SRI KRISHNA COLLEGE OF ENGINEERING AND TECHNOLOGY
An Autonomous Institution | Approved by AICTE | Affiliated to Anna University | Accredited by NAAC with A++ Grade
Kuniamuthur, Coimbatore – 641008
Phone : (0422)-2678001 (7 Lines) | Email : info@skcet.ac.in | Website : www.skcet.ac.in

Curriculum & Syllabi

Regulation 2022

2024-2028 Batch

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Batch 2024-2028)

VISION OF THE INSTITUTION

- To Produce Globally Competitive Engineers with High Ethical Values and Social Responsibilities

MISSION OF THE INSTITUTION

- To impart the highest quality state-of-the-art technical education by providing impetus to innovation, research, and development and empowering students with entrepreneurship skills
- To instill ethical values, imbibe a sense of social responsibility, and strive for societal well-being
- To identify the needs of society and offer sustainable solutions through outreach programs

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

VISION OF THE DEPARTMENT

- To prepare professionals with high technical, research and entrepreneurial skills as well as ethical values who will contribute to the computational world.

MISSION OF THE DEPARTMENT

- To develop human resources with the ability and attitude to adapt to emergingtechnological changes through academic and research-oriented events
- To identify current socio, economic problems of national and international significance and provide solutions through competency centers
- To impart ethics, social responsibilities and necessary professional, entrepreneurialand leadership skills through student lead activities

I.	PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)
To enable graduates to	
PEO 1	Be successful in their career in industries associated with Computer Science and Engineering
PEO 2	Comprehend, analyze, design, and create novel products and solutions for the real-life problems
PEO 3	Possess professional and ethical attitude, effective communication skills, team working skills, multi-disciplinary approach, and an ability to relate engineering issues to broader social context
PEO 4	Exhibit leadership qualities and progress through life-long learning

II.	PROGRAMME OUTCOMES (POs)
PO 1	**Engineering knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems
PO 2	**Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
PO 3	**Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
PO 4	**Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8)
PO 5	**Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
PO 6	**The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7)

PO 7	**Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
PO 8	**Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams
PO 9	**Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
PO 10	**Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
PO 11	**Life-Long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Knowledge and Attitude Profile (WK)

WK1	A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences
WK2	Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline
WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline
WK4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline
WK5	Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area
WK6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline
WK7	Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development
WK8	Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues
WK9	Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes

III. PROGRAMME SPECIFIC OUTCOMES (PSOs)	
The Graduates of B.E – CSE programme will be able to:	
PSO 1	Apply the fundamental knowledge for problem solving and analysis as well as conduct investigations in computer science and engineering for sustainable development
PSO 2	Design and develop the solutions for real time problems and implement them by using modern software tools in lieu of deploying them in the society for its growth
PSO 3	Communicate effectively, adopt ethics and engage in life-long learning

IV. MAPPING OF PEOs WITH Pos

PEO	POs										
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
1	3	3	3	2	2	3		1	1	1	2
2	3	3	3	3	3	2	1	1	1	2	2
3	-	-	-	-	-	3	3	3	2	2	2
4	-	-	-	-	-	-	-	-	3	3	3
	1- low, 2 - medium, 3 - high, '-' - no correlation										

V. MAPPING OF PEOs WITH PSOs

	PSO 1	PSO 2	PSO 3
PEO 1	2	2	2
PEO 2	3	1	-
PEO 3	1	3	2
PEO 4	-	-	3

AUTONOMOUS CURRICULUM AND SYLLABI

Regulation 2022 (2024-2028 Batch)

SEMESTER I						
S. No.	**Course Code**	**Courses**	**L/T/P**	**Total Hours**	**Credits**	**SDG Mapping**
Theory (Internal 40 Marks & External 60 Marks)						
1	23MA101	Mathematics I	3 / 1 / 0	4	4	4,8,9
2	23SB101	Engineering Biology	3 / 0 / 0	3	3	3,6,7,13
3	23AS101	Applied Science	4 / 0 / 0	4	4	3, 4, 7, 9, 11, 12, 13, 16
4	23EC111	Digital Logic Design and Computer Architecture	3 / 1 / 0	4	4	4, 8, 9, 12
Theory with Practical (Internal 50 Marks & External 50 Marks)						
5	23CS101	Problem Solving using C++	1 / 0 / 4	5	3	4,8,9
6	23IT101	Application Development Practices	1 / 0 / 4	5	3	4,8,9
Practical (Internal 60 Marks & External 40 Marks)						
7	23AS102	Applied Science Laboratory	0 / 0 / 4	4	2	3, 4, 7, 9, 11, 12, 13, 16
Indian Knowledge System						
7	23TA101	Heritage of Tamils	1 / 0 / 0	1	1	2, 7, 9, 12, 15, 16
Mandatory Course (Internal 100 Marks)						
8	23MC101	Induction Programme	3 weeks		0	3,4,5,10,16
Total				**30**	**24**	

SEMESTER - II						
S. No.	**Course Code**	**Courses**	**L/T/P**	**Total Hours**	**Credits**	**SDG Mapping**
Theory (Internal 40 Marks & External 60 Marks)						
1	23MA201	Mathematics II	3 / 1 / 0	4	4	4,8,9
Theory with Practical (Internal 50 Marks & External 50 Marks)						
2	23EN101	Oral and Written Communication Skills	2 / 0 / 2	4	3	4,5,8,10
3	23CD202	Object Oriented Analysis and Design	3 / 0 / 2	5	4	4,9
4	23CS201	Data Structures and Algorithms	1 / 0 / 4	5	3	4,8,9
5	23CD201	Database Management Systems	1 / 0 / 4	5	3	4,8,9
6	23CY203	Programming in Java	1 / 0 / 4	5	3	4,8,9
Indian Knowledge System						
7	23TA201	Tamils and Technology	1 / 0 / 0	1	1	2, 7, 9, 11, 12, 15, 17
Mandatory Course-Blended Learning (Internal 100 Marks)						
8	23MC102	Environmental Sciences	1 / 0 / 0	1	0	3,4,5,6,7,8, 11,13,15,16
Total				**30**	**21**	

SEMESTER - III						
S. No.	**Course Code**	**Courses**	**L/T/P**	**Total Hours**	**Credits**	**SDG Mapping**
Theory-Blended Learning (Internal 100 Marks)						
1	23GE301	Universal Human Values	3 / 0 / 0	3	3	4,5,10,16
Theory with Practical (Internal 50 Marks & External 50 Marks)						
2	23CY202	Operating Systems	3 / 0 / 2	5	4	4,8,9
3	23ADC01	Artificial Intelligence and Its Application	2 / 0 / 2	4	3	4,9,11
4	23ITC02	Data Communication and Networks	2 / 0 / 2	4	3	4,9,17
5	23CS303	Algorithm Design Techniques	3 / 0 / 2	5	4	4,8,9
6	23CY305	Applied Statistics Using Python	3 / 0 / 2	5	4	4,8,9
Practical (Internal 60 Marks & External 40 Marks)						
7	23CS304	Frontend Frameworks	0 / 0 / 4	4	2	4,8,9
Total				**30**	**23**	

SEMESTER - IV						
S. No.	**Course Code**	**Courses**	**L/T/P**	**Total Hours**	**Credits**	**SDG Mapping**
Theory-Blended Learning (Internal 100 Marks)						
1	23GEC01	Entrepreneurship and Startups	3 / 0 / 0	3	3	3,4,5,8,9,17
Theory (Internal 40 Marks & External 60 Marks)						
2	23IT401	Formal Languages and Automata Theory	3 / 1 / 0	4	4	4,8,9

3	23CYC01	Cybersecurity Essentials	3 / 0 / 0	3	3	4,9,16,17
Theory with Practical (Internal 50 Marks & External 50 Marks)						
4	23CSC02	Machine Learning Techniques	2 / 0 / 2	4	3	4,9
5	23ITC01	Internet of Things	2 / 0 / 2	4	3	4,9
Practical (Internal 60 Marks & External 40 Marks)						
6	23ME305	Design Thinking and Idea Lab	0 / 0 / 2	2	1	4, 9, 11, 12
7	23CS404	Backend Frameworks	0 / 0 / 4	4	2	4,9
Spoken Language (Internal 100 Marks)						
7	23SLC01	Multilingual Practices	0 / 0 /2	2	1	4,11,16
Total				**26**	**20**	

SEMESTER - V						
S. No.	**Course Code**	**Courses**	**L/T/P**	**Total Hours**	**Credits**	**SDG Mapping**
Theory (Internal 40 Marks & External 60 Marks)						
1	23CS501	Mobile and Edge Computing	3 / 0 / 0	3	3	4,9
2	23CSC03	Quantum Computing	3 / 0 / 0	3	3	3,7,9
Theory with Practical (Internal 50 Marks & External 50 Marks)						
3	23CS504	Signal Processing	2 / 0 / 2	4	3	4,9
4		Professional Elective – I	2 / 0 / 2	4	3	
5		Professional Elective - II	2 / 0 / 2	4	3	
Practical (Internal 60 Marks & External 40 Marks)						
6	23CS505	Cloud Infrastructure and Services Management	0 / 0 / 4	4	2	4,9

Mini Project (Internal 100 Marks)						
7	23CS503	Application Development	0 / 0 / 6	6	3	4,9
Mandatory Course-Blended Learning (Internal 100 Marks)						
8	23MCC03	Indian Constitution	1 / 0 / 0	1	0	1,2,3,5,6,8,11
Total				**29**	**20**	

SEMESTER - VI						
S. No.	**Course Code**	**Courses**	**L/T/P**	**Total Hours**	**Credits**	**SDG Mapping**
Theory (Internal 40 Marks & External 60 Marks)						
1	23CS602	Advanced Graph Theory	3 / 0 / 0	3	3	7,9,10,11
2	23CS603	Parallel and Distributed Computing	3 / 0 / 0	3	3	4,7,9
3	23CS604	Real-time Operating Systems	3 / 0 / 0	3	3	3,4,7,9
Theory with Practical (Internal 50 Marks & External 50 Marks)						
4	23IT604	Mobile Application Development	3 / 0 / 2	5	4	9,17
5	23CSC04	Principles of Compiler Design	3/0/2	5	4	4,7,9
6		Professional Elective – III	2 / 0 / 2	4	3	
7		Professional Elective - IV	2 / 0 / 2	4	3	
Mini Project (Internal 100 Marks)						
8	23CS605	Prototype Lab	0 / 0 / 2	2	1	4,8,9,17
Total				**29**	**24**	

