NEHRU INSTITUTE OF TECHNOLOGY
(AUTONOMOUS)
Approved by AICTE, New Delhi and Affiliated to Anna University, Chennai
Accredited by NAAC with A+ grade Recognized by UGC Under Section 2(f)
JAWAHAR GARDENS, KALIYAPURAM, COIMBATORE-641105

B.E. Computer Science and Engineering (CyberSecurity)

2024-2028 Batch

Curriculum & Syllabi

Regulation 2023

Vision and Mission of the Institution

Vision

- To be leading Institution in Academic excellence, Multidisciplinary Research, Innovation, Entrepreneurship and Industry relation in order to mould true citizens of the country.

Mission

- To create innovative and vibrant young leaders in Engineering and Technology field for building India as a knowledge power by improving the teaching-learning process.
- To enhance employability, entrepreneurship and to improve the research competence to address Societal needs
- To generate engineering graduates who use knowledge as a powerful tool to drive societal transformation and inculcate in them ethical and moral values.

Department of Computer Science and Engineering(CyberSecurity)

Vision

- To produce globally competent cybersecurity professionals with ethical values and innovative skills to safeguard the digital world.

Mission

- To provide quality education in cybersecurity through a comprehensive curriculum and hands-on training.
- To foster innovation and research in securing digital systems and emerging technologies.
- To instill ethical practices and a sense of social responsibility in addressing cybersecurity challenges.

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Program Educational Objectives

Computer Science and Engineering (CyberSecurity) graduate can

1. **Core Competency:** Graduates will apply fundamental knowledge of computer science and cybersecurity principles to analyze, design, and implement secure computing systems.
2. **Professional Growth:** Graduates will pursue successful careers or higher studies in cybersecurity and related fields, continually updating their skills to meet evolving technological demands.
3. **Ethical Leadership:** Graduates will exhibit professional ethics, teamwork, communication skills, and leadership qualities to address societal and organizational cybersecurity challenges responsibly.

Program Outcomes

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

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

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

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

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

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

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

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

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

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

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

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

Programme Specific Outcomes (PSOs)

PSO 1 – Cybersecurity Principles and Practices:

Apply foundational and advanced cybersecurity principles to design and develop secure systems, networks, and software solutions.

PSO 2 – Threat Detection and Response:

Analyze cyber threats and attacks using tools and techniques such as ethical hacking, intrusion detection, and digital forensics to implement effective defense mechanisms.

PSO 3 – Professional and Ethical Competence:

Demonstrate professional ethics, effective communication, and lifelong learning in addressing legal, social, and ethical issues related to cybersecurity practices.

SEMESTER-I								
S.No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PERIODS PER WEEK**			**TOTAL CONTACT PERIODS**	**CREDITS**
				L	**T**	**P**		
	U23IP101	Induction Program	MC	-	-	-	-	0
THEORY								
1	U23EN101	English for Engineers	HSMC	3	0	0	3	3
2	U23MA101	Calculus and Differential Equations	BSC	3	1	0	4	4
3	U23PH101	Engineering Physics	BSC	3	0	0	3	3
4	U23CY101	Engineering Chemistry	BSC	3	0	0	3	3
5	U23CS101	C- Programming	ESC	3	0	0	3	3
6	U23HS101	Heritage of Tamils	HSMC	1	0	0	1	1
PRACTICAL								
7	U23BS111	Basic Science Laboratory	BSC	0	0	4	4	2
8	U23EN111	Communicative English Laboratory	HSMC	0	0	2	2	1
9	U23CS111	C- Programming Laboratory	ESC	0	0	4	4	2
10	U23EE121	Career Enhancement Training I	EEC	3	0	0	3	1
11	U23VEC03	Vocational Enhancement Training-I *	VEC	0	0	2	2	1*
Total				**19**	**1**	**12**	**32**	**23**

*Vocational enhancement training is compulsory for all students.
The credit earned will be recorded in the grade sheet and included in academic criteria for continuation and not considered for SGPA / CGPA calculation.
Student shall select one of the courses from the list given under VEC

BOS CHAIRMAN **HEAD – ACADEMICS** **PRINCIPAL**

SEMESTER-II								
S.No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PERIODS PER WEEK**			**TOTAL CONTACT PERIODS**	**CREDITS**
				L	**T**	**P**		
THEORY								
1	U23PH203	Physics for Information Science	BSC	3	0	0	3	3
2	U23CS204	Basic Electrical and Electronics Engineering	ESC	2	0	0	4	3
3	U23HS202	Tamils & Technology	HSMC	1	0	0	1	1
4	U23CS201	Python Programming and Practices	ESC	3	0	0	3	3
5	U23EN203	Technical English	HSMC	2	0	0	4	2
THEORY WITH LAB COMPONENT								
6	U23MA202	Advanced Calculus and Statistics	BSC	3	0	2	5	4
PRACTICAL								
7	U23CS211	Python Programming Laboratory	ESC	0	0	2	2	1
8	U23GE212	Engineering Practices Laboratory	ESC	0	0	2	2	1
9	U23GE213	Engineering Graphics Laboratory	ESC	0	0	2	2	1
10	U23EE212	Career Enhancement Training - II	EEC	0	0	2	2	1
11	U23VExxx	Vocational Enhancement Training-II *	VEC	0	0	2	2	1*
Total				**14**	**0**	**16**	**30**	**20**

*Vocational enhancement training is compulsory for all students.
The credit earned will be recorded in the grade sheet and included in academic criteria for continuation and not considered for SGPA / CGPA calculation.
Student shall select one of the courses from the list given under VEC

BOS CHAIRMAN **HEAD – ACADEMICS** **PRINCIPAL**

SEMESTER-III								
S.No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PERIODS PER WEEK**			**TOTAL CONTACT PERIODS**	**CREDITS**
				L	**T**	**P**		
THEORY								
1	U23MA309	Discrete Mathematics for Computing	BSC	3	1	0	4	4
2	U23CS301	Data Structures and Algorithms	PCC	3	1	0	4	4
3	U23CS302	Object Oriented Programming using JAVA	PCC	3	0	0	3	3
4	U23CS305	Digital Principles and Computer Organization	ESC	3	0	0	3	3
THEORY WITH LAB COMPONENT								
5	U23CS304	Foundations of Data Science	PCC	3	0	2	5	4
PRACTICAL								
6	U23CS311	Data Structures Laboratory	PCC	0	0	2	2	1
7	U23CS312	JAVA Programming Laboratory	PCC	0	0	2	2	1
8	U23EE313	Aptitude and communication for Engineers -I	EEC	0	0	2	2	1
9	U23VECx3	Vocational Enhancement Training-III	VEC	0	0	2	2	1*
MANDATORY COURSE								
10	U23MC302	Universal Human Values	MC	2	0	0	2	0
Total				**17**	**2**	**10**	**29**	**21**

*Vocational enhancement training is compulsory for all students.
The credit earned will be recorded in the grade sheet and included in academic criteria for continuation and not considered for SGPA / CGPA calculation.
Student shall select one of the courses from the list given under VEC

BOS CHAIRMAN **HEAD – ACADEMICS** **PRINCIPAL**

SEMESTER-IV								
S.No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PERIODS PER WEEK**			**TOTAL CONTACT PERIODS**	**CREDITS**
				L	**T**	**P**		
THEORY								
1	U23MA410	Linear Algebra and Number Theory	BSC	3	1	0	4	4
2	U23CB401	Design of Algorithms	PCC	3	0	0	3	3
3	U23CB402	Introduction to Secure Operating Systems	PCC	3	0	0	3	3
4	U23CS502	Computer Networks	PCC	3	0	0	3	3
5	U23CS404	Theory of Computation	PCC	3	1	0	4	4
THEORY WITH LAB COMPONENT								
6	U23CS603	Cryptography and Cyber Security	PCC	3	0	2	5	4
PRACTICAL								
7	U23CB411	Computer Networks Lab	PCC	0	0	2	2	1
8	U23CB412	Introduction to Secure Operating Systems Lab	PCC	0	0	2	2	1
9	U23EE414	Aptitude and communication for Engineers -II	EEC	0	0	2	2	1
10	U23VE405	Vocational Enhancement Training-IV	VEC	0	0	2	2	1*
MANDATORY COURSE								
11	U23MC402	Environmental Ecosystem and Sustainability	MC	2	0	0	2	0
Total				**20**	**2**	**10**	**32**	**24**

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SEMESTER-V								
S.No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PERIODS PER WEEK**			**TOTAL CONTACT PERIODS**	**CREDITS**
				L	**T**	**P**		
THEORY								
1	U23CB501	Cyber Forensics	PCC	3	0	2	4	3
2	U23CB502	Secure Database Management systems	PCC	3	0	0	3	3
3	U23CBPxx	Professional Elective – I	PEC	-	-	-	-	3
4	U23CBPxx	Professional Elective – II	PEC	-	-	-	-	3
5	U23CBPxx	Professional Elective – III	PEC	-	-	-	-	3
THEORY WITH LAB COMPONENT								
6	U23CB503	Engineering Secure Software Systems	PCC	3	0	2	5	4
PRACTICAL								
7	U23CB511	Secure Database Management systems Lab	PCC	0	0	2	2	1
8	U23EE517	Campus to Corporate - 1	EEC	0	0	2	2	1
9		Internship - I	EEC	0	0	0	0	2
10	U23VECx5	Vocational Enhancement Training-V	VEC	0	0	2	2	1*
MANDATORY COURSE								
11	U23MC504	Entrepreneurship and Innovation	MC	1	0	0	1	0
Total				**19**	**1**	**8**	**28**	**23**

BOS CHAIRMAN **HEAD – ACADEMICS** **PRINCIPAL**

SEMESTER-VI								
S.No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PERIODS PER WEEK**			**TOTAL CONTACT PERIODS**	**CREDITS**
				L	**T**	**P**		
THEORY								
1	U23CB601	Compiler Design	PCC	3	0	0	3	3
2	U23CB602	Web Technologies	PCC	3	0	0	3	3
3	U23CBPxx	Professional Elective -IV	PEC	-	-	-	-	3
4	U23CBPxx	Professional Elective –V	PEC	-	-	-	-	3
5	U23XXOxx	Open Elective - I	PEC	-	-	-	-	3
THEORY WITH LAB COMPONENT								
6	U23CB602	Security and Privacy in Cloud	PCC	3	0	2	5	4
PRACTICAL								
7	U23CB611	Web Technologies Laboratory	PCC	0	0	2	2	1
8	U23EE618	Campus to Corporate – II	EEC	0	0	2	2	1
9	U23VECx6	Vocational Enhancement Training-VI	VEC	0	0	2	2	1*
MANDATORY COURSE								
10	U23MC601	Intellectual Property Rights	MC	1	0	0	1	0
Total				**19**	**0**	**10**	**29**	**21**

BOS CHAIRMAN **HEAD – ACADEMICS** **PRINCIPAL**

SEMESTER-VII								
S.No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PERIODS PER WEEK**			**TOTAL CONTACT PERIODS**	**CREDITS**
				L	**T**	**P**		
THEORY								
1	U23CB701	Professional Elective –VI	OEC	-	-	-	-	3
2	U23CBPxx	Open Elective – II	OEC	-	-	-	-	3
3	U23CBPxx	Open Elective – III	OEC	-	-	-	-	3
4	U23CBPxx	Open Elective – IV	OEC	-	-	-	-	3
5		Management Elective	HSMC	3	0	0	3	3
THEORY WITH LAB COMPONENT								
6	U23CB702	Ethical Hacking	PCC	3	0	2	5	4
PRACTICAL								
7	U23CB711	Project Phase-I/ Internship	EEC	0	0	2	2	2
Total				**18**	**0**	**4**	**22**	**21**

BOS CHAIRMAN **HEAD – ACADEMICS** **PRINCIPAL**

SEMESTER-VIII								
S.No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PERIODS PER WEEK**			**TOTAL CONTACT PERIODS**	**CREDITS**
				L	**T**	**P**		
PRACTICAL								
1	U23CB811	Project Phase – II / Internship	EEC	0	0	20	20	10
Total				**0**	**0**	**20**	**20**	**10**

*Indicated courses have not been included for Total credits and CGPA calculation of individual semesters, it can be provided additionally as special credits.

Scheme of Credit Distribution- Summary

S. No.	Category	Semester								Total Credits
		I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	
1.	Humanities and Management Courses(HSMC)	5	3					3		**11**
2.	Basic Science Course (BSC)	12	7	4	4					**27**
3.	Engineering Science Course(ESC)	5	9	3						**17**
4.	Professional Core Course(PCC)			13	19	11	11	4		**58**
5.	Professional Elective Course(PEC)					9	9			**18**
6.	Open Elective Course(OEC)							12		**12**
7.	Employability Enhancement Skills	1	1	1	1	3	1	3	10	**21**
8.	Mandatory Course(MC)	--	--	✓	✓	✓	✓	--	--	--
Total		**23**	**20**	**21**	**24**	**23**	**21**	**22**	**10**	**164**

BOS CHAIRMAN **HEAD – ACADEMICS** **PRINCIPAL**

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL 1: FULL STACK DEVELOPMENT

S.NO.	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	App Development	PEC	2	0	2	4	3
2.	Cloud Services Management	PEC	2	0	2	4	3
3.	UI and UX Design	PEC	2	0	2	4	3
4.	Software Testing and Automation	PEC	2	0	2	4	3
5.	DevOps	PEC	2	0	2	4	3
6.	Principles of Programming Languages	PEC	3	0	0	3	3

VERTICAL 2: CLOUD COMPUTING AND DATA CENTER TECHNOLOGIES

S.NO	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	Cloud Computing	PEC	2	0	2	4	3
2.	Virtualization	PEC	2	0	2	4	3
3.	Linux Programming	PEC	2	0	2	4	3
4.	Data Warehousing	PEC	2	0	2	4	3
5.	Storage Technologies	PEC	3	0	0	3	3
6.	Software Defined Networks	PEC	2	0	2	4	3
7.	Stream Processing	PEC	2	0	2	4	3

BOS CHAIRMAN **HEAD – ACADEMICS** **PRINCIPAL**

VERTICAL 3: CYBER SECURITY AND DATA PRIVACY

S.NO.	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	Digital and Mobile Forensics	PEC	2	0	2	4	3
2.	Social Network Security	PEC	2	0	2	4	3
3.	Modern Cryptography	PEC	2	0	2	4	3
4.	Cryptocurrency and Blockchain Technologies	PEC	2	0	2	4	3
5.	Network Security	PEC	2	0	2	4	3
6.	Malware Analysis	PEC	2	0	2	4	3
7.	Web Application Security	PEC	2	0	2	4	3
8.	Artificial Intelligence for CyberSecurity	PEC	2	0	2	4	3

VERTICAL 4: EMERGING TECHNOLOGIES

S.NO	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	Augmented Reality/Virtual Reality	PEC	2	0	2	4	3
2.	Artificial Intelligence and Machine Learning	PEC	2	0	2	4	3
3.	Robotic Process Automation	PEC	2	0	2	4	3
4.	Neural Networks and Deep Learning	PEC	2	0	2	4	3
5.	Quantum Computing	PEC	2	0	2	4	3
6.	Game Development	PEC	2	0	2	4	3
7.	3D Printing and Design	PEC	2	0	2	4	3

BOS CHAIRMAN **HEAD – ACADEMICS** **PRINCIPAL**

OPEN ELECTIVE COURSES
OFFERED BY CSE (CYBERSECURITY)

S.NO.	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	Introduction to CyberSecurity	OEC	3	0	0	3	3
2.	Basics of Cryptography	OEC	3	0	0	3	3

MANDATORY COURSES

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	U23MC302	Universal Human Values	MC	2	0	0	2	0
2	U23MC402	Environmental Ecosystem and Sustainability	MC	2	0	0	2	0
3	U23MC504	Entrepreneurship and Innovation	MC	1	0	0	1	0
4	U23MC601	Intellectual Property Rights	MC	1	0	0	1	0

BOS CHAIRMAN **HEAD – ACADEMICS** **PRINCIPAL**

SEMESTER I

U23EN101 SDG: 4	ENGLISH FOR ENGINEERS	Category: HSMC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

1.	To enable learners of engineering and technology to develop their basic communication skills in English.
2.	To acquire, command in both the respective skills (listening and reading) and the productive skills (writing and speaking) of the English language.
3.	To understand the key concepts of values, life skills and business communication and motivate students to look within and create a better version of themselves.
4.	To focus on the development of basic fluency in English, usage of vocabulary in the technical field, and strengthening reading and official written communication skills.
5.	To use language efficiently in expressing their opinions via various media.

UNIT 1	INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION	9

Listening– listening to Audio/video(formal & informal);Telephonic conversation (Activity) Speaking-Self Introduction; Introducing a friend (Activity);Conversation-politeness strategies; Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts-Writing-Writing on self, Writing Definition; Jumbled sentence Grammar – Simple present tense, Present continuous, Present perfect, Present perfect continuous; Question types: Wh/ Yes or No/ and Tags; Word formation, One-word substitution.

UNIT 2	NARRATION AND SUMMATION	9

Listening- Listening to the podcast, anecdotes/stories/event narration; documentaries and interviews with celebrities (Activity). Speaking-Narrating personal experiences/events; interviewing a celebrity (Activity). Reading- Reading biographies, travelogues, newspaper reports, Writing- Guided Writing- Paragraph writing, Short Report on an event (field trip etc.) - Grammar– Simple past tense, Past continuous, Past perfect, Past perfect continuous; Subject- Verb Agreement; Prepositions, Word forms (prefixes & suffixes); Error Correction.

UNIT 3	DESCRIPTION OF PROCESS/PRODUCT	9

Listening – Listening to specific audio tracks (Activity) Speaking – Picture description; giving instruction to use the product; presenting a product; Role play (Activity) -Reading – Reading advertisements, gadget reviews; finding key information from a given text- Writing - Instructions; Process description; Grammar - Simple future tense, Future continuous, Future perfect, Future perfect continuous; Imperatives; Adjectives; Degrees of comparison; Compound Words.

UNIT 4	CLASSIFICATION AND RECOMMENDATIONS	9

Listening – watching videos/ documentaries and responding to the questions based on them, Scientific

lectures; and educational videos. Speaking – Small Talk; Mini presentations (Activity) - Reading – Journal reports, predicting content of reading habits, Reading articles (Activity)- Writing –Memos to colleagues or friends; Opinion Blogs; Grammar – Articles; Pronouns - Possessive & Relative pronouns, Cause and Effect.		
UNIT 5	**EXPRESSION**	**9**
Listening – Listening to different accent, Listening to speeches or presentation- Speaking – Debates and Expressing opinions through Simulations, exchanging personal information - (Activity)- Reading – Reading editorials; Poster making (Activity)- Writing – Creative Writing, Checklist- Grammar – Punctuation; Compound Nouns, Homonyms; and Homophones, Simple, Compound & Complex Sentences.		

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	-	-	-	-	-	1	1	-	3	1	-	2	-	-	-
CO2	-	-	-	-	-	1	1	-	3	-	-	2	-	-	-
CO3	-	-	-	-	-	1	1	-	3	2	-	3	-	-	-
CO4	-	-	-	-	-	1	2	-	3	1	-	2	-	-	-
CO5	-	-	-	-	-	1	2	-	3	2	-	3	-	-	-

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

BOS CHAIRMAN HEAD – ACADEMICS PRINCIPAL

U23MA101 SDG: 4	CALCULUS AND DIFFERENTIAL EQUATIONS	Category: BSC			
		L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

1.	To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
2.	To familiarize the students with differential calculus.
3.	To enlighten the students with functions of several variables. This is needed in many branches of engineering.
4.	To make the students acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
5.	To acquaint the students with mathematical tools needed in evaluating multiple integrals and their applications.

UNIT 1	**MATRICES**	**9 + 3**

Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values and Eigen vectors (without proof) – Cayley – Hamilton theorem (Statement and applications only) - Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic form – Nature of Quadratic forms - Reduction of quadratic form to canonical form by orthogonal transformation.

UNIT 2	**DIFFERENTIAL CALCULUS**	**9 + 3**

Representation of functions - Limit of a function - Continuity - Derivatives -Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation - Applications: Maxima and Minima of functions of one variable.

UNIT 3	**MULTIVARIABLE CALCULUS**	**9 + 3**

Functions of two variables – Partial derivatives – Total differential – Taylor's series for functions of two variables – Jacobian's – Constrained maxima and minima – Lagrange's multiplier and its applications.

UNIT 4	**ORDINARY DIFFERENTIAL EQUATIONS OF SECOND ORDER**	**9+3**

Linear differential equations of second order with constant coefficients. Linear differential Equations of second order with variable coefficients: Cauchy's linear differential equation - Method of variation of parameters for second order differential equations

UNIT 5	**MULTIPLE INTEGRALS**	**9 + 3**

Double integration with constant and variable limits - Region of integration - Area as double integral in Cartesian coordinates. Triple integral in Cartesian coordinates. Application of integration – Volume of Solids

COURSE OUTCOME :

At the end of the course, students would

CO1:	Comprehend the concepts of Eigen values, Eigen vectors, limits, continuity, functions of several variables, double integration and region of integration for solving complex problems.
CO2:	Use rules of differentiation to solve maxima and minima problems.

CO3:	Apply various techniques in solving ordinary and partial differential equations for practical applications.
CO4:	Apply differential and integral calculus tools in modeling problems.
CO5:	Evaluate integrals to compute area, volume and other practical problems.
	TOTAL: 45 PERIODS

TEXT BOOKS:

1.	Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition 2018.
2.	James Stewart, "Calculus : Early Transcendentals", Cengage Learning, 8th Edition, New Delhi,2015.
3.	Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New
4.	delhi,2016.
5.	Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition 2018.

REFERENCES:

1.	Bali. N., Goyal. M. and Watkins. C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009
2.	Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New delhi,2016
3.	Anton. H, Bivens. I and Davis. S, " Calculus ", Wiley, 10th Edition, 2016
4.	Narayanan. S. and Manicavachagom Pillai. T. K., "Calculus" Volume I and II, S.Viswanathan Publishers Pvt. Ltd., Chennai, 2009.
5.	Jain. R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 5th Edition, 2016.
6.	Srimantha Pal and Bhunia. S.C, " Engineering Mathematics " Oxford University Press, 2015

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	1	1	3	-	-	-	-	-	-	-	-	-
CO2	3	3	1	-	-	3	-	-	-	-	-	-	-	-	-
CO3	3	3	2	-	1	3	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	3	-	-	-	-	-	-	-	-	-
CO5	3	3	2	1	-	3	-	-	-	-	-	-	-	-	-

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

BOS CHAIRMAN **HEAD – ACADEMICS** **PRINCIPAL**

U23PH101 SDG: 4	ENGINEERING PHYSICS	Category: BSC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

1.	Understand the basics of Properties of Matter and apply them to Engineering.
2.	Explore the applications of Lasers and Fiber optics in engineering contexts.
3.	Apply principles of Ultrasonics and Thermal Physics to Engineering challenges.
4.	Grasp foundational Quantum Physics concepts and their modern applications.
5.	Analyze Crystal systems and their structures in Engineering and Technology.

UNIT 1	PROPERTIES OF MATTER	9

Elasticity – Stress-strain diagram and its uses - Factors affecting elastic modulus – Torsional stress and deformations –Torsion pendulum: theory and experiment - Bending of beams - Bending moment – Cantilever: theory and experiment – Uniform and non-uniform bending: theory and experiment - I-shaped girders - Applications. – Basic Solved Problems

UNIT 2	LASER AND FIBER OPTICS	9

Introduction – Principle of Spontaneous emission and stimulated emission. Population inversion, pumping- Einstein's A and B coefficients: derivation. Types of lasers – Nd-YAG, CO2- Industrial Applications of Lasers –Fiber Optics: Principle and propagation of light – Numerical aperture and Acceptance angle - Types of optical fibres (material, refractive index, mode) – Temperature and displacement sensors.

UNIT 3	ULTRASONICS AND THERMAL PHYSICS	9

Introduction – Piezoelectric effect - piezoelectric generator - Velocity measurement – Acoustic grating – Ultrasonic Medical applications - Introduction to heat - Transfer of heat energy:Thermal conduction, convection and radiation –Thermal conductivity - Forbe's and Lee's disc method: theory and experiment – Applications: heat exchangers, refrigerators, ovens and solar water heaters

UNIT 4	QUANTUM PHYSICS	9

Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh-Jeans' Law from Planck's theory – Compton effect :Theory and experimental verification – Matter waves – Schrödinger's wave equation: Time independent and time dependent equations – Physical significance of wave function – Particle in a one-dimensional box- Microscope: Scanning Tunnelling microscope.

UNIT 5	CRYSTAL PHYSIC	9

Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – 'd' spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Diamond and graphite structures – Polymorphism and allotropy - Crystal defects – Point, line and surface defects- Burger vector.

COURSE OUTCOME :

At the end of the course, students would

CO1:	Realize the fundamental engineering ideas of matter, optics, heat, sound, and quantum theory.
CO2:	Demonstrate a solid understanding of fundamental matter properties, Laser and Fiber optics classification, Quantum concepts and apply them successfully to solve practical engineering problems.
CO3:	Apply the elastic modulus theory, Fiber Optic Sensors, Ultrasonics and thermal applications to integrate knowledge and problem solve at an advanced level.
CO4:	Categorize the Elastic moduli concepts, Fiber optic lasers and Crystal structures to implement in Engineer problems in Material Science and electronics.
CO5:	Analyze the foundational Quantum and Crystal Physics concepts to implement solutions for modern engineering problems.
	TOTAL: 45 PERIODS

TEXT BOOKS:

1.	Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2.	Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3.	Pandey, B.K. &Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012

REFERENCES:

1.	Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2.	Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2010.
3.	Palanisamy P.K. Engineering Physics. SCITECH Publications, 2011.
4.	Kittle,C,: Introduction to solid state Physics:, Wiley, 2005.
5.	Mani P. Engineering Physics I. Dhanam Publications, 2011.
6.	Senthilkumar G. Engineering Physics I. VRB Publishers, 2011.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	3	3	1	-	1	-	1	-	-	1	-	1	-	-	-
CO2	3	3	1	-	1	-	1	-	1	-	-	1	-	-	-
CO3	3	3	1	-	1	-	1	-	1	-	-	1	-	-	-
CO4	3	2	1	-	1	-	-	-	-	1	-	1	-	-	-
CO5	3	3	1	-	-	-	1	-	1	-	-	1	-	-	-

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

BOS CHAIRMAN HEAD – ACADEMICS PRINCIPAL

U23CY101 SDG: 9	ENGINEERING CHEMISTRY	Category: BSC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

1.	Learn boiler feed water requirements, and water treatment techniques.
2.	To acquire knowledge about the preparation, properties and applications of polymers.
3	Understand the basic concepts of electrochemistry and its applications.
4.	Learn corrosion control and protective techniques.
5.	Acquire the knowledge about the fuels and properties of energy storage devices.

UNIT 1	WATER TECHNOLOGY	9

Introduction - Sources of water - Impurities in water - Types of water –Hardness of water - Expression of hardness - Units of hardness - Estimation of hardness of water by EDTA method - Disadvantages of using hard water - Boiler troubles - Scale and sludge - Softening of water - External treatment method - Demineralization process - Internal treatment process – Carbonate, Phosphate and Calgon conditioning - Desalination by reverse osmosis method.

UNIT 2	POLYMERS	9

Introduction: Classification of polymers – Natural and synthetic; Thermoplastic and Thermosetting. Functionality – Degree of polymerization. Types: Addition, condensation and copolymerization and mechanism of Addition polymerization (Free Radical); Techniques of polymerization: Bulk, emulsion, solution and suspension. Preparation, properties and uses of Nylon (6,6 and 11) and Epoxy resin. Engineering application of plastics- PVC, PTFE and Bakelite. Types of compounding of plastics- Moulding, injection moulding.

UNIT 3	ELECTRO CHEMISTRY	9

Electrochemistry**:** Introduction - Cells - Representation of a galvanic cell - Reversible and irreversible cells - Electrode potential - Nernst equation - Reference electrode (Calomel electrode) - Standard hydrogen electrode - Glass electrode - Electrochemical series and its applications –Battery: Introduction, Types of batteries- alkaline battery- lead storage battery - H2 -O2 fuel cell- applications. Construction of solar cells and E-Vehicle.

UNIT 4	CORROSION AND ITS CONTROL	9

Introduction - Chemical corrosion and Wet corrosion - Galvanic and differential aeration (Pitting, Crevice and Pipeline) - Factors influencing rate of corrosion - Corrosion- causes- factors- corrosion control - material selection and design aspects - electrochemical protection – sacrificial anode method and impressed current cathodic method- Cathodic protection method.

UNIT 5	FUELS AND COMBUSTION	9

Introduction - Classification of fuels - Requirements of a good fuel – Combustion: Principle of combustion - Calorific value - Gross and net calorific values - Explosive range - Spontaneous ignition temperature. Fuels: Solid fuels - Coal and its varieties - Proximate analysis - Significance - Metallurgical coke - Otto-Hoffman byproduct method - Liquid fuel: Manufacture of synthetic petrol - Bergius method - Knocking - Octane number - Cetane number - Gaseous fuel: Liquefied petroleum gas (LPG), Compressed natural gas (CNG).

COURSE OUTCOME :	
At the end of the course, students would	
CO1:	Recall the concept about water technology, engineering polymers, electrodes, corrosion and combustion of fuels.
CO2:	Understand the boiler problems and categorize the polymers.
CO3:	Classify plastics, batteries, corrosion, and the calorific value of fuels.
CO4:	Apply enough knowledge of contemporary water softening, polymerization, fuel cell, electrochemical protection, and fuel manufacturing procedures.
CO5:	Analyze the hardness of water using the EDTA technique and characterization of coal.
	TOTAL: 45 PERIODS

TEXT BOOKS:	
1.	Jain P C and Monica Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Co., 2018.
2.	Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2017.
REFERENCES:	
1.	B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Textbook of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
2.	O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.
3.	Friedrich Emich, "Engineering Chemistry", Scientific International Pvt, Ltd, New Delhi, 2017.
4.	Shikha
5.	R.D. Madan, "Modern Inorganic Chemistry", S. Chand, New Delhi, 2012
6.	S.S. Dara, "A Textbook of Engineering Chemistry", S. Chand Publishing, 12th Edition, 2018.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	2	-	-	2	-	-	-	-	1	-	-	-
CO2	3	-	-	2	2	-	2	-	-	-	-	2	-	-	-
CO3	3	-	-	2	2	-	2	-	-	-	-	2	-	-	-
CO4	3	-	-	2	3	-	2	-	-	-	-	3	-	-	-
CO5	3	-	-	2	3	-	2	-	-	-	-	3	-	-	-

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

BOS CHAIRMAN HEAD – ACADEMICS PRINCIPAL

U23CS101 SDG : 8	C-PROGRAMMING	Category: ESC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

1.	To learn basic knowledge on computer hardware and software
2.	To learn simple algorithms for arithmetic and logical problems.
3	To translate the algorithms into modular, readable C program & execution in C language.
4.	To decompose a problem into functions and synthesize a complete program using divide and conquer approach.
5.	To develop C program using C tokens, arrays, function, structures and files.

UNIT 1	BASICS OF COMPUTING AND C PROGRAMMING	9

Introduction to Computer Systems: Hardware and Software - Computer Languages – Concept of compiler, interpreter - Algorithm – Flowchart - Representation of Algorithm and Flowchart with examples - Introduction to C – Features of C, Structure of C Program, Applications of C, Character Set, C Tokens: Keywords, Identifiers, Constants, Variables, Data types, Operators – Expressions.

UNIT 2	C STATEMENTS AND PREPROCESSOR	9

Statements: Input/Output Statements - Assignment Statements - Decision Making Statements - Switch Statement - Looping Statements: while, do-while, for statements with examples - Unconditional statements - break, continue, goto statements with examples - Preprocessor Directives: Header file, Macro - Compilation Process

UNIT 3	ARRAYS AND STRINGS	9

Introduction To Arrays: Declaration, Initialization – One Dimensional Array – Two Dimensional Arrays – Matrix operation: addition, subtraction, multiplication and transpose – String - String Operations: Length, Compare, Concatenate, Copy

UNIT 4	FUNCTIONS AND POINTERS	9

Function: Function Call, Function Definition, Function Prototype, Built-In Functions: Standard Function, Math Functions, String Functions – Recursion – Storage classes – Pointers: Definition And Initialization – Parameter Passing: Pass By Value, Pass By Reference

UNIT 5	STRUCTURE, UNION AND FILE PROCESSING	9

Structure - Nested Structures – Self Referential Structures – Union - Files – Types of File: Binary File, Text File – File Operations - Types of File Processing: Sequential Access File - Random Access File – Command line Arguments

COURSE OUTCOME :

At the end of the course, students would

CO1:	Demonstrate the basic knowledge of computer hardware, software and c basics
CO2:	Utilize the knowledge on simple algorithms and flowchart for arithmetic and logical problems.
CO3:	Execute the C programs with correct syntax and logical errors
CO4:	Apply solving and logical skills in C language using array and function
CO5:	Implement problem solving skills using concept of Structure, pointers and files in C language

TOTAL: 45 PERIODS

TEXT BOOKS:	
1.	ReemaThareja, "Programming in C", Oxford University Press, Second Edition, 2016.
2.	Kernighan, B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2015.
REFERENCES:	
1.	Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++", Eighth edition, Pearson Education, 2018.
2.	Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.
3.	Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", McGraw-Hill Education, 1996.
4.	Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", Second Edition, Oxford University Press, 2013.
5.	Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", 1st Edition, Pearson Education, 2013

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	P O9	PO 10	PO 11	PO 12	PS O1	PSO 2	PS O3
CO1	1	1	1	1	1	-	-	-	1	1	1	1	1	2	1
CO2	1	1	1	1	1	-	-	-	2	2	1	1	1	2	1
CO3	2	3	2	1	1	-	-	-	2	2	3	2	3	1	2
CO4	3	2	2	1	2	-	-	-	2	2	3	3	3	1	2
CO5	2	3	3	1	1	-	-		2	2	3	2	3	1	2

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

BOS CHAIRMAN **HEAD – ACADEMICS** **PRINCIPAL**

U23HS101 SDG:4	HERITAGE OF TAMILS	Category: HSMC			
		L	T	P	C
		1	0	0	1

COURSE OBJECTIVE:

1.	To learn the extensive literature of classical tamil
2.	To review the fine arts heritage of tamil culture
3	To realize the contribution in Indian freedom struggle

UNIT 1	LANGUAGE AND LITERATURE	3

Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan

UNIT 2	HERITAGE - ROCK ART PAINTINGS TO MODERN ART –SCULPTURE	3

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT 3	FOLK AND MARTIAL ARTS	3

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT 4	THINAI CONCEPT OF TAMILS	3

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT 5	CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE	3

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

COURSE OUTCOME :

At the end of the course, students would

CO1:	Remember the extensive literature of tamil and its classical nature, musical instruments, Folk, thinai concept, Indian Freedom Struggle& Aham, Puram and Aram Concept.
CO2:	Remember the principles in Thirukural, Bakthi Literature Azhwars and Nayanmars , heritage of sculpture, painting and musical instruments of ancient people, victory of chozha dynasty.
CO3:	Understand on folk and martial arts of tamil people, Justice in Sangam Literature, Development of Modern literature in Tamil, Making of musical instruments.
CO4:	Understand the role of Temples in Social and Economic Life of Tamils, Ancient Cities and Ports of Sangam Age, Conquest of Cholas.

