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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

3rd Board of Studies Meeting

Venue: Board Room

Date & Time: 17.05.2025 & 1100 a.m

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DEPARTMENT OF

ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

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AEC/AI&DS/2025-26/BOS/AD03

DATE: 07.05.2025

CIRCULAR

The Third Board of Studies meeting of **Artificial Intelligence and Data Science** department has been scheduled under the chairmanship of Dr.M.Poonguzhali, Head of the Department of the AI&DS of Annapoorana Engineering College at Board Room on **17.05.2025** at **11.00 am**. All the faculty members are requested to attend the meeting to discuss the following agenda

Agenda:

1. Welcome note by Head of the Department
2. Introduction of the members
3. Proposal for Curriculum & Syllabi.

Dr.M.Poonguzhali

HOD/AI&DS

Dr.A.Anbuchezian

Principal

Copy to:

1. Director Academics
2. Director Administration
3. All HoDs
4. All Faculty members
5. Main Notice Board
6. File

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Minutes of Board of Studies Meeting on 17.05.2025

Minutes of the meeting of Board of Studies, Department of Artificial Inntelligence& Data Science, held at10.00 am on 17th May 2025(Saturday) at Board Room.

Members Present

S.No	Member	Position	Category	Signature
1.	Dr.M.Poonguzhali	Professor / HOD	Chairman	
2.	Dr.S.Nagarajan	Associate Professor, Department of Computer Science Engineering, Government College of Engineering, Srirangam	University Nominee	
3.	Dr.J.ShinyDuela	Associate Professor, Computer Science & Engineering,SRM Institute of Science and Technology, Chennai	Academic Experts from outside the Parent University	
	Dr.T.Senthil Kumar	Professor, Computer Science Engineering, Amrita School of Engineering, Amrita Vishwa Vidyapeetham, Coimbatore		
4.	Mr.SP.Balamurugan	Co-Founder , GUVI	Industry Representative	
5.	Mr.Selvakumar	TCS, IT Analyst, Bangalore	Meritorious Alumnus	
6.	Dr.T.Parameswaran	Professor	Faculty Members	
7.	Mr.C.Sukumar	Associate Professor		
8.	Mrs.M.Ammuindrapriya	Associate Professor		
9.	Mr.T.Poornachandar	Assistant Professor		
10.	Mr.K.Venkatesh	Assistant Professor		
11.	Mrs.P.Divyapriya	Assistant Professor		
12.	Mr.R.Gokul	Assistant Professor		
13.	Mrs.J.Indumathi	Assistant Professor		
14.	Mrs.P.Priya	Assistant Professor		

Principal
Dr.A.Anbuchezian

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12/5/25
Dr.S. Nagarajan
Anna University Nominee

12/5/2025
Dr. T.Senthil Kumar
Academic Expert

17/5/25
Dr.J. ShinyDuela
Academic Expert

(Dr.T. Senthil Kumar)
Mr.SP.Balamurugan
Industry Representative

Mr. Selvakumar
Meritorious Alumnus

17/5/25
Dr.M.Poonguzhali
Chairman BOS

Dr.A. Anbuchezian
Principal

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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Venue: Board Room

Date & Time: 17.05.2025 & 11.00 a.m.





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MINUTES OF BOARD OF STUDIES MEETING

Date : Saturday, 17th May 2025
Time : 10:00 AM
Venue : Board Room

The Board of Studies (BoS) meeting for the Department of Artificial Intelligence and Data Science was convened on Saturday, 17th May 2025, at 10:00 AM in the Board Room of Annapoorana Engineering College.

The meeting commenced with a warm welcome by **Dr.M.Poonguzhali**, Professor and Head of the Department, who also serves as the Chairman of the BoS. She introduced the esteemed members of the board and set the context for the meeting.

Dr.M.Poonguzhali provided a brief overview of the institution, highlighting its history, vision, mission, and quality policy, with particular emphasis on the department's ongoing initiatives and future goals.

The core agenda of the meeting was the presentation of the curriculum for the Artificial Intelligence and Data Science programs. Dr.M.Poonguzhali invited constructive feedback and valuable suggestions from the expert members to enhance the curriculum in alignment with industry trends, local relevance, and the academic freedom offered through autonomous status.

SUGGESTIONS AND RECOMMENDATIONS

Curriculum Discussion – 5th and 6th Semesters

The primary focus of the BoS meeting was the review and discussion of the curriculum for the **5th and 6th semesters** of the **B.Tech. Artificial Intelligence and Data Science program**.

Dr. T. Senthilkumar, Academic Expert from Other University, appreciated the subject choices for the 5th semester, stating they are **well-aligned with current industry needs**. He emphasized that core

subjects like **Deep Learning**, **Embedded Systems and IoT**, and **Full Stack Development** are highly relevant. He recommended encouraging students to **undertake mini-projects in their preferred domain** based on these subjects to enhance practical exposure and domain specialization.

Mr. S.P. Balamurugan, the Industry Member advised that students should be **strongly encouraged to pursue internships** during or after the 5th semester to gain hands-on industrial experience. He stressed that such exposure would significantly boost employability and real-world skills.

Dr. J. Shiny Duela, Academic Expert from Other University, recommended exposing students to industry-based problems early on, despite the department not having alumni yet. She proposed that the department establish **academic or industrial collaborations** that can offer students opportunities to explore live industrial case studies, participate in industry-driven problem-solving, and receive mentoring from professionals through guest lectures and workshops.

Dr. S. Nagarajan, Anna University Nominee highlighted the significant scope for AI applications in the healthcare domain. He suggested guiding students to undertake AI- and IoT-based projects focused on healthcare-related challenges. He encouraged the department to integrate healthcare problem statements within the curriculum and advised initiating collaborations with nearby hospitals or healthcare institutions to support real-time project development.

All members unanimously observed that **there is tremendous scope for innovation at the intersection of IoT and AI in the healthcare sector**. They recommended the department actively seek **collaborations with nearby hospitals or healthcare centers** to identify real-world problems and guide students to **develop AI- and IoT-based solutions** to address those challenges.

Additional Recommendations and Curriculum Enhancements

In terms of curriculum enrichment, Dr.S.Nagarajan proposed including emerging interdisciplinary subjects such as **Applications of 3D Printing Techniques**, **Solar Energy Technologies**, and **Foundations of Robotics** under Open Elective I. These electives, he noted, would provide students with a broader technological perspective and promote cross-disciplinary innovation.

Dr. T. Senthilkumar suggested introducing hands-on training with advanced tools and platforms such as **ChatGPT API**, **Hugging Face Transformers**, and **AutoML frameworks**, which would equip students with practical skills in contemporary AI technologies and deployment practices.

Both Dr. J. Shiny Duela and Dr. S. Nagarajan emphasized the importance of **strengthening industry-academia integration**. They recommended introducing **industry-led certificate courses**, conducting **guest lectures by domain experts**, and promoting **collaborative projects** with industry and R&D centers. These initiatives would help ensure that students are not only academically proficient but also industry-ready.

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B.TECH ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

REGULATION - 2022

CHOICE BASED CREDIT SYSTEM

CURRICULUM FOR SEMESTER I TO VIII

Applicable to the students admitted from the Academic year 2023-2024 onwards

SEMESTER-I

S.No	Course Code	Course Title	Category	L	T	P	Contact Periods	C
1.	22IP001	Induction Programme	-	0	0	0	0	0
THEORY								
2.	22HS101	Professional English - I	HSMC	3	0	0	3	3
3.	22MA101	Matrices and Calculus	BSC	3	0	0	3	3
4.	22PH101	Engineering Physics	BSC	3	0	0	3	3
5.	22CY101	Engineering Chemistry	BSC	3	0	0	3	3
6.	22GE101	Problem Solving and Python Programming	ESC	3	0	0	3	3
7.	22GE102	Engineering Graphics	ESC	2	0	2	4	3
8.	22GE103	Heritage of Tamil	HSMC	1	0	0	1	1
PRACTICALS								
9.	22GE104	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
10.	22PC101	Physics and Chemistry Laboratory	BSC	0	0	4	4	2
11.	22GE105	English Laboratory	EEC	0	0	2	2	1
TOTAL				**18**	**0**	**12**	**30**	**24**

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SEMESTER-II

S.No	Course Code	Course Title	Category	L	T	P	Contact Periods	C
THEORY								
1.	22HS201	Professional English-II	HSMC	3	0	0	3	3
2.	22MA201	Vectors and Complex Function	BSC	3	0	0	3	3
3.	22PH203	Physics for Information Science	BSC	3	0	0	3	3
4.	22CY201	Environmental Science and Sustainability	BSC	2	0	0	2	2
5.	22GE201	Basic Electrical and Electronics Engineering	ESC	3	0	0	3	3
6.	22CS201	Programming in C	PC	3	0	0	3	3
7.	22GE202	Tamils and Technology	HSMC	1	0	0	1	1
PRACTICALS								
8.	22GE203	Basic Electrical and Electronics Engineering Laboratory	ESC	0	0	4	4	2
9.	22CS202	Programming in C Laboratory	PC	0	0	4	4	2
10.	22GE204	Engineering Practice Laboratory	ESC	0	0	4	4	2
11.	22GE205	Communication Laboratory/ Foreign Language	EEC	0	0	4	4	2
TOTAL				**18**	**0**	**16**	**34**	**26**

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SEMESTER-III

S.No	Course Code	Course Title	Category	L	T	P	Contact Periods	C
THEORY								
1.	22MA303	Discrete Mathematics	BSC	3	0	0	3	3
2.	22EC307	Digital Principles and Computer Organization	PC	3	0	2	5	4
3.	22AD301	Data Base Design and Management	PC	3	0	0	3	3
4.	22AD302	Design and Analysis of Algorithms	PC	3	0	0	3	3
5.	22AD303	Data Exploration and Visualization	PC	3	0	2	5	4
6.	22AD304	Artificial Intelligence	PC	3	0	0	3	3
PRACTICALS								
7.	22AD305	Data Base Design and Management Laboratory	PC	0	0	4	3	2
8.	22AD306	Artificial Intelligence Laboratory	PC	0	0	4	3	2
9.		Physical and Mental Health using Yoga	NCMC	0	0	2	2	0
TOTAL				**18**	**0**	**14**	**30**	**24**

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SEMESTER-IV

S.No	Course Code	Course Title	Category	L	T	P	Contact Periods	C
THEORY								
1.	22MA401	Probability and Statistics	BSC	3	0	0	3	3
2.	22CS402	Operating Systems	PC	3	0	0	3	3
3.	22AD402	Machine Learning	PC	3	0	0	3	3
4.	22AD403	Fundamentals of Data Science and Analytics	PC	3	0	0	3	3
5.	22AD404	Computer Communication Networks	PC	3	0	2	5	4
PRACTICALS								
6.	22AD405	Data Science and Analytics Laboratory	PC	0	0	4	4	2
7.	22AD406	Machine Learning Laboratory	PC	0	0	4	4	2
8.	22CS404	Operating System Laboratory	PC	0	0	4	4	2
9.		Entrepreneurial Skill Development	NCMC	2	0	0	2	0
TOTAL				**17**	**0**	**14**	**30**	**22**

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SEMESTER-V

S.No	Course Code	Course Title	Category	L	T	P	Contact Periods	C
THEORY								
1.	22AD501	Deep Learning	PC	3	0	2	5	4
2.	22AD502	Big Data Analytics	PC	2	0	2	4	3
3.	22AD503	Object Oriented Programming using Java	PC	3	0	0	3	3
4.	22EC408	Embedded Systems with IOT	PC	3	0	2	5	4
5.		Professional Elective I	PE	2	0	2	4	3
6.		Professional Elective II	PE	2	0	2	4	3
PRACTICALS								
7.	22AD504	Object Oriented Programming using Java Laboratory	PC	0	0	4	4	2
8.		Skill Development	NCMC	2	0	0	2	0
TOTAL				-	-	-	-	**22**

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SEMESTER-VI

S.No	Course Code	Course Title	Category	L	T	P	Contact Periods	C
THEORY								
1.	22CS408	Mobile App Development	PC	3	0	0	3	3
2.		Open Elective– I	OE	3	0	0	3	3
3.		Open Elective– II	OE	3	0	0	3	3
4.		Professional Elective III	PE	2	0	2	4	3
5.		Professional Elective IV	PE	2	0	2	4	3
6.		Professional Elective V	PE	2	0	2	4	3
PRACTICALS								
7.	22CS409	Mobile App Development Laboratory	PC	0	0	4	4	2
TOTAL				-	-	-	-	**20**