SEMESTER - VII						
S. No.	**Course Code**	**Courses**	**L/T/P**	**Total Hours**	**Credits**	**SDG Mapping**
Theory (Internal 40 Marks & External 60 Marks)						
1		Open / Emerging/ Industrial Elective- I	3/0/0	3	3	
2		Open / Emerging/ Industrial Elective- II	3/0/0	3	3	
3		Open / Emerging/ Industrial Elective- III	3/0/0	3	3	
Theory with Practical (Internal 50 Marks & External 50 Marks)						
4		Professional Elective - V	2/0/2	4	3	
5		Professional Elective - VI	2/0/2	4	3	
Project (Internal 60 Marks & External 40 Marks)						
6	23CS701	Project - I	0 / 0 / 6	6	3	4,9,17
Internship (Internal 100 Marks)						
7	23CS702	Employability Enhancement Skills (Internship)	28 Days		2	8,12,17
Total				**23**	**20**	

SEMESTER - VIII						
S. No.	**Course Code**	**Courses**	**L/T/P**	**Total Hours**	**Credits**	**SDG Mapping**
Project (Internal 60 Marks & External 40 Marks)						
1	23CS801	Project - II	0 / 0 / 24	24	12	4,9,17
Total				**24**	**12**	

SCHEME OF CREDIT DISTRIBUTION – SUMMARY											
S. No.	Stream	Credits/Semester								C	%
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities & Social Sciences Including Management (HSMC)	1	4	3	3					11	6.7
2	Basic Sciences (BSC)	13	4							17	10.4
3	Engineering Sciences (ESC)	10			1					11	6.7
4	Professional Core (PCC)		13	20	15	11	17			76	46.0
5	Professional Electives (PEC)					6	6	6		18	11.0
6	Open/Emerging/ Industry (OEC)							9		9	5.5
7	Project Work (PROJ)					3	1	5	12	21	12.8
8	Mandatory Course (MC) / Multilingual Practices				1					1	0.6
Total		24	21	23	20	20	24	20	12	164	100

STRUCTURE FOR UNDERGRADUATE ENGINEERING PROGRAM			
S. No.	**Course Work - Subject Area**	**AICTE Suggested Credits**	**SKCET Credits (164)**
1	Humanities and Social Sciences (HS), including Management;	**16**	**11**
2	Basic Sciences (BS) including Mathematics, Physics, Chemistry, Biology;	**23**	**17**
3	Engineering Sciences (ES), including Materials, Workshop, Drawing, Basics of Electrical/Electronics/Mechanical/Computer Engineering, Instrumentation;	**29**	**11**
4	Professional Subjects-Core (PC), relevant to the chosen specialization/branch; (May be split into Hard (no choice) and Soft (with choice), if required	**59**	**75**
5	Professional Subjects – Electives (PE), relevant to the chosen specialization/ branch;	**12**	**18**
6	Open Subjects- Electives (OE), from other technical and/or emerging subject areas;	**9**	**9**
7	Project Work, Seminar and/or Internship in Industry or elsewhere.	**15**	**21**
8	Mandatory Courses (MC)	**Non-credit**	**1**
Total		**163**	**163**
**Minor Variations is allowed as per need of the respective disciplines*			

HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT (11 Credits)					
S. No.	**Course Code**	**Course Title**	**L/T/P**	**Contact hrs./Wk.**	**C**
1	23EN101	Oral & Written Communication Skills	2/0/2	4	3
2	23TA101	Heritage of Tamils	1/0/0	1	1
3	23TA201	Tamils and Technology	1/0/0	1	1
4	23GE301	Universal Human Values	3/0/0	3	3
5	23GEC01	Entrepreneurship and Startups	3/0/0	3	3

BASIC SCIENCE COURSES (17 Credits)					
S. No.	**Course Code**	**Course Title**	**L/T/P**	**Contact hrs./Wk.**	**C**
1	23MA101	Mathematics I	3/1/0	4	4
2	23MA201	Mathematics II	3/1/0	4	4
3	23AS101	Applied Science	4/0/0	4	4
4	23AS102	Applied Science Laboratory	0/0/4	4	2
5	23SB101	Engineering Biology	3/0/0	3	3

ENGINEERING SCIENCE COURSES (11 Credits)					
S. No.	**Course Code**	**Course Title**	**L/T/P**	**Contact hrs./Wk.**	**C**
1	23EC111	Digital Logic Design and Computer Architecture	3/1/0	4	4
2	23IT101	Application Development Practices	1/0/4	5	3
3	23CS101	Problem Solving using C++	1/0/4	5	3
4	23ME305	Design Thinking and Idea Lab	0 / 0 / 2	2	1

PROFESSIONAL CORE COURSES (79 Credits)					
S. No.	**Course Code**	**Course Title**	**L/T/P**	**Contact hrs./Wk.**	**C**
1	23CS201	Data Structures and Algorithms	1 / 0 /4	5	3
2	23CD201	Database Management Systems	1 / 0 /4	5	3
3	23CY203	Programming in Java	1 / 0 /4	5	3
4	23CD202	Object Oriented Analysis and Design	3 / 0 / 2	5	4
5	23CY202	Operating Systems	3 / 0 / 2	5	4
6	23ADC01	Artificial Intelligence and Its Application	2 / 0 / 2	4	3
7	23ITC02	Data Communication and Networks	2 / 0 / 2	4	3
8	23CS303	Algorithm Design Techniques	3 / 0 / 2	5	4
9	23CY305	Applied Statistics Using Python	3 / 0 / 2	5	4
10	23CS304	Frontend Frameworks	0 / 0 / 4	4	2

11	23IT401	Formal Languages and Automata Theory	3 / 1 / 0	4	4
12	23CYC01	Cybersecurity Essentials	3 / 0 / 0	3	3
13	23CSC02	Machine Learning Techniques	2 / 0 / 2	4	3
14	23ITC01	Internet of Things	2 / 0 / 2	4	3
15	23CS404	Backend Frameworks	0 / 0 / 4	4	2
16	23CSC03	Quantum Computing	3 / 0 / 0	3	3
17	23CSC04	Principles of Compiler Design	3 / 0 / 2	5	4
18	23CS501	Mobile and Edge Computing	3 / 0 / 0	3	3
19	23CS504	Signal Processing	2 / 0 / 2	4	3
20	23CS505	Cloud Infrastructure and Services Management	0 / 0 / 4	4	2
21	23CS602	Advanced Graph Theory	3 / 0 / 0	3	3
22	23CS603	Parallel and Distributed Computing	3 / 0 / 0	3	3
23	23CS604	Real-time Operating Systems	2 / 0 / 2	4	3
24	23IT604	Mobile Application Development	3 / 0 / 2	5	4

PROFESSIONAL ELECTIVE COURSES (18 Credits)							
S. No.	**Course Code**	**Course Title**	**L/T/P**	**Contact hrs./Wk.**	**C**	**Ext/ Int**	**Cat.**
ELECTIVE STREAM I – MACHINE LEARNING ENGINEERING							
1	23AD902	Exploratory Data Analysis (EDA) using Python	2/0/2	4	3	50/50	PEC
2	23AD905	Statistical Methods and Basic Machine Learning Models	2/0/2	4	3	50/50	PEC
3	23IT901	Advanced ML Techniques	2/0/2	4	3	50/50	PEC

4	23IT902	NLP	2/0/2	4	3	50/50	PEC
5	23IT903	Computer Vision	1/0/4	5	3	50/50	PEC
6	23AD906	GenAI Advanced Prompt Engineering & LLMs	1/0/4	5	3	50/50	PEC
ELECTIVE STREAM II - DATA ANALYST WITH ML ESSENTIALS							
1	23AD901	Data Storytelling and Visualization	2/0/2	4	3	50/50	PEC
2	23AD902	Exploratory Data Analysis (EDA) using Python	2/0/2	4	3	50/50	PEC
3	23AD903	Problem solving with Analytical & Design Thinking	2/0/2	4	3	50/50	PEC
4	23AD904	PowerBI	2/0/2	4	3	50/50	PEC
5	23AD905	Statistical Methods and Machine Learning Models	2/0/2	4	3	50/50	PEC
6	23AD906	GenAI Advanced Prompt Engineering & LLMs	1/0/4	5	3	50/50	PEC
ELECTIVE STREAM III - CLOUD IT ADMINISTRATION							
1	23CS901	Implementing and Administering Enterprise Networks	2/0/2	4	3	50/50	PEC
2	23CS902	Linux System Administration	2/0/2	4	3	50/50	PEC
3	23CS903	Information Security Systems	2/0/2	4	3	50/50	PEC
4	23CS904	Low-Code No-Code Application Building	2/0/2	4	3	50/50	PEC
5	23CS905	Virtualization, Cloud Computing and SysOps	1/0/4	5	3	50/50	PEC
6	23CS906	Continuous Monitoring and Observability (AWS)	1/0/4	5	3	50/50	PEC
ELECTIVE STREAM IV – CYBER SECURITY							
1	23CS901	Implementing and Administering Enterprise Networks	2/0/2	4	3	50/50	PEC
2	23CS902	Linux System Administration	2/0/2	4	3	50/50	PEC
3	23CS903	Information Security Systems	2/0/2	4	3	50/50	PEC
4	23CY901	Cloud Computing and Containerized Virtual Infrastructure	2/0/2	4	3	50/50	PEC
5	23CY902	Penetration Testing	1/0/4	5	3	50/50	PEC