CO5:	Understand the Cultural Influence of Tamils over the other parts of India, contribution of tamils self-esteem movement and siddha medicine, Print History of Tamil Books.
	TOTAL: 45 PERIODS

TEXT BOOKS:

1.	தமிழக வரலாறு – மக்களும் பண்பாடும் – .கக. கக பிள்ளை (வெளியீடு): தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள்கழகம்
2.	கணினித்தமிழ் – முனைவர் இல. சுந்தரம் . (விகடன்பிரசுரம்).
3.	கீழடி – மவமக நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை (வெளியீடு)

REFERENCES:

1.	Social Life of Tamils (Dr. K. K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2.	Historical Heritage of the Tamils (Dr .S. V. Subaramanian, Dr .K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
3.	The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies)
4.	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
5.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
CO2	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
CO3	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
CO4	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
CO5	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

BOS CHAIRMAN HEAD – ACADEMICS PRINCIPAL

U23BS111 SDG:4	BASIC SCIENCE LABORATORY	Category: BSC			
		L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:	
1.	Realize the fundamental engineering ideas of matter, optics, heat, sound, and quantum theory.
2.	Demonstrate a solid understanding of fundamental matter properties, Laser and Fiber optics classification, Quantum concepts and apply them successfully to solve practical engineering problems.
3.	Apply the elastic modulus theory, Fiber Optic Sensors, Ultrasonics and thermal applications to integrate knowledge and problem solve at an advanced level.
4.	Categorize the Elastic moduli concepts, Fiber optic lasers and Crystal structures to implement in Engineer problems in Material Science and electronics.
5.	Analyse the foundational Quantum and Crystal Physics concepts to implement solutions for modern engineering problems.
PHYSICS - LIST OF EXPERIMENTS (Any 5 Experiments)	
1.	Determination of rigidity modulus – Torsion pendulum
2.	Determination of Young's modulus - Non uniform bending method.
3.	Determination of Young's modulus - Uniform bending method.
4.	Determination of thickness of a thin wire – Air wedge method.
5.	Determination of the wavelength of the laser using grating .
6.	Determination of Numerical Aperture and acceptance angle using Optical fibre.
7.	Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
8.	Determination of thermal conductivity of a bad conductor – Lee's Disc method.
9.	Melde's string experiment.
10.	Determination of Band gap of a semiconductor
CHEMISTRY- LIST OF EXPERIMENTS (Any 5 Experiments)	
1.	Estimation of total, temporary and permanent hardness of water by EDTA method.
2.	Estimation of alkalinity of the given water sample.
3.	Determination of chloride content of water sample by Argentometric method.
4.	Determination of strength of given hydrochloride acid using pH meter
5.	Determination of DO content of water sample by Winkler's method.
6.	Conduct metric titration strong acid Vs Strong Base.
7.	Estimation of BOD of the given water sample.
8.	Estimation of iron content of the given solution using potentiometer.

9.	Estimation of Iron content by spectrophotometer.
10.	Estimation of sodium present in water using flame photometer
COURSE OUTCOMES:	
At the end of the course, students would	
CO1:	Apply Physics principles of elasticity to evaluate engineering properties of materials.
CO2:	Analyze the physical principle involved in various instruments in acoustics, optics and thermal physics.
CO3:	Characterize the quality of water samples with respect to their acidity, alkalinity and hardness.
CO4:	Apply chemistry principles to evaluate DO, BOD, Iron content of the given samples.
CO5:	Analyze the strength and amount of acids using pH, potentiometer, conductivity meter and the amount of chloride, sodium iron using Argentometric method and flame photometer for the given solution.
	TOTAL: 60 PERIODS

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PSO 3
CO1	3	2	1	1	-	-	1	-	1	-	-	-			-
CO2	3	2	1	1	-	-	1	-	1	-	-	1			-
CO3	3	2	1	1	-	-	1	-	1	-	-	-			-
CO4	3	2	1	1	-	-	1	-	1	-	-	1			-
CO5	3	2	-	1	-	-	1	-	1	-	-	1			-

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

BOS CHAIRMAN **HEAD – ACADEMICS** **PRINCIPAL**

U23EN111 SDG : 4	COMMUNICATIVE ENGLISH LABORATORY	Category: HSMC			
		L	T	P	C
		0	0	2	1

COURSE OBJECTIVE:

1.	To enable learners of engineering and technology to develop their basic communication skills in English.
2.	To acquire, command in both the respective skills (listening and reading) and the productive skills (writing and speaking) of the English language.
3.	To understand the key concepts of values, life skills and business communication and motivate students to look within and create a better version of themselves.
4.	To focus on the development of basic fluency in English, usage of vocabulary in the technical field, and strengthening reading and official written communication skills.
5.	To use language efficiently in expressing their opinions via various media.

LIST OF EXPERIMENTS:

1.	Conversation: Introduction to Classmates-Audio/Video (formal & informal)
2.	Self-Introduction
3.	Telephone Conversation
4.	Listening to voicemail & messages
5.	Listening and filling a form
6.	Debate
7.	Group Discussion
8.	Exchanging personal Information
9.	Introducing a friend politeness strategy
10.	Essay Writing

COURSE OUTCOME :

At the end of the course, students would

CO1:	To improve the communicative competence of learners
CO2:	To help learners use language effectively in academic /work contexts
CO3:	To develop various listening strategies to comprehend various types of audio materials like lectures, discussions, videos etc.
CO4:	To build on students' English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts.
CO5:	To use language efficiently in expressing their opinions via various media.
	TOTAL: 60 PERIODS

BOS CHAIRMAN **HEAD – ACADEMICS** **PRINCIPAL**

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	3	1	1	1	-	-	2	-	2	2	2	2	-
CO2	3	2	2	2	1	1	-	-	2	-	2	2	3	3	-
CO3	3	2	3	2	1	2	-	-	2	-	2	2	2	2	-
CO4	3	2	2	2	1	2	-	-	3	-	2	3	3	3	-
CO5	3	2	3	1	1	2	-	-	3	-	2	3	2	3	-

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

BOS CHAIRMAN **HEAD – ACADEMICS** **PRINCIPAL**

U23CS111 SDG: 4	C -PROGRAMMING LABORATORY	Category: ESC			
		L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

1.	To familiarize with C programming constructs.
2.	To develop programs in C using basic constructs.
3.	To develop programs in C using arrays.
4.	To develop applications in C using strings, pointers, functions.
5.	To develop applications in C using structures.
6.	To develop applications in C using file processing.

LIST OF EXPERIMENTS:

1.	Writing algorithms, flow charts and pseudo codes for simple problems.
2.	Programs on expressions and conversions.
3.	Programs using if, if-else, switch and nested if statements.
4.	Programs using while, do-while, for loops.
5.	Programs on one dimensional array, passing arrays to functions and array operations.
6.	Programs using two dimensional arrays, passing 2D arrays to functions.
7.	Programs using String functions.
8.	Programs using function calls, recursion, call by value.
9.	Programs on pointer operators, call by reference, pointers with arrays
10.	Programs using structures and unions.
11.	Programs on file operations and modes.
12.	Working with text files, random files and binary files.

COURSE OUTCOME :

At the end of the course, students would

CO1:	Demonstrate knowledge on C programming constructs.
CO2:	Develop programs in C using arrays.
CO3:	Develop applications in C using strings, pointers, functions.
CO4:	Develop applications in C using structures.
CO5:	Develop applications in C using file processing.

TOTAL: 60 PERIODS

BOS CHAIRMAN **HEAD – ACADEMICS** **PRINCIPAL**

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	2	3	1	1	1	-	-	2	-	2	2	2	2	-
CO2	3	2	2	2	1	1	-	-	2	-	2	2	3	3	-
CO3	3	2	3	2	1	2	-	-	2	-	2	2	2	2	-
CO4	3	2	2	2	1	2	-	-	3	-	2	3	3	3	-
CO5	3	2	3	1	1	2	-	-	3	-	2	3	2	3	-

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

BOS CHAIRMAN **HEAD – ACADEMICS** **PRINCIPAL**

U23EE121 SDG: 17	CAREER ENHANCEMENT TRAINING - I	Category: EEC			
		L	T	P	C
		3	0	0	1

COURSE OBJECTIVE:

1.	To improve mathematical and analytical abilities of students, particularly in the context of comprehending engineering concepts and making data-driven decision.
2.	To develop critical thinking skills including problem solving, logic, patterns, and reasoning.
3.	To Comprehend and appreciate mathematical terminologies and concepts in order to understand, interpret, and represent science and technology.

UNIT 1	**FUNDAMENTALS**	**6**
Divisibility Test - Square root and Cube roots – HCF & LCM - problems on Numbers		
UNIT 2	**ALGEBRA**	**5**
Simplification – Surds & Indices – Linear & Quadratic Equations		
UNIT 3	**BANKING ESSENTIALS**	**8**
Average – Percentage – Profit & Loss – Simple Interest – Compound Interest		
UNIT 4	**TIME AND EFFICIENCY**	**8**
Time Speed Distance – Problems on Trains – Boats & Streams – Time & Work – Pipes & Cisterns		
UNIT 5	**LOGICAL REASONING**	**3**
Number & letter series – Analogy– Pattern classification – Coding & Decoding		

COURSE OUTCOME:

At the end of the course, students would

CO1:	Exhibit a clear understanding of fundamental concepts of aptitude for engineering.
CO2:	Demonstrate problem-solving skills and critical thinking abilities in the context of recruitment aptitude tests.
CO3:	To use appropriate strategies and shortcuts to improve speed and accuracy in solving aptitude problems during recruitment processes.
CO4:	Evaluate and interpret aptitude test results to identify areas of improvement and develop a personalized study plan for further enhancement.

TOTAL: 45 PERIODS

TEXT BOOKS:

1.	The Pearson Guide to Quantitative Aptitude For Competitive Examinations, Dinesh Khattar. Pearson
2.	Quantitative Aptitude Dr. R.S. Aggarwal S. Chand Publication.
3.	A modern Approach to Verbal and Non-Verbal Reasoning R.s. Aggarwal.

REFERENCES:

1.	Quantitative Aptitude for CAT, Arun Sharma.
2.	Fast Track Objective Arithmetic, Rajesh Verma, Arihant Publication
3.	Quantitative Aptitude Quantum CAT Common Admission Tests for Admission into IIMs,

	Sarvesh K. Verma.
4.	Effective Communication Skill,Kulbhusan Kumar,R S Salaria,Khanna Publishing House.
5.	Wiley's Exam Expert Quantitative Ability for CAT, 2ed, Ashu Jain.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	1	1	2	-	-	-	-	-	-	-	-	-	-	-
CO4	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

BOS CHAIRMAN **HEAD – ACADEMICS** **PRINCIPAL**

SEMESTER II

U23PH203 SDG : 4	PHYSICS FOR INFORMATION SCIENCE	Category: BSC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

1.	Make the students understand the importance in studying electrical properties of materials.
2.	Enable the students to gain knowledge in semiconductor physics.
3.	Make the students to learn the origin of magnetism in magnetic materials and their classifications; to learn the physics of superconductivity and various properties exhibited by superconductors.
4.	Make the students to learn the mechanisms of polarization in dielectric materials, and about classification and properties of dielectric materials; familiarize with the optical properties of materials.
5.	Inculcate an idea of significance of Nano structures, quantum confinement, ensuing Nano materials preparation and applications.

UNIT 1	ELECTRICAL PROPERTIES OF MATERIALS	9

Introduction - Classical free electron theory - Expressions for Electrical and Thermal conductivity - Wiedemann-Franz law – Lorentz Number - Quantum free electron theory – Fermi distribution function – Effect of temperature on fermi function-Density of energy states – Carrier concentration in metals - Electron effective mass- concept of hole.

UNIT 2	SEMICONDUCTOR PHYSICS	9

Elemental and compound semiconductors - Intrinsic semiconductor – carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination – Extrinsic semiconductor - Derivation of carrier concentration in n-type and p-type semiconductor – variation of Fermi level with temperature and impurity concentration — Hall effect –Determination of Hall coefficient – Applications.

UNIT 3	MAGNETISM AND SUPERCONDUCTIVITY	9

Origin of magnetic moment – Bohr magneton – Comparison of Dia, Para and Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – anti-ferromagnetic materials – Ferrites and its applications. Superconductivity: properties – Type I and Type II superconductors – High Tc superconductors – Applications of superconductors – SQUID, cryotron, magnetic levitation.

UNIT 4	DIELECTRIC AND OPTICAL PROPERTIES OF MATERIALS	9

Electrical susceptibility – Dielectric constant – Electronic, ionic, orientational and space charge polarization – Frequency and temperature dependence of polarisation – Internal field – Claussius – Mosotti relation (derivation) – Dielectric loss - Light absorption - Luminescence, Phosphors and white LEDs -Birefringence, Dichroism - Electro-optic effect and amplitude modulators.

UNIT 5	NANO DEVICES	9

Introduction - Quantum confinement – Quantum structures: quantum wells, wires and dots — Band gap of nano-materials - Classification of nanomaterials - Thin Film Growth, Ball Milling, Sol-Gel – Properties and applications – Carbon nanotubes: types and applications.

COURSE OUTCOME :	
At the end of the course, students would	
CO1:	Grasp the fundamental principles of classical and quantum mechanics, semiconductor physics, magnetic properties of materials, dielectric materials, superconducting materials, optical and nano materials and acquire insights into the essentials of emerging engineering materials.
CO2:	Demonstrate a comprehensive understanding of classical and quantum mechanics, semiconductor physics, magnetic properties of materials, dielectric materials, and superconducting materials optical and nano materials, enabling the adept resolution of practical engineering challenges.
CO3:	Apply the foundational theories of classical and quantum mechanics, semiconductor physics, and the properties of magnetic, dielectric, superconducting materials, optical and nano materials to seamlessly integrate knowledge into diverse engineering applications.
CO4:	Classify the semiconductor, magnetic, dielectric, and superconducting properties of materials, utilizing this systematic categorization to effectively address engineering problems in Material Science.
CO5:	Analyze the foundational knowledge of conductors, semiconductors, magnetic, dielectric, superconducting materials, optical and nano materials to formulate and implement solutions for contemporary engineering issues.
	TOTAL: 45 PERIODS

TEXT BOOKS:	
1.	Arumugam M., Materials Science. Anuradha publishers, 2010.
2.	S.O. Kasap. Principles of Electronic Materials and Devices, McGraw Hill Education (Indian Edition), 2020.
3.	The Physics and Chemistry of NanoSolids by Frank J. Owens and Charles P. Poole Jr, Wiley-Interscience, 2008.

REFERENCES:	
1.	Palanisamy P.K. Materials Science. SCITECH Publishers, 2011.
2.	Senthilkumar G. Engineering Physics II. VRB Publishers, 2011.
3.	Handbook of nanoscience, Eng. & Technology by W. Gaddand, D. Bernner, S.L. Solnki& G.J. Infrate (Eds) , CRC press 2002.
4.	Charles Kittel, Introduction to Solid State Physics, Wiley India Edition, 2019.
5.	Amnon Yariv and P.Yeh, Photonics: Optical Electronics in Modern Communications, Oxford Univ.Press, 2007.
6.	Nanostructure and Nanomaterials: Synthesis , Properties and Application by G. Cao, Imperial College Press, 2004.

BOS CHAIRMAN **HEAD – ACADEMICS** **PRINCIPAL**

CO's-PO's & PSO's MAPPING															
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	2	1	-	-	-	1	-	-	-	-	1	-	-	-
CO2	3	2	-	-	1	-	1	-	-	-	-	-	-	-	-
CO3	3	2	1	-	1	-	1	-	-	1	-	1	-	-	-
CO4	3	2	1	-	1	-	1	-	-	1	-	1	-	-	-
CO5	3	2	1	-	1	-	1	-	-	1	-	1	-	-	-
Correlation levels:			**1 – low**			**2 – medium**			**3 – high**			**"-"- no correlation**			

BOS CHAIRMAN **HEAD – ACADEMICS** **PRINCIPAL**

U23CS204 SDG: 12	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	Category: ESC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

1.	To familiarize with various laws and theorems to solve electric and electronic circuits
2.	Provide an overview on working principle of machines
3.	Excel the concepts of semiconductor devices, op-amps and digital circuits

UNIT 1	**DC CIRCUITS**	7
Basic circuit elements and sources; Ohms law; Kirchhoff's laws; Series and Parallel connection of circuit elements; Mesh current analysis; Node voltage analysis; Theorems: Thevenin's, Maximum power transfer and Superposition theorem. (Problems only on Independent Sources)		
UNIT 2	**AC CIRCUITS**	8
Alternating voltages and currents, RMS, average, maximum values, Single Phase RL, RC, RLC series circuits, Power in AC circuits, Power Factor, Three phase balanced systems, Star and delta Connections, Electrical Safety, Fuses and Earthing.		
UNIT 3	**MAGNETIC CIRCUITS**	7
Magnetic field; Toroidal core: Flux density, Flux linkage; Magnetic circuit with airgap; Reluctance in series and parallel circuits; Self and mutual inductance; Transformer: turn ratio determination.(Simple Problems)		
UNIT 4	**ELECTRICAL MACHINES**	8
Construction, working principle and applications of DC Machines, Transformers, Three phase Induction motors, synchronous generators, single phase induction motors, special machines stepper motor, universal motor and BLDC motor.		
UNIT 5	**ANALOG ELECTRONICS**	7
Characteristics: PN junction diode, Zener diode, BJT, MOSFET; Applications: Rectifier, Voltage regulator, Operational amplifier.		
UNIT 6	**DIGITAL ELECTRONICS**	8
Binary arithmetic; Number base conversion; Boolean algebra: simplification of Boolean functions using K-maps; Logic gates; Design of basic combinational circuits: adders, multiplexers, de-multiplexers.		

COURSE OUTCOME :

At the end of the course, students would

CO1:	Recall and describe basic circuit elements, electrical sources, Ohm's Law, Kirchhoff's laws, Magnetic field concepts, Flux density, Flux linkage, and Self/Mutual inductance principles in toroidal cores.
CO2:	Understand and explain the principles of series and parallel connections, electrical safety mechanisms, Characteristics of semiconductor devices.
CO3:	Illustrate various types of electrical machines and their applications, as well as Binary arithmetic and Number base conversions.
CO4:	Apply laws and theorems to construct DC circuit parameters, and utilize Boolean algebra and K- maps to design digital circuits by simplifying Boolean functions.

CO5:	Analyze AC circuit parameters, Magnetic circuits (including air gaps and reluctance), turns ratios, and design adders, multiplexers, and de-multiplexers using logic gates.
	TOTAL: 45 PERIODS

TEXT BOOKS:

1.	R. Muthusubramanian, S Salivahanan, "Basic Electrical and Electronics Engineering", 2nd Edition, Tata McGraw-Hill, New Delhi, 2025
2.	Allan R. Hambley, "Electrical Engineering -Principles & Applications", 2021, 7th Edition, Pearson Education

REFERENCES:

1.	William H. Hayt, Jack Kemmerly, Jamie Phillips, Steven M. Durbin "Engineering Circuit Analysis", 10th Edition, Tata McGraw-Hill, New Delhi, 2025.
2.	Electronic Devices and Circuits by S Salivahanan (Author), N. Suresh Kumar (Author)-5th Edition-2022

WEB RESOURCES:

1.	***https://onlinecourses.nptel.ac.in/noc22_ee113/preview***
2.	***https://onlinecourses.nptel.ac.in/noc21_ee55/preview***

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	-	-	1	-	-	-	-	-	-	-	3	-	3
CO2	3	2	1	-	1	-	-	-	-	-	-	-	2	-	3
CO3	3	2	3	1	2	-	-	-	-	-	1	1	2	2	3
CO4	3	3	2	2	1	-	-	-	-	-	-	2	3	1	3
CO5	3	3	2	2	2	1	-	-	-	-	-	2	3	2	3

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

BOS CHAIRMAN **HEAD – ACADEMICS** **PRINCIPAL**

U23HS202 SDG:4	TAMILS AND TECHNOLOGY	Category: HSMC			
		L	T	P	C
		1	0	0	1

COURSE OBJECTIVE:

1.	To learn the extensive literature of classical Tamil.
2.	To review the fine arts heritage of Tamil culture.
3.	To realize the contribution in Indian freedom struggle.

UNIT 1	TAMIL AND TECHNOLOGY	3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries,

UNIT 2	DESIGN AND CONSTRUCTION TECHNOLOGY	3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT 3	MANUFACTURING TECHNOLOGY	3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold-Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT 4	AGRICULTURE AND IRRIGATION TECHNOLOGY	3

Dam, Tank, ponds, Sluice, Significance of KumizhiThoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT 5	SCIENTIFIC TAMIL & TAMIL COMPUTING	3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

COURSE OUTCOME :

At the end of the course, students would

CO1:	Understand the extensive literature of Tamil and its classical nature (understand).
CO2:	Understand the heritage of sculpture, painting and musical instruments of ancient people (understand).
CO3:	Review on folk and martial arts of Tamil people (understand).
CO4:	Realization of thinai concepts, trade and victory of chozha dynasty (understand).
CO5:	Understand the contribution of Tamils in Indian freedom struggle, self-esteem movement and siddha medicine (understand).

TOTAL: 15 PERIODS

TEXT BOOKS:

1.	தமிழக வரலாறு - மக்களும் பண்பாடும் - . கக. கக பிள்ளை (வெளியீடு): தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்
2.	கணினித் தமிழ் - முனைவர் இல. சுந்தரம் . (விகடன் பிரசுரம்).
3.	கீழடி – மவமக நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை (வெளியீடு)

REFERENCES:

1.	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2.	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
3.	National The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: Interl Institute of Tamil Studies).
4.	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu.
5.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
6.	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
CO2	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
CO3	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
CO4	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
CO5	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

BOS CHAIRMAN HEAD – ACADEMICS PRINCIPAL

U23CS201 SDG:4	PYTHON PROGRAMMING AND PRACTICES	Category: ESC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

1.	To understand and develop programs using Python
2.	To use the concepts of strings, control flow, data types in python programs.
3.	To create programs using list, tuples, dictionaries, and files concept in Python.
4.	To analyze image processing, networking and object-oriented programming in Python.
5.	To create new ideas for problems in real world application using python.

UNIT 1	**INTRODUCTION TO PYTHON PROGRAMMING**	**6**

Introduction to Python Programming- Python Interpreter and Interactive Mode -Variables- Numerical types- Arithmetic operators and Expressions- Psuedo Code - Values and types: int, float, Boolean - Variables, Expressions, Statements -Illustrative Problems.

UNIT 2	**DATA TYPES, CONTROL FLOW, STRINGS**	**8**

Control Flow -conditional (if), Alternative (if-else), Chained conditional (if-else if-else)- Iteration: state, while, for, break, continue, pass - Strings: string slices, immutability, string functions and methods, string module, Regular expression, Pattern matching. - Illustrative Problems.

UNIT 3	**LISTS, TUPLES DICTIONARIES AND FUNCTIONS**	**10**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters- Tuples: tuple assignment, tuple as return value- Dictionaries: operations and methods, advanced list processing – list comprehension. Functions and User Defined Functions: Simple and Mathematical Built–in Functions, Recursion -Illustrative Problems.

UNIT 4	**FILES AND OOPS CONCEPT IN PYTHON**	**10**

Files, Text files, reading and writing files-format operator; Files and exception handling - Introduction to Object Oriented Programming – Basic principles of Object Oriented Programming in Python – Class Definition-Object Creation - Inheritance, Composition, Operator Overloading.

UNIT 5	**IMAGE PROCESSING & NETWORKING WITH PYTHON AND APPLICATIONS**	**11**

Basics of Image processing- Image File Formats – Introduction to Classic Image Processing Algorithm- Image Processing Tools-Fundamentals of Networking- Introduction to Python Sockets- Simple Client/Server Programming-Python Applications.

COURSE OUTCOME :

At the end of the course, students would

CO1:	Explain the concepts of Python.
CO2:	Use appropriate constructs to represent data.
CO3:	Write programs using different constructs in Python.
CO4:	Develop real world applications in image processing and networking.
CO5:	Develop various simple programs for real world application using python.

TOTAL: 45 PERIODS

TEXT BOOKS:	
1.	Python Programming for Beginners: Skyrocket Your Code and Master Python in Less than a Week. Discover the Foolproof, Practical Route to Uncover Insider Hacks, Unlock New Opportunities, and Revolution Kindle Edition by Kit Jackson (Author), 31 May 2023
2.	Introducing Python, 2nd Edition, by Bill Lubanovic, O'Reilly Media, Inc., 2019.
REFERENCES:	
1.	Python Programming for Beginners,ISBN-13-979-8870875248, Narry Prince, 2023.
2.	Python Programming, West McKinney,ISBN-13-979-8870534817,2023.
3.	Python Quick Start Guide: The Simplified Beginner's Guide to Python Programming Using Hands-On Projects and Real-World Applications, by Robert Oliver,ISBN-13-978-163610037, 2023.
4.	Mastering Python Networking: Utilize Python packages and frameworks for network automation, monitoring, cloud, and management by Eric Chou,2023.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	-	1	-	-	-	-	-	1	1	-	3	1	1	-
CO2	2	-	1	-	-	-	-	-	1	1	-	3	1	1	-
CO3	2	-	1	-	-	-	-	-	1	1	-	3	1	1	-
CO4	2	3	1	-	3	-	-	1	1	1	3	3	1	1	-
CO5	2	3	1	1	3	-	-	1	3	1	3	3	1	1	-

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

BOS CHAIRMAN HEAD – ACADEMICS PRINCIPAL

U23EN203 SDG:4	TECHNICAL ENGLISH	Category: HSMC			
		L	T	P	C
		2	0	0	2

COURSE OBJECTIVE:

1.	To improve the communicative competence of learners.
2.	To help learners use language effectively in academic /work contexts.
3.	To develop various listening strategies to comprehend various types of audio materials like lectures, discussions, videos, etc
4.	To build on students' English language skills by engaging them in listening, speaking, and grammar learning activities that are relevant to authentic contexts.
5.	To use language efficiently in expressing their opinions via various media.

UNIT 1	INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION	6

Listening -conversation: Introduction to classmates - Audio / video (formal & informal), Speaking - making telephone calls-Self Introduction; Introducing a friend; - politeness strategies.

UNIT 2	NARRATION AND SUMMATION	6

Listening - Listening to podcasts, anecdotes / stories / event narration; documentaries and interviews with celebrities. Speaking - Narrating personal experiences describing experiences and feelings- engaging in small talk- describing requirements and abilities.

UNIT 3	DESCRIPTION OF A PROCESS / PRODUCT	6

Listening - Listen to product and process descriptions; a classroom lecture; and advertisements about products. Speaking – Picture description- describing locations in workplaces- Giving instruction to use the product- explaining uses and purposes- Presenting a product.

UNIT 4	CLASSIFICATION AND RECOMMENDATIONS	6

Listening –Listening to lectures - and educational videos. Speaking – Small Talk; discussing and making plans-talking about tasks-talking about progress talking about travel preparations.

UNIT 5	EXPRESSION	6

Listening – Listening to debates/ discussions; panel discussions. Speaking –making predictions- talking about a given topic-giving opinions

LIST OF EXPERIMENTS

1. Conversation: Introduction to Classmates-Audio/video (formal & informal).
2. Self-Introduction.
3. Telephone Conversation.
4. Listening to voicemail & messages.
5. Listening and filling a form.
6. Debate.
7. Group Discussion.
8. Exchanging personal Information.

COURSE OUTCOME :

At the end of the course, students would

CO1:	To listen and comprehend general as well as complex academic information

CO2:	To listen to and understand different points of view in a discussion.
CO3:	To speak fluently and accurately in formal and informal communicative contexts.
CO4:	To describe products and processes and explain their uses and purposes clearly and accurately.
CO5:	To express their opinions effectively in both formal and informal discussions.
	TOTAL: 45 PERIODS

TEXT BOOKS:

1.	English for Engineers & Technologists, Orient Blackswan Private Ltd. Department of English, Anna University, 2020
2.	English for Science & Technology Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.
3.	A Handbook for English Language Laboratories, E. Suresh Kumar, Department of English, College of Engineering, Osmania University, P. Sreehari, Department of English, College of Engineering, Osmania University. 2011.

REFERENCES:

1.	Technical Communication – Principles And Practices By Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
2.	A Course Book on Technical English By Lakshmi Narayanan, Scitech Publications (India) Pvt. Ltd.
3.	English For Technical Communication (With CD) By Aysha Viswamohan Mcgraw Hill Education, ISBN : 0070264244.
4.	Effective Communication Skill, Kulbhusan Kumar, R S Salaria, Khanna Publishing House.
5.	Learning to Communicate – Dr. V. Chellammal, Allied Publishing House, New Delhi, 2003.
6.	A Manual For English Language Laboratory, D. Sudha Rani, Pearson Education India, 2009.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	-	-	1	2	2	2	-	3	-	-	-
CO2	-	-	-	-	-	-	-	3	3	1	-	2	-	-	-
CO3	-	-	-	-	-	-	-	2	-	2	-	3	-	-	-
CO4	-	-	-	-	-	-	2	3	3	1	-	3	-	-	-
CO5	-	-	-	-	-	-	1	3	2	1	-	3	-	-	-

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

BOS CHAIRMAN HEAD – ACADEMICS PRINCIPAL

U23MA202 SDG:4	ADVANCED CALCULUS AND STATISTICS	Category: BSC			
		L	T	P	C
		3	0	2	4

COURSE OBJECTIVE:

1.	Familiarize the student with vector calculus ideas in order to find line, surface and volume integrals in basic coordinate systems.
2.	Understand and demonstrate basic conclusions by using Gauss, Stokes and Greens theorems.
3.	Provide the required skill to apply the statistical tools in engineering problems.
4.	Learn the theory of hypothesis testing for both small as well as large samples, which is an essential skill for solving real life problems.
5.	Introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of statistical quality control.

UNIT 1	VECTOR DIFFERENTIAL CALCULUS	9

Differentiation of Vectors– Scalar and Vector Point Functions–Gradient, divergence and curl– Directional derivative–Irrotational and Solenoidal vector fields– Application: Decision Review System in Cricket and Hit Distance Using Differentiation of Vectors.

UNIT 2	VECTOR INTEGRAL CALCULUS	9

Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs). Simple applications involving cubes and rectangular parallelepipeds.

UNIT 3	CORRELATION AND LINEAR REGRESSION	9

Correlation–Karl Pearson's correlation coefficients–Spearman's Rank Correlation– Regression– Estimation of Regression line–Application: Measuring the influences between factors- Estimation of association among the variables.

UNIT 4	HYPOTHESIS TESTING	9

Small sample tests: Student t-test - Single mean and difference of two means – F Test for Variance - Chi square test for goodness of fit –Independence of attributes. Application: Performance analysis- Comparative analysis–Quality testing.

UNIT 5	DESIGN OF EXPERIMENTS	9

Analysis of Variance: One way and two –way Classifications-Completely randomized design– Randomized block design– Latin square design. Application: Response Surface Methodology.

COURSE OUTCOME :

At the end of the course, students would

CO1:	Determine the identities that link grad, div and curl in Cartesian and other basic coordinate systems.
CO2:	Apply the Gauss, Stokes and Greens theorems to stream line integral computations and demonstrate basic outcomes.
CO3:	Compute correlation between variables and use regression to predict unknown values using

	R- studio.
CO4:	Apply the idea of hypothesis testing for both small and large samples in practical problems utilizing R- studio.
CO5:	Construct the design of experiments modeling and analysis of variance using R- studio.
	TOTAL: 45 PERIODS

TEXT BOOKS:

1.	Erwin Kreyszig," Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2.	Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 41st Edition,2011.
3.	Veerarajan T., Probability, Statistics and Random Processes, Tata McGraw Hill, 3rd edition, 2008.

CO's-PO's & PSO's MAPPING

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

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

BOS CHAIRMAN HEAD – ACADEMICS PRINCIPAL

U23CS211 SDG: 4 & 8	PYTHON PROGRAMMING LAB	Category: ESC			
		L	T	P	C
		0	0	2	1

COURSE OBJECTIVE:	
1.	To understand and develop programs using Python.
2.	To use the concepts of strings, control flow, data types in python programs.
3.	To create programs using list, tuples, dictionaries, and files concept in Python.
4.	To analyze image processing, networking and object-oriented programming in Python.
5.	To create new ideas for problems in real world application using python.
LIST OF EXPERIMENTS:	
1.	Simple programs to execute the concept of python for editing, saving and handling error message.
2.	Python program using Statements and Expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3.	Scientific problems using Conditionals and Iterative loops (Number series, Number patterns, pyramid pattern).
4.	Programs for functions using python (Factorial, larger number in a list).
5.	Implementing programs using regular expressions.
6.	Program for implementing strings (reverse, palindrome).
7.	Implementingreal time application using List, Tuples (Items present in library, operations of list and tuples).
8.	Python programs for real time using file handling (Coping from one file to another, word count, longest word)
9.	Python program using image processing, networking.
10.	Python program using Oops concept.
11.	Mini Project
COURSE OUTCOMES:	
At the end of the course, students would	
CO1:	Explain the concepts of Python.

