersonal Process of Communication: Sender, Message, Channel, Receiver, Feedback Barriers: Intrapersonal, Interpersonal, Organizational Overcoming Barriers	8
II	**Listening and Speaking:** Active Listening: Types of Listening, Reasons for poor listening Traits of the good listener, Effective Speaking: Achieving Confidence, Clarity, and Fluency, Public Speaking, Drafting the Speech	5
III	**Reading and Writing:** Reading Comprehension**:** Improving Comprehension Skills, Scanning and Skimming, Predicting the Content, Understanding the Gist, PQRST Technique Grammar and Vocabulary**:** Sentence Structure, Preposition, Punctuation, Articles, Common errors and Correct Usage, Word formation: Affixes, Active and Passive Vocabulary	8
IV	**Presentation Skills** Planning: Occasion, Audience, Purpose, Thesis Statement, Material, Outlining and Structuring, Guidelines for Effective Delivery, Strategies for Reducing Stage Fright	6
V	**Practice:** Grammar Bites, English Fluency Drills	3

Text Books

1. Kumar, Sanjay and Pushp Lata. *Communication Skills*. 2nd. ed., Oxford University Press, 2015.
2. Raman, Meenakshi and Sangeetha Sharma. *Technical Communication: Principles and Practice*, 4th ed., Oxford University Press, 2022.

Reference Books

1. Adair, John. *Effective Communication: The Most Important Management Skill of All.* Pan Books Publishers, 1997.
2. Gorrell, Robert M and Charlton Laird. *Modern English Handbook.* 6th ed., Pentice Hall Publications, 1976.
3. Rose, William. *GNVQ Core Skills Communication*. 2nd. ed., Pitman Publishing, 1995.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	**Identify** and **understand** the different types and processes of communication and the barriers that may arise.	**K2**
CO2 :	**Demonstrate** active listening skills and **apply** strategies for confident and fluent public speaking.	**K3**
CO3 :	**Analyze** and **enhance** reading comprehension through effective reading techniques.	**K4**
CO4 :	**Utilize** proper grammar, sentence structures, and vocabulary for clear and correct written communication.	**K3**
CO5 :	**Create** and **present** structured presentations, incorporating techniques to manage stage fright and engage the audience effectively.	**K6**

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	2	0	0	0	0	0	0	0	0
CO2	1	0	0	0	0	0	0	0	0
CO3	3	0	0	0	0	0	0	0	3
CO4	3	0	0	0	0	0	0	0	2
CO5	3	0	0	0	0	0	0	0	0

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY211	Number of Hours/Wk	2		
Semester	I	Max. Marks	100		
Course Category	Core Course	Credits	1		
Course Title	FUNDAMENTALS OF COMPUTING LAB		L	T	P
			0	0	2

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To have a comprehensive understanding of a foundational understanding of computer systems.
- To learn about various number systems including decimal, binary, octal, and hexadecimal
- To develop a comprehensive grasp of how computers function, the types of software used and the significance of networking in today's digital world.

LIST OF PROGRAMS

1. Basics of Microsoft Word.
2. Insert Table and Generating Chart.
3. Mail Merging.
4. Study on features of Microsoft Excel.
5. Incorporating the predefined functions in Excel.
6. Inserting table and generating chart in Excel.
7. Pivot chart, table and slicing in Excel.
8. Study on features in Microsoft PowerPoint.
9. Creating presentation incorporating the features of PowerPoint.
10. Study on HTML.
11. Basic web page design, formatting, inclusion of image and video.
12. Creation of Table.
13. Designing own web page.

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1	Understand the basic concepts of computers.	K2
CO2	Analyze the basics of number systems.	K4
CO3	Apply system development programs to create and manage simple software projects.	K3
CO4	Analyze the performance of different memory management techniques and their impact on system efficiency.	K4
CO5	Evaluate the knowledge of Internet history to understand current Internet technologies and to solve problems in communication and information access.	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	0	3	0	0	2	3	1
CO2	3	3	3	2	3	2	2	2	1
CO3	3	3	2	3	2	2	3	2	3
CO4	3	2	2	3	1	1	3	1	1
CO5	3	2	2	2	1	3	2	1	1

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY212	Number of Hours/Wk	2		
Semester	I	Max. Marks	100		
Course category	Core Course	Credits	1		
Course Title	INTRODUCTION TO PROGRAMMING LAB		L	T	P
			0	0	2

COURSE OBJECTIVES:

The main aim of learning this course is to:

- To learn the fundamental concepts of programming, including algorithms, flowcharts, and the logical approach to problem solving that is applicable to any programming language.
- To acquire comprehensive understanding of the syntax, semantics and the basic constructs of C language
- Learn to use of pointers, Arrays, and dynamic memory allocation which are key to understanding data structure, memory management.
- Build a foundation for advanced programming and software development. To develop skills to handle complex programming challenges such as file handling, Debugging.

LIST OF PROGRAMS

1. Write a C program to print Integer, Float, Character values
2. a)Write a c program to demonstrate use of arithmetic operators
   b)Write a C program using increment and decrement operators
3. a)Write a C program using Decision making constructs (Switch case statement)
   b)Program to find if a number is Negative, Positive, or zero(using if..elseif..else statement)
4. C program to perform factorial of a number
5. a) Write a C program to print a message 5 times using"while" statement
   b) Illustrate the Do-while statement using C program
   c)Program using for loop statement
6. a) Program to implement break statement
   b) write a program to demonstrate continue statement
7. Program to insert elements into an array and display the array elements using C language
8. Program to solve multiplication of 2 matrices
9. String
   a) Program to accept a string and display it as reverse using C language
   b) program to concatenate 2 string using C
10. Array
    a) Program to illustrate the concepts of arrays
    b) Program to illustrate pointer to 2-dimensional array
11. Program to take mark details of students and display the name of the students with highest marks using Structure concept
12. Program to implement union concept

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Acquiring foundational knowledge of programming including Algorithm, Flowcharts, assembly language basics, Program structure.	K2
CO2 :	Understanding C language fundamentals	K2,K4
CO3 :	Applying various types of arrays and string manipulation technique to manage and process data in programming scenarios	K3
CO4 :	Analyze and experiment with functions, develop recursive solutions, and apply pointers to solve complex problems.	K4
CO5 :	Develop modular programs using control structures, unions	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	2	2	3	1
CO2	3	3	3	2	3	2	2	2	1
CO3	3	3	2	3	2	2	3	2	3
CO4	3	2	2	3	1	2	3	2	1
CO5	3	2	3	2	1	2	3	3	1

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY121	Number of Hours/Week	3		
Semester	II	Max. Marks	100		
Course Category	Core Course	Credits	3		
Course Title	PYTHON PROGRAMMING		L	T	P
			3	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To Understand the fundamentals of the Python programming language and its historical development
- To Master Python basics, including data types, operators, tuples, dictionaries, and string manipulation.
- To demonstrate object oriented concept in python
- To familiarize with machine learning tools in python

UNIT	TOPICS	HOURS
I	**Introduction to python programming** Introduction to python ; setting up python programming environment; variables; strings and its operations; special characters; striping whitespace; numbers; comments; list and its operations; indexing; looping through lists; indentation; range function; slicing a list; copying list; looping through slice;	9
II	**Python datatypes** Tuples and its operations; relational operators; conditional statements – if, if-else, if-elif-else; multiple conditional blocks; dictionaries; key-value pairs – adding, modifying, removing; looping through dictionary; list of dictionaries; dictionary in a dictionary; user input function; type casting;	9
III	**Loop and function** While loop; break and continue; functions; arguments; passing arguments – positional arguments, keyword arguments, default values; optional arguments; returning from function; passing arbitrary number of arguments; storing functions in modules; import specific function or module;	9
IV	**OOPs in python** Classes; __init__() method; instance of a class; accessing attributes; calling methods; creating multiple instances; inheritance – parent class, child class; importing classes; files – reading a file, writing to a file, appending to a file; exceptions – try-except block, else block;	9
V	**Python machine learning tools** Python tools for machine learning; python modules – numpy, pandas, matplotlib, scipy; python based machine learning libraries – pytorch, tensorflow; virtual environment; machine learning application using python tools;	9

Text Book

1. Matthes, Eric. *Python Crash Course: A Hands-On, Project-Based Introduction to Programming*. 2nd ed., No Starch Press, Inc., 2019.

Reference Book

1. Sweigart, Al. *Automate the Boring Stuff with Python*. William Pollock, 2015.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Comprehend the holistic view of programming language design and behavior	**K2**
CO2 :	Understand the programming concepts in abstract and paradigm level	**K2**
CO3 :	Structure python programs for solving problems	**K3**
CO4 :	Develop python programs using OOP concept	**K5/K6**
CO5 :	Execute ML project using python tools	**K6**

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	1	3	1	2	2	1	3	2	1
CO2	1	3	1	2	1	1	3	2	1
CO3	2	2	2	3	2	3	3	3	2
CO4	2	3	0	3	2	3	3	3	1
CO5	1	3	3	3	2	3	3	2	2

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY122	Number of Hours/Wk	4		
Semester	II	Max. Marks	100		
Course Category	Core Course Allied	Credit	4		
Course Title	PROBABILITY ,STATISTICS AND STOCHASTIC PROCESSES		L	T	P
			3	1	0

COURSE OBJECTIVES

- **Understand fundamental probability concepts** and their applications in real-world scenarios.
- Analyze data using descriptive statistics **such as mean, variance, and standard deviation.**
- Apply probability distributions **(e.g., binomial, normal) to model and solve problems.**
- Conduct hypothesis testing and confidence intervals **to make informed statistical inferences.**
- Utilize statistical tools and software **for data analysis and decision-making invarious fields.**.

UNIT	TOPIC	HOURS
I	**Introduction to Probability:** Introduction to set algebra-sigma algebra-Borel sigma algebra-sequence of sets and its limits-lim-sup and lim-inf of sequence of sets; Axiomatic definition of probability-probability space-properties of probability functions-conditional probability-Bayes' rule-independence of events-continuity of probability functions-Borel Cantelli lemmas.	10
II	**Random variables**-distribution function and its property probability mass and density functions-symmetric distribution and its properties-expectation-moments moment generating function-Markov inequality-Chebyshev's inequality.	6
III	**Joint distributions**-marginal and conditional distributions-moments-independence of random variables-covariance, and correlation joint moment generating functions-additive properties of random variables-functions of random variables-ordered Statistics.	8
IV	**Special distributions**: Discrete uniform-Bernoulli-binomial-geometric negative binomial-hypergeometric-Poisson-exponential-gamma-normal- bivariate normal distribution; Population- sample-parameters- distributions of the sample mean and the sample variance for a normal population-Chi-Square-t, F distributions-law of large numbers–central limit theorem-point estimation-method of moments-maximum likelihood estimator-unbiasedness.	8
V	**Testing of hypothesis**: Null and alternate hypothesis-Neyman Pearson fundamental lemma and its applications-tests for one sample and two sample problems for normal populations-tests for proportions-confidence interval estimation-confidence interval for parameters of normal population	10

Text Books:

1. First Course in Probability, Sheldon Ross, 2022.
2. An Introduction to Probability and Statistics, V.K. Rohatgi and A.K. Md. E. Saleh, 2015.

Reference Books:

1. Introduction to Probability and Statistics, S. Milton and J.C. Arnold, 2003.
2. Introduction to Mathematical Statistics, R V Hogg, A Craig and J W McKean, 2019

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Understand Basic Probability Concepts	K3
CO2 :	Analyse Random Variables and Probability Distributions, Joint Distributions and ConditionalProbability	K4
CO3 :	Implement the Central Limit Theorem and Law of Large Numbers	K5
CO4 :	Perform Hypothesis Testing and Statistical Inference, Regression and Correlation for DataAnalysis	K3
CO5 :	Employ Statistical Tools in Engineering Applications	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	2	2	1	0	1	0	2	1	1
CO2	2	1	1	2	1	2	1	2	1
CO3	2	0	2	2	2	2	2	0	2
CO4	2	2	1	2	0	2	2	2	2
CO5	2	2	0	2	1	2	0	0	2

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY123	Number of Hours/Wk	4		
Semester	II	Max. Marks	100		
Course Category	Core Course Allied	Credit	4		
Course Title	MATHEMATICS -II		L	T	P
			3	1	0

COURSE OBJECTIVES

- To develop a strong understanding of vector spaces, subspaces, basis, and dimension, as well as how linear transformations relate to matrices and their properties.
- To gain proficiency in solving systems of linear equations using techniques like Gaussian elimination, matrix operations, and determinants.
- To compute eigenvalues and eigenvectors, and apply them to diagonalize matrices, a critical tool for solving differential equations.
- To solve first-order and second-order ordinary differential equations (ODEs) with applications to physical, biological, and engineering problems.
- To understand the interplay between linear algebra and differential equations, especially in systems of linear differential equations, using matrix methods such as the Laplace transform and matrix exponentials.

UNIT	TOPIC	HOURS
I	**Advanced Matrix Theory: Systems of linear equations**: Elementary operations-row-reduced echelon matrices-Gauss elimination LU factorization-linear independence-rank of a matrix-solutions of linear systems-existence and uniqueness.	10
II	**Vector spaces**: Vector space-subspaces-spanning space-bases and dimensions. Linear transformation-matrix representations of linear transformations-range space and rank-null space and nullity-the rank and nullity theorem-invertibility.	6
III	**Eigenvalues and eigenvectors**: Eigen values-eigenvectors and some applications of eigenvalue problems-Hermitian, skew-Hermitian, unitary matrices and their eigenvalues-eigen bases.	8
IV	**Elementary Canonical Forms:** Diagonalization: Annihilating polynomial-the minimal polynomial and the characteristic polynomial-Cayley-Hamilton theorem-real quadratic form; Inner product spaces: Inner product spaces-orthonormal bases- Gram-Schmidt process.	8
V	**Ordinary Differential Equations**: Review of First Order ODE- Lipschitz condition-Picard`s theorem; Linear differential equations: Linear dependence and Wronskian-linear ODE with constant coefficients of higher order characteristic equations- Cauchy-Euler equations-method of undetermined coefficients-method of variation of parameters- solutions methods using Laplace Transform.	10

Text Books:

1. "Linear Algebra", Hoffman Kunze, Prentice Hall. 1971
2. "Differential Equations", S. L Ross, Third Edition,2007

Reference Books:

1. "Introduction to Linear Algebra", Gilbert Strang, Fifth edition, 2016
2. "Advanced Engineering Mathematics", Erwin Kreyszig, Wiley Publishers, Tenth Edition, 2011

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Learn different types of matrices, concept of rank, methods of matrix inversion and their applications, systems of linear equations, and manipulate vectors in various dimensions.	**K3**
CO2 :	Understand linear spaces, its basis and dimension with corresponding applications in the field of computer science.	**K4**
CO3 :	Apply the concept of eigen values, eigen vectors, diagonalisation of matrices and orthogonalization in inner product spaces for understanding physical and engineering problems.	**K3**
CO4 :	Understand the first- and second-order ordinary differential equations (ODEs), both analytically and numerically, with applications to real-world phenomena	**K3**
CO5 :	Develop the skills to model physical systems using differential equations and linear algebra.	**K5**

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	2	1	2	2	2	1	2	1	1
CO2	2	0	1	1	0	2	1	2	1
CO3	2	2	2	2	1	1	0	2	2
CO4	2	2	2	1	2	0	2	2	2
CO5	2	1	1	0	1	0	2	2	1

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY124	Number of Hours/Wk	3		
Semester	II	Max. Marks	100		
Course Category	Core Course	Credit	3		
Course Title	OFFICE AUTOMATION TOOLS		L	T	P
			3	0	0

COURSE OBJECTIVES

- To gain comprehensive knowledge of various office automation tools and their applications in a professional setting.
- To develop proficiency in creating, formatting and managing documents using advanced features of word processing software.
- To acquire the ability to develop and analyze data using spreadsheet software.
- To manage email communications and calendar events efficiently with organizational tool inorder to streamline workflow.
- To utilize cloud storage and collaboration tools to enhance team productivity.

UNIT	TOPICS	HOURS
I	**Introduction to MS Word:** Overview of MS Word Interface, Creating, Saving, and Opening Documents, Basic Text Formatting (Font styles, sizes, and colors), Paragraph Formatting (Alignment, indentation, line spacing),	8
II	**Basic Document Formatting Advanced Document Formatting**, Using Styles and Templates, Creating and Managing Tables, Using Headers, Footers, and Page Numbers, Creating a Table of Contents and Index. **Document Review and Collaboration**-Track Changes and Comments, Comparing and Merging Documents, Using and Creating Forms, Managing References and Citations, Integrating MS Word with Other MS Office Applications, Creating a Professional Report or Resume	8
III	**Data Management and Analysis with MS Excel** **Introduction to MS Excel:** Overview of Excel Interface, Basic Operations (Entering Data, Basic Formulas), Cell Referencing and Basic Functions (SUM, AVERAGE), **Data Analysis Techniques**-Creating and Formatting Tables, Using Advanced Functions (VLOOKUP, INDEX-MATCH, IF Statements), Data Validation Techniques, **Data Visualization-**Creating and Customizing Charts, Using Conditional Formatting, Pivot Tables and Pivot Charts , **Practical Applications and Project**- Data Analysis Project: Import, Clean, Analyse, and Visualize Data, Automation with Macros: Recording and Running Basic Macros	8
IV	**Designing Presentations with MS PowerPoint** **Introduction to MS PowerPoint**: Overview of PowerPoint Interface, Creating and Formatting Slides, Using Slide Layouts and Themes, **Enhancing Presentations**- Adding and Customizing Text, Images, and Shapes, Applying Slide Transitions and Animations, Incorporating Multimedia Elements (Audio, Video), **Advanced Presentation Techniques**- Designing Effective Slide Masters, Creating Interactive Elements (Hyperlinks, Action Buttons), custom Animations and Timing, **Practical Applications and Project**- Creating a Professional Presentation on a Given Topic, Incorporating Feedback and Revising Presentation.	10
V	**Creating and Managing Forms- Google Forms, Microsoft Forms-** Designing forms and surveys- Adding different types of questions- Setting up branching logic- Collecting and analyzing responses.	10

	Cloud storage-Collaboration tools, Desktop Publishing-Microsoft Publisher- Creating brochures, newsletters, and flyers-Using templates and design elements-Inserting and formatting text, images, and graphics- Preparing documents for printing.	