6	23CY903	Security Operations of Information systems	1/0/4	5	3	50/50	PEC
ELECTIVE STREAM V – FULL STACK SOFTWARE DEVELOPMENT (for Minor)							
1	23CS911	Managing and Querying Database (RDBMS) MySQL / Postgre SQL	2/0/2	4	3	50/50	PEC
2	23CS912	Java / Python: Object-Oriented Programming	2/0/2	4	3	50/50	PEC
3	23IT911	Web Development and UI/UX Essentials	2/0/2	4	3	50/50	PEC
4	23IT912	Build Single-Page Applications using React	2/0/2	4	3	50/50	PEC
5	23IT913	Build Back-end Application using Spring Boot / FAST API	1/0/4	5	3	50/50	PEC
6	23AD906	GenAI Advanced Prompt Engineering & LLMs	1/0/4	5	3	50/50	PEC

OPEN/ EMERGING/ INDUSTRY					
S. No.	**Course Code**	**Course Title**	**L/T/P**	**Contact hrs./Wk.**	**C**
1	23CS001	Programming with Data Structures	2/ 0/ 2	4	3

PROJECT WORK (21 Credits)					
S. No.	**Course Code**	**Course Title**	**L/T/P**	**Contact hrs./Wk.**	**C**
1	23CS503	Application Development	0 / 0 / 6	6	3
2	23CS603	Prototype Lab	0 / 0 / 2	2	1
3	23CS701	Project - I	0 / 0 / 6	6	3
4	23CS702	Employability Enhancement Skills (Internship)	28 Days		2
5	23CS801	Project - II	0 / 0 / 24	24	12

PROFESSIONAL ELECTIVE COURSES: VERTICALS				
Vertical I - ML Engineering	**Vertical II - Data Analyst with ML Essentials**	**Vertical III - Cloud IT Administration**	**Vertical IV - Cybersecurity**	**Vertical V – Full Stack Software Development (Minor)**
Exploratory Data Analysis (EDA) using Python	Data Storytelling and Visualization	Implementing and Administering Enterprise Networks	Implementing and Administering Enterprise Networks	Managing and Querying Database (RDBMS) MySQL / Postgre SQL
Statistical Methods and Basic Machine Learning Models	Exploratory Data Analysis (EDA) using Python	Linux System Administration	Linux System Administration	Java / Python: Object-Oriented Programming
Advanced ML Techniques	Problem solving with Analytical & Design Thinking	Information Security Systems	Information Security Systems	Web Development and UI/UX Essentials
NLP	PowerBI	Low-Code No-Code Application Building	Cloud Computing and Containerized Virtual Infrastructure	Build Single-Page Applications using React
Computer Vision	Statistical Methods and Machine Learning Models	Virtualization, Cloud Computing and SysOps	Penetration Testing	Build Back-end Application using Spring Boot / FAST API
GenAI Advanced Prompt Engineering & LLMs	GenAI Advanced Prompt Engineering & LLMs	Continuous Monitoring and Observability (AWS)	Security Operations of Information systems	GenAI Advanced Prompt Engineering & LLMs

INTERN (02 Credits)					
S. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C
1	23CS702	Employability Enhancement Skills (Internship)	28 Days		2

VALUE ADDED COURSES (Based on student's interest)						
S. No	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Sem
1	23VA200	Cassandra	1 / 0 / 0	1	1	III
2	23VA201	MongoDB	1 / 0 / 0	1	1	IV
3	23VA202	Edge Computing	1 / 0 / 0	1	1	V
4	23VA203	PyCharm	1 / 0 / 0	1	1	VI
5	23VA204	Generative AI	1 / 0 / 0	1	1	VI

MANDATORY COURSES (01) (Courses conducted either by internal faculty or through MOOCs)					
S. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C
1	23MC101	Induction Programme			0
2	23MC102	Environmental Sciences	1 / 0 / 0	1	0
3	23SLC01	Multilingual Practices	0 / 0 /2	2	1
4	23MCC01	Indian Constitution	1 / 0 / 0	1	0

L: Lecture **T:** Tutorial **P:** Practical **C:** Credit **O:** Outside Class hours **Cat.:** Category

HSMC : Humanities and Social Sciences including Management

BSC : Basic Science Courses

ESC : Engineering Science Courses

PCC : Professional Core Courses

PEC : Professional Elective Courses

OEC : Open and Emerging Elective Courses

PRJ : Project Work

INT : Internship

MC : Mandatory Course

Definition of Credit:

L – Lecture	1 Hr. Lecture (L) per week	1 credit
T – Tutorial	1 Hr. Tutorial (T) per week	1 credit
P - Practical/Practice (Project and Industry based Courses)	1 Hr. Practical (P) per week	0.5 credit

SEMESTER – III

23GE301	UNIVERSAL HUMAN VALUES (Common to all branches)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection
4. Development of commitment and courage to act
5. Helping the students to appreciate the essential complementarities between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings
6. Highlighting plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature

COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION, UNDERSTANDING HARMONY IN THE HUMAN BEING-HARMONY IN MYSELF! 10

Self-evaluation of the students -Pre-test of UHV- Purpose and motivation for the course. Self-exploration –Its content and process- A look at basic Human Aspirations. Understanding Happiness and Prosperity correctly-Understanding the needs of Self ('I') and 'Body'- Understanding the Body as an instrument of 'I'(being the doer, seer and enjoyer)- Understanding the characteristics and activities of 'I' and harmony in 'I' - Understanding the harmony of I' with the Body- Social activities – Waste Management - Water Conservation-Soil Pollution - Physical Health and related activities - Lectures by eminent persons- Literary activities

UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY- HARMONY IN HUMAN-HUMAN RELATIONSHIP, UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE- WHOLE EXISTENCE AS COEXISTENCE 10

Understanding values in human relationship - Understanding the harmony in the society (society being an extension of family): - Visualizing a universal harmonious order in society - Understanding the harmony in Nature.-Understanding Existence as Coexistence of mutually Interacting units in all - pervasive space. Holistic perception of harmony at all levels of existence-Buddy program - Relationships – Homesickness - Managing peer pressure - Projects - Socially responsible engineers - Visit to local areas (orphanages, special children) - Physical Activities (games)

IMPLICATIONS OF HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS 10

Natural acceptance of human values- Definitiveness of Ethical Human Conduct- Basis for Humanistic Education-Humanistic Constitution and Humanistic Universal Order-Competence in professional ethics-Case studies of typical holistic technologies, management models and eco-friendly production systems - Strategy for transition from the present state to Universal Human Order-Sum up: Self-evaluation of the students-Post test of UHV.

TOTAL : 30 PERIODS

COURSE OUTCOMES

Upon completion of the course, students shall have ability to

CO1	Understand and take responsibilities in life and handle problems to attain sustainable solutions while keeping human relationships and human nature in mind	[U]
CO2	Apply responsibilities towards their commitments (human values, human relationship and human society)	[AP]
CO3	Apply what they have learnt to their own self indifferent day-to-day settings in real life, at least a beginning would be made in this direction	[AP]
CO4	Analyze ethical and unethical practices, and formulate strategies to actualize a harmonious environment wherever they work	[AN]
CO5	Understand the harmony in nature and existence, and work out mutually on fulfilling participation in nature	[U]

TEXT BOOKS

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

REFERENCE BOOKS

1. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
2. The Story of My Experiments with Truth –by Mohandas Karamchand Gandhi India Wins Freedom-Maulana Abdul Kalam Azad.

WEB RESOURCES

1. https://examupdates.in/professional-ethics-and-human-values/
2. http://hvpe1.blogspot.com/2016/06/notes-human-values-and-professional.html
3. https://www.yourmorals.org/schwartz.2006.basic%20human%20values.pdf

23CY202	OPERATING SYSTEMS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES

1. To understand the structure and functions of Operating System
2. To familiarize the OS mechanisms to handle processes and threads
3. To acquire the knowledge in CPU scheduling policies, synchronization techniques and deadlock handling
4. To articulate Memory management schemes
5. To explorethe device Management, I/O and File systems concepts

INTRODUCTION **15**

Defining Operating Systems - User view - System view - Computer-System organization - Computer System Architecture - Operating System Operations - Resource Management - Virtualization - Computing Environments - OS Services - System Calls - Overview of Operating System Specific applications - OS Structures - System Boot. Process: Concept - Scheduling – Operations. Thread: Overview - Multicore Programming - Multithreading Models

PROCESS & MEMORY MANAGEMENT **15**

CPU Scheduling - Process Synchronization: Synchronization Tools - Classic Problems of Synchronization – Deadlocks: System Model- Deadlock in Multithreaded Applications - Deadlock Characterization - Methods for Handling Deadlocks - Prevention - Avoidance - Detection – Recovery. Main memory: Background - Contiguous Memory Allocation – Paging - Structure of the Page Table – Swapping. Virtual memory -Background - Demand Paging - Copy-on-Write- Page Replacement - Allocation of Frames - Thrashing - Memory Compression

FILE MANAGEMENT, I/O AND STORAGE **15**

File-System Interface: File concept - Access Methods-Directory Structure - Protection. File System Implementation: File System Structure- Directory implementation- Allocation Methods- Free Space Management. File system Internals: File Systems - File System mounting - Partitions and Mounting - File Sharing. I/O Systems: Overview - I/O Hardware. Mass Storage Structure: Overview - HDD Scheduling - NVM Scheduling - Storage Device Management - Storage Attachment. Case Study: NAND flash storage system, IPC in windows

TOTAL (Theory): 45 PERIODS

LIST OF EXPERIMENTS

1. Study of basic Linux commands, proc file system of Linux, disk I/O, buffer caches, and disk monitoring tools
2. Implementation of shell programming

3. Implementation of Unix system calls
4. Implementation of non-preemptive and preemptive CPU scheduling algorithms.
5. Implementation of the Dining Philosopher's Problem to demonstrate process synchronization
6. Implementation of Banker's Algorithm for deadlock avoidance
7. Implementation of memory allocation and management techniques
8. Implementation of page replacement techniques
9. Implementation of file organization techniques and a study on modern file systems like ZFS, btrfs, and ext4
10. Implementation of disk scheduling algorithms and comparison of CPU and disk scheduling algorithms in terms of the number of voluntary and involuntary context switches