CO2:	Use appropriate constructs to represent data.
CO3:	Write programs using different constructs in Python.
CO4:	Develop real world applications in image processing and networking.
CO5:	Develop various simple programs for real world application using python.
	TOTAL: 30 PERIODS

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	2	1	1	0	0	1	0	0	0	2	1	0	0
CO2	3	3	3	1	2	0	0	1	0	0	0	2	1	3	0
CO3	2	2	3	2	3	0	0	1	1	0	1	2	1	3	0
CO4	2	2	2	3	2	1	1	1	0	0	0	2	1	0	2
CO5	1	3	2	3	2	2	1	1	2	2	1	3	1	1	0

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

BOS CHAIRMAN **HEAD – ACADEMICS** **PRINCIPAL**

U23GE212 SDG:4	ENGINEERING PRACTICES LABORATORY	Category: ESC			
		L	T	P	C
		0	0	2	1

COURSE OBJECTIVE:	
1.	Connecting various pipe fittings used in common household plumbing work; Planning; making joints in wood materials used in common household wood work.
2.	Welding various joints in steel plates using arc welding work; Machining various simple processes like turning and drilling in parts.
3.	Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work.
4.	Wiring various electrical joints in common household electrical wire work.
5.	Soldering and testing simple electronic circuits; Assembling and testing simple electronic components.
LIST OF EXPERIMENTS	
GROUP A (CIVIL & MECHANICAL)	
PART I-CIVIL ENGINEERING PRACTICES	
PLUMBING WORK:	
1.	Connecting various basic pipe fittings like valves, taps and other components which are commonly used in household.
WOOD WORK:	
2.	Planning
3.	Making T- Joint.
PART II-MECHAINICAL ENGINEERING PRACTICES	
WELDING WORK:	
4.	Welding of Butt Joints using arc welding.
5.	Practicing gas welding
BASIC MACHINING WORK:	
6.	(Simple)Turning.
7.	(Simple)Drilling.
MACHINE ASSEMBLY PRACTICE:	
8.	Study of Centrifugal pump.
9.	Study of Air conditioner.
SHEET METAL WORK:	
10.	Making of a square tray.
GROUP B (ELECTRICAL & ELECTRONICS)	
PART I- ELECTRICAL ENGINEERING PRACTICES	
1.	Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin sockets
2.	Staircase wiring.

3.	Fluorescent Lamp wiring with introduction LED types.
PART II- ELECTRONICS ENGINEERING PRACTICES	
4.	Study of Electronic components and equipments – Resistor, color coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.
5.	Soldering simple electronic circuits and checking continuity.
6.	Assembly and dismantle of LED TV.
COURSE OUTCOMES:	
At the end of the course, students would	
CO1:	Fabricate carpentry components and pipe connections including plumbing works.
CO2:	Use welding equipments to join the structures.
CO3:	Carry out the basic assembling and machining operations; Make the models using sheet metal.
CO4:	Carry out basic home electrical works and appliances and to measure the electrical quantities.
CO5:	Soldering the simple electronic circuits; Assemble the simple electronic devices.
	TOTAL: 30 PERIODS

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2	0	0	0	0	1	2	2	1	0	0	0
CO2	2	2	2	2	0	0	0	0	1	2	2	1	0	0	0
CO3	2	2	2	2	0	0	0	0	1	2	2	1	0	0	0
CO4	2	2	2	2	0	0	0	0	1	2	2	1	0	0	0
CO5	2	2	2	2	0	0	0	0	1	2	2	1	0	0	0

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

BOS CHAIRMAN **HEAD – ACADEMICS** **PRINCIPAL**

U23GE213 SDG: 4	ENGINEERING GRAPHICS LABORATORY	Category: ESC			
		L	T	P	C
		0	0	2	1

COURSE OBJECTIVE:

1.	To improve imagination skills
2.	To develop graphic skills for communication of concepts, ideas and design of Engineering products.
3.	To learn drafting & modeling packages in orthographic and isometric drawings.
4.	To train the usage of 2D and 3D modeling.
5.	To learn graphical representation of machine components.

INTRODUCTION TO CAD

Basic drawing and editing commands: line, circle, rectangle, erase, view, undo, redo, snap, object editing, moving, copying, rotating, scaling, mirroring, layers, templates, polylines, trimming, extending, stretching, fillets, arrays, dimensions. Dimensioning principles and conventional representations.

ORTHOGRAPHIC PROJECTIONS

Systems of projections, conventions and application to orthographic projections - simple objects. Lines, planes, simple solids.

ISOMETRIC PROJECTIONS

Principles of isometric projection- Isometric scale; Isometric views

1.	Introduction to Computer Aided Drafting software packages.
2.	Practice on features of a Computer Aided Drafting package.
3.	Practice Sheet -Title Block.
4.	Loci of Points.
5.	Engineering curves.
6.	Projection of Lines.
7.	Projection of Planes.
8.	Projection of Solids.
9.	Drafting of Isometric Projection.
10.	Drafting of Orthographic views of simple parts.

COURSE OUTCOME:

At the end of the course, students would

CO1:	Understand the standards and common cases as well as dimensioning in technical drawings development.
CO2:	Communicate the technical ideas in the form of drawings.
CO3:	Apply the drawing skills in representing various geometrical features.
CO4:	Develop orthographic projections and isometric views of various objects.
CO5:	Sketch simple objects and their pictorial views using CAD.

TOTAL: 30 PERIODS

TEXT BOOKS:

1. K. Venugopal, V.Prabhu Raja, Engineering Drawing + Auto Cad, New Age International

	Publishers.
2.	Kulkarni D.M, AP Rastogi and AK Sarkar, Engineering Graphics with Auto Cad, PHILearning, Eastern Economy editions.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	1	-	2	-	2	-	-	-	1	-	-	1	2	2	1
CO2	1	-	2	-	2	-	-	-	1	-	-	1	2	2	1
CO3	1	-	2	-	2	-	-	-	1	-	-	1	2	2	1
CO4	1	-	2	-	2	-	-	-	1	-	-	1	2	2	1
CO5	1	-	2	-	2	-	-	-	1	-	-	1	2	2	1

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

BOS CHAIRMAN **HEAD – ACADEMICS** **PRINCIPAL**

U23EE212 SDG:4	CAREER ENHANCEMENT TRAINING - II	Category: EEC			
		L	T	P	C
		1	0	1	1

COURSE OBJECTIVE:

This course is a part of series of 6 courses aimed at enhancing the industry readiness of the Engineering students. This series aims at honing their multiple intelligence like Numerical, Linguistic, Logical, spatial and interpersonal intelligence. This is course 2 of 6. The following are the specific objective of this module.

1.	To enhance the students' ability to contribute effectively and confidently in classrooms and other forums and there by demonstrate their skills.
2.	To further enhance and improve their communicative English for industry readiness through various speech craft activities in groups.
3.	To help students hone their numerical intelligence so that they can handle numbers efficiently and thereby reducing the time taken for performing job functions - Level II
4.	To stimulate their logical thinking skills by training them on logical reasoning and image based puzzles. – Level II
5.	To help students fine tune their proficiency in English by learning the essential grammar for real-time scenarios, improving their reading skills and enhancing their vocabulary. Level II

UNIT 1	**COURSE INTRODUCTION**	**2**
Problems on Ages – Arithmetic Reasoning - Ratio & Proportion – Alligation & Mixtures		
UNIT 2	**COMMUNICATION SKILLS II**	**12**
Mensuration 2D –Mensuration 3D – Height – Distance - Perimeter – Area – Volume		
UNIT 3	**NUMERICAL APTITUDE -II**	**8**
Permutation and Combination – Probability-Circular Permutation - Clocks and Calendars		
UNIT 4	**LOGICAL REASONING - II**	**4**
Blood Relation – Direction Sense – Seating Arrangement – Syllogism – Statement & Conclusion		
UNIT 5	**LANGUAGE GYM II– ENGLISH PROFICIENCY**	**4**
Synonyms Antonyms – Spotting Error – Sentence Correction – Change of Voice – Change of Speech – Spelling – Reading Comprehension – Select Words – Closet Test.		
		TOTAL: 30 PERIODS

COURSE OUTCOME :

At the end of the course, students would

CO1:	Students will be able to participate in any learning activity without any reservations. They shall be ready to move beyond their comfort zone to acquire new skills throughout their life
CO2:	Students shall understand and appreciate the importance of English in the current global scenario and make efforts towards up skilling the same.
CO3:	They shall demonstrate a good understanding of basic mathematical concepts required to learn engineering. To use appropriate strategies and shortcuts to improve speed and accuracy in solving aptitude problems during recruitment processes.
CO4:	Demonstrate good logical thinking and thought process in approaching various engineering concepts.
CO5:	Use the correct Grammar and Vocabulary, ensuring the enhancement their language skills and

	effective communication
	TOTAL:30 PERIODS
TEXT BOOKS:	
1.	The Pearson Guide to Quantitative Aptitude For Competitive Examinations, Dinesh Khattar. Pearson
2.	Quantitative Aptitude Dr. R.S. Aggarwal S. Chand Publication
3.	A modern Approach to Verbal and Non-Verbal Reasoning R.s. Aggarwal
REFERENCES:	
1.	Quantitative Aptitude for CAT, Arun Sharma.
2.	Fast Track Objective Arithmetic, Rajesh Verma, Arihant Publication.
3.	Quantitative Aptitude Quantum CAT Common Admission Tests for Admission into IIMs, Sarvesh K. Verma.
4.	Wiley's Exam Expert Quantitative Ability for CAT, 2ed, Ashu Jain.

CO's-PO's & PSO's MAPPING

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

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

BOS CHAIRMAN **HEAD – ACADEMICS** **PRINCIPAL**

SEMESTER III

U23MA309 SDG:9	DISCRETE MATHEMATICS FOR COMPUTING	Category: BSC			
		L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

1.	To build problem solving skills by enhancing students logical and mathematical maturity.
2.	To acquire the knowledge of combinatorics.
3.	To gain the knowledge of graph theory and to solve the practical problems.
4.	To familiarize the applications of algebraic structures.
5.	To Understand the basic concepts in sets and relations.

UNIT 1	LOGIC	9

Truth Tables, Tautology and Contradiction - Logical Equivalence: The Laws of Logic, Logical Implication, - Disjunctive and Conjunctive Normal Form. Application: Knowledge representation in artificial intelligence using Basic Connectives.

UNIT 2	COMBINATORICS	9

Mathematical induction – Strong induction and well ordering – The basics of counting – Permutations and combinations – Recurrence relations - Solving linear recurrence relations. Application : Pigeon hole principle.

UNIT 3	GRAPH THEORY	9

Graphs and graph models – Graph terminology and special type of graph – Matrix representation of graphs and graph isomorphism – Degree, Connectivity – Path – Cycle – Sub Graph, Isomorphism – Eulerian and Hamiltonian paths and circuits. Application: Map for Online Food Delivery System

UNIT 4	ALGEBRAIC STRUCTURES	9

Algebraic systems – Semi groups and monoids – Groups – Subgroups – Normal subgroup and cosets – Lagrange's theorem. Application: Error detection and encoding functions.

UNIT 5	SET THEORY AND LATTICES	9

Set theory – Operations and Laws of Sets - Cartesian Product, Binary Relation - Equivalence Relation - Partial ordering – Poset – Lattices as Posets – Hasse diagram. Application: Vehicle Model Catalogue.

COURSE OUTCOME :

At the end of the course, students would

CO1:	Solve the problems using the concepts of sets, Truth Tables, counting techniques, properties of algebraic structures and graph network techniques to solve engineering problems.
CO2:	Comprehend the concepts needed to test the relations, laws of logic, Strong induction, Groups and Properties of Graphs.
CO3:	Demonstrate the knowledge in functions, Logical Implication, Mathematical induction, Subgroups and Graph Coloring.
CO4:	Analyze the concepts and Poset, Normal Form , Permutations and combinations, Normal subgroup

	and Eulerian and Hamiltonian paths and circuits.
CO5:	Apply and Analyze Hasse diagram, Rules of Inference, linear recurrence relations, Lagrange's theorem and Matrices of Graph Isomorphism.
	TOTAL: 60 PERIODS

TEXT BOOKS:

1.	Rosen. K.H., "Discrete Mathematics and its Applications", 7th Edition, Tata McGraw Hill Pub. Co. Ltd., New Delhi, Special Indian Edition, 2017.
2.	Tremblay. J.P. and Manohar. R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub. Co. Ltd, New Delhi, 30th Reprint, 2011.
3.	Venkatraman M.K, Sridharan. N and Chandrasekaran N. Discrete Mathematics, The National Publishing Company, Chennai, Fourth edition, 2014.

REFERENCES:

1.	Grimaldi. R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", 5th Edition, Pearson Education Asia, Delhi, 2013.
2.	Lipschutz. S. and Mark Lipson., "Discrete Mathematics", Schaum's Outlines, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 3rd Edition, 2010.
3.	Koshy. T. "Discrete Mathematics with Applications", Elsevier Publications, 2006.
4.	Kenneth. H. Rosen, Discrete Mathematics and its Applications, Tata McGraw Hill P.Co, New Delhi, Seventh Edition, 2014.
5.	Bernard Kolman, Robert C. Busby, Sharan Cutler Ross, Discrete Mathematical Structures, Pearson Education Pvt Ltd ,New Delhi, Sixth Edition, 2013.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	3	3	3	1	-	-	-	-	-	-	-	-	-	-
CO 2	3	3	3	1	-	-	-	-	-	-	-	-	-	-
CO 3	3	3	3	1	-	-	-	-	-	-	-	-	-	-
CO 4	3	3	3	1	-	-	-	-	-	-	-	-	-	-
CO 5	3	3	3	1	-	-	-	-	-	-	-	-	-	-

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

BOS CHAIRMAN HEAD – ACADEMICS PRINCIPAL

U23CS301 SDG:4	DATA STRUCTURES AND ALGORITHMS	Category: PCC			
		3	1	0	4

COURSE OBJECTIVE:

1.	To introduce and learn about the concepts of linear data structures.
2.	To introduce and learn about the concept of non-linear data structures.
3.	To learn about the concepts of the graph and graph traversal structures.
4.	To understand the concept of sorting and searching.
5.	To get exposure on various algorithm design and analysis techniques.

UNIT 1	LINEAR DATA STRUCTURE	9+3

Abstract Data types (ADT) - List ADT - Array based implantation - Linked Lists implementation - Singly Linked Lists - Doubly Linked Lists - Stacks ADT : Operations - Application of stack - Queues ADT : Operations - Circular Queue - Applications of Queues.

UNIT 2	NON LINEAR DATA STRUCTURE : TREES	9+3

Tree ADT – Tree Traversal: In-order, Pre-order, Post order – Binary Search Tree ADT – Application of Trees : AVL Trees – B+ trees – B- Trees – Heap Data structure : Operations – Binary heap

UNIT 3	GRAPH ALGORITHMS	9+3

Graph: Terminologies – Representation of Graph - Graph traversal – Breadth-first traversal – Depth-first traversal - Topological sort – Shortest path algorithm - Dijkstra's algorithm- Minimum Spanning Tree Algorithm: Prim's , Kruskal algorithm

UNIT 4	SORTING AND SEARCHING ALGORITHMS	9+3

Searching – Types of Searching : Linear Search , Binary Search – Sorting : Insertion Sort – Selection Sort – Bubble Sort – Quick Sort – Analysis and Comparison of Sorting Algorithms – Hashing: Hash table – Hash functions –Resolving Collision Techniques: Separate chaining – Open addressing – Rehashing – Extendible Hashing

UNIT 5	FUNDAMENTALS OF ALGORITHMS AND ITS ANALYSIS	9+3

Algorithm, Notation of Algorithm, Performance Analysis of Algorithm : Space complexity,Time complexity, Asymptotic Notation - Big (O) Notation, Omega Notation, Theta Notation and Little (o) notation, Recurrences, Probabilistic Analysis, Disjoint Set Operations, Union And Find Algorithms, Amortized Analysis

COURSE OUTCOME :

At the end of the course, students would

CO1:	Design and implement linear data structures, such as lists, queues, and stacks, according to the needs of different applications.
CO2:	Design and analyze tree structures and Heap.
CO3:	Apply graph algorithms to solve problems and analyze their efficiency.
CO4:	Critically analyze and implement various searching, sorting algorithms with its competence
CO5:	Analyze the performance of algorithms, time and space complexity of algorithms

TOTAL: 60 PERIODS

TEXT BOOKS:	
1.	"Data Structures and Algorithm Analysis in C++" by Mark Allen Weiss (4th Edition, 2020)
2.	"Data Structures And Algorithms In C++" by Michael T. Goodrich (2nd Edition, 2011)
REFERENCES:	
1.	Data structures using C++" by Patil, Varsha H(2nd Edition, 2012)
2.	"Problem Solving with Algorithms and Data Structures Using C++" by Bradley N. Miller and David L. Ranum (2nd Edition, 2010)

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	1	2	1	-	-	-	1	-	2	3	2	1	1
CO2	1	2	1	2	2	-	-	-	2	-	2	2	2	2	2
CO3	2	3	1	2	3	-	-	-	2	-	1	2	2	1	1
CO4	1	2	1	2	1	-	-	-	1	-	2	3	2	2	2
CO5	2	1	-	1	1	-	-	-	1	-	2	3	2	3	2

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

BOS CHAIRMAN HEAD – ACADEMICS PRINCIPAL

U23CS302 SDG:4	OBJECT ORIENTED PROGRAMMING USING JAVA	Category: PCC			
		L	T	P	C
		3	0	0	0

COURSE OBJECTIVE:

1.	To understand and develop programs using Java, leveraging object-oriented programming principles.
2.	To create and manage Java programs utilizing constructors, destructors, member functions, static members, and nested classes.
3.	To use the concepts of classes, objects, inheritance, polymorphism, and function overloading in Java programs.
4.	To handle exceptions and implement multithreading in Java for efficient and robust application development.
5.	To perform file operations and implement networking using Java, applying relevant classes and techniques for real-world applications.

UNIT 1	INTRODUCTION TO OOPS AND JAVA	5

Introduction to Java and OOP - Key Concepts of OOP - Advantages of OOP - Java Basics - Control Structures – Array.

UNIT 2	CLASSES AND OBJECTS	8

Defining Classes and Objects - Access Specifiers and Modifiers - Defining Member – Functions - Static Members and Methods - Constructors and Destructors - Inline Methods and Nested Classes - Object Assignment and Management - Arrays of Objects - Passing Objects to Methods - Returning Objects from Methods.

UNIT 3	INHERITANCE AND OVERLOADING	10

Inheritance: Introduction, purpose and benefits - Single Inheritance, Multilevel Inheritance, Hierarchical Inheritance, Multiple Inheritance using Interface and Hybrid Inheritance - Method Overriding - Use of 'super' keyword. **Polymorphism:** Concept and Runtime polymorphism - Abstract Classes and Methods - Use of 'final' keyword - Protected Members - use of 'protected' keyword - Type Casting in Inheritance – Interfaces. **Function Overloading:** Introduction, Syntax and Rules - Difference between overloading and overriding - Automatic Type Conversion - Overloading in Inheritance.

UNIT 4	EXCEPTION HANDLING AND MULTITHREADING	11

Exception Handling: Definition and Purpose - Checked Exceptions - Unchecked Exceptions - Errors - Throwable, Exception, and Error classes - try-catch Blocks - Multiple catch blocks - finally Block - Nested try-catch - Common Java Exceptions – User defined Exceptions. **Java Multithreading:** Introduction - Processes vs. Threads - Creating Threads - Extending 'Thread' class - Implementing 'Runnable' interface – 'synchronized' keyword - Locks and monitors - Thread Lifecycle.

UNIT 5	FILES AND JAVA NETWORKING	11

Working with Files: Input Stream, Output Stream, Reader, Writer - Creating, deleting, and inspecting file properties - Reading from and writing to text files - Renaming, moving, and copying files using Files class - EOF Detection - Updating a File - Command Line Arguments Handling. **Networking with Java:** TCP Sockets - Using 'ServerSocket' and 'Socket' classes - UDP Sockets - Using 'Datagram Socket' and 'Datagram Packet' - Networking Utilities - Using 'InetAddress' class.	
COURSE OUTCOME :	
At the end of the course, students would	
CO1:	Explain the fundamental concepts of Object-Oriented Programming and Java, including key OOP principles and Java basics.
CO2:	Use appropriate Java constructs such as classes, objects, to represent and manage data.
CO3:	Write Java programs incorporating control structures, arrays, inheritance, and polymorphism to solve complex problems.
CO4:	Handle exceptions and implement exception handling, and multithreading in Java to develop efficient and robust applications.
CO5:	Perform file operations and implement networking using Java to create practical, real-world applications.
	TOTAL: 45 PERIODS

TEXT BOOKS:	
1.	Java: The Complete Reference, Herbert Schildt, McGraw Hill Education, 12th Edition 2022
2.	Java How to Program, Early Objects, Harvey Deitel & Paul J. Deitel, Pearson, 11th Edition, 2018
3.	Head First Java, Kathy Sierra, Bert Bates, Trisha Gee, O'Reilly Media, Inc. 3rd Edition, May 2022
4.	Effective Java, Joshua Bloch, Addison-Wesley Professional, 3rd Edition, December 2017

REFERENCES:	
1.	Java Programming: From Beginner to Expert - Durdana Siddiqui, 2022.
2.	Learning Java - Marc Loy & Patrick Niemeyer & Daniel Leuck, 6th Edition O'Reilly Media, September 2023.
3.	Java Network Programming - Elliotte Rusty Harold, 4th Edition, O'Reilly Media, 2013.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	-	2	-	-	-	-	-	-	2	2	-	-
CO2	3	2	2	-	3	-	-	-	-	-	-	3	3	-	-
CO3	3	2	1	-	2	-	-	-	-	-	-	2	2	-	-
CO4	3	3	3	-	3	-	-	-	-	-	-	3	3	-	-
CO5	3	3	3	-	3	-	-	-	-	-	-	3	3	-	-

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23CS305 SDG:4	DIGITAL PRINCIPLES AND COMPUTER ORGANAIZATION	Category: ESC			
		3	0	0	3

COURSE OBJECTIVE:

1.	To introduce the fundamental concepts, design techniques, and applications of combinational and sequential logic circuits.
2.	To develop an understanding of computer architecture, instruction set architecture, and the functioning of hardware instructions and addressing modes.
3.	To impart knowledge of control unit design, instruction execution, and pipelining organization in modern computer systems.
4.	To explain memory hierarchy, cache and virtual memory management, and I/O mechanisms including DMA, interrupts, and interconnection standards.
5.	To provide the foundation for analyzing, designing, and optimizing digital systems for efficiency, performance, and trade-offs in real-world applications

UNIT 1	COMBINATIONAL LOGIC	9+3

Combinational Circuits – Karnaugh Map - Analysis and Design Procedures – Binary Adder – Subtractor – Decimal Adder - Magnitude Comparator – Decoder – Encoder – Multiplexers - Demultiplexers

UNIT 2	SYNCHRONOUS SEQUENTIAL LOGIC	9+3

Introduction to Sequential Circuits – Flip-Flops – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design – Moore/Mealy models, state minimization, state assignment, circuit implementation - Registers – Counters.

UNIT 3	COMPUTER FUNDAMENTALS	9+3

Functional Units of a Digital Computer: Von Neumann Architecture – Operation and Operands of Computer Hardware Instruction – Instruction Set Architecture (ISA): Memory Location, Address and Operation – Instruction and Instruction Sequencing – Addressing Modes, Encoding of Machine Instruction – Interaction between Assembly and High Level Language

UNIT 4	PROCESSOR	9+3

Instruction Execution – Building a Data Path – Designing a Control Unit – Hardwired Control, Microprogrammed Control – Pipelining – Data Hazard – Control Hazards

UNIT 5	MEMORY AND I/O	9+3

Memory Concepts and Hierarchy – Memory Management – Cache Memories: Mapping and Replacement Techniques – Virtual Memory – DMA – I/O – Accessing I/O: Parallel and Serial Interface – Interrupt I/O – Interconnection Standards: USB, SATA

COURSE OUTCOME :

At the end of the course, students would

CO1:	Recall and describe the fundamental concepts and operations of combinational and sequential circuits, including adders, comparators, decoders, encoders, multiplexers, demultiplexers, and flip-flops, and relate them to basic computer functional units and instruction operations.
CO2:	Explain the principles of computer architecture, instruction set architecture, instruction sequencing

	and the interaction between assembly and high-level languages
CO3:	Apply design procedures to implement registers, counters, data paths, and control units using hardwired and microprogrammed approaches
CO4:	Analyze Moore and Mealy models, state minimization, instruction sequencing, pipelining issues, hazards, and cache mapping techniques to assess overall system design efficiency and correctness.
CO5:	Evaluate memory management strategies, cache replacement policies, virtual memory, DMA vs. interrupt-driven I/O and interconnection standards for performance and trade-offs.
	TOTAL: 60 PERIODS

TEXT BOOKS:

1.	M. Morris Mano, Michael D. Ciletti, "Digital Design : With an Introduction to the Verilog HDL, VHDL, and System Verilog", Sixth Edition, Pearson Education, 2018
2.	David A. Patterson, John L. Hennessy, "Computer Organization and Design, The Hardware/Software Interface", Sixth Edition, Morgan Kaufmann/Elsevier, 2020

REFERENCES:

1.	M. Morris Mano, "Digital Logic and Computer Design", Pearson Education, 2016
2.	William Stallings, "Computer Organization and Architecture – Designing for Performance", Tenth Edition, Pearson Education, 2016

WEB RESOURCES:

	https://archive.nptel.ac.in/courses/108/105/108105132/
	https://nptel.ac.in/courses/117105078

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	-	-	-	-	-	-	-	1	-	1	1	-	-
CO2	3	-	2	-	-	-	-	-	-	1	-	1	-	1	-
CO3	3	-	2	-	-	-	-	-	-	1	-	1	-	-	1
CO4	3	2	-	-	-	-	-	-	-	1	-	1	-	-	-
CO5	3	2	-	-	-	-	-	-	-	3	-	1	1	-	-

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23CS304 SDG:4	FOUNDATIONS OF DATA SCIENCE	Category: PCC			
		3	0	2	4

COURSE OBJECTIVE:

1.	To understand the data science fundamentals and process.
2.	To learn to describe the data for the data science process.
3.	To learn to describe the relationship between data.
4.	To utilize the Python libraries for Data Wrangling.
5.	To present and interpret data using visualization libraries in Python.

UNIT 1	INTRODUCTION	9

Data Science: What is Data Science - Benefits and uses - Data Science Process: Overview – Defining research goals – Retrieving data – Data preparation - Exploratory Data analysis – building the model – Prerequisites for a Data Scientist - Tools and Skills required - presenting findings and building applications – Basics of NumPy Array.

UNIT 2	DESCRIBING DATA	9

Types of Data - Types of Variables - Describing Data with Tables and Graphs – Describing Data with Averages - Describing Variability - Normal Distributions and Standard (z) Scores, Basics – Pandas data frames. Case Study: Population (Sample Size Estimating the statistics of given population).

UNIT 3	DESCRIBING RELATIONSHIPS	9

Correlation – Scatter plots – correlation coefficient for quantitative data – computational formula for correlation coefficient – Regression – regression line – least squares regression line – Standard error of estimate – interpretation of r2 – multiple regression equations – regression towards the mean. Case Study: Prediction Regression Methodologies with example.

UNIT 4	PYTHON LIBRARIES FOR DATA WRANGLING	9

Python for Data Science – Python Libraries – Data Frame Manipulation with numpy and pandas – Exploration Data Analysis – Time Series Dataset – Clustering with Python – Dimensionality Reduction. Python integrated Development Environments (IDE) for Data Science.

UNIT 5	DATA VISUALIZATION	9

Importing Matplotlib – Line plots – Scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three-dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn. Case Study: Graph of Sine and Cosine function.

PRACTICAL EXERCISES:

1. Download, install and explore the features of NumPy, SciPy, Jupyter, Stats models and Pandas packages.
2. Working with Numpy arrays
3. Working with Pandas data frames
4. Reading data from text files, Excel and the web and exploring various commands for doing descriptive analytics on the Iris data set.
5. Use the diabetes data set from UCI and Pima Indians Diabetes data set for performing the following:
    a. Univariate analysis: Frequency, Mean, Median, Mode, Variance,

Standard Deviation, Skewness and Kurtosis.

b. Bivariate analysis: Linear and logistic regression modeling

c. Multiple Regression analysis.

d. Also compare the results of the above analysis for the two data sets.

6. Apply and explore various plotting functions on UCI data sets.
   a. Normal curves
   b. Density and contour plots
   c. Correlation and scatter plots
   d. Histograms
   e. Three-dimensional plotting
7. Visualizing Geographic Data with Base map.

COURSE OUTCOME :

At the end of the course, students would

CO1:	Define the data science process.
CO2:	Understand different types of data descriptions for data science process.
CO3:	Gain knowledge on relationships between data.
CO4:	Use the Python Libraries for Data Wrangling.
CO5:	Apply visualization Libraries in Python to interpret and explore data.
	TOTAL: 75 PERIODS

TEXT BOOKS:

1.	David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016. (Unit I)
2.	Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017. (Units II and III)
3.	Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016. (Units IV and V)

REFERENCES:

1.	Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, 2014.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	1	2	2	-	-	-	1	1	1	2	2	2	1
CO2	2	1	-	1	1	-	-	-	2	1	1	2	2	1	-
CO3	2	2	1	2	2	1	1	-	1	2	1	3	2	2	1
CO4	3	2	2	1	2	-	-	-	1	1	2	2	3	2	2
CO5	2	2	1	2	2	-	-	-	1	1	1	2	2	2	1

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23CS311 SDG: 4 & 8	DATA STRUCTURES LABORATORY	Category: PCC			
		L	T	P	C
		0	0	2	1

COURSE OBJECTIVE:

1.	To introduce and learn about the concepts of linear data structures.
2.	To introduce and learn about the concept of non-linear data structures.
3.	To learn about the concept of the graph traversal structures.
4.	To understand the concept of sorting and searching.
5.	To get exposure on various algorithm design and analysis techniques.

LIST OF EXPERIMENTS:

1.	Stack implementations.
2.	Queue implementations.
3.	Singly linked list implementations.
4.	Binary search tree implementations.
5.	Breath first search implementation.
6.	Depth first search implementation.
7.	Selection sort implementation.
8.	Bubble sort implementation.
9.	Insertion sort implementation.
10.	Binary and Linear Search Implementations.
11.	Mini Project.

COURSE OUTCOMES:

At the end of the course, students would

CO1:	Design and implement linear data structures, such as lists, queues, and stacks, according to the needs of different applications.
CO2:	Design and analyze tree structures and Heap.
CO3:	Apply graph algorithms to solve problems and analyze their efficiency.
CO4:	Critically analyze and implement various searching, sorting algorithms with its competence.
CO5:	Analyze the performance of algorithms, time and space complexity of algorithms.

TOTAL: 30 PERIODS

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	1	2	1	-	-	-	1	-	2	3	2	3	1
CO2	1	2	1	2	2	-	-	-	2	-	2	2	1	2	1
CO3	2	3	1	2	3	-	-	-	2	-	1	2	2	3	1
CO4	1	2	1	2	1	-	-	-	1	-	2	3	1	2	1
CO5	2	1	-	1	1	-	-	-	1	-	2	3	2	1	-

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23CS312 SDG: 4 & 8	JAVA PROGRAMMING LAB	Category: PCC			
		L	T	P	C
		0	0	2	1

COURSE OBJECTIVE:	
1.	To understand and develop programs using Java, leveraging object-oriented programming principles
2.	To create and manage Java programs utilizing constructors, destructors, member functions, static members, and nested classes.
3.	To use the concepts of classes, objects, inheritance, polymorphism, and function overloading in Java programs.
4.	To handle exceptions and implement multithreading in Java for efficient and robust application development.
5.	To perform file operations and implement networking using Java, applying relevant classes and techniques for real-world applications.
LIST OF EXPERIMENTS:	
1.	Simple program to experiment branching statements.
2.	Simple program to experiment looping statements.
3.	Simple program that implements array.
4.	Simple program to implement classes and objects.
5.	Java program that implements inheritance.
6.	Java program that implements overloading.
7.	Java program to handle exceptions.
8.	Java program to implement multithreading.
9.	Java program to perform file operations.
10.	Java program to demonstrate basic networking using TCP sockets.
11.	Mini Project.
COURSE OUTCOMES:	
At the end of the course, students would	
CO1:	Explain the fundamental concepts of Object-Oriented Programming and Java, including key OOP principles and Java basics.

CO2:	Use appropriate Java constructs such as classes, objects, to represent and manage data.
CO3:	Write Java programs incorporating control structures, arrays, inheritance, and polymorphism to solve complex problems.
CO4:	Handle exceptions and implement exception handling, and multithreading in Java to develop efficient and robust applications.
CO5:	Perform file operations and implement networking using Java to create practical, real-world applications.
	TOTAL: 30 PERIODS

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	2	1	1		2	-	-	-	-	1	-	-	3	-	2
CO2	2	1	1	1	2	-	-	-	-	1	-	-	3	-	2
CO3	2	1	1	1	2	-	-	-	-	1	-	-	3	-	2
CO4	2	1	1	1	2	-	-	-	-	1	-	-	3	-	2
CO5	2	1	1	1	2	-	-	-	-	1	-	-	3	-	2

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23EE313 SDG:8 & 17	APTITUDE & COMMUNICATION FOR ENGINEERS - I	Category: EEC			
		L	T	P	C
		0	0	2	1

COURSE OBJECTIVE:

1.	To create an awareness regarding the internal inhibitions that prevents the students from opening out in classrooms and other forums and there by overcoming the shyness to perform.
2.	To make students understand the importance of English as a global language and train them for simple English communication through various speech craft activities and improve their communicative English for industry readiness.
3.	To develop an awareness about making a conscious effort towards avoiding errors in daily communication.
4.	To train students on clearing various placement papers with greater accuracy.

UNIT 1	**INTRODUCTION**	**3**
Introduction about the Course - Learning expectations - Communication pre-assessment		
UNIT 2	**SPEAKING SKILLS - NOVICE**	**6**
Communication skills – Shy barrier - Importance of English - Challenges faced in English communication - Developing a globally comprehensible accent - Speech Craft - Public Speaking – Squabble.		
UNIT 3	**SPEAKING SKILLS - INTERMEDIATE**	**6**
Speech Craft – for and against – Debate (Ship Wreck Activity)		
UNIT 4	**LANGUAGE GYM - I**	**6**
Tenses for various communication scenarios – Common errors in daily communication – Thought Group reading – Passage writing.		
UNIT 5	**APTITUDE FOR PLACEMENTS - I**	**9**
Placement Paper 1 – HCF & LCM, Problems on Numbers - Placement Paper 2 – Average, Simplification - Placement Paper 3 - Percentage, Simple & compound Interest - Placement Paper 4 – Time & Distance - Placement Paper 5 - Trains & Boats, Placement Paper 6 – Time & Work, Pipes & Cistern.		