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SEMESTER-VII

S.No	Course Code	Course Title	Category	L	T	P	Contact Periods	C
THEORY								
1.		Human Values and Ethics	HSMC	3	0	0	3	3
2.		Elective - Management	HSMC	3	0	0	3	3
3.		Professional Elective – VI	PE	2	0	2	4	3
4.		Open Elective – III	OE	3	0	0	3	3
5.		Open Elective – IV	OE	3	0	0	3	3
PRACTICALS								
6.		Summer Internship	EEC	0	0	0	0	2
TOTAL				**14**	**0**	**0**	**16**	**17**

SEMESTER-VIII

S.No	Course Code	Course Title	Category	L	T	P	Contact Periods	C
PRACTICALS								
1.	22AD801	Project Work / Internship	EEC	0	0	20	20	**10**
TOTAL				**0**	**0**	**20**	**20**	**10**

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HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT (HSMC)

S.No	Course Code	Course Title	Category	L	T	P	Contact Periods	C
1.	22HS101	Professional English-I	HSMC	3	0	0	3	3
2.	22GE103	Heritage of Tamil	HSMC	1	0	0	1	1
3.	22HS201	Professional English-II	HSMC	3	0	0	3	3
4.	22GE202	Tamils and Technology	HSMC	1	0	0	1	1
5.	22GE501	Professional Ethics in Engineering	HSMC	3	0	0	3	3

EMPLOYMENT ENHANCEMENT COURSES (EEC)

S.No	Course Code	Course Title	Category	L	T	P	Contact Periods	C
1.	22GE105	English Laboratory	EEC	0	0	2	2	1
2.	22GE205	Communication Laboratory/ Foreign Language	EEC	0	0	4	4	2
3.	22CS605	Summer Internship	EEC	0	0	0	0	2
4.	22CS702	Project Phase – I	EEC	0	0	8	8	4
5.	22CS802	Project Phase – II	EEC	0	0	12	12	6

NON CREDITABLE MANDATARY COURSE (NCMC)

S.No	Course Code	Course Title	Category	L	T	P	Contact Periods	C
1.	22CSN01	Physical and Mental Health using Yoga	NCMC	1	0	1	2	0
2.	22CSN02	Entrepreneurial Skill Development	NCMC	2	0	0	2	0
3.	22CSN03	Essence of Indian Knowledge Tradition	NCMC	2	0	0	2	0
4.	22CSN04	Introduction to Women and Gender Studies	NCMC	2	0	0	2	0

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BASIC SCIENCES (BS)

S.No	Course Code	Course Title	Category	L	T	P	Contact Periods	C
1.	22MA101	Matrices And Calculus	BSC	3	0	0	3	3
2.	22PH101	Engineering Physics	BSC	3	0	0	3	3
3.	22CY101	Engineering Chemistry	BSC	3	0	0	3	3
4.	22PC101	Physics and Chemistry Laboratory	BSC	0	0	4	4	2
5.	22MA201	Vectors and Complex Function	BSC	3	0	0	3	3
6.	22PH203	Physics for Information Science	BSC	3	0	0	3	3
7.	22CY201	Environmental Science and Sustainability	BSC	2	0	0	2	2
8.	22MA302	Statistics and Numerical Methods	BSC	3	0	0	3	3
9.	22MA402	Discrete Mathematics	BSC	3	0	0	3	3

ENGINEERING SCIENCES (ESC)

S.No	Course Code	Course Title	Category	L	T	P	Contact Periods	C
1.	22GE101	Problem Solving and Python Programming	ESC	3	0	0	3	3
2.	22GE102	Engineering Graphics	ESC	3	0	0	3	3
3.	22GE104	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
4.	22GE201	Basic Electrical and Electronics Engineering	ESC	3	0	0	3	3
5.	22GE203	Basic Electrical and Electronics Engineering Laboratory	ESC	0	0	4	4	2
6.	22GE204	Engineering Practice Laboratory	ESC	0	0	4	4	2
7.	22EC307	Digital Principles and Computer Organization	ESC	3	0	2	5	4
8.	22EC408	Embedded Systems with IOT	ESC	3	0	2	5	4

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PROFESSIONAL CORE (PC)

S.No	Course Code	Course Title	Category	L	T	P	Contact Periods	C
1.	22CS201	Programming In C	PC	3	0	0	3	3
2.	22CS202	Programming In C Lab	PC	0	0	4	4	2
3.	22AD301	Database Design and Management	PC	3	0	0	3	3
4.	22EC307	Digital Principles and Computer Organization	PC	3	0	2	5	4
5.	22AD302	Design and Analysis of Algorithms	PC	3	0	0	3	3
6.	22AD303	Data Exploration and Visualization	PC	3	0	2	5	4
7.	22AD304	Artificial Intelligence	PC	3	0	0	3	3
8.	22AD305	Data Base Design and Management Laboratory	PC	0	0	4	3	2
9.	22AD306	Artificial Intelligence Laboratory	PC	0	0	4	3	2
10.	22CS402	Operating Systems	PC	3	0	0	3	3
11.	22AD402	Machine Learning	PC	3	0	0	3	3
12.	22AD403	Fundamentals of Data Science and Analytics	PC	3	0	0	3	3
13.	22AD404	Computer Communication Networks	PC	3	0	2	5	4
14.	22AD405	Data Science and Analytics Laboratory	PC	0	0	4	4	2
15.	22AD406	Machine Learning Laboratory	PC	0	0	4	4	2
16.	22CS404	Operating System Laboratory	PC	0	0	4	4	2
17.	22AD501	Deep Learning	PC	3	0	2	5	4
18.	22AD502	Big Data Analytics	PC	2	0	2	4	3
19.	22AD503	Object Oriented Programming using Java	PC	3	0	0	3	3

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20.	22EC408	Embedded Systems with IOT	PC	3	0	2	5	4
21.	22AD504	Object Oriented Programming using Java Laboratory	PC	0	0	4	4	2
22.	22CS408	Mobile App Development	PC	3	0	0	3	3
23.	22CS409	Mobile App Development Laboratory	PC	0	0	4	4	2

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VERTICALS

PROFESSIONAL ELECTIVE COURSES

PROFESSIONAL ELECTIVE-I: DATA SCIENCE

Sl.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
1.	22ADV101	Knowledge Engineering	PE	2	0	2	4	3
2.	22ADV102	Recommender Systems	PE	2	0	2	4	3
3.	22ADV103	Exploratory Data Analysis	PE	2	0	2	4	3
4.	22ADV104	Text and Speech Analysis	PE	2	0	2	4	3
5.	22ADV105	Business Analytics	PE	2	0	2	4	3
6.	22ADV106	Image and Video Analytics	PE	2	0	2	4	3
7.	22ADV107	Computer Vision	PE	2	0	2	4	3
8.	22ADV108	Data Warehousing and Data Mining	PE	2	0	2	4	3

PROFESSIONAL ELECTIVE-II: FULLSTACK DEVELOPMENT

Sl.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
1.	22ADV201	Full Stack Software Development	PE	2	0	2	4	3
2.	22ADV202	App Development	PE	2	0	2	4	3
3.	22ADV203	Cloud Services Management	PE	2	0	2	4	3
4.	22ADV204	UI and UX Design	PE	2	0	2	4	3
5.	22ADV205	Software Testing and Automation	PE	2	0	2	4	3
6.	22ADV206	Web Development 5.0	PE	2	0	2	4	3
7.	22ADV207	DevOps	PE	2	0	2	4	3
8.	22ADV208	Agile Methodologies	PE	2	0	2	4	3

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PROFESSIONAL ELECTIVE-III: CLOUD COMPUTING

Sl.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
1.	22ADV301	Cloud Computing	PE	2	0	2	4	3
2.	22ADV302	Virtualization	PE	2	0	2	4	3
3.	22ADV303	Cloud Architectures	PE	2	0	2	4	3
4.	22ADV304	Cloud Application Development	PE	2	0	2	4	3
5.	22ADV305	Storage Technologies	PE	2	0	2	4	3
6.	22ADV306	Software Defined Networks	PE	2	0	2	4	3
7.	22ADV307	Stream Processing	PE	2	0	2	4	3
8.	22ADV308	Security and Privacy in Cloud	PE	2	0	2	4	3

PROFESSIONAL ELECTIVE- IV : CYBER SECURITY

Sl.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
1.	22ADV401	Ethical Hacking	PE	2	0	2	4	3
2.	22ADV402	Digital and Mobile Forensics	PE	2	0	2	4	3
3.	22ADV403	Social Network Security	PE	2	0	2	4	3
4.	22ADV404	Modern Cryptography	PE	2	0	2	4	3
5.	22ADV405	Engineering Secure Software Systems	PE	2	0	2	4	3
6.	22ADV406	Web Application Security	PE	2	0	2	4	3
7.	22ADV407	Data and Information Security	PE	2	0	2	4	3
8.	22ADV408	Cyber Security	PE	2	0	2	4	3

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PROFESSIONAL ELECTIVE- V : CREATIVE MEDIA

Sl.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
1.	22ADV501	Augmented Reality/ Virtual Reality	PE	2	0	2	4	3
2.	22ADV502	Multimedia and Animation	PE	2	0	2	4	3
3.	22ADV503	Video Creation and Editing	PE	2	0	2	4	3
4.	22ADV504	3D Modeling and Game Design	PE	2	0	2	4	3
5.	22ADV505	Digital Marketing	PE	2	0	2	4	3
6.	22ADV506	Multimedia Data Compression and Storage	PE	2	0	2	4	3
7.	22ADV507	Game Development	PE	2	0	2	4	3
8.	22ADV508	Visual Effects	PE	2	0	2	4	3

PROFESSIONAL ELECTIVE- VI : EMERGING TECHNOLOGIES

Sl.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
1.	22ADV601	Natural Language Processing	PE	2	0	2	4	3
2.	22ADV602	Robotic Process Automation	PE	2	0	2	4	3
3.	22ADV603	Intelligent Automation Systems	PE	2	0	2	4	3
4.	22ADV604	Neural Networks and Deep Learning	PE	2	0	2	4	3
5.	22ADV605	Quantum Computing	PE	2	0	2	4	3
6.	22ADV606	Cryptocurrency and Blockchain Technologies	PE	2	0	2	4	3
7.	22ADV607	Fog and Edge Computing	PE	2	0	2	4	3
8.	22ADV608	3D Printing and Design	PE	2	0	2	4	3

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PROFESSIONAL ELECTIVE- VII: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Sl.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
1.	22ADV701	Bio-Inspired Optimization Techniques	PE	2	0	2	4	3
2.	22ADV702	Soft Computing	PE	2	0	2	4	3
3.	22ADV703	Health Care Analytics	PE	2	0	2	4	3
4.	22ADV704	Generative AI	PE	2	0	2	4	3
5.	22ADV705	Optimization Techniques	PE	2	0	2	4	3
6.	22ADV706	Game Theory	PE	2	0	2	4	3
7.	22ADV707	Cognitive Science	PE	2	0	2	4	3
8.	22ADV708	Ethics and AI	PE	2	0	2	4	3

MANAGEMENT ELECTIVES

Sl.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
1.	22GE	Principles of Management	HSMC	3	0	0	3	3
2.	22GE	Total Quality Management	HSMC	3	0	0	3	3
3.	22GE	Engineering Economics and Financial Accounting	HSMC	3	0	0	3	3
4.	22GE	Human Resource Management	HSMC	3	0	0	3	3
5.	22GE	Knowledge Management	HSMC	3	0	0	3	3
6.	22GE	Industrial Management	HSMC	3	0	0	3	3

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OPEN ELECTIVES

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
1	22OEE01	Introduction to Control Systems	OE	3	0	0	3	3
2	22OEE02	Renewable Energy Systems	OE	3	0	0	3	3
3	22OEE03	Energy Conservation and Management	OE	3	0	0	3	3
4	22OEE04	Renewable Energy Technologies	OE	3	0	0	3	3
5	22OEE05	Electric Vehicle Technology	OE	3	0	0	3	3
6	22OME01	Applications of 3D printing Techniques	OE	3	0	0	3	3
7	22OME02	Introduction to Non-Destructive Testing	OE	3	0	0	3	3
8	22OME03	Concepts of Competitive manufacturing	OE	3	0	0	3	3
9	22OME04	Production Planning and Control	OE	3	0	0	3	3
10	22OME05	Solar Energy Technologies	OE	3	0	0	3	3
11	22OEC01	MEMS and NEMS	OE	3	0	0	3	3
12	22OEC02	Space Time Wireless Communication	OE	3	0	0	3	3
13	22OEC03	Telecommunication Network Management	OE	3	0	0	3	3
14	22OEC04	Nano Technology	OE	3	0	0	3	3
15	22OEC05	Foundation of Robotics	OE	3	0	0	3	3
16	22OEC06	Remote Sensing Concepts	OE	3	0	0	3	3
17	22OEC07	Sensors	OE	3	0	0	3	3
18	22OBM01	Basics of Microbial Technology	OE	3	0	0	3	3
19	22OBM02	Basics of Biomolecules	OE	3	0	0	3	3