TOTAL (Lab): 30 PERIODS

TOTAL: 75 PERIODS

COURSE OUTCOMES

Upon completion of the course, students shall have ability to

C202.1	Review the basic concepts and functions of operating systems	[U]
C202.2	Interpret the processes and threads in operating systems for real world problems	[U]
C202.3	Examine CPU scheduling algorithms, process synchronization mechanisms and deadlock handling methods	[AP]
C202.4	Practice memory management techniques including virtual memory and page replacement algorithms	[AP]
C202.5	Illustrate the concepts related to mass storage, I/O and file system	[AP]

TEXTBOOKS

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts" 10th Edition, John Wiley, 2018
2. D.M Dhamdhere, "Operating Systems"- A Concept based Approach, 3rdEdition, McGraw Hill,2017
3. William Stallings, "Operating Systems: Internals and Design Principles", 9th Edition, Pearson, 2018

REFERENCE BOOKS

1. Andrew S. Tanenbaum, Modern Operating Systems 5thEdition, Pearson Education, 2016
2. Gary Nutt, "Operating Systems: A Modern Perspective", 3rd Edition, Pearson, 2004

3. Remzi H. Arpaci-Dusseau, Andrea C. Arpaci-Dusseau, "Operating Systems: Three Easy Pieces", 1st Edition, Arpaci-Dusseau Books, 2018

WEB RESOURCES

1. https://nptel.ac.in/courses/106108101
2. https://www.studocu.com/sg/course/nanyang-technological-university/operating-systems/1390534
3. https://www.cs.uic.edu/~jbell/CourseNotes/OperatingSystems/
4. https://ocw.mit.edu/courses/6-828-operating-system-engineering-fall-2012/

23ADC01	ARTIFICIAL INTELLIGENCE AND ITS APPLICATIONS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES

1. To explore AI's history, definitions, and ethical dimension of AI and differentiate it from Machine Learning and Deep Learning
2. To study search algorithms, logic-based reasoning, and knowledge representation methods for problem-solving in AI
3. To gain insights into knowledge representation, logic-based reasoning and expert systems
4. To implement AI algorithms in domains such as Natural Language Processing (NLP), Computer Vision, and Decision-Making systems
5. To investigate bias, fairness, accountability, and ethical considerations in designing and implementing AI technologies

FOUNDATIONS OF ARTIFICIAL INTELLIGENCE **10**

Definition and History of AI - AI vs Machine Learning vs Deep Learning - Applications of AI in Healthcare, Finance, and Robotics - AI Ethics and Challenges - Turing Test and AI Approaches (Symbolic AI vs Subsymbolic AI). PROBLEM SOLVING in AI - Problem Formulation - Uninformed Search (BFS, DFS) - Informed Search (A*, Greedy Search) - Constraint Satisfaction Problems (CSPs) - Adversarial Search and Game Theory (Minimax Algorithm, Alpha-Beta Pruning)

KNOWLEDGE, REASONING AND LEARNING **10**

Logic in AI: Propositional and First-Order Logic - Knowledge Representation: Semantic Networks, Frames, Ontologies - Inference Mechanisms: Forward Chaining, Backward Chaining - Introduction to Expert Systems - Fundamentals of Language -Probabilistic Language Processing -NLP Basics - Reinforcement Learning and AI Agents

AI IN ACTION – PERCEPTION, COMMUNICATION & APPLICATIONS **10**

Information Retrieval & Extraction – Perception: Image Formation, Object Recognition – AI in Computer Vision (Image Recognition) – AI in Edge Computing and IoT- Case Study - AI Applications in Smart Cities, Healthcare, and Business

TOTAL (THEORY): 30 PERIODS

LIST OF EXPERIMENTS

1. Implement a simple AI-based Python script
2. Exploring AI applications in real-world case studies
3. Implementing BFS and DFS in Python
4. Implement A* and Greedy Best-First Search to find the shortest path in a grid
5. Implement an AI agent to play Tic-Tac-Toe using the Minimax algorithm
6. Implement a basic propositional logic reasoning system
7. Build a simple knowledge base using First-Order Logic
8. Create a semantic network to represent relationships between objects
9. Design a basic expert system for medical diagnosis
10. Perform tokenization, stemming, and stop-word removal on sample text
11. Implement a speech-to-text system using Python's speech recognition library
12. Implementing AI for a real-world problem (e.g., predicting student performance)

TOTAL (LAB): 15 PERIODS

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of the course, students shall have ability to

CO1	Assess various Artificial Intelligence (AI) techniques and identify their fundamental concepts	[U]
CO2	Apply problem-solving techniques such as search algorithms and game theory in AI systems	[AP]
CO3	Implement knowledge representation and reasoning techniques for intelligent decision-making	[AP]
CO4	Demonstrate Machine Learning algorithms and AI frameworks to solve real-world problems	[AP]
CO5	Design AI-based applications for NLP, Computer Vision, and Robotics. Evaluate the ethical considerations and social impacts of AI in various domains	[AP]

TEXTBOOKS

1. Stuart Russell & Peter Norvig, "Artificial Intelligence: A Modern Approach", 4th Edition, Pearson, 2021
2. K. R. Chowdhary, Fundamentals of Artificial Intelligence, Springer, 2020
3. Elaine Rich & Kevin Knight, "Artificial Intelligence", 3rd Edition, McGraw-Hill, 2017

REFERENCE BOOKS

1. Wolfgang Ertel, Introduction to Artificial Intelligence, 2nd Edition, Springer, 2018
2. Mariusz Flasiński, Introduction to Artificial Intelligence, Springer, 2016

3. Stephen Lucci & Danny Kopec, Artificial Intelligence in the 21st Century: A Living Introduction, 2nd Edition, Mercury Learning and Information, 2016

WEB RESOURCES

https://www.coursera.org/learn/introduction-to-ai

https://www.coursera.org/learn/ai-for-everyone

https://ai.google/get-started/for-developers/

https://nptel.ac.in/courses/106102220

https://nptel.ac.in/courses/106106140

23ITC02	DATA COMMUNICATION AND NETWORKS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES

1. To introduce students to the basics of computer networking, including network topologies, data flow, and various layering models
2. To teach students to understand the components used in the physical layer and their functionalities and their impact on network performance
3. To equip students with the concepts, functions, and protocols of the Data Link and Network layers
4. To train students in implementing the different types of protocols in the Transport layer and their roles in data transmission
5. To enable students to study advanced protocols in the Application layer and their applications in modern networking

DATA COMMUNICATION AND PHYSICAL LAYER 10

Components of data communication - Data Representation – Data flow - Network Topology - Protocols and Standards - Layers in OSI Model - TCP / IP protocol suite – Repeaters - Hubs – Bridges – Switches - Routers and Gateways. Packet switching vs. circuit switching.

DATA LINK AND NETWORK LAYER 10

Data Link Layer: Block Coding - Cyclic Codes – Checksum. Stop-and-Wait ARQ - Go-Back-N ARQ - Selective Repeat ARQ. Ethernet – IEEE 802.11 – Bluetooth. IP semantics and syntax - **IPv4:** Addresses, Datagram. **IPv6:** Addresses - Advantages, Packet Format – Subnetting. **Routing:** Distance Vector Routing – Link State Routing. ARP – RARP – DHCP - ICMP. Internet – Voice and video over IP. Computer Networks and the Internet

TRANSPORT LAYER AND APPLICATION LAYER 10

Transport Layer: Elements of transport protocols - Process to Process delivery - UDP - TCP - Congestion - Congestion control in TCP, QoS, Marking, Shaping, Policing.

Application Layer: Domain Name System – Electronic Mail – FTP – WWW - HTTP - SNMP-DDoS Attacks and Application layer Attacks - Firewalls.

Case Study: Software Defined Networking for IoT, Network Troubleshooting with Wireshark

TOTAL (Theory): 30 PERIODS

LIST OF EXPERIMENTS

1. Demonstrate the working of network tools such as Ping, TCPDump, Traceroute, Netstat

2. Build simple LANs, perform basic configurations for switches using simulator
3. Implement IPv4 and IPv6 addressing schemes and test it with comments
4. Build Connected LANs different subnets with router and Test performance using simulator
5. Performance analysis of TCP and UDP protocol using simulator
6. Performance analysis of routing protocols using simulator
7. Analyze the network traffic using Wireshark tool/Packet tracer tool
8. Write a program on a datagram socket for the client/server to display the messages on the client side typed at the server-side
9. Simulate a wireless network using cisco packet tracer
10. Implement email client server in packet tracer

TOTAL (Lab): 30 PERIODS

TOTAL: 60 PERIODS

COURSE OUTCOMES

Upon completion of the course, students shall have ability to

CO1	Assess the functionalities of the layers in the OSI and TCP/IP models, highlighting their differences and similarities	[U]
CO2	Apply flow control and error control mechanisms using data link layer protocols	[AP]
CO3	Apply the concepts of various routing algorithms and IP addresses to fulfil network requirements of an organization	[AP]
CO4	Develop the reliable/unreliable communication model using various Transport Layer Protocols and assess their Quality of service	[AP]
CO5	Analyse the features and operations of various application layer protocols and demonstrate application layer attacks and its countermeasures	[AN]

TEXTBOOKS

1. Behrouz A. Forouzan, “Data Communications and Networking with TCP/IP Protocol Suite”, 6th Edition, McGraw Hill Education, 2022
2. Andrew S. Tanenbaum, Nick Feamster, David J. Wetherall, “Computer Networks”, 6th Edition, Pearson Education, 2021
3. Andrei Gurtov, Madhusanka Liyanage, Mika Ylianttila, “Software Defined Mobile Networks (SDMN): Beyond LTE Network Architecture”, Wiley, 2021
4. James F. Kurose, Keith W. Ross, “Computer Networking: A Top-Down Approach”, 8th Edition, Pearson Education, 2020

REFERENCE BOOKS

1. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, 6th Edition, Elsevier, 2021

2. William Stallings, “Data and Computer Communications”, 10th Edition, PHI, 2017.
3. Xingqin Lin, Namyoon Lee, “5G and Beyond: Fundamentals and Standards”, Springer, 2021.