Text Books:

1. "Microsoft Office 2019 Step by Step", Joan Lambert and Curtis Frye, First Edition, Microsoft Press, 2018.
2. "Learning Microsoft Office", First Edition, Wiley,2019.
3. "Google Workspace User Guide", Eric Butow First Edition, , Packt Publishing, 2021.
4. "Mastering LibreOffice", Jean Hollis Weber, Friends of OpenDocument, First Edition, 2014.
5. "Microsoft Excel 2019 Bible", Michael Alexander, Richard Kusleika, and John Walkenbach, First Edition, Wiley, 2018
6. "Google Sheets: The Comprehensive Guide", Ian Lamont, First Edition, i30 Media Corporation, 2020.
7. "Microsoft PowerPoint 2019 For Dummies", Doug Lowe, First Edition, Wiley, 2018.
8. "Access 2019 Bible", Michael Alexander and Richard Kusleika, First Edition, Wiley, 2018.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar,

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Create professional documents using word processing software, applying advanced features such as mail merge, styles, and templates.	**K6**
CO2 :	Utilize complex formulas, functions, pivot tables, and data visualization tools in spreadsheet software presenting data effectively.	**K3**
CO3 :	Design engaging presentations using presentation software, incorporating multimedia elements, custom animations, and utilizing presenter tools.	**K6**
CO4 :	Understand fundamental database concepts to manipulate and interpret data effectively	**K2**
CO5 :	Utilize cloud storage solutions and collaboration tools for file management, sharing, real-time collaboration, managing permissions, and ensuring data security and accessibility.	**K3**

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	2	3	2	2	1	1	2	1	2
CO2	3	3	3	2	2	2	2	1	2
CO3	2	2	2	2	1	2	2	1	2
CO4	2	1	2	2	2	3	1	1	2
CO5	3	3	2	3	2	2	2	1	2

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY125	Number of Hours/Wk	3		
Semester	II	Max. Marks	100		
Course Category	Core Course	Credit	3		
Course Title	DISCRETE STRUCTURES FOR COMPUTER SCIENCE		L	T	P
			3	0	0

COURSE OBJECTIVES

- To get familiar and understand the fundamental notions in discrete structures focusing on aspects of computer science
- To describe binary relations between two sets, combine relations using set operations and composition.
- To understand and demonstrate the basic concept of algorithm and its application in combinatorial mathematics.
- To identify the base step and the recursive or inductive step in applied problems and give a recursive and a non-recursive definition for an iterative algorithm.
- To classify the basic properties of graphs and trees and model simple applications.

UNIT	TOPIC	HOURS
I	**Set Theory and Logic** Sets – Functions – Relations - Equivalence Relation – Poset - Functions Logic: Propositional logic - Truth Tables – Tautologies - Resolution Proof System - Predicate Logic	9
II	**Induction and Combinatorics** Peano's Axioms - Mathematical Induction - Pigeon-Hole Principle - Principle of Inclusion and Exclusion - Review of Permutations and Combinations - Distribution Problems - Derangements - Bijection Principle.	9
III	**Algebraic Structures** Semi-Groups – Monoids – Groups - Subgroups and Their Properties - Cyclic Groups - Cosets - Permutation Groups - Lagrange's Theorem - Cayley's Theorem - Normal Subgroups - Homomorphism of Groups - Quotient Groups –Introduction to Rings and Fields	9
IV	**Linear Algebra and Recurrence Relations** Linear Algebra: Vector Space – Basis, Dimension, Orthogonality - Recurrence Relations: Homogeneous and Inhomogeneous Recurrences and their Solutions - Solving Recurrences Using Generating Functions.	9
V	**Graph Theory** Definitions and Basic Results - Representation of a Graph by a Matrix and Adjacency List - Trees - Cycles - Properties - Paths and Connectedness - Subgraphs - Graph Isomorphism - Operations on Graphs - Vertex and Edge Cuts - Vertex and Edge Connectivity.	9

Text Books

1. "Elements of Discrete Mathematics: A Computer Oriented Approach", C. L. Liu, D. P. Mohapatra, McGraw Hill, Third Edition, 2012.
2. "Applied Discrete Structures", Al Doerr, Ken Levasseur, LibreTexts, Third Edition, 2023

Reference Books

1. "Discrete Mathematical Structures with applications to Computer Science", Tremblay J.P. and Manohar R., McGraw Hill International Edition, 1987.
2. "Discrete Mathematics and Its Applications", Kenneth H. Rosen, Sixth Edition, Tata McGraw Hill, 2012.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K - Level's
CO1 :	Understand the fundamental aspects of discrete and continuous mathematical structures.	**K2**
CO2 :	Demonstrate the principles of mathematical induction to prove statements.	**K3**
CO3 :	Differentiate between various algebraic structures and analyze their properties.	**K4**
CO4 :	Apply logical reasoning and mathematical techniques to solve problems in set theory, algebra, and graph theory.	**K3**
CO5 :	Construct new mathematical models and generate solutions to complex recurrence relations and graph problems.	**K6**

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	2	0	3	3	2	2	1	1	1
CO2	0	0	2	0	2	1	2	0	1
CO3	1	0	2	1	2	2	2	1	0
CO4	2	2	2	0	2	3	1	2	1
CO5	0	0	1	2	1	2	2	1	1

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25EVST921	Number of Hours/Week	2		
Semester	II	Max. Marks	100		
Course Category	Value Added Course	Credits	2		
Course Title	ENVIRONMENTAL SCIENCE		L	T	P
			2	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students to:

- To understand the Environmental Foundations
- To differentiate between renewable and non-renewable resources and assess the impacts of land use changes, land degradation, and water resource exploitation.
- To study the causes and effects of pollution and its impacts on earth
- To analyse the population causes, its effects and control measures.

UNIT	TOPICS	HOURS
I	**Introduction to Environmental studies** Definition and Scope of Environmental Studies - Interdisciplinary Nature of Environmental Science-Historical Perspectives on Environmental Issues-Principles of Sustainability and Sustainable Development, Ecosystem- Structure and functions of ecosystem--Aquatic ecosystems	6
II	**Natural Resources- Renewable and Non-renewable Resources** Land resources and land use change, Land degradation, soil erosion, Desertification- Deforestation- exploitation of surface and ground water, floods, droughts, conflicts over water Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.	6
III	**Biodiversity and Conservation** Levels of biological diversity- genetic, species and ecosystem diversity, Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots.	6
IV	**Environmental Pollution** Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution - Nuclear hazards and human health risks-Solid waste management: Control measures of urban and industrial waste. Pollution case studies, Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture, Environment Laws: Environment Protection Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD), Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.	12
V	**Human Communities and the Environment** Human population growth: Impacts on environment, human health and welfare-Resettlement and rehabilitation of project affected persons, Disaster management: floods, earthquake, cyclones and landslides, Environmental movements- Chipko, Silent valley, Bishnoi's of Rajasthan	10

Textbooks

1. Environmental and Sustainable Development, Keiji Ujikawa, Mikio Ishiwatari, Eric van Hullebusch, 1st Edition springer publishers Singapore.
2. Environmental Science: Toward A Sustainable Future, Dorothy F. Bourse and Richard T. Wright, 13th edition,Pearson publishers.
3. Social Learning in Environmental Management: Towards a Sustainable Future, Meg Keen, Valerie A. Brown, Rob Dyball.

4. Principles of Environmental Science, William P. Cunningham and Mary Ann Cunningham, 10th edition, Mc graw hill publishers.
5. Visualizing Environmental Science, Linda R. Berg, Mary Catherine Hager and David M. Hassenzahl.

Reference Books:

1. Waste Water Treatment, Rao, M.N., Datta, A.K.,Oxford and IBH Publishing Co. Pvt. Ltd, 1987.
2. Fundamentals of Ecology, Odum, E.P., Odum, H.T., and Andrews, J., , Saunders, Philadelphia, 1971, USA.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar,

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Define environmental studies and its interdisciplinary nature	K1
CO2 :	Analyze the structure and functions of various ecosystems, including aquatic ecosystems.	K2,K4
CO3 :	Evaluate the growing energy needs and the role of alternative energy sources	K5
CO4 :	Understand levels of biodiversity (genetic, species, and ecosystem) and identify biodiversity hotspots, with a focus on conservation strategies.	K2,K3
CO5 :	Evaluate the effects of human population growth on the environment and the importance of disaster management, resettlement, and environmental movements	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	0	1	0	0	0	1	0	0	0
CO2	0	0	0	0	0	1	0	0	0
CO3	0	0	0	0	0	1	0	0	0
CO4	0	0	0	0	0	1	0	0	0
CO5	0	0	0	0	0	1	0	0	0

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY221	Number of Hours/Wk	2		
Semester	II	Max. Marks	100		
Course Category	Core Course	Credit	1		
Course Title	PYTHON PROGRAMMING LABORATORY		L	T	P
			0	0	2

COURSE OBJECTIVE:

The main learning objective of this course is to prepare the students for:

- To learn fundamentals in python programming language
- To introduce python modules for application
- To familiarize python framework for machine learning applications
- To develop machine learning application using python
- To implement research topic as Course Category of python project

LIST OF EXPERIMENTS

1. Implement basic algebraic problems to get into python programming
2. Implement string manipulations problems using python
3. Implement problems using python datatypes such as tuple, list, dictionary etc.
4. Implement problems for python loops, conditional statements and functions
5. Implement object oriented programming concepts in python to solve different problems
6. Implement problems for python file manipulations
7. Implement standard machine learning algorithms using python frameworks such as TensorFlow, PyTorch etc.
8. Implement adavanced problems using python tools in a virtual environment as Course Category of python project

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Comprehend the holistic view of programming language design and behavior	K2
CO2 :	Understand the programming concepts in abstract and paradigm level	K2
CO3 :	Structure python programs for solving problems	K3
CO4 :	Develop python programs using OOP concept	K5/K6
CO5 :	Execute ML project using python tools	K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	1	3	1	2	2	1	3	2	1
CO2	1	3	1	2	1	1	3	2	1
CO3	2	2	2	3	2	3	3	3	2
CO4	2	3	0	3	2	3	3	3	1
CO5	1	3	3	3	2	3	3	2	2

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY222	Number of Hours/Wk	2		
Semester	II	Max. Marks	100		
Course Category	Core Course	Credit	1		
Course Title	OFFICE AUTOMATION TOOLS LAB		L	T	P
			0	0	2

COURSE OBJECTIVES

- To gain comprehensive knowledge of various office automation tools and their applications in a professional setting.
- To develop proficiency in creating, formatting and managing documents using advanced features of word processing software.
- To acquire the ability to develop and analyze data using spreadsheet software.
- To manage email communications and calendar events efficiently with organizational tool inorder to streamline workflow

List of Experiment

1. **Introduction to Office Automation Tools**
   - Overview of different office automation tools.
   - Understanding the interface and basic functionalities of popular office suites (Microsoft Office, Google Workspace).
2. **Word Processing (e.g., Microsoft Word, Google Docs)**
   - Creating and formatting documents.
   - Using templates and styles.
   - Inserting and formatting tables, images, and charts.
   - Utilizing headers, footers, and page numbers.
   - Implementing document review features: track changes, comments, and comparing documents.
   - Mail merge for letters and labels.
3. **Spreadsheet Management (e.g., Microsoft Excel, Google Sheets)**
   - Creating and formatting spreadsheets.
   - Basic and advanced formulas and functions.
   - Data validation and conditional formatting.
   - Chart creation and customization.
   - Using pivot tables and pivot charts for data analysis.
   - Implementing macros to automate repetitive tasks.
4. **Presentation Software (e.g., Microsoft PowerPoint, Google Slides)**
   - Creating and designing presentations.
   - Using themes and templates.
   - Adding and formatting text, images, audio, and video.
   - Applying animations and slide transitions.
   - Presenter view and slide show settings.
   - Collaborating on presentations in real-time.
5. **Database Management (e.g., Microsoft Access, LibreOffice Base)**
   - Introduction to database concepts.
   - Creating and managing tables.
   - Designing and running queries.
   - Creating forms for data entry.
   - Generating reports.
6. **Email and Calendar Management (e.g., Microsoft Outlook, Google Calendar)**
   - Composing, sending, and organizing emails.
   - Using folders, labels, and rules to manage emails.
   - Scheduling, managing calendar events, setting up reminders and notifications.
   - Sharing calendars and scheduling meetings.

7. **Collaboration and Cloud Storage (e.g., Microsoft OneDrive, Google Drive)**
    - Uploading and managing files in cloud storage, sharing files and setting permissions.
    - Real-time collaboration on documents.
    - Version control and file recovery.
8. **Creating and Managing Forms (e.g., Google Forms, Microsoft Forms)**
    - Designing forms and surveys.
    - Adding different types of questions.
    - Setting up branching logic- Collecting and analyzing responses.
9. **Desktop Publishing (e.g., Microsoft Publisher)**
    - Creating brochures, newsletters, and flyers, using templates and design elements.
    - Inserting and formatting text, images, and graphics, preparing documents for printing

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Create professional documents using word processing software, applying advanced features such as mail merge, styles, and templates.	**K6**
CO2 :	Utilize complex formulas, functions, pivot tables, and data visualization tools in spreadsheet software presenting data effectively.	**K3**
CO3 :	Design engaging presentations using presentation software, incorporating multimedia elements, custom animations, and utilizing presenter tools.	**K6**
CO4 :	Understand fundamental database concepts to manipulate and interpret data effectively	**K2**
CO5 :	Utilize cloud storage solutions and collaboration tools for file management, sharing, real-time collaboration, managing permissions, and ensuring data security and accessibility.	**K3**

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	2	3	2	2	1	1	2	1	2
CO2	3	3	3	2	2	2	2	1	2
CO3	2	2	2	2	1	2	2	1	2
CO4	2	1	2	2	2	3	1	1	2
CO5	3	3	2	3	2	2	2	1	2

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY131	Number of Hours/Week	3		
Semester	III	Max. Marks	100		
Course Category	CORE COURSE	Credits	3		
Course Title	FUNDAMENTALS OF INFORMATION SECURITY		L	T	P
			3	0	0

COURSE OBJECTIVES:

The main aim of learning this course is:

- To introduce the fundamental concepts of Information security
- Ability to identify key security principles, recognize common threats and vulnerabilities
- Implement basic security measures and understand the importance of compliance and policies.

UNIT	TOPICS	HOURS
I	**Introduction to Information Security** Overview of Information Security, Key Concepts and Terminology, Goals of Information Security, Security Threats and Attacks, Security Controls and Countermeasures	9
II	**Cryptography** Principles of Cryptography, Symmetric and Asymmetric Encryption, Hash Functions and Message Digests, Digital Signatures and Certificates, Cryptographic Applications: SSL/TLS, PGP, VPNs	9
III	**Access Control and Authentication** Access Control Models, DAC, MAC, RBAC, Authentication Methods, Passwords, Biometrics, Tokens, Single Sign On (SSO) and Federated Identity, Role Based Access Control (RBAC), Access Control Lists (ACLs) and Permissions	9
IV	**Security in Software Development** Secure Software Development Lifecycle (SDLC), Common Software Security Vulnerabilities (OWASP Top 10), Secure Coding Practices, Code Review and Static Analysis Tools, Secure Development Frameworks and Libraries	9
V	**Security Management and Governance** Security Policies, Standards, and Procedures, Risk Management and Assessment Security Incident Handling and Response, Security Awareness and Training Compliance and Regulatory Requirements.	9

Text Book

1. Principles of Information Security, Michael E. Whitman and Herbert J. Mattord, 6th edition, 2017
2. Cryptography and Network Security: Principles and Practices, William Stallings, 7th edition, 2017

Reference Books

1. CISSP (ISC)2 Certified Information Systems Security Professional Official Study Guide, Mike Chapple, James Michael Stewart, Darril Gibson, 8th edition, 2018
2. Security Engineering: A Guide to Building Dependable Distributed Systems, Ross J. Anderson, 2 nd edition, 2018.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Understand the Information security system, mechanisms and CIA triad	K2
CO2 :	Apply the different cryptographic operations of symmetric, asymmetric algorithms, authentication schemes	K3
CO3 :	Evaluate and differentiate access control models along with various authentication methods.	K5
CO4 :	Assess and Enhance security in SDLC by applying code reviews and utilizing static analysis tools.	K4,K5
CO5 :	Create and evaluate comprehensive security policies, Implement governance frameworks, ensure compliance to manage organizational security risks.	K6,K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	0	0	0	2	2	2	2	1
CO2	3	2	0	2	2	0	2	1	2
CO3	0	3	0	0	3	2	3	2	2
CO4	0	0	3	2	0	1	2	1	0
CO5	2	0	0	0	2	2	2	2	1

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY132	Number of Hours/Week	3		
Semester	III	Max. Marks	100		
Course Category	CORE COURSE	Credits	3		
Course Title	DATA STRUCTURE AND ALGORITHMS		L	T	P
			3	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To Comprehensive understanding of fundamental data structures and algorithms.
- To equip algorithms with the skills to analyze and implement various computational techniques.
- Learn to select appropriate data structures for solving complex problems, optimize algorithm performance, and gain insight into advanced topics such as dynamic programming and NP-completeness.