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CATEGORY	CREDITS	CREDIT %
HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT	11	7
BASIC SCIENCES	25	15
ENGINEERING SCIENCES	23	14
PROFESSIONAL CORE	67	41
PROFESSONAL ELECTIVE	15	9
OPEN ELECTIVE	9	5
EMPLOYMENT ENHANCEMENT COURSES	15	9
TOTAL	**165**	**100**

CHOICE BASED CREDIT SYSTEM (CBCS)

I TO VIII SEMESTER CURRICULUM SUMMARY

S. No.	SUBJECT AREA	CREDITS AS PER SEMESTER								TOTAL CREDITS	PERCENTAGE
		I	II	III	IV	V	VI	VII	VIII		
1.	HSMC	4	4					6		14	**8.4%**
2.	BSC	11	6	3	3					23	**13.9%**
3.	ESC	8	9							17	**10.4%**
4.	PC		5	21	19	16	5			66	**40%**
5.	PE					6	9	3		18	**11%**
6.	OE						6	6		12	**7.2%**
7.	EEC	1	2			0		2	10	15	**9.1%**
8.	NC/MC					√	√				
	Total	24	26	24	22	22	20	17	10	165	**100%**
	Non Credit / Mandatory	-	-	-	-	-	-	-	-	-	-

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20	22OBM03	Fundamentals of Cell and Molecular Biology	OE	3	0	0	3	3
21	22OBM04	Nanomaterials and Applications	OE	3	0	0	3	3
22	22OBM05	Food, Nutrition and Health	OE	3	0	0	3	3
23	22OCE01	Drinking Water supply and Treatment	OE	3	0	0	3	3
24	22OCE02	Green building concepts	OE	3	0	0	3	3
25	22OCE03	Disaster mitigation and management	OE	3	0	0	3	3
26	22OCE04	Road safety and Management	OE	3	0	0	3	3
27	22OIT01	IT in Agricultural System	OE	3	0	0	3	3
28	22OAU01	Vehicle Technology	OE	3	0	0	3	3
29	22OAU02	Automotive Power Train System	OE	3	0	0	3	3
30	22OAU03	Autonomous Vehicle and Safety Systems	OE	3	0	0	3	3
31	22OAU04	Two-Wheeler Technology	OE	3	0	0	3	3

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III SEMESTER

SYLLABUS

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22MA303	DISCRETE MATHEMATICS	L	T	P	C
		3	0	0	3

Course Objectives:

- To extend student's logical and mathematical maturity and ability to deal with abstraction.
- To introduce most of the basic terminologies used in computer science courses and application of ideas to solve practical problems.
- To understand the basic concepts of combinatorics and graph theory.
- To familiarize the applications of algebraic structures.
- To understand the concepts and significance of lattices and boolean algebra which are widely used in computer science and engineering.

UNIT I	LOGIC AND PROOFS	9

Propositional logic – Propositional equivalences - Predicates and quantifiers – Nested quantifiers – Rules of inference - Introduction to proofs – Proof methods and strategy.

UNIT II	COMBINATORICS	9

Mathematical induction – Strong induction and well ordering – The basics of counting – The pigeonhole principle – Permutations and combinations – Recurrence relations – Solving linear recurrence relations –Generating functions –Inclusion and exclusion principle and its applications.

UNIT III	GRAPHS	9

Graphs and graph models –Graph terminology and special types of graphs –Matrix representation of graphs and graph isomorphism – Connectivity – Euler and Hamilton paths.

UNIT IV	ALGEBRAIC STRUCTURES	9

Algebraic systems–Semi groups and monoids-Groups–Subgroups–Homomorphism's–Normal subgroup and cosets – Lagrange's theorem – Definitions and examples of Rings and Fields.

UNIT V	LATTICES AND BOOLEAN ALGEBRA	9

Partial ordering–Posets–Lattices as posets–Properties of lattices-Lattices as algebraic systems – Sub lattices–Direct product and homomorphism–Some special lattices–Boolean algebra–Sub Boolean Algebra – Boolean Homomorphism.

TOTAL: 45 PERIODS

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	TEXT BOOKS:
1	Grimaldi.R.P."Discrete and Combinatorial Mathematics: An Applied Introduction ",5th Edition, Pearson Education Asia, Delhi, 2013.
2	Tremblay.J.P.and Manohar.R,"Discrete Mathematical Structures with Applications to Computer Science", TataMcGrawHill Pub. Co. Ltd, New Delhi, 30th Reprint, 2011.

	REFERENCES:
1	Grimaldi.R.P."Discrete and Combinatorial Mathematics: An Applied Introduction", 5th Edition, Pearson Education Asia, Delhi, 2013.
2	Koshy.T."Discrete Mathematics with Applications", Elsevier Publications,2006.
3	Lipschutz. S. and Mark Lipson., "Discrete Mathematics", Schaum's Outlines, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 3rd Edition, 2010.

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Course Name: DISCRETE MATHEMATICS		**Course code: 22MA303**			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Have knowledge of the concepts needed to test the logic of a program.	I	K1	1,2,12	-
CO2	Have an understanding in identifying structures on many levels.	II	K1, K2	1,2	-
CO3	Be aware of a class of functions which transform a finite set into another finite set which relates to input and output functions in computer science.	III	K5	2,3,6, 10	-
CO4	Be aware of the counting principles.	IV	K6	2,3,4	-
CO5	Be exposed to concepts and properties of algebraic structures such as groups, rings and fields.	V	K5, K6	2,3,4, 10	-

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

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22EC307	DIGITAL PRINCIPLES AND COMPUTER ORGANIZATION	L	T	P	C
		3	0	2	4

Course Objectives:

- To analyze and design combinational circuits.
- To analyze and design sequential circuits
- To understand the basic structure and operation of a digital computer.
- To study the design of data path unit, control unit for process o and to familiarize with the hazards.
- To understand the concept of various memories and I/O interfacing.

UNIT I	COMBINATIONAL LOGIC	9

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

UNIT II	SYNCHRONOUS SEQUENTIAL LOGIC	9

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

UNIT III	COMPUTER FUNDAMENTALS	9

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

UNIT IV	PROCESSOR	9

Instruction Execution – Building a Data Path – Designing a Control Unit – Hardwired Control, Micro programmed Control – Pipelining – Data Hazard – Control Hazards.

UNIT V	MEMORY AND I/O	9

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

TOTAL: 45 PERIODS

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PRACTICAL EXERCISES:	30 PERIODS
1. Verification of Boolean theorems using logic gates. 2. Design and implementation of combinational circuits using gates for arbitrary functions. 3. Implementation of 4-bit binary adder/subtractor circuits. 4. Implementation of code converters. 5. Implementation of BCD adder, encoder and decoder circuits 6. Implementation of functions using Multiplexers. 7. Implementation of the synchronous counters 8. Implementation of a Universal Shift register. 9. Simulator based study of Computer Architecture	
	TOTAL: 75 PERIODS

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

REFERENCES:	
1	Carl Hamacher, ZvonkoVranesic, Safwat Zaky,Naraig Manjikian, "Computer Organization and Embedded Systems", Sixth Edition, Tata McGraw-Hill, 2012.
2	William Stallings, "Computer Organization and Architecture – Designing for Performance", Tenth Edition, Pearson Education, 2016.
3	M.Morris Mano, "Digital Logic and Computer Design", Pearson Education, 2016.

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Course Name: DIGITAL PRINCIPLES AND COMPUTER ORGANIZATION		**Course code: 22EC307**			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Design various combinational digital circuits using logic gates	I	K1	1,2,3,4,5 ,6,7,8,9, 10,11,12	1,2
CO2	Design sequential circuits and analyze the design procedures	II	K2, K3	1,2,3,4,5 ,6,7,8,9, 10,11,12	1,2
CO3	State the fundamentals of computer systems and analyze the execution of an instruction	III	K3, K4	1,2,3,4,5 ,6,7,8,9, 10,11,12	1,2
CO4	Analyze different types of control design and identify hazards	IV	K4, K5	1,2,3,4,5 ,6,7,8,9, 10,11,12	1,2
CO5	Identify the characteristics of various memory systems and I/O communication	V	K5, K6	1,2,3,4,5 ,6,7,8,9, 10,11,12	1,2

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

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22AD301	DATABASE DESIGN AND MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:

- To introduce data base development life cycle and conceptual modelling
- To learn SQL for data definition, manipulation and querying a database
- To learn relational database design using conceptual mapping and normalization
- To learn transaction concepts and serializability of schedules
- To learn data model and querying in object-relational and No-SQL databases

UNIT I	CONCEPTUAL DATA MODELING	9

Database environment – Database system development lifecycle – Requirements collection -- Database design -- Entity-Relationship model – Enhanced-ER model – UML class diagrams.

UNIT II	RELATIONAL MODEL AND SQL	9

Relational model concepts—Integrity constraints—SQL Data manipulation–SQL Data definition– Views -- SQL programming.

UNIT III	RELATIONAL DATABASE DESIGN AND NORMALIZATION	9

ER and EER-to-Relational mapping – Update anomalies – Functional dependencies – Inference rules – Minimal cover – Properties of relational decomposition – Normalization (upto BCNF).

UNIT IV	TRANSACTION MANAGEMENT	9

Transaction concepts–properties–Schedules–Serializability–Concurrency Control–Two-phase locking techniques.

UNIT V	OBJECT RELATIONAL AND NO-SQL DATABASES	9

Mapping EER to ODB schema –Object identifier – reference types –row types – UDTs – Subtypes and super types – user – defined routines –Collection types–Object Query Language; No-SQL:CAP theorem – Document-based: MongoDB data model and CRUD operations; Column-based: Hbase data model and CRUD operations.

TOTAL: 45 PERIODS

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TEXT BOOKS:	
1	Thomas M. Connolly, Carolyn E. Begg, Database Systems – Apractical Approach to Design, Implementation, and Management, Sixth Edition, Global Edition, Pearson Education, 2015.
2	RamezElmasri,ShamkantB.Navathe,FundamentalsofDatabaseSystems,7th Edition, Pearson, 2017.

REFERENCES:	
1	TobyTeorey,SamLightstone,TomNadeau,H.V.Jagadish,"DATABASEMODELINGAND DESIGN - Logical Design", Fifth Edition, Morgan Kaufmann Publishers, 2011.
2	CarlosCoronel,StevenMorris,andPeterRob,DatabaseSystems:Design,Implementation, and Management, Ninth Edition, Cengage learning, 2012
3	Abraham Silberschatz, HenryF Korth,SSudharshan, "Database System Concepts",6th Edition, Tata Mc Graw Hill, 2011.
4	HectorGarcia-Molina,JeffreyDUllman,JenniferWidom,"DatabaseSystems:TheComplete Book", 2nd edition, Pearson.
5	Raghu Ramakrishnan, "Database Management Systems", 4th Edition, Tata Mc Graw Hill, 2010.

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Course Name: DATABASE DESIGN ANDMANAGEMENT		Course code: 22AD301			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the database development life cycle and apply conceptual modeling	I	K1, K2	1,2,3,4 ,9,10,1 1,12	1,2
CO2	Apply SQL and programming in SQL to create, manipulate and query the database	II	K3	1,2,3,4 ,5,9,10 ,11,12	1,2
CO3	Apply the conceptual-to relational mapping and normalization to design relational database	III	K4	1,2,3,4 ,5,9,10 ,11,12	1,2
CO4	Determine the serializability of any non-serial schedule using concurrency techniques	IV	K2, K4	1,2,3,4 ,9,10,1 1,12	1,2
CO5	Apply the data model and querying in Object-relational and No-SQL databases.	V	K1, K2, K5	1,2,3,4 ,5,9,10 ,11,12	1,2

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

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22AD302	DESIGN AND ANALYSIS OF ALGORITHMS	L	T	P	C
		3	0	0	3

Course Objectives:

- To critically analyze the efficiency of alternative algorithmic solutions for the same problem
- To illustrate brute force and divide and conquer design techniques.
- To explain dynamic programming and greedy techniques for solving various problems.
- To apply iterative improvement technique to solve optimization problems
- To examine the limitations of algorithmic power and handling it indifferent problems.