COURSE OUTCOME :

At the end of the course, students would

CO1:	Students will be able to participate in any learning activity without any reservations. They shall be ready to move beyond their comfort zone to acquire new skills throughout their life.
CO2:	Students shall understand and appreciate the importance of English in the current global scenario and make efforts towards up skilling the same.
CO3:	Students shall be able to present their view and standpoints in any scenarios confidently.
CO4:	Use the correct Grammar and Vocabulary, ensuring the enhancement their language skills and effective communication.
CO5:	To use appropriate strategies and shortcuts to improve speed and accuracy in solving aptitude

	problems during recruitment processes.
	TOTAL: 45 PERIODS

TEXT BOOKS:	
1.	The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Dinesh Khattar. Pearson.
2.	Quantitative Aptitude, Dr. R.S. Aggarwal, S. Chand Publication.
3.	A Modern Approach to Verbal and Non-Verbal Reasoning, R.S. Aggarwal.
REFERENCES:	
1.	Quantitative Aptitude for CAT, Arun Sharma.
2.	Fast Track Objective Arithmetic, Rajesh Verma, Arihant Publication.
3.	Quantitative Aptitude Quantum CAT Common Admission Tests for Admission into IIMs, Sarvesh K. Verma.
4.	Wiley's Exam Xpert Quantitative Ability for CAT, 2ed, Ashu Jain.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	-	-	-	-	-	-	1	-	3	-	-	-	-	-
CO2	1	-	-	-	-	-	-	1	-	3	-	-	-	-	-
CO3	1	-	-	-	-	-	-	1	-	3	-	-	-	-	-
CO4	1	-	-	-	-	-	-	1	-	3	-	-	-	-	-
CO5	3	-	-	-	-	-	-	1	1	-	-	-	-	-	-

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23MC302 SDG:3,4 & 8	UNIVERSAL HUMAN VALUES	Category: MC			
		L	T	P	C
		2	0	0	0

COURSE OBJECTIVE:

1.	To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2.	To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3.	To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

UNIT 1	INTRODUCTION TO VALUE EDUCATION	6

Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) - Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations.

UNIT 2	HARMONY IN THE HUMAN BEING	6

Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health.

UNIT 3	HARMONY IN THE FAMILY AND SOCIETY	6

Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order.

UNIT 4	HARMONY IN THE NATURE/EXISTENCE	6

Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence.

UNIT 5	IMPLICATIONS OF THE HOLISTIC UNDERSTANDING – A LOOK AT PROFESSIONAL ETHICS	6

Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models - Typical Case Studies, Strategies for Transition towards Value-based Life and Profession.

COURSE OUTCOME :

At the end of the course, students would	
CO1:	To become more aware of themselves, and their surroundings (family, society, nature).
CO2:	To become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
CO3:	To have better critical ability.
CO4:	To become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
CO5:	To apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.
	TOTAL: 30 PERIODS

TEXT BOOKS:	
1.	(The Textbook) A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-[…]
2.	(The Teacher's Manual) Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G […]
REFERENCES:	
1.	Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2.	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3.	The Story of Stuff (Book).
4.	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.
5.	Small is Beautiful - E. F Schumacher.
6.	Slow is Beautiful - Cecile Andrews.
7.	Economy of Permanence - J C Kumarappa.
8.	Bharat Mein Angreji Raj – Pandit Sunderlal.
9.	Rediscovering India - by Dharampal.
10.	Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi.
11.	India Wins Freedom - Maulana Abdul Kalam Azad.
12.	Vivekananda - Romain Rolland (English).
13.	Gandhi - Romain Rolland (English).
14.	Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991.
15.	Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
16.	A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
17.	P L Dhar, R R Gaur, 1990, Science and Humanism, Commonwealth Publishers.
18.	A N Tripathy, 2003, Human Values, New Age International Publishers.
19.	Subhas Palekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) Krishi Tantra Shodh, Amravati.
20.	E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press.

21.	M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
22.	B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
23.	B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	1	1	1	1	3	3	0	0	1	1	3	2	1	1
CO2	1	1	1	1	1	2	0	2	0	1	1	3	2	1	2
CO3	1	1	1	1	1	0	2	0	0	1	1	3	2	2	1
CO4	1	1	1	1	1	3	3	3	0	1	1	3	2	3	1
CO5	1	1	1	1	1	3	3	3	0	1	1	3	2	1	2

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

SEMESTER IV

U23MA410 SDG:4	LINEAR ALGEBRA AND NUMBER THEORY	Category: BSC			
		L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

1.	To understand the nature of the equation AX = B.
2.	To understand postulates of vector spaces and linear transformations.
3.	To comprehend the ideas behind inner product spaces.
4.	To gain knowledge on division algorithm and fundamental theorem of arithmetic.
5.	To solve Diophantine equations.

UNIT 1	AX = B AND THE FOUR SUBSPACES	9+3
The Geometry of Linear equations: Linear combination – Dependence and Independence vectors – Basis and Dimension – Rank of a matrix – Elimination and Solving Ax = b in matrices: Gauss Elimination method – Gauss Jordan method – Inverse of a matrix using Gauss Jordan method.		
UNIT 2	**VECTOR SPACES**	**9+3**
Vector spaces – Subspaces – Linear combination, span, linear independence and dependence – Null space, Column space and row space – Basis and dimension of a vector space – Rank and nullity. Application: Digital Image Enhancement Using Transformations.		
UNIT 3	**INNER PRODUCT SPACES**	**9+3**
Inner product, length, angle and orthogonality – orthogonal sets – orthogonal projections – Inner product spaces – orthonormal basis; Gram-Schmidt process. Application: Designing the Movement of Robotic Arms.		
UNIT 4	**DIVISIBILITY THEORY AND CANONICAL DECOMPOSITIONS**	**9+3**
Division algorithm — Base – b representations — Number patterns — Prime and composite numbers — GCD — Euclidean algorithm — Fundamental theorem of arithmetic — LCM.		
UNIT 5	**DIOPHANTINE EQUATIONS AND CONGRUENCES**	**9+3**
Linear Diophantine equations — Congruences — Linear Congruences — Applications: Divisibility tests — Modular exponentiation — Chinese remainder theorem — 2 x 2 linear systems.		

COURSE OUTCOME :

At the end of the course, students would

CO1:	Explain the fundamental concepts of linear equations, vector spaces, inner product spaces, divisibility theory, Diophantine equations, and congruences.
CO2:	Interpret the geometric and algebraic significance of matrices, subspaces, orthogonality, rank and nullity, divisibility properties, and modular arithmetic.
CO3:	Apply matrix methods and vector space concepts to solve systems of linear equations and related mathematical problems.
CO4:	Apply orthogonalization techniques and number theoretic algorithms such as the Euclidean

	algorithm and modular arithmetic to solve problems.
CO5:	Apply appropriate linear algebra and number theory techniques to solve mathematical problems involving linear systems, vector space structures, orthogonality, divisibility, and congruences.
	TOTAL: 60 PERIODS

TEXT BOOKS:

1.	Steven J. Leon, "Linear Algebra with Applications", Ninth Edition, Pearson, 2015.
2.	Gilbert Strang, Linear Algebra, 5th Edition, ANE Books, 2016.
3.	Koshy. T, "Elementary Number Theory with Applications", Elsevier Publications, New Delhi, Second Edition, 2007.

REFERENCES:

1.	Friedberg, A.H., Insel, A.J. and Spence, L., "Linear Algebra", Prentice Hall of India, New Delhi, 2004.
2.	David C. Lay, "Linear Algebra and Its Applications", 5th Edition, 2015.
3.	Kumaresan, S., "Linear Algebra – A Geometric Approach", Prentice-Hall of India, New Delhi, Reprint, 2010.
4.	Bernard Kolman, Robert C. Busby, Sharan Cutler Ross, "Discrete Mathematical Structures", Sixth Edition, Pearson Education Pvt Ltd., New Delhi, 2017.
5.	Ralph P. Grimaldi, "Discrete and Combinatorial Mathematics: An Applied Introduction", Fifth Edition, Pearson Education Asia, New Delhi, 2019.

CO's-PO's & PSO's MAPPING

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

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23CB401 SDG:4	DESIGN OF ALGORITHMS	Category: PCC			
		L	T	P	C
		3	0	0	4

COURSE OBJECTIVE:

1.	To learn strategic approaches like brute force and greedy methods.
2.	To learn optimization and sequencing problems using dynamic programming techniques.
3.	To learn branch and bound strategies to solve optimization problems such as TSP and assignment.
4.	To learn backtracking techniques to solve constraint problems like 8-queens and subset sum.
5.	To understand the limits of efficient computation.

UNIT 1	Brute Force and Greedy Methods	9

Brute-Force: String Matching - Greedy: General Method - Huffman Codes - Knapsack Problem - Task Scheduling - Optimal Merge Pattern – Randomized Design Paradigm.

UNIT 2	Divide & Conquer and Dynamic Programming	9

Divide & Conquer: Convex Hull - Matrix Chain Multiplication – Dynamic Programming: Longest Common Subsequence - Warshall's Transitive Closure - Floyd's All Pairs Shortest Path Algorithm - 0/1 Knapsack - Optimal Binary Search Tree.

UNIT 3	Branch-and-Bound Algorithms	9

Branch-and-Bound: Introduction and Framework – Components - Node selection strategies (FIFO, LIFO, and LC) - Travelling Salesman Problem - Assignment problem.

UNIT 4	Backtracking Algorithms	9

Introduction to Backtracking - State space tree – Sum of Subsets: Problem formulation - Memory management - 8-Queens Problem - Resource allocation using Bin-packing.

UNIT 5	Class P and NP	9

Computability of Algorithms - Computability class P: Strassen's algorithm - Simplex algorithm - Class NP: NP-hardness and NP-completeness - Approximation algorithms.

COURSE OUTCOME :

At the end of the course, students would

CO1:	Develop effective algorithms by employing strategic approaches like brute force and greedy methods.
CO2:	Develop optimized solutions for optimization and sequencing problems using dynamic programming techniques.
CO3:	Apply branch and bound strategies to solve optimization problems such as TSP and assignment.
CO4:	Apply backtracking techniques to solve constraint problems like 8-queens and subset sum.
CO5:	To evaluate the computation through the study of classes P and NP, NP-hardness/NP-completeness, and approximation algorithms for intractable problems.

	THEORY: 45 PERIODS
TEXT BOOKS:	
1.	Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein (2022), Introduction to Algorithms (4th Edition), MIT Press, ISBN: 978-0262046305
2.	Udi Manber, "Algorithms - A Creative Approach", Addison-Wesley, 3rd Edition, ISBN: 0201120372, 9780201120370.
REFERENCES:	
1.	Skiena, Steven S (2020), "The Algorithm Design Manual" (3rd Edition), Springer.
2.	Eva Tardos, Jon Kleinberg (2014), Algorithm Design (1st Edition), Pearson Education, ISBN: 9789332518643.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	2	1	2	–	–	–	1	1	–	1	1	1
CO2	3	3	2	2	2	–	–	–	1	1	–	1	1	1
CO3	2	3	3	2	2	–	–	–	1	1	1	1	1	1
CO4	2	3	2	2	2	–	–	–	1	1	–	1	1	1
CO5	3	3	1	2	1	–	–	–	–	1	–	–	–	2

U23CB402 SDG:4	INTRODUCTION TO SECURE OPERATING SYSTEMS	Category: PCC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

1.	To understand the basic concepts of Operating Systems.
2.	To explore the process management concepts including scheduling, synchronization, threads and deadlock.
3.	To understand the memory, file and I/O management activities of OS.
4.	To understand the requirements of a trust model.
5.	To learn how security is implemented in various operating systems.

UNIT 1	OPERATING SYSTEM OVERVIEW	9

Computer-System Organization – Architecture – Operating-System Operations – Resource Management – Security and Protection – Kernel Data Structures – Operating-System Services – System Calls – Operating-System Structure – Operating-System Design and Implementation.

UNIT 2	PROCESS MANAGEMENT	9

Process Concept – Process Scheduling – Operation on Processes, Inter-process Communication – Threads – Overview – Multithreading models; CPU Scheduling – Scheduling criteria, Scheduling algorithms; Process Synchronization – critical-section problem, Mutex locks, Semaphores; Deadlock – System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance.

UNIT 3	MEMORY MANAGEMENT AND FILE SYSTEMS	9

Main Memory – Background, Swapping, Paging, Segmentation – Virtual Memory – Demand Paging, Page Replacement, Thrashing; File concept, Access methods, Directory Structure, Sharing and Protection; File System Structure, Directory implementation, Allocation Methods, Free Space Management

UNIT 4	SECURE SYSTEMS AND VERIFIABLE SECURITY GOALS	9

Security Goals – Trust and Threat Model – Access Control Fundamentals – Protection System – Reference Monitor – Secure Operating System Definition and Concept.

UNIT 5	SECURITY IN OPERATING SYSTEMS	9

UNIX Security – UNIX Protection System – UNIX Authorization – UNIX Vulnerabilities – Windows Security – Windows Protection System – Windows Authorization – Windows Vulnerabilities – Address Space Layout Randomizations.

COURSE OUTCOME:

At the end of the course, students would

CO1:	To gain understanding on the concepts of Operating Systems.
CO2:	To acquire knowledge on process management concepts including scheduling, synchronization, threads and deadlock.
CO3:	To have understanding on memory, file and I/O management activities of OS.
CO4:	To understand security issues in operating systems and appreciate the need for security models
CO5:	To gain exposure to the operating systems security models of WINDOWS and UNIX OS.

	TOTAL: 45 PERIODS

TEXT BOOKS:

1.	Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", John Wiley & Sons, Inc., 10th Edition, 2021.
2.	Trent Jaeger, Operating System Security, Morgan & Claypool Publishers series, 2008.

REFERENCES:

1.	Morrie Gasser, "Building A Secure Computer System", Van Nostrand Reinhold, New York, 1988.
2.	Charles Pfleeger, Shari Pfleeger, Jonathan Margulies, "Security in Computing", Fifth Edition, Prentice Hall, New Delhi, 2015.
3.	William Stallings, "Operating Systems – Internals and Design Principles", 9th Edition, Pearson, 2017.
4.	Michael Palmer, "Guide to Operating Systems Security", Course Technology – Cengage Learning, New Delhi, 2008.
5.	Introduction to Hardware, Security and Trust, book by Mohammad Tehranipoor, Cliff Wang, Springer, 2012.
6.	Gary McGraw, Software Security: Building Security In, Addison Wesley software security series, 2005.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	2	1	1	1	1	2	3	2	3	1
CO2	3	3	3	3	2	1	1	1	1	1	2	3	1	2	2
CO3	3	3	3	3	2	2	1	1	1	1	2	3	2	3	3
CO4	3	3	2	3	1	1	1	1	1	1	1	2	1	2	2
CO5	3	3	3	3	1	2	1	1	1	1	1	2	2	3	3

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23CS502 SDG:4	COMPUTER NETWORKS	Category: PCC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

1.	To understand the data communication system and the purpose of layered architecture.
2.	To understand the basics of data flows from one node to another in data link layer.
3.	To study the functions of network layer and the various routing protocols.
4.	To familiarize the functions and protocols of the Transport layer.
5.	To learn different protocols used in the application layer.

UNIT 1	DATA COMMUNICATION AND PHYSICAL LAYERS	9
Introduction to Network - Data Communication - Networks – Network Types – The OSI Model – TCP/IP Protocol Suite – Addressing – Transmission Media.		
UNIT 2	**DATA LINK LAYER**	**9**
Data link layer - Framing – Flow control – Error control – Data-Link Layer Protocols – HDLC – PPP - Media Access Control – Ethernet Basics – CSMA/CD – Wireless LAN: Ethernet — Wireless LANs.		
UNIT 3	**NETWORK LAYER**	**9**
Switching: Circuit Switching – Packet Switching – Internetworking - IPv6 – Routing Techniques: Distance vector (RIP) – Link state (OSPF) – Interdomain Routing (BGP) - ARP, RARP, ICMP, DHCP.		
UNIT 4	**TRANSPORT LAYER**	**9**
UDP – TCP – TCP Connection Management - Congestion Control and Resource Allocation: TCP Congestion Control – Congestion Avoidance Mechanisms – Quality of Service - SCTP.		
UNIT 5	**APPLICATION LAYER**	**9**
Domain Name System – Electronic Mail (SMTP, MIME, IMAP, POP3) – File Transfer (FTP) – WWW (HTTP) – Network Management (SNMP).		

COURSE OUTCOME :

At the end of the course, students would

CO1:	Outline the basic layers and its functions in computer networks.
CO2:	Visualize the end-to-end flow of information in the data link layer protocols.
CO3:	Analyze routing algorithms and protocols for various functions in the network.
CO4:	Summarize the different functions of transport layer protocols.
CO5:	Apply the working of various application layer protocols in networks.

TOTAL: 45 PERIODS

TEXT BOOKS:

1.	James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach Featuring the Internet, Eighth Edition, Pearson Education, 2021.

2.	Behrouz A. Forouzan, Data Communications and Networking with TCP/IP Protocol Suite, Sixth Edition, TMH, 2022.
REFERENCES:	
1.	Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.
2.	William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013.
3.	Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.
4.	Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", McGraw Hill, 2012.

CO's-PO's & PSO's MAPPING

CO	*PO 1*	*PO2*	*PO3*	*PO4*	*PO5*	*PO6*	*PO7*	*PO8*	*PO9*	*PO10*	*PO11*	*PO12*	*PSO1*	*PSO2*	*PSO3*
CO1	2	1	1	-	-	-	-	-	-	1	1	3	1	1	-
CO2	3	1	1	-	-	-	-	-	-	1	1	3	1	1	-
CO3	3	1	-	-	-	-	-	-	-	1	1	2	1	1	-
CO4	3	2	2	-	-	-	-	-	-	1	1	2	1	1	-
CO5	2	1	1	-	-	-	-	-	-	1	1	2	1	1	-
Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation															

U23CS404 SDG:4	THEORY OF COMPUTATION	Category: PCC			
		L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

1.	To understand the foundations of computation including automata theory
2.	To construct models of regular expressions and languages.
3.	To design context-free grammar and push down automata
4.	To understand Turing machines and their capability
5.	To understand Undesirability and NP class problems

UNIT 1	AUTOMATA AND REGULAR EXPRESSIONS	9

Introduction to formal proof – Basic Mathematical Notation and techniques- Automata (FA) – Deterministic Finite Automata (DFA) – Non-deterministic Finite Automata (NFA) – Equivalence between NFA and DFA – Finite Automata with Epsilon transitions – Equivalence of NFA and DFA- Equivalence of NFAs with and without ε-moves- Conversion of NFA into DFA – Minimization of DFAs.

UNIT 2	REGULAR EXPRESSIONS (RE) AND LANGUAGES	9

Regular expression – Regular Languages- Equivalence of NFA and regular expressions –Direct method for Conversion: Regular Expressions to FA, Proving languages to be not regular (Pumping Lemma) – Closure properties of regular languages.

UNIT 3	CONTEXT-FREE GRAMMAR AND PUSH DOWN AUTOMATA	9

Introduction of Grammar- Types of Grammar -Context-Free Grammar (CFG) – Derivations and Parse trees – Ambiguity in grammars and languages – Push Down Automata (PDA): Definition – Moves - Instantaneous descriptions -Languages of pushdown automata – Equivalence of pushdown automata and CFG, CFG to PDA, PDA to CFG – Deterministic Pushdown Automata.

UNIT 4	NORMAL FORMS AND TURING MACHINES	9

Normal forms for CFG – Simplification of CFG- Chomsky Normal Form (CNF) and Greibach Normal Form (GNF) – Pumping lemma for CFL – Closure properties of Context Free Languages –Turing Machines: Definitions – Models – Programming Techniques for TM.

UNIT 5	UNDECIDABILITY	9

A language that is not Recursively Enumerable – An undecidable problem that is RE – Undecidable problems about Turing Machine – Post's Correspondence Problem – Intractable problems: The classes P and NP: The class of languages P – The class of languages NP – Travelling Salesman's Problem.

COURSE OUTCOME :

At the end of the course, students would

CO1:	Design and develop various finite-state machines
CO2:	Analyze the properties of different languages
CO3:	Demonstrate the push-down automata model for a given language
CO4:	Understand and design the various types of Turing machine
CO5:	Differentiate between decidable and undecidable problems.

TOTAL: 60 PERIODS

TEXT BOOKS:	
1.	J.E.Hopcroft, R.Motwani and J.D Ullman, "Introduction to Automata Theory, Languages and Computations", Pearson Education, Third Edition, 2011.
2.	J.E.Hopcroft, R.Motwani and J.D Ullman, ―Introduction to Automata Theory, Languages and Computations‖, Second Edition, Pearson Education, 2003.
REFERENCES:	
1.	Micheal Sipser, ―Introduction of the Theory and Computation‖, Thomson Brokecole, 1997.
2.	K V N Sunitha, N Kalyani: Formal Languages and Automata Theory, Tata McGraw Hill, New Delhi,2010.
3.	A A Puntambekar – Theory of Computation, Technical Publication, India.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	2	2	-	-	-	-	1	2	1	2	1	2
CO2	2	2	3	3	2	-	-	-	2	1	3	2	2	2	2
CO3	2	3	2	1	1	-	-	-	2	2	3	1	2	3	2
CO4	2	3	1	2	3	-	-	-	2	-	2	3	2	3	1
CO5	2	1	1	1	2	-	-	-	-	2	3	3	2	2	2

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23CS603 SDG:4	CRYPTOGRAPHY AND CYBER SECURITY	Category : PCC			
		L	T	P	C
		3	0	2	4

COURSE OBJECTIVE:

1. Understand fundamental concepts of computer security, including security attacks, services, and mechanisms.
2. Explain classical encryption techniques and the foundations of modern cryptography.
3. Apply mathematical principles and symmetric cryptographic algorithms for secure communication.
4. Analyze asymmetric cryptographic algorithms, key exchange methods, and key management techniques.
5. Evaluate integrity, authentication mechanisms, and cyber security challenges in modern computing environments.

UNIT 1	INTRODUCTION TO SECURITY	9

Computer Security Concepts – The OSI Security Architecture – Security Attacks – Security Services and Mechanisms – A Model for Network Security – Classical encryption techniques: Substitution techniques, Transposition techniques, Steganography – Foundations of modern cryptography: Perfect security – Information Theory – Product Cryptosystem – Cryptanalysis.

UNIT 2	SYMMETRIC CIPHERS	9

Number theory – Algebraic Structures – Modular Arithmetic - Euclid‘s algorithm – Congruence and matrices – Group, Rings, Fields, Finite Fields

SYMMETRIC KEY CIPHERS: SDES – Block Ciphers – DES, Strength of DES – Differential and linear cryptanalysis – Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – Pseudorandom Number Generators – RC4 – Key distribution.

UNIT 3	ASYMMETRIC CRYPTOGRAPHY	9

MATHEMATICS OF ASYMMETRIC KEY CRYPTOGRAPHY: Primes – Primality 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 management – Diffie Hellman key exchange -– Elliptic curve arithmetic – Elliptic curve cryptography.

UNIT 4	INTEGRITY AND AUTHENTICATION ALGORITHMS	9

Authentication requirement – Authentication function – MAC – Hash function – Security of hash function: HMAC, CMAC – SHA – Digital signature and authentication protocols – DSS – Schnorr Digital Signature Scheme – ElGamal cryptosystem – Entity Authentication: Biometrics, Passwords, Challenge Response protocols – Authentication applications – Kerberos

MUTUAL TRUST: Key management and distribution – Symmetric key distribution using symmetric and asymmetric encryption – Distribution of public keys – X.509 Certificates.

UNIT 5	CYBER CRIMES AND CYBER SECURITY	9

Cyber Crime and Information Security – classifications of Cyber Crimes – Tools and Methods – Password Cracking, Keyloggers, Spywares, SQL Injection – Network Access Control – Cloud Security – Web Security – Wireless Security

TOTAL: 45 PERIODS

PRACTICAL EXERCISES:

1. Write a program to implement the following cipher techniques to perform encryption and decryption

a) Caesar Cipher

b) Playfair Cipher
c) Hill Cipher
2. Write a program to implement the following transposition techniques
a) Rail fence technique -Row major transformation
b) Rail fence technique – Column major transformation
3. Write a program to implement DES algorithm
4. Write a program to implement AES algorithm
5. Write a program to implement RSA Encryption algorithm
6. Write a program to implement the Diffie-Hellman Key Exchange mechanism. Consider one of the parties as Alice and the other party as bob.
7. Write a program to calculate the message digest of a text using the SHA-1 algorithm.
8. Write a program to implement digital signature standard.
9. Demonstration of Intrusion Detection System(IDS)
10. Exploring N-Stalker, a Vulnerability Assessment Tool
11. Defeating Malware - Building Trojans

COURSE OUTCOMES:

At the end of the course, students would

CO1:	Describe security concepts, OSI security architecture, security attacks, services, and mechanisms.
CO2:	Explain and analyze classical and modern cryptographic techniques and cryptanalysis methods.
CO3:	Apply number theory concepts and symmetric key algorithms such as DES, AES, and RC4.
CO4:	Analyze and apply asymmetric cryptographic systems including RSA, Diffie-Hellman, and Elliptic Curve Cryptography.
CO5:	Analyze various network, cloud, web security mechanisms and cyber security crimes to protect digital environments.

TOTAL: 75 PERIODS

TEXT BOOKS:

1. William Stallings, "Cryptography and Network Security - Principles and Practice", Seventh Edition, Pearson Education, 2017.
2. Nina Godbole, Sunit Belapure, “Cyber Security: Understanding Cyber crimes, Computer Forensics and Legal Perspectives”, First Edition, Wiley India, 2011.

REFERENCES:

1. Behrouz A. Ferouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security", 3rdEdition, Tata Mc Graw Hill, 2015.
2. Charles Pfleeger, Shari Pfleeger, Jonathan Margulies, "Security in Computing", Fifth Edition, Prentice Hall, New Delhi, 2015.

CO’s-PO’s & PSO’s MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO1	PSO2
CO1	3	3	2	0	2	2	1	0	0	0	2	1	0
CO2	3	3	2	0	3	2	1	0	0	0	2	2	0
CO3	3	2	3	0	3	1	1	0	0	0	2	2	0
CO4	3	3	2	0	3	2	1	0	0	0	2	2	0
CO5	3	3	3	0	3	3	2	0	0	0	3	2	0

Correlation levels: 1 – low 2 – medium 3 – high “-“- no correlation

U23CB411 SDG: 4 & 8	COMPUTER NETWORKS LABORATORY	Category: PCC			
		L	T	P	C
		0	0	2	1

COURSE OBJECTIVE:	
1.	To learn various commands in computer networks.
2.	To picture the simulation of TCP sockets, DNS using UDP sockets.
3.	To envision network simulator of Congestion Control Algorithms using NS, ARP/RARP protocols.
4.	To study TCP/UDP performance, Distance Vector/Link State Routing algorithm using Simulation tool.
5.	To check error correction code using simulator.
LIST OF EXPERIMENTS:	
1.	Learn to use commands like tcpdump, netstat, ifconfig, nslookup and traceroute.
2.	Capture ping and trace route PDUs using a network protocol analyzer and examine.
3.	Write a HTTP web client program to download a web page using TCP sockets.
4.	Applications using TCP sockets like: a) Echo client and echo server b) Chat.
5.	Simulation of DNS using UDP sockets.
6.	Use a tool like Wireshark to capture packets and examine the packets.
7.	Write a code simulating ARP/RARP protocols.
8.	Study of Network simulator (NS) and Simulation of Congestion Control Algorithms using NS.
9.	Study of TCP/UDP performance using Simulation tool.
10.	Simulation of Distance Vector/Link State Routing algorithm.
11.	Simulation of an error correction code (like CRC).
COURSE OUTCOMES:	
At the end of the course, students would	
CO1:	Implement the various commands, trace route PDU's.
CO2:	Visualize and apply simulation of TCP sockets, DNS using UDP sockets.
CO3:	Implement network simulator of Congestion Control Algorithms using NS, ARP/RARP protocols.
CO4:	Apply and analyze the TCP/UDP performance, Distance Vector/Link State Routing algorithm using Simulation tool.
CO5:	Identify the error correction code using simulator.
	TOTAL: 30 PERIODS

U23CB412 SDG:4 & 8	INTRODUCTION TO SECURE OPERATING SYSTEMS LABORATORY	Category: PCC			
		L	T	P	C
		0	0	2	1

COURSE OBJECTIVE:

1.	To install and configure Windows operating systems.
2.	To understand the basics of Unix commands and shell programming.
3.	To implement various CPU scheduling algorithms, page replacement algorithms, and memory allocation methods.
4.	To implement Deadlock Avoidance and Deadlock Detection algorithms.
5.	To be familiar with file organization and file allocation strategies

LIST OF EXPERIMENTS:

1.	Installation of windows operating system.
2.	Illustrate UNIX commands and Shell Programming.
3.	Process Management using System Calls : Fork, Exit, Getpid, Wait, Close.
4.	Write C programs to implement the various CPU Scheduling Algorithms.
5.	Illustrate the inter process communication strategy.
6.	Implement mutual exclusion by Semaphore.
7.	Write C programs to avoid Deadlock using Banker's Algorithm.
8.	Write a C program to Implement Deadlock Detection Algorithm.
9.	Write C program to implement Threading.
10.	Implement the paging Technique using C program.
11.	Write C programs to implement the various Page Replacement Algorithms.
12.	Write C programs to implement the various File Organization Techniques.
13.	Write C programs for the implementation of various disk scheduling algorithms.

COURSE OUTCOME :

At the end of the course, students would

CO1:	Define and implement UNIX Commands.
CO2:	Compare the performance of various CPU Scheduling Algorithms.
CO3:	Compare and contrast various Memory Allocation Methods.
CO4:	Define File Organization and File Allocation Strategies.
CO5:	Implement various Disk Scheduling AlgorithmsCO1: Define and implement UNIX commands, file organization, and file allocation strategies.

TOTAL: 30 PERIODS

U23EE414 SDG:8&17	APTITUDE & COMMUNICATION FOR ENGINEERS - II	Category: EEC			
		L	T	P	C
		0	0	2	1

COURSE OBJECTIVE:

1.	To enhance the students' ability to contribute effectively and confidently in classroom and other forums and thereby they can exhibit their skills and gain attention.
2.	To further enhance and improve their communicative English for industry readiness through various speech craft activities.
3.	To take a stock of internal strength and weakness and prepare a plan to manage external threats and opportunities
4.	To get ready to kick start their career journey by assessing their current skills and talents.
5.	To train students on clearing various placement papers with greater accuracy
6.	To enhance the students' ability to contribute effectively and confidently in classroom and other forums and thereby they can exhibit their skills and gain attention.

UNIT 1	**INTRODUCTION**	**2**
Introduction about the Course - Learning expectations.		
UNIT 2	**SPEAKING SKILLS -VANTAGE**	**12**
Speech Craft –My buddy – Impromptu		
UNIT 3	**PERSONALITY DEVELOPMENT**	**3**
Psychometric Assessments - SWOT analysis.		
UNIT 4	**PLACEMENT READINESS**	**4**
Placement inventory-– Resume – Grooming.		
UNIT 5	**APTITUDE FOR PLACEMENTS - II**	**9**
Placement Paper 7–Permutation & Combination – Probability, Placement Paper 8 – Arithmetic Reasoning – Problems on Ages, Placement Paper 9 – Ratio Proportion & Alligation Mixture, Placement Paper 10 – Clocks & Calendars.		

COURSE OUTCOME :

At the end of the course, students would

CO1:	Students will be able to participate in any learning activity without any reservations. They shall be ready to move beyond their comfort zone to acquire new skills throughout their life.
CO2:	Students shall understand and appreciate the importance of English in the current global scenario and make efforts towards up skilling the same.
CO3:	They must be able to identify their strength and enhance the same.
CO4:	They shall prepare themselves to kick start their career by taking a stock of their existing skills and plan to acquire new skills required to achieve their goals.
CO5:	They shall demonstrate a good understanding of basic mathematical concepts required to learn engineering. To use appropriate strategies and shortcuts to improve speed and accuracy in solving aptitude problems during recruitment processes.

TOTAL: 30 PERIODS

TEXT BOOKS:

1.	The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Dinesh Khattar. Pearson
2.	Quantitative Aptitude Dr. R.S. Aggarwal S. Chand Publication
3.	A modern Approach to Verbal and Non-Verbal Reasoning R.S. Aggarwal
4.	A Modern Approach to Verbal & Non-Verbal Reasoning - Aggarwal R. S
REFERENCES:	
1.	Quantitative Aptitude for CAT, Arun Sharma.
2.	Fast Track Objective Arithmetic, Rajesh Verma, Arihant Publication.
3.	Quantitative Aptitude Quantum CAT Common Admission Tests for Admission into IIMs, Sarvesh.
4.	Wiley's Exam Xpert Quantitative Ability for CAT, 2ed, Ashu Jain.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	-	-	-	-	-	-	2	-	3	-	3	-	-	-
CO2	-	-	-	-	-	2	2	1	-	3	-	-	-	-	-
CO3	3	3	3	3	-	-	-	-	-	1	-	-	-	-	-
CO4	3	2	1	3	-	-	-	-	-	1	-	-	-	-	-
CO5	1	1	1	1	-	-	-	-	-	3	-	-	-	-	-

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23MC402 SDG: 11	ENVIRONMENTAL ECOSYSTEM AND SUSTAINABILITY	Category: ESC			
		L	T	P	C
		2	0	0	0

COURSE OBJECTIVE:

1.	To study the interrelationship between living organisms and environment.
2.	To assess the environmental pollution and its impact.
3.	To understand the significance of natural resources and their conservation.
4.	To identify and implement scientific, economic and political solutions to environmental problems.
5.	To understand the influence of human population on environmental issues and the role of information technology as a tool to minimize environmental problems.

UNIT 1	ECOSYSTEMS AND BIODIVERSITY	3

Definition, Scope and importance of environment - Concept of an ecosystem - Structure and function of an ecosystem (Grassland and River ecosystem only) - Food chains, Food webs and ecological pyramids - Introduction to biodiversity - Definition - Genetic, Species and ecosystem diversity - Value of biodiversity - Threats to biodiversity - Conservation of biodiversity. Case study of simple ecosystems: pond, river, hill slopes, etc.

UNIT 2	ENVIRONMENTAL POLLUTION	3

Definition - Causes, Effects and control measures of (a) Air pollution (b) Water pollution (c) Thermal pollution - Solid waste management: Causes, Effects and control measures of municipal solid wastes - Role of an individual in prevention of pollution - Pollution case studies - Disaster management: Floods, Earthquake, Cyclone and Landslides. Case study of local polluted site: Urban/Rural/Industrial/Agricultural.

UNIT 3	NATURAL RESOURCES	3

Forest resources - Use and over-exploitation, Deforestation - Water resources - Use and over-utilization of surface and ground water, Drought, Conflicts over water, Dams - Benefits and problems - Food resources - Changes caused by agriculture and overgrazing, Effects of modern agriculture, Fertilizer-pesticide problems, Water logging, Salinity - Role of an individual in conservation of natural resources (National and International level).

UNIT 4	SOCIAL ISSUES AND SUSTAINABILITY MANAGEMENT	3

Unsustainable to sustainable development - Millennium development goals and protocols - Sustainable Development Goals - Targets - Zero waste and R concept - ISO 14000 Series - Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials - Sustainable transport - Carbon credit, Carbon footprint, Climate change, Global warming, Acid rain, Ozone layer depletion.

UNIT 5	HUMAN POPULATION AND THE ENVIRONMENT	3

Population growth, Variation among nations - Population explosion - Family welfare programme - Environment and human health - Value education - Pandemic issues and management - Women and child welfare - Role of information technology in environment and human health - Case studies.

