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

for 2024 - 28 Batch

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

(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 instil 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 ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

VISION OF THE DEPARTMENT

- To produce globally competitive professionals in Artificial Intelligence and Data Science by imparting cognitive learning and encouraging industry collaboration towards serving the greater cause of society.

MISSION OF THE DEPARTMENT

- Impart knowledge in cutting edge Artificial Intelligence and Data Science technologies in par with industrial standards.
- Inculcate research and lifelong learning that benefit society at large.
- Promote ethical values and entrepreneurial skills.

I.	PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)
PEO 1	To build a successful career in IT/relevant industry or carryout research in advance areas of Artificial Intelligence, Data Science and address various issues in the society.
PEO 2	To develop problem solving skills and ability to provide solution for real time problems.
PEO 3	To develop the ability and attitude of adapting themselves to emerging technological Challenges.
PEO 4	To excel with excellent communication skills, leadership qualities and social responsibilities.

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 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.
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.
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.
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.
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.
PO 7	**Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.
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, and 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.

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.Tech – Artificial Intelligence and Data Science programme will be able to:	
PSO 1	Understand, analyze and develop innovative solutions for real world problems in industry and research establishments related to Artificial Intelligence and Data Science.
PSO 2	Ability to choose or develop the right tool for Data analysis and develop high end intelligent systems.
PSO 3	Apply programming principles and practices for developing software solutions to meet future business and society needs.

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	3	3	3	2	1	2	2	3
2	3	3	3	3	3	2	2	2	3	3	3
3	1	3	1	2	3	3	1	1	2	2	2
4	1	1	3	2	1	3	3	3	3	3	1

V. MAPPING OF PEOs WITH PSOs

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

AUTONOMOUS CURRICULA AND SYLLABI

Regulations 2022

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	23AS101	Applied Science	4 / 0 / 0	4	4	4,8,9,17
3	23EC111	Digital Logic Design and Computer Architecture	3 / 1 / 0	4	4	4,8,9,12
Theory with Practicals (Internal 50 Marks & External 50 Marks)						
4	23CS101	Problem Solving using C++	1 / 0 / 4	5	3	4,5,8,10
5	23IT101	Application Development Practices	1 / 0 / 4	5	3	4,8,9
Practicals (Internal 60 Marks & External 40 Marks)						
6	23AS102	Applied Science Laboratory	0 / 0 / 4	4	2	4,8,9,11,17
Indian Knowledge System - Blended Learning (Internal 100 Marks)						
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				**27**	**21**	
Certification/Online Course						
Certification/Spoken Tutorial/Coursera/NPTEL Courses- Minimum one Course						

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 Practicals (Internal 50 Marks & External 50 Marks)						

2	23EN101	Oral and Written Communication Skills	2 / 0 / 2	4	3	3,4,7,9, 11,12,1 3,16
3	23AD201	Artificial Intelligence and Machine Learning Basics	3 / 1 / 0	4	4	4,8,9
4	23CS201	Data Structures and Algorithms	1 / 0 / 4	5	3	4,9
5	23CD201	Database Management Systems	1 / 0 / 4	5	3	4,9,17
6	23CY201	Programming in Java	1 / 0 / 4	5	3	4,9,17
Indian Knowledge System - Blended Learning (Internal 100 Marks)						
7	23TA201	Tamils and Technology	1 / 0 / 0	1	1	2,7,9,11 ,12,15,1 7
Mandatory Course-Blended Learning (Internal 100 Marks)						
8	23MC102	Environmental Sciences	1 / 0 / 0	1	0	3,5,7,9, 11,13,1 5,17
			TOTAL	**28**	**21**	
Certification/Online Course						
Certification/Spoken Tutorial/Coursera/NPTEL Courses- Minimum one Course						

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	3,4,5,8, 16
Theory (Internal 40 Marks & External 60 Marks)						
2	23AD305	Data Warehousing and Mining	3 / 0 / 0	3	3	
Theory with Practicals (Internal 50 Marks & External 50 Marks)						
3	23CY202	Operating Systems	3 / 0 / 2	5	4	4,9
4	23ITC02	Data Communication and Networks	2 / 0 / 2	4	3	4,9,11
5	23CS303	Algorithm Design Techniques	3 / 0 / 2	5	4	4,9
6	23CY305	Applied Statistics Using Python	3 / 0 / 2	5	4	4,9
Practicals (Internal 60 Marks & External 40 Marks)						

7	23CS304	Frontend Frameworks	0 / 0 / 4	4	2	
Spoken Language (Internal 100 Marks)						
8	23SLC01	Multilingual Practices	0 / 0 / 2	2	1	4,11,16
			TOTAL	**31**	**24**	
Certification/Online Course						
Certification/Spoken Tutorial/Coursera/NPTEL Courses- Minimum one Course						