UNIT I	INTRODUCTION	9

Notion of an Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem Types –FundamentalsoftheAnalysisofAlgorithmEfficiency–AnalysisFramework-AsymptoticNotations and their properties – Empirical analysis - Mathematical analysis of Recursive and Non-recursive algorithms – Visualization.

UNIT II	BRUTE FORCE AND DIVIDE AND CONQUER	9

Brute Force – String Matching - Exhaustive Search - Traveling Salesman Problem - Knapsack Problem – Assignment problem. Divide and Conquer Methodology –Multiplication of Large Integers and Strassen's Matrix Multiplication – Closest-Pair and Convex - Hull Problems. Decrease and Conquer: - Topological Sorting – Transform and Conquer: Presorting – Heaps and Heap Sort.

UNIT III	DYNAMIC PROGRAMMING AND GREEDY TECHNIQUE	9

Dynamic programming – Principle of optimality - Coin changing problem – Warshall's and Floyd's algorithms – Optimal Binary Search Trees - Multi stage graph - Knapsack Problem and Memory functions. Greedy Technique – Dijkstra's algorithm -Huffman Trees and codes - 0/1 Knapsack problem.

UNIT IV	ITERATIVE IMPROVEMENT	9

The Simplex Method-The Maximum-Flow Problem – Maximum Matching in Bipartite Graphs- The Stable marriage Problem.

UNIT V	LIMITATIONS OF ALGORITHM POWER	9

Lower- Bound Arguments-P,NP,NP-Complete and NP Hard Problems. Backtracking–N-Queen problem - Hamiltonian Circuit Problem – Subset Sum Problem. Branch and Bound – LIFO Search and FIFO search - Assignment problem – Knapsack Problem – Traveling Salesman Problem - Approximation Algorithms for NP-Hard Problems – Traveling Salesman problem – Knapsack problem.

TOTAL: 45 PERIODS

TEXT BOOKS:	
1	Anany Levitin, Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education, 2012.

REFERENCES:	
1	Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Computer Algorithms/C++, Second Edition, Universities Press, 2019.
2	Analyze the efficiency of brute force, divide and conquer, decrease and conquer, Transform and conquer algorithmic techniques
3	Implement and analyze the problems using dynamic programming and greedy algorithmic techniques.
4	Solve the problems using iterative improvement techniques for optimization.
5	Compute the limitations of algorithmic power and solve the problems using backtracking and branch and bound techniques.

Course Name: DESIGN AND ANALYSIS OF ALGORITHMS		Course code: 22AD302			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Analyze the efficiency of recursive and non-recursive algorithms mathematically	I	K1, K2	1,2,7,12	2
CO2	Analyze the efficiency of brute force, divide and conquer, decrease and conquer, Transform and conquer algorithmic techniques	II	K3	1,2,7,12	2
CO3	Implement and analyze the problems using dynamic programming and greedy algorithmic techniques.	III	K4	1,2,3,4,7	2
CO4	Solve the problems using iterative improvement techniques for optimization.	IV	K5	1,2	-
CO5	Compute the limitations of algorithmic power and solve the problems using backtracking and branch and bound techniques.	V	K5, K6	1,2	-

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

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22AD303	DATA EXPLORATION AND VISUALIZATION	L	T	P	C
		5	0	2	4

Course Objectives:

- To out line an overview of exploratory data analysis.
- To implement data visualization using Matplotlib.
- To perform univariate data exploration and analysis.
- To apply bivariate data exploration and analysis.
- TouseDataexplorationandvisualizationtechniquesformultivariateandtimeseriesdat

UNIT I	EXPLORATORY DATA ANALYSIS	9

EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data – ComparingEDAwithclassicalandBayesiananalysis–SoftwaretoolsforEDA-VisualAidsforEDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques - Grouping Datasets - data aggregation – Pivot tables and cross-tabulations.

UNIT II	VISUALIZING USING MATPLOT LIB	9

Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn.

UNIT III	UNIVARIATE ANALYSIS	9

Introduction to Single variable: Distributions and Variables - Numerical Summaries of Level and Spread - Scaling and Standardizing – Inequality - Smoothing Time Series.

UNIT IV	BIVARIATE ANALYSIS	9

Relationships between Two Variables - Percentage Tables - Analyzing Contingency Tables - Handling Several Batches - Scatterplots and Resistant Lines – Transformations.

UNIT V	MULTIVARIATE AND TIME SERIES ANALYSIS	9

IntroducingaThirdVariable-CausalExplanations-Three-VariableContingencyTablesandBeyond - Longitudinal Data – Fundamentalsof TSA– Characteristics of timeseries data – DataCleaning – Time-based indexing – Visualizing – Grouping – Resampling.

TOTAL: 45 PERIODS

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PRACTICAL EXERCISES:	30 PERIODS
1. Install the data Analysis and Visualization tool :R/Python/Tableau Public/ PowerBI. 2. Perform exploratory data analysis (EDA) on with datasets like email data set. Export all your emails as a dataset, import them inside a pandas dataframe, visualize the mand get different insights from the data. 3. Working with Numpy arrays,Pandas dataframes,Basic plots using Mat plotlib. 4.Explore various variable and row filters in R for cleaning data. Apply various plot features in R on sample data sets and visualize. 5. Perform Time Series Analysis and apply the various visualization techniques. 6. Perform Data Analysis and representation on a Map using various Map datasets with Mouse Rollover effect, user interaction, etc.. 7. Build cartographic visualization for multiple datasets involving various countries of the world; states and districts in India etc. 8. Perform EDA on Wine Quality Data Set. 9. Use a case study on a data set and apply the various EDA and visualization techniques and present an analysis report.	
	TOTAL: 75 PERIODS

TEXT BOOKS:	
1	Suresh Kumar Mukhiya, Usman Ahmed, "Hands-On Exploratory Data Analysis with Python", Packt Publishing, 2020.(Unit 1)
2	Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", Oreilly, 1st Edition, 2016. (Unit 2)
3	Catherine Marsh, Jane Elliott, "Exploring Data: An Introduction to Data Analysis for Social Scientists", Wiley Publications, 2nd Edition, 2008. (Unit 3,4,5)

REFERENCES:	
1	Eric Pimpler, Data Visualization and Exploration with R, Geo Spatial Training service, 2017 Wilke, "Fundamentals of Data Visualization", O'reilly publications,2019.
2	Ward, Ward, Georges Grinstein, Daniel Keim, "Interactive Data Visualization: Foundations, Techniques, and Applications", 2nd Edition, CRC press, 2015.

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Course Name: DATA EXPLORATION AND VISUALIZATION		**Course code: 22AD303**			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the fundamentals of exploratory data analysis.	I	K2	1,2,3,4,9 ,10,11,12	1,2
CO2	Implement the data visualization using Matplotlib.	II	K3	1,2,3,4,5 ,9,10,11, 12	1,2
CO3	Perform univariate data exploration and analysis.	III	K4	1,2,3,4,5 ,9,10,11, 12	1,2
CO4	Apply bivariate data exploration and analysis.	IV	K4, K5	1,2,3,4,9 ,10,11,12	1,2
CO5	Use Data exploration and visualization techniques form ultivariate and time series data.	V	K6	1,2,3,4,5 ,9,10,11, 12	1,2

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

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22AD304	ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

Course Objectives:

- Learn the basic AI approaches
- Develop problem solving agents
- Perform logical and probabilistic reasoning

UNIT I	INTELLIGENT AGENTS	9

Introduction to AI – Agents and Environments – concept of rationality – nature of environments – structure of agents. Problem solving agents – search algorithms – uninformed search strategies.

UNIT II	PROBLEM SOLVING	9

Heuristic search strategies – heuristic functions. Local search and optimization problems – local search in continuous space –search with non-deterministic actions– search in partially observable environments – online search agents and unknown environments

UNIT III	GAME PLAYING AND CSP	9

Game theory – optimal decisions in games – alpha-beta search – monte-carlo tree search – stochastic games – partially observable games. Constraint satisfaction problems – constraint propagation – backtracking search for CSP – local search for CSP – structure of CSP.

UNIT IV	LOGICAL REASONING	9

Knowledge-basedagents–propositionallogic–propositionaltheoremproving–propositionalmodel checking – agents based on propositional logic. First-order logic – syntax and semantics – knowledge representation and engineering – inferences in first-order logic – forward chaining – backward chaining – resolution.

UNIT V	PROBABILISTIC REASONING	9

Acting under uncertainty – Bayesian inference – naïve Bayes models. Probabilistic reasoning – Bayesian networks – exact inference in BN – approximate inference in BN – causal networks.

TOTAL: 45 PERIODS

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TEXT BOOKS:	
1	StuartRussellandPeterNorvig,"ArtificialIntelligence–AModernApproach",Fourth Edition, Pearson Education, 2021.

REFERENCES:	
1	DanW.Patterson,"IntroductiontoAIandES",PearsonEducation,2007
2	KevinNight,ElaineRich,andNairB.,"ArtificialIntelligence",McGrawHill,2008
3	PatrickH.Winston,"ArtificialIntelligence",ThirdEdition,PearsonEducation,2006
4	DeepakKhemani,"ArtificialIntelligence",TataMcGrawHillEducation,2013.
5	http://nptel.ac.in/

Course Name: ARTIFICIAL INTELLIGENCE		Course code: 22AD304			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Explain intelligent agent frameworks.	I	K1	1,2,3,4,9 ,10,11,12	1,2
CO2	Apply problem solving techniques	II	K4	1,2,3,4,5 ,9,10,11, 12	1,2
CO3	Apply game playing and CSP techniques	III	K2, K4	1,2,3,4,9 ,10,11,12	1,2
CO4	Perform logical reasoning	IV	K4	1,2,3,4,9 ,10,11,12	1,2
CO5	Perform probabilistic reasoning under uncertainty	V	K5, K6	1,2,3,4,5 ,9,10,11, 12	1,2

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CO-PO-PSO Mapping

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

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22AD305	DATABASE DESIGN AND MANAGEMENT LABORATORY	L	T	P	C
		0	0	4	2
Course Objectives:	• To understand the database development lifecycle • To learn data base design using conceptual modeling, Normalization • To implement data base using Data definition, Querying using SQL manipulation and SQL programming • To implement data base applications using IDE/RAD tools • To learn querying Object-relational databases				

PRACTICAL EXERCISES:	**60PERIODS**
1. Database Development Lifecycle: Problem definition and Requirement analysis Scope and Constraints 2. Database design using Conceptual modeling (ER-EER) – top-down approach Mapping conceptual to relational database and validate using Normalization 3. Implement the database using SQL Data definition with constraints, Views 4. Query the database using SQL Manipulation 5. Querying/Managing the database using SQL Programming - Stored Procedures/Functions - Constraints and security using Triggers 6. Database design using Normalization–bottom-up approach 7. Develop database applications using IDE/RAD tools (Eg., Net Beans, Visual Studio) 8. Database design using EER-to-ODB mapping/UML class diagrams 9. Object features of SQL-UDTs and sub-types, Tables using UDTs, Inheritance, Method definition 10. Querying the Object-relational database using Objet Query language	
	TOTAL: 60PERIODS

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Course Name: DATABASE DESIGN AND MANAGEMENT LABORATORY		**Course code**: 22AD305			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the database development life cycle	I	K1,K2	1,2,3,4,9,10,11,12	1,2
CO2	Design relational database using conceptual-to-relational mapping, Normalization	II	K3	1,2,3,4,5,9,10,11,12	1,2
CO3	Apply SQL for creation, manipulation and retrieval of data	III	K2,K4	1,2,3,4,9,10,11,12	1,2
CO4	Perform logical reasoning	IV	K5	1,2,3,4,9,10,11,12	1,2
CO5	Design and query object-relational databases	V	K5,K6	1,2,3,4,5,9,10,11,12	1,2

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

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22AD306	ARTIFICIAL INTELLIGENCE LABORATORY	L	T	P	C
		0	0	4	2
Course Objectives:	• To design and implement search strategies • To implement game playing techniques • To implement CSP techniques • To develop systems with logical reasoning • To develop systems with probabilistic reasoning				

PRACTICAL EXERCISES:	**60PERIODS**
1. Implement basic search strategies–8-Puzzle,8-Queensproblem,Cryptarithmetic. 2. Implement A* and memory bounded A*algorithms 3. Implement Minimax algorithm for game playing (Alpha-Betapruning) 4. Solve constraint satisfaction problems 5. Implement propositional model checking algorithms 6. Implementforwardchaining,backwardchaining,andresolutionstrategies 7. Build naïve Bayes models 8. Implement Bayesian networks and perform in ferences 9. Mini-Project	
	TOTAL: 60 PERIODS

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Course Name: ARTIFICIAL INTELLIGENCE LABORATORY					**Course code: 22AD306**
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Design and implement search strategies	I	K1, K2	1,2,3,4,10,11,12	1,2
CO2	Implement game playing and CSP techniques	II	K3	1,2,3,4,5,9,10,11,12	1,2
CO3	Develop logical reasoning systems	III	K2, K4	1,2,3,4,9,10,11,12	1,2
CO4	Develop probabilistic reasoning systems	IV	K5	1,2,3,4,9,10,11,12	1,2
CO5	Implement networks and perform systems	V	K5; K6	1,2,3,4,9,10,11,12	1,2

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

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IV SEMESTER

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22MA404	PROBABILITY AND STATISTICS	L	T	P	C
		3	0	0	3

Course Objectives:

- To acquaint the basic knowledge of probabilities and random variables related to engineering field.
- To acquaint the knowledge of some standard distributions and it help in handling various probability situations in real life.
- To familiarize of various distribution functions and help in acquiring skills in handling situations involving more than one variable.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To familiarize of various design of experiments and it helps in acquiring skills in various practical situations.