UNIT	TOPICS	HOURS
I	**Introduction to Data Structures** Algorithms- asymptotic notations and analysis- Analysing Algorithms - Insertion sort, Divide and Conquer approach, Sorting, Building Heaps, Heap sort, Quick sort, Analysis of sorting algorithms,	12
II	**Elementary data structures** Stacks and Queues, linked lists and its operations, Hash Tables - Direct and Open addressing- **Tree data structure** Tree- Tree Traversals-Binary Search Trees-Red Black Trees - Red-black trees and its operations. B-Tree-Insertion-Deletion.	10
III	**Dynamic programming** Memoization, Tabulation, Rod Cutting, Matrix Chain Multiplication, Longest common subsequence, Greedy Algorithms-Introducing greedy approach, activity selection problem, Huffman codes, Graphs, Trees and Algorithms	8
IV	**Introducing spanning trees**, Minimum spanning tree, algorithms,Kruskal, Prims, Bellman-Ford algorithm, Single source shortest path in directed acyclic graphs, Dijkstra's algorithms, Floyd-Warshall algorithm	8
V	**NP-Completeness** Polynomial time, Verification algorithms, NP-Complete, NP-Hard	7

Text Book

1. Cormen, Thomas H., Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. Introduction to algorithms. MIT press, 2022.
2. Data Structures and Algorithms In C++, 2nd Edition by Michael T. Goodrich
3. Data Structures and Algorithms Made Easy by Narasimha Karumanchi.
4. Fundamentals of Data Structures by Ellis Horowitz and Sartaj Sahni

Reference Books

1. Chitra.A, Rajan.P.T , (2016*), Data Structures*, Vijay Nicol Imprints Pvt Ltd, McGraw-Hill Education of India Pvt Ltd, India, SecondEdition.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Understand the Fundamental Data Structures.	K2
CO2 :	Applying the concept of stack, queue, list, binary search tree and Red black tree.	K3
CO3 :	Analyzing the dynamic programming , greedy algorithms and binary search trees, including performing tree traversals, insertions, and deletions..	K4
CO4 :	Utilize graph representations and perform operations.	K3
CO5 :	Evaluating the implications of computational complexity for algorithm design and problem-solving strategies, including approaches for handling NP-Complete and NP-Hard problems.	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	0	3	2	1
CO2	3	3	3	2	2	0	3	2	2
CO3	3	3	3	3	2	1	3	3	3
CO4	3	2	2	3	2	1	3	3	3
CO5	3	2	3	3	3	1	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY133	Number of Hrs/Wk	3		
Semester	III	Max. Marks	100		
Course Category	Core Course	Credits	3		
Course Title	Object Oriented Programming		L	T	P
			3	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To introduce the fundamentals of Java programming language.
- To enable students to write object-oriented programs.
- To familiarize students with advanced Java concepts like multithreading, exception handling, and collections.
- To provide hands-on experience in developing real-world applications using Java.

UNIT	TOPICS	HOURS
I	**Basics of Java Programming** Introduction to Java: Features, JVM, JDK, and JRE.-Writing, compiling, and executing Java programs.-Data types, variables, and operators.-Control structures: Decision-making , loops .-Arrays and Strings: Declaration, initialization, and operations.	12
II	**Object-Oriented Programming in Java** Classes and Objects: Declaration, instantiation, and initialization-Methods: Static, instance, and parameterized methods -Constructors and destructors-Inheritance: Single, multilevel, hierarchical, and overriding. Polymorphism: Compile-time and runtime, Encapsulation and abstraction. Interfaces and abstract classes.	12
III	**Exception Handling and Multithreading** Exception handling: Try-catch block, multiple catch, finally, throw, and throws. Built-in exceptions and user-defined exceptions. Multithreading: Thread lifecycle, creating threads - Thread class, Runnable interface. Thread synchronization and inter-thread communication.	12
IV	**File I/O and Streams** Reading and writing files using FileReader, FileWriter, BufferedReader, and BufferedWriter. Byte and character streams. Serialization and deserialization.	12
V	**GUI Programming and Event Handling** Introduction to AWT and Swing-Layout managers -FlowLayout, GridLayout, BorderLayout.Event handling: ActionListener, MouseListener, KeyListener. Creating simple GUI applications.	12

Text Books:

1. "Programming in Java" by K. Somasundaram, by **PHI Learning Pvt. Ltd.**
2. "Java: The Complete Reference" by Herbert Schildt

Reference Books:

1. "Thinking in Java" by Bruce Eckel
2. "Effective Java" by Joshua Bloch
3. "Java Programming for Beginners" by Mark Lassoff

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Understand and apply Java syntax and semantics.	K2,K3
CO2 :	Implement object-oriented programming concepts in Java.	K3
CO3 :	Develop Java applications with exception handling and multithreading.	K4,K3
CO4 :	Use Java frameworks and APIs for GUI and database integration.	K3,K4
CO5 :	Solve real-world problems using Java programming.	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	2	1	3	-	3	2	-
CO2	3	3	3	2	3	-	3	3	2
CO3	3	3	3	3	3	2	3	3	2
CO4	3	3	3	3	3	-	3	3	3
CO5	3	3	3	3	3	2	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY134	Number of Hours/Week	3		
Semester	III	Max. Marks	100		
Course Category	CORE COURSE	Credits	3		
Course Title	COMPUTER NETWORK		L	T	P
			3	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To understand the concept of Computer network
- To Category knowledge about networking and inter networking devices

UNIT	TOPICS	HOURS
I	Introduction – Network Hardware - Software - Reference Models - OSI and TCP/IP Models - Example Networks: Internet, ATM, Ethernet and Wireless LANs - Physical Layer - Theoretical Basis for Data Communication - Guided Transmission Media.	8
II	Wireless Transmission - Communication Satellites - Telephone System: Structure, Local Loop, Trunks and Multiplexing and Switching. Data Link Layer: Design Issues - Error Detection and Correction.	7
III	Elementary Data Link Protocols - Sliding Window Protocols - Data Link Layer in the Internet - Medium Access Layer - Channel Allocation Problem - Multiple Access Protocols - Bluetooth.	12
IV	Network Layer - Design Issues - Routing Algorithms - Congestion Control Algorithms - IP Protocol - IP Addresses - Internet Control Protocols.	10
V	Transport Layer - Services - Connection Management - Addressing, Establishing and Releasing a Connection - Simple Transport Protocol - Internet Transport Protocols (ITP) - Network Security: Cryptography.	8

Text Book :

1. A. S. Tanenbaum, “Computer Networks”, Prentice-Hall of India 2008, 4th Edition.

Reference Books:

1. Stallings, “Data and Computer Communications”, Pearson Education 2012, 7th Edition.
2. B. A. Forouzan, “Data Communications and Networking”, Tata McGraw Hill 2007, 4th Edition.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	To Learn various principles & concepts of Computer networks.	K1
CO2 :	To Analyze different network models.	K4
CO3 :	To Evaluate the data flow through TCP/IP & ISO Layers.	K5
CO4 :	To Assess key networking protocols and their hierarchical relationship In the conceptual model like TCP/IP and OSI	K5,K6
CO5 :	To Identify networking and inter-networking devices	K2,K3

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	1	0	0	0	3	0	0
CO2	3	3	2	0	1	0	2	2	0
CO3	3	3	3	2	0	0	3	3	3
CO4	3	2	2	0	2	0	2	2	2
CO5	3	3	3	1	1	1	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY135	Number of Hours/Week	3		
Semester	III	Max. Marks	100		
Course Category	CORE COURSE	Credits	3		
Course Title	AI IN CYBERSECURITY		L	T	P
			3	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To understand AI and ML fundamentals and their role in cyber security.
- To study AI-based threat detection, malware analysis, and incident response.
- To learn ethical considerations and future trends in AI-driven cyber security.

UNIT	TOPICS	HOURS
I	**INTRODUCTION TO AI IN CYBER SECURITY & THREAT LANDSCAPE** Overview of Artificial Intelligence (AI) and Machine Learning (ML), Role of AI/ML in Cyber Security, Types of Machine Learning: Supervised, Unsupervised, Reinforcement, Cyber Threat Landscape: Malware, Phishing, Insider Threats, APTs, Attack Vectors: Email, Web, USB, Network vulnerabilities	12
II	**AI FOR INTRUSION DETECTION AND PREVENTION SYSTEMS** Intrusion Detection System (IDS), Intrusion Prevention System (IPS), Traditional vs AI-based IDS/IPS, Anomaly-based and Signature-based Detection, Machine Learning techniques for IDS/IPS	10
III	**DEEP LEARNING AND NLP IN CYBER SECURITY** Deep Learning concepts and architectures, Deep Learning for Malware Classification and Detection, Static and Dynamic Malware Analysis, Natural Language Processing (NLP) concepts, NLP techniques for Phishing and Spam Detection	8
IV	**AI FOR SIEM AND INCIDENT RESPONSE AUTOMATION** Security Information and Event Management (SIEM), AI-enhanced SIEM systems, Log analysis and threat correlation, Automated Incident Response using AI, SOAR and AI-driven response mechanisms	8
V	**ETHICAL ISSUES AND FUTURE TRENDS IN AI-DRIVEN CYBER SECURITY** Ethical and Legal considerations in AI-based security, Data Privacy and Compliance issues, Explainable AI (XAI), Adversarial AI, Autonomous Security Systems and Future Trends	7

Text Book

1. Clarence Chio and David Freeman, Machine Learning and Security: Protecting Systems with Data and Algorithms, O'Reilly Media, 2018.

Reference Books

2. Alessandro Di Nucci and Davide Appice, Applied Machine Learning for Cybersecurity, Springer, 2018.
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Explain the fundamentals of Artificial Intelligence and Machine Learning and the cyber threat landscape in cyber security.	K2
CO2 :	Apply AI and ML techniques for intrusion detection and intrusion prevention systems.	K3
CO3 :	Analyze malware, phishing, and spam using Deep Learning and Natural Language Processing techniques.	K4
CO4 :	Apply AI-based SIEM and automation techniques for effective incident detection and response.	K3
CO5 :	Evaluate ethical, legal issues and future trends such as Explainable AI, Adversarial AI, and autonomous security systems.	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	2	0	2	1	2	1	2	1	2
CO2	2	2	2	3	3	2	3	2	3
CO3	3	0	3	3	3	2	3	2	3
CO4	2	2	2	3	3	3	3	2	3
CO5	3	2	2	2	2	1	2	2	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY231	Number of Hours/Week	2		
Semester	III	Max. Marks	100		
Course Category	CORE COURSE	Credits	1		
Course Title	COMPUTER NETWORK LAB		L	T	P
			0	0	2

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To understand the concept of Computer network
- To import Category knowledge about networking and inter networking devices

List of Experiment

1. Implement the data link layer framing methods such as character, character stuffing and bit stuffing.
2. Implement on a data set of characters the three CRC polynomials – CRC 12, CRC 16 and CRC CCIP.
3. Implement Dijkstra's algorithm to compute the Shortest path thru a graph.
4. Take an example subnet graph with weights indicating delay between nodes. Now obtain Routing
5. table art each node using distance vector routing algorithm
6. Take an example subnet of hosts. Obtain broadcast tree for it.
7. Take a 64 bit playing text and encrypt the same using DES algorithm.
8. Write a program to break the above DES coding
9. Using RSA algorithm encrypt a text data and Decrypt the same.

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	To Learn various principles & concepts of Computer networks.	K1
CO2 :	To Analyze different network models.	K4
CO3 :	To Evaluate the data flow through TCP/IP & ISO Layers.	K5
CO4 :	To Assess key networking protocols and their hierarchical relationship In the conceptual model like TCP/IP and OSI	K5,K6
CO5 :	To Identify networking and inter-networking devices	K2,K3

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	1	0	0	0	3	0	0
CO2	3	3	2	0	1	0	2	2	0
CO3	3	3	3	2	0	0	3	3	3
CO4	3	2	2	0	2	0	2	2	2
CO5	3	3	3	1	1	1	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY232	Number of Hours/Wk	2		
Semester	III	Max. Marks	100		
Course Category	CORE COURSE	Credits	1		
Course Title	DATA STRUCTURE AND ALGORITHMS LAB		L	T	P
			0	0	2

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To Comprehensive understanding of fundamental data structures and algorithms.
- To equip algorithms with the skills to analyze and implement various computational techniques.
- To select appropriate data structures for solving complex problems and optimize algorithm performance.
- To gain insight into advanced topics such as dynamic programming and NP-completeness.

List of Experiments

1. Insertion sort
2. Divide and conquer approach
3. Quick sort, Merge sort, Heap sort
4. Find mean , median , mode
5. Implement a stack using an array with push and pop operations. Find the top element of the stack and check if the stack is empty or not.
6. Implementation of swap() function using stack
7. Implement two stacks in an array by dividing the space into two halves
8. Sort a stack using a temporary stack
9. Implement a queue with push and pop operation.
10. Enqueue the elements in the queue using emplace() function.
11. Implementation of swap() function using queue.
12. Implement a singly linked list, double linked list with basic operations.
13. Implement a hash table using direct addressing and indirect addressing
14. Implement a binary search tree with insertion and traversal
15. Implement a red-black tree including:
    a. Basic Red-Black Tree Properties
    b. Rotations (Left and Right)
    c. Insertion with Balancing
    d. Deletion with Balancing
16. Memoization
    a. Rod Cutting
    b. Matrix Chain Multiplication
    c. Longest Common Subsequence
17. Tabulation
    a. Rod Cutting (Tabulation)
    b. Matrix Chain Multiplication(Tabulation)
18. Greedy Algorithms
    a. Activity Selection Problem
    b. Huffman Codes
19. Graphs
    a. Depth First Search (DFS)
    b. Breadth First Search (BFS)
    c. Dijkstra's Algorithm (Shortest Path in Weighted Graph)
    d. Kruskal's Algorithm (Minimum Spanning Tree)

20. Tree Algorithms
    a. Binary Search Tree (BST) Operations
    b. AVL Tree (Balanced BST) Insertions
21. B-Tree and Its Operations
22. Prim's Algorithm
23. Shortest Path Algorithms
    a. Bellman-Ford Algorithm
    b. Floyd-Warshall Algorithm
    c. Single Source Shortest Path in Directed Acyclic Graphs (DAGs)
24. Polynomial Time Algorithm for Sorting
25. Verifying a Solution for the Knapsack Problem
26. NP-Complete Problem Example: 3-SAT Problem
27. NP-Hard Problem Example: Traveling Salesman Problem (TSP)

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Understand the Fundamental Data Structures.	K2
CO2 :	Applying the concept of stack, queue, list, binary search tree and Red black tree.	K3
CO3 :	Analyzing the dynamic programming , greedy algorithms and binary search trees, including performing tree traversals, insertions, and deletions..	K4
CO4 :	Utilize graph representations and perform operations.	K3
CO5 :	Evaluating the implications of computational complexity for algorithm design and problem-solving strategies, including approaches for handling NP-Complete and NP-Hard problems.	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	0	3	2	1
CO2	3	3	3	2	2	0	3	2	2
CO3	3	3	3	3	2	1	3	3	3
CO4	3	2	2	3	2	1	3	3	3
CO5	3	2	3	3	3	1	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY233	Number of Hours/Wk	2		
Semester	III	Max. Marks	100		
Course Category	Core Course	Credits	1		
Course Title	OBJECT ORIENTED PROGRAMMING LAB		L	T	P
			0	0	2

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To introduce the fundamentals of Java programming language.
- To enable students to write object-oriented programs.
- To familiarize students with advanced Java concepts like multithreading, exception handling, and collections.
- To provide hands-on experience in developing real-world applications using Java.

List of Programs

1. Write a Java program to calculate the factorial of a number using loops.
2. Implement a program to demonstrate the use of arrays and string operations (reverse, concatenate, length).
3. Create a program to find the largest and smallest numbers in an array.
4. Create a class Student with properties name, rollNumber, and marks. Write methods to calculate and display the grade.
5. Demonstrate single and multilevel inheritance using classes for Shape, Rectangle, and Square.
6. Implement polymorphism using method overloading and method overriding.
7. Write a program to handle ArrayIndexOutOfBoundsException and NumberFormatException.
8. Create a multithreaded program to calculate the sum of odd and even numbers in an array using two threads.
9. Demonstrate thread synchronization by simulating a producer-consumer problem.
10. Write a program to copy the contents of one text file to another using FileReader and FileWriter.
11. Implement a program to serialize and deserialize an object of a class Employee.
12. Create a program to count the number of words and characters in a text file.
13. Create a simple calculator using AWT/Swing with basic arithmetic operations.
14. Develop a GUI application to accept student details and display them in a table format.
15. Create a Java Swing application to simulate a login screen with username and password validation.

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Understand and apply Java syntax and semantics.	K2,K3
CO2 :	Implement object-oriented programming concepts in Java.	K3
CO3 :	Develop Java applications with exception handling and multithreading.	K4,K3
CO4 :	Use Java frameworks and APIs for GUI and database integration.	K3,K4
CO5 :	Solve real-world problems using Java programming.	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	2	1	3	-	3	2	-
CO2	3	3	3	2	3	-	3	3	2
CO3	3	3	3	3	3	2	3	3	2
CO4	3	3	3	3	3	-	3	3	3
CO5	3	3	3	3	3	2	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

IV SEMESTER

Programme	BCA (CY)	Programme Code	BCCY		
Course Code	25BCCY141	Number of Hours/Wk	3		
Semester	IV	Max. Marks	100		
Course Category	Core Course	Credits	3		
Course Title	CRYPTOGRAPHY AND NETWORK SECURITY		L	T	P
			3	0	0

COURSE OBJECTIVES:

The main aim of this course is to prepare the students for:

- To gain insights into security principles, legal aspects, and threat mitigation strategies.
- To explore encryption techniques and their role in ensuring data confidentiality.
- To understand cryptographic algorithms and key management in secure communication.
- To analyze authentication protocols and digital security measures for integrity.
- To study real-world cybersecurity practices, including intrusion detection and firewall defense.