SEMESTER IV						
S. No.	**Course Code**	**Courses**	**L/T/P**	**Total Hours**	**Credits**	**SDG Mapping**
Theory-Blended Learning (Internal 100 Marks)						
1	23GE301	Entrepreneurship and Startups	3 / 0 / 0	3	3	4,9
Theory (Internal 40 Marks & External 60 Marks)						
2	23CYC01	Cybersecurity Essentials	3 / 0 / 0	3	3	
Theory with Practicals (Internal 50 Marks & External 50 Marks)						
3	23AD505	Advanced Machine Learning	3 / 0 / 2	5	4	4,9
4	23ADC02	Data Analytics	2 / 0 / 2	4	3	4,9,11
5	23AD401	Data Science	2 / 0 / 2	4	3	4,9
Practicals (Internal 60 Marks & External 40 Marks)						
6	23ME305	Design Thinking and Idea Lab	0 / 0 / 2	2	1	4,9
7	23CS404	Backend Frameworks	0 / 0 / 4	4	2	4,9
Mandatory Course-Blended Learning (Internal 100 Marks)						
8	23MCC03	Indian Constitution	1 / 0 / 0	1	0	3,4,5,6, 7,8,11,1 3,15,16
			TOTAL	**26**	**19**	
Certification/Online Course						
Certification/Spoken Tutorial/Coursera/NPTEL Courses- Minimum one Course						

SEMESTER V						
S. No.	**Course Code**	**Courses**	**L/T/P**	**Total Hours**	**Credits**	**SDG Mapping**
Theory (Internal 40 Marks & External 60 Marks)						
1	23AD501	Virtual Reality and Augmented Reality	3 / 0 / 0	3	3	4,9

2	23AD502	AI Ethics	3 / 0 / 0	3	3	4,8,9
Theory with Practicals (Internal 50 Marks & External 50 Marks)						
3	23XXXXX	Professional Elective - I	2 / 0 / 2	4	3	4,9
4	23XXXXX	Professional Elective - II	2 / 0 / 2	4	3	4,9
5	23ADC04	Deep Learning	3 / 0 / 2	5	4	4,9
Practicals (Internal 60 Marks & External 40 Marks)						
6	23CS506	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
			TOTAL	**29**	**21**	

SEMESTER VI						
S. No.	**Course Code**	**Courses**	**L/T/P**	**Total Hours**	**Credits**	**SDG Mapping**
Theory (Internal 40 Marks & External 60 Marks)						
1	23AD601	Optimization Techniques in Machine Learning	3 / 1 / 0	4	4	4,9
2	23AD602	Quantum Artificial Intelligence	3 / 0 / 0	3	3	4,9
Theory with Practicals (Internal 50 Marks & External 50 Marks)						
3	23XXXXX	Professional Elective - III	2 / 0 / 2	4	3	
4	23XXXXX	Professional Elective - IV	2 / 0 / 2	4	3	
5	23AD606	Prompt Engineering	2 / 0 / 2	4	3	4,9
6	23AD503	Artificial Intelligence for Internet of Things	2 / 0 / 2	4	3	4,9
Mini Project						
7	23AD605	Capstone Model	0 / 0 / 6	6	3	4,8,9,17
			TOTAL	**29**	**22**	

SEMESTER VII						
S. No.	**Course Code**	**Courses**	**L/T/P**	**Total Hours**	**Credits**	**SDG Mapping**
Theory (Internal 40 Marks & External 60 Marks)						
1	23XXXXX	Open / Emerging/ Industrial Elective- I	3 / 0 / 0	3	3	-

2	23XXXXX	Open / Emerging/ Industrial Elective- II	3 / 0 / 0	3	3	-
3	23XXXXX	Open / Emerging/ Industrial Elective- III	3 / 0 / 0	3	3	-
4	23XXXXX	Professional Elective - V	2 / 0 / 2	4	3	-
5	23XXXXX	Professional Elective - VI	2 / 0 / 2	4	3	-
Project (Internal 60 Marks & External 40 Marks)						
6	23AD701	Project Phase - I	0 / 0 / 6	6	3	4,9,17
Internship (Internal 100 Marks)						
7	23EES01	Employability Enhancement Skills (Internship)	28 Days		2	8,12,17
Mandatory Course (Internal 100 Marks)						
			TOTAL	**26**	**20**	

SEMESTER VIII						
S. No.	**Course Code**	**Courses**	**L/T/P**	**Total Hours**	**Credits**	**SDG Mapping**
Project (Internal 60 Marks & External 40 Marks)						
1	23AD801	Project Phase - II	0 / 0 / 24	24	12	4,9,17
			TOTAL		**12**	
				Total Credits	**161**	