COURSE OUTCOME :	
At the end of the course, students would	
CO1:	Understand the basis of ecological principles and environmental regulations which in turn help in sustainable development, human population and environment, and the use and over-exploitation of forest, water and food resources.
CO2:	Understand various schemes for the protection of species, role of an individual in prevention of pollution and conservation of natural resources.
CO3:	Understand the design of pollution control structures, resettlement and rehabilitation of people, and welfare of women and children.
CO4:	Apply knowledge to implement various environmental ethics, regulations and schemes, pandemic issues and management, dam benefits and problems, and conservation of biodiversity.
CO5:	Analyze disaster management – floods, earthquake, cyclone and landslides; water logging, salinity, climate change, global warming, acid rain and ozone layer depletion.
	TOTAL: 15 PERIODS

TEXT BOOKS:	
1.	Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2017.
2.	Gilbert M. Masters, "Introduction to Environmental Engineering and Science", 2nd Edition, Pearson Education, 2016.
3.	George Tchobanoglous, Frank Kreith, "Handbook of Solid Waste Management" (McGraw-Hill Handbooks), McGraw-Hill Education, 2nd Edition, July 2017.
REFERENCES:	
1.	R. K. Trivedi, "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media, 2015.
2.	Erach Bharucha, "Textbook of Environmental Studies", Universities Press (I) Private Limited, Hyderabad, 2015.
3.	Rajagopalan R, "Environmental Studies – From Crisis to Cure", Oxford University Press, 2005.

SEMESTER V

U23CB501 SDG:	CYBER FORENSICS	Category: PCC			
		L	T	P	C
		3	0	2	3

COURSE OBJECTIVE:

1.	To learn cyber crime and forensics.
2.	To become familiar with forensics tools.
3.	To learn to analyze and validate forensics data.
4.	To understand cyber laws and the admissibility of evidence with case studies.
5.	To learn the vulnerabilities in network infrastructure with ethical hacking.

UNIT 1	INTRODUCTION TO CYBER CRIME AND FORENSICS	9

Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime - Role of ECD and ICT in Cybercrime - Classification of Cyber Crime - The Present and Future of Cybercrime - Cyber Forensics - Steps in Forensic Investigation - Forensic Examination Process - Types of CF Techniques - Forensic Duplication and Investigation - Forensics Technology and Systems - Understanding Computer Investigation – Data Acquisition.

UNIT 2	EVIDENCE COLLECTION AND FORENSICS TOOLS	9

Processing Crime and Incident Scenes – Digital Evidence - Sources of Evidence - Working with File Systems - Registry - Artifacts - Current Computer Forensics Tools: Software/Hardware Tools - Forensic Suite - Acquisition and Seizure of Evidence from Computers and Mobile Devices - Chain of Custody - Forensic Tools.

UNIT 3	ANALYSIS AND VALIDATION	9

Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics - Analysis of Digital Evidence - Admissibility of Evidence - Cyber Laws in India - Case Studies.

UNIT 4	ETHICAL HACKING	9

Introduction to Ethical Hacking - Footprinting and Reconnaissance - Scanning Networks - Enumeration - System Hacking - Malware Threats – Sniffing – Email Tracking.

UNIT 5	ETHICAL HACKING IN WEB	9

Social Engineering - Denial of Service - Session Hijacking - Hacking Web Servers - Hacking Web Applications – SQL Injection - Hacking Wireless Networks - Hacking Mobile Platforms.

PRACTICAL EXERCISES:

1.	Study and Explore the following forensic tools: (a) FTK Imager (b) Autopsy (c) EnCase Forensic Imager (d) LastActivityView (e) USBDeview.
2.	Recover deleted files using FTK Imager.
3.	Acquire forensic image of hard disk using EnCase Forensics Imager and also perform integrity checking/validation.

4.	Restore the Evidence Image using EnCase Forensics Imager.
5.	Study the following: (a) Collect Email Evidence in Victim PC. (b) Extract Browser Artifacts (ChromeHistoryView for Google Chrome).
6.	Use USBDeview to find the last connected USB to the system.
7.	Perform Live Forensics Case Investigation using Autopsy.
8.	Study Email Tracking and Email Tracing and write a report on them.

COURSE OUTCOME :

At the end of the course, students would

CO1:	Understand the basics of cyber crime and computer forensics.
CO2:	Apply several different computer forensic tools to a given scenario.
CO3:	Analyze and validate forensics data, and understand admissibility of evidence in India with cyber laws and case studies.
CO4:	Identify the vulnerabilities in each network infrastructure.
CO5:	Implement real-world hacking techniques to test system security.

TOTAL: 75 PERIODS

TEXT BOOKS:

1.	Bill Nelson, Amelia Phillips, Christopher Steuart, "Guide to Computer Forensics and Investigations", Cengage Learning, India, Sixth Edition, 2019.
2.	CEH Official Certified Ethical Hacking Review Guide, Wiley India Edition, Version 11, 2021.
3.	Dejey, S. Murugan, "Cyber Forensics", Oxford University Press, India, 2018.

REFERENCES:

1.	John R. Vacca, "Computer Forensics", Cengage Learning, 2005.
2.	Marjie T. Britz, "Computer Forensics and Cyber Crime: An Introduction", 3rd Edition, Prentice Hall, 2013.
3.	Ankit Fadia, "Ethical Hacking", Second Edition, Macmillan India Ltd., 2006.
4.	Kenneth C. Brancik, "Insider Computer Fraud", Auerbach Publications, Taylor & Francis Group, 2008.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	-	-	1	1	-	-	-	2	-	3	
CO2	2	1	1	2	-	-	-	-	-	-	-	2	2	1	
CO3	2	2	1	1	2	-	-	-	-	-	-	1	3	-	
CO4	-	-	-	-	-	-	1	2	-	-	-	1	-	2	

CO5	-	3	-	2	-	-	1	1	-	-	-	2	2	1	
CO6	2	2	1	2	2	-	-	-	1	1	1	2	2	2	
Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation															

U23CB502 SDG: 9	SECURE DATABASE MANAGEMENT SYSTEMS	Category:PCC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

1.	To learn the fundamentals of data models and to design a database system using Entity-Relationship diagrams and the relational model.
2.	To create effective relational databases through normalization and to write SQL queries to store and retrieve data from database systems.
3.	To understand transaction processing, concurrency control techniques and recovery procedures.
4.	To analyze threats and attacks on databases and to apply access-control and authentication mechanisms to defend against them.
5.	To secure data through encryption, and to audit databases in line with data-privacy and compliance requirements.

UNIT 1	RELATIONAL DATABASES	9

Data Models – Relational Data Model – Relational Algebra – Structured Query Language (DDL, DML, DCL) – Entity-Relationship Model – Mapping ER Models to Relations – Introduction to Distributed Databases – Data Fragmentation and Replication (concepts).

UNIT 2	DATABASE DESIGN AND NORMALIZATION	9

ER Diagrams – Functional Dependencies – Non-Loss Decomposition – First Normal Form – Second Normal Form – Third Normal Form – Dependency Preservation – Boyce/Codd Normal Form – Overview of Multi-Valued Dependencies and Fourth Normal Form – Overview of Join Dependencies and Fifth Normal Form.

UNIT 3	TRANSACTION MANAGEMENT	9

Transaction Concepts – ACID Properties – Serializability – Transaction Isolation Levels – Concurrency Control – Need for Concurrency – Lock-Based Protocols – Deadlock Handling – Recovery System – Failure Classification – Recovery Algorithm.

UNIT 4	DATABASE SECURITY AND ACCESS CONTROL	9

Need for Database Security – SQL Injection Attacks: The Injection Technique, SQLi Attack Avenues and Types – Introduction to NoSQL Injection – Privilege Escalation and Insider Threats – Authentication Mechanisms – Database Access Control – Discretionary Access Control (DAC) – Role-Based Access Control (RBAC), with an introduction to Attribute-Based Access Control (ABAC) – Cascading Authorizations – Inference and Inference Control.

UNIT 5	ENCRYPTION, AUDITING AND COMPLIANCE	9

Database Encryption – Encryption at Rest and in Transit – Transparent Data Encryption (TDE) – Column-Level Encryption – Database Auditing and Logging– Data Privacy and Compliance: Digital Personal Data Protection (DPDP) Act 2023

COURSE OUTCOME:	
At the end of the course, students would be able to:	
CO1:	Design database schemas for an application using conceptual (ER) modeling and the relational data model.
CO2:	Formulate solutions to query problems using relational algebra and SQL, and normalize relational schemas up to BCNF.
CO3:	Analyze transaction processing, concurrency-control and recovery mechanisms for controlling concurrent data access.
CO4:	Analyze database attacks and design appropriate access-control and authentication schemes to mitigate them.
CO5:	Evaluate encryption, auditing and privacy-compliance strategies for securing database management systems.
	TOTAL: 45 PERIODS

TEXT BOOKS:	
1.	Abraham Silberschatz, Henry F. Korth and S. Sudarshan, *Database System Concepts*, 7th Edition, McGraw-Hill, 2019.
2.	Alfred Basta and Melissa Zgola, *Database Security*, Cengage Learning, 2012.

REFERENCE BOOKS:	
1.	Ramez Elmasri and Shamkant B. Navathe, *Fundamentals of Database Systems*, 7th Edition, Pearson, 2016.
2.	C. J. Date, *Database Design and Relational Theory: Normal Forms and All That Jazz*, 2nd Edition, Apress, 2019.
3.	William Stallings and Lawrie Brown, *Computer Security: Principles and Practice*, 5th Edition, Pearson, 2024.
4.	Justin Clarke, *SQL Injection Attacks and Defense*, 2nd Edition, Syngress (Elsevier), 2012.

WEB REFERENCES:	
1.	Digital Personal Data Protection Act, 2023 – Ministry of Electronics and Information Technology (MeitY), Government of India: https://www.meity.gov.in
2.	OWASP Foundation – Injection and NoSQL Injection resources: https://owasp.org
3.	NIST Computer Security Resource Center – Access Control and Key Management publications: https://csrc.nist.gov

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	3	–	2	–	–	–	–	–	–	1	3	–	–
CO2	3	3	2	–	3	–	–	–	–	–	–	1	3	–	–
CO3	3	3	2	2	2	–	–	–	–	–	–	1	2	2	–
CO4	2	3	3	2	3	2	–	2	–	–	–	1	3	3	2
CO5	2	3	2	2	3	3	–	3	–	–	–	2	3	3	3

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23CB503 SDG:9	ENGINEERING SECURE SOFTWARE SYSTEMS	Category:PCC			
		L	T	P	C
		3	0	2	4

COURSE OBJECTIVE:

1.	To understand the importance and need for software security.
2.	To learn about various software attacks and vulnerabilities.
3.	To learn secure software design and threat modeling.
4.	To understand risk management in secure software development.
5.	To learn modern security testing tools and DevSecOps practices.

UNIT 1	NEED OF SOFTWARE SECURITY AND LOW-LEVEL ATTACKS	6

Software Assurance and Software Security – Threats to Software Security – Sources of Software Insecurity – Benefits of Detecting Software Security – Properties of Secure Software – Memory-Based Attacks: Low-Level Attacks Against Heap and Stack – Defense Against Memory-Based Attacks – Introduction to Memory-Safe Languages and the Industry Shift Toward Memory Safety.

UNIT 2	SECURE SOFTWARE DESIGN	7

Requirements Engineering for Secure Software – Requirements Elicitation and Prioritization – Security Design Principles – Threat Modeling using STRIDE – OWASP Top 10 and API Security Top 10 – Vulnerability Trends – Common Vulnerabilities: Buffer Overflow, Code Injection and Session Hijacking – Secure Design Patterns.

UNIT 3	SECURITY RISK MANAGEMENT	5

Risk Management Life Cycle – Risk Profiling – Risk Exposure Factors – Risk Evaluation and Mitigation – Risk Assessment Techniques – Threat and Vulnerability Management – Third-Party and Supply-Chain Risk.

UNIT 4	SECURITY TESTING	8

Traditional Software Testing and Comparison – Secure Software Development Life Cycle (Secure SDLC) – Risk-Based Security Testing – Prioritizing Security Testing with Threat Modeling – Static, Dynamic and Interactive Application Security Testing (SAST, DAST, IAST) – Software Composition Analysis (SCA) – DevSecOps and Secure CI/CD Pipelines (Shift-Left Security) – Penetration Testing: Planning and Scoping, Enumeration and Web Application Exploitation – Tools for Security Testing.

UNIT 5	SECURE PROJECT MANAGEMENT	4

Governance and Security – Security and Project Management – Adopting a Secure Software Development Framework: Microsoft SDL and OWASP SAMM – Software Security Maturity Models (BSIMM) – Software Supply Chain Security and Software Bill of Materials (SBOM).

30 PERIODS

PRACTICAL EXERCISES:

1.	Implement the SQL Injection attack and defend against it.
2.	Implement the Buffer Overflow attack and apply defenses.
3.	Implement Cross-Site Scripting (XSS) and prevent XSS.

4.	Perform penetration testing on a web application to gather information about the system, then initiate XSS and SQL injection attacks using tools like Kali Linux.
5.	Develop and test secure test cases.
6.	Perform Static Application Security Testing (SAST) and Software Composition Analysis (SCA) using open-source tools (e.g., Semgrep, OWASP Dependency-Check), and integrate a security scan into a CI/CD pipeline (DevSecOps).
	30 PERIODS
COURSE OUTCOME:	
At the end of the course, students would be able to:	
CO1:	Identify vulnerabilities related to memory-based attacks and apply appropriate defenses.
CO2:	Apply secure design principles, threat modeling and OWASP guidelines in software development.
CO3:	Evaluate and manage software security risks, including third-party and supply-chain risk.
CO4:	Select and apply appropriate security testing techniques (SAST, DAST, SCA and penetration testing) across the secure SDLC.
CO5:	Use industry-standard tools and DevSecOps practices to secure software.
	TOTAL: 60 PERIODS
TEXT BOOKS:	
1.	Tanya Janca, *Alice and Bob Learn Application Security*, Wiley, 2020.
2.	Tanya Janca, *Alice and Bob Learn Secure Coding*, Wiley, 2025.
3.	Loren Kohnfelder, *Designing Secure Software: A Guide for Developers*, No Starch Press, 2021.
4.	Adam Shostack, *Threat Modeling: Designing for Security*, Wiley, 2014.
REFERENCE BOOKS:	
1.	Robert C. Seacord, *Secure Coding in C and C++ (SEI Series in Software Engineering)*, 2nd Edition, Addison-Wesley Professional, 2013.
2.	Jon Erickson, *Hacking: The Art of Exploitation*, 2nd Edition, No Starch Press, 2008.
3.	Evan Wheeler, *Security Risk Management: Building an Information Security Risk Management Program from the Ground Up*, First Edition, Syngress, 2011.
4.	Julia H. Allen, Sean Barnum, Robert J. Ellison, Gary McGraw and Nancy R. Mead, *Software Security Engineering: A Guide for Project Managers*, Pearson Education, 2008.
5.	Lee Allen and Kevin Cardwell, *Advanced Penetration Testing for Highly-Secured Environments*, 2nd Edition, Packt Publishing, 2016.
6.	Mike Shema, *Hacking Web Apps: Detecting and Preventing Web Application Security Problems*, First Edition, Syngress, 2012.
WEB REFERENCES:	
For the current industry frameworks and tooling introduced in Units 2, 4 and 5:	
1.	OWASP Foundation – Top 10, API Security Top 10, SAMM and ASVS: https://owasp.org
2.	NIST Secure Software Development Framework (SSDF), SP 800-218 – NIST: https://csrc.nist.gov
3.	BSIMM (Building Security In Maturity Model): https://www.bsimm.com
4.	Microsoft Security Development Lifecycle (SDL): https://www.microsoft.com/sdl

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	2	3	2	-	-	-	2	1	2	2	-	2	2
CO2	2	2	2	3	3	-	-	-	2	1	2	2	-	3	2
CO3	1	2	2	2	1	-	-	-	1	1	2	1	-	2	2
CO4	2	3	2	2	2	-	-	-	2	1	2	2	-	1	1
CO5	2	1	2	2	3	-	-	-	2	1	2	2	1	1	1

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23MC504 SDG: 4	ENTREPRENEURSHIP AND INNOVATION	Category: MC			
		L	T	P	C
		1	0	0	0

COURSE OBJECTIVE:

1.	Learn basic concepts in entrepreneurship, develop mind-set and skills necessary to explore entrepreneurship
2.	Apply process of problem - opportunity identification and validation through human centred approach to design thinking in building solutions as part of engineering projects
3.	Analyse market types, conduct market estimation, identify customers, create customer persona, develop the skills to create a compelling value proposition and build a Minimum Viable Product
4.	Explore business models, create business plan, conduct financial analysis and feasibility analysis to assess the financial viability of a venture ideas & solutions built with domain expertise
5.	Prepare and present an investible pitch deck of their practice venture to attract stakeholders

UNIT 1	ENTREPRENEURIAL MINDSET	4+8

Introduction to Entrepreneurship: Definition – Types of Entrepreneurs – Emerging Economics – Developing and Understanding an Entrepreneurial Mindset – Importance of Technology Entrepreneurship – Benefits to the Society. Case Analysis: Study cases of successful & failed engineering entrepreneurs - Foster Creative Thinking: Engage in a series of Problem-Identification and Problem-Solving tasks

UNIT 2	OPPORTUNITIES	4+8

Problems and Opportunities – Ideas and Opportunities – Identifying problems in society – Creation of opportunities – Exploring Market Types – Estimating the Market Size, - Knowing the Customer and Consumer - Customer Segmentation - Identifying niche markets – Customer discovery and validation; Market research techniques, tools for validation of ideas and opportunities Activity Session: Identify emerging sectors / potential opportunities in existing markets - Customer Interviews: Conduct preliminary interviews with potential customers for Opportunity Validation - Analyse feedback to refine the opportunity.

UNIT 3	PROTOTYPING & ITERATION	4+8

Prototyping – Importance in entrepreneurial process – Types of Prototypes - Different methods – Tools & Techniques. Hands-on sessions on prototyping tools (3D printing, electronics, software), Develop a prototype based on identified opportunities; Receive feedback and iterate on the prototypes

UNIT 4	BUSINESS MODELS & PITCHING	4+8

Business Model and Types - Lean Approach - 9 block Lean Canvas Model - Riskiest assumptions to Business Models – Using Business Model Canvas as a Tool – Pitching Techniques: Importance of pitching - Types of pitches - crafting a compelling pitch – pitch presentation skills - using storytelling to gain investor/customer attention. Activity Session: Develop a business model canvas for the prototype; present and receive feedback from peers and mentors - Prepare and practice pitching the business ideasParticipate in a Pitching Competition and present to a panel of judges - receive & reflect feedback

UNIT 5	ENTREPRENEURIAL ECOSYSTEM	4+8

Understanding the Entrepreneurial Ecosystem – Components: Angels, Venture Capitalists, Maker Spaces, Incubators, Accelerators, Investors. Financing models – equity, debt, crowdfunding, etc, Support from the government and corporates. Navigating Ecosystem Support: Searching &

Identifying the Right Ecosystem Partner – Leveraging the Ecosystem - Building the right stakeholder network Activity Session: Arrangement of Guest Speaker Sessions by successful entrepreneurs and entrepreneurial ecosystem leaders (incubation managers; angels; etc), Visit one or two entrepreneurial ecosystem players (Travel and visit a research park or incubator or makerspace or interact with startup founders).	
COURSE OUTCOMES:	
At the end of the course, students would	
CO1:	Develop an Entrepreneurial Mind-set and Understand the Entrepreneurial Ecosystem Components and Funding types
CO2:	Comprehend the process of opportunity identification through design thinking, identify market potential and customers
CO3:	Generate and develop creative ideas through ideation techniques
CO4:	Create prototypes to materialize design concepts and conduct testing to gather feedback and refine prototypes to build a validated MVP
CO5:	Analyse and refine business models to ensure sustainability and profitability Prepare and deliver an investible pitch deck of their practice venture to attract stakeholders
	TOTAL: 60 PERIODS
REFERENCES:	

1.	Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha (2020). Entrepreneurship, McGrawHill, 11th Edition
2.	Ries, E. (2011). The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses. Crown Business
3.	Blank, S. G., & Dorf, B. (2012). The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company. K&S Ranch
4.	Roy, R. (2017). Indian Entrepreneurship: Theory and Practice. New Delhi: Oxford University Press
5.	Osterwalder, A., & Pigneur, Y. (2010). Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. John Wiley & Sons

SEMESTER VI

U23CB601 SDG:9	Compiler Design	Category: PCC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

1.	To understand the various phases of compiler.
2.	To learn the various parsing techniques.
3.	To understand intermediate code generation and run-time environment.
4.	To learn to implement the front-end of the compiler.
5.	To learn to implement code generator and code optimization.

UNIT 1	INTRODUCTION TO COMPILERS & LEXICAL ANALYSIS	9

Introduction- Translators- Compilation and Interpretation- Language processors -The Phases of Compiler – Lexical Analysis – Input Buffering – Specification of Tokens – Recognition of Tokens – Finite Automata – Regular Expressions to Automata NFA, Lex / Flex tool.

UNIT 2	SYNTAX ANALYSIS	9

Role of Parser – Grammars – Context-free grammars – Writing a grammar TopDown Parsing - General Strategies - Recursive Descent Parser Predictive Parser-LL (1) - Parser-Shift Reduce Parser-LR Parser- LR (0) Item Construction of SLR Parsing Table - Introduction to LALR Parser - Error Handling and Recovery in Syntax Analyzer-YACC / Bison tool - Design of a syntax Analyzer for a Sample Language

UNIT 3	SYNTAX DIRECTED TRANSLATION & INTERMEDIATE CODE GENERATION	9

Syntax directed Definitions-Construction of Syntax Tree-Bottom-up Evaluation of S-Attribute Definitions- Design of predictive translator - Type Systems-Specification of a simple type Checker-Equivalence of Type Expressions-Type Conversions. Intermediate Languages: Syntax Tree, Three Address Code, Modern IRs: LLVM IR (overview), Types and Declarations, Translation of Expressions, Type Checking, Back patching.

UNIT 4	RUN-TIME ENVIRONMENT AND CODE GENERATION	9

Runtime Environments – source language issues – Storage organization – Storage Allocation Strategies: Static, Stack and Heap allocation - Parameter Passing-Symbol Tables - Dynamic Storage Allocation - Issues in the Design of a code generator – Basic Blocks and Flow graphs - Design of a simple Code Generator - Optimal Code Generation for Expressions– Dynamic Programming Code Generation.

UNIT 5	CODE OPTIMIZATION	9

Principal Sources of Optimization – Peep-hole optimization - DAG- Optimization of Basic Blocks - Global Data Flow Analysis - Efficient Data Flow Algorithm – Static Single Assignment (SSA) Form and SSA-based Optimization

COURSE OUTCOMES:

At the end of the course, students would

CO1:	Explain the structure and phases of a compiler and design lexical analyzers using regular expressions, finite automata, and lexical analysis tools.
CO2:	Apply context-free grammars and parsing techniques to design and implement top-down and bottom-up syntax analyzers using standard parser generation tools.
CO3:	Construct syntax-directed definitions and generate intermediate code with appropriate type checking and translation schemes.
CO4:	Analyze run-time environments, storage allocation strategies, and generate efficient target code using code generation techniques.
CO5:	Apply code optimization techniques and data flow analysis to improve the performance and efficiency of generated code.
	TOTAL: 45 PERIODS

TEXT BOOKS:

1.	Douglas Thain, "Introduction to Compilers and Language Design", Second Edition, 2020
2.	Aho, Lam, Sethi & Ullman, "Compilers: Principles, Techniques, and Tools", Revised/Updated Edition

REFERENCES:

1.	Randy Allen, Ken Kennedy, Optimizing Compilers for Modern Architectures: A Dependence based Approach, Morgan Kaufmann Publishers, 2002.
2.	Steven S. Muchnick, Advanced Compiler Design and Implementation‖, Morgan Kaufmann Publishers - Elsevier Science, India, Indian Reprint 2003.
3.	Keith D Cooper and Linda Torczon, Engineering a Compiler‖, Morgan Kaufmann Publishers Elsevier Science, 2004.
4.	V. Raghavan, Principles of Compiler Design‖, Tata McGraw Hill Education Publishers, 2010.
5.	Allen I. Holub, Compiler Design in C‖, Prentice-Hall Software Series, 1993.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	2	–	–	2	-	-	-	-	1	1	3	2	2
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CO3	2	3	3	2	–	-	-	-	-	1	1	3	3	2
CO4	2	3	3	2	2	-	-	-	-	2	3	2	1	1
CO5	2	3	2	3	2	-	-	-	-	1	3	2	2	2

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23CB602 SDG: 4	WEB TECHNOLOGIES	Category: PCC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

1.	To understand different Internet Technologies
2.	To learn java-specific web services architecture
3.	To Develop web applications using frameworks

UNIT 1	WEBSITE BASICS, HTML 5, CSS 3, WEB 2.0	9

Web Essentials: Clients, Servers and Communication – The Internet – World wide web – HTTP Request Message – HTTP Response Message – Web Clients – Web Servers – HTML5 – Tables – Lists – Image – HTML5 control elements – Drag and Drop – Audio – Video controls - CSS3 – Inline, embedded and external style sheets – Rule cascading – Inheritance – Backgrounds – Border Images – Colors – Shadows – Text – Transformations – Transitions – Animations. Bootstrap Framework

UNIT 2	CLIENT SIDE PROGRAMMING	9

Java Script: An introduction to JavaScript–JavaScript DOM Model-Exception Handling-ValidationBuilt-in objects-Event Handling- DHTML with JavaScript- JSON introduction – Syntax – Function Files.

UNIT 3	SERVER SIDE PROGRAMMING	9

Servlets: Java Servlet Architecture- Servlet Life Cycle- Form GET and POST actions- Session Handling- Understanding Cookies- DATABASE CONNECTIVITY: JDBC

UNIT 4	PHP and XML	9

An introduction to PHP: PHP- Using PHP- Variables- Program control- Built-in functions- Form Validation. XML: Basic XML- Document Type Definition- XML Schema, XML Parsers and Validation, XSL

UNIT 5	INTRODUCTION TO ANGULAR and WEB APPLICATIONS FRAMEWORKS	9

Introduction to AngularJS, MVC Architecture, Understanding ng attributes, Expressions and data binding, Conditional Directives, Style Directives, Controllers, Filters, Forms, Routers, Modules, Services; Web Applications Frameworks and Tools – Firebase- Docker- Node JS- React- DjangoUI & UX.

COURSE OUTCOME:

At the end of the course, students would

CO1:	Construct a basic website using HTML and Cascading Style Sheets
CO2:	Build dynamic web page with validation using Java Script objects and by applying different event handling mechanisms.
CO3:	Develop server side programs using Servlets and JSP.
CO4:	Construct simple web pages in PHP and to represent data in XML format.
CO5:	Develop interactive web applications.

THEORY: 45 PERIODS

TEXT BOOKS:	
1.	Deitel and Deitel and Nieto, Internet and World Wide Web - How to Program, Prentice Hall, 5th Edition, 2011.
2.	Jeffrey C and Jackson, Web Technologies A Computer Science Perspective, Pearson Education, 2011.
3.	Angular 6 for Enterprise-Ready Web Applications, Doguhan Uluca, 1st edition, Packt Publishing
REFERENCES:	
1.	Stephen Wynkoop and John Burke "Running a Perfect Website", QUE, 2nd Edition,1999
2.	Chris Bates, Web Programming – Building Intranet Applications, 3rd Edition, Wiley Publications, 2009
3.	Gopalan N.P. and Akilandeswari J., "Web Technology", Prentice Hall of India, 2011.
4.	UttamK.Roy, "Web Technologies", Oxford University Press, 2011.
5.	Angular: Up and Running: Learning Angular, Step by Step, Shyam Seshadri, 1st edition, O′Reilly

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	3	3	3	-	-	-	1	3	3	1	3	2	3
CO2	2	2	2	1	2	-	-	-	2	2	1	3	2	2	2
CO3	1	1	3	2	3	-	-	-	1	2	1	1	1	2	1
CO4	2	3	3	1	2	-	-	-	3	1	2	2	2	2	2
CO5	1	2	3	2	2	-	-	-	2	1	3	1	1	1	2

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23CB603 SDG: 4	SECURITY AND PRIVACY IN CLOUD	Category: PEC			
		L	T	P	C
		3	0	2	4

COURSE OBJECTIVE:

1.	To introduce Cloud Computing terminology, definition & concepts
2.	To understand the security design and architectural considerations for Cloud
3.	To understand the Identity, Access control in Cloud
4.	To follow best practices for Cloud security using various design patterns
5.	To be able to monitor and audit cloud applications for security

UNIT 1	FUNDAMENTALS OF CLOUD SECURITY CONCEPTS	7

Overview of cloud security- Security Services - Confidentiality, Integrity, Authentication, Non repudiation, Access Control - Basic of cryptography - Conventional and public-key cryptography, hash functions, authentication, and digital signatures.

UNIT 2	SECURITY DESIGN AND ARCHITECTURE FOR CLOUD	6

Security design principles for Cloud Computing - Comprehensive data protection - End-to-end access control - Common attack vectors and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies - Data Protection strategies: Data retention, deletion and archiving procedures for tenant data, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key

UNIT 3	ACCESS CONTROL AND IDENTITY MANAGEMENT	6

Access control requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles-based Access Control - Multi-factor authentication - Single Sign-on, Identity Federation - Identity providers and service consumers - Storage and network access control options - OS Hardening and minimization - Verified and measured boot - Intruder Detection and prevention

UNIT 4	CLOUD SECURITY DESIGN PATTERNS	6

Introduction to Design Patterns, Cloud bursting, Geo-tagging, Secure Cloud Interfaces, Cloud Resource Access Control, Secure On-Premise Internet Access, Secure External Cloud

UNIT 5	MONITORING, AUDITING AND MANAGEMENT	5

Proactive activity monitoring - Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges - Events and alerts - Auditing – Record generation, Reporting and Management, Tamper-proofing audit logs, Quality of Services, Secure Management, User management, Identity management, Security Information and Event Management

30 PERIODS

PRACTICAL EXERCISES:

1. Simulate a cloud scenario using Cloud Sim and run a scheduling algorithm not present in Cloud Sim
2. Simulate resource management using cloud sim
3. Simulate log forensics using cloud sim
4. Simulate a secure file sharing using a cloud sim

5. Implement data anonymization techniques over the simple dataset (masking, k anonymization, etc)
6. Implement any encryption algorithm to protect the images
7. Implement any image obfuscation mechanism
8. Implement a role-based access control mechanism in a specific scenario
9. Implement an attribute-based access control mechanism based on a particular scenario
10. Develop a log monitoring system with incident management in the cloud

COURSE OBJECTIVE:	
At the end of the course, students would	
CO1:	Understand the cloud concepts and fundamentals.
CO2:	Explain the security challenges in the cloud.
CO3:	Define cloud policy and Identity and Access Management.
CO4:	Understand various risks and audit and monitoring mechanisms in the cloud.
CO5:	Define the various architectural and design considerations for security in the cloud.
	LAB: 30 PERIODS **TOTAL: 60 PERIODS**

TEXT BOOKS:	
1.	Raj Kumar Buyya , James Broberg, andrzejGoscinski, "Cloud Computing:‖, Wiley 2013
2.	Dave shackleford, "Virtualization Security‖, SYBEX a wiley Brand 2013.
3.	Mather, Kumaraswamy and Latif, "Cloud Security and Privacy‖, OREILLY 2011

REFERENCES:	
1.	Mark C. Chu-Carroll "Code in the Cloud‖,CRC Press, 2011
2.	Mastering Cloud Computing Foundations and Applications Programming RajkumarBuyya, Christian Vechhiola, S. ThamaraiSelvi

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2	PS O3
CO1	3	3	3	1	2	-	-	-	1	1	1	3	3	1	2
CO2	1	3	2	3	1	-	-	-	2	2	3	2	3	1	2
CO3	3	2	2	3	2	-	-	-	3	1	1	2	2	3	1
CO4	2	1	2	3	3	-	-	-	3	2	3	3	1	1	2
CO5	1	3	3	1	1	-	-	-	2	3	3	2	2	3	2
AVG	2	2.4	2.4	2.2	1.8	-	-	-	2.2	1.8	2.2	2.4	2.2	1.8	1.8

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

SEMESTER VII

U23CB702 SDG: 4	ETHICAL HACKING	Category: PCC			
		L	T	P	C
		3	0	2	4

COURSE OBJECTIVE:

1	To understand the fundamentals of ethical hacking and its legal framework.
2	To explore TCP/IP protocols and their role in network security.
3	To practice using security tools to scan and analyze networks for vulnerabilities.
4	To examine techniques used by attackers to bypass defenses and exploit vulnerabilities.
5	To evaluate vulnerabilities in operating systems and understand their security

UNIT 1	INTRODUCTION	6

Ethical Hacking Overview - Role of Security and Penetration Testers .- Penetration-Testing Methodologies- Laws of the Land - Overview of TCP/IP- The Application Layer - The Transport Layer - The Internet Layer - IP Addressing .- Network and Computer Attacks - Malware – Protecting Against Malware Attacks.- Intruder Attacks - Addressing Physical Security

UNIT 2	FOOT PRINTING, RECONNAISSANCE AND SCANNING NETWORKS	6

Footprinting Concepts - Footprinting through Search Engines, Web Services, Social Networking Sites, Website, Email - Competitive Intelligence - Footprinting through Social Engineering - Footprinting Tools - Network Scanning Concepts - Port-Scanning Tools - Scanning Techniques - Scanning Beyond IDS and Firewall

UNIT 3	ENUMERATION AND VULNERABILITY ANALYSIS	6

Enumeration Concepts - NetBIOS Enumeration – SNMP, LDAP, NTP, SMTP and DNS Enumeration - Vulnerability Assessment Concepts - Desktop and Server OS Vulnerabilities - Windows OS Vulnerabilities - Tools for Identifying Vulnerabilities in Windows- Linux OS Vulnerabilities- Vulnerabilities of Embedded Oss

UNIT 4	SYSTEM HACKING	6

Hacking Web Servers - Web Application Components- Vulnerabilities - Tools for Web Attackers and Security Testers Hacking Wireless Networks - Components of a Wireless Network – Wardriving- Wireless Hacking - Tools of the Trade

UNIT 5	NETWORK PROTECTION SYSTEMS	6

Access Control Lists. - Cisco Adaptive Security Appliance Firewall - Configuration and Risk Analysis Tools for Firewalls and Routers - Intrusion Detection and Prevention Systems - Network-Based and Host-Based IDSs and IPSs - Web Filtering - Security Incident Response Teams – Honeypots.