WEB RESOURCES

1. https://www.geeksforgeeks.org/network-and-communication/
2. https://www.britannica.com/science/computer-science/Networking-and-communication
3. https://www.ibm.com/docs/en/aix/7.2?topic=management-network-communication-concepts
4. https://www.networkstraining.com/
5. Coursera: Computer Networking

23CS303	ALGORITHM DESIGN TECHNIQUES	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES

1. To enable students to analyze the performance of algorithms mathematically and apply problem-solving techniques effectively
2. To guide students in utilizing greedy techniques for solving optimization problems, including applications in pattern matching and palindrome identification
3. To train students in designing solutions for constraint satisfaction problems using backtracking algorithms
4. To equip students with an in-depth understanding of advanced dynamic programming algorithms and their practical applications
5. To facilitate learning of graph algorithms and range query optimizations, helping students implement these techniques in real-world problem-solving scenarios

ALGORITHM COMPLEXITY ANALYSIS & GREEDY APPROACH 15

Time Complexity Analysis: Mathematical analysis of recursive and non-recursive algorithms, Master's Theorem, Sieve of Sundaram. Recursion: Concept of recursion, base cases, and recursive problem-solving strategies. Greedy Algorithms: Activity Selection Problem, Fractional Knapsack. Industry Focus: Demonstration of built-in functions and optimization practices in C++

STRING ALGORITHMS AND BACKTRACKING 15

String Algorithms: Naïve Pattern Matching, Rabin-Karp Algorithm, Z Algorithm, Knuth-Morris-Pratt (KMP) Algorithm, Manacher's Algorithm for longest palindromic substring. Backtracking: Rat in a Maze, Permutation and Combination, N-Queen Problem. Knight's Tour Problem, Subset Sum, M-Coloring Problem, Hamiltonian Cycle Problem. Sudoku Solver, Prime Numbers after Prime P with Sum S

DYNAMIC PROGRAMMING, GRAPH & RANGE QUERY ALGORITHMS 15

Dynamic Programming: Top-down and Bottom-up Approach, 0-1 Knapsack, Coin Change Problem, Subset Sum Problem, Minimum Cost Path. Longest Common Subsequence (LCS), Longest Increasing Subsequence (LIS), Longest Palindromic Subsequence. Graph Algorithms: Single Source Shortest Path Algorithm (Dijkstra's Algorithm). All-Pairs Shortest Path (Floyd Warshall Algorithm). Minimum Spanning Tree (Prim's and Kruskal's Algorithm). Range Query Algorithms: Range Minimum Query (RMQ) - Brute Force Approach, RMQ Using Segment Tree, RMQ using Sparse Table

TOTAL (Theory): 45 PERIODS

LIST OF EXPERIMENTS

1. Implement time complexity analysis for recursive and non-recursive algorithms
2. Solve the Activity Selection Problem and Fractional Knapsack using the greedy approach
3. Implement Rabin-Karp and Knuth-Morris-Pratt (KMP) string matching algorithms
4. Solve backtracking problems: N-Queen, Knight's Tour, Subset Sum, and Sudoku Solver
5. Implement dynamic programming algorithms: Longest Common Subsequence (LCS), 0-1 Knapsack, and Minimum Cost Path
6. Implement graph algorithms: Dijkstra's Algorithm, Floyd-Warshall Algorithm, and Minimum Spanning Tree (MST)
7. Solve Range Minimum Query problems using Segment Tree and Sparse Table

TOTAL (Lab): 30 PERIODS

TOTAL: 75 PERIODS

COURSE OUTCOMES

Upon completion of the course, students shall have ability to

CO1	Analyze the computational complexity of algorithms applied to real-world problem-solving	[AN]
CO2	Implement greedy algorithms for solving optimization problems and string-matching algorithms for pattern searching	[AP]
CO3	Solve constraint satisfaction problems using backtracking techniques	[AP]
CO4	Apply dynamic programming algorithms to real-world optimization and sequence-related challenges	[AP]
CO5	Assess the efficiency and applicability of graph algorithms and range query techniques for solving optimization problems	[AN]

TEXTBOOKS

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, "Introduction to Algorithms", 4th Edition, The MIT Press, April 5, 2022
2. Jon Kleinberg and Éva Tardos, "Algorithm Design", 2nd Edition, Pearson, 2022
3. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3rd Edition, Pearson Education, 2019
4. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy", 6th Edition, CareerMonk Publications, 2022

REFERENCE BOOKS

1. Steven S. Skiena, “The Algorithm Design Manual”, 3rd Edition, Springer, 2020
2. Robert Sedgewick, Kevin Wayne, “Algorithms”, 4th Edition, Addison-Wesley, 2021
3. Aditya Bhargava, “Grokking Algorithms”, 2nd Edition, Manning Publications, 2024
4. Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser, “Data Structures and Algorithms in Java”, 6th Edition, Wiley India, June 21, 2022

WEB RESOURCES

1. https://www.coursera.org/learn/cpsc-8400-design-and-analysis-of-algorithm
2. https://ocw.mit.edu/courses/6-046j-design-and-analysis-of-algorithms-spring-2015/pages/syllabus/
3. https://onlinecourses.nptel.ac.in/noc25_cs23/preview
4. https://www.codechef.com/learn/course/college-design-analysis-algorithms

23CY305	APPLIED STATISTICS USING PYTHON	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES

1. To understand and gain the knowledge of linear regression models
2. To learn the concept of testing hypotheses using statistical analysis
3. To develop a sound understanding of current, modern computational statistical approaches and their application to a variety of datasets.
4. To understand the key technologies in data science and business analytics.
5. To effectively visualize the data using tools Matplotlib and Seaborn to communicate statistical findings.

DESCRIPTIVE AND PREDICTIVE STATISTICS 15

Central tendency - Mean, Median and Mode, Dispersion- Range, Quartile deviation, Standard deviation. Bivariate data. Summarization, marginal and conditional frequency distribution - Linear Regression Model - Standard multiple regression models. Test of hypothesis: Concept and formulation – Neyman Pearson lemma– Procedures of testing: Small samples: Student's t test – F test – Chi square test – Large samples: Difference of Means and proportions. Multivariate Analysis of Variance.

PRINCIPAL COMPONENT ANALYSIS AND CLUSTERING 15

Principal Component Analysis: Principal components, Algorithm for conducting principal component analysis, deciding on how many principal components to retain, H-plot. Cluster Analysis: Introduction, Types of clustering, Correlations and distances, clustering by partitioning methods, hierarchical clustering, overlapping clustering, K-Means Clustering-Profiling and Interpreting Clusters.

PYTHON DATA STRUCTURES, CLASSES, TIME SERIES AND VISUALIZATION 15

Interpreter, Program Execution, Statements, Expressions, Flow Controls, Functions, Numeric Types, Sequences and Class Definition, Constructors, Text & Binary Files - Reading and Writing. Data Wrangling: Combining and Merging Datasets, Reshaping and Pivoting, Data Transformation, String Manipulation, Regular Expressions. Group by Mechanics, Data Aggregation, Groupwise Operations and Transformations, Pivot Tables and Cross Tabulations, Time Series Basics, Data Ranges, Frequencies and Shifting Visualization in Python: Matplotlib package, Plotting Graphs, Controlling Graph, Adding Text, More Graph Types, Getting and setting values, Patches.

TOTAL (Theory): 45 PERIODS

LIST OF EXPERIMENTS

1. Generation of prime numbers and computation of GCD for foundational cryptographic operations.
2. Analysis of student scores to determine statistical measures and grade classification.
3. Execution of matrix operations using NumPy to simulate basic image processing functions.
4. Solving linear equations for engineering and business use cases using matrix algebra in Python.
5. Conducting hypothesis testing using t-test and chi-square test on small and large samples.
6. Building a logistic regression model to predict student performance outcomes.
7. Performing sales data analysis through data wrangling techniques using the pandas library.
8. Analyzing and visualizing time-series trends from datasets such as COVID-19 case statistics.
9. Application of K-Means clustering for customer segmentation using Scikit-learn.
10. Generating and interpreting statistical visualizations using the Seaborn package.

TOTAL (Lab): 30 PERIODS

TOTAL: 75 PERIODS

COURSE OUTCOMES

Upon completion of the course, students shall have ability to

CO1	Interpret the coefficients in linear and multiple linear regression model and understand their relevance in modelling complex datasets.	[U]
CO2	Use testing hypotheses in statistical analysis, estimators and time series analysis.	[AP]
CO3	Categorize datasets using modern computational statistical approaches.	[U]
CO4	Demonstrate original, non-trivial Python programs.	[AP]
CO5	Apply algorithms to build machine intelligence.	[AP]

TEXTBOOKS

1. Anderson. T.W, “An Introduction to Multivariate Statistical Analysis”, 3rd Edition, Wiley, 2003
2. Jobson. J.D, “Applied Multivariate Data Analysis”, Vol I & II, Springer, 2012
3. Magnus Lie Hetland, “Beginning Python: From Novice to Professional”, 2ndEdition, A press, 2008
4. Miller. I.R, Freund. J.E and Johnson. R, “Probability and Statistics for Engineers”, 9th Edition, Pearson Education, Asia, 2016

REFERENCE BOOKS

1. Stanley A Mulaik, “Foundations of Factor Analysis”, 2nd Edition, CRC Press, 2009
2. Douglas C. Montogomery,Elizabeth A.Peck, G.Geoffrey Vining, “Introduction to Linear Regression Analysis”, 5th Edition, Wiley,2012
3. Wes Mc Kinney, “Python for Data Analysis”, O’Reilly, 2018
4. Mark Lutz, “Programming Python”, 3rd Edition, Shroff Publishers, 2006
5. Tim Hall and J-P Stacey, “Python 3 for Absolute Beginners”,Apress, 2009

WEB RESOURCES

1. https://www.edx.org/course/statistical-modeling-and-regression-analysis
2. https://www.cin.ufpe.br/~embat/Python%20for%20Data%20Analysis.pdf
3. https://www.kdnuggets.com/2016/07/statistical-data-analysis-python.html
4. https://people.duke.edu/~ccc14/sta-663/

23CS304	FRONTEND FRAMEWORKS	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

1. Provide a quick refresher on core JavaScript concepts essential for React
2. Explore the fundamental and advanced concepts of React, including component-based architecture and state management
3. Implement dynamic and responsive web applications using React's best practices
4. Introduce practical techniques like HTTP requests, form handling, routing, and lazy loading
5. Enable learners to build scalable, real-world projects with React and backend integration

CORE JAVASCRIPT & REACT FUNDAMENTALS

JavaScript refresher covering Variables (var, let, const), Operators, and Control Flow. Functions including Callback Functions, Arrow Functions, Promises, and Async/Await. JavaScript Objects and Arrays with ES6+ Features such as Destructuring, Spread/Rest Operators, and Template Literals. Error Handling using Try-Catch and Debugging with Developer Tools. Modern JavaScript Features including Modules (import/export), Classes, and Closures. Introduction to React covering Core Concepts, Virtual DOM, and React Ecosystem. Setting up a React Development Environment using npm and create-react-app. JSX and React Components including Functional and Class-based Components, along with Props and Dynamic Rendering.