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

Sl. 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	8.70
2	Basic Sciences (BSC)	10	4							14	8.70
3	Engineering Sciences (ESC)	10	3		1					14	6.21

4	Professional Core (PCC)		10	20	15	10	13			68	48.45
5	Professional Electives (PEC)					6	6	6		18	9.32
6	Open/Emerging/Industry (OEC)							9		9	5.59
7	Project Work (PROJ)					5	3	5	12	25	14.29
8.	Mandatory Course (MC) / Spoken Hindi			1						1	0.62
Total		21	21	24	19	21	22	20	12	160	

STRUCTURE FOR UNDERGRADUATE ENGINEERING PROGRAM			
S. No.	**Course Work - Subject Area**	**AICTE Suggested Credits**	**SKCET Credits (AI&DS)**
1.	Humanities and Social Sciences (HS), including Management;	15	14
2.	Basic Sciences (BS) including Mathematics, Physics, Chemistry, Biology;	23	14
3.	Engineering Sciences (ES), including Materials, Workshop, Drawing, Basics of Electrical/Electronics/Mechanical/Computer Engineering, Instrumentation;	22	14
4.	Professional Subjects-Core (PC), relevant to the chosen specialization/branch; (May be split into Hard (no choice) and Soft (with choice), if required	54	74
5.	Professional Subjects – Electives (PE), relevant to the chosen specialization/ branch;	18	15
6.	Open Subjects- Electives (OE), from other technical and/or emerging subject areas;	15	9
7.	Project Work, Seminar and/or Internship in Industry or elsewhere.	16	23
8.	Mandatory Courses (MC)	Non-credit	1
Total		163	161
**Minor Variations is allowed as per need of the respective disciplines*			

HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT (11 Credits)						
SL. No.	**Course Code**	**Course Title**	**L/T/P**	**Contact hrs./ Wk.**	**C**	**SDG Mapping**

1.	23TA101	Heritage of Tamils	1 / 0 / 0	1	1	2, 7, 9, 12, 15, 16
2.	23EN101	Oral and Written Communication Skills	2 / 0 / 2	4	3	2, 7, 9, 12, 15, 16
3.	23TA201	Tamils and Technology	1 / 0 / 0	1	1	2, 7, 9, 11, 12, 15, 17
4.	23GE301	Universal Human Values	3 / 0 / 0	3	3	3,4,5,8,16
5.	25GE01	Entrepreneurship and Startups	3 / 0 / 0	3	3	3,4,5,8,9,17

BASIC SCIENCE COURSES (14 Credits)						
SL. No.	**Course Code**	**Course Title**	**L/T/P**	**Contact hrs./Wk.**	**C**	**SDG Mapping**
1.	23MA101	Mathematics I	3 / 1 / 0	4	4	4,8,9
2.	23AS101	Applied Science	4 / 0 / 0	4	4	3, 4, 7, 9, 11, 12, 13, 16
3.	23AS102	Applied Science Laboratory	0 / 0 / 4	4	2	3, 4, 7, 9, 11, 12, 13, 16
4.	23MA201	Mathematics II	3 / 1 / 0	4	4	4,8,9

ENGINEERING SCIENCE COURSES (14 Credits)						
SL. No.	**Course Code**	**Course Title**	**L/T/P**	**Contact hrs./Wk.**	**C**	**SDG Mapping**
1.	23CS101	Problem Solving using C++	1 / 0 / 4	5	3	4, 8, 9, 17
2.	23EC111	Digital Logic Design and Computer Architecture	3 / 1 / 0	4	4	4, 8, 9, 12
3.	23IT101	Application Development Practices	1 / 0 / 4	5	3	4,9
4.	23CY201	Programming in Java	1 / 0 / 4	5	3	4,8,9
5.	25IK401	Course on Mathematical and Computer Logic for Nyaya Sastra Studies	2 / 0 / 0	2	2	3,4,5,8,10,16

6.	25IK401	Multilingual and Heritage Computing	2 / 0 / 0	2	2	4,8,9
7.	23ME305	Design Thinking and Idea Lab	0 / 0 / 2	2	1	4,8,9,11,17