TOTAL: 30 PERIODS

PRACTICAL EXERCISES:

1. Install Kali or Backtrack Linux / Metasploitable/ Windows XP
2. Practice the basics of reconnaissance.
3. Using FOCA / SearchDiggity tools, extract metadata and expanding the target list.
4. Aggregates information from public databases using online free tools like Paterva’s Maltego.

5. Information gathering using tools like Robtex. 6. Scan the target using tools like Nessus. 7. View and capture network traffic using Wireshark. 8. Automate dig for vulnerabilities and match exploits using Armitage	
TOTAL: 30 PERIODS	
COURSE OUTCOME:	
At the end of the course, students would	
CO1:	Describe basic ethical hacking footprinting and security concepts
CO2:	Demonstrate TCP/IP and security tools for scanning and footprinting.
CO3:	Use security tools to scan, analyze, and monitor networks.
CO4:	Examine security testing, attacks, and methods to bypass defenses.
CO5:	Evaluate OS vulnerabilities and the use of IDS, IPS, and honeypots.
	TOTAL: 60 PERIODS
TEXT BOOKS:	
1.	Michael T. Simpson, Kent Backman, and James E. Corley, Hands-On Ethical Hacking and Network Defense, Course Technology, Delmar Cengage Learning, 2010.
2.	The Basics of Hacking and Penetration Testing - Patrick Engebretson, SYNGRESS, Elsevier, 2013.
3.	The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, Dafydd Stuttard and Marcus Pinto, 2011.
REFERENCES:	
1.	Black Hat Python: Python Programming for Hackers and Pentesters, Justin Seitz , 2014.
2.	FOCA : http://www.informatica64.com/foca.aspx. Nessus : http://www.tenable.com/products/nessus. Wireshark : http://www.wireshark.org. Armitage : http://www.fastandeasyhacking.com/. Kali or Backtrack Linux, Metasploitable, Windows XP

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO 1	PSO 2	PSO3
CO1	3	2	-	1	-	-	-	-	-	-	-	2	-	-
CO2	2	3	2	-	2	-	-	-	-	-	-	3	2	2
CO3	2	3	3	-	3	-	-	-	-	-	-	3	3	2
CO4	2	3	3	-	3	-	-	-	-	-	-	3	3	2
CO5	2	3	3	-	2	-	-	-	-	-	-	3	3	2

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23CS611 SDG: 4 & 8	WEB TECHNOLOGIES LAB	Category: PCC			
		L	T	P	C
		0	0	2	1

COURSE OBJECTIVE:	
1.	
2.	
3.	
4.	
5.	
LIST OF EXPERIMENTS:	
1.	Create a web page with the following using HTML. • To embed an image map in a web page. • To fix the hot spots. Show all the related information when the hot spots are clicked.
2.	Create a web page with all types of Cascading style sheets.
3.	Client Side Scripts for Validating Web Form Controls using DHTML.
4.	Installation of Apache Tomcat web server.
5.	Write programs in Java using Servlets: • To invoke servlets from HTML forms. Session Tracking
6.	Write programs in Java to create three-tier applications using JSP and Databases • For conducting on-line examination. For displaying student mark list. Assume that student information is available in a database which has been stored in a database server.
7.	Programs using XML – Schema – XSLT/XSL.
8.	Mini Project
COURSE OUTCOMES:	
At the end of the course, students would	
CO1:	
CO2:	
CO3:	
CO4:	
CO5:	
	TOTAL: 30 PERIODS

VERTICAL 1

U23CBP11 SDG: 9	APP DEVELOPMENT	Category:			
		L	T	P	C
		2	0	2	3

COURSE OBJECTIVE:

1.	To learn development of native applications with basic GUI components.
2.	To develop cross-platform applications with event handling.
3.	To develop applications with location and data storage capabilities.
4.	To develop web applications with database access.

UNIT 1	FUNDAMENTALS OF MOBILE & WEB APPLICATION DEVELOPMENT	6

Basics of Web and Mobile Application Development – Native App – Hybrid App – Cross-platform App – What is Progressive Web App – Responsive Web Design.

UNIT 2	NATIVE APP DEVELOPMENT USING JAVA	6

Native Web App – Benefits of Native App – Scenarios to create Native App – Tools for creating Native App – Cons of Native App – Popular Native App Development Frameworks – Java & Kotlin for Android – Swift & Objective-C for iOS – Basics of React Native – Native Components – JSX – State – Props.

UNIT 3	HYBRID APP DEVELOPMENT	6

Hybrid Web App – Benefits of Hybrid App – Criteria for creating Native App – Tools for creating Hybrid App – Cons of Hybrid App – Popular Hybrid App Development Frameworks – Ionic – Apache Cordova.

UNIT 4	CROSS-PLATFORM APP DEVELOPMENT USING REACT-NATIVE	6

What is Cross-platform App – Benefits of Cross-platform App – Criteria for creating Cross-platform App – Tools for creating Cross-platform App – Cons of Cross-platform App – Popular Cross-platform App Development Frameworks – Flutter – Xamarin – React-Native – Basics of React Native – Native Components – JSX – State – Props.

UNIT 5	NON-FUNCTIONAL CHARACTERISTICS OF APP FRAMEWORKS	6

Comparison of different App Frameworks – Build Performance – App Performance – Debugging Capabilities – Time to Market – Maintainability – Ease of Development – UI/UX – Reusability.

PRACTICAL EXERCISES:

1. Using React Native, build a cross-platform application for a BMI calculator.
2. Build a cross-platform application for a simple expense manager which allows entering expenses and income on each day and displays category-wise weekly income and expense.
3. Develop a cross-platform application to convert units from the imperial system to the metric system (km to miles, kg to pounds, etc.).
4. Design and develop a cross-platform application for day-to-day task (to-do) management.
5. Design an Android application using Cordova for a user login screen with username, password, reset button and a submit button. Also, include header image and a label. Use layout managers.

6. Design and develop an Android application using Apache Cordova to find and display the current location of the user.
7. Write programs using Java to create Android application having Databases:
   a. For a simple library application.
   b. For displaying books available, books lend, book reservation. Assume that student information is available in a database which has been stored in a database server.

COURSE OUTCOME:

At the end of the course, students would be able to:

CO1:	Develop native applications with GUI components.
CO2:	Develop hybrid applications with basic event handling.
CO3:	Implement cross-platform applications with location and data storage capabilities.
CO4:	Implement cross-platform applications with basic GUI and event handling.
CO5:	Develop web applications with cloud database access.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Dawn Griffiths, "Head First Android Development", O'Reilly, 1st Edition.
2. Raymond K. Camden, "Apache Cordova in Action", Manning, 2015.
3. Anthony Accomazzo, Houssein Djirdeh, Sophia Shoemaker and Devin Abbott, "Full Stack React Native: Create Beautiful Mobile Apps with JavaScript and React Native", FullStack Publishing.

REFERENCES:

1. John Horton, "Android Programming for Beginners", Packt Publishing, 2nd Edition.
2. Shaun Lewis and Mike Dunn, "Native Mobile Development".
3. Pawan Lingras, Matt Triff and Rucha Lingras, "Building Cross-Platform Mobile and Web Apps for Engineers and Scientists: An Active Learning Approach".
4. John M. Wargo, "Apache Cordova 4 Programming", 2015.
5. Daniel Ward, "React Native Cookbook", Packt Publishing, 2nd Edition.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2	PS O3
CO1	3	3	3	1	2	-	-	-	1	1	1	3	1	2	1
CO2	1	3	2	3	1	-	-	-	2	2	3	3	1	2	1
CO3	3	2	2	3	2	-	-	-	3	1	1	2	3	1	2
CO4	2	1	2	3	3	-	-	-	3	2	3	1	1	2	2
CO5	1	3	3	1	1	-	-	-	2	3	3	2	3	2	3
AVG	2	2.4	2.4	2.2	1.8	-	-	-	2.2	1.8	2.2	2.2	1.8	1.8	1.8

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23CBP12 SDG: 9	CLOUD SERVICES MANAGEMENT	Category:			
		L	T	P	C
		2	0	2	3

COURSE OBJECTIVE:

1.	Introduce Cloud Service Management terminology, definition and concepts.
2.	Compare and contrast cloud service management with traditional IT service management.
3.	Identify strategies to reduce risk and eliminate issues associated with adoption of cloud services.
4.	Select appropriate structures for designing, deploying and running cloud-based services in a business environment.
5.	Illustrate the benefits and drive the adoption of cloud-based services to solve real world problems.

UNIT 1	CLOUD SERVICE MANAGEMENT FUNDAMENTALS	6

Cloud Ecosystem – The Essential Characteristics – Basics of Information Technology Service Management and Cloud Service Management – Service Perspectives – Cloud Service Models – Cloud Service Deployment Models.

UNIT 2	CLOUD SERVICES STRATEGY	6

Cloud Strategy Fundamentals – Cloud Strategy Management Framework – Cloud Policy – Key Driver for Adoption – Risk Management – IT Capacity and Utilization – Demand and Capacity Matching – Demand Queueing – Change Management – Cloud Service Architecture.

UNIT 3	CLOUD SERVICE MANAGEMENT	6

Cloud Service Reference Model – Cloud Service Life Cycle – Basics of Cloud Service Design – Dealing with Legacy Systems and Services – Benchmarking of Cloud Services – Cloud Service Capacity Planning – Cloud Service Deployment and Migration – Cloud Marketplace – Cloud Service Operations Management.

UNIT 4	CLOUD SERVICE ECONOMICS	6

Pricing Models for Cloud Services – Freemium – Pay Per Reservation – Pay Per User – Subscription-based Charging – Procurement of Cloud-based Services – Capex vs Opex Shift – Cloud Service Charging – Cloud Cost Models.

UNIT 5	CLOUD SERVICE GOVERNANCE & VALUE	6

IT Governance Definition – Cloud Governance Definition – Cloud Governance Framework – Cloud Governance Structure – Cloud Governance Considerations – Cloud Service Model Risk Matrix – Understanding Value of Cloud Services – Measuring the Value of Cloud Services – Balanced Scorecard – Total Cost of Ownership.

PRACTICAL EXERCISES:

1. Create a Cloud Organization in AWS / Google Cloud or any equivalent open source cloud software like OpenStack, Eucalyptus or OpenNebula with Role-based access control.
2. Create a Cost-model for a web application using various services and do Cost-benefit analysis.

3. Create alerts for usage of Cloud resources.
4. Create Billing alerts for your Cloud Organization.
5. Compare Cloud cost for a simple web application across AWS, Azure and GCP and suggest the best one.

COURSE OUTCOME:

At the end of the course, students would be able to:

CO1:	Exhibit cloud-design skills to build and automate business solutions using cloud technologies.
CO2:	Possess strong theoretical foundation leading to excellence and excitement towards adoption of cloud-based services.
CO3:	Solve the real world problems using Cloud services and technologies.

TOTAL: 60 PERIODS

TEXT BOOKS:

1.	Enamul Haque, "Cloud Service Management and Governance: Smart Service Management in Cloud Era", Enel Publications.
2.	Thomas Erl, Ricardo Puttini and Zaigham Mahmood, "Cloud Computing: Concepts, Technology & Architecture", 2013.
3.	Thomas Erl, Robert Cope and Amin Naserpour, "Cloud Computing Design Patterns".

REFERENCES:

1.	Praveen Ayyappa, "Economics of Cloud Computing", LAP Lambert Academic Publishing.
2.	Rajkumar Buyya, Christian Vecchiola and S. Thamarai Selvi, "Mastering Cloud Computing: Foundations and Applications Programming".

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2	PS O3
CO1	1	2	2	1	-	-	-	-	1	1	2	2	1	2	1
CO2	1	2	1	1	-	-	-	-	2	-	2	2	2	2	1
CO3	2	2	2	1	1	1	-	-	3	-	3	2	2	3	2
CO4	2	3	3	2	-	1	1	-	3	-	3	3	2	3	2
CO5	3	3	3	2	1	1	1	-	3	-	3	3	3	3	3
AVG	1.8	2.4	2.2	1.4	1	1	1	-	2.4	1	2.6	2.4	2	2.6	1.8

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23CBP13 SDG:9	UI AND UX DESIGN	Category:PEC			
		L	T	P	C
		2	0	2	3

COURSE OBJECTIVE:

1.	To provide a sound knowledge in UI and UX.
2.	To understand the need for UI and UX.
3.	To understand the various Research Methods used in Design.
4.	To explore the various Tools used in UI and UX.
5.	Creating a wireframe and prototype.

UNIT 1	FOUNDATIONS OF DESIGN	6

UI vs. UX Design – Core Stages of Design Thinking – Divergent and Convergent Thinking – Brainstorming and Gamestorming – Observational Empathy.

UNIT 2	FOUNDATIONS OF UI DESIGN	6

Visual and UI Principles – UI Elements and Patterns – Interaction Behaviors and Principles – Branding – Style Guides.

UNIT 3	FOUNDATIONS OF UX DESIGN	6

Introduction to User Experience – Why You Should Care about User Experience – Understanding User Experience – Defining the UX Design Process and its Methodology – Research in User Experience Design – Tools and Methods used for Research – User Needs and its Goals – Know about Business Goals.

UNIT 4	WIREFRAMING, PROTOTYPING AND TESTING	6

Sketching Principles – Sketching Red Routes – Responsive Design – Wireframing – Creating Wireflows – Building a Prototype – Building High-Fidelity Mockups – Designing Efficiently with Tools – Interaction Patterns – Conducting Usability Tests – Other Evaluative User Research Methods – Synthesizing Test Findings – Prototype Iteration.

UNIT 5	RESEARCH, DESIGNING, IDEATING & INFORMATION ARCHITECTURE	6

Identifying and Writing Problem Statements – Identifying Appropriate Research Methods – Creating Personas – Solution Ideation – Creating User Stories – Creating Scenarios – Flow Diagrams – Flow Mapping – Information Architecture.

PRACTICAL EXERCISES:

1. Designing a responsive layout for a societal application.
2. Exploring various UI interaction patterns.
3. Developing an interface with proper UI style guides.
4. Developing a wireflow diagram for an application using open source software.
5. Exploring various open source collaborative interface platforms.
6. Hands on Design Thinking Process for a new product.
7. Brainstorming features for a proposed product.
8. Defining the look and feel of the new project.

9. Create a sample pattern library for that product (Mood board, Fonts, Colors based on UI principles).
10. Identify a customer problem to solve.
11. Conduct end-to-end user research: user research, creating personas, ideation process (user stories, scenarios), flow diagrams and flow mapping.
12. Sketch, design with a popular tool, build a prototype, perform usability testing and identify improvements.

COURSE OUTCOME:

At the end of the course, students would be able to:

CO1:	Build UI for user applications.
CO2:	Evaluate UX design of any product or application.
CO3:	Demonstrate UX skills in product development.
CO4:	Implement sketching principles.
CO5:	Create wireframe and prototype.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Joel Marsh, "UX for Beginners", O'Reilly, 2022.
2. Jon Yablonski, "Laws of UX: Using Psychology to Design Better Products & Services", O'Reilly, 2021.

REFERENCES:

1. Jenifer Tidwell, Charles Brewer and Aynne Valencia, "Designing Interfaces", 3rd Edition, O'Reilly, 2020.
2. Adam Wathan and Steve Schoger, "Refactoring UI", 2018.
3. Steve Krug, "Don't Make Me Think, Revisited: A Common Sense Approach to Web and Mobile Usability", Third Edition, 2015.
4. https://www.nngroup.com/articles/
5. https://www.interaction-design.org/literature

CO's-PO's & PSO's MAPPING

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CO2	3	3	3	2	-	-	-	-	1	-	1	2	3	2	3
CO3	3	2	2	1	1	-	1	1	2	-	1	2	3	1	3
CO4	3	2	3	2	2	-	1	-	2	-	3	3	3	2	3
CO5	2	3	3	2	3	-	-	2	3	-	2	3	3	1	2
AVG	2.6	2.6	2.4	1.8	1.7	-	1	1.5	2	-	1.8	2.4	3	1.4	2.6

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23CBP14 SDG: 9	SOFTWARE TESTING AND AUTOMATION	Category:PEC			
		L	T	P	C
		2	0	2	3

COURSE OBJECTIVE:

1.	To understand the basics of software testing.
2.	To learn how to do the testing and planning effectively.
3.	To build test cases and execute them.
4.	To focus on wide aspects of testing and understanding multiple facets of testing.
5.	To get an insight about test automation and the tools used for test automation.

UNIT 1	FOUNDATIONS OF SOFTWARE TESTING	6

Why do we test Software? – Black-Box Testing and White-Box Testing – Software Testing Life Cycle – V-model of Software Testing – Program Correctness and Verification – Reliability versus Safety – Failures, Errors and Faults (Defects) – Software Testing Principles – Program Inspections – Stages of Testing: Unit Testing, Integration Testing, System Testing.

UNIT 2	TEST PLANNING	6

The Goal of Test Planning – High Level Expectations – Intergroup Responsibilities – Test Phases – Test Strategy – Resource Requirements – Tester Assignments – Test Schedule – Test Cases – Bug Reporting – Metrics and Statistics.

UNIT 3	TEST DESIGN AND EXECUTION	6

Test Objective Identification – Test Design Factors – Requirement Identification – Testable Requirements – Modeling a Test Design Process – Modeling Test Results – Boundary Value Testing – Equivalence Class Testing – Path Testing – Data Flow Testing – Test Design Preparedness Metrics – Test Case Design Effectiveness – Model-Driven Test Design – Test Procedures – Test Case Organization and Tracking – Bug Reporting – Bug Life Cycle.

UNIT 4	ADVANCED TESTING CONCEPTS	6

Performance Testing: Load Testing, Stress Testing, Volume Testing – Fail-Over Testing – Recovery Testing – Configuration Testing – Compatibility Testing – Usability Testing – Testing the Documentation – Security Testing – Testing in the Agile Environment – Testing Web and Mobile Applications.

UNIT 5	TEST AUTOMATION AND TOOLS	6

Automated Software Testing – Automate Testing of Web Applications – Selenium: Introducing Web Driver and Web Elements – Locating Web Elements – Actions on Web Elements – Different Web Drivers – Understanding Web Driver Events – TestNG: Understanding testng.xml – Adding Classes, Packages and Methods to Test – Test Reports.

PRACTICAL EXERCISES:

1. Develop the test plan for testing an e-commerce web/mobile application (www.amazon.in).
2. Design the test cases for testing the e-commerce application.
3. Test the e-commerce application and report the defects in it.
4. Develop the test plan and design the test cases for an inventory control system.
5. Execute the test cases against a client server or desktop application and identify the defects.
6. Test the performance of the e-commerce application.

7. Automate the testing of e-commerce applications using Selenium.
8. Integrate TestNG with the above test automation.
9. Mini Project:
    a. Build a data-driven framework using Selenium and TestNG.
    b. Build Page Object Model using Selenium and TestNG.
    c. Build BDD framework with Selenium, TestNG and Cucumber.

COURSE OUTCOME:

At the end of the course, students would be able to:

CO1:	Understand the basic concepts of software testing and the need for software testing.
CO2:	Design test planning and different activities involved in test planning.
CO3:	Design effective test cases that can uncover critical defects in the application.
CO4:	Carry out advanced types of testing.
CO5:	Automate the software testing using Selenium and TestNG.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Yogesh Singh, "Software Testing", Cambridge University Press, 2012.
2. Unmesh Gundecha and Satya Avasarala, "Selenium WebDriver 3 Practical Guide", Second Edition, 2018.

REFERENCES:

1. Glenford J. Myers, Corey Sandler and Tom Badgett, "The Art of Software Testing", 3rd Edition, John Wiley & Sons, Inc., 2012.
2. Ron Patton, "Software Testing", 2nd Edition, Sams Publishing, 2006.
3. Paul C. Jorgensen, "Software Testing: A Craftsman's Approach", Fourth Edition, Taylor & Francis Group, 2014.
4. Carl Cocchiaro, "Selenium Framework Design in Data-Driven Testing", Packt Publishing, 2018.
5. Elfriede Dustin, Thom Garrett and Bernie Gaurf, "Implementing Automated Software Testing", Pearson Education, Inc., 2009.
6. Satya Avasarala, "Selenium WebDriver Practical Guide", Packt Publishing, 2014.
7. Varun Menon, "TestNG Beginner's Guide", Packt Publishing, 2013.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O 1	PS O 2	PSO3
CO1	1	3	-	2	-	-	-	-	-	-	-	-	2	
CO2	2	3	-	2	-	-	-	-	-	-	-	-	3	
CO3	2	2	1	2	1	-	-	-	-	-	-	1	2	
CO4	2	2	1	3	-	-	-	-	-	-	-	-	1	
CO5	1	1	2	2	3	-	-	-	-	-	-	2	1	
AVG	1.6	2.2	1.3	2.2	2	-	-	-	-	-	-	1.5	1.8	

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23CBP15 SDG:9	DEVOPS	Category:			
		L	T	P	C
		2	0	2	3

COURSE OBJECTIVE:

1.	To introduce DevOps terminology, definition and concepts.
2.	To understand the different Version Control tools like Git and Mercurial.
3.	To understand the concepts of Continuous Integration, Continuous Testing and Continuous Deployment.
4.	To understand Configuration Management using Ansible.
5.	Illustrate the benefits and drive the adoption of cloud-based DevOps tools to solve real world problems.

UNIT 1	INTRODUCTION TO DEVOPS	6

DevOps Essentials – Introduction to AWS, GCP and Azure – Version Control Systems: Git and GitHub.

UNIT 2	COMPILE AND BUILD USING MAVEN & GRADLE	6

Introduction – Installation of Maven – POM Files – Maven Build Lifecycle – Build Phases (Compile, Build, Test, Package) – Maven Profiles – Maven Repositories (Local, Central, Global) – Maven Plugins – Maven Create and Build Artifacts – Dependency Management – Installation of Gradle – Understand Build using Gradle.

UNIT 3	CONTINUOUS INTEGRATION USING JENKINS	6

Install and Configure Jenkins – Jenkins Architecture Overview – Creating a Jenkins Job – Configuring a Jenkins Job – Introduction to Plugins – Adding Plugins to Jenkins – Commonly used Plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended Choice Parameters) – Configuring Jenkins to work with Java, Git and Maven – Creating a Jenkins Build and Jenkins Workspace.

UNIT 4	CONFIGURATION MANAGEMENT USING ANSIBLE	6

Ansible Introduction – Installation – Ansible Master/Slave Configuration – YAML Basics – Ansible Modules – Ansible Inventory Files – Ansible Playbooks – Ansible Roles – Adhoc Commands in Ansible.

UNIT 5	BUILDING DEVOPS PIPELINES USING AZURE	6

Create GitHub Account – Create Repository – Create Azure Organization – Create a New Pipeline – Build a Sample Code – Modify azure-pipelines.yaml File.

PRACTICAL EXERCISES:

1. Create Maven Build pipeline in Azure.
2. Run regression tests using Maven Build pipeline in Azure.
3. Install Jenkins in Cloud.
4. Create CI pipeline using Jenkins.
5. Create a CD pipeline in Jenkins and deploy in Cloud.
6. Create an Ansible playbook for a simple web application infrastructure.
7. Build a simple application using Gradle.

8. Install Ansible, configure Ansible roles and write playbooks.	
COURSE OUTCOME:	
At the end of the course, students would be able to:	
CO1:	Understand different actions performed through Version Control tools like Git.
CO2:	Perform Continuous Integration, Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven and Gradle.
CO3:	Perform automated Continuous Deployment.
CO4:	Perform configuration management using Ansible.
CO5:	Leverage cloud-based DevOps tools using Azure DevOps.
	TOTAL: 60 PERIODS

TEXT BOOKS:	
1.	Roberto Vormittag, "A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises", Second Edition, Kindle Edition, 2016.
2.	Jason Cannon, "Linux for Beginners: An Introduction to the Linux Operating System and Command Line", Kindle Edition, 2014.
REFERENCES:	
1.	Mitesh Soni, "Hands-On Azure DevOps: CICD Implementation for Mobile, Hybrid and Web Applications Using Azure DevOps and Microsoft Azure", 2020.
2.	Jeff Geerling, "Ansible for DevOps: Server and Configuration Management for Humans", First Edition, 2015.
3.	David Johnson, "Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps", Second Edition, 2016.
4.	Mariot Tsitoara, "Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer", Second Edition, 2019.
5.	https://www.jenkins.io/user-handbook.pdf
6.	https://maven.apache.org/guides/getting-started/

CO's-PO's & PSO's MAPPING

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

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23CBP16 SDG:9	PRINCIPLES OF PROGRAMMING LANGUAGES	Category:PEC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

1.	To understand and describe syntax and semantics of programming languages.
2.	To understand data, data types, and basic statements.
3.	To understand call-return architecture and ways of implementing them.
4.	To understand object-orientation, concurrency, and event handling in programming languages.
5.	To develop programs in non-procedural programming paradigms.

UNIT 1	SYNTAX AND SEMANTICS	9

Evolution of Programming Languages – Describing Syntax – Context-Free Grammars – Attribute Grammars – Describing Semantics – Lexical Analysis – Parsing – Recursive-Descent – Bottom-Up Parsing.

UNIT 2	DATA, DATA TYPES, AND BASIC STATEMENTS	9

Names – Variables – Binding – Type Checking – Scope – Scope Rules – Lifetime and Garbage Collection – Primitive Data Types – Strings – Array Types – Associative Arrays – Record Types – Union Types – Pointers and References – Arithmetic Expressions – Overloaded Operators – Type Conversions – Relational and Boolean Expressions – Assignment Statements – Mixed Mode Assignments – Control Structures – Selection – Iterations – Branching – Guarded Statements.

UNIT 3	SUBPROGRAMS AND IMPLEMENTATIONS	9

Subprograms – Design Issues – Local Referencing – Parameter Passing – Overloaded Methods – Generic Methods – Design Issues for Functions – Semantics of Call and Return – Implementing Simple Subprograms – Stack and Dynamic Local Variables – Nested Subprograms – Blocks – Dynamic Scoping.

UNIT 4	OBJECT-ORIENTATION, CONCURRENCY, AND EVENT HANDLING	9

Object-Orientation – Design Issues for OOP Languages – Implementation of Object-Oriented Constructs – Concurrency – Semaphores – Monitors – Message Passing – Threads – Statement Level Concurrency – Exception Handling – Event Handling.

UNIT 5	FUNCTIONAL AND LOGIC PROGRAMMING LANGUAGES	9

Introduction to Lambda Calculus – Fundamentals of Functional Programming Languages – Programming with Scheme – Programming with ML – Introduction to Logic and Logic Programming – Programming with Prolog – Multi-Paradigm Languages.

COURSE OUTCOME:

At the end of the course, students would be able to:

CO1:	Describe syntax and semantics of programming languages.
CO2:	Explain data, data types, and basic statements of programming languages.
CO3:	Design and implement subprogram constructs.

CO4:	Apply object-oriented, concurrency, and event handling programming constructs and develop programs in Scheme, ML and Prolog.
CO5:	Understand and adopt new programming languages.
	TOTAL: 45 PERIODS

TEXT BOOKS:

1.	Robert W. Sebesta, "Concepts of Programming Languages", Twelfth Edition (Global Edition), Pearson, 2022.
2.	Michael L. Scott, "Programming Language Pragmatics", Fourth Edition, Elsevier, 2018.
3.	R. Kent Dybvig, "The Scheme Programming Language", Fourth Edition, Prentice Hall, 2011.
4.	Jeffrey D. Ullman, "Elements of ML Programming", Second Edition, Pearson, 1997.
5.	W. F. Clocksin and C. S. Mellish, "Programming in Prolog: Using the ISO Standard", Fifth Edition, Springer, 2003.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	2	2	3	2	1	-	-	-	-	-	-	3	2	3	
CO2	3	3	3	2	2	-	-	-	-	-	-	3	2	3	
CO3	3	3	3	2	2	-	-	-	-	-	-	3	2	3	
CO4	3	3	3	3	2	2	-	-	-	-	-	-	3	2	
CO5	3	3	3	3	3	3	2	2	1	3	1	3	3	3	
AVG	2.8	2.8	3	2.4	2	2.5	2	2	1	3	1	3	2.4	2.8	

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23CBP21 SDG:9	CLOUD COMPUTING	Category: PEC			
		L	T	P	C
		2	0	2	3

COURSE OBJECTIVE:

1.	To understand the principles of cloud architecture, models and infrastructure.
2.	To understand the concepts of virtualization and virtual machines.
3.	To gain knowledge about virtualization infrastructure.
4.	To explore and experiment with various Cloud deployment environments.
5.	To learn about the security issues in the cloud environment.

UNIT 1	CLOUD ARCHITECTURE, MODELS AND INFRASTRUCTURE	6

Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud Deployment Models – Cloud Service Models; Cloud Infrastructure: Architectural Design of Compute and Storage Clouds – Design Challenges.

UNIT 2	VIRTUALIZATION BASICS	6

Virtual Machine Basics – Taxonomy of Virtual Machines – Hypervisor – Key Concepts – Virtualization Structure – Implementation Levels of Virtualization – Virtualization Types: Full Virtualization – Para Virtualization – Hardware Virtualization – Virtualization of CPU, Memory and I/O Devices.

UNIT 3	VIRTUALIZATION INFRASTRUCTURE AND DOCKER	7

Desktop Virtualization – Network Virtualization – Storage Virtualization – System-level of Operating Virtualization – Application Virtualization – Virtual Clusters and Resource Management – Containers vs. Virtual Machines – Introduction to Docker – Docker Components – Docker Container – Docker Images and Repositories.

UNIT 4	CLOUD DEPLOYMENT ENVIRONMENT	6

Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments – Eucalyptus – OpenStack.

UNIT 5	CLOUD SECURITY	5

Virtualization System-Specific Attacks: Guest Hopping – VM Migration Attack – Hyperjacking – Data Security and Storage; Identity and Access Management (IAM) – IAM Challenges – IAM Architecture and Practice.

PRACTICAL EXERCISES:

1. Install VirtualBox / VMware / equivalent open source Workstation with different flavours of Linux or Windows OS on top of Windows 8 and above.
2. Install a C compiler in the virtual machine created using a virtual box and execute simple programs.
3. Install Google App Engine. Create a hello world app and other simple web applications using Python / Java.
4. Use the GAE launcher to launch the web applications.
5. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.

6. Find a procedure to transfer the files from one virtual machine to another virtual machine.
7. Install Hadoop single node cluster and run simple applications like wordcount.
8. Creating and executing your first container using Docker.
9. Run a container from Docker Hub.

COURSE OUTCOME:

At the end of the course, students would be able to:

CO1:	Understand the design challenges in the cloud.
CO2:	Apply the concept of virtualization and its types.
CO3:	Experiment with virtualization of hardware resources and Docker.
CO4:	Develop and deploy services on the cloud and set up a cloud environment.
CO5:	Explain security challenges in the cloud environment.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Kai Hwang, Geoffrey C. Fox and Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. James Turnbull, "The Docker Book", O'Reilly Publishers, 2014.
3. R. L. Krutz and R. D. Vines, "Cloud Security: A Comprehensive Guide to Secure Cloud Computing", Wiley Publishing, 2010.

REFERENCES:

1. James E. Smith and Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier / Morgan Kaufmann, 2005.
2. Tim Mather, Subra Kumaraswamy and Shahed Latif, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance", O'Reilly Media, Inc., 2009.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	3	2	1	1	1	-	-	-	2	3	1	3	2	1	3
CO2	3	1	2	2	1	-	-	-	1	2	1	3	2	2	3
CO3	2	3	2	3	1	-	-	-	3	1	1	3	1	1	2
CO4	1	2	3	3	3	-	-	-	3	3	1	2	1	3	1
CO5	2	3	3	1	3	-	-	-	2	2	1	2	2	2	2
AVG	2.2	2.2	2.2	2	1.8	-	-	-	2.2	2.2	1	2.6	1.6	1.8	2.2

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23CBP22 SDG: 9	VIRTUALIZATION	Category: PEC			
		L	T	P	C
		2	0	2	3

COURSE OBJECTIVE:

1.	To Learn the basics and types of Virtualization.
2.	To understand the Hypervisors and its types.
3.	To Explore the Virtualization Solutions.
4.	To Experiment the virtualization platforms.

UNIT I	INTRODUCTION TO VIRTUALIZATION	7

Virtualization and cloud computing - Need of virtualization: cost, administration, fast deployment, reduce infrastructure cost - Limitations - Types of hardware virtualization: Full virtualization - Partial virtualization - Paravirtualization - Types of Hypervisors.

UNIT II	SERVER AND DESKTOP VIRTUALIZATION	6

Virtual machine basics - Types of virtual machines - Understanding Server Virtualization - Types of server virtualization - Business Cases for Server Virtualization - Uses of Virtual Server Consolidation - Selecting Server Virtualization Platform - Desktop Virtualization - Types of Desktop Virtualization.

UNIT III	NETWORK VIRTUALIZATION	6

Introduction to Network Virtualization - Advantages - Functions - Tools for Network Virtualization - VLAN - WAN Architecture - WAN Virtualization.

UNIT IV	STORAGE VIRTUALIZATION	5

Memory Virtualization - Types of Storage Virtualization - Block, File - Address space Remapping - Risks of Storage Virtualization - SAN - NAS - RAID.

UNIT V	VIRTUALIZATION TOOLS	6

VMWare - Amazon AWS - Microsoft HyperV - Oracle VM Virtual Box - IBM PowerVM - Google Virtualization - Case study.

PRACTICAL EXERCISES:

- Create type 2 virtualization in VMWARE or any equivalent Open Source Tool. Allocate memory and storage space as per requirement. Install Guest OS on that VMWARE.
- Shrink and extend virtual disk.
- Create, Manage, Configure and schedule snapshots.
- Create Spanned, Mirrored and Striped volume.
- Create RAID 5 volume.
- Desktop Virtualization using VNC.

- Desktop Virtualization using Chrome Remote Desktop.
- Create type 2 virtualization on ESXI 6.5 server.
- Create a VLAN in CISCO packet tracer.
- Install KVM in Linux.
- Create Nested Virtual Machine (VM under another VM).

COURSE OUTCOME:

At the end of the course, students would

CO1:	Analyse the virtualization concepts and Hypervisor.
CO2:	Apply the Virtualization for real-world applications.
CO3:	Install & Configure the different VM platforms.
CO4:	Experiment with the VM with various software.

TOTAL: 60 PERIODS

TEXT BOOKS:

1.	Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", TATA McGraw-Hill, New Delhi, 2010.
2.	Rajkumar Buyya, James Broberg, Andrzej Goscinski (Eds.), "Cloud Computing: Principles and Paradigms", John Wiley & Sons, Inc., 2011.
3.	David Marshall, Wade A. Reynolds, "Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center", Auerbach Publications, 2006.