UNIT	TOPICS	HOURS
I	**INTRODUCTION** Security trends - Legal, Ethical and Professional Aspects of Security, Need for Security at Multiple levels, Security Policies - Model of network security – Security attacks, services and mechanisms – OSI security architecture – Classical encryption techniques: substitution techniques, transposition techniques, steganography) - Foundations of modern cryptography: perfect security – information theory – product cryptosystem – cryptanalysis.	9
II	**SYMMETRIC CRYPTOGRAPHY** Mathematics Of Symmetric Key Cryptography: Algebraic structures - Modular arithmetic- Euclids algorithm- Congruence and matrices - Groups, Rings, Fields- Finite fields- SYMMETRIC KEY CIPHERS: SDES – Block cipher Principles of DES – Strength of DES – Differential and linear cryptanalysis - Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – Advanced Encryption Standard - RC4 – Key distribution	9
III	**PUBLIC KEY CRYPTOGRAPHY** Mathematics Of Asymmetric Key Cryptography: Primes – Primarily Testing –Factorization – Euler 's totient function, Fermat 's and Euler 's Theorem - Chinese Remainder Theorem – Exponentiation and logarithm - Asymmetric Key Ciphers: RSA cryptosystem – Key distribution – Key	9

	management – Diffie Hellman key exchange - ElGamal cryptosystem – Elliptic curve arithmetic-Elliptic curve cryptography.	
IV	**MESSAGE AUTHENTICATION AND INTEGRITY** Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC – SHA –Digital signature and authentication protocols – DSS- Entity Authentication: Biometrics, Passwords, Challenge Response protocols- Authentication applications - Kerberos, X.509	9
V	**SECURITY PRACTICE AND SYSTEM SECURITY** Electronic Mail security – PGP, S/MIME – IP security – Web Security – SYSTEM SECURITY: Intruders – Malicious software – viruses – Firewalls	9

Text Book

1. William Stallings, Cryptography and Network Security: Principles and Practice, PHI 3rd Edition, 2006.
2. Cryptography and Network Security: Atul Kahate, Mc Graw Hill, 3rd Edition

Reference Books

1. Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, Wiley India, 1st Edition.
2. Cryptography and Network Security: Forouzan Mukhopadhyay, Mc Graw Hill, 3rd Edition

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Understand fundamental security concepts, threats, and classical encryption techniques	K2
CO2 :	Apply symmetric and asymmetric cryptographic algorithms for secure communication	K3
CO3 :	Implement authentication mechanisms, digital signatures, and hash functions for data integrity	K3,K4
CO4 :	Analyze network and system security threats, including malware, intrusion detection, and firewalls.	K4
CO5 :	Explore security applications in email, web, and IP communication, ensuring end-to-end protection.	K2,K3

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	2	3	2	2
CO2	3	3	3	3	3	3	3	2	3
CO3	2	2	3	3	3	2	3	2	3
CO4	3	3	3	3	3	3	3	3	3
CO5	2	2	2	3	2	3	3	2	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY142	Number of Hrs/Week	3		
Semester	IV	Max. Marks	100		
Course Category	CORE COURSE	Credits	3		
Course Title	DATABASE MANAGEMENT SYSTEMS		L	T	P
			3	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To learn data models, conceptualize and depict a database system using ER diagram
- To understand the internal storage structures in a physical DB design
- To know the fundamental concepts of transaction processing techniques
- To understand the concept of Database Design in Normalization techniques
- To know the manipulation of SQL Queries

UNIT	TOPICS	HOURS
I	Data base System Applications, Purpose of Database Systems, View of Data, Data Abstraction, Instances and Schemas, data Models , the ER Model , Relational Model , Other Models , Database Languages , DDL , DML , database Access for applications Programs, data base Users and Administrator , Transaction Management , data base Architecture, Storage Manager , the Query Processor Data base design and ER diagrams , ER Model, Entities, Attributes and Entity sets , Relationships and Relationship sets , ER Design Issues, Concept Design , Conceptual Design for University Enterprise. Introduction to the Relational Model, Structure, Database Schema, Keys, Schema Diagrams.	8
II	Relational Query Languages, Relational Operations. Relational Algebra, Selection and projection set operations, renaming , Joins , Division , Examples of Algebra overviews , Relational calculus , Tuple relational Calculus , Domain relational calculus. Overview of the SQL Query Language, Basic Structure of SQL Queries, Set Operations, Aggregate Functions , GROUPBY , HAVING, Nested Sub queries, Views, Triggers.	8
III	Normalization, Introduction, Non loss decomposition and functional dependencies, First, Second, and third normal forms , dependency preservation, Boyee/Codd normal form. Higher Normal Forms ,Introduction, Multi,valued dependencies and Fourth normal form, Join dependencies and Fifth normal form	8
IV	Transaction State, Implementation of Atomicity and Durability, Concurrent, Executions, Serializability, Recoverability , Implementation of Isolation , Testing for serializability, Lock ,Based Protocols , Timestamp Based Protocols, Validation, Based Protocols , Multiple Granularity. Recovery and Atomicity, Log Based Recovery , Recovery with Concurrent Transactions , Buffer Management , Failure with loss of nonvolatile storage,Advance Recovery systems, Remote Backup systems.	8
V	File organization, various kinds of indexes. Query Processing, Measures of query cost , Selection operation , Projection operation, , Join operation , set operation and aggregate operation , Relational Query Optimization , Transacting SQL queries , Estimating the cost , Equivalence Rules.	8

Text Books:

1. Data base System Concepts, Silberschatz, Korth, McGraw hill, Sixth Edition.
2. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGrawHill 3rd Edition.

Reference Books:

1. Fundamentals of Database Systems, Elmasri Navathe Pearson Education.
2. An Introduction to Database systems, C.J. Date, A.Kannan, S.Swami Nadhan, Pearson, Eight Edition for UNIT III.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Understand Data Warehousing Concepts	K2
CO2 :	Apply data extraction, cleanup, and transformation tools effectively. Utilize metadata in reporting and querying applications.	K3
CO3 :	Analyze Data Using OLAP and Create and interpret reports that utilize OLAP capabilities.	K4
CO4 :	Apply Data Mining Techniques and explain the functionalities of data mining and the processes of data preprocessing, cleaning, integration, and transformation.	K3
CO5 :	Evaluate Data Analysis Techniques and assess the accuracy of classifiers and predictors through appropriate evaluation metrics.Utilize ensemble methods for improved prediction accuracy.	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	0	3	2	3	3	3	3	1
CO2	3	2	2	3	3	2	3	3	2
CO3	3	2	2	3	3	2	3	3	2
CO4	3	3	3	3	3	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCCY	Programme Code	BCCY		
Course Code	25BCCY143	Number of Hrs/Week	3		
Semester	IV	Max. Marks	100		
Course Category	CORE COURSE	Credits	3		
Course Title	Ethical Hacking and Penetration Testing		L	T	P
			3	0	0

COURSE OBJECTIVES:

The main aim of this course is to prepare the students for:

- Interpret the fundamentals of Ethical Hacking
- Illustrate the concept of Reconnaissance, Footprinting, Scanning and Enumeration
- Experiment with System Hacking techniques and Malware Attacks
- Analyze the Concepts of attacks such as Sniffing, Denial of Service, Session Hijacking, SQL Injection and Buffer Overflows
- Analyze the importance of following Ethics of Ethical Hacking.

UNIT	TOPICS	HOURS
I	**Introduction to Ethical Hacking -** Introduction to Ethical Hacking : Gathering Target Information - Introduction to Ethical Hacking - Defining Ethical Hacking - Understanding the Purpose of Ethical Hacking -An Ethical Hacker's Skill Set - Ethical Hacking Terminology - The Phases of Ethical Hacking - Identifying Types of Hacking Technologies - Identifying Types of Ethical Hacks - Understanding Testing Types - **Gathering Target Information: Reconnaissance, Foot printing, and Social Engineering** -Reconnaissance - Understanding Competitive Intelligence . Information-Gathering Methodology : Foot printing - Using Google to Gather Information - Understanding DNS Enumeration - Understanding Who is and ARIN Lookups - Identifying Types of DNS Records - Using Trace route in Foot printing - Understanding Email Tracking - Understanding Web Spiders - Social Engineering - The Art of Manipulation - Types of Social Engineering-Attacks - Social-Engineering Countermeasures	9
II	**Gathering Network and Host Information** : Scanning and Enumeration : Scanning - The CEH Scanning Methodology - Ping Sweep Techniques - Nmap Command Switches - Scan Types - TCP Communication Flag Types - War-Dialing Techniques - Banner Grabbing and OS Fingerprinting Techniques - Scanning Anonymously. Enumeration : Null Sessions - SNMP Enumeration - **System Hacking: Password Cracking, Escalating Privileges, and Hiding Files** - The Simplest Way to Get a Password - Types of Passwords - Passive Online Attacks - Active Online Attacks - Offline Attacks - Non-electronic Attacks - Cracking a Password - Understanding the LAN Manager Hash - Redirecting the SMB Logon to the Attacker - SMB Relay MITM Attacks and Countermeasures - Password-Cracking Countermeasures - Understanding Key-loggers and Other Spyware Technologies - Escalating Privileges - Executing Applications - Buffer Overflows . Understanding Rootkits: Planting Rootkits on Windows 2000 and XP Machines - Rootkit Countermeasures. Hiding Files: NTFS File	9

	Streaming - NTFS Stream Countermeasures - Understanding Steganography Technologies - Covering Your Tracks and Erasing Evidence.	
III	**Trojans, Backdoors, Viruses, and Worms:** Trojans and Backdoors - Overt and Covert Channels - Types of Trojans - Trojan Construction Kit and Trojan Makers - Trojan Countermeasures - Viruses and Worms - Types of Viruses - Virus Detection Methods. **Gathering Data from Networks -** Understanding Host-to-Host Communication - How a Sniffer Works - Sniffing Countermeasures - Bypassing the Limitations of Switches - How ARP Works - ARP Spoofing and Poisoning Countermeasures - Wire shark Filters - Understanding MAC Flooding and DNS Spoofing. **Denial of Service and Session Hijacking**: .Denial of Service : How DDoS Attacks Work - How BOTs/BOTNETs Work - Smurf and SYN Flood Attacks – DoS/DDoS Countermeasures - Session Hijacking - Sequence Prediction - Dangers Posed by Session Hijacking - Preventing Session Hijacking	9
IV	**Website hacking:** How Web Servers Work - Types of Web Server Vulnerabilities. **Attacking Applications: SQL Injection and Buffer Overflows.** SQL Injection - Finding a SQL Injection Vulnerability - The Purpose of SQL Injection - SQL Injection Countermeasures - BufferOverflows - Types of Buffer Overflows and Methods of Detection - Buffer Overflow Countermeasures.	9
V	**Wireless Network Hacking**: Wi-Fi and Ethernet - Authentication and Cracking Techniques - MAC Filters and MAC Spoofing - Rogue Access Points - Evil Twin or AP Masquerading - Wireless Hacking Techniques - Securing Wireless Networks. **Physical Site Security, Bypassing Network Security & Ethics of Ethical Hacking: -** Components of Physical Security - Understanding Physical Security - Physical Site Security Countermeasures - What to Do after a Security Breach Occurs - Bypassing Network Security: Evading IDSs, Honeypots, and Firewalls	9

Text Book

1. Kimberly Graves ,Sybex(2010),CEH - Certified Ethical Hacker STUDY GUIDE,Wiley Publishing Incorp

Reference Books

1. Sean-Philip Oriyano ,Sybex(2016) ,CEH V9 - Certified Ethical Hacker STUDY GUIDE (version 9),Wiley Publishing Incorp
2. Patrick Engebretson (2011), The Basics of Hacking and Penetration Testing (Second Edition), Syngress/Elsevier.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Interpret the fundamentals of Ethical Hacking	K2
CO2 :	Illustrate the concept of Reconnaissance, Footprinting, Scanning and Enumeration	K2
CO3 :	Experiment with System Hacking techniques and Malware Attacks	K3
CO4 :	Analyze the Concepts of attacks such as Sniffing, Denial of Service, Session Hijacking, SQL Injection and Buffer Overflows	K4
CO5 :	Analyze the importance of following Ethics of Ethical Hacking.	K4

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	2	2	2	3
CO2	3	3	3	2	3	2	2	2	2
CO3	3	3	2	3	2	2	3	3	2
CO4	3	2	2	3	1	2	3	3	2
CO5	3	2	2	2	1	2	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY144	Number of Hours/Week	3		
Semester	IV	Max. Marks	100		
Course Category	CORE COURSE	Credits	3		
Course Title	COMPUTER ORGANIZATION		L	T	P
			3	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To understand the basic hardware and software issues of computer organization
- To understand the representation of data at machine level
- To understand how computations are performed at machine level
- To understand the memory hierarchies, cache memories and virtual memories
- To learn the different ways of communication with I/O devices

UNIT	TOPICS	HOURS
I	Introduction, Technologies for building Processors and Memory, Performance, The Power Wall, Operations of the Computer Hardware, Operands Signed and Unsigned numbers, Representing Instructions, Logical Operations, Instructions for Making Decisions	10
II	MIPS Addressing for 32, Bit Immediates and Addresses, Parallelism and Instructions: Synchronization, Translating and Starting a Program, Addition and Subtraction, Multiplication, Division, Floating Point, Parallelism and Computer Arithmetic: Subword Parallelism, Streaming SIMD Extensions and Advanced Vector Extensions in x86.	8
III	Logic Design Conventions - Building a Datapath, A Simple Implementation Scheme, overview of Pipelining, Pipelined Datapath, Data Hazards: Forwarding versus Stalling, Control Hazards, Exception, Parallelism via Instructions, The ARM Cortex–A8 and Intel Core i7 Pipelines, Instruction, Level Parallelism and Matrix Multiply Hardware Design language.	10
IV	Memory Technologies, Basics of Caches, Measuring and Improving Cache Performance, dependable memory hierarchy, Virtual Machines, Virtual Memory, Using FSM to Control a Simple Cache, Parallelism and Memory Hierarchy: Redundant Arrays of Inexpensive Disks, Advanced Material: Implementing Cache Controllers.	10
V	Disk Storage and Dependability, Parallelism and Memory Hierarchy: RAID levels, performance of storage systems, Introduction to multi-threading clusters, message passing multiprocessors.	8

Text Books:

1. David A. Patterson, John L. Hennessey, "Computer Organization and Design, The Hardware/Software Interface", Fifth Edition, Morgan Kauffman/Elsevier, 2014.

2. Smruti Ranjan Sarangi, "Computer Organization and Architecture", McGraw Hill Education, 2015.

Reference Books:

1. V. Carl Hamacher, Zvonko G. Varanesic, Safat G. Zaky, "Computer Organization", Sixth Edition, McGrawHill Inc., 2012.
2. William Stallings, "Computer Organization and Architecture", Eighth Edition, Pearson Education, 2010.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Understand the architecture and functionality of central processing unit	K4
CO2 :	Analyze the abstraction of various components of a computer	K4
CO3 :	Analyze the hardware and software issues and the interfacing	K3
CO4 :	Work out the trade-offs involved in designing a modern computer system	K2
CO5 :	Understand the various memory systems and I/O communication	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	2	2	3	1
CO2	3	3	3	2	3	2	2	2	1
CO3	3	3	2	3	2	2	3	2	3
CO4	3	2	2	3	1	2	3	2	1
CO5	3	2	2	2	1	2	3	3	1

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY145	Number of Hours/Wk	3		
Semester	IV	Max. Marks	100		
Course Category	CORE COURSE	Credit	3		
Course Title	OPERATING SYSTEM CONCEPTS		L	T	P
			3	0	0

COURSE OBJECTIVE

- To understand the fundamental concepts and role of Operating System.
- To learn the Process Management and Scheduling Algorithms
- To understand the Memory Management policies
- To gain insight on I/O and File management techniques

UNIT	TOPIC	HOURS
I	**Introduction**- Computer system organization- Operating System Structure and Operations-operating system services- System Calls, types of system calls-operating system structure. **Processes :** Process Concept, Process Scheduling, Operations on Processes, Inter-process Communication;	9
II	**Threads:** Overview, Multithreading models, Threading issues; **CPU Scheduling** - Scheduling criteria, Scheduling algorithms, Multiple-processor scheduling, Real time scheduling;	9
III	**Deadlock** - System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock. **Main Memory**: Background, Swapping, Contiguous Memory Allocation, Paging- Segmentation with paging. **Virtual Memory** – Page Replacement, Allocation, Thrashing.	9
IV	**Mass Storage system** – Overview of Mass Storage Structure- Disk Structure-Disk Scheduling and Management- RAID structure. **File-System Interface** - File concept-Access methods- Directory Structure-Directory Organization-**File System Implementation-** File System Structure, Directory implementation, Allocation Methods, Free Space Management- **I/O Systems** – I/O Hardware, Application I/O interface, Kernel I/O subsystem.	9
V	**Virtual Machines:** Benefits and features Types of VM and implementation-Virtualization and OS Components. **Distributed Systems:** Real time OS-Advantages of real time OS and distributed OS- Types of network-based Operating Systems- Network structure- Communication structure-Communication protocols.	9

TEXT BOOK:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne., (2018),"Operating System Concepts ", John Wiley and Sons Inc., 9th Edition.

REFERENCES:

1. Ramaz Elmasri, A. Gil Carrick, David Levine.,(2010),"Operating Systems – A Spiral Approach", Tata McGraw Hill Edition.
2. Achyut S. Godbole, Atul Kahate.,(2016), "Operating Systems", McGraw Hill Education.
3. Andrew S. Tanenbaum.,(2004),"Modern Operating Systems", Pearson Education, 2nd Edition.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Understand the structure, operations, and services of operating systems, including system calls and process management.	K2
CO2 :	Analyze process scheduling, multithreading models, and CPU scheduling algorithms for efficient system performance.	K4
CO3 :	Apply deadlock handling techniques such as prevention, avoidance, detection, and recovery to system resource management.	K3
CO4 :	Evaluate memory management schemes including paging, segmentation, and virtual memory to optimize system utilization.	K5
CO5 :	Analyze file systems, mass storage structures, and I/O subsystem operations to understand data management in operating systems.	K4

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	2	2	3	1
CO2	3	3	3	2	3	2	2	2	1
CO3	3	3	2	3	2	2	3	2	3
CO4	3	2	2	3	1	2	3	2	1
CO5	3	2	2	2	1	2	3	3	1

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY141	Number of Hrs/Wk	3		
Semester	IV	Max. Marks	100		
Course Category	CORE COURSE	Credit	3		
Course Title	DATA MINING AND DATA WAREHOUSING		L	T	P
			3	0	0

COURSE OBJECTIVE

- To understanding of data warehousing, data mining, and advanced analytics techniques essential for effective business decision-making.
- To learn how to build, manage, and utilize data warehouses and apply various data mining techniques for insightful analysis.