PROFESSIONAL CORE COURSES (68 Credits)						
SL. No.	**Course Code**	**Course Title**	**L/T/P**	**Contact hrs./Wk.**	**C**	**SDG Mapping**
1	23AD201	Artificial Intelligence and Machine Learning Basics	3 / 1 / 0	4	4	4,9,11
2	23CS201	Data Structures and Algorithms	1 / 0 / 4	5	3	4,9
3	23CD201	Database Management Systems	1 / 0 / 4	5	3	4,9
4	23AD305	Data Warehousing and Mining	3 / 0 / 0	3	3	4,8,9
5	23CY202	Operating Systems	3 / 0 / 2	5	4	4,9
6	23ITC02	Data Communication and Networks	2 / 0 / 2	4	3	4,9,11
7	23CS303	Algorithm Design Techniques	3 / 0 / 2	5	4	4,9
8	23CY305	Applied Statistics Using Python	3 / 0 / 2	5	4	4,8,9
9	23CSC03	Frontend Frameworks	0 / 0 / 4	4	2	4,9
10	23CYC01	Cybersecurity Essentials	3 / 0 / 0	3	3	4,9
11	23AD505	Advanced Machine Learning	3 / 0 / 2	5	4	4,9
12	23ADC02	Data Analytics	2 / 0 / 2	4	3	4,9
13	23AD401	Data Science	2 / 0 / 2	4	3	4,9
14	23CSC04	Backend Frameworks	0 / 0 / 4	4	2	4,9
15	23AD501	Virtual Reality and Augmented Reality	3 / 0 / 0	3	3	4,9
16	23AD502	AI Ethics	3 / 0 / 0	3	3	4,8,9
17	23AD503	Artificial Intelligence for Internet of Things	2 / 0 / 2	4	3	4,9
19	23ADC04	Deep Learning	3 / 0 / 2	5	4	4,9
20	23AD601	Optimization Techniques in Machine Learning	3 / 1 / 0	4	4	4,9
21	23AD602	Quantum Artificial Intelligence	3 / 0 / 0	3	3	4,9
23	23AD606	Prompt Engineering	2 / 0 / 2	4	3	4,9

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 ENGINEER							
1	23AD902	Exploratory Data Analysis 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 Machine Learning Techniques	2/0/2	4	3	50/50	PEC
4	23IT902	Natural Language Processing	2/0/2	4	3	50/50	PEC
5	23IT903	Computer Vision	1/0/4	5	3	40/60	PEC
6	23AD906	GenAI Advanced Prompt Engineering & LLMs	1/0/4	5	3	40/60	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 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	Power BI	2/0/2	4	3	50/50	PEC
5	23AD905	Statistical Methods and Basic Machine Learning Models	2/0/2	4	3	50/50	PEC
6	23AD906	GenAI Advanced Prompt Engineering & LLMs	1/0/4	5	3	40/60	PEC
ELECTIVE STREAM III - CLOUD IT ADMINISTRATOR							
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 & SysOps	1/0/4	5	3	40/60	PEC
6	23CS906	Continuous Monitoring and Observability	1/0/4	5	3	40/60	PEC
ELECTIVE STREAM IV – CYBERSECURITY ANALYST							
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	40/60	PEC
6	23CY903	Security Operations of Information systems	1/0/4	5	3	40/60	PEC
ELECTIVE STREAM V – FULL STACK SOFTWARE ENGINEER							
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	40/60	PEC
6	23AD906	GenAI Advanced Prompt Engineering & LLMs	1/0/4	5	3	40/60	PEC

INDIAN KNOWLEDGE SYSTEM (11 Credits)						
SL. No.	**Course Code**	**Course Title**	**L/T/P**	**Contact hrs./Wk.**	**C**	**SDG Mapping**
1.	23TA101	Heritage of Tamils	1 / 0 / 0	1	1	2, 7, 9, 12, 15, 16
2.	23MC101	Induction Programme			0	3,4,5,10,16
3.	23TA201	Tamils and Technology	1 / 0 / 0	1	1	2, 7, 9, 11, 12, 15, 17
4.	23SLC01	Multilingual Practices	0 / 0 / 2	2	1	4,11,16
5.	23MC201	Environmental Sciences	1 / 0 / 0	1	0	3,4,5,6,7,8,11, 13,15,16
6.	23MCXXX	Indian Constitution	1 / 0 / 0	1	0	1,2,3,5,6,8,11
7.	23EES001	Internship	28 Days		2	8,12,17

OPEN/ EMERGING/ INDUSTRY (9 Credits)						
SL. No.	**Course Code**	**Course Title**	**L/T/P**	**Contact hrs./Wk.**	**C**	**SDG Mapping**
1.	25AD007	Geospatial Data Science and Location Intelligence	3/0/0	3	3	7,9,11
2.	25AD008	Healthcare Analytics	3/0/0	3	3	11,13,15
3.	25AD008	Genomics Data Science	3/0/0	3	3	1,3,9
4.	25AD008	Responsible AI	3/0/0	3	3	2,3,9
5.	25AD008	Brain and Neuroscience	3/0/0	3	3	10,16,17