STATE MANAGEMENT, EVENT HANDLING & ROUTING

Understanding React State and State Manipulation using the useState Hook and Class-based State. Event Handling in React including User Inputs, Events, and Form Handling. React Forms covering Controlled and Uncontrolled Components with Form Validation. Component Lifecycle Methods including Mounting, Updating, and Unmounting Phases. Advanced Hooks such as useEffect, useContext, and Custom Hooks. React Router for Navigation including Setting Up Routing, Nested Routes, and Navigation Strategies in SPAs.

ADVANCED REACT CONCEPTS, API INTEGRATION & OPTIMIZATION

State Management with Redux for handling complex state efficiently. Fetching and Posting Data using Fetch API or Axios for REST API integration, including API Response Handling and Error Management. Performance Optimization using Lazy Loading and Code Splitting. Working with Environment Variables using .env Files and Configuration Management. End-to-End Integration of React with Backend APIs. Unit Testing in React and Implementing Continuous Integration and Deployment (CI/CD) strategies

LIST OF EXPERIMENTS

1	Create basic JavaScript functions, objects, and arrays with ES6+ features
2	Build a simple SPA with React functional components and props
3	Implement dynamic list rendering and conditional rendering in React
4	Handle user input and form validation in a React app
5	Manage component state using the useState hook and class-based state
6	Work with React lifecycle methods and implement useEffect for side effects
7	Implement routing and navigation using React Router
8	Configure lazy loading and optimize app performance
9	Fetch and display data from a REST API using Axios/Fetch API in React

TOTAL: 60 PERIODS

COURSE OUTCOMES

Upon completion of the course, students shall have ability to

CO1	Apply key JavaScript concepts (objects, functions, and asynchronous operations) in React development	[U]
CO2	Develop React applications with component-based architecture, props, and state management	[AP]
CO3	Implement advanced React concepts, including lifecycle methods, forms, event handling, and hooks	[AP]
CO4	Integrate React with REST APIs and optimize app performance with lazy loading	[AN]
CO5	Build Single Page Applications (SPAs) using React Router and implement navigation and routing strategies	[AP]

TEXTBOOKS

1. Ethan Brown, *Learning JavaScript: JavaScript Essentials for Modern Application Development*, 2nd Edition, O'Reilly Media, 2020
2. Robin Wieruch, *The Road to React: Your Journey to Master React.js in JavaScript*, Leanpub, 2023
3. Alex Banks & Eve Porcello, *Learning React: Modern Patterns for Developing React Apps*, 3rd Edition, O'Reilly Media, 2023
4. Mark Tielens Thomas, *React in Action*, Manning Publications, 2018

REFERENCE BOOKS

1. David Flanagan, *JavaScript: The Definitive Guide*, 7th Edition, O'Reilly Media, 2020
2. Axel Rauschmayer, *JavaScript for Impatient Programmers*, 2nd Edition, O'Reilly Media, 2020
3. Kent C. Dodds, *Testing JavaScript Applications*, Pragmatic Programmers, 2021
4. Adam Freeman, *Pro React 16*, 2nd Edition, Apress, 2019

WEB REFERENCE

1. https://reactjs.org/docs/getting-started.html
2. https://javascript.info/
3. https://developer.mozilla.org/en-US/docs/Web/JavaScript
4. https://redux.js.org/introduction/getting-started

SEMESTER – IV

23GEC01	ENTREPRENEURSHIP AND STARTUP	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To provide a comprehensive understanding of the entrepreneurial process, from idea generation to startup growth
2. To familiarize students with different startup funding mechanisms and legal frameworks
3. To equip students with problem-solving, innovation, and business decision-making skills
4. To enhance students' ability to use technology, market research, and financial planning in their entrepreneurial journey
5. To develop practical entrepreneurial skills through blended learning, real-world case studies, and project-based learning

INTRODUCTION TO ENTREPRENEURSHIP & STARTUP ECOSYSTEM 15

Overview of Entrepreneurship & Startups - Characteristics of Successful Entrepreneurs - Identifying Business Opportunities and Idea Generation - Types of Startups: Lifestyle, Scalable, Small Business, Social, etc.- Lean Startup Methodology & Business Model Canvas - The Role of Incubators, Accelerators, and Startup Ecosystems - Government Initiatives & Policies for Startups in India and Globally

Blended Learning Components: Online Resources: TED Talks, YouTube case studies, startup success/failure analysis. Interactive Tools: Google Jamboard, Miro for brainstorming ideas. Peer Collaboration: Discussion forums, peer feedback on ideas

Blended Learning Activities: Online Case Study & Discussion: Analyze Airbnb's startup journey and discuss key success factors, Post reflections in an LMS discussion forum. Business Idea Brainstorming & Validation: Use Google Jamboard/ Miro for real-time ideation, Peer feedback and faculty guidance on feasibility Live Expert Q&A Session: Industry expert session (Incubator/Founder/Startup Mentor), Pre-session task: Students prepare 3-5 key questions. Mini Startup Pitch Challenge: Each student delivers a 2-minute elevator pitch to the class.

STARTUP FINANCE, LEGAL FRAMEWORK & BUSINESS STRATEGY 15

Startup Financial Planning: Bootstrapping, Angel Investors, Venture Capital, Crowdfunding - Developing a Financial Model & Revenue Strategy - Legal Aspects of Startups: Business Registration, IP & Patent Protection, Taxation & Compliance Risk Analysis and Mitigation Strategies - Go-to-Market Strategy and Product-Market Fit - Digital Marketing & Branding Strategies for Startups - Growth Hacking & Scaling Strategies.

Blended Learning Components: Simulation-based Learning: Crowdfunding campaign simulation, Workshop-based Learning: Hands-on experience with legal forms, compliance, Industry Collaboration: Investor/VC guest lecture.

Blended Learning Activities: Crowdfunding Simulation: Develop a Kickstarter campaign for a startup idea, Create a video pitch, funding goal, and reward structure. Startup Legal Workshop: Draft a business contract or IP filing document in teams, Present the drafted document for peer review. Digital Marketing Challenge: Design a Google Ads or Social Media campaign for a startup, run a dummy ad campaign and analyze engagement. Shark Tank-Style Investment Pitch: Teams pitch ideas to a panel of faculty/industry investors, Evaluation based on Business Model, Financial Viability, Market Potential.

STARTUP SUSTAINABILITY, SCALING, AND EXIT STRATEGIES 15

Startup Growth Stages: Expansion, Scaling, Diversification - Sustainable Business Models and Social Entrepreneurship - Leadership and Team Building in Startups - Fail Fast, Learn Faster: Case Studies on Startup Failures - Mergers, Acquisitions, and IPOs - Ethical & Social Responsibilities of Entrepreneurs - Future Trends in Entrepreneurship & Startups (AI-driven Startups, Blockchain, Green Startups)

Blended Learning Components: Project-Based Learning: Startup failure analysis report, Role-Playing & Gamification: Crisis management simulation, Hackathons & Competitions: Sustainability-focused startup challenge.

Blended Learning Activities: Startup Failure Analysis Report: Study 3 failed startups (e.g., Quibi, Theranos, Juicero), Submit a failure report identifying key reasons & lessons learned. Crisis Management Role-Playing: Teams are given a real-world startup crisis (financial loss, leadership change, PR crisis), Create a crisis response plan & present solution. sustainability Hackathon: Design a social impact startup model, Pitch with impact assessment & business viability. Startup Exit Strategy Simulation: Teams simulate an IPO, merger, or acquisition, Prepare a strategic exit report & investor pitch.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of the course, students shall have ability to

CO1	Apply the knowledge of entrepreneurship and startup ecosystem concepts to identify potential business opportunities and suitable startup types	[AP]
CO2	Apply lean startup methodology and create a Business Model Canvas for a selected startup idea using brainstorming tools like Miro or Google Jamboard	[AP]
CO3	Analyze various startup financing options, legal compliance requirements, and value chain positioning to construct a feasible financial and go-to-market strategy	[AN]
CO4	Analyze real-world startup failures and crisis scenarios to identify root causes	[AN]

	and recommend corrective strategies for future ventures	
CO5	Apply the principles of sustainable business practices and strategic scaling to design a socially impactful startup model and simulate a realistic exit strategy	[AP]

TEXTBOOKS

1. Steven Fisher, Ja-nae' Duane, "The Startup Equation -A Visual Guidebook for Building Your Startup", Indian Edition, Mc Graw Hill Education India Pvt. Ltd, 2016
2. Donald F Kuratko, Jeffrey S. Hornsby, "New Venture Management: The Entrepreneur's Road Map", 2nd Edition, Routledge, 2017
3. David H. Hott, "Entrepreneurship New Venture Creation", PHI, 2018
4. P. Narayana Reddy, "Entrepreneurship – Text and Cases", 1st Edition. Cengage Learning 2019
5. Neck, Heidi, Christopher P. Neck, Emma L. Murray. "Entrepreneurship: The Practice and Mindset", Sage Publications, 2018

REFERENCE BOOKS

1. Greco, F. "Startup Ecosystems: Components for an Interpretative Model and International Benchmarks", Springer Nature Switzerland, 2023
2. Aulet, B., Disciplined "Entrepreneurship: 24 Steps to a Successful Startup". Wiley, 2013
3. Harris, T, "Start-up: A Practical Guide to Starting and Running a New Business", Springer International Publishing, 2018

WEB RESOURCES

1. https://onlinecourses.nptel.ac.in/noc20_mg35/preview
2. https://cloud.google.com/startup
3. https://startup.google.com/
4. https://www.startupindia.gov.in/

23IT401	FORMAL LANGUAGES AND AUTOMATA THEORY	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

1. To familiarize mathematical models such as Finite Automata, Pushdown Automata, and Turing Machines
2. To analyze languages using the Pumping Lemma to demonstrate their non-regularity
3. To construct context free grammar to represent and accept various programming constructs
4. To design Turing machines to accept recursive languages
5. To categorize different types of grammar based on their structural patterns

FINITE AUTOMATA AND REGULAR LANGUAGES 20

Mathematical Preliminaries and Notations, Chomsky Hierarchy of languages, Concepts of Automata Theory, Finite Automata - Deterministic Finite Automata (DFA)- Non-Deterministic Finite Automata (NFA) - Finite Automata with epsilon transitions - NFA with epsilon to NFA - NFA with epsilon to DFA conversion - NFA to DFA conversion. Regular Expressions: Finite Automata and Regular Expressions - Applications of Regular Expressions-Regular Grammars. Properties of regular languages - Pumping lemma for regular languages - Equivalence of Minimization of Finite Automata - Closure properties of regular languages.