UNIT	TOPIC	HOURS
I	**Data Warehousing and Business Analysis** Data warehousing Components –Building a Data warehouse –Data Warehouse Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –Metadata – reporting – Query tools and Applications – Online Analytical Processing (OLAP) – OLAP and Multidimensional Data Analysis.	10
II	**Data Mining** Data Mining Functionalities – Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation- Architecture Of A Typical Data Mining Systems- Classification Of Data Mining Systems.	10
III	**Association Rule Mining** Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-Based Association Mining.	8
IV	**Classification and Prediction** Issues Regarding Classification and Prediction – Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Section.	8
V	**Cluster Analysis** Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Course Categoryitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods – Clustering High-Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis	8

Text Books:

1. Jiawei Han, Micheline Kamber and Jian Pei "Data Mining Concepts and Techniques", Third Edition, Elsevier, 2011.

Reference Books:

1. Alex Berson and Stephen J. Smith "Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill Edition, Tenth Reprint 2007.
2. K.P. Soman, Shyam Diwakar and V. Ajay "Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2006.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Understand Data Warehousing Concepts	K2
CO2 :	Apply data extraction, cleanup, and transformation tools effectively. Utilize metadata in reporting and querying applications.	K3
CO3 :	Analyze Data Using OLAP and Create and interpret reports that utilize OLAP capabilities.	K4
CO4 :	Apply Data Mining Techniques and explain the functionalities of data mining and the processes of data preprocessing, cleaning, integration, and transformation.	K3
CO5 :	Evaluate Data Analysis Techniques and assess the accuracy of classifiers and predictors through appropriate evaluation metrics.Utilize ensemble methods for improved prediction accuracy.	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	0	3	2	3	3	3	3	1
CO2	3	2	2	3	3	2	3	3	2
CO3	3	2	2	3	3	2	3	3	2
CO4	3	3	3	3	3	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY241	Number of Hours/Week	2		
Semester	IV	Max. Marks	100		
Course Category	CORE COURSE	Credits	1		
Course Title	Cryptography and Network Security Lab		L	T	P
			0	0	2

The main aim of this course is to prepare the students for:

- To gain insights into security principles, legal aspects, and threat mitigation strategies.
- To explore encryption techniques and their role in ensuring data confidentiality.
- To understand cryptographic algorithms and key management in secure communication.
- To analyze authentication protocols and digital security measures for integrity.
- To study real-world cybersecurity practices, including intrusion detection and firewall defense.

List of Experiments

1. Perform encryption, decryption using the following substitution techniques

i. Ceaser cipher

ii. Playfair cipher

iii. Hill Cipher

iv. Vigenere cipher

2. Perform encryption and decryption using following transposition techniques

i. Rail fence

ii. Row & Column Transformation

3. Apply DES algorithm for practical applications.

4. Apply AES algorithm for practical applications.

5. Implement RSA Algorithm using HTML and JavaScript

6. Implement the Diffie-Hellman Key Exchange algorithm for a given problem.

7. Calculate the message digest of a text using the SHA-1 algorithm.

8. Implement the SIGNATURE SCHEME - Digital Signature Standard.

9. Demonstrate intrusion detection system (ids) using any tool eg. Snort or any

other s/w.

10. Automated Attack and Penetration Tools Exploring N-Stalker, a

Vulnerability Assessment Tool

11. Defeating Malware

i. Building Trojans

ii. Rootkit Hunter

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Understand fundamental security concepts, threats, and classical encryption techniques	K2
CO2 :	Apply symmetric and asymmetric cryptographic algorithms for secure communication	K3
CO3 :	Implement authentication mechanisms, digital signatures, and hash functions for data integrity	K3,K4
CO4 :	Analyze network and system security threats, including malware, intrusion detection, and firewalls.	K4
CO5 :	Explore security applications in email, web, and IP communication, ensuring end-to-end protection.	K2,K3

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	2	3	2	2
CO2	3	3	3	3	3	3	3	2	3
CO3	2	2	3	3	3	2	3	2	3
CO4	3	3	3	3	3	3	3	3	3
CO5	2	2	2	3	2	3	3	2	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY242	Number of Hours/Week	2		
Semester	IV	Max. Marks	100		
Course Category	CORE COURSE	Credits	1		
Course Title	DATABASE MANAGEMENT SYSTEMS LAB		L	T	P
			0	0	2

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understand and Apply SQL DDL and DML Commands
- Utilize SQL Functions and Operators Effectively
- Implement SQL Joins and Advanced Clauses
- Work with Constraints, Views, and Subqueries in SQL
- Master Database Management and PL/SQL Concepts

LIST OF EXPERIMENTS

1. DDL commands of SQL with suitable examples
   - Create table
   - Alter table
   - Drop Table

2. DML commands of SQL with suitable examples
   - Insert
   - Update
   - Delete

3. Different types of function with suitable examples
   - Number function
   - Aggregate Function
   - Character Function
   - Conversion Function
   - Date Function

4. Different types of operators in SQL
   - Arithmetic Operators
   - Logical Operators
   - Comparison Operator
   - Special Operator
   - Set Operation

5. Different types of Joins
   - Inner Join
   - Outer Join
   - Natural Join etc..

6. Study and Implementation of
   - Group By & having clause
   - Order by clause
   - Indexing

7. Study & Implementation of
   - Sub queries
   - Views

8. Different types of constraints

9. Database Backup & Recovery commands.
   Rollback, Commit, Savepoint.

10. Creating Database /Table Space
Managing Users: Create User, Delete User
Managing roles:-Grant, Revoke

11. PL/SQL

12. SQL Triggers

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Understand Data Warehousing Concepts	**K2**
CO2 :	Apply data extraction, cleanup, and transformation tools effectively. Utilize metadata in reporting and querying applications.	**K3**
CO3 :	Analyze Data Using OLAP and Create and interpret reports that utilize OLAP capabilities.	**K4**
CO4 :	Apply Data Mining Techniques and explain the functionalities of data mining and the processes of data preprocessing, cleaning, integration, and transformation.	**K3**
CO5 :	Evaluate Data Analysis Techniques and assess the accuracy of classifiers and predictors through appropriate evaluation metrics.Utilize ensemble methods for improved prediction accuracy.	**K5**

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	0	3	2	3	3	3	3	1
CO2	3	2	2	3	3	2	3	3	2
CO3	3	2	2	3	3	2	3	3	2
CO4	3	3	3	3	3	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY243	Number of Hours/Week	2		
Semester	IV	Max. Marks	100		
Course Category	CORE COURSE	Credits	1		
Course Title	Ethical Hacking and Penetration Testing Lab		L	T	P
			0	0	2

The main aim of this course is to prepare the students for:

- Interpret the fundamentals of Ethical Hacking
- Illustrate the concept of Reconnaissance, Footprinting, Scanning and Enumeration
- Experiment with System Hacking techniques and Malware Attacks
- Analyze the Concepts of attacks such as Sniffing, Denial of Service, Session Hijacking, SQL Injection and Buffer Overflows
- Analyze the importance of following Ethics of Ethical Hacking.

List of Experiments

1. Introduction to Kali Linux
2. Foot Printing and Reconnaissance
3. Scanning using NMAP – Live Host, Open Ports
4. Scanning – Vulnerability, Network Diagram
5. Understanding Ping, ARP, and nslookup Commands
6. SNMP Enumeration
7. Sniffing using Wireshark
8. DOS/ DDOS Attack
9. ARP Poisoning using Ettercap
10. TCP DUMP – Network Traffic Analyzer Working

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Interpret the fundamentals of Ethical Hacking	K2
CO2 :	Illustrate the concept of Reconnaissance, Footprinting, Scanning and Enumeration	K2
CO3 :	Experiment with System Hacking techniques and Malware Attacks	K3
CO4 :	Analyze the Concepts of attacks such as Sniffing, Denial of Service, Session Hijacking, SQL Injection and Buffer Overflows	K4
CO5 :	Analyze the importance of following Ethics of Ethical Hacking.	K4

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	2	2	2	3
CO2	3	3	3	2	3	2	2	2	2
CO3	3	3	2	3	2	2	3	3	2
CO4	3	2	2	3	1	2	3	3	2
CO5	3	2	2	2	1	2	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Discipline Specific Elective

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY341	Number of Hours/Wk	3		
Semester		Max. Marks	100		
Course Category	Discipline Specific Elective	Credits	3		
Course Title	FULL STACK DEVELOPMENT		L	T	P
			3	0	0

COURSE OBJECTIVES

The main aim of learning this course is to:

- To understand the various components of full stack development
- To learn Node.js features and applications
- To develop applications with MongoDB
- To understand the role of Angular and Express in web applications
- To develop simple web applications with React

UNIT	TOPICS	HOURS
I	**Basics Of Full Stack:** Understanding the Basic Web Development Framework – User – Browser – Webserver – Backend Services – MVC Architecture – Understanding the different stacks –The role of Express – Angular – Node – Mongo DB – React	9
II	**Node JS:** Basics of Node JS – Installation – Working with Node packages – Using Node package manager – Creating a simple Node.js application – Using Events – Listeners –Timers – Call backs – Handling Data I/O – Implementing HTTP services in Node.js	9
III	**Mongo DB:** Understanding NoSQL and MongoDB – Building MongoDB Environment – User accounts – Access control – Administering databases – Managing collections – Connecting to MongoDB from Node.js – simple applications	9
IV	**Express And Angular:** Implementing Express in Node.js – Configuring routes – Using Request and Response objects Angular – Typescript – Angular Components – Expressions – Data binding – Built-in directives	9
V	**React:** MERN STACK – Basic React applications – React Components – React State – Express REST APIs – Modularization and Web pack – Routing with React Router – Server-side rendering	9

Text Book:

1. Brad Dayley, Brendan Dayley, Caleb Dayley, 'Node.js, MongoDB and Angular Web Development', Addison-Wesley, Second Edition, 2018
2. Vasan Subramanian, 'Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node', Second Edition, Apress, 2019.

Reference Books

1. Full-Stack JavaScript Development by Eric Bush.

2. Mastering Full Stack React Web Development Paperback – April 28, 2017 by Tomasz Dyl, Kamil Przeorski, Maciej Czarnecki
3. Chris Northwood, 'The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer', Apress; 1st edition, 2018
4. Kirupa Chinnathambi, 'Learning React: A Hands-On Guide to Building Web Applications Using React and Redux', Addison-Wesley Professional, 2nd edition, 2018

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Understanding of full-stack development, including front-end, back-end, and database integration using popular technologies.	K6
CO2 :	Develop practical knowledge of Node.js, including installation, using npm, creating applications, and handling asynchronous operations with events, callbacks, and timers.	K3
CO3 :	Master MongoDB and NoSQL concepts, from database setup to collection management, and connecting MongoDB with Node.js applications.	K6
CO4 :	Learn how to build dynamic web applications using Angular, including components, directives, data binding, and Typescript.	K6
CO5 :	Acquire hands-on experience with the MERN stack to build full-stack applications with React, Express, and REST APIs, including routing and server-side rendering.	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	1	2	1	3
CO2	3	2	3	2	3	1	2	1	3
CO3	3	3	3	2	3	2	2	1	3
CO4	3	3	3	2	3	2	3	1	3
CO5	3	3	3	2	3	3	3	2	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY342	Number of Hours/Wk	3		
Semester		Max. Marks	100		
Course Category	Discipline Specific Elective	Credits	3		
Course Title	NUMBER THEROY IN CYBERSECURITY		L	T	P
			3	0	0

COURSE OBJECTIVES

The main aim of learning this course is to:

- Provide a foundational understanding of cryptographic principles and algorithms
- Explore key concepts in number theory and their application in cryptography.
- Equip students with practical skills in implementing encryption, key exchange, and digital signature protocols.

UNIT	TOPICS	HOURS
I	**Introduction to Cryptography and Computational Complexity.** Basics of Cryptography, Definitions and principles of cryptography, Symmetric vs Asymmetric Encryption, Complexity of Computation, Time and Space complexity, Big O notation in cryptography, Number Theory in Cryptography, Divisibility, prime numbers, greatest common divisor (GCD)	9
II	**Modular Arithmetic and Euclid's Algorithm** Modular Arithmetic-Introduction to Modulo operation, Operations in modular arithmetic, Euclid's Algorithm: GCD and its computation, Extended Euclidean Algorithm, Application in key generation, Chinese Remainder Theorem: Solving simultaneous modular equations, Application in RSA and speeding up decryption, Fermat's Little Theorem: Modular exponentiation and primality testing, Applications in Diffie-Hellman and RSA.	9
III	**Prime Numbers and Factorization** Prime Numbers- Primality testing algorithms, Prime Factorization, Cryptosystems based on Prime Factorization: RSA key generation, encryption, and decryption Applications and attacks related to prime factorization, Pollard's Rho Algorithm	9
IV	**Discrete Logarithms and Diffie-Hellman Key Exchange** Discrete Logarithms, Diffie-Hellman Key Exchange Protocol, Elgamal Cryptosystem: Public key encryption using discrete logarithms, Digital signatures based on DLP	9
V	**Elliptic Curve Cryptography and Advanced Topics** Introduction to Elliptic Curves, Elliptic Curve Discrete Logarithm Problem (ECDLP), Elliptic Curve Digital Signature Algorithm (ECDSA), Zero Knowledge Proofs, Advanced Cryptographic Techniques	9

Text Book

1. N. Koblitz, A Course in Number Theory and Cryptography, Springer 2006.
2. L. C. Washington, Elliptic curves: number theory and cryptography, Chapman & Hall/CRC, 2003.
3. I. Niven, H.S. Zuckerman, H.L. Montgomery, An Introduction to theory of numbers, Wiley, 2006.

Reference Books

1. William Stallings , "Cryptography and Network Security Principles and Practice", Pearson Education Inc., 6th Edition, 2014, ISBN: 978-93- 325-1877-3
2. Handbook of Applied Cryptography, A. Menzes, P. van Oorschot and S. Vanstone.

Scribes: Rakesh Yarlagadda, Ravi Ranjan

3. D. Hankerson, A. Menezes and S. Vanstone, Guide to elliptic curve cryptography, Springer-Verlag, 2004.
4. J. Pipher, J. Hoffstein and J. H. Silverman, An Introduction to Mathematical Cryptography, Springer-Verlag, 2008.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Understand and Apply Basic Concepts of Cryptography and Number Theory	K6
CO2 :	Implement and Solve Problems Using Modular Arithmetic and Euclid's Algorithm	K3
CO3 :	Understand and Apply Prime Factorization in Cryptographic Systems	K6
CO4 :	Analyze and Solve Discrete Logarithm Problems in Key Exchange Protocols	K6
CO5 :	Implement and Understand Elliptic Curve Cryptography (ECC) and Advanced Topics	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	1	2	2	0
CO2	2	3	3	3	2	1	3	2	2
CO3	3	3	2	3	2	1	3	2	1
CO4	3	3	3	3	3	2	3	2	2
CO5	3	3	2	3	3	2	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY343	Number of Hours/Wk	3		
Semester		Max. Marks	100		
Course Category	Discipline Specific Elective	Credits	3		
Course Title	SOCIAL NETWORK ANALYSIS		L	T	P
			3	0	0

COURSE OBJECTIVES

The main aim of learning this course is to:

- Explain the evolution of the Semantic Web, its limitations, and the role of social web platforms in network analysis.
- Apply ontology-based knowledge representation and advanced modelling techniques to social network data.
- Analyse and extract insights from web communities and study their evolution using archival data.
- Evaluate human behaviour in social networks and address privacy, trust, and reputation challenges.
- Utilize visualization techniques and graph theory to analyse and interpret social networks in practical scenarios.

UNIT	TOPICS	HOURS
I	**INTRODUCTION** Introduction to Semantic Web: Limitations of current Web – Development of Semantic Web.Emergence of the Social Web – Social Network analysis: Development of Social Network.Analysis – Key concepts and measures in network analysis – Electronic sources for network.	9
II	**MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION** Ontology and their role in the Semantic Web: Ontology-based knowledge Representation –Language – Modelling and aggregating social network data: State-of-the-art in network data.social relationships – Aggregating and reasoning with social network data – Advanced.Representations.	9
III	**EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS:** Extracting evolution of Web Community from a Series of Web Archive – Detecting.	9
IV	**VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS** Graph theory – Centrality – Clustering – Node-Edge Diagrams – Matrix representation –Visualizing online social networks, visualizing social networks with matrix-based.representations – Matrix and Node-Link Diagrams – Hybrid representations – Applications –Cover networks – Community welfare – Collaboration networks – Co-Citation networks.	9
V	**PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES** Understanding and predicting human behaviour for social communities – User data management.– Inference and Distribution – Enabling new human experiences – Reality mining – Context –Awareness – Privacy in online social networks – Trust in online environment – Trust modelsbased on subjective logic – Trust network analysis – Trust transitivity analysis – Combining Trust and reputation – Trust derivation based on trust comparisons.	9

Text Books:

1. Semantic Web for the Working Ontologist: Effective Modeling in RDFS and OWL, **Authors**: Dean Allemang, James Hendle, **Publisher**: Morgan Kaufmann, Edition: 2nd

Edition (2011)

Reference Books:

1. The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management, **Authors**: Tim Berners-Lee, James Hendler, Ora Lassila, **Publisher**: Morgan Kaufmann, **Edition**: 1st Edition (2001)

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Illustrate the Evolution of the Semantic Web and Social Web Platforms	K6
CO2 :	Apply Ontology-Based Knowledge Representation and Modeling Techniques	K3
CO3 :	Extract Insights from Web Communities and Evaluate Evolution	K6
CO4 :	Assess Human Behavior and Address Privacy, Trust, and Reputation Challenges	K6
CO5 :	Employ Graph Theory and Visualization Techniques for Social Network Analysis	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	1	2	2	1	2	1	2
CO2	3	3	3	2	3	2	3	3	3
CO3	2	3	3	3	3	2	3	3	3
CO4	3	2	2	3	2	2	3	2	2
CO5	3	3	3	2	3	3	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

SEMESTER- V

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY151	Number of Hours/Wk	3		
Semester	V	Max. Marks	100		
Course Category	CORE COURSE	Credits	3		
Course Title	INTRODUCTION TO BLOCKCHAIN AND CRYPTOCURRENCY		L	T	P
			3	0	0

COURSE OBJECTIVES:

The main aim of learning this course is to:

- Introduce the basics of Blockchain technology and cryptocurrency.
- Understand blockchain structure, consensus models, and public vs. private blockchains.
- Explore key cryptographic techniques such as hash functions and digital signatures.
- Learn about Bitcoin transactions, mining, and Proof of Work (PoW).
- Examine blockchain applications and permissioned systems, with a focus on smart contracts using Hyperledger Fabric and Ethereum.