PROJECT WORK (25 Credits)						
SL. No.	**Course Code**	**Course Title**	**L/T/P**	**Contact hrs./Wk.**	**C**	**SDG Mapping**

1.	23CS506	Cloud Infrastructure and Services Management	0/0/4	4	2	4,9
2.	23CS503	Application Development	0/0/6	6	3	3,4,8,9
3.	23AD605	Capstone Model	0/0/6	6	3	4,8,9,17
4.	23AD701	Project Phase - I	0/0/6	6	3	4,9,17
5.	23EES01	Internship	28 Days		2	8,12,17
6.	23AD801	Project Phase - II	0/0/24	12	12	4,9,17

INTERN (02 Credits)						
SL. No.	**Course Code**	**Course Title**	**L/T/P**	**Contact hrs./Wk.**	**C**	**SDG Mapping**
1.	23EES01	Employability Enhancement Skills (Internship)	28 Days		2	8,12,17

PROFESSIONAL ELECTIVE COURSES: VERTICALS				
Vertical I - ML Engineer	**Vertical II - Data Analyst with ML Essentials**	**Vertical III - Cloud IT Administrator**	**Vertical IV - Cybersecurity Analyst**	**Vertical V – Full Stack Software Engineer**
Exploratory Data Analysis 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 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	Power BI	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

VALUE ADDED COURSES
(Based on student's interest)

S. No	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	SDG Mapping	Sem
1.	23VA701	Machine Learning for Soil and Crop Management	1/0/0	1	1	2,12,13	3/4/5/6
2.	23VA702	Chatbot Development	1/0/0	1	1	4,9,10	3/4/5/6
3.	23VA703	Hardware and Troubleshooting	1/0/0	1	1	8,9,12	3/4/5/6
4.	23VA704	Rapid Development for AI	1/0/0	1	1	9,17	3/4/5/6
5.	23VA705	Visual Language Processing	1/0/0	1	1	4,10,16	3/4/5/6
6.	23VA706	Spark and Scala	1/0/0	1	1	9,11,13	3/4/5/6
7	23VA707	AI in Sports Analytics and Performance Optimization	1/0/0	1	1	3,4,8	3/4/5/6

MANDATORY COURSES (Non-Credits)
(Courses conducted either by internal faculty or through MOOCs)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	SDG Mapping
1.	23MC101	Induction Programme			0	3,4,5,10,16
2.	23MC201	Environmental Sciences	1 / 0 / 0	1	0	3,4,5,6,7,8, 11,13,15,16
3.	23MCXXX	Indian Constitution	1 / 0 / 0	1	0	1,2,3,5,6,8, 11

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.

Module 1: 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.

Module 2: 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).

Module 3: Implications of the 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 PERIODS: 30

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.	[A]
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.

6Web 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

Online Resources:

1. https://nptel.ac.in/courses/109/104/109104068/
2. https://medium.com/the-mission/the-12-important-life-skills-i-wish-id-learned-in-school-f4593b49445b
3. https://www.thebalancecareers.com/life-skills-list-and-examples-4147222

23AD305	DATA WAREHOUSING AND MINING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To conceptualize the concepts of Data Warehouse and mining
2. To understand the mining principles and pre-process techniques
3. To familiarise with techniques such as classification, clustering and association rules.
4. To develop data mining applications for data analysis using various tools
5. To learn skills in identifying patterns and large datasets using clustering techniques

INTRODUCTION TO DATA WAREHOUSING AND DATA MINING **15**

Data Warehousing Components - Data Warehouse Architecture, OLAP vs OLTP, OLAP operations - Data Warehouse v/s Data Mining, Data Mining Process, Data Mining Functionalities - Data Pre-processing - Data Cleaning, Integration and Transformation, Reduction - Data Summarization - Data Pre-processing Applications in Healthcare - **Case study** – Working with Weka Tool.

DATA MINING CONCEPTS **15**

Classification - Issues in Classification, Statistical-Based Algorithms, Distance-Based Algorithms, Prediction techniques, Linear and Non-Linear Regression. Association Rule Mining: Efficient and Scalable Frequent Item set Mining Methods Mining Various Kinds of Association Rule - Association Mining to Correlation Analysis - Applications: Intrusion detection. **Case study** - A web data mining.

CLUSTERING AND ITS REAL TIME APPLICATIONS **15**

Categorization of Major Clustering Methods: Partitioning Methods, Hierarchical Methods, Density- Based Methods, Grid-Based Methods, Outlier Detection. Applications of clustering – Pattern recognition, Clustering Algorithm in Identifying Cancerous Data. **Case Study**: Finding similar users on Twitter, Analyzing the Stack Overflow data set.