REFERENCES:

1.	Chris Wolf, Erick M. Halter, "Virtualization: From the Desktop to the Enterprise", APress, 2005.
2.	James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2	PS O3
CO1	1	3	1	3	2	-	-	-	1	1	3	1	2	3	
CO2	3	2	2	1	2	-	-	-	1	2	2	3	3	2	
CO3	3	2	1	3	1	-	-	-	2	2	1	3	3	3	
CO4	1	1	2	3	3	-	-	-	3	3	1	1	3	2	
CO5	1	3	2	3	1	-	-	-	2	1	3	3	1	1	
AVG	1.8	2.2	1.6	2.6	1.8	-	-	-	1.8	1.8	2	2.2	2.4	2.2	

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23CBP24 SDG:9	DATA WAREHOUSING	Category:PEC			
		L	T	P	C
		2	0	2	3

COURSE OBJECTIVE:

1.	To know the details of data warehouse architecture.
2.	To understand the OLAP technology.
3.	To understand the partitioning strategy.
4.	To differentiate various schema.
5.	To understand the roles of process manager and system manager.

UNIT 1	INTRODUCTION TO DATA WAREHOUSE	5

Data Warehouse Introduction – Data Warehouse Components – Operational Database vs. Data Warehouse – Data Warehouse Architecture – Three-Tier Data Warehouse Architecture – Autonomous Data Warehouse – Autonomous Data Warehouse vs. Snowflake – Modern Data Warehouse.

UNIT 2	ETL AND OLAP TECHNOLOGY	6

What is ETL – ETL vs. ELT – Types of Data Warehouses – Data Warehouse Design and Modeling – Delivery Process – Online Analytical Processing (OLAP) – Characteristics of OLAP – Online Transaction Processing (OLTP) vs. OLAP – OLAP Operations – Types of OLAP – ROLAP vs. MOLAP vs. HOLAP.

UNIT 3	META DATA, DATA MART AND PARTITION STRATEGY	7

Meta Data – Categories of Metadata – Role of Metadata – Metadata Repository – Challenges for Meta Management – Data Mart – Need of Data Mart – Cost Effective Data Mart – Designing Data Marts – Cost of Data Marts – Partitioning Strategy – Vertical Partition – Normalization – Row Splitting – Horizontal Partition.

UNIT 4	DIMENSIONAL MODELING AND SCHEMA	6

Dimensional Modeling – Multi-Dimensional Data Modeling – Data Cube – Star Schema – Snowflake Schema – Star vs. Snowflake Schema – Fact Constellation Schema – Schema Definition – Process Architecture – Types of Database Parallelism – Data Warehouse Tools.

UNIT 5	SYSTEM & PROCESS MANAGERS	6

Data Warehousing System Managers: System Configuration Manager – System Scheduling Manager – System Event Manager – System Database Manager – System Backup Recovery Manager – Data Warehousing Process Managers: Load Manager – Warehouse Manager – Query Manager – Tuning – Testing.

PRACTICAL EXERCISES:

1. Data exploration and integration with WEKA.
2. Apply WEKA tool for data validation.
3. Plan the architecture for real time application.
4. Write the query for schema definition.
5. Design data warehouse for real time applications.
6. Analyse the dimensional modeling.

7. Case study using OLAP.
8. Case study using OLTP.
9. Implementation of warehouse testing.

COURSE OUTCOME:

At the end of the course, students would be able to:

CO1:	Design data warehouse architecture for various problems.
CO2:	Apply the OLAP technology.
CO3:	Analyse the partitioning strategy.
CO4:	Critically analyze the differentiation of various schema for a given problem.
CO5:	Frame roles of process manager and system manager.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Alex Berson and Stephen J. Smith, "Data Warehousing, Data Mining & OLAP", Tata McGraw-Hill Edition, Thirteenth Reprint, 2008.
2. Ralph Kimball, "The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling", Third Edition, 2013.

REFERENCES:

1. Paul Raj Ponniah, "Data Warehousing Fundamentals for IT Professionals", 2012.
2. K. P. Soman, Shyam Diwakar and V. Ajay, "Insight into Data Mining: Theory and Practice", Eastern Economy Edition, Prentice Hall of India, 2006.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	3	3	3	2	2	-	-	-	3	-	-	3			
CO2	3	2	2	2	3	-	-	-	2	-	2	2			
CO3	3	3	3	3	-	-	-	-	-	-	-	3			
CO4	3	3	3	3	-	-	-	-	-	-	-	3			
CO5	3	2	2	2	-	2	-	-	-	-	2	2			
AVG	3	2.6	2.6	2.4	2.5	2	-	-	2.5	-	2	2.6			

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23CBP25 SDG: 9	STORAGE TECHNOLOGIES	Category:PEC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

1.	Characterize the functionalities of logical and physical components of storage.
2.	Describe various storage networking technologies.
3.	Identify different storage virtualization technologies.
4.	Discuss the different backup and recovery strategies.
5.	Understand common storage management activities and solutions.

UNIT 1	STORAGE SYSTEMS	9

Introduction to Information Storage: Digital Data and its Types – Information Storage – Key Characteristics of Data Center – Evolution of Computing Platforms – Information Lifecycle Management. Third Platform Technologies: Cloud Computing and its Essential Characteristics – Cloud Services and Cloud Deployment Models – Big Data Analytics – Social Networking and Mobile Computing – Characteristics of Third Platform Infrastructure – Imperatives for Third Platform Transformation. Data Center Environment: Building Blocks of a Data Center – Compute Systems and Compute Virtualization – Software-Defined Data Center.

UNIT 2	INTELLIGENT STORAGE SYSTEMS AND RAID	5

Components of an Intelligent Storage System – Components, Addressing, and Performance of Hard Disk Drives and Solid-State Drives – RAID – Types of Intelligent Storage Systems – Scale-up and Scale-out Storage Architecture.

UNIT 3	STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION	13

Block-Based Storage System – File-Based Storage System – Object-Based and Unified Storage. Fibre Channel SAN: Software-Defined Networking – FC SAN Components and Architecture – FC SAN Topologies, Link Aggregation, and Zoning – Virtualization in FC SAN Environment. Internet Protocol SAN: iSCSI Protocol, Network Components, and Connectivity – Link Aggregation, Switch Aggregation, and VLAN – FCIP Protocol, Connectivity, and Configuration. Fibre Channel over Ethernet SAN: Components of FCoE SAN – FCoE SAN Connectivity – Converged Enhanced Ethernet – FCoE Architecture.

UNIT 4	BACKUP, ARCHIVE AND REPLICATION	12

Introduction to Business Continuity – Backup Architecture – Backup Targets and Methods – Data Deduplication – Cloud-Based and Mobile Device Backup – Data Archive – Uses of Replication and its Characteristics – Compute-Based, Storage-Based, and Network-Based Replication – Data Migration – Disaster Recovery as a Service (DRaaS).

UNIT 5	SECURING STORAGE INFRASTRUCTURE	6

Information Security Goals – Storage Security Domains – Threats to a Storage Infrastructure – Security Controls to Protect a Storage Infrastructure – Governance, Risk, and Compliance – Storage Infrastructure Management Functions – Storage Infrastructure Management Processes.

COURSE OUTCOME:	
At the end of the course, students would be able to:	
CO1:	Demonstrate the fundamentals of information storage management and various models of cloud infrastructure services and deployment.
CO2:	Illustrate the usage of advanced intelligent storage systems and RAID.
CO3:	Interpret various storage networking architectures – SAN, including storage subsystems and virtualization.
CO4:	Examine the different roles in providing disaster recovery and remote replication technologies.
CO5:	Infer the security needs and security measures to be employed in information storage management.
	TOTAL: 45 PERIODS

TEXT BOOKS:	
1.	EMC Corporation, "Information Storage and Management", Wiley, India.
2.	Jon Tate, Pall Beck, Hector Hugo Ibarra, Shanmuganathan Kumaravel and Libor Miklas, "Introduction to Storage Area Networks", Ninth Edition, IBM Redbooks, December 2017.
3.	Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka and Nils Haustein, "Storage Networks Explained", Second Edition, Wiley, 2009.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	2	2	3	3	2	-	-	-	1	-	-	2	3		
CO2	3	1	2	2	3	-	-	-	2	-	-	3	2	1	
CO3	1	2	2	3	2	-	-	-	1	-	-	2	2	2	
CO4	2	3	2	2	3	-	-	-	2	-	-	2	3		
CO5	2	2	3	1	2	-	-	-	3	-	-	2	3	1	
AVG	2	2	2.4	2.2	2.4	-	-	-	1.8	-	-	2.2	2.6	1.3	

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23CBP26 SDG:9	SOFTWARE DEFINED NETWORKS	Category: PEC			
		L	T	P	C
		2	0	2	3

COURSE OBJECTIVE:

1.	To understand the need for SDN and its data plane operations.
2.	To understand the functions of control plane.
3.	To comprehend the migration of networking functions to SDN environment.
4.	To explore various techniques of network function virtualization.
5.	To comprehend the concepts behind network virtualization.

UNIT 1	SDN: INTRODUCTION	6

Evolving Network Requirements – The SDN Approach – SDN Architecture – SDN Data Plane, Control Plane and Application Plane.

UNIT 2	SDN DATA PLANE AND CONTROL PLANE	6

Data Plane Functions and Protocols – OpenFlow Protocol – Flow Table – Control Plane Functions – Southbound Interface – Northbound Interface – SDN Controllers – Ryu, OpenDaylight, ONOS – Distributed Controllers.

UNIT 3	SDN APPLICATIONS	6

SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking.

UNIT 4	NETWORK FUNCTION VIRTUALIZATION	6

Network Virtualization – Virtual LANs – OpenFlow VLAN Support – NFV Concepts – Benefits and Requirements – Reference Architecture.

UNIT 5	NFV FUNCTIONALITY	6

NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFV Use Cases – SDN and NFV.

PRACTICAL EXERCISES:

1. Setup your own virtual SDN lab (VirtualBox / Mininet Environment for SDN – http://mininet.org, https://www.kathara.org, GNS3).
2. Create a simple Mininet topology with SDN controller and use Wireshark to capture and visualize the OpenFlow messages such as OpenFlow FLOW MOD, PACKET IN, PACKET OUT, etc.
3. Create an SDN application that uses the Northbound API to program flow table rules on the switch for various use cases like L2 learning switch, Traffic Engineering, Firewall, etc.
4. Create a simple end-to-end network service with two VNFs using vim-emu (https://github.com/containernet/vim-emu).
5. Install OSM and onboard and orchestrate a network service.

COURSE OUTCOME:

At the end of the course, students would be able to:

CO1:	Describe the motivation behind SDN.
CO2:	Identify the functions of the data plane and control plane.

CO3:	Design and develop network applications using SDN.
CO4:	Orchestrate network services using NFV.
CO5:	Explain various use cases of SDN and NFV.
	TOTAL: 60 PERIODS

TEXT BOOKS:	
1.	William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud", First Edition, Pearson Education, 2015.
REFERENCES:	
1.	Ken Gray and Thomas D. Nadeau, "Network Function Virtualization", Morgan Kaufmann, 2016.
2.	Thomas D. Nadeau and Ken Gray, "SDN: Software Defined Networks", O'Reilly Media, 2013.
3.	Fei Hu, "Network Innovation through OpenFlow and SDN: Principles and Design", First Edition, CRC Press, 2014.
4.	Paul Goransson, Chuck Black and Timothy Culver, "Software Defined Networks: A Comprehensive Approach", Second Edition, Morgan Kaufmann, 2016.
5.	Oswald Coker and Siamak Azodolmolky, "Software-Defined Networking with OpenFlow", Second Edition, O'Reilly Media, 2017.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2	PS O3
CO1	3	2	2	2	-	-	-	-	-	-	-	2	-	3	
CO2	2	2	3	2	-	-	-	-	-	-	-	3	3	-	
CO3	2	3	2	1	-	-	-	-	-	-	-	2	2	2	
CO4	2	3	3	2	-	-	-	-	-	-	-	2	-	3	
CO5	2	2	1	1	-	-	-	-	-	-	-	1	1	2	
AVG	2.2	2.4	2.2	1.6	-	-	-	-	-	-	-	2	2	2.5	

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23CBP27 SDG: 9	STREAM PROCESSING	Category: PEC			
		L	T	P	C
		2	0	2	3

COURSE OBJECTIVE:

1.	Introduce Data Processing terminology, definition & concepts.
2.	Define different types of Data Processing.
3.	Explain the concepts of Real-time Data processing.
4.	Select appropriate structures for designing and running real-time data services in a business environment.
5.	Illustrate the benefits and drive the adoption of real-time data services to solve real world problems.

UNIT I	FOUNDATIONS OF DATA SYSTEMS	6

Introduction to Data Processing, Stages of Data processing, Data Analytics, Batch Processing, Stream processing, Data Migration, Transactional Data processing, Data Mining, Data Management Strategy, Storage, Processing, Integration, Analytics, Benefits of Data as a Service, Challenges.

UNIT II	REAL-TIME DATA PROCESSING	6

Introduction to Big data, Big data infrastructure, Real-time Analytics, Near real-time solution, Lambda architecture, Kappa Architecture, Stream Processing, Understanding Data Streams, Message Broker, Stream Processor, Batch & Real-time ETL tools, Streaming Data Storage.

UNIT III	DATA MODELS AND QUERY LANGUAGES	6

Relational Model, Document Model, Key-Value Pairs, NoSQL, Object-Relational Mismatch, Many-to-One and Many-to-Many Relationships, Network data models, Schema Flexibility, Structured Query Language, Data Locality for Queries, Declarative Queries, Graph Data models, Cypher Query Language, Graph Queries in SQL, The Semantic Web, CODASYL, SPARQL.

UNIT IV	EVENT PROCESSING WITH APACHE KAFKA	6

Apache Kafka, Kafka as Event Streaming platform, Events, Producers, Consumers, Topics, Partitions, Brokers, Kafka APIs, Admin API, Producer API, Consumer API, Kafka Streams API, Kafka Connect API.

UNIT V	REAL-TIME PROCESSING USING SPARK STREAMING	6

Structured Streaming, Basic Concepts, Handling Event-time and Late Data, Fault-tolerant Semantics, Exactly-once Semantics, Creating Streaming Datasets, Schema Inference, Partitioning of Streaming datasets, Operations on Streaming Data, Selection, Aggregation, Projection, Watermarking, Window operations, Types of Time windows, Join Operations, Deduplication.

PRACTICAL EXERCISES:

- Install MongoDB.

- Design and Implement Simple application using MongoDB.
- Query the designed system using MongoDB.
- Create an Event Stream with Apache Kafka.
- Create a Real-time Stream processing application using Spark Streaming.
- Build a Micro-batch application.
- Real-time Fraud and Anomaly Detection.
- Real-time personalization, Marketing, Advertising.

COURSE OUTCOME:

At the end of the course, students would

CO1:	Understand the applicability and utility of different streaming algorithms.
CO2:	Describe and apply current research trends in data-stream processing.
CO3:	Analyze the suitability of stream mining algorithms for data stream systems.
CO4:	Program and build stream processing systems, services and applications.
CO5:	Solve problems in real-world applications that process data streams.

TOTAL: 60 PERIODS

TEXT BOOKS:

1.	Tyler Akidau, Slava Chemyak, Reuven Lax, "Streaming Systems: The What, Where, When and How of Large-Scale Data Processing", O'Reilly Publication.
2.	Martin Kleppmann, "Designing Data-Intensive Applications", O'Reilly Media.
3.	"Practical Real-time Data Processing and Analytics: Distributed Computing and Event Processing using Apache Spark, Flink, Storm and Kafka", Packt Publishing.

REFERENCES:

1.	https://spark.apache.org/docs/latest/streaming-programming-guide.html
2.	https://kafka.apache.org

U23CBP31 SDG:9	DIGITAL AND MOBILE FORENSICS	Category:PEC			
		L	T	P	C
		2	0	2	3

COURSE OBJECTIVE:

1.	To understand basic digital forensics and techniques.
2.	To understand digital crime and investigation.
3.	To understand how to be prepared for digital forensic readiness.
4.	To understand and use forensics tools for iOS devices.
5.	To understand and use forensics tools for Android devices.

UNIT 1	INTRODUCTION TO DIGITAL FORENSICS	6

Forensic Science – Digital Forensics – Digital Evidence – The Digital Forensics Process – Introduction – The Identification Phase – The Collection Phase – The Examination Phase – The Analysis Phase – The Presentation Phase.

UNIT 2	DIGITAL CRIME AND INVESTIGATION	6

Digital Crime – Substantive Criminal Law – General Conditions – Offenses – Investigation Methods for Collecting Digital Evidence – International Cooperation to Collect Digital Evidence.

UNIT 3	DIGITAL FORENSIC READINESS	6

Introduction – Law Enforcement versus Enterprise Digital Forensic Readiness – Rationale for Digital Forensic Readiness – Frameworks, Standards and Methodologies – Enterprise Digital Forensic Readiness – Challenges in Digital Forensics.

UNIT 4	iOS FORENSICS	6

Mobile Hardware and Operating Systems – iOS Fundamentals – Jailbreaking – File System – Hardware – iPhone Security – iOS Forensics – Procedures and Processes – Tools – Oxygen Forensics – MobilEdit – iCloud.

UNIT 5	ANDROID FORENSICS	6

Android Basics – Key Codes – ADB – Rooting Android – Boot Process – File Systems – Security – Tools – Android Forensics – Forensic Procedures – ADB – Android-Only Tools – Dual-Use Tools – Oxygen Forensics – MobilEdit – Android App Decompiling.

PRACTICAL EXERCISES:

1. Installation of Sleuth Kit on Linux. List all data blocks. Analyze allocated as well as unallocated blocks of a disk image.
2. Data extraction from call logs using Sleuth Kit.
3. Data extraction from SMS and contacts using Sleuth Kit.
4. Install Mobile Verification Toolkit (MVT) and decrypt encrypted iOS backups.
5. Process and parse records from the iOS system.
6. Extract installed applications from Android devices.
7. Extract diagnostic information from Android devices through the adb protocol.
8. Generate a unified chronological timeline of extracted records.

COURSE OUTCOME:

At the end of the course, students would be able to:

CO1:	Have knowledge on digital forensics.
CO2:	Know about digital crime and investigations.
CO3:	Be forensic ready.
CO4:	Investigate, identify and extract digital evidence from iOS devices.
CO5:	Investigate, identify and extract digital evidence from Android devices.
	TOTAL: 60 PERIODS

TEXT BOOKS:

1.	Andre Arnes, "Digital Forensics", Wiley, 2018.
2.	Chuck Easttom, "An In-depth Guide to Mobile Device Forensics", First Edition, CRC Press, 2022.

REFERENCES:

1.	J. Vacca, "Computer Forensics: Computer Crime Scene Investigation", Second Edition, Charles River Media, 2005.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PSO 3
CO1	3	1	3	2	1	-	-	-	1	1	3	1	3	
CO2	3	3	3	3	3	-	-	-	2	2	1	1	3	
CO3	3	3	2	3	1	-	-	-	3	2	1	3	2	
CO4	3	1	2	2	3	-	-	-	1	3	3	1	3	
CO5	1	3	2	3	2	-	-	-	2	3	2	1	2	
AVG	3	2	2	3	2	-	-	-	2	2	2	1	3	

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23CBP32 SDG:9	SOCIAL NETWORK SECURITY	Category: PEC			
		L	T	P	C
		2	0	2	3

COURSE OBJECTIVE:

1.	To develop semantic web related simple applications.
2.	To explain Privacy and Security issues in Social Networking.
3.	To explain the data extraction and mining of social networks.
4.	To discuss the prediction of human behavior in social communities.
5.	To describe the Access Control, Privacy and Security management of social networks.

UNIT I	FUNDAMENTALS OF SOCIAL NETWORKING	6

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, Historical overview of privacy and security, Major paradigms for understanding privacy and security.

UNIT II	SECURITY ISSUES IN SOCIAL NETWORKS	6

The evolution of privacy and security concerns with networked technologies, Contextual influences on privacy attitudes and behaviors, Anonymity in a networked world.

UNIT III	EXTRACTION AND MINING IN SOCIAL NETWORKING DATA	6

Extracting evolution of Web Community from a Series of Web Archive, Detecting communities in social networks, Definition of community, Evaluating communities, Methods for community detection and mining, Applications of community mining algorithms, Tools for detecting communities, Social network infrastructures and communities, Big data and Privacy.

UNIT IV	PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES	6

Understanding and predicting human behavior 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, What is Neo4j, Nodes, Relationships, Properties.

UNIT V	ACCESS CONTROL, PRIVACY AND IDENTITY MANAGEMENT	6

Understand the access control requirements for Social Network, Enforcing Access Control Strategies, Authentication and Authorization, Roles-based Access Control, Host, storage and network access control options, Firewalls, Authentication, and Authorization in Social Network, Identity & Access Management, Single Sign-on, Identity Federation, Identity providers and service consumers, The role of Identity provisioning.

PRACTICAL EXERCISES:

- Design own social media application.
- Create a Network model using Neo4j.
- Read and write Data from Graph Database.
- Find "Friend of Friends" using Neo4j.
- Implement secure search in social media.
- Create a simple Security & Privacy detector.

COURSE OUTCOME:

At the end of the course, students would

CO1:	Develop semantic web related simple applications.
CO2:	Address Privacy and Security issues in Social Networking.
CO3:	Explain the data extraction and mining of social networks.
CO4:	Discuss the prediction of human behavior in social communities.
CO5:	Describe the applications of social networks.

TOTAL: 60 PERIODS

TEXT BOOKS:

1.	Peter Mika, "Social Networks and the Semantic Web", First Edition, Springer, 2007.
2.	Borko Furht, "Handbook of Social Network Technologies and Applications", First Edition, Springer, 2010.
3.	Jérôme Baton, Rik Van Bruggen, "Learning Neo4j 3.x", Second Edition, Packt Publishing.
4.	David Easley, Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning about a Highly Connected World", First Edition, Cambridge University Press, 2010.

REFERENCES:

1.	Easley D., Kleinberg J., "Networks, Crowds, and Markets – Reasoning about a Highly Connected World", Cambridge University Press, 2010.
2.	Jackson, Matthew O., "Social and Economic Networks", Princeton University Press, 2008.
3.	Guandong Xu, Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and Applications", First Edition, Springer, 2011.
4.	Dion Goh and Schubert Foo, "Social Information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively", IGI Global Snippet, 2008.
5.	Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, "Collaborative and Social Information Retrieval and Access: Techniques for Improved User Modeling", IGI Global Snippet, 2009.
6.	John G. Breslin, Alexander Passant and Stefan Decker, "The Social Semantic Web", Springer, 2009.

CO's-PO's & PSO's MAPPING														
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PS O1**	**PS O2**	**PSO 3**
CO1	3	1	2	3	2	-	-	-	3	2	1	2	3	3
CO2	2	2	2	3	3	-	-	-	1	2	2	3	3	3
CO3	2	1	1	3	2	-	-	-	1	2	1	1	1	3
CO4	3	3	3	3	2	-	-	-	1	1	1	1	2	1
CO5	1	3	2	2	2	-	-	-	1	1	3	1	2	3
AVG	2.2	2	2	2.8	2.2	-	-	-	1.4	1.6	1.6	1.6	2.2	2.6
Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation														

U23CBP33 SDG:9	MODERN CRYPTOGRAPHY	Category:PEC			
		L	T	P	C
		2	0	2	3

COURSE OBJECTIVE:

1.	To learn about modern cryptography.
2.	To focus on how cryptographic algorithms and protocols work and how to use them.
3.	To build a pseudorandom permutation.
4.	To construct basic cryptanalytic techniques.
5.	To provide instruction on how to use the concepts of block ciphers and message authentication codes.

UNIT 1	INTRODUCTION	6

Basics of Symmetric Key Cryptography – Basics of Asymmetric Key Cryptography – Hardness of Functions. Notions of Semantic Security (SS) and Message Indistinguishability (MI): Proof of Equivalence of SS and MI – Hard Core Predicate – Trap-door Permutation – Goldwasser-Micali Encryption. Goldreich-Levin Theorem: Relation between Hardcore Predicates and Trap-door Permutations.

UNIT 2	FORMAL NOTIONS OF ATTACKS	6

Attacks under Message Indistinguishability: Chosen Plaintext Attack (IND-CPA) – Chosen Ciphertext Attacks (IND-CCA1 and IND-CCA2). Attacks under Message Non-malleability: NM-CPA and NM-CCA2 – Inter-relations among the Attack Models.

UNIT 3	RANDOM ORACLES	6

Provable Security and Asymmetric Cryptography – Hash Functions. One-way Functions: Weak and Strong One-way Functions. Pseudo-random Generators (PRG): Blum-Micali-Yao Construction – Construction of More Powerful PRG – Relation between One-way Functions and PRG – Pseudo-random Functions (PRF).

UNIT 4	BUILDING A PSEUDORANDOM PERMUTATION	6

The Luby-Rackoff Construction: Formal Definition – Application of the Luby-Rackoff Construction to the Construction of Block Ciphers – The DES in the Light of Luby-Rackoff Construction.

UNIT 5	MESSAGE AUTHENTICATION CODES	6

Left or Right Security (LOR). Formal Definition of Weak and Strong MACs – Using a PRF as a MAC – Variable Length MAC. Public Key Signature Schemes: Formal Definitions – Signing and Verification – Formal Proofs of Security of Full Domain Hashing. Assumptions for Public Key Signature Schemes: One-way Functions Imply Secure One-time Signatures – Shamir's Secret Sharing Scheme – Formally Analyzing Cryptographic Protocols – Zero Knowledge Proofs and Protocols.

PRACTICAL EXERCISES:

1. Implement Feige-Fiat-Shamir identification protocol.
2. Implement GQ identification protocol.
3. Implement Schnorr identification protocol.
4. Implement Rabin one-time signature scheme.

5. Implement Merkle one-time signature scheme.
6. Implement Authentication trees and one-time signatures.
7. Implement GMR one-time signature scheme.

COURSE OUTCOME:

At the end of the course, students would be able to:

CO1:	Interpret the basic principles of cryptography and general cryptanalysis.
CO2:	Determine the concepts of symmetric encryption and authentication.
CO3:	Identify the use of public key encryption, digital signatures, and key establishment.
CO4:	Articulate the cryptographic algorithms to compose, build and analyze simple cryptographic solutions.
CO5:	Express the use of Message Authentication Codes.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Hans Delfs and Helmut Knebl, "Introduction to Cryptography: Principles and Applications", Springer-Verlag.
2. Wenbo Mao, "Modern Cryptography: Theory and Practice", Pearson Education (Low Priced Edition).

REFERENCES:

1. Shafi Goldwasser and Mihir Bellare, "Lecture Notes on Cryptography", available at http://citeseerx.ist.psu.edu/.
2. Oded Goldreich, "Foundations of Cryptography", Part 1 and Part 2, CRC Press (Low Priced Edition Available).
3. William Stallings, "Cryptography and Network Security: Principles and Practice", Third Edition, PHI, 2006.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2	PS O3
CO1	3	3	3	3	1	-	-	-	2	1	1	2	2	1	
CO2	1	3	2	1	2	-	-	-	3	2	2	2	2	1	
CO3	1	1	2	3	2	-	-	-	1	1	1	3	1	1	
CO4	3	1	2	1	3	-	-	-	3	2	1	2	3	2	
CO5	2	3	3	3	3	-	-	-	3	1	1	1	2	1	
AVG	2	2.2	2.4	2.2	2.2	-	-	-	2.4	1.4	1.2	2	2	1.2	

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23CBP34 SDG:9	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES	Category: PEC			
		L	T	P	C
		2	0	2	3

COURSE OBJECTIVE:

1.	To understand the basics of Blockchain.
2.	To learn different protocols and consensus algorithms in Blockchain.
3.	To learn the Blockchain implementation frameworks.
4.	To understand the Blockchain Applications.
5.	To experiment the Hyperledger Fabric, Ethereum networks.

UNIT I	INTRODUCTION TO BLOCKCHAIN	7

Blockchain - Public Ledgers, Blockchain as Public Ledgers - Block in a Blockchain, Transactions - The Chain and the Longest Chain - Permissioned Model of Blockchain, Cryptographic Hash Function, Properties of a hash function - Hash pointer and Merkle tree.

UNIT II	BITCOIN AND CRYPTOCURRENCY	6

A basic crypto currency, Creation of coins, Payments and double spending, FORTH – the precursor for Bitcoin scripting, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay.

UNIT III	BITCOIN CONSENSUS	6

Bitcoin Consensus, Proof of Work (PoW) - Hashcash PoW, Bitcoin PoW, Attacks on PoW, Monopoly problem - Proof of Stake - Proof of Burn - Proof of Elapsed Time - Bitcoin Miner, Mining Difficulty, Mining Pool - Permissioned model and use cases.

UNIT IV	HYPERLEDGER FABRIC & ETHEREUM	5

Architecture of Hyperledger Fabric v1.1 - Chain code - Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity.

UNIT V	BLOCKCHAIN APPLICATIONS	6

Smart contracts, Truffle Design and issue - DApps - NFT. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance, etc. - Case Study.

PRACTICAL EXERCISES:

- Install and understand Docker container, Node.js, Java and Hyperledger Fabric, Ethereum and perform necessary software installation on local machine / create instance on cloud to run.
- Create and deploy a blockchain network using Hyperledger Fabric SDK for Java. Set up and initialize the channel, install and instantiate chain code, and perform invoke and query on your blockchain network.

- Interact with a blockchain network. Execute transactions and requests against a blockchain network by creating an app to test the network and its rules.
- Deploy an asset-transfer app using blockchain. Learn app development within a Hyperledger Fabric network.
- Use blockchain to track fitness club rewards. Build a web app that uses Hyperledger Fabric to track and trace member rewards.
- Car auction network: A Hello World example with Hyperledger Fabric Node SDK and IBM Blockchain Starter Plan. Use Hyperledger Fabric to invoke chain code while storing results and data in the starter plan.

COURSE OUTCOME:

At the end of the course, students would

CO1:	Understand emerging abstract models for Blockchain Technology.
CO2:	Identify major research challenges and technical gaps existing between theory and practice in the crypto currency domain.
CO3:	Understand the function of Blockchain as a method of securing distributed ledgers, how consensus on their contents is achieved, and the new applications that they enable.
CO4:	Apply Hyperledger Fabric and Ethereum platform to implement the Blockchain Application.

TOTAL: 60 PERIODS

TEXT BOOKS:

1.	Bashir and Imran, "Mastering Blockchain: Deeper Insights into Decentralization, Cryptography, Bitcoin, and Popular Blockchain Frameworks", 2017.
2.	Andreas Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly, 2014.

REFERENCES:

1.	Daniel Drescher, "Blockchain Basics", First Edition, Apress, 2017.
2.	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press, 2016.
3.	Melanie Swan, "Blockchain: Blueprint for a New Economy", O'Reilly, 2015.
4.	Ritesh Modi, "Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain", Packt Publishing.
5.	"Handbook of Research on Blockchain Technology", Elsevier Inc., ISBN: 9780128198162, 2020.

CO's-PO's & PSO's MAPPING														
CO	**PO 1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO 6**	**PO 7**	**PO 8**	**PO9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**	**PSO3**
CO1	3	3	2	2	1	-	-	-	1	-	-	3	3	3
CO2	3	3	3	3	1	-	-	-	2	-	-	3	3	3
CO3	3	3	3	3	2	-	-	-	3	-	-	3	3	3
CO4	3	2	3	2	3	-	-	-	3	-	-	3	2	3
CO5	3	2.7	2.7	2.5	1.7	-	-	-	2.2	-	-	3	2.7	3
AVG	3	3	2	2	1	-	-	-	1	-	-	3	3	3
Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation														

U23CBP35 SDG:9	**NETWORK SECURITY**	**Category: PEC**			
		L	**T**	**P**	**C**
		3	**0**	**2**	**4**

COURSE OBJECTIVE:

1.	To understand the basic concepts of security.
2.	To understand the concept of authentication protocols and digital signatures.
3.	To learn various methods and protocols to understand the cryptography.
4.	To learn various network security attacks.
5.	To understand the IP and Web security.

UNIT I	**FUNDAMENTALS OF NETWORKING SECURITY**	**9**

Overview of networking security - Security Services: Confidentiality, Authentication, Integrity, Non-repudiation, Access Control - Availability and Mechanisms - Security Attacks: Interruption, Interception, Modification and Fabrication.

UNIT II	**AUTHENTICATION AND SECURITY**	**9**

Authentication overview - Authentication protocols - Authentication and key establishment - Key exchange - Mediated key exchange - User Authentication - Password based authentication - Password security - Certificate Authority and key management - Digital signatures - Digital Certificates.

UNIT III	**PUBLIC-KEY CRYPTOGRAPHY AND MESSAGE AUTHENTICATION**	**9**

Basics of cryptography - Cryptographic hash functions - Symmetric and public-key encryption - Public key cryptography principles & algorithms - Cipher block modes of operation - Secure Hash

Functions - HMAC.		
UNIT IV	**SECURITY ATTACKS**	**9**
Buffer overflow attacks & format string vulnerabilities - Denial-of-Service Attacks - Hijacking attacks: exploits and defenses - Internet worms - Viruses - Spyware - Phishing - Botnets - TCP session hijacking - ARP attacks - Route table modification - UDP hijacking - Man-in-the-middle attacks.		
UNIT V	**IP SECURITY AND WEB SECURITY**	**9**
Network defense tools: Firewalls, VPNs, Intrusion Detection, and filters - Email privacy: Pretty Good Privacy (PGP) and S/MIME - Network security protocols in practice - Introduction to Wireshark - SSL - IPsec and IKE - DNS security - Secure Socket Layer (SSL) and Transport Layer Security (TLS) - Secure Electronic Transaction (SET).		

PRACTICAL EXERCISES:

- Using Wireshark explore the different layer protocol headers.
- Demonstrate two different Certificates producing the same MD5 hash.
- Computing MACs, HASH and HMAC for messages.
- Implement and demonstrate Buffer overflow attack.
- Implement and demonstrate Denial of service attacks (DoS) and DDoS.
- Implement the ARP attack and MITM.
- Implement the Botnet attack detection using publically available dataset.
- Explore and install Snort intrusion detection tool.
- Implement Firewall rules using Snort.
- Generate the network attack and Detect the attack using Snort.

COURSE OUTCOME:

At the end of the course, students would

CO1:	Describe computer and network security fundamental concepts and principles.
CO2:	Acquire the knowledge of various authentication protocols, key exchange mechanism, and digital certificates.
CO3:	Gain better knowledge on fundamental concepts of cryptography, encryption and hashing techniques.
CO4:	Identify and assess different types of threats and attacks such as social engineering, rootkit, and botnets, etc.
CO5:	Demonstrate the ability to select among available network security technology and protocols such as IDS, firewalls, SSL, TLS, etc.