UNIT	TOPICS	HOURS
I	**Introduction** Overview of Blockchain, Public Ledgers, Bitcoin, Smart Contracts, Block in a Blockchain, Transactions, Distributed Consensus, Public vs Private Blockchain, Understanding Crypto currency to Blockchain, Permissioned Model of Blockchain, Overview of Security aspects of Blockchain, Basic Crypto Primitives: Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography, A basic cryptocurrency.	9
II	**Blockchain With Crypto Currency** Bitcoin and Blockchain: Creation of coins, Payments and double spending, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay. Working with Consensus in Bitcoin: Distributed consensus in open environments, Consensus in a Bitcoin network, Proof of Work (PoW) – basic introduction, HashcashPoW, Bitcoin PoW, Attacks on PoW and the monopoly problem, Proof of Stake, Proof of Burn and Proof of Elapsed Time, The life of a Bitcoin Miner, Mining Difficulty, Mining Pool.	9
III	**Permissioned blockchain and Consensus mechanisms.** Permissioned Blockchain: Permissioned model and use cases, Design issues for Permissioned blockchains, Execute contracts, State machine replication, Overview of Consensus models for permissioned blockchain, Distributed consensus in closed environment, Paxos, RAFT Consensus, Byzantine general problem, Byzantine fault tolerant system, Lamport-Shostak-Pease BFT Algorithm, BFT over Asynchronous systems.	9

IV	**Blockchain and Cryptocurrency Applications** Cross-Border Payments, Know Your Customer (KYC) and Blockchain, Blockchain in Food Security, Mortgage over Blockchain, Supply Chain Financing and Blockchain, Identity, Smart Property, and Digital Transactions, Transactions, Payments, and Market Mechanisms, Multi-Party Lotteries on Blockchain	9
V	**Blockchain Frameworks and Smart Contract Development** Hyperledger Fabric- Architecture, Identities and Policies, Membership and Access Control, Channels, Transaction Validation, Writing smart contract using Hyperledger Fabric, Writing smart contract using Ethereum, Overview of Ripple and Corda.	9

Text Book

1. Dhillon, V., Metcalf, D., and Hooper, M, Blockchain enabled applications, 2017, 1st Proceedings of the 65th Academic Council (17.03.2022) 1042 Edition, CA: Apress, Berkeley.
2. Blockchain: A Practical Guide to Developing Business, Law, and Technology Solutions" by Joseph J. Bambara, Paul R. Allen, Kedar Iyer, Rene Madsen, Solomon Lederer, and Michael Wuehler
3. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Agenda Item 65/39 - Annexure - 35 Proceedings of the 65th Academic Council (17.03.2022) 1047 Bitcoin and cryptocurrency technologies: a comprehensive introduction, 2016, Princeton University Press

Reference Books

1. Diedrich, H., “Ethereum: Blockchains, digital assets, smart contracts, decentralized autonomous organizations”, 2016, 1st Edition, Wildfire publishing, Sydney
2. Cryptography and Network Security: Principles and Practices, William Stallings, 7th edition, 2017
3. Bashir, I., "Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained", 2nd Edition, Packt Publishing Ltd, March 30, 2018.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Understand the fundamentals of blockchain, cryptographic techniques, and consensus models.	K2
CO2 :	Learn about cryptocurrency mechanisms, Bitcoin transactions, and Proof of Work	K2
CO3 :	Apply various consensus models and understand distributed consensus in blockchains.	K3
CO4 :	Explore real-world blockchain applications in payments, security, and identity management.	K4
CO5 :	Develop smart contracts using frameworks like Hyperledger Fabric and Ethereum.	K

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	2	3	2	3
CO2	3	3	2	3	3	2	3	3	2
CO3	3	3	3	3	3	3	3	2	3
CO4	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY152	Number of Hours/Wk	3		
Semester	V	Max. Marks	100		
Course Category	Core Course	Credits	3		
Course Title	MALWARE ANALYSIS		L	T	P
			3	0	0

COURSE OBJECTIVES:

The main aim of learning this course is to:

- Equip students with the skills to analyse and detect malware using both static and dynamic techniques.
- Identify malicious software, assemble an analysis toolkit.
- Understand various detection methods to uncover and mitigate threats effectively

UNIT	TOPICS	HOURS
I	**Introduction to Malware and Basic Analysis Techniques** Introduction to malware, OS security concepts, malware threats, evolution of malware, malware types – viruses, rootkits, worms, bots, Trojans, spyware, adware, logic bombs, basic malware analysis, static malware analysis, dynamic malware analysis.	9
II	**Malware Analysis Techniques** Assembling a toolkit for effective malware analysis - examining static properties of suspicious programs - performing behavioural analysis of malicious Windows executables - performing static and dynamic code analysis of malicious Windows executables -interacting with malware in a lab to derive additional behavioural characteristics.	9
III	**Static Malware Analysis** Architecture of X86 - Main Memory, Instructions, Opcodes and Endianness, Operands, Registers, Simple Instructions, The Stack, Conditionals, Branching, Rep Instructions, C Main Method and Offsets, Antivirus Scanning - Fingerprint for Malware, Portable Executable File Format, The PE File Headers and Sections.	9
IV	**Dynamic Malware Analysis** Malware Sandbox - running malware, Monitoring with Process Monitor, Packet Sniffing with Wireshark, source-level vs. assembly level debuggers, Kernel vs. User-Mode Debugging, OLLYDBG - Breakpoints, Tracing, Exception Handling, Patching	9
V	**Malware Behaviour and Detection Strategies** Downloaders, Backdoors, Credential Stealers, Persistence Mechanisms, Privilege Escalation, Covert malware launching, Launchers, Process Injection, Process Replacement, Hook Injection, Detours, APC injection, Signature-based techniques: malware signatures, packed malware signature, metamorphic and polymorphic malware signature, non-signature-based techniques: similarity-based techniques, machine-learning methods, invariant inferences	9

Text Book

1. Practical malware analysis, "The Hands-On Guide to Dissecting Malicious Software", by Michael Sikorski and Andrew Honig ISBN-10: 159327-290-1, ISBN-13: 978-1-59327-290-6, 2012.
2. Dang, Gazet and Bachaalany, "Practical Reverse Engineering", Wiley,2014

Reference Books

1. Computer viruses: From theory to applications by Filiol, Eric Springer Science & Business Media,2006

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Identify and classify various types of malwares based on behavior and structure.	K3
CO2 :	Effectively use static and dynamic analysis techniques to examine and detect malicious software	K4
CO3 :	Develop a strong understanding of malware analysis tools and how to set up a controlled analysis environment.	K2
CO4 :	Apply malware detection methods, including signature-based and machine-learning techniques, to identify and mitigate threats.	K3
CO5 :	Demonstrate the ability to analyze and interpret malicious code, recognizing key indicators of compromise and suspicious activity.	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	2	1	2	1	3	1	1
CO2	3	3	3	2	3	2	2	1	2
CO3	3	2	2	3	3	2	3	1	2
CO4	3	3	3	2	3	1	2	2	3
CO5	2	2	3	3	3	2	3	3	2

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY153	Number of Hrs/Wk	4		
Semester	V	Max. Marks	100		
Course Category	Core Course	Credits	3		
Course Title	THEORY OF COMPUTATION		L	T	P
			3	1	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students:

- To give an overview of the theoretical foundations of computer science from the perspective of formal languages.
- To illustrate finite state machines to solve problems in computing
- To familiarize Regular grammars and Context Free Grammar.
- To solve various problems by normal form techniques, Push Down Automata and Turing Machines.

UNIT	UNIT	HOURS
I	**Introduction-Finite Automata** Introduction to Computation and Formal Languages- Syntax and Semantics- Finite Automata- Alphabets - Strings and Languages - Automata and Grammars - Deterministic Finite Automata (DFA) - Formal Definition - Simplified notation: State transition graph - Transition table - Language of DFA - Nondeterministic Finite Automata (NFA) - NFA with epsilon transition - Language of NFA - Equivalence of NFA and DFA - Minimization of Finite Automata - Distinguishing one string from other - Myhill-Nerode Theorem.	9
II	**Regular Expression (RE)** Definition - Operators of regular expression and their precedence - Algebraic laws for Regular expressions - Kleen's Theorem - Regular expression to FA - DFA to Regular expression - Arden Theorem - Non Regular Languages - Pumping Lemma for regular Languages. Application of Pumping Lemma - Closure properties of Regular Languages - Decision properties of Regular Languages - FA with output: Moore and Mealy machine - Equivalence of Moore and Mealy Machine - Applications and Limitation of FA.	9
III	**Context Free Grammar (CFG) and Context Free Languages** Definition - Examples - Derivation - Derivation trees - Ambiguity in Grammar - Inherent ambiguity - Ambiguous to Unambiguous CFG - Useless symbols - Simplification of CFGs - Normal forms for CFGs: CNF and GNF - Closure properties of CFLs - Decision Properties of CFLs: Emptiness - Finiteness and Membership - Pumping lemma for CFLs.	9
IV	**Push Down Automata (PDA)** Description and definition - Instantaneous Description - Language of PDA - Acceptance by Final state - Acceptance by empty stack - Deterministic PDA - Equivalence of acceptance by empty stack and final state - Conversion of CFG to PDA and PDA to CFG.	9
V	**Turing Machines (TM) and Undecidability**	9

	Basic model - definition and representation - Instantaneous Description - Language acceptance by TM - Variants of Turing Machine - TM as Computer of Integer functions - Universal TM - Church's Thesis - Recursive and recursively enumerable languages - Halting problem - Introduction to Undecidability - Undecidable problems about TMs - Post correspondence problem (PCP) - Modified PCP and undecidable nature of post correspondence problem - Introduction to recursive function theory.	

Text Book:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Introduction to Automata Theory Languages and Computation, 3rd edition, Pearson Education, India, 2007

Reference Books:

1. K. L. P Mishra, N. Chandrashekaran, Theory of Computer Science-Automata Languages and Computation, 2nd edition, Prentice Hall of India, India, 2003

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Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Design finite automata or regular expression for any tokenization task	K2
CO2 :	Construct a context free grammar for parsing any language	K2
CO3 :	Design Turing machine for any language	K2
CO4 :	Conclude the decidable / undecidable nature of any language	K4
CO5 :	Apply mathematical and formal techniques for solving real-world problems	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	2	3	2	1
CO2	2	3	2	1	3	2	2	3	2
CO3	3	2	3	2	2	3	3	2	2
CO4	2	3	2	3	2	1	2	1	3
CO5	1	1	2	3	1	2	1	2	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY154	Number of Hrs/Wk	3		
Semester	V	Max. Marks	100		
Course Category	Core Course	Credits	3		
Course Title	SOFTWARE ENGINEERING		L	T	P
			3	0	0

COURSE OBJECTIVES:

The main aim of this course is to prepare the students for:

- Understand the nature of the software
- Understand the different types of process models, agile developments and aspects of software engineer
- Gain knowledge about the requirements stage and development of the software
- Analyze the different types of architectural designs of the software
- Evaluate different testing strategies of the software and Develop the software

UNIT	TOPICS	HOURS
I	The Nature of Software - Software Engineering - Software Process.	9
II	**Process Models:** Prescriptive Process Models - **Agile Development - Human Aspects of Software Engineering**	9
III	**Understanding Requirements:** Requirements Engineering - Establishing the Groundwork Building the Analysis Model - Negotiating Requirements **Requirements Modeling: Scenario-Based Methods:** Requirements Analysis - Scenario-Based Modeling	9
IV	**Design Concepts:** Design within the Context of Software Engineering - The Design Process - Design Concepts **Architectural Design:** Software Architecture - Architectural Genres - Architectural Styles - Architectural Considerations - Architectural Decisions - Architectural Design	9
V	**User Interface Design:** The Golden Rules - User Interface Analysis and Design - Interface Analysis - Interface Design Steps - WebApp and Mobile Interface Design - Design Evaluation. **Software Testing Strategies -** Software Testing Fundamentals. **Maintenance and Reengineering.**	9

Text Book

1. Roger S Pressman, **"Software Engineering a Practioner's Approach"**, 9th Edition, McGraw-Hill Higher Education, 2023.

Reference Books

1. Richard E.Fairly (2005),"Software Engineering" Concepts, Tata Mc Graw Hill Book Company.
2. Jawadekar (2004), "Software Engineering" ,Tata Mc Graw-Hill Book Company.
3. Dr. Richard Hall Thayer and Dr. Merlin Dorfman(2012),"Software Engineering Essentials, Volume I: The Development Process", Software Management Training; Fourth edition,.

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Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Understand the nature of the software	K2
CO2 :	Understand the different types of process models, agile developments and aspects of software engineer	K2
CO3 :	Gain knowledge about the requirements stage and development of the software	K2
CO4 :	Analyze the different types of architectural designs of the software	K4
CO5 :	Evaluate different testing strategies of the software and Develop the software	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	2	1	3	-	3	2	-
CO2	3	3	3	2	3	-	3	3	2
CO3	3	3	3	3	3	2	3	3	2
CO4	3	3	3	3	3	-	3	3	3
CO5	3	3	3	3	3	2	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY155	Number of Hrs/Wk	3		
Semester	V	Max. Marks	100		
Course Category	Core Course	Credits	3		
Course Title	Criminology and Cyber Crimes		L	T	P
			3	0	0

COURSE OBJECTIVES:

The main aim of this course is to prepare the students for:

- Explore security challenges in mobile/wireless devices and common cybercrime techniques.
- Introduce computer forensics principles, including evidence handling and investigation.
- Understand the role of security policies and cyber laws in protecting digital assets

UNIT	TOPICS	HOURS
I	**Introduction to Cyber Crime:** Cybercrime- Definition and Origins of the word Cybercrime and Information Security, who are Cybercriminals? Classifications of Cybercrimes, A Global Perspective on Cybercrimes, Cybercrime Era: Survival Mantra for the Netizens. Cyber offenses: How Criminals Plan the Attacks, Social Engineering, Cyber stalking, Cybercafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector	9
II	**Cyber Crime:** Mobile and Wireless Devices-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, Mobile Devices: Security Implications for organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era	9
III	**Tools and Methos used in Cyber Crime:** Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan-horses and Backdoors, Steganography, DoS and DDoS At-tacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks. Phishing and Identity Theft: Introduction to Phishing, Identity Theft (ID Theft)	9
IV	**Understanding Computer Forensics:** Introduction, Digital Forensics Science, The Need for Computer Forensics, Cyber forensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation. Forensics and Social Networking Sites: The Security/Privacy Threats, Challenges in Computer Forensics.	9
V	**Introduction to Security Policies and Cyber Laws:** Downloaders, Backdoors, Credential Stealers, Persistence Mechanisms, Privilege Escalation, Covert malware launching, Launchers, Process Injection, Process Replacement, Hook Injection, Detours, APC injection, Signature-based techniques: malware signatures, packed malware signature, metamorphic and polymorphic malware signature, non-	9

	signature-based techniques: similarity-based techniques, machine-learning methods, invariant inferences	

Text Book

1. Sunit Belapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India Pvt Ltd, ISBN: 978-81-265-21791, Publish Date 2013.
2. Basta, Basta, Brown, Kumar, Cyber Security and Cyber Laws, 1st edition, Cengage Learning publication
3. Dr. Surya Prakash Tripathi, Ritendra Goyal, Praveen Kumar Shukla, KLSI. "Introduction to information security and cyber laws". Dream tech Press. ISBN: 9789351194736, 2015

Reference Books

1. Cyber Security and Date Privacy by Krishan Kumar Goyal , Amit Garg , Saurabh Singhal , HP HAMILTON LIMITED Publication, ISBN-13-978-1913936020
2. James Graham, Ryan Olson, Rick Howard, "Cyber Security Essentials", CRC Press, 15-Dec 2010

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Understand the fundamentals of cyber-crime, its types, and global impact.	K2
CO2 :	Identify various cyber offenses, attack methods, and social engineering techniques.	K2
CO3 :	Analyze security challenges in mobile and wireless environments.	K2
CO4 :	Apply forensic techniques to investigate cybercrimes and handle digital evidence.	K4
CO5 :	Interpret cybersecurity policies and cyber laws, including the IT Act 2000 and DPDP Act 2023.	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	2	3	2	2
CO2	3	3	2	3	3	2	3	3	2
CO3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	3	3	3
CO5	3	2	3	3	3	3	3	2	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY251	Number of Hours/Wk	2		
Semester	V	Max. Marks	100		
Course Category	CORE COURSE	Credits	1		
Course Title	INTRODUCTION TO BLOCKCHAIN AND CRYPTOCURRENCY LAB		L	T	P
			0	0	2

COURSE OBJECTIVES:

The main aim of learning this course is to:

- Introduce the basics of Blockchain technology and cryptocurrency.
- Understand blockchain structure, consensus models, and public vs. private blockchains.
- Explore key cryptographic techniques such as hash functions and digital signatures.
- Learn about Bitcoin transactions, mining, and Proof of Work (PoW).
- Examine blockchain applications and permissioned systems, with a focus on smart contracts using Hyperledger Fabric and Ethereum.