Total: 45 Periods

Course Outcomes

CO1	Understand the components of Data Warehouse and Data Mining techniques.	[U]
CO2	Apply data preprocessing techniques for data cleaning, integration, transformation, and reduction.	[AP]

CO3	Analyze classification and Clustering algorithms to extract knowledge from large datasets.	[AN]
CO4	Apply data mining tools and software to extract patterns and knowledge for decision-making.	[AP]
CO5	Discover patterns from large amounts of data to analyze for predictions and classification.	[AP]

TEXTBOOKS

1. Mohammed J. Zaki, Wagner Meira, Jr, ”Data Mining and Machine Learning Fundamental Concepts and Algorithms”, cambrdge university press,2020.
2. ParteekBhatia ,“Data Mining and Data Warehousing Principles and Practical Techniques”, Cambridge University Press, 2019.
3. Dr. Dipali P. Meher , Dr. Pallawi Bulakh,” Data Warehousing and Data Mining ,Nirali prakashan,2022

REFERENCE BOOKS

1. Jiawei Han, Micheline Kamber, "Data Mining Concepts and Techniques", 4th Edition, Elsevier, 2022.
2. Arti deshpande,Tech -max ,”Data Warehousing and Mining”, paperback, 2017.
3. Dr. Manmohan Singh, Data Warehousing and Mining”, paperback, Technical, 2023.

WEB RESOURCES

1. https://examupdates.in/data-mining-lecture-notes/
2. http://www.miet.edu/course/wp-content/uploads/2019/05/dwdm-completed
3. https://livebook.manning.com/book/mahout-in-action/chapter-12/82
4. https://www.oracle.com/in/database
5. https://docs.oracle.com/cd/E11882_01/server.112/e25554/concept.htm

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

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 explore the 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/

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 LAYER 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”, Wiley, 3rd Edition, 2003.
2. Jobson. J.D, “Applied Multivariate Data Analysis”, Vol I & II, Springer, 2012.
3. Magnus Lie Hetland, “Beginning Python: From Novice to Professional”, A press, 2nd Edition, 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.

Axel Rauschmayer, JavaScript for Impatient Programmers, 2nd Edition, O'Reilly Media, 2020.

Kent C. Dodds, Testing JavaScript Applications, Pragmatic Programmers, 2021.

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

23GECO1	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

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. – Incubation - support - The Role of Incubators - , Accelerators, and Startup Ecosystems - Government Initiatives & Policies for Startups in India and Globally.

STARTUP FINANCE, LEGAL FRAMEWORK & BUSINESS STRATEGY **15**

Startup Financial Planning: Start-up financing metrics- 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.

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.

Blended Learning Activities:

- Case Study and Discussion: Analyze Airbnb's startup journey,
- Draft a business contract or IP filing procedure.
- Startup Exit Strategy Simulation

TOTAL PERIODS (Theory): 45

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, 2e, Routledge (2017)
3. David H. Hott, "Entrepreneurship New Venture Creation", PHI (2018)
4. P. Narayana Reddy, "Entrepreneurship – Text and Cases", 1st Edition. Cengage Lerning (2019)
5. Neck, Heidi, Christopher P. Neck, Emma L. Murray. Entrepreneurship: The Practice and Mindset. Los Angeles: Sage Publications, (2018)

REFERENCE BOOKS

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

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/

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	[A]
CO4	Analyze real-world startup failures and crisis scenarios to identify root causes and recommend corrective strategies for future ventures	[A]
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]

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.

NTRODUCTION 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	[A]
CO3	Analyse the risks involved in a complex real time systems with countermeasures.	[A]
CO4	Analyze cyber-attacks and learn data privacy issues and preventive measures in the scalable network domain	[A]
CO5	Associate the Compliance standards and Computer Ethics with cyber security	[A]

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 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 ll”, 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

5. https://elearn.nptel.ac.in/shop/iit-workshops/ongoing/open-source-tools-for-cyber- security

23AD505	ADVANCED MACHINE LEARNING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES

1.To discuss the basic concepts of machine learning and its usage in real world scenarios.

2.To explore the different machine learning techniques.

3.To describe about the Graphical models and their applicability to real world problems

4.To employ discovering clusters in the given data and also apply different clustering algorithms in different datasets

5.To interpret dimensionality reduction for the given data.

LEARNING CONCEPTS **15**

Learning Problems – Perspectives and Issues – Concept Learning – Designing a learning system issue – Examples of machine learning issues - Version Spaces and Candidate Eliminations algorithms – Inductive bias – PAC learning – Representation – Algorithm – Heuristic Space Search.

NEURAL NETWORKS AND GENETIC ALGORITHMS **15**

Neural Network Representation – Problems – Perceptron – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evaluation and Learning.