UNIT I	PROBABILITY AND RANDOM VARIABLES	9

Probability — Axioms of probability — Conditional probability — Baye's theorem — Discrete and continuous random variables — Moments — Moment generating functions.

UNIT II	STANDARD DISTRIBUTIONS OF RANDOM VARIABLES	9

Discrete distributions: Binomial, Poisson, Geometric, and their properties – Continuous distributions : Uniform, Exponential, Gamma, Normal distributions and their properties.

UNIT III	TWO - DIMENSIONAL RANDOM VARIABLES	9

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables.

UNIT IV	TESTING OF HYPOTHESIS	9

Introduction to probability- Sampling distributions - Estimation of parameters - Statistical hypothesis- Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square.

UNIT V	DESIGN OF EXPERIMENTS	9

One way and two way classifications - Completely randomized design – Randomized block design – Latin square design.

TOTAL: 45 PERIODS

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TEXTBOOKS:	
1	Ibe.O.C., "Fundamentals of Applied Probability and Random Processes", Elsevier, 1st Indian Reprint, 2007
2	S.C., Kapoor V.K., "Fundamentals of Mathematical Statistics"., Sultan Chand & Sons Gupta Twelfth edition., 2014.
REFERENCES:	
1	Yates. R.D. and Goodman. D.J., "Probability and Stochastic Processes", 2nd Edition, Wiley India Pvt. Ltd., Bangalore, 2012.
2	Veerarajan,T "Probability, Statistics and Random with Queueing Theory and Queueing Networks" Tata McGraw-Hill Publishing Company Limited, New Delhi. 3rd Edition, 2010.
3	Miller. S.L. and Childers. D.G., "Probability and Random Processes with Applications to Signal Processing and Communications", Academic Press, 2004
4	Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
5	Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 2004

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Course Name: PROBABILITY AND STATISTICS		Course Code:22MA404			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Solve the basic concepts of probability to solve real-life applications	**I**	K3	1,2,9,12	1,2
CO2	Apply some standard distributions to solve applications oriented problems.	**II**	K3	1,2,9,12	1,2
CO3	Apply two dimensional standard distributions to solve real-life applications.	**III**	K4	1,2,9,12	1,2
CO4	Apply the concept of testing of hypothesis for small and large samples in real life problems.	**IV**	K5	1,2,3,4,9, 12	1,2
CO5	Calculate the basic concepts of classifications of design of experiments in the field of agriculture.	**V**	K5	1,2,3,4 ,9,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	0	0	0	0	0	0	2	0	0	2	-	-
CO2	3	3	0	0	0	0	0	0	2	0	0	2	-	-
CO3	3	3	0	0	0	0	0	0	2	0	0	2	-	-
CO4	3	3	3	2	0	0	0	0	2	0	0	2	-	-
CO5	3	3	2	2	0	0	0	0	2	0	0	2	-	-
CO	3	3	0	0	0	0	0	0	2	0	0	2	-	-

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22CS402	OPERATING SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

- To understand the basics and functions of operating systems.
- To understand Processes and Threads
- To analyze Scheduling algorithms and process synchronization.
- To understand the concept of Deadlocks.
- To analyze various memory management schemes.
- To be familiar with I/O management and File systems.
- To be familiar with the basics of virtual machines and Mobile OS like iOS and Android.



UNIT I	INTRODUCTION	7

Computer System - Elements and organization; Operating System Overview - Objectives and Functions - Evolution of Operating System; Operating System Structures – Operating System Services - User Operating System Interface - System Calls – System Programs - Design and Implementation - Structuring methods.

UNITII	PROCESS MANAGEMENT	11

Processes - Process Concept - Process Scheduling - Operations on Processes - Inter-process Communication; CPU Scheduling - Scheduling criteria - Scheduling algorithms: Threads - Multithread Models – Threading issues; Process Synchronization - The critical-section problem - Synchronization hardware – Semaphores – Mutex - Classical problems of synchronization - Monitors; Deadlock - Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.

UNITIII	MEMORY MANAGEMENT	10

Main Memory - Swapping - Contiguous Memory Allocation – Paging - Structure of the Page Table - Segmentation, Segmentation with paging; Virtual Memory - Demand Paging – Copy on Write - Page Replacement - Allocation of Frames –Thrashing.

UNITIV	STORAGE MANAGEMENT	10

Mass Storage system – Disk Structure - Disk Scheduling and Management; File-System Interface - File concept - Access methods - Directory Structure - Directory organization - File system mounting - File Sharing and Protection; File System Implementation - File System Structure - Directory implementation - Allocation Methods - Free Space Management; I/O Systems – I/O Hardware, Application I/O interface, Kernel I/O subsystem.

UNITV	VIRTUAL MACHINES AND MOBILE OS	7

Virtual Machines – History, Benefits and Features, Building Blocks, Types of Virtual Machines and their Implementations, Virtualization and Operating-System Components; Mobile OS - iOS and Android.

TOTAL:45PERIODS

TEXTBOOKS:	
1	Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 9th Edition, John Wiley and Sons Inc., 2018.
2	Andrew S Tanenbaum, "Modern Operating Systems", Pearson, 4th Edition, New Delhi, 2016.
3	Operating Systems by Garg &Verma Publication Date: 2017
REFERENCES:	
1	Ramaz Elmasri, A. Gil Carrick, David Levine, "Operating Systems – A Spiral Approach", Tata McGraw Hill Edition, 2010
2	William Stallings, "Operating Systems: Internals and Design Principles", 7 th Edition, Prentice Hall, 2018
3	AchyutS.Godbole, AtulKahate, "Operating Systems", McGraw Hill Education, 2016.
4	https://drive.uqu.edu.sa/_/mskhayat/files/MySubjects/2017SS%20Operating%20Systems/Abraham%20Silberschatz-Operating%20System%20Concepts%20(9th,2012_12).pdf

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Course Name: OPERATING SYSTEMS		**Course Code:22CS402**			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Analyze various scheduling algorithms and process synchronization	**I**	K3	1,2,3,4,9,10, 11,12	1,2
CO2	Explain deadlock, prevention and avoidance algorithms.	**II**	K4	1,2,3,4,5,9, 10,11,12	1,2
CO3	Compare and contrast various memory management schemes.	**III**	K4	1,2,3,4,5,9, 10,11,12	1,2
CO4	Explain the functionality of file systems I/O systems, and Virtualization	**IV**	K6	1,2,3,4,5,9, 10,11,12	1,2
CO5	Compare iOS and Android Operating Systems.	**V**	K6	1,2,3,4,5,9, 10, 11,12	1,2

CO-PO-PSO Mapping

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

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22AD401	MACHINE LEARNING	L	T	P	C
		3	0	0	3

Course Objectives:

- To understand the basic concepts of machine learning.
- To understand and build supervised learning models.
- To understand and build unsupervised learning models.
- To understand and build neural networks models.
- To evaluate the algorithms based on corresponding metrics identified

UNIT I	INTRODUCTION TO MACHINE LEARNING	8

Review of Linear Algebra for machine learning; Introduction and motivation for machine learning; Examples of machine learning applications, Vapnik-Chervonenkis (VC) dimension, Probably Approximately Correct (PAC) learning, Hypothesis spaces, Inductive bias, Generalization, Bias variance trade-off.

UNIT II	SUPERVISED LEARNING	11

Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Perceptron algorithm, Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random Forests

UNIT III	ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING	9

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization

UNIT IV	NEURAL NETWORKS	9

Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error backpropagation, from shallow networks to deep networks –Unit saturation (aka the vanishing gradient problem) – ReLU, hyperparameter tuning, batch normalization, regularization, dropout.

UNIT V	DESIGN AND ANALYSIS OF MACHINE LEARNING EXPERIMENTS	8

Guidelines for machine learning experiments, Cross Validation (CV) and resampling – K-fold CV, bootstrapping, measuring classifier performance, assessing a single classification algorithm and comparing two classification algorithms – t test, McNemar's test, K-fold CV paired t test

TOTAL:45PERIODS

TEXTBOOKS:	
1	Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.
2	Stephen Marsland, "Machine Learning: An Algorithmic Perspective, "Second Edition", CRC Press, 2014
3	"Introduction to Machine Learning with Python" by Andreas C. Müller and Sarah Guido was first published in October 2016.
REFERENCES:	
1	Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006
2	Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition, 1997.
3	MehryarMohri, AfshinRostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", Second Edition, MIT Press, 2012, 2018.
4	Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016
5	SebastainRaschka, VahidMirjalili , "Python Machine Learning", Packt publishing, 3rd Edition, 2019.
6	https://ai.stanford.edu/~nilsson/MLBOOK.pdf?utm_source=chatgpt.com

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Course Name: MACHINE LEARNING		Course Code:22AD401			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Explain the basic concepts of machine learning.	**I**	K3	1,2,3,4,9,10,11,12	1,2
CO2	Construct supervised learning models.	**II**	K4	1,2,3,4,5,9,10,11,12	1,2
CO3	Construct unsupervised learning algorithms.	**III**	K4	1,2,3,4,5,9,10,11,12	1,2
CO4	Evaluate and compare different models	**IV**	K4	1,2,3,4,5,9,10,11,12	1,2
CO5	Perform the design and analysis of experiments	**V**	K6	1,2,3,4,5,9,10,11,12	1,2

CO-PO-PSO Mapping

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

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22AD402	FUNDAMENTALS OF DATA SCIENCE AND ANALYTICS	L	T	P	C
		3	0	0	3

Course Objectives:

- To understand the techniques and processes of data science
- To apply descriptive data analytics
- To visualize data for various applications
- To understand inferential data analytics
- To analysis and build predictive models from data



UNIT I	INTRODUCTION TO DATA SCIENCE	7

Need for data science – benefits and uses – facets of data – data science process – setting the research goal – retrieving data – cleansing, integrating, and transforming data – exploratory data analysis – build the models – presenting and building applications.

UNIT II	DESCRIPTIVE ANALYTICS	11

Frequency distributions – Outliers –interpreting distributions – graphs – averages - describing variability – interquartile range – variability for qualitative and ranked data - Normal distributions – z scores –correlation – scatter plots – regression – regression line – least squares regression line – standard error of estimate – interpretation of r2 – multiple regression equations – regression toward the mean.

UNIT III	INFERENTIAL STATISTICS	10

Populations – samples – random sampling – Sampling distribution- standard error of the mean - Hypothesis testing – z-test – z-test procedure –decision rule – calculations – decisions – interpretations - one-tailed and two-tailed tests – Estimation – point estimate – confidence interval – level of confidence – effect of sample size

UNIT IV	ANALYSIS OF VARIANCE	10

t-test for one sample – sampling distribution of t – t-test procedure – t-test for two independent samples – p-value – statistical significance – t-test for two related samples. F-test – ANOVA – Two factor experiments – three f-tests – two-factor

UNIT V	PREDICTIVE ANALYTICS	7

Linear least squares – implementation – goodness of fit – testing a linear model – weighted resampling. Regression using StatsModels – multiple regression – nonlinear relationships – logistic regression – estimating parameters – Time series analysis – moving averages – missing values – serial correlation – autocorrelation. Introduction to survival analysis.

TOTAL:45PERIODS

TEXTBOOKS:	
1	David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016. (first two chapters for Unit I).
2	Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017.
3	Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016
REFERENCES:	
1	Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, 2014.
2	Sanjeev J. Wagh, Manisha S. Bhende, Anuradha D. Thakare, "Fundamentals of Data Science", CRC Press, 2022.
3	"Foundations of Data Science"Authors: Avrim Blum, John Hopcroft, and Ravindran Kannan
4	https://www.cs.cornell.edu/jeh/book.pdf

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Course Name: FUNDAMENTALS OF DATA SCIENCE AND ANALYTICS		Course Code:22AD402			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Explain the data analytics pipeline	**I**	K3	1,2,3,4,5,9,10 ,11,12	1,2
CO2	Describe and visualize data	**II**	K4	1,2,4,5,6,9,10 ,11,12	1,2
CO3	Perform statistical inferences from data	**III**	K4	1,2,3,4,5,6,7, 9,10,11,12	1,2
CO4	Analyze the variance in the data	**IV**	K5	1,2,3,4,5,9,10 ,11,12	1,2
CO5	Build models for predictive analytics	**V**	K6	1,2,3,4,5,9,10 ,11,12	1,2

CO-PO-PSO Mapping

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

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22AD403	COMPUTER COMMUNICATION NETWORKS	L	T	P	C
		3	0	2	4

Course Objectives:

- To understand the concept of layering in networks and Application layer.
- To know the functions of Transport layer and its protocols.
- To learn the functions of Network layer and the various routing protocols
- To learn the flow control, flow control and medium access control.
- To know the basics of signals, the media and switching techniques.

UNIT I	INTRODUCTION AND APPLICATION LAYER	9

Data Communication - Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Introduction to Sockets - Application Layer protocols: HTTP – FTP – Email protocols (SMTP - POP3 - IMAP - MIME) – DNS – SNMP

UNIT II	TRANSPORT LAYER	9

Introduction - Transport-Layer Protocols: UDP – TCP: Connection Management – Flow control - Congestion Control - Congestion avoidance (DECbit, RED) – SCTP – Quality of Service

UNIT III	NETWORK LAYER	9

Network Layer Services - Packet Switching - Internet protocol - IPV4 – IP Addressing – Subnetting - IPV6, ARP, RARP, ICMP, DHCP, Routing Algorithms: Unicast Routing Protocols - Distance Vector Routing - RIP - Link State Routing – OSPF – Path-vector routing - BGP - Multicast Routing: DVMRP – PIM

UNIT IV	DATA LINK LAYER	9

Data Link Layer – Framing – Flow control – Error control – Data-Link Layer Protocols – HDLC – PPP - Media Access Control – Ethernet Basics – CSMA/CD – Virtual LAN – Wireless LAN (802.11)

UNIT V	PHYSICAL LAYER	9

Physical Layer: Data and Signals –Analog and Digital Signals - Performance – Frequency Division Multiplexing – Time Division Multiplexing - Transmission media Guided and Unguided - Switching – Circuit Switching.

TOTAL: 45 PERIODS

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LIST OF EXPERIMENTS:	30 PERIODS
1. Learn to use commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Capture ping and trace route PDUs using a network protocol analyzer and examine. 2. Write a HTTP web client program to download a web page using TCP sockets. 3. Applications using TCP sockets like: a) Echo client and echo server b) Chat 4. Simulation of DNS using UDP sockets. 5. Use a tool like Wireshark to capture packets and examine the packets 6. Write a code simulating ARP /RARP protocols. 7. Study of Network simulator (NS) and Simulation of Congestion Control Algorithms using NS. 8. Study of TCP/UDP performance using Simulation tool. 9. Simulation of Distance Vector/ Link State Routing algorithm. 10. Simulation of an error correction code (like CRC)	
	TOTAL: 75 PERIODS

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TEXTBOOKS:	
1	James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Eighth Edition, Pearson Education, 2021
2	Behrouz A. Forouzan, Data Communications and Networking with TCP/IP Protocol Suite, Sixth Edition TMH, 2022
3	"Computer Networks" by Andrew S. Tanenbaum and David J. Wetheralland published in 1981
REFERENCES:	
1	Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012
2	William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013
3	Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 201
4	Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", McGraw Hill, 2012
5	file:///C:/Users/Lenovo/Downloads/book.pdf

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Course Name: COMPUTER COMMUNICATION NETWORKS		Course Code: 22AD403			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the working of various application layer protocols	**I**	K2	1,2,3,4,9,10, 11,12	1,2
CO2	Understand the basics of Transport layer and its protocols.	**II**	K2	1,2,3,4,5,9,10 ,11,12	1,2
CO3	Understand the working of Network layer, addressing and routing of packets.	**III**	K2	1,2,3,4,5,9, 10,11,12	1,2
CO4	To learn the error control, flow control and medium access control functions of the Datalink layer.	**IV**	K2	1,2,3,4,5,9, 10,11,12	1,2
CO5	To explain the Physical layers and its functions in computer networks.	**V**	K1	1,2,3,4,5,9, 10,11,12	1,2

CO-PO-PSO Mapping

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

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22AD404	DATA SCIENCE AND ANALYTICS LABORATORY	L	T	P	C
		0	0	4	2
Course Objectives:	• To develop data analytic code in python • To be able to use python libraries for handling data • To develop analytical applications using python • To perform data visualization using plots				

LIST OF EXPERIMENTS:	60 PERIODS
1. Working with Pandas data frames 2. Basic plots using Matplotlib 3. Frequency distributions, Averages, Variability 4. Normal curves, Correlation and scatter plots, Correlation coefficient 5. Regression 6. Z-test 7. T-test 8. ANOVA 9. Building and validating linear models 10. Building and validating logistic models 11. Time series analysis	
TOTAL: 60 PERIODS	

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REFERENCES:	
1	Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016
2	Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, 2014.
3	Data Analysis and Visualization Using Python, Analyze Data to Create Visualizations for BI Systems — Dr. Ossama Embarak

Course Name: DATA SCIENCE AND ANALYTICS LABORATORY		**Course Code: 22AD404**			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Explain the data analytics pipeline	**I**	K3	1,2,3,4,5,9,10 ,11,12	1,2
CO2	Describe and visualize data	**II**	K4	1,2,4,5,6,9,10 ,11,12	1,2
CO3	Perform statistical inferences from data	**III**	K4	1,2,3,4,5,6,7, 9,10,11,12	1,2
CO4	Analyze the variance in the data	**IV**	K5	1,2,3,4,5,9,10 ,11,12	1,2
CO5	Build models for predictive analytics	**V**	K6	1,2,3,4,5,9,10 ,11,12	1,2

CO-PO-PSO Mapping

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

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22AD405	MACHINE LEARNING LABORATORY	L	T	P	C
		0	0	4	2
Course Objectives:	• To understand the data sets and apply suitable algorithms for selecting the appropriate features for analysis. • To learn to implement supervised machine learning algorithms on standard datasets and evaluate the performance. • To experiment the unsupervised machine learning algorithms on standard datasets and evaluate the performance. • To build the graph based learning models for standard data sets. • To compare the performance of different ML algorithms and select the suitable one based on the application.				

LIST OF EXPERIMENTS:	**60 PERIODS**
1. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples. 2. 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. 3. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets. 4. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file and compute the accuracy with a few test data sets. 5. Implement naïve Bayesian Classifier model to classify a set of documents and measure the accuracy, precision, and recall. 6. Write a program to construct a Bayesian network to diagnose CORONA infection using standard WHO Data Set. 7. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using the k-Means algorithm. Compare the results of these two algorithms. 8. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. 9. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select an appropriate data set for your experiment and draw graphs.	
	TOTAL: 60 PERIODS

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Course Name: MACHINE LEARNING LABORATORY		**Course Code: 22AD405**			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Apply suitable algorithms for selecting the appropriate features for analysis.	**I**	K3	1,2,3,4,9,10,11,12	1,2
CO2	Implement supervised machine learning algorithms on standard datasets and evaluate the performance.	**II**	K4	1,2,3,4,5,9,10,11,12	1,2
CO3	Apply unsupervised machine learning algorithms on standard datasets and evaluate the performance.	**III**	K4	1,2,3,4,5,9,10,11,12	1,2
CO4	Build the graph based learning models for standard datasets.	**IV**	K4	1,2,3,4,5,9,10,11,12	1,2
CO5	Assess and compare the performance of different ML algorithms and select the suitable one based on the application.	**V**	K6	1,2,3,4,5,9,10,11,12	1,2

CO-PO-PSO Mapping

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

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22CS404	OPERATING SYSTEM LABORATORY	L	T	P	C
		0	0	4	2
Course Objectives:	• To analyze Scheduling algorithms and process synchronization. • To understand the concept of Deadline. • To analyze various memory management ans file systems. • To be familiar with I/O management and File systems. • To be familiar with the basics of virtual machines and Mobile OS like iOS an Android.				

LIST OF EXPERIMENTS:	**60 PERIODS**
1. Installation of Operating system : Windows/ Linux 2. Illustrate UNIX commands and Shell Programming 3. Process Management using System Calls : Fork, Exec, Getpid, Exit, Wait, Close 4. Write C programs to implement the various CPU Scheduling Algorithms 5. Illustrate the inter process communication strategy 6. Implement mutual exclusion by Semaphores 7. Write a C program to avoid Deadlock using Banker's Algorithm 8. Write a C program to Implement Deadlock Detection Algorithm 9. Write C program to implement Threading 10. Implement the paging Technique using C program	
	TOTAL: 60 PERIODS

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Course Name: OPERATING SYSTEMS LABORATORY		Course Code: 22CS404			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Analyze various scheduling algorithms and process synchronization	**I**	K3	1,2,3,4,9,10, 11,12	1,2
CO2	Explain deadlock, prevention and avoidance algorithms.	**II**	K4	1,2,3,4,5,9, 10,11,12	1,2
CO3	Compare and contrast various memory management schemes.	**III**	K4	1,2,3,4,5,9, 10,11,12	1,2
CO4	Explain the functionality of file systems I/O systems, and Virtualization	**IV**	K6	1,2,3,4,5,9, 10,11,12	1,2
CO5	Compare iOS and Android Operating Systems.	**V**	K6	1,2,3,4, 5,9,10, 11,12	1,2

CO-PO-PSO Mapping

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

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V SEMESTER

SYLLABUS

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22AD501	DEEP LEARNING	L	T	P	C
		3	0	2	4

Course Objectives:

- To understand thebasics of deep neural networks (DNN)
- To understand Convolutional Neural Networks(CNN)
- To understand the Recurrent Neural Networks(RNN)
- To understand the Long Short-Term Memory (LSTM)
- To learn the Autoencoders(AE)

UNITI DEEP LEARNING BASICS — **9**

Challenges in Machine Learning: Capacity – Overfitting and Underfitting – StochasticGradient Descent, Motivating Deep Learning: The Curse of Dimensionality – Local Constancy and Smoothness, Manifold Learning, Introduction to Deep Learning Networks – Applications – Deep Feedforward Network - Example – Learning XOR

UNITII CONVOLUTIONAL NEURAL NETWORKS(CNN) — **9**

Convolution Operation -- Sparse Interactions -- Parameter Sharing -- Equivariance -- Pooling -- Convolution Variants: Strided -- Tiled -- Transposed and dilated convolutions.

UNITIII RECURRENT NEURAL NETWORKS(RNN) — **9**

Unfolding Graphs -- RNN Design Patterns: Acceptor -- Encoder --Transducer; Gradient Computation -- Sequence Modelling Conditioned on Contexts -- Bidirectional RNN -- Sequence to Sequence RNN – Deep Recurrent Networks -- Recursive Neural Networks – The challenge of Long-Term Dependencies – Echo State Networks

UNITIV LONG SHORT-TERM MEMORY (LSTM) — **9**

Leaky Units: Skip connections and dropouts – The Long short – Term Memory: LSTM model, Other gated RNNs – Optimization for long-Term Dependencies – Explicit Memory.

UNITV AUTOENCODERS(AE) — **9**

Undercomplete autoencoders - Regularized autoencoders - Stochastic encoders and decoders – Denoising Autoencoders – Learning manifolds with auto encoders – Contractive auto encoders – Predictive Sparse Decomposition.

TOTAL:45PERIODS

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Course Name: DEEP LEARNING	Course Code: 22AD501

LIST OF EXPERIMENTS:

1. Solving XOR problem using Deep Feedforward Networks
2. Effect of Learning Rate and Batch size on SGD
3. ImageClassification using CNN
4. Convolution Variants: Strided and Dilated Convolutions
5. Sentiment Classification using LSTM
6. Bidirectional RNN for Language Modeling
7. LSTM for Time Series Forecasting
8. Denoising Autoencoder for image noise removal
9. Contractive vs Denoising Autoencoder Comparison

TOTAL: 75 PERIODS

TEXT BOOKS:

1	Ian Goodfellow, YoshuaBengio, Aaron Courville, ``Deep Learning", MIT Press, 2016
2	Andrew Glassner, "Deep Learning: A Visual Approach", No Starch Press, 2021

REFERENCES:

1	Salman Khan, Hossein Rahmani, Syed Afaq Ali Shah, Mohammed Bennamoun, ``A Guide to Convolutional Neural Networks for Computer Vision", Synthesis Lectures on Computer Vision, Morgan & Claypool publishers, 2018
2	Yoav Goldberg, ``Neural Network Methods for Natural Language Processing", Synthesis Lectures on Human Language Technologies, Morgan & Claypool publishers, 2017
3	Francois Chollet, ``Deep Learning with Python", Manning Publications Co, 2018
4	Charu C. Aggarwal, ``Neural Networks and Deep Learning: A Textbook", Springer International Publishing, 2018
5	Josh Patterson, Adam Gibson, ``Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017.

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CourseName:DEEP LEARNING		Course Code:22AD501			
CO	**CourseOutcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the basics of Deep Learning	**I**	K1	1,2,3,4,5,9, 10,11,12	1,2
CO2	Apply Convolution Neural Network for image processing	**II**	K2, K3	1,2,3,4,5,9, 10,11,12	1,2
CO3	Apply Recurrent Neural Network and its variants for text analysis	**III**	K2, K3	1,2,3,4,5, 9,10,11,1 2	1,2
CO4	Apply Long short-term memory(LSTM) for various applications	**IV**	K2, K3, K4	1,2,3,4,5,9, 10,11,12	1,2
CO5	Apply autoencoder modelsfor suitable applications.	**V**	K2, K3, K6	1,2,3,4 ,5,9,10 ,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	1	-	-	-	2	3	1	2	3	3
CO2	2	2	2	3	3	-	-	-	1	2	2	3	1	1
CO3	3	3	3	3	3	-	-	-	2	1	1	2	2	1
CO4	3	3	1	1	1	-	-	-	1	3	1	3	2	1
CO5	3	2	2	2	3	-	-	-	2	3	2	2	2	3
CO	2.8	2.4	2	2.4	2.	-	-	-	1.6	2.4	1.4	2.4	2	1.8

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22AD502	BIG DATA ANALYTICS	L	T	P	C
		2	0	2	3

Course Objectives:

- To understand big data.
- To learn and use NoSQL big data management.
- To learn mapreduce analytics using Hadoop and related tools.
- To work with map reduce applications
- To understand the usage of Hadoop related tools for Big Data Analytics

UNIT I	UNDERSTANDING BIG DATA	6

Introduction to big data – convergence of key trends – unstructured data – industry examples of big data – web analytics – big data applications– big data technologies – introduction to Hadoop – open 87 source technologies – cloud and big data – mobile business intelligence – Crowd sourcing analytics – inter and trans firewall analytics.

UNIT II	NOSQL DATA MANAGEMENT	6

Introduction to NoSQL – aggregate data models – key-value and document data models – relationships – graph databases – schemaless databases – materialized views – distribution models – master-slave replication – consistency - Cassandra – Cassandra data model – Cassandra examples – Cassandra clients

UNIT III	BASICS OF HADOOP	6

Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes – design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow – Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures - Cassandra – Hadoop integration.

UNIT IV	MAP REDUCE APPLICATIONS	6

MapReduce workflows – unit tests with MRUnit – test data and local tests – anatomy of MapReduce job run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN – job scheduling – shuffle and sort – task execution – MapReduce types – input formats – output formats.

UNIT V	HADOOP RELATED TOOLS	6

Hbase – data model and implementations – Hbase clients – Hbase examples – praxis. Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts. Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQL queries.

TOTAL:30PERIODS

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Course Name:BIG DATA ANALYTICS	**Course Code:22AD502**

LIST OF EXPERIMENTS: 30 PERIODS

1. Downloading and installing Hadoop; Understanding different Hadoop modes. Startup scripts, Configuration files.
2. Hadoop Implementation of file management tasks, such as Adding files and directories, retrieving files and Deleting files
3. Implement of Matrix Multiplication with Hadoop Map Reduce
4. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.
5. Installation of Hive along with practice examples.
7. Installation of HBase, Installing thrift along with Practice examples
8. Practice importing and exporting data from various databases.

TOTAL:60PERIODS

TEXTBOOKS:

1	Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013
2	Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
3	Sadalage, Pramod J. "NoSQL distilled", 2013

REFERENCES:

1	E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012
2	Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
3	Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.
4	Alan Gates, "Programming Pig", O'Reilley, 2011.

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Course Name:BIG DATA ANALYTICS		Course Code:22AD502			
CO	**CourseOutcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Describe big data and use cases from selected business domains.	**I**	K3	1,2,3,4,5,9,10 ,11,12	1,2
CO2	Explain NoSQL big data management.	**II**	K4	1,2,4,5,6,9,10 ,11,12	1,2
CO3	Install, configure, and run Hadoop and HDFS.	**III**	K4	1,2,3,4,5,6,7, 9,10,11,12	1,2
CO4	Perform map-reduce analytics using Hadoop.	**IV**	K5	1,2,3,4,5,9,10 ,11,12	1,2
CO5	Use Hadoop-related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.	**V**	K6	1,2,3,4,5,9,10 ,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	-	-	-	2	2	3	1	1	3
CO2	3	3	2	3	2	-	-	-	2	2	3	3	2	3
CO3	3	3	3	2	3	-	-	-	2	2	1	2	2	3
CO4	2	3	3	3	3	-	-	-	2	2	3	2	3	3
CO5	3	3	3	3	3	-	-	-	3	1	3	2	2	3
CO	2.8	3	2.8	2.8	2.8	-	-	-	2.2	1.8	2.6	2	2.2	2.6

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22AD503	OBJECT ORIENTED PROGRAMMING USING JAVA	L	T	P	C
		3	0	0	3

Course Objectives:

- To understand Object Oriented Programming concepts and basics of Java programming language
- To know the principles of packages, inheritance and interfaces
- To develop a java application with threads and generics classes
- To define exceptions and use I/O streams
- To design and build Graphical User Interface Application using JAVAFX

UNIT I	INTRODUCTION TO OOP AND JAVA	9

Overview of OOP – Object oriented programming paradigms – Features of Object Oriented Programming – Java Buzzwords – Overview of Java – Data Types, Variables and Arrays – Operators – Control Statements – Programming Structures in Java – Defining classes in Java – Constructors-Methods -Access specifiers - Static members- JavaDoc comments

UNITII	INHERITANCE, PACKAGES AND INTERFACES	9

Overloading Methods – Objects as Parameters – Returning Objects –Static, Nested and Inner Classes. Inheritance: Basics– Types of Inheritance -Super keyword -Method Overriding – Dynamic Method Dispatch –Abstract Classes – final with Inheritance. Packages and Interfaces: Packages – Packages and Member Access –Importing Packages – Interfaces.

UNITIII	EXCEPTION HANDLING AND MULTITHREADING	9

Exception Handling basics – Multiple catch Clauses – Nested try Statements – Java's Built-in Exceptions – User defined Exception. Multithreaded Programming: Java Thread Model–Creating a Thread and Multiple Threads – Priorities – Synchronization – Inter Thread Communication- Suspending –Resuming, and Stopping Threads –Multithreading. Wrappers – Auto boxing.

UNITIV	I/O, GENERICS, STRING HANDLING	9

I/O Basics – Reading and Writing Console I/O – Reading and Writing Files. Generics: Generic Programming – Generic classes – Generic Methods – Bounded Types – Restrictions and Limitations. Strings: Basic String class, methods and String Buffer Class.

UNITV	JAVAFX EVENT HANDLING	9

JAVAFX Events and Controls: Event Basics – Handling Key and Mouse Events. Controls: Checkbox, ToggleButton – RadioButtons – ListView – ComboBox – ChoiceBox – Text Controls – ScrollPane. Layouts – FlowPane – HBox and VBox – BorderPane – StackPane – GridPane. Menus – Basics – Menu – Menu bars – MenuItem.

TOTAL:45PERIODS

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TEXTBOOKS:	
1	Herbert Schildt, "Java: The Complete Reference", 11 th Edition, McGraw Hill Education, New Delhi, 2019
2	Herbert Schildt, "Introducing JavaFX 8 Programming", 1 st Edition, McGraw Hill Education, New Delhi, 2015
3	"Thinking in Java" Author: Bruce Eckel
REFERENCES:	
1	Cay S. Horstmann, "Core Java Fundamentals", Volume 1, 11 th Edition, Prentice Hall, 2018.
2	"Effective Java" Author: Joshua Bloch
3	"Java: How to Program" Authors: Paul Deitel and Harvey Deitel
4	https://www.ms.sapientia.ro/~manyi/teaching/oop/oop_java.pdf

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CourseName: OBJECT ORIENTED PROGRAMMING USING JAVA		Course Code: 22AD503			
CO	**CourseOutcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Apply the concepts of classes and objects to solve simple problems	**I**	K1,K2	1,2,3,4,6,9,10, 11,12	1,2
CO2	Develop programs using inheritance, packages and interfaces.	**II**	K3	1,2,3,4,5,6,9,1 0,11,12	1,2
CO3	Make use of exception handling mechanisms and multi threaded model to solve real world problems.	**III**	K2,K4	1,2,3,4,5,6,9,1 0,11,12	1,2
CO4	Build Java applications with I/O packages, string classes, Collections and generics concepts.	**IV**	K5	1,2,3,4,6,9,10, 11,12	1,2
CO5	Integrate the concepts of event handling and JavaFX components and controls for developing GUI based applications.	V	K7	1,2,3,4,5,6,10, 11,12	1,2

CO-PO-PSO Mapping

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

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22EC408	EMBEDDED SYSTEMS AND IOT	L	T	P	C
		3	0	2	4

Course Objectives:

- To learn the internal architecture and programming of an embedded processor.
- To introduce interfacing, I/O devices to the processor.
- To introduce the evolution of the Internet of Things (IoT).
- To build a small low-cost embedded and IoT system using Arduino/Raspberry Pi/ open platform.
- To apply the concept of Internet of Things in real world scenario.

UNIT I	8-BIT EMBEDDED PROCESSOR	9

8-Bit Microcontroller – Architecture – Instruction Set and Programming – Programming Parallel Ports – Timers and Serial Port – Interrupt Handling

UNIT II	EMBEDDED C PROGRAMMING	9

Memory And I/O Devices Interfacing – Programming Embedded Systems in C – Need For RTOS – Multiple Tasks and Processes – Context Switching – Priority Based Scheduling Policies.

UNIT III	IOT AND ARDUINO PROGRAMMING	9

Introduction to the Concept of IoT Devices – IoT Devices Versus Computers – IoT Configurations – Basic Components – Introduction to Arduino – Types of Arduino – Arduino Toolchain – Arduino Programming Structure – Sketches – Pins – Input/Output From Pins Using Sketches – Introduction to Arduino Shields – Integration of Sensors and Actuators with Arduino.

UNIT IV	IOT COMMUNICATION AND OPEN PLATFORMS	9

IoT Communication Models and APIs – IoT Communication Protocols – Bluetooth – WiFi – ZigBee – GPS – GSM modules – Open Platform (like Raspberry Pi) – Architecture – Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.

UNIT V	APPLICATIONS DEVELOPMENT	9

Complete Design of Embedded Systems – Development of IoT Applications – Home Automation – Smart Agriculture – Smart Cities – Smart Healthcare.

TOTAL: 45 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
1. Write 8051 Assembly Language experiments using simulator. 2. Test data transfer between registers and memory. 3. Perform ALU operations. 4. Write Basic and arithmetic Programs Using Embedded C. 5. Introduction to Arduino platform and programming 6. Explore different communication methods with IoT devices (Zigbee, GSM,Bluetooth) 7. Introduction to Raspberry PI platform and python programming 8. Interfacing sensors with RaspberryPI 9. Communicate between Arduino and RaspberryPI using any wireless medium 10. Setup a cloud platform to log the data 11. Log Data using RaspberryPI and upload to the cloud platform 12. Design an IOT based system
TOTAL : 75 PERIODS

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Course Name: EMBEDDED SYSTEMS AND IOT	**Course Code: 22EC408**
TEXT BOOKS:	
1	Muhammed Ali Mazidi,Janice Gillispie Mazidi,RolinD.McKinlay,"The 8051 Microcontroller and Embedded Systems", Pearson Education, Second Edition, 2014
2	Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.
3	Wayne Wolf, "Computers as Components: Principles of Embedded Computer System Design", Elsevier, 2006.
REFERENCES:	
1	Michael J. Pont, "Embedded C", Pearson Education, 2007
2	Andrew N Sloss, D. Symes, C. Wright, "Arm System Developer's Guide", Morgan Kauffman/ Elsevier, 2006.
3	Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015
4	https://dlib.hust.edu.vn/bitstream/HUST/21763/1/OER000001386-1.pdf

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Course Name: EMBEDDED SYSTEMS AND IOT		Course Code: 22EC408			
CO	**CourseOutcomes**	Unit	K-CO	POs	PSOs
CO1	Explain the architecture of embedded processors.	**I**	K1,K2	1,2,3,4,6,9, 10,11,12	1,2
CO2	Write embedded C programs.	**II**	K3	1,2,3,4,5,6, 9,10,11,12	1,2
CO3	Design simple embedded applications.	**III**	K2,K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Compare the communication models in IOT	**IV**	K5	1,2,3,4,6,9, 10,11,12	1,2
CO5	Design IoT applications using Arduino/Raspberry Pi /open platform.	**V**	K7	1,2,3,4,5,6, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-	-	-	-	1	2	3	3	2	1
CO2	2	1	3	2	2	-	-	-	1	2	2	3	3	1
CO3	3	1	3	3	1	-	-	-	1	2	1	1	1	3
CO4	3	2	3	2	1	-	-	-	1	2	2	3	2	2
CO5	2	3	3	2	2	-	-	-	1	3	3	2	3	1
CO	2.6	2	3	2.4	1.5	-	-	-	1	2.2	2.2	2.4	2.2	1.6

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22AD504	COURSE NAME: OBJECT ORIENTED PROGRMMING USING JAVA LABORATORY	L	T	P	C
		0	0	4	2
Course Objectives:	• To build software development skills using java programming for real-world applications. • To understand and apply the concepts of classes, packages, interfaces, inheritance, exception handling and file processing. • To develop applications using generic programming and event handling				

LIST OF EXPERIMENTS:	60 PERIODS

1.Solve problems by using sequential search, binary search, and quadratic sorting algorithms (selection, insertion)

2. Develop stack and queue data structures using classes and objects.

3. Develop a java application with an Employee class with Emp_name, Emp_id, Address, Mail_id, Mobile_no as members. Inherit the classes, Programmer, Assistant Professor, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of
BP as PF, 0.1% of BP for staff club funds. Generate pay slips for the employees with their gross and net salary.

4. Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named printArea(). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method printArea( ) that prints the area of the given shape.

5. Solve the above problem using an interface.

6. Implement exception handling and creation of user defined exceptions.

7. Write a java program that implements a multi-threaded application that has three threads. First thread generates a random integer every 1 second and if the value is even, the second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of the cube of the number.

8. Write a program to perform file operations.

9. Develop applications to demonstrate the features of generics classes.

10. Develop applications using JavaFX controls, layouts and menus.

11. Develop a mini project for any application using Java concepts.

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Course Name: OBJECT ORIENTED PROGRMMING USING JAVA LABORATORY		Course Code:22AD504			
CO	**CourseOutcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Design and develop java programs using object oriented programming concepts	**I**	K3	1,2,3,4,5,9,10 ,11,12	1,2
CO2	Develop simple applications using object oriented concepts such as package, exceptions	**II**	K4	1,2,4,5,6,9,10 ,11,12	1,2
CO3	Implement multithreading, and generics concepts	**III**	K4	1,2,3,4,5,6,7, 9,10,11,12	1,2
CO4	Create GUIs and event driven programming applications for real world problems	**IV**	K5	1,2,3,4,5,9,10 ,11,12	1,2
CO5	Implement and deploy web applications using Javav	**V**	K6	1,2,3,4,5,9,10 ,11,12	1,2

CO-PO-PSO Mapping

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

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VI SEMESTER

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22CS502	MOBILE APP DEVELOPMENT	L	T	P	C
		3	0	0	3

Course Objectives:

- To understand the concept of Variables, constants and Datatypes.
- To understand the concept of functions and data structures.
- To understand the concept of Class and Structure.
- To understand the concept of SwiftUI and Auto Layout.
- To develop realtime swift applications.

UNIT I	INTRODUCTION TO PROGRAMMING AND SWIFT BASICS	9

Introduction to Programming, Introduction to Swift Programming - Setting up a development environment (Xcode), Swift Basics – Variables-Constants, Introduction to Data types - Strings and Numbers, Booleans, String functions, Introduction to Data structures - Arrays, Dictionaries, sets and enum.Realtime Project #1 - Task App with Local Data Storage

UNIT II	INTRODUCTION TO SWIFTUI	9

Introduction to Declarative Programming - Difference between Imperative and Declarative Programming - Comparision between UIKit and SwiftUI approaches to UI Design, Overview of the SwiftUI framework - Understanding the basic structure of a SwiftUI App, Forms, Navigation, Modifying Program state, Binding state to user interface controls and creating views in a loop.Realtime Project #2 - Places App with JSON Data Storage

UNIT III	CONTROL FLOW, OPERATORS AND FUNCTIONS	9

Control Flow - If statements and conditional control - Switch Statements, Basic Arithmetic Operators- Comparison and logical operators- Assignment operators, Advanced Operators - Bitwise operators - Compound assignment operators, Introduction to Loops - For and While Loops, Introduction to Functions - Function definition, parameters and return values.Realtime Project #3 - Student List App with JSON Storage

UNIT IV	CLASS, STRUCTURE AND INSTANCES	9

Introduction to Classes - Classes, Structures - Instances - Instance Methods - Classes and Inheritance. Creation of Custom Types. Introduction to Structs and Tuple - Mutating Methods, Property Observers. Introduction to Access Control - Static Property and Methods.Realtime Project #4 - E-Commerce App with Standard APIs

UNIT V	USING SWIFT AND SWIFTUI TO CREATE AN APP	9

Overview of App Creation - Requirements, Design, Development, testing and release process. App Development work flow - Swift, SwiftUI, XCode, Apple Developer Program and App Store. Basics of Trouble Shooting - Bugs and Debugging, Coding Best Practices, Code Analysis, Building and Release.Capstone Project - Project defined by Industry, Department or Team.

TOTAL: 45 PERIODS

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22CS505	MOBILE APP DEVELOPMENT LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

- To understand the concept of Variables, constants and Data types.
- To understand the concept of functions and data structures.
- To understand the concept of Class and Structure.
- To understand the concept of SwiftUI and Auto Layout.
- To develop realtime swift applications.

LIST OF EXPERIMENTS

1. Create a program to initialize and print variable and constant.
2. Create a Program to Initialize a String and Perform Basic String Manipulations
3. Create a Program to Initialize a Boolean Variable and Use It in a Logic
4. Create a Mutable List and Set and Add an Item in Them
5. Create a Mutable Map and Add, Set, and Remove Items from the Map
6. Write a code to show the functions of 5 binary operators
7. Code to showcase range and in and not in operators
8. Create a code to showcase operator overloading
9. Create a Class for Student with Attributes and Functions, and Print the Object
10. Create a class and subclass to showcase the concept of inheritance
11. Create a class to showcase the concept of Encapsulation.
12. Create a sample code to showcase the concept of Polymorphism
13. Create a sample code to showcase the concept of Abstraction
14. Create Two Functions with Two Parameters and Return Value in Swift
15. Create a code to showcase for loop and while loop

TOTAL: 45 PERIODS

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22CS505	MOBILE APP DEVELOPMENT LABORATORY
TEXT BOOKS:	
1	Neil Smyth, "iOS 15 Programming for Beginners", 1st Edition, Payload Media, 2021
2	Matt Neuburg, "iOS 15 Programming Fundamentals with Swift", 8th Edition, O'Reilly Media, 2022
3	Raywenderlich Tutorial Team, "SwiftUI by Tutorials: Declarative App Development on iOS", 4th Edition, Razeware LLC, 2021
REFERENCES:	
1	Develop in Swift Fundamentals, Apple Education, https://books.apple.com/in/book/develop-in-swift- fundamentals/id1581182804
2	Fahim Farook, "iOS Development with Swift", 1st Edition, Apress, 2019
3	Head First Swift, O'Reilly Media, https://books.apple.com/us/book/head-first-swift/id1600495158
4	SwiftUI Cookbook, Packt, Publishing, https://books.apple.com/us/book/swiftui-cookbook/id1525046427

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Course Name: MOBILE APP DEVELOPMENT LABORATORY		Course code: 22CS505			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Demonstrate knowledge on Swift Basics - Variables, Constants and Data Types.	I	K4	1,2,3,4,5,11, 12	1,2
CO2	Demonstrate knowledge on Swift Data Structures and Control Flows.	II	K5	1,2,3,4,5,11, 12	1,2
CO3	Develop Swift programs using Classes, Structs and Functions	III	K6	1,2,3,4,5,11	1,2
CO4	Develop App UI using SwiftUI Components	IV	K6	1,2,4,5,11	1,2
CO5	Develop Apps using Swift, Swift UI and Xcode and Develop Apps for Apple App Store and for worldwide users	V	K6	1,2,4,5,11	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	-	-	-	-	-	2	2	3	2
CO2	3	3	3	3	2	-	-	-	-	-	2	2	3	2
CO3	3	3	2	3	2	-	-	-	-	-	2	-	3	2
CO4	3	2	-	2	2	-	-	-	-	-	1	-	3	3
CO5	3	2	-	-	1	-	-	-	-	-	1	-	2	3
CO	3	2.6	2.6	2.8	1.8						1.6	2	2.8	2.4

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B.TECH

ARTIFICIAL INTELLIGENCE

& DATA SCIENCE

VERTICALS

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PROFESSIONAL ELECTIVE COURSES

VERTICALS

VERTICAL 1: DATA SCIENCE

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22ADV101	Knowledge Engineering	PE	2	0	2	4	3
2.	22ADV102	Recommender Systems	PE	2	0	2	4	3
3.	22ADV103	Exploratory Data Analysis	PE	2	0	2	4	3
4.	22ADV104	Text and Speech Analysis	PE	2	0	2	4	3
5.	22ADV105	Business Analytics	PE	2	0	2	4	3
6.	22ADV106	Image and Video Analytics	PE	2	0	2	4	3
7.	22ADV107	Computer Vision	PE	2	0	2	4	3
8.	22ADV108	Data Warehousing and Data Mining	PE	2	0	2	4	3

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22ADV101	KNOWLEDGE ENGINEERING	L	T	P	C
		2	0	2	3

Course Objectives:

- To understand the basics of Knowledge Engineering.
- To discuss methodologies and modeling for Agent Design and Development.
- To design and develop ontologies.
- To apply reasoning with ontologies and rules.
- To understand learning and rule learning.

UNIT I	REASONING UNDER UNCERTAINTY	9

Introduction – Abductive reasoning – Probabilistic reasoning: Enumerative Probabilities – Subjective Bayesian view – Belief Functions – Baconian Probability – Fuzzy Probability – Uncertainty methods - Evidence-based reasoning – Intelligent Agent – Mixed-Initiative Reasoning – Knowledge Engineering

UNIT II	METHODOLOGY AND MODELING	9

Conventional Design and Development – Development tools and Reusable Ontologies – Agent Design and Development using Learning Technology – Problem Solving through Analysis and Synthesis – Inquiry-driven Analysis and Synthesis – Evidence-based Assessment – Believability Assessment – Drill-Down Analysis, Assumption-based Reasoning, and What-If Scenarios.

UNIT III	ONTOLOGIES – DESIGN AND DEVELOPMENT	9

Concepts and Instances – Generalization Hierarchies – Object Features – Defining Features – Representation – Transitivity – Inheritance – Concepts as Feature Values – Ontology Matching. Design and Development Methodologies – Steps in Ontology Development – Domain Understanding and Concept Elicitation – Modelling-based Ontology Specification.

UNIT IV	REASONIING WITH ONTOLOGIES AND RULES	9

Production System Architecture – Complex Ontology-based Concepts – Reduction and Synthesis