LIST OF EXPERIMENTS

1. Write the program to implement a Solidity smart contract using array and function in Remix IDE with following functions
    a. Creation of static and dynamic array
    b. Addition and deletion of array elements
    c. Finding length of a given array
    d. Printing array element in sorted order
    e. Searching a particular element in an array

2. Install a Meta mask testnet. Use the Metamask testnet for embedding wallet and transferring ethers to other wallets through a smart contract.

3. To install Truffle & Ganache and use Ethreum -Ganache to create an account and illustrate using solidity smart contract compilation and development environment

4. Deploy an Ethereum Testnet and use Web3.py for writing smart contracts.

5. Write a chain-code application in GO to alter the state of a distributed hyper ledger fabric account with assets; check to see if the asset exists; transfer assets from one account wallet to another

6. Design and develop a Blockchain based referendum system with Ethereum Blockchain. Based on the result of the referendum a series of steps have to be put in pace through a smart contract. (Innovative Experiment)

7. Creating Crypto-currency Wallet

8. Creating and Building Up Crypto Token

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Understand the fundamentals of blockchain, cryptographic techniques, and consensus models.	K2
CO2 :	Learn about cryptocurrency mechanisms, Bitcoin transactions, and Proof of Work	K2
CO3 :	Apply various consensus models and understand distributed consensus in blockchains.	K3
CO4 :	Explore real-world blockchain applications in payments, security, and identity management.	K4
CO5 :	Develop smart contracts using frameworks like Hyperledger Fabric and Ethereum.	K

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	2	3	2	3
CO2	3	3	2	3	3	2	3	3	2
CO3	3	3	3	3	3	3	3	2	3
CO4	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY252	Number of Hours/Wk	2		
Semester	V	Max. Marks	100		
Course Category	CORE COURSE	Credits	1		
Course Title	MALWARE ANALYSIS LAB		L	T	P
			0	0	2

COURSE OBJECTIVES:

The main aim of learning this course is to:

- Equip students with the skills to analyse and detect malware using both static and dynamic techniques.
- Identify malicious software, assemble an analysis toolkit.
- Understand various detection methods to uncover and mitigate threats effectivel

LIST OF EXPERIMENTS

2. Write the program to implement a Solidity smart contract using array and function in Remix IDE with following functions
    a. Creation of static and dynamic array
    b. Addition and deletion of array elements
    c. Finding length of a given array
    d. Printing array element in sorted order
    e. Searching a particular element in an array

2. Install a Meta mask testnet. Use the Metamask testnet for embedding wallet and transferring ethers to other wallets through a smart contract.

3. To install Truffle & Ganache and use Ethreum -Ganache to create an account and illustrate using solidity smart contract compilation and development environment

4. Deploy an Ethereum Testnet and use Web3.py for writing smart contracts.

5. Write a chain-code application in GO to alter the state of a distributed hyper ledger fabric account with assets; check to see if the asset exists; transfer assets from one account wallet to another

6. Design and develop a Blockchain based referendum system with Ethereum Blockchain. Based on the result of the referendum a series of steps have to be put in pace through a smart contract. (Innovative Experiment)

7. Creating Crypto-currency Wallet

8. Creating and Building Up Crypto Token

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Identify and classify various types of malwares based on behavior and structure.	K3
CO2 :	Effectively use static and dynamic analysis techniques to examine and detect malicious software	K4
CO3 :	Develop a strong understanding of malware analysis tools and how to set up a controlled analysis environment.	K2
CO4 :	Apply malware detection methods, including signature-based and machine-learning techniques, to identify and mitigate threats.	K3
CO5 :	Demonstrate the ability to analyze and interpret malicious code, recognizing key indicators of compromise and suspicious activity.	K5

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	2	1	2	1	3	1	1
CO2	3	3	3	2	3	2	2	1	2
CO3	3	2	2	3	3	2	3	1	2
CO4	3	3	3	2	3	1	2	2	3
CO5	2	2	3	3	3	2	3	3	2

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Discipline Specific Elective

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY351	Number of Hours/Wk	3		
Semester	V	Max. Marks	100		
Course Category	Discipline Specific Elective	Credits	3		
Course Title	CLOUD SECURITY		L	T	P
			3	0	0

COURSE OBJECTIVES

The main aim of learning this course is to:

- Understand the architecture, models, and benefits of cloud computing
- Learn about compliance, auditing, and risk management in cloud security
- Explore data security measures, including encryption and key management
- Gain knowledge of identity management, virtualization, and secure cloud operations.

UNIT	TOPICS	HOURS
I	**Cloud Computing Architecture and Security Framework** Cloud Computing Architectural Framework: Cloud Benefits, Business scenarios, Cloud Computing Evolution, cloud vocabulary, Essential Characteristics of Cloud Computing, Cloud deployment models, Cloud Service Models, Multi- Tenancy, Approaches to create a barrier between the Tenants, cloud computing vendors, Cloud Computing threats, Cloud Reference Model, The Cloud Cube Model, Security for Cloud Computing, How Security Gets Integrated.	9
II	**Cloud Computing: Compliance, Audit, Portability, and Interoperability** Compliance and Audit: Cloud customer responsibilities, Compliance and Audit Security Recommendations. Portability and Interoperability: Changing providers reasons, Changing providers expectations, Recommendations all cloud solutions, IaaS Cloud Solutions, PaaS Cloud Solutions, SaaS Cloud Solutions.	9
III	**Cloud Security and Risk Management** Traditional Security, Business Continuity, Disaster Recovery, Risk of insider abuse, Security baseline, Customers actions, Contract, Documentation, Recovery Time Objectives (RTOs), Customers responsibility, Vendor Security Process (VSP).	9
IV	**Cloud Computing Security:** Data Center Operations, Security challenge, Implement Five Principal Characteristics of Cloud Computing, Data center Security Recommendations. Encryption and Key Management: Encryption for Confidentiality and Integrity, Encrypting data at rest, Key Management Lifecycle, Cloud Encryption Standards, Recommendations.	9
V	**Cloud Security Framework** Identity and Access Management in the cloud, Identity and Access Management functions, Identity and Access Management (IAM) Model, Identity Federation, Identity Provisioning Recommendations, Authentication for SaaS and Paas customers, Authentication for IaaS customers, Introducing Identity Services, Enterprise Architecture with IDaaS, IDaaS Security Recommendations. Virtualization: Hardware Virtualization, Software Virtualization, Memory Virtualization, Storage Virtualization, Data Virtualization, Network Virtualization, Virtualization Security Recommendations.	9

Text Book

1. Dhillon, V., Metcalf, D., and Hooper, M, Blockchain enabled applications, 2017, 1st Proceedings of the 65th Academic Council (17.03.2022) 1042 Edition, CA: Apress, Berkeley.
2. Blockchain: A Practical Guide to Developing Business, Law, and Technology Solutions" by Joseph J. Bambara, Paul R. Allen, Kedar Iyer, Rene Madsen, Solomon Lederer, and Michael Wuehler

3. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Agenda Item 65/39 - Annexure - 35 Proceedings of the 65th Academic Council (17.03.2022) 1047 Bitcoin and cryptocurrency technologies: a comprehensive introduction, 2016, Princeton University Press

Reference Books

1. Diedrich, H., "Ethereum: Blockchains, digital assets, smart contracts, decentralized autonomous organizations", 2016, 1st Edition, Wildfire publishing, Sydney
2. Cryptography and Network Security: Principles and Practices, William Stallings, 7th edition, 2017
3. Bashir, I., "Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained", 2nd Edition, Packt Publishing Ltd, March 30, 2018.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Understand the fundamental architecture of cloud computing, including cloud deployment models, service models, and essential characteristics	K6
CO2 :	Analyze cloud security challenges and integrate security measures into the cloud computing framework	K3
CO3 :	Examine the importance of compliance, audit, portability, and interoperability in cloud environments.	K6
CO4 :	Explore risk management practices, business continuity, and disaster recovery strategies within cloud computing.	K6
CO5 :	Learn encryption techniques, key management lifecycle, and security standards to ensure data confidentiality and integrity in the cloud.	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	2	3	2	2
CO2	3	3	2	3	3	2	3	3	2
CO3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA (CY)	Programme Code	BCCY		
Course Code	25BCCY352	Number of Hours/Wk	3		
Semester	V	Max. Marks	100		
Course Category	Discipline Specific Elective	Credits	3		
Course Title	CLOUD COMPUTING		L	T	P
			3	0	0

COURSE OBJECTIVES:

The main aim of learning this course is to:

- To understand the fundamental concepts, architecture, and services of cloud computing.
- To explore cloud models, virtualization techniques, and cloud infrastructure.
- To analyze cloud storage, data management, and security challenges.
- To examine cloud platforms, service and case studies.

UNIT	TOPIC	HOURS
I	**Introduction to Cloud Computing:** Vision of Cloud Computing – Cloud Computing Reference Model – Characteristics and Benefits – Challenges Ahead – Evolution and Historical Developments – Distributed Systems – Virtualization – Building Cloud Environments – Application and Infrastructure Development – Cloud Computing Platforms – Parallel vs. Distributed Computing – Elements of Parallel Computing – Hardware Architectures for Parallel Processing – Parallel Programming Approaches.	10
II	**Cloud Models and Virtualization:** Cloud Computing Reference Model – Types of Clouds (Public, Private, Hybrid, Community) – Economics of Cloud Computing – Virtualization Basics – Characteristics of Virtualized Environments – Taxonomy of Virtualization Techniques – Virtualization and Cloud Computing – Advantages and Disadvantages of Virtualization – Technology Example: VMware Full Virtualization.	9
III	**Cloud Platforms and Parallel Computing:** Aneka Cloud Platform – Anatomy of Aneka Container – Introducing Parallelism in Cloud – Multithreading in Aneka – Developing Parallel Applications in Aneka – Cloud Computing Economics – Cloud Infrastructure Cost Analysis – Economics of Private vs. Public Clouds – Software Productivity in Cloud – Economies of Scale in Cloud Deployments.	9
IV	**Cloud Storage and Data Management:** Multi-Tenancy and Multi-Schema Approaches – Data Access Control for Enterprise Applications – Cloud Data Management – Cloud File Systems (GFS, HDFS) – NoSQL Databases (BigTable, HBase) – Cloud Data Stores (Google Datastore, Amazon SimpleDB) – Challenges in Cloud Data Security.	9
V	**Cloud Service Providers and Case Studies:** Amazon Web Services (AWS) – Compute Services (EC2, Lambda) – Storage Services (S3, Glacier) – Communication Services (SNS, SQS) – Additional AWS Services. Microsoft Azure – Azure Core Concepts – SQL Azure – Windows Azure Platform Appliance.	8

Text book:

1. "Mastering Cloud Computing: Foundations and Applications Programming", Rajkumar Buyya, Christian Vecchiola, & Thamarai Selvi, McGraw Hill, 2013.
2. "Cloud Computing: Concepts, Technology & Architecture", Thomas Erl, Zaigham Mahmood, & Ricardo Puttini, Pearson, 2013.

References:

1. "Cloud Computing: A Practical Approach", Anthony T. Velte, Toby J. Velte, & Robert Elsenpeter, McGraw Hill, 2010.
2. "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud", George Reese, O'Reilly Media, 2009.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Define cloud computing fundamentals, classify cloud architectures, and illustrate its benefits.	K6
CO2 :	Differentiate cloud models, analyze virtualization techniques, and assess their impact on cloud environments.	K3
CO3 :	Implement parallel computing concepts, measure performance, and evaluate cloud infrastructure cost-effectiveness.	K6
CO4 :	Examine cloud storage mechanisms, investigate data management techniques, and assess security challenges in distributed cloud environments.	K6
CO5 :	Contrast cloud service providers, analyze their features, and justify the selection of cloud computing solutions for real-world applications.	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	0	3	2	3
CO2	3	3	2	3	3	0	3	3	3
CO3	3	3	3	3	3	2	3	3	3
CO4	3	3	3	3	3	2	3	3	3
CO5	3	2	1	3	3	1	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA (CY)	Programme Code	BCCY		
Course Code	25BCCY353	Number of Hours/Wk	3		
Semester	V	Max. Marks	100		
Course Category	Discipline Specific Elective	Credits	3		
Course Title	FUZZY LOGIC AND APPLICATIONS		L	T	P
			3	0	0

COURSE OBJECTIVES

- To understand the principles of fuzzy logic and its applications in real-world scenarios.
- To develop skills in fuzzy inference, approximate reasoning, and decision-making.
- To explore the integration of fuzzy logic with optimization and AI techniques.
- To apply fuzzy systems in various domains such as image processing, robotics, and control systems.

UNIT	TOPIC	HOURS
I	**Introduction to Fuzzy Logic**: Introduction to Fuzzy Logic - Classical vs. Fuzzy Sets - Membership Functions - – Set Operations – Fuzzy Relations – Properties of Fuzzy Sets – Applications of Fuzzy Sets in Decision-Making.	8
II	**Fuzzy Logic Systems and Approximate Reasoning:** Fuzzy If-Then Rules – Linguistic Variables – Approximate Reasoning – Fuzzy Rule-Based Systems – Mamdani vs. Sugeno Models – Fuzzy Decision-Making.	8
III	**Fuzzification and Defuzzification Techniques:** Need for Fuzzification – Membership Function Selection – Methods of Defuzzification – Centroid, Mean of Maximum (MoM), and Weighted Average Techniques – Case Studies in Control Systems.	8
IV	**Fuzzy Systems in Optimization and Hybrid AI Models:** Fuzzy Clustering (Fuzzy C-Means) – Genetic Algorithms in Fuzzy Optimization – Hybrid Systems (Fuzzy + Neural Networks, Fuzzy + Evolutionary Computing) – Adaptive Neuro-Fuzzy Inference Systems (ANFIS).	11
V	**Applications of Fuzzy Logic:** - Fuzzy Logic in Pattern Recognition – Fuzzy-Based Image Processing – Fuzzy Control Systems – Fuzzy Expert Systems – AI and Machine Learning Applications – Case Studies in Engineering and Industry.	10

Text book:

1. Fuzzy logic with engineering applications, Ross, T. J., John Wiley and Sons, 2005.
2. Neuro-Fuzzy and Soft Computing", J.-S. R. Jang, C.-T. Sun, and E. Mizutani, Prentice Hall, 1997.
3. Fuzzy Sets and Fuzzy Logic: Theory and Applications", Klir, G. J., & Yuan, B., Prentice Hall, 1995

References:

2. Uncertain Rule-Based Fuzzy Systems: Introduction and New Directions", Mendel, J. M., Springer, 2nd Edition, 2017.
3. Fuzzy Sets and Applications", Zimmermann, H. J., Springer, 2010.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Define the principles of fuzzy logic and classify fuzzy set operations.	K6
CO2 :	Compare fuzzy inference mechanisms and demonstrate approximate reasoning methods.	K3
CO3 :	Implement fuzzification and defuzzification techniques in fuzzy logic systems.	K6
CO4 :	Analyze fuzzy optimization methods and construct hybrid AI models.	K6
CO5 :	Evaluate fuzzy logic applications in control systems, pattern recognition, and AI.	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	1	3	2	3
CO2	3	3	3	2	3	1	3	3	3
CO3	3	3	3	3	3	2	3	3	3
CO4	3	3	3	3	3	2	3	3	3
CO5	3	3	3	3	3	2	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA (CY)	Programme Code	BCCY		
Course Code	25BCCY354	Number of Hours/Wk	3		
Semester	V	Max. Marks	100		
Course Category	Discipline Specific Elective	Credits	3		
Course Title	Introduction to Machine Learning		L	T	P
			3	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To explore fundamental concepts in machine learning
- To equip different concepts in machine learning with mathematical intuition
- To construct an existing problem into standard machine learning paradigm
- To develop an innovative ML model for research problems using different ML toolsand standard datasets

UNIT	TOPIC	HOURS
I	**Introduction to machine learning** Introduction to machine learning; Mathematics behind machine learning; Linear algebra - Vector space, system of linear equations, projection, Solving Ax=b, projection, least square problem, eigen values and vectors, eigen decomposition, singular value decomposition; Probability – expectation, variance, covariance; Multivariable calculus basics;	8
II	**Linear and Logistic Regression** Linear Regression – cost function, optimization function; gradient descent – batch, mini-batch, stochastic; normal equation; regularization -ridge regression; feature scaling; logistic regression – sigmoid function, solving cost function; maximum likelihood estimation; gaussian discriminant analysis; naïve bayes;	8
III	**SVM and Bayesian learning** Support vector machine – linear discriminant analysis, KKT theorem, primal-dual problem; Kernels – polynomial, gaussian; decision trees – information gain, gini index; Bayesian learning – bayes minimum risk classifier; multivariate normal distribution; softmax classifier; Non-linear functions – threshold, sigmoid, ReLU, tanh;	8
IV	**Neural Networks and CNN** Neural networks; perceptron; multilayer perceptron; backpropagation algorithm; autoencoder – deep autoencoder, sparse auto encoder, denoising autoencoder; convolution; convolutional neural network – pooling, padding, strided convolution; CNN example – LeNet, AlexNet, VGGNet, ResNeT GoogleNet;	11

V	**Clustering and Dictionary learning** Clustering – K-means, K-medoids; issues in deep learning – vanishing/exploding gradient problem, overfitting, covariate shift; momentum optimizer; Nesterov accelerated gradient; adagrad; RMS prob; ada delta; underdetermined system of linear equations; pursuit algorithms; sparse coding; dictionary learning;	**10**

Text Books:

1.Gilbert Strang. Introduction to Linear Algebra. Wellesley-Cambridge Press, USA, 5th edition, 2016.
2.Andrew Ng. Machine Learning Yearning. deeplearning.ai, 2018.