ADVANCED LEARNING **15**

Learning Sets of Rules – Sequential Covering Algorithm – Principal Component analysis – Dimensionality reduction – Genetic programming – Analytical Learning – Perfect Domain - Theories – Explanation Base Learning – FOCL Algorithm – Reinforcement - Learning – Task – Q-Learning – Temporal Difference Learning.

Total : 45 Periods

List of Experiments

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.

2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate- Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.

3. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.

4. Implement an algorithm to demonstrate the significance of genetic algorithm.

5. Write a program to perform Principal Component Analysis on real time datasets.

6. Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions.

7. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

8. Build an Artificial Neural Network by implementing the Back propagation algorithm

and test the same using appropriate data sets.

9. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.

10. Create a Bayesian Graphical Model for earthquake problem (using python package pgmpy)

11. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

Total: 30 Periods

COURSE OUTCOMES

Upon completion of the course, students shall have ability to

CO1	Analyze the mathematical formulation of learning problems, including the assumptions and limitations of various learning frameworks	[AN]
CO2	Implement the concept of learning algorithms, including candidate elimination and version space construction for consistent hypotheses training data	[AP]
CO3	Construct problem-specific genetic programming solutions and evaluate their performance in symbolic regression and automated feature discovery	[AN]
CO4	Integrate neural and evolutionary methods to engineer adaptive, scalable learning systems for real-world problems.	[AP]
CO5	Apply reinforcement learning principles to solve decision-making tasks using Q-learning and temporal difference method.	[AP]

TEXTBOOKS

1. Dr. R Kumar, Mr. J. Jegan Amarnath, Dr. P. Visu, “Advanced Machine Learning”, Notion Press, 2020.

2. Dr Amit Kumar Tyagi, Dr Khushboo Tripathi, “Advanced Machine Learning: Fundamentals and algorithms”, Kindle edition - 2024.

3. A. Ramesh Babu , D. Nagarajan, ”Advanced Machine Learning Techniques”,Paperback,2022

REFERENCE BOOKS

1. Ethem Alpaydın, “Introduction to Machine Learning”, 4th Edition, The MIT Press, 2020.
2. Stephen Marsland, “Machine Learning: An Algorithmic Perspective”, Taylor & Francis 2019.
3. Shiva Vashishtha , Hardik Sharma ,”Advanced Machine Learning Algorithms: Master ML's Powerhouse Techniques”,2021

WEB RESOURCES

1. https://onlinecourses.nptel.ac.in/noc23_cs18/preview.
2. http://freevideolectures.com/Course/2257/Machine-Learning
3. https://www.coursera.org/courses?query=machine%20learning&productDifficultyLevel=Advanced
4. https://www.cse.iitb.ac.in/~sunita/cs726/

23ADC02	DATA ANALYTICS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES

1. To introduce the fundamentals of data analytics and its applications.
2. To understand statistical methods, data preprocessing, and modeling techniques.
3. To explore machine learning models for predictive analytics.
4. To infer streaming data and implement real-time analytics.
5. To examine data visualization techniques for effective decision-making.

INTRODUCTION TO DATA ANALYTICS **10**

Basics of Data Analytics – Importance, Applications, and Challenges - Big Data Overview – Characteristics, Storage and Processing - Data Preprocessing Techniques – Cleaning, Normalization, Feature Engineering- Statistical Analysis & Hypothesis Testing – Probability Distributions, Sampling, and Correlation - Exploratory Data Analysis (EDA) – Data Visualization and Pattern Identification

DATA ANALYSIS & MACHINE LEARNING **10**

Regression Modeling: Linear, Polynomial, and Multiple Regression – Multivariate Analysis: Correlation, Factor Analysis, Principal Component Analysis (PCA)- Bayesian Modeling & Inference: Bayesian Networks and Probabilistic Reasoning - Support Vector Machines (SVM) & Kernel Methods for Classification - Time-Series Analysis: ARIMA, Linear Systems Analysis, Nonlinear Dynamics - Rule Induction & Neural Networks: Competitive Learning, Back propagation - Fuzzy Logic: Extracting Fuzzy Models, Fuzzy Decision Trees - Stochastic Search Methods: Genetic Algorithms, Simulated Annealing

MINING DATA STREAMS & REAL-TIME ANALYTICS **10**

Introduction to Data Streams: Stream Data Model and Architecture- Stream Computing Techniques: Real-Time Processing Frameworks- Sampling & Filtering Streams: Random Sampling, Reservoir Sampling-Counting & Aggregation: Counting Distinct Elements, Estimating Moments-Sliding Window & Decaying Window Models for Dynamic Data-Real-Time Analytics Platform (RTAP) Applications - Case Studies- Real-time Sentiment Analysis (Twitter/Facebook Data) - Stock Market Prediction using Streaming Data

List of Experiments

1. Data Preprocessing & Cleaning – Handle missing values, remove duplicates, and normalize data using Pandas.
2. Exploratory Data Analysis (EDA) – Perform statistical analysis and visualize data distributions.
3. Regression & Bayesian Modeling – Implement Linear Regression and Bayesian inference models.