TOTAL: 75 PERIODS

TEXT BOOKS:

1. William Stallings, "Network Security Essentials: Applications and Standards", Pearson Education.

REFERENCES:

1. Ryan Russell, Dan Kaminsky, Rain Forest Puppy, Joe Grand, David Ahmad, Hal Flynn, Ido Dubrawsky, Steve W. Manzuik and Ryan Permeh, "Hack Proofing Your Network", Wiley

	Dreamtech.
2.	William Stallings, "Cryptography and Network Security", Third Edition, PHI/Pearson.
3.	S. Bellovin, "A Look Back at Security Problems in the TCP/IP Protocol Suite", ACSAC, 2004.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO9	PO 10	PO 11	PSO 1	PSO 2	PS O3
CO1	3	2	1	1	1	-	-	-	1	-	-	1	1	3
CO2	3	3	3	3	3	-	-	-	2	-	-	1	3	3
CO3	3	3	3	3	3	-	-	-	2	-	-	1	3	3
CO4	3	3	2	3	2	-	-	-	3	-	-	3	3	3
CO5	3	3	3	3	3	-	-	-	3	-	-	2	3	3
AVG	3	2.8	2.4	2.6	2.4	-	-	-	2.2	-	-	1.6	2.6	3

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23CBP36 SDG:9	**MALWARE ANALYSIS**	**Category: PEC**			
		L	**T**	**P**	**C**
		2	**0**	**2**	**3**

COURSE OBJECTIVE:

1.	To introduce the fundamentals of malware, types and its effects.
2.	To enable to identify and analyse various malware types by static analysis.
3.	To enable to identify and analyse various malware types by dynamic analysis.
4.	To deal with detection, analysis, understanding, controlling, and eradication of malware.

UNIT I	**INTRODUCTION AND BASIC ANALYSIS**	**6**

Goals of Malware Analysis, AV Scanning, Hashing, Finding Strings, Packing and Obfuscation, PE file format, Static Linked Libraries and Functions, Static Analysis tools, Virtual Machines and their usage in malware analysis, Sandboxing, Basic dynamic analysis, Malware execution, Process Monitoring, Viewing processes, Registry snapshots.

UNIT II	**ADVANCED STATIC ANALYSIS**	**7**

The Stack, Conditionals, Branching, Rep Instructions, Disassembly, Global and local variables, Arithmetic operations, Loops, Function Call Conventions, C Main Method and Offsets. Portable Executable File Format, The PE File Headers and Sections, IDA Pro, Function analysis, Graphing, The Structure of a Virtual Machine, Analyzing Windows programs, Anti-static analysis techniques, obfuscation, packing, metamorphism, polymorphism.

UNIT III	ADVANCED DYNAMIC ANALYSIS	7
Live malware analysis, dead malware analysis, analyzing traces of malware, system calls, API calls, registries, network activities. Anti-dynamic analysis techniques, VM detection techniques, Evasion techniques, Malware Sandbox, Monitoring with Process Monitor, Packet Sniffing with Wireshark, Kernel vs. User-Mode Debugging, OllyDbg, Breakpoints, Tracing, Exception Handling, Patching.		
UNIT IV	**MALWARE FUNCTIONALITY**	**5**
Downloaders and Launchers, Backdoors, Credential Stealers, Persistence Mechanisms, Handles, Mutexes, Privilege Escalation, Covert malware launching - Launchers, Process Injection, Process Replacement, Hook Injection, Detours, APC injection.		
UNIT V	**ANDROID MALWARE ANALYSIS**	**5**
Android architecture, App development cycle, APKTool, APKInspector, Dex2Jar, JD-GUI, Static and Dynamic Analysis of Android Malware, Case studies.		

PRACTICAL EXERCISES:

- Experimentation on Initial Infection Vectors and Malware Discovery.
- Implementation on Sandboxing Malware and Gathering Information From Runtime Analysis.
- Implementation on Portable Executable (PE32) File Format.
- Implementation on Executable Metadata and Executable Packers.
- Experimentation on Malware Self-Defense, Compression, and Obfuscation Techniques.
- Experimentation on Malware behaviour analysis.
- Experimentation on analyzing Malicious Microsoft Office and Adobe PDF Documents.
- Experimentation on Mobile malware analysis.
- Experimentation on Packing and Unpacking of malware.
- Experimentation on Rootkit AntiForensics and Covert Channels.
- Experimentation on Modern Rootkit Analysis.
- Experimentation on Malware traffic analysis.
- Static analysis of malwares.
- Dynamic analysis of malwares.
- Classification of malwares based on their behaviour.
- Usage of tools to classify malware.
- Advanced malware analysis.
- Android malware analysis.
- Applying antivirus tools in various applications.
- Malware report documentation.

COURSE OUTCOME:

At the end of the course, students would

CO1:	Understand the various concepts of malware analysis and their technologies used.
CO2:	Possess the skills necessary to carry out independent analysis of modern malware samples

	using both static and dynamic analysis techniques.
CO3:	Understand the methods and techniques used by professional malware analysts.
CO4:	Safely analyze, debug, and disassemble any malicious software by malware analysis.
CO5:	Understand the concept of Android malware analysis, their architecture, and App development.
	TOTAL: 60 PERIODS

TEXT BOOKS:

1.	Michael Sikorski and Andrew Honig, "Practical Malware Analysis", No Starch Press, 2012, ISBN: 9781593272906.
2.	Bill Blunden, "The Rootkit Arsenal: Escape and Evasion in the Dark Corners of the System", Second Edition, Jones & Bartlett Publishers, 2009.

REFERENCES:

1.	Jamie Butler and Greg Hoglund, "Rootkits: Subverting the Windows Kernel", Addison-Wesley Professional, 2005.
2.	Bruce Dang, Alexandre Gazet, Elias Bachaalany, Sébastien Josse, "Practical Reverse Engineering: x86, x64, ARM, Windows Kernel, Reversing Tools, and Obfuscation", 2014.
3.	Victor Marak, "Windows Malware Analysis Essentials", Packt Publishing, O'Reilly, 2015.
4.	Ken Dunham, Shane Hartman, Manu Quintans, Jose Andre Morales, Tim Strazzere, "Android Malware and Analysis", CRC Press, Taylor & Francis Group, 2015.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PS O3
CO1	2	1	1	1	-	1	-	1	-	-	1	-	2	2
CO2	1	3	1	3	2	1	-	-	-	-	-	-	2	2
CO3	1	1	1	1	-	1	-	-	-	-	1	-	2	2
CO4	2	3	2	2	2	1	-	-	-	-	-	-	2	2
CO5	2	2	1	1	1	1	-	1	-	-	1	-	2	2
AVG	1.6	2	1.2	1.6	1	1	0	0.4	0	0	0.6	0	2	2

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23CBP37 SDG:9	WEB APPLICATION SECURITY	Category: PEC			
		L	T	P	C
		2	0	2	3

COURSE OBJECTIVE:

1.	To understand the fundamentals of web application security.
2.	To focus on wide aspects of secure development and deployment of web applications.
3.	To learn how to build secure APIs.
4.	To learn the basics of vulnerability assessment and penetration testing.
5.	To get an insight about Hacking techniques and Tools.

UNIT I	FUNDAMENTALS OF WEB APPLICATION SECURITY	6

The history of Software Security - Recognizing Web Application Security Threats, Web Application Security, Authentication and Authorization, Secure Socket Layer, Transport Layer Security, Session Management - Input Validation.

UNIT II	SECURE DEVELOPMENT AND DEPLOYMENT	5

Web Applications Security - Security Testing, Security Incident Response Planning, The Microsoft Security Development Lifecycle (SDL), OWASP Comprehensive Lightweight Application Security Process (CLASP), The Software Assurance Maturity Model (SAMM).

UNIT III	SECURE API DEVELOPMENT	6

API Security - Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, Securing service-to-service APIs: API Keys, OAuth2, Securing Microservice APIs: Service Mesh, Locking Down Network Connections, Securing Incoming Requests.

UNIT IV	VULNERABILITY ASSESSMENT AND PENETRATION TESTING	6

Vulnerability Assessment Lifecycle, Vulnerability Assessment Tools: Cloud-based vulnerability scanners, Host-based vulnerability scanners, Network-based vulnerability scanners, Database-based vulnerability scanners, Types of Penetration Tests: External Testing, Web Application Testing, Internal Penetration Testing, SSID or Wireless Testing, Mobile Application Testing.

UNIT V	HACKING TECHNIQUES AND TOOLS	7

Social Engineering, Injection, Cross-Site Scripting (XSS), Broken Authentication and Session Management, Cross-Site Request Forgery, Security Misconfiguration, Insecure Cryptographic Storage, Failure to Restrict URL Access, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite, etc.

PRACTICAL EXERCISES:

- Install Wireshark and explore the various protocols.

- Analyze the difference between HTTP vs HTTPS.
- Analyze the various security mechanisms embedded with different protocols.
- Identify the vulnerabilities using OWASP ZAP tool.
- Create simple REST API using Python for the following operations: GET, PUSH, POST, DELETE.
- Install Burp Suite to exploit the following vulnerabilities: SQL Injection, Cross-Site Scripting (XSS).
- Attack the website using Social Engineering method.

COURSE OUTCOME:

At the end of the course, students would

CO1:	Understand the basic concepts of web application security and the need for it.
CO2:	Be acquainted with the process for secure development and deployment of web applications.
CO3:	Acquire the skill to design and develop Secure Web Applications that use Secure APIs.
CO4:	Understand the importance of carrying out vulnerability assessment and penetration testing.
CO5:	Acquire the skill to think like a hacker and to use hackers tool sets.

TOTAL: 60 PERIODS

TEXT BOOKS:

1.	Andrew Hoffman, "Web Application Security: Exploitation and Countermeasures for Modern Web Applications", First Edition, O'Reilly Media, Inc., 2020.
2.	Bryan Sullivan, Vincent Liu, "Web Application Security: A Beginners Guide", The McGraw-Hill Companies, 2012.
3.	Neil Madden, "API Security in Action", Manning Publications Co., NY, USA, 2020.

REFERENCES:

1.	Michael Cross, "Developer's Guide to Web Application Security", Syngress Publishing, Inc., 2007.
2.	Ravi Das and Greg Johnson, "Testing and Securing Web Applications", Taylor & Francis Group, LLC, 2021.
3.	Prabath Siriwardena, "Advanced API Security", Apress Media LLC, USA, 2020.
4.	Malcom McDonald, "Web Security for Developers", No Starch Press, Inc., 2020.
5.	Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gideon Lenkey, and Terron Williams, "Grey Hat Hacking: The Ethical Hacker's Handbook", Third Edition, The McGraw-Hill Companies, 2011.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO3
CO1	-	-	-	-	-	-	-	1	-	-	-	2	-	3

CO2	-	-	-	-	2	1	-	1	-	-	-	2	-	2
CO3	1	2	3	1	3	-	-	-	-	-	-	3	2	-
CO4	2	1	3	1	2	1	-	-	-	-	-	2	2	-
CO5	2	3	2	1	1	2	-	1	-	-	-	2	3	-
AVG	1.67	2	2.67	1	2	1.33	-	1	-	-	-	2.2	2.33	2.5
Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation														

U23CBP38 SDG:9	ARTIFICIAL INTELLIGENCE FOR CYBERSECURITY	Category: PEC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

1.	To introduce supervised and unsupervised machine learning algorithms, model evaluation metrics, and benchmark security datasets relevant to cybersecurity applications
2.	To develop proficiency in feature engineering for security data
3.	To build neural network models and deep learning models for Security
4.	To design and evaluate ML-based anomaly detection systems for host intrusion detection, web application security, and static malware analysis using PE header features.
5.	To examine the role of Generative AI and Large Language Models in cybersecurity,

UNIT 1	MACHINE LEARNING FUNDAMENTALS FOR CYBERSECURITY	9

Why AI/ML in cybersecurity — the shift from rule-based to learning-based defence; threat landscape evolution, Supervised learning — classification and regression; decision trees, random forests, k-NN, SVM applied to security datasets, Unsupervised learning — clustering (k-means, DBSCAN) for anomaly detection; why labels are scarce in security data, Model evaluation — accuracy, precision, recall, F1, ROC-AUC, Overfitting, underfitting, train-test split, cross-validation — why security models fail in real-world deployment, Overview of benchmark security datasets — NSL-KDD, CICIDS2017, UNSW-NB15, VirusShare.

UNIT 2	FEATURE ENGINEERING	9

Feature engineering for security data — network flow features (duration, bytes, flags), log features, binary/PE header features, Feature selection and dimensionality reduction — identifying relevant features for attack detection; correlation analysis.

UNIT 3	NEURAL NETWORKS AND DEEP LEARNING FOR SECURITY	9

Neural networks fundamentals — perceptron, activation functions, backpropagation (conceptual treatment); Deep learning for security — CNNs for image-based malware visualization, RNNs/LSTMs for log sequence analysis and threat detection, Bayesian reasoning in security — Bayesian networks for threat scoring and alert correlation (applied focus).

UNIT 4	AI FOR SECURING INFRASTRUCTURE	9

Anomaly detection — statistical vs ML-based; threshold tuning; concept drift in evolving threat environments, Host Intrusion Detection (HIDS) — system call analysis, user behaviour analytics (UBA), Web Application Intrusion Detection — ML for WAF, SQL injection and XSS detection from HTTP logs, Malware analysis — ML-based static analysis using PE header features; malware classification.

UNIT 5	GENERATIVE AI, LLMs AND EMERGING CYBERSECURITY TRENDS	9

Generative AI in cybersecurity — LLM-assisted attacks, AI-generated phishing, deepfake-based social engineering, Prompt injection attacks — how attackers manipulate LLMs; security implications for AI-integrated applications, AI in IoT and Cyber-Physical Systems security — anomaly detection in sensor data, securing smart infrastructure.

COURSE OUTCOME :

At the end of the course, students would	
CO1:	Recall and explain the working principles of supervised and unsupervised machine learning algorithms
CO2:	Apply feature engineering techniques to extract and select relevant security features
CO3:	Construct neural network and deep learning models to detect malware and analyse threat patterns in security data.
CO4:	Analyse and build ML-based anomaly detection and intrusion detection systems for host, network, and web application security, and evaluate their performance under real-world conditions.
CO5:	Evaluate the use of Generative AI and Large Language Models in offensive cybersecurity scenarios.
	TOTAL: 45 PERIODS

TEXT BOOKS:	
1.	David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016. (Unit I)
2.	Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017. (Units II and III)
3.	Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016. (Units IV and V)

REFERENCES:	
1.	Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, 2014.

U23CBP41 SDG:9	AUGMENTED REALITY/VIRTUAL REALITY	Category:PEC			
		L	T	P	C
		2	0	2	3

COURSE OBJECTIVE:

1.	To impart the fundamental aspects and principles of AR/VR technologies.
2.	To know the internals of the hardware and software components involved in the development of AR/VR enabled applications.
3.	To learn about the graphical processing units and their architectures.
4.	To gain knowledge about AR/VR application development.
5.	To know the technologies involved in the development of AR/VR based applications.

UNIT 1	INTRODUCTION	7

Introduction to Virtual Reality and Augmented Reality – Definition – Introduction to Trajectories and Hybrid Space – Three I's of Virtual Reality – Virtual Reality vs. 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Introduction to AR – AR Technologies – Input Devices – 3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System.

UNIT 2	VR MODELING	6

Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants – Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management.

UNIT 3	VR PROGRAMMING	6

VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D.

UNIT 4	APPLICATIONS	6

Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society – Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications – Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – VR in Business – VR in Entertainment – VR in Education.

UNIT 5	AUGMENTED REALITY	5

Introduction to Augmented Reality – Computer Vision for AR – Interaction – Modelling and Annotation – Navigation – Wearable Devices.

PRACTICAL EXERCISES:

1. Study of tools like Unity, Maya, 3DS MAX, AR Toolkit, Vuforia and Blender.
2. Use the primitive objects and apply various projection types by handling the camera.
3. Download objects from the asset store and apply various lighting and shading effects.

4. Model three-dimensional objects using various modeling techniques and apply textures over them.
5. Create three-dimensional realistic scenes and develop simple virtual reality enabled mobile applications which have limited interactivity.
6. Add audio and text special effects to the developed application.
7. Develop VR enabled applications using motion trackers and sensors incorporating full haptic interactivity.
8. Develop AR enabled applications with interactivity like E-learning environment, virtual walkthroughs and visualization of historic places.
9. Develop AR enabled simple applications like human anatomy visualization, DNA/RNA structure visualization and surgery simulation.
10. Develop simple MR enabled gaming applications.

COURSE OUTCOME:

At the end of the course, students would be able to:

CO1:	Understand the basic concepts of AR and VR.
CO2:	Understand the tools and technologies related to AR/VR.
CO3:	Know the working principle of AR/VR related sensor devices.
CO4:	Design various models using modeling techniques.
CO5:	Develop AR/VR applications in different domains.

TOTAL: 60 PERIODS

TEXT BOOKS:

1.	Charles Palmer and John Williamson, "Virtual Reality Blueprints: Create Compelling VR Experiences for Mobile", Packt Publishing, 2018.
2.	Dieter Schmalstieg and Tobias Hollerer, "Augmented Reality: Principles & Practice", Addison-Wesley, 2016.
3.	John Vince, "Introduction to Virtual Reality", Springer-Verlag, 2004.
4.	William R. Sherman and Alan B. Craig, "Understanding Virtual Reality: Interface, Application, Design", Morgan Kaufmann, 2003.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2	PS O3
CO1	3	2	2	-	3	-	-	-	2	2	1	2	2	1	
CO2	3	2	2	1	3	-	-	-	3	2	2	3	3	1	
CO3	3	3	2	2	3	-	-	-	3	2	1	2	3	2	
CO4	3	3	3	2	3	-	-	-	3	2	2	3	3	2	
CO5	3	3	3	3	3	-	-	-	3	3	3	3	3	3	
AVG	3	2.6	2.4	2	3	-	-	-	2.8	2.2	1.8	2.6	2.8	1.8	

Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation

U23CBP42 SDG:9	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	Category:PEC			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

1.	Study about uninformed and Heuristic search techniques.
2.	Learn techniques for reasoning under uncertainty.
3.	Introduce Machine Learning and supervised learning algorithms.
4.	Study about ensembling and unsupervised learning algorithms.
5.	Learn the basics of deep learning using neural networks.

UNIT 1	PROBLEM SOLVING	9

Introduction to AI – AI Applications – Problem solving agents – search algorithms – uninformed search strategies – Heuristic search strategies – Local search and optimization problems – adversarial search – constraint satisfaction problems (CSP)

UNIT 2	PROBABILISTIC REASONING	9

Acting under uncertainty – Bayesian inference – naïve bayes models. Probabilistic reasoning – Bayesian networks – Causal networks – Introduction to Explainable AI (XAI): SHAP and LIME concepts

UNIT 3	SUPERVISED LEARNING	9

Introduction to machine learning – Linear Regression Models: Least squares, single & multiple variables, gradient descent – Feature Engineering: preprocessing, scaling, encoding, train-test split, cross-validation – Linear Classification Models: Discriminant function – Probabilistic discriminative model – Logistic regression – Naive Bayes – Support Vector Machine – Decision Trees, Random Forests

UNIT 4	ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING	9

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning – bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models – Expectation Maximization (overview) – Model Evaluation Metrics: Accuracy, Precision, Recall, F1-score, ROC-AUC (concepts)

UNIT 5	NEURAL NETWORKS	9

Perceptron – Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error backpropagation, from shallow networks to deep networks – Unit saturation (aka the vanishing gradient problem) – ReLU, hyperparameter tuning, batch normalization, regularization, dropout – Introduction to Generative AI: Foundation Models, LLMs, Transformer overview, Prompt Engineering, Responsible AI

COURSE OUTCOME:

At the end of the course, students would be able to:

CO1:	Use appropriate search algorithms for problem solving.
CO2:	Apply reasoning under uncertainty.
CO3:	Build supervised learning models.

CO4:	Build ensembling and unsupervised models.
CO5:	Build deep learning neural network models.
	TOTAL: 45 PERIODS

TEXT BOOKS:	
1.	Stuart Russell and Peter Norvig, *Artificial Intelligence – A Modern Approach*, Fourth Edition, Pearson Education, 2021.
2.	Ethem Alpaydin, *Introduction to Machine Learning*, MIT Press, Fourth Edition, 2020.
REFERENCE BOOKS:	
1.	Dan W. Patterson, *Introduction to Artificial Intelligence and Expert Systems*, Pearson Education, 2007.
2.	Kevin Night, Elaine Rich, and Nair B., *Artificial Intelligence*, McGraw Hill, 2008.
3.	Patrick H. Winston, *Artificial Intelligence*, Third Edition, Pearson Education, 2006.
4.	Deepak Khemani, *Artificial Intelligence*, Tata McGraw Hill Education, 2013. (http://nptel.ac.in/)
5.	Christopher M. Bishop, *Pattern Recognition and Machine Learning*, Springer, 2006.
6.	Tom Mitchell, *Machine Learning*, McGraw Hill, 3rd Edition, 1997.
7.	Charu C. Aggarwal, *Data Classification Algorithms and Applications*, CRC Press, 2014.
8.	Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, *Foundations of Machine Learning*, MIT Press, 2012.
9.	Ian Goodfellow, Yoshua Bengio, Aaron Courville, *Deep Learning*, MIT Press, 2016.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	-	-	-	-	1	-
CO2	3	3	2	2	2	-	-	-	-	-	-	-	1	-
CO3	3	3	3	3	3	-	-	-	-	-	-	1	2	-
CO4	3	3	3	3	3	-	-	-	-	-	-	1	2	-
CO5	3	3	3	3	3	-	-	-	-	-	-	1	2	1

Correlation levels: 1 – low 2 – medium 3 – high "-" - no correlation

U23CBP43 **SDG:9**	**ROBOTIC PROCESS AUTOMATION**	**Category: PEC**			
		L	**T**	**P**	**C**
		2	**0**	**2**	**3**

COURSE OBJECTIVE:

1.	To understand the basic concepts of Robotic Process Automation.
2.	To expose to the key RPA design and development strategies and methodologies.
3.	To learn the fundamental RPA logic and structure.

4.	To explore the Exception Handling, Debugging and Logging operations in RPA.
5.	To learn to deploy and maintain the software bot.

UNIT I	INTRODUCTION TO ROBOTIC PROCESS AUTOMATION	6

Emergence of Robotic Process Automation (RPA), Evolution of RPA, Differentiating RPA from Automation - Benefits of RPA - Application areas of RPA, Components of RPA, RPA Platforms. Robotic Process Automation Tools - Templates, User Interface, Domains in Activities, Workflow Files.

UNIT II	AUTOMATION PROCESS ACTIVITIES	6

Sequence, Flowchart & Control Flow: Sequencing the Workflow, Activities, Flowchart, Control Flow for Decision making. Data Manipulation: Variables, Collection, Arguments, Data Table, Clipboard management, File operations. Controls: Finding the control, Waiting for a control, Act on a control, UiExplorer, Handling Events.

UNIT III	APP INTEGRATION, RECORDING AND SCRAPING	6

App Integration, Recording, Scraping, Selector, Workflow Activities. Recording mouse and keyboard actions to perform operation, Scraping data from website and writing to CSV. Process Mining.

UNIT IV	EXCEPTION HANDLING AND CODE MANAGEMENT	6

Exception handling, Common exceptions, Logging - Debugging techniques, Collecting crash dumps, Error reporting. Code management and maintenance: Project organization, Nesting workflows, Reusability, Templates, Commenting techniques, State Machine.

UNIT V	DEPLOYMENT AND MAINTENANCE	6

Publishing using publish utility, Orchestration Server, Control bots, Orchestration Server to deploy bots, License management, Publishing and managing updates. RPA Vendors - Open Source RPA, Future of RPA.

PRACTICAL EXERCISES:

- Setup and configure an RPA tool and understand the user interface of the tool.
- Create a Sequence to obtain user inputs and display them using a message box.
- Create a Flowchart to navigate to a desired page based on a condition.
- Create a State Machine workflow to compare user input with a random number.
- Build a process in the RPA platform using UI Automation Activities.
- Create an automation process using key System Activities, Variables and Arguments; also implement Automation using System Trigger.
- Automate login to a web-based Email account.
- Recording mouse and keyboard actions.
- Scraping data from website and writing to CSV.
- Implement Error Handling in RPA platform.
- Web Scraping and Email Query Processing.

COURSE OUTCOME:	
At the end of the course, students would	
CO1:	Enunciate the key distinctions between RPA and existing automation techniques and platforms.
CO2:	Use UiPath to design control flows and workflows for the target process.
CO3:	Implement recording, web scraping and process mining by automation.
CO4:	Use UiPath Studio to detect and handle exceptions in automation processes.
CO5:	Implement and use Orchestrator for creation, monitoring, scheduling, and controlling of automated bots and processes.
	TOTAL: 60 PERIODS

TEXT BOOKS:	
1.	Alok Mani Tripathi, "Learning Robotic Process Automation: Create Software Robots and Automate Business Processes with the Leading RPA Tool - UiPath", Packt Publishing, 2018.
2.	Tom Taulli, "The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems", Apress Publications, 2020.

REFERENCES:	
1.	Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, "Introduction to Robotic Process Automation: A Primer", Institute of Robotic Process Automation, Amazon Asia-Pacific Holdings Private Limited, 2018.
2.	Richard Murdoch, "Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant", Amazon Asia-Pacific Holdings Private Limited, 2018.
3.	Gerardus Blokdyk, "Robotic Process Automation RPA: A Complete Guide", 2020.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	-	-	-	-	1	-
CO2	3	3	2	2	2	-	-	-	-	-	-	-	1	-
CO3	3	3	3	3	3	-	-	-	-	-	-	1	2	-
CO4	3	3	3	3	3	-	-	-	-	-	-	1	2	-
CO5	3	3	3	3	3	-	-	-	-	-	-	1	2	1

Correlation levels: 1 – low 2 – medium 3 – high "-" - no correlation

U23CBP44 SDG: 9	NEURAL NETWORKS AND DEEP LEARNING	Category:PEC			
		L	T	P	C
		2	0	2	3

COURSE OBJECTIVE:

1.	To understand the basics of deep neural networks.
2.	To understand the basics of associative memory and unsupervised learning networks.
3.	To apply CNN architectures of deep neural networks.
4.	To analyze the key computations underlying deep learning, then use them to build and train deep neural networks for various tasks.
5.	To apply autoencoders and generative models for suitable applications.

UNIT 1	INTRODUCTION	6

Neural Networks – Application Scope of Neural Networks – Artificial Neural Network: An Introduction – Evolution of Neural Networks – Basic Models of Artificial Neural Network – Important Terminologies of ANNs – Supervised Learning Network.

UNIT 2	ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS	6

Training Algorithms for Pattern Association – Autoassociative Memory Network – Heteroassociative Memory Network – Bidirectional Associative Memory (BAM) – Hopfield Networks – Iterative Autoassociative Memory Networks – Temporal Associative Memory Network – Fixed Weight Competitive Nets – Kohonen Self-Organizing Feature Maps – Learning Vector Quantization – Counterpropagation Networks – Adaptive Resonance Theory Network.

UNIT 3	THIRD-GENERATION NEURAL NETWORKS	6

Spiking Neural Networks – Convolutional Neural Networks – Deep Learning Neural Networks – Extreme Learning Machine Model. Convolutional Neural Networks: The Convolution Operation – Motivation – Pooling – Variants of the Basic Convolution Function – Structured Outputs – Data Types – Efficient Convolution Algorithms – Neuroscientific Basis – Applications: Computer Vision, Image Generation, Image Compression.

UNIT 4	DEEP FEEDFORWARD NETWORKS	6

History of Deep Learning – A Probabilistic Theory of Deep Learning – Gradient Learning – Chain Rule and Backpropagation – Regularization: Dataset Augmentation – Noise Robustness – Early Stopping, Bagging and Dropout – Batch Normalization – VC Dimension and Neural Nets.

UNIT 5	RECURRENT NEURAL NETWORKS	6

Recurrent Neural Networks: Introduction – Recursive Neural Networks – Bidirectional RNNs – Deep Recurrent Networks – Applications: Image Generation, Image Compression, Natural Language Processing. Complete Autoencoder – Regularized Autoencoder – Stochastic Encoders and Decoders – Contractive Encoders.

PRACTICAL EXERCISES:

1. Implement simple vector addition in TensorFlow.
2. Implement a regression model in Keras.
3. Implement a perceptron in a TensorFlow/Keras environment.

4. Implement a Feed-Forward Network in TensorFlow/Keras.
5. Implement an Image Classifier using CNN in TensorFlow/Keras.
6. Improve the deep learning model by fine-tuning hyperparameters.
7. Implement a Transfer Learning concept in image classification.
8. Use a pre-trained model on Keras for Transfer Learning.
9. Perform Sentiment Analysis using RNN.
10. Implement an LSTM-based Autoencoder in TensorFlow/Keras.
11. Image generation using GAN.

Additional Experiments:

12. Train a deep learning model to classify a given image using a pre-trained model.
13. Recommendation system from sales data using Deep Learning.
14. Implement Object Detection using CNN.
15. Implement any simple Reinforcement Learning algorithm for an NLP problem.

COURSE OUTCOME:

At the end of the course, students would be able to:

CO1:	Apply Convolutional Neural Networks for image processing.
CO2:	Understand the basics of associative memory and unsupervised learning networks.
CO3:	Apply CNN and its variants for suitable applications.
CO4:	Analyze the key computations underlying deep learning and use them to build and train deep neural networks for various tasks.
CO5:	Apply autoencoders and generative models for suitable applications.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, “Deep Learning”, MIT Press, 2016.
2. Francois Chollet, “Deep Learning with Python”, Second Edition, Manning Publications, 2021.

REFERENCES:

1. Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn and TensorFlow”, O’Reilly, 2018.
2. Josh Patterson and Adam Gibson, “Deep Learning: A Practitioner’s Approach”, O’Reilly Media, 2017.
3. Charu C. Aggarwal, “Neural Networks and Deep Learning: A Textbook”, First Edition, Springer International Publishing, 2018.
4. Jojo Moolayil, “Learn Keras for Deep Neural Networks”, Apress, 2018.
5. Vinita Silaparasetty, “Deep Learning Projects Using TensorFlow 2”, Apress, 2020.
6. S. Rajasekaran and G. A. Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and Applications”, PHI Learning, 2017.
7. Santanu Pattanayak, “Pro Deep Learning with TensorFlow”, Apress, 2017.
8. James A. Freeman and David M. Skapura, “Neural Networks: Algorithms, Applications, and Programming Techniques”, Addison-Wesley, 2003.

CO's-PO's & PSO's MAPPING														
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PS O 1**	**PS O 2**	**PSO 3**
CO1	3	2	**2**	2	-	-	-	-	**2**	-	-	2	3	3
CO2	3	2	2	2	-	-	-	-	2	-	-	2	3	3
CO3	3	3	3	3	**2**	-	-	-	3	-	-	3	3	3
CO4	3	3	3	3	**3**	-	-	-	3	-	-	3	3	3
CO5	3	3	2	3	-	-	-	-	2	-	-	**3**	3	3
AVG	**3**	**2.6**	**2.4**	**2.6**	**1**	**-**	**-**	**-**	**2.4**	**-**	**-**	**2.6**	**3**	**3**
Correlation levels: 1 – low 2 – medium 3 – high "-"- no correlation														

U23CBP45 SDG:9	**QUANTUM COMPUTING**	**Category: PEC**			
		L	**T**	**P**	**C**
		2	**0**	**2**	**3**

COURSE OBJECTIVE:

1.	To know the background of classical computing and quantum computing.
2.	To learn the fundamental concepts behind quantum computation.
3.	To study the details of quantum mechanics and its relation to Computer Science.
4.	To gain knowledge about the basic hardware and mathematical models of quantum computation.
5.	To learn the basics of quantum information and the theory behind it.

UNIT I	**QUANTUM COMPUTING BASIC CONCEPTS**	**6**
Complex Numbers - Linear Algebra - Matrices and Operators - Global Perspectives - Postulates of Quantum Mechanics - Quantum Bits - Representations of Qubits - Superpositions.		
UNIT II	**QUANTUM GATES AND CIRCUITS**	**5**
Universal logic gates - Basic single qubit gates - Multiple qubit gates - Circuit development - Quantum error correction.		
UNIT III	**QUANTUM ALGORITHMS**	**7**
Quantum parallelism - Deutsch's algorithm - The Deutsch-Jozsa algorithm - Quantum Fourier transform and its applications - Quantum Search Algorithms: Grover's Algorithm.		
UNIT IV	**QUANTUM INFORMATION THEORY**	**6**
Data compression - Shannon's noiseless channel coding theorem - Schumacher's quantum noiseless		

channel coding theorem - Classical information over noisy quantum channels.

UNIT V	QUANTUM CRYPTOGRAPHY	6

Classical cryptography basic concepts - Private key cryptography - Shor's Factoring Algorithm - Quantum Key Distribution - BB84 - Ekart 91.

PRACTICAL EXERCISES:

- Single qubit gate simulation using Quantum Composer.
- Multiple qubit gate simulation using Quantum Composer.
- Composing simple quantum circuits with q-gates and measuring the output into classical bits.
- IBM Qiskit Platform Introduction.
- Implementation of Shor's Algorithm.
- Implementation of Grover's Algorithm.
- Implementation of Deutsch's Algorithm.
- Implementation of Deutsch-Jozsa's Algorithm.
- Integer factorization using Shor's Algorithm.
- QKD Simulation.
- Mini Project: Implementing an API for efficient search using Grover's Algorithm.

COURSE OUTCOME:

At the end of the course, students would

CO1:	Understand the basics of quantum computing.
CO2:	Understand the background of Quantum Mechanics.
CO3:	Analyze the computation models.
CO4:	Model the circuits using quantum computation environments and frameworks.
CO5:	Understand the quantum operations such as noise and error-correction.

TOTAL: 60 PERIODS

TEXT BOOKS:

1.	Parag K. Lala, "Quantum Computing: A Beginners Introduction", First Edition, McGraw Hill Education, 2020.
2.	Michael A. Nielsen, Isaac L. Chuang, "Quantum Computation and Quantum Information", Tenth Edition, Cambridge University Press, 2010.
3.	Chris Bernhardt, "Quantum Computing for Everyone", Reprint Edition, The MIT Press, 2020.

REFERENCES:

1.	Scott Aaronson, "Quantum Computing Since Democritus", Cambridge University Press, 2013.
2.	N. David Mermin, "Quantum Computer Science: An Introduction", Cambridge University Press, 2007.

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CO2	3	2	2	2	-	-	-	-	2	-	-	2	3	3
CO3	3	3	3	3	**2**	-	-	-	3	-	-	3	3	3
CO4	3	3	3	3	**3**	-	-	-	3	-	-	3	3	3
CO5	3	3	2	3	-	-	-	-	2	-	-	**3**	3	3
AVG	**3**	**2.6**	**2.4**	**2.6**	**1**	**-**	**-**	**-**	**2.4**	**-**	**-**	**2.6**	**3**	**3**
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