CONTEXT FREE LANGUAGES 20

Context Free Grammar (CFG) - Derivation Trees-Ambiguous Grammar - Equivalence of Parse Trees and Derivation - Applications of Context Free grammar. Definition of Pushdown Automata-Language of Pushdown Automata - Acceptance of String in Pushdown Automata-Equivalence of CFG and Pushdown Automata - Pumping Lemma for CFL – Closure Properties of CFL - Deterministic Pushdown Automata - Simplification of CFG – Chomsky Normal Form - Greibach Normal form

TURING MACHINES 20

Turing Machines - Language of Turing Machines - Instantaneous Description of Turing Machine - Turing machine as a computing device-Techniques of Turing Machine – Universal Turing Machine - Types of Turing Machine - Multiple Track Turing Machine-Two-way infinite tape Turing Machine - Multi Tape Turing Machine - Recursive and Recursive Enumerable Sets - Post Correspondence problem

TOTAL: 60 PERIODS

COURSE OUTCOMES

Upon completion of the course, students shall have ability to

CO1	Design Finite Automata and formulate Regular Expressions to represent specific patterns of regular languages	[AP]
CO2	Develop Context-Free Grammars to model languages with recursive structures	[AP]
CO3	Construct Pushdown Automata and Turing Machines to represent computational models for language recognition	[AP]
CO4	Analyse the regularity and context-freeness of languages using the Pumping Lemma	[AN]
CO5	Analyse Turing Machines and their role in recognizing recursive languages and addressing problems	[AN]

TEXTBOOKS

1. Hopcroft J.E, Motwani R and Ullman J.D, “Introduction to Automata Theory, Language and Computations”, 3rdEdition, Pearson Education, 2014
2. Martin J, “Introduction to Languages and the Theory of Computation”, 4thEdition, TMH, 2011
3. Emre Sermutlu, “Automata, Formal Languages, and Turing Machines”, Paperback, 2020

REFERENCE BOOKS

1. Peter Linz, “An Introduction to Formal Language and Automata”, Narosa Publishers, 6thEdition, Jones and Bartlett Publishers, Inc, 2016
2. Kamala Krithivasan and Rama R, “Introduction to Formal Languages, Automata Theory and Computation”, Pearson Education, 2009
3. Ajit singh,” Formal Language and Automata Theory” Kindle Edition,2019
4. Michael Sipser, “Introduction to the Theory of Computation”, 3rdEdition, Cengage India, 2014

WEB RESOURCES

1. https://www.cl.cam.ac.uk/teaching/1213/RLFA/materials.html
2. https://www.cse.iitb.ac.in/~akg/courses/2019-cs310/index.html
3. https://www.udemy.com/course/theory-of-computation-online-course/
4. https://nptel.ac.in/courses/106/104/106104148/

23CYC01	CYBER SECURITY ESSENTIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To obtain comprehensive knowledge in the field of Cyber security and understanding Threats, Vulnerabilities and Attacks
2. To analyse the principles and techniques used in intrusion detection and also analyse the technical challenges and fundamental limitations
3. To identify and investigate in-depth both early and contemporary threats in mobile and wireless security
4. To understand and analyse the challenging Internet cyber-attacks and its countermeasures
5. To associate the Compliance standards and Computer Ethics with cyber security

INTRODUCTION TO SECURITY **15**

Computer Security Concepts – Cybersecurity Threats, Vulnerabilities and Attacks, 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 - Zero trust Security.

SECURITY IN OPERATING SYSTEMS AND DEFENCES **15**

Security in Operating Systems: Security in the Design of Operating Systems – Rootkit – Network security attack – Threats to Network Communications – Wireless Network Security – Denial of Service – Distributed Denial-of-Service. Security Countermeasures: Cryptography in Network Security – Firewalls – Intrusion Detection and Prevention Systems – Network Management – Databases – Security Requirements of Databases – Reliability and Integrity – Database Disclosure.

CYBER SECURITY MANAGEMENT **15**

Security Planning – Business Continuity Planning – Handling Incidents – Risk Analysis – Dealing with Disaster – Incident response and management. Cyber security in industrial contexts Information Governance in Industry – Securing Industrial Internet of Things (IIoT) Intrusion detection and prevention - Compliance standards, Computer Ethics.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of the course, students shall have ability to

CO1	Understand the fundamentals of Cybersecurity Threats, Vulnerabilities and Attacks.	[U]
CO2	Analyse the technical challenges and fundamental limitations of intrusion detection	[AN]
CO3	Analyse the risks involved in a complex real time systems with countermeasures.	[AN]
CO4	Analyze cyber-attacks and learn data privacy issues and preventive measures in the scalable network domain	[AN]
CO5	Associate the Compliance standards and Computer Ethics with cyber security	[AN]

TEXTBOOKS

1. William Stallings, "Cryptography and Network Security - Principles and Practice", Seventh Edition, Pearson Education, 2017
2. Brooks, Charles J., Christopher Grow, Philip Craig, and Donald Short, “Cybersecurity essentials”, John Wiley & Sons, 2018
3. Amit Garg, Krishna Kumar Goyal, “Cyber Security”, Laxmi Publications, 2022
4. Charles P. Pfleeger Shari Lawrence Pfleeger Jonathan Margulies, “Security in
5. Computing”, 5th Edition, Pearson Education, 2015

REFERENCE BOOKS

1. George K. Kostopoulous, “Cyber Space and Cyber Security”, CRC Press, 2013
2. Graham, J. Howard, R., Olson, R., “Cyber Security Essentials”, CRC Press, 2011
3. Nelson Phillips and Enfinger Steuart, “Computer Forensics and Investigations II”, Cengage Learning, New Delhi,2009
4. MarttiLehto, Pekka Neittaanmäki, “Cyber Security: Analytics, Technology and Automation”, Springer International Publishing Switzerland 2015

WEB RESOURCES

1. https://skillsforall.com/course/cybersecurity-essentials
2. https://www.ncsc.gov.uk/cyberessentials/overview
3. https://in.coursera.org/learn/introduction-to-cybersecurity-essentials#syllabus
4. https://www.netacad.com/courses/cybersecurity/cybersecurity-essentials

23ITC01	INTERNET OF THINGS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES

1. To understand the concepts of the Internet of Things (IoT) and its design methodologies
2. To summarize the architecture of the Internet of Things (IoT)
3. To familiarise with the design constraints and challenges of applications
4. To design basic solutions using embedded platforms for IoT
5. To assess suitable cloud solutions for IoT systems

INTRODUCTION TO INTERNET OF THINGS AND IoT DESIGN METHODOLOGIES 15

Characteristics of IoT, Physical Design of IoT, IoT Protocols, IoT Reference Architecture, Logical Design of IoT, IoT Levels & Deployment Templates, Domain Specific IoT, IoT Vs M2M Vs IoE, IoT Design Methodologies

SYSTEM HARDWARE FOR IoT 5

Sensors and Actuators – Hardware Kits: Arduino, Node MCU, Raspberry Pi. Arduino UNO: Physical Design – Interfaces – Arduino IDE – Arduino Programming with examples: Digital IO – Analog IO – Serial Communication – Condition and Looping statements. Raspberry Pi: Physical Design – Interfaces – Pi programming using Python with examples – Python Packages for IoT

CLOUD AND DATA ANALYTICS FOR IoT 10

Cloud: Types of Cloud - IoT with Cloud challenges - Selection of cloud for IoT applications - Fog and Edge computing for IoT - Cloud security aspects for IoT applications. Data Analytics for IoT: Overview of Hadoop ecosystem – MapReduce architecture – MapReduce Job Execution – MapReduce Schedulers. Case study: Internet of Medical Things (IoMT)

TOTAL (THEORY):30 PERIODS

LIST OF EXPERIMENTS

1. Study and Configuration of Arduino kit / Node MCU / Raspberry PI
2. Basic Programming using Arduino / Raspberry PI:
   a. LED and Switch Interface

   b. Analog & Digital Sensor Interface

   c. Serial Communication

   d. Local display of sensor data using LCD

   e. Display of Sensor values in Mobile handset using Bluetooth

3. Basic Programming using NodeMCU
   a. Remote control of Electrical appliances using Mobile handset and Wi-Fi

   b. Local Web server using NodeMCU and displaying Sensor values
4. Design and development of a System using LM35 temperature sensor
5. Design and development of a System using MQ5 sensor
6. Design and development of a System using Soil Moisture sensor
7. Design and development of a System using PIR sensor
8. Design and development of a System using Heart beat sensor

TOTAL (LAB): 30 PERIODS

TOTAL: 60 PERIODS

COURSE OUTCOMES

Upon completion of the course, students shall have ability to

CO1	Understand the core principles and architecture of IoT systems	[U]
CO2	Identify the design constraints and challenges in developing IoT systems	[AP]
CO3	Develop cost-effective IoT solutions and interface with embedded platforms like Arduino, Raspberry Pi, or similar boards	[AP]
CO4	Analyze cloud platforms for deploying, managing, and ensuring the security of IoT solutions	[AN]
CO5	Apply data analytics to IoT data using Hadoop and MapReduce, demonstrating effective IoT design and implementation	[AP]