4. Classification Techniques – Train SVM and Decision Tree models for text classification.
5. Clustering Techniques – Implement K-Means and DBSCAN clustering for customer segmentation.
6. Time-Series Forecasting – Use ARIMA models to predict stock prices.
7. Frequent Pattern Mining – Apply Apriori algorithm for market basket analysis.
8. Streaming Data Analysis – Process live data using Apache Spark Streaming.
9. Real-Time Sentiment Analysis – Use NLP techniques on Twitter data streams.
10. Data Visualization & Dashboards – Create interactive analytics dashboards using Tableau/Power BI.

TOTAL PERIODS: 30

COURSE OUTCOMES

Upon completion of the course, students shall have ability to

CO1	Understand the fundamental concepts of data analytics, including data pre-processing and visualization techniques.	[U]
CO2	Apply regression models, multivariate analysis, Bayesian modeling and neural networks for data-driven decision-making.	[AP]
CO3	Apply machine learning methods for time-series and pattern recognition.	[AP]
CO4	Utilize streaming data models and real-time analytics techniques.	[AP]
CO5	Develop interactive visualizations for decision-making using analytics tools.	[AP]

TEXTBOOKS

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
2. "Mining of Massive Datasets" (3rd Edition) by Jure Leskovec, Anand Rajaraman, and Jeffrey David Ullman, Cambridge University Press, 2020.
3. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", Springer, 2009.
4. "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville , MIT Press, 2016.

REFERENCE BOOKS

1. Bill Franks, "Taming the Big Data Tidal Wave", John Wiley & Sons, 2012.
2. Jiawei Han, Micheline Kamber, "Data Mining Concepts and Techniques"(4th Edition), Elsevier, 2022.
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.

WEB RESOURCES

1. https://www.coursera.org/specializations/data-analytics
2. https://www.coursera.org/learn/google-data-analytics-capstone
3. https://www.edx.org/course/data-science-and-machine-learning

23AD401	DATA SCIENCE	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES

1. To familiarize the various methods of retrieving data from multiple sources, both structured and unstructured.
2. To apply core principles of data mining and data warehousing, along with basic statistical techniques
3. To explore measures of variability including range, variance, and standard deviation.
4. To select appropriate descriptive techniques based on data type and context.
5. To performing multivariate data analysis using multiple regression approaches

INTRODUCTION **10**

Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – Data preparation - Exploratory Data analysis – build the model – presenting findings and building applications - Data Mining - Data Warehousing – Basic Statistical descriptions of Data.

DESCRIBING DATA **10**

Types of Data in R Programming - Types of Variables - Describing Data with Tables and Graphs –Describing Data with Averages - Describing Variability - Normal Distributions and Standard (z) Scores.

DESCRIBING RELATIONSHIPS **10**

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.

TOTAL: 30 PERIODS

LIST OF EXPERIMENTS:

1. Introduction to Python for Data Science & Data Retrieval
2. Data Preprocessing & Cleaning
3. Exploratory Data Analysis (EDA)
4. Data Mining using Clustering
5. Data Warehousing & SQL Operations
6. Descriptive Statistics & Data Visualization
7. Analyzing Data Variability & Standard Scores

8. Normal Distribution & Probability Distributions
9. Correlation Analysis & Scatter Plots
10. Regression Analysis & Model Evaluation

TOTAL: 60 PERIODS

COURSE OUTCOMES

Upon completion of the course, students shall have ability to

CO1	Apply data preparation methods to clean, transform, and organize raw data for subsequent analysis	[AP]
CO2	Conduct exploratory data analysis (EDA) using statistical and visualization techniques to uncover underlying patterns and insights	[AP]
CO3	Apply statistical procedures to compute measures of central tendency for given datasets	[AP]
CO4	Analyze the coefficient of determination to interpret the proportion of variance	[AN]
CO5	Apply techniques to calculate and interpret the standard error of estimate, evaluating the accuracy of the regression mode	[AP]

TEXTBOOKS

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016.
2. Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017.
3. Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016.

REFERENCE BOOKS

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

WEB RESOURCES

1. http://nptel.ac.in/courses/112105126/
2. https://onlinecourses.nptel.ac.in/noc22_me119/preview

24MEC04	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.

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

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

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. *Effective Java* by Joshua Bloch (3rd 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