Reference Books:

1.Ian J. Goodfellow, Yoshua Bengio, and Aaron Courville. Deep Learning. MIT Press, Cambridge, MA, USA, 2016.
2.M. Elad, Sparse and Redundant Representations: From Theory to Applications in Signal and Image Processing, Springer, 2010.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Infers mathematical concepts behind machine learning	K6
CO2 :	Distinguish different ML concepts in terms of applications	K3
CO3 :	Implement standard ML algorithms for applications	K6
CO4 :	Validate the ML models to improve the performance	K6
CO5 :	Develop an ML model for existing problems	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	1	3	2	3
CO2	3	3	3	2	3	1	3	3	3
CO3	3	3	3	3	3	2	3	3	3
CO4	3	3	3	3	3	2	3	3	3
CO5	3	3	3	3	3	2	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Open Elective

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY051	Number of Hours/Wk	3		
Semester	V	Max. Marks	100		
Course Category	Open Elective	Credits	3		
Course Title	ARTIFICIAL INTELLIGENCE		L	T	P
			3	0	0

COURSE OBJECTIVES

The main aim of learning this course is to:

- To explore history and revolution of artificial intelligence
- To formulate artificial intelligence problem by defining intelligent agent and its environment
- To learn problem solving approaches through state space search and its different algorithms.
- To develop an AI model with the help of concepts such as state space search,adversarial search, knowledge representation, inference etc.

UNIT	TOPICS	HOURS
I	**Introduction to AI** Introducing the structure and scope of the course; Introduction and History of AI; Turing Test; Chinese Room Argument; Milestones in AI; AI Project Discussion – Problem finding, Project resources, Report writing; Intelligent agent – Sensors and Actuators; Examples of Agents; Rationality – perfect and bounded rationality;	9
II	**Intelligent agent and state space search** Intelligent agent and its environment; Types of environments; Multi- agent environment; Structure of the agent – table based agent, percept based agent, state based agent, goal based agent, utility based agent; Subsumption architecture; Learning agent; State and State spacedefinition; State space search; Problem formulation; 8 Queens problem;8 Puzzle problem; Problem formulation examples;	9
III	**Uninformed and Informed Searches** Uninformed search – Breadth first search, Depth first search, Depth limited search, Iterative deepening search, Bidirectional search, Uniformcost search; Informed Search – Greedy best first search, A* search, Memory-bounded search; Heuristic function;	9
IV	**Local search and adversarial search** Search in complex environment; Local search and optimizationsproblems; Hill-climbing search; Simulated annealing; Local beam search; Adversarial search; Game theory – Two-player zero-sum games – max and min, utility function, state space graph, game tree, tic-tac-toe example; Minimax search; Alpha-Beta pruning;	9
V	**Constraint satisfaction and Knowledge representation** Constraint satisfaction problem; satisfiability; propagating constraints; forward checking; backward checking; Knowledge representation – Logic, Propositional logic, Reasoning, Modus Ponens; First order logic;quantifiers; Mathematics behind machine learning – Linear algebra basics	9

Text Books:

1. Stuart Russell and Peter Norvig. Artificial Intelligence: A Modern Approach. Prentice Hall Press, USA,3rd edition, 2009

Reference Books:

1. Ian J. Goodfellow, Yoshua Bengio, and Aaron Courville. Deep Learning. MIT Press, Cambridge, MA,USA, 2016.
2. Gilbert Strang. Introduction to Linear Algebra. Wellesley-Cambridge Press, USA, 5th edition, 2016.

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Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Describe the history behind artificial intelligence	K6
CO2 :	Illustrate fundamental AI concepts	K3
CO3 :	Demonstrate problem formulation in state space search	K6
CO4 :	Infers adversarial search with alpha-beta pruning	K6
CO5 :	Develop an AI model for existing problems	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	1	2	1	0	0	1	2	0	0
CO2	3	2	3	3	0	2	0	3	3
CO3	3	1	2	2	0	2	1	1	3
CO4	3	1	2	2	0	2	0	1	2
CO5	2	2	3	3	3	1	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY052	Number of Hours/Week	3		
Semester	V	Max. Marks	100		
Course Category	Open Elective	Credits	3		
Course Title	PYTHON PROGRAMMING		L	T	P
			3	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To Understand the fundamentals of the Python programming language and its historical development
- To Master Python basics, including data types, operators, tuples, dictionaries, and string manipulation.
- To demonstrate object oriented concept in python
- To familiarize with machine learning tools in python

UNIT	TOPICS	HOURS
I	**Introduction to python programming** Introduction to python ; setting up python programming environment; variables; strings and its operations; special characters; striping whitespace; numbers; comments; list and its operations; indexing; looping through lists; indentation; range function; slicing a list; copying list; looping through slice;	9
II	**Python datatypes** Tuples and its operations; relational operators; conditional statements – if, if-else, if-elif-else; multiple conditional blocks; dictionaries; key-value pairs – adding, modifying, removing; looping through dictionary; list of dictionaries; dictionary in a dictionary; user input function; type casting;	9
III	**Loop and function** While loop; break and continue; functions; arguments; passing arguments – positional arguments, keyword arguments, default values; optional arguments; returning from function; passing arbitrary number of arguments; storing functions in modules; import specific function or module;	9
IV	**OOPs in python** Classes; __init__() method; instance of a class; accessing attributes; calling methods; creating multiple instances; inheritance – parent class, child class; importing classes; files – reading a file, writing to a file, appending to a file; exceptions – try-except block, else block;	9
V	**Python machine learning tools** Python tools for machine learning; python modules – numpy, pandas, matplotlib, scipy; python based machine learning libraries – pytorch, tensorflow; virtual environment; machine learning application using python tools;	9

Text Book

2. Matthes, Eric. *Python Crash Course: A Hands-On, Project-Based Introduction to Programming*. 2nd ed., No Starch Press, Inc., 2019.

Reference Book

2. Sweigart, Al. *Automate the Boring Stuff with Python*. William Pollock, 2015.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Comprehend the holistic view of programming language design and behavior	**K2**
CO2 :	Understand the programming concepts in abstract and paradigm level	**K2**
CO3 :	Structure python programs for solving problems	**K3**
CO4 :	Develop python programs using OOP concept	**K5/K6**
CO5 :	Execute ML project using python tools	**K6**

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	1	3	1	2	2	1	3	2	1
CO2	1	3	1	2	1	1	3	2	1
CO3	2	2	2	3	2	3	3	3	2
CO4	2	3	0	3	2	3	3	3	1
CO5	1	3	3	3	2	3	3	2	2

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY053	Number of Hours/Week	3		
Semester	V	Max. Marks	100		
Course Category	Open Elective	Credits	3		
Course Title	COMPUTER NETWORK		L	T	P
			3	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To understand the concept of Computer network
- To Category knowledge about networking and inter networking devices

UNIT	TOPICS	HOURS
I	Introduction – Network Hardware - Software - Reference Models - OSI and TCP/IP Models - Example Networks: Internet, ATM, Ethernet and Wireless LANs - Physical Layer - Theoretical Basis for Data Communication - Guided Transmission Media.	8
II	Wireless Transmission - Communication Satellites - Telephone System: Structure, Local Loop, Trunks and Multiplexing and Switching. Data Link Layer: Design Issues - Error Detection and Correction.	7
III	Elementary Data Link Protocols - Sliding Window Protocols - Data Link Layer in the Internet - Medium Access Layer - Channel Allocation Problem - Multiple Access Protocols - Bluetooth.	12
IV	Network Layer - Design Issues - Routing Algorithms - Congestion Control Algorithms - IP Protocol - IP Addresses - Internet Control Protocols.	10
V	Transport Layer - Services - Connection Management - Addressing, Establishing and Releasing a Connection - Simple Transport Protocol - Internet Transport Protocols (ITP) - Network Security: Cryptography.	8

Text Book :

1. A. S. Tanenbaum, “Computer Networks”, Prentice-Hall of India 2008, 4th Edition.

Reference Books:

1. Stallings, “Data and Computer Communications”, Pearson Education 2012, 7th Edition.
2. B. A. Forouzan, “Data Communications and Networking”, Tata McGraw Hill 2007, 4th Edition.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	To Learn various principles & concepts of Computer networks.	K1
CO2 :	To Analyze different network models.	K4
CO3 :	To Evaluate the data flow through TCP/IP & ISO Layers.	K5
CO4 :	To Assess key networking protocols and their hierarchical relationship In the conceptual model like TCP/IP and OSI	K5,K6
CO5 :	To Identify networking and inter-networking devices	K2,K3

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	1	0	0	0	3	0	0
CO2	3	3	2	0	1	0	2	2	0
CO3	3	3	3	2	0	0	3	3	3
CO4	3	2	2	0	2	0	2	2	2
CO5	3	3	3	1	1	1	3	3	3

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

SEMESTER -VI

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY161	Number of Hours/Wk	3		
Semester	VI	Max. Marks	100		
Course Category	Core Course	Credits	3		
Course Title	Natural Language Processing		L	T	P
			3	0	0

COURSE OBJECTIVES:

The main learning objectives of this course are to prepare students to:

1. **Understand** the fundamental concepts of Natural Language Processing (NLP) and its applications.
2. **Implement** basic NLP techniques such as tokenization, stemming, lemmatization, and POS tagging.
3. **Analyze** various NLP models for text classification, sentiment analysis, and named entity recognition.
4. **Evaluate** the performance of different NLP algorithms using appropriate metrics.
5. **Develop** real-world NLP applications using machine learning and deep learning frameworks

UNIT	TOPICS	HOURS
I	**Lexical Analysis** Lexical Analysis - Regular expression and Automata for string matching - Words and Word Forms - Morphology fundamentals - Morphological Diversity of Indian Languages - Morphology Paradigms - Finite State Machine / Transducers Based Morphology - Automatic Morphology Learning - Parts of Speech - N-gram Models - Hidden Markov Models.	9
II	**Speech Processing** Biology of Speech Processing - Place and Manner of Articulation - Word Boundary Detection - Argmax based computations - HMM and Speech Recognition - Text to Speech Synthesis - Rule Based-Concatenative based approach.	9
III	**Parsing** Theories of Parsing - Parsing Algorithms – Earley Parser - CYK Parser - Probabilistic Parsing - CYK - Resolving attachment and structural ambiguity - Shallow Parsing - Dependency Parsing - Named Entity Recognition - Maximum Entropy Models - Conditional Random Fields.	9
IV	**Lexical Knowledge Networks** Meaning: Lexical Knowledge Networks - Wordnet Theory - Indian Language Wordnets and Multilingual Dictionaries - Semantic Roles - Word Sense Disambiguation - WSD and Multilingualism - Metaphors - Coreference and Anaphora Resolution.	9
V	**UNIT V Applications** Applications: Sentiment Analysis - Text Entailment - Machine Translation - Question Answering System - Information Retrieval - Information Extraction - Cross Lingual Information Retrieval (CLIR).	9

Text Books:

1. Jurafsky Daniel, Martin James, "Speech and Language Processing", Second Edition, Tenth Impression, Pearson Education, 2018.
2. Christopher Manning, Schutze Heinrich, "Foundations of Statistical Natural Language Processing", MIT Press, 1999.
3. Operating System Concepts, Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Wiley publishers, Nineth edition, 2013.

Reference Books:

1. Allen James, "Natural Language Understanding", Second Edition, Benjamin Cumming, 1995.
2. Charniack Eugene, "Statistical Language Learning", MIT Press, 1993.
3. Foundations of Statistical Natural Language Processing, The MIT Press Cambridge, Massachusetts London, England,1999.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Ability to Analyze Lexical Structures	K6
CO2 :	Competence in Speech Processing Techniques	K3
CO3 :	Proficiency in Parsing Algorithms	K6
CO4 :	Understanding and Application of Lexical Knowledge Networks	K6
CO5 :	Application of NLP Techniques in Various Domains	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	1	1	0	0	0	0	1	0	1
CO2	2	2	0	0	0	0	2	1	3
CO3	1	2	1	0	0	0	1	2	1
CO4	2	2	2	0	1	0	1	1	0
CO5	3	3	1	0	0	0	2	2	0

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY162	Number of Hours/Wk	3		
Semester	VI	Max. Marks	100		
Course Category	Core Course	Credits	3		
Course Title	Cyber Threat Intelligence		L	T	P
			3	0	0

COURSE OBJECTIVES:

The main learning objectives of this course are to prepare students to:

- Introduce the concept of Cyber Threat Intelligence (CTI), its need, and how it differs from traditional cybersecurity.
- Explain the various types of threat actors and their behavior, motivations, and tactics.
- Equip students with knowledge about different threat intelligence data sources, platforms, and data analysis techniques.
- Enable students to perform threat analysis and hunting using modern tools.
- Emphasize ethical considerations and the importance of information sharing frameworks in CTI

UNIT	TOPICS	HOURS
I	**Introduction to Cyber Threat Intelligence** Definition and need for Cyber Threat Intelligence (CTI) - Types of CTI: Tactical, Operational, Strategic - Intelligence Cycle: Direction -Collection, Processing, Analysis, Dissemination, Feedback - CTI vs Traditional Cyber Security	9
II	**Threat Actors and Adversary Behavior** Types of Threat Actors: Hacktivists, Cybercriminals, APTs, Insider threats - Motivations and Objectives of Threat Actors - Adversary Tactics, Techniques, and Procedures (TTPs) - Kill Chain Model & MITRE ATT&CK Framework	9
III	**Data Collection and Threat Intelligence Platforms** Intelligence sources: Open Source Intelligence (OSINT), Dark Web, Social Media, Logs - Indicators of Compromise (IoCs), TTPs, Threat Feeds - Threat Intelligence Platforms (TIPs): MISP, Open Threat Exchange (OTX) - Data enrichment and analysis techniques	9
IV	**Threat Analysis and Hunting** Threat analysis lifecycle - Correlation and prioritization of intelligence - Threat hunting methodologies (hypothesis-based, IOC-driven) - Introduction to tools: Splunk, ELK stack, Wireshark for threat analysis	9
V	**CTI Reporting, Ethics and Information Sharing** Creating intelligence reports: tactical vs strategic - Visualization of CTI: dashboards, graphs - Legal, Ethical and Privacy Issues in CTI - Information sharing frameworks: ISACs, STIX/TAXII	9

Text Book

1.Zane Pokorny, et al., *The Threat Intelligence Handbook*

Reference Books

1. Dalziel, H. (2014). *Cyber threat intelligence*. Syngress. https://doi.org/10.1016/C2013-0-18052-6

2. Roberts, S. J., & Brown, R. (2017). *Intelligence-driven incident response: Outwitting the adversary*. O'Reilly Media.

3.Bejtlich, R. (2013). *The practice of network security monitoring: Understanding incident detection and response*. No Starch Press.

4.Whaley, B. (2016). *Cyber intelligence: Using data to understand emerging threats*. Rowman & Littlefield.

5.White, A. J., & Clark, B. (2017). *Blue team field manual (BTFM)*. CreateSpace Independent Publishing Platform.

Andragogy

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	Understand CTI principles and why organizations need it	K6
CO2 :	Classify different threat actors and their behaviors	K3
CO3 :	Understand CTI data sources and how to extract useful threat data	K6
CO4 :	Analyze and correlate threat data	K6
CO5 :	Understand CTI sharing laws, ethics, and frameworks	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	1	1	0	0	0	0	1	0	1
CO2	2	2	0	0	0	0	2	1	3
CO3	1	2	1	0	0	0	1	2	1
CO4	2	2	2	0	1	0	1	1	0
CO5	3	3	1	0	0	0	2	2	0

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)

Programme	BCA(CY)	Programme Code	BCCY		
Course Code	25BCCY261	Number of Hours/Wk	2		
Semester	VI	Max. Marks	100		
Course Category	Core Course	Credits	1		
Course Title	Natural Language Processing Lab		L	T	P
			0	0	2

COURSE OBJECTIVES:

The main learning objectives of this course are to prepare students to:

1. **Understand** the fundamental concepts of Natural Language Processing (NLP) and its applications.
2. **Implement** basic NLP techniques such as tokenization, stemming, lemmatization, and POS tagging.
3. **Analyze** various NLP models for text classification, sentiment analysis, and named entity recognition.
4. **Evaluate** the performance of different NLP algorithms using appropriate metrics.

   Develop real-world NLP applications using machine learning and deep learning frameworks

List of Experiments

1. Tokenization and Text Preprocessing in NLP
2. Part-of-Speech (POS) Tagging using NLTK and SpaCy
3. Named Entity Recognition (NER) for Text Analysis
4. Sentiment Analysis using Machine Learning
5. Text Classification with Naïve Bayes and SVM
6. Word Embeddings: Word2Vec, GloVe, and FastText
7. Machine Translation using Seq2Seq Models
8. Text Summarization: Extractive vs. Abstractive Methods
9. Building a Chatbot using Transformer Models
10. Topic Modeling with Latent Dirichlet Allocation (LDA)

Course Outcomes

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

CO's	Outcomes	K -Level's
CO1 :	**Explain** the key concepts and challenges in NLP.	K6
CO2 :	**Apply** NLP preprocessing techniques to process and clean textual data.	K3
CO3 :	**Demonstrate** the working of different NLP models in practical scenarios.	K6
CO4 :	**Assess** the efficiency and effectiveness of NLP models using evaluation metrics.	K6
CO5 :	**Design** and implement NLP-based solutions for real-world applications.	K5,K6

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Mapping of Course Outcomes (CO's) with PO's & PSO's									
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	1	1	0	0	0	0	1	0	1
CO2	2	2	0	0	0	0	2	1	3
CO3	1	2	1	0	0	0	1	2	1
CO4	2	2	2	0	1	0	1	1	0
CO5	3	3	1	0	0	0	2	2	0

(3 – Strong, 2 –Medium, 1 - Low, 0-No Correlation)