TEXTBOOKS

1. Arshdeep Bahga and Vijay Madisetti, “Internet of Things: A Hands-on Approach”, Universities Press, 2015
2. Hanes David, Salgueiro Gonzalo, Grossetete Patrick, Barton Rob, Henry Jerome, “IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things”, Pearson Education, 2017
3. Mark Torvalds, “Arduino Programming: Step-by-step guide to mastering Arduino hardware and software”, 2nd Edition, 2018

REFERENCE BOOKS

1. Srinivasa K. G.,Siddesh G. M., Hanumantha Raju R., “Internet of Things”, Cengage Learning India Pvt. Ltd., 1st Edition, 2018
2. Raj Kamal, “Internet of Things”, 1st Edition, McGraw Hill Education, 2017
3. Dr. Simon Monk, “Programming the Raspberry Pi: Getting Started with Python”,2nd Edition, McGraw-Hill Education, 2016
4. Arshdeep bahga, Vijay madisetti,“Internet of Things A Hands-On Approach”, Paperback, 2023

WEB RESOURCES

1. https://www.techtarget.com/iotagenda/definition/Internet-of-Things-IoT
2. https://it.uw.edu/guides/internet-of-things-iot/iot-resources/
3. https://docs.arduino.cc/tutorials/
4. https://www.hackster.io/iot
5. https://www.coursera.org/learn/introduction-iot-boards

23ME305	DESIGN THINKING AND IDEA LAB	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

1 To accelerate development of indigenous products in line with the "Make in India" campaign

2 To encourage aspiring engineers to actualize their ideas under one roof

3 To impart multidisciplinary education to all students to promote innovation and product development

4 To initiate new ways of creative thinking and enable the students to learn the cycle of Design Thinking process for developing innovative products

5 To promote experiential learning and entrepreneurial skills among the students.

DESIGN THINKING

Design Thinking: Definition, Need and Objective, Concepts and Brainstorming, Stages – Empathize, Define, Ideate, Prototype, Test. Practical Examples of Customer Challenges, Alignment of Customer Expectations with Product Design - Feedback, Re-Design and Re-Create

INTRODUCTION TO TOOLS AND EQUIPMENT

Introduction to Hand Tools and Power Tools - 3-axis CNC routing, basic turning, milling, drilling and grinding operations, Laser cutting, Laser engraving etc

Basic 2D and 3D designing using CAD tools such as FreeCAD, Sketchup, Prusa Slicer, FlatCAM, Inkspace and OpenBSP - 2D and 3D structures for prototype building using CNC machine - Basic welding and other joining techniques for assembly - Basics of 3D scanning, Point cloud data generation for reverse engineering

Exposure to PCB prototype fabrication - Familiarity and use of soldering and de-soldering equipment - Usage of Arduino, Raspberry Pi and BeagleBone

EXPERIMENTAL LEARNING

1. 2D profile cutting of press fit box / casing in acrylic (3 or 6 mm thickness) / polymer / cardboard / MDF (2 mm thickness) board using laser cutter and engraver
2. Machine 3D geometry on soft material such as soft wood using CNC router
3. Fabricate products like trusses using cutting and welding tools
4. 3D printing of scanned geometry using FDM or SLA printer
5. Designing a suitable PCB layout, fabrication and testing of the circuit

6. Assemble and disassemble electronic components on a PCB using soldering and de-soldering equipment
7. Embedded programming using Arduino, Raspberry Pi and BeagleBone

DESIGN THINKING PROJECT

1. Design and implementation of a capstone project.

TOTAL: 30 PERIODS

COURSE OUTCOMES

Upon completion of the course, students shall have ability to

CO1	Recall the basic concepts of Design Thinking	[U]
CO2	Utilize the equipment, tools and inventories associated with Design Thinking Laboratory	[AP]
CO3	Perform fundamental fabrication operation using hand tools, power tools, welding equipment, laser cutter and engraver	[AP]
CO4	Perform fundamental electrical and electronic circuit design using PCB machine	[AP]
CO5	Develop innovative products by implementing the design thinking approach	[C]

TEXT BOOKS

1. Veeranna D.K, “Workshop / Manufacturing Practices (with Lab Manual)”, AICTE’s Prescribed Textbook, Khanna Book Publishing, 1st edition, 2022
2. E. Balaguruswamy, “Design Thinking: A Beginner's Perspective”, McGraw-Hill Education, 1st edition, 2024
3. Anuja Agarwal, “Design Thinking: A Framework for Applying Design Thinking in Problem Solving”, Cengage India, 1st edition, 2024

REFERENCE BOOKS

1. Lal, D. M., “Design Thinking- Beyond the Sticky Notes”, Sage Publications India Pvt. Ltd., 1st edition, 2021
2. Kaushik Kumar and Muralidhar Kurni, “Design Thinking: A Forefront Insight”, CRC Press, 1st edition, 2023
3. Shalini Rahul Tiwari, “Design Thinking: A Comprehensive Textbook”, Wiley India, 1st edition, 2024

WEB RESOURCES

1. https://fab-coep.vlabs.ac.in/List%20of%20experiments.html
2. https://www.innovationtraining.org/how-to-use-design-thinking-to-design-an-innovation-lab/
3. https://www.erdster.co.in/design-thinking-lab.html
4. https://www.coursera.org/learn/uva-darden-design-thinking-innovation

23CS404	BACKEND FRAMEWORKS	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

1. Introduce core web service concepts, including server communication and JSON/XML handling
2. Understand Spring Framework basics, IoC, DI, and REST API layers using Spring Boot
3. Explore ORM concepts with Hibernate, including Architecture, JPA, Generator class, Dialects, Mapping, and Transaction Management
4. Analyze database normalization concepts, referential integrity, and advanced JPA mapping
5. Develop expertise in HQL, HCQL, and CRUD operations using Hibernate and JPA

WEB SERVICES, TOMCAT SERVER, AND SPRING BOOT BASICS

Introduction to Web Services: Client-Server Communication, HTTP Protocol, JSON, and XML. Overview of Tomcat Server: Setup, Configuration, and Deployment of Web Applications. Introduction to Servlets: Servlet API, Lifecycle, and Handling HTTP Requests. Spring Framework Basics: Understanding IoC (Inversion of Control), Dependency Injection (DI), and Autowiring. Spring Boot Architecture: Setting up a Spring Boot Project, Layers in REST APIs, and Handling HTTP Responses. Exception Handling and Validation: Implementing Custom Exceptions, Validation Techniques, and HTTP Status Codes. Performing CRUD Operations: Working with Collections and Managing Data in Spring Boot

HIBERNATE ORM, JPA, AND DATABASE MANAGEMENT

Introduction to Hibernate ORM: Understanding Object-Relational Mapping, Hibernate Architecture, and JPA Overview. Hibernate Setup and Configuration: Generator Classes, Dialects, and Entity Relationships. Hibernate Mapping: Implementing One-to-One, One-to-Many, and Many-to-Many Relationships with Annotations. Transaction Management: Handling Database Transactions, Hibernate Query Language (HQL), and Hibernate Criteria Query Language (HCQL). Database Normalization: RDBMS Concepts, Referential Integrity Constraints, and Normalization up to 3NF. JPA Mapping in Spring Boot: Establishing Entity Relationships, Query Optimization, and Data Persistence with CRUD Operations

ADVANCED JPA MAPPING, SPRING SECURITY, AND AUTHENTICATION

Advanced JPA Mapping: Handling Complex Entity Relationships, Many-to-Many Mapping, and Debugging Spring Boot Applications. Introduction to Spring Security: Implementing Basic Authentication, Role-based Access Control, and Authorization. Securing APIs with JWT Authentication: Token Generation, User Authentication, and Protecting Endpoints. Enhancing Security in Spring Boot Applications: Managing Authentication Tokens, Enforcing Secure Data Access, and Securing REST Endpoints

LIST OF EXPERIMENTS

1. Develop and deploy a simple servlet using Tomcat Server
2. Implement CRUD operations using Spring Boot and REST APIs
3. Configure and perform Dependency Injection and IoC using Spring Framework
4. Implement Hibernate configurations, generator classes, annotations, and CRUD operations
5. Perform JPA mapping with normalization (1NF, 2NF, and 3NF)
6. Create Many-to-Many relationships and test associations in Spring Boot
7. Implement basic security controls and JWT token-based authentication in Spring Boot
8. Use HQL and HCQL to perform advanced data querying with Hibernate

TOTAL: 60 PERIODS

COURSE OUTCOMES

Upon completion of the course, students shall have ability to

CO1	Understand client-server communication and deploy web services using Tomcat	[U]
CO2	Implement REST APIs with Spring Boot, handle exceptions, and validate requests	[AP]
CO3	Utilize ORM tools like Hibernate for database interaction, including JPA, Dialects, HQL, and HCQL	[AP]
CO4	Develop relational databases and implement various mappings in Spring Boot JPA	[AP]
CO5	Apply Spring Boot applications for authentication, authorization, and JWT tokens	[AP]

TEXTBOOKS

1. Herbert Schildt, “Java: The Complete Reference”, 11th Edition, McGraw-Hill Education, 2019
2. Craig Walls, “Spring in Action”, 5th Edition, Manning Publications, 2018
3. Joshua Bloch, “Effective Java”, 3rd Edition, Kindle Edition, 2018

REFERENCE BOOKS

1. Rod Johnson, *Expert One-on-One J2EE Design and Development*, Wrox Press, 2004.
2. Gavin King, *Hibernate in Action*, Manning Publications, 2005.
3. Subrahmanyam Allamaraju, *RESTful Java Web Services*, 2nd Edition, O'Reilly Media,2010.

WEB RESOURCES

1. https://fab-coep.vlabs.ac.in/List%20of%20experiments.html
2. https://www.innovationtraining.org/how-to-use-design-thinking-to-design-an-innovation-lab/
3. https://www.erdster.co.in/design-thinking-lab.html
4. https://www.coursera.org/learn/uva-darden-design-thinking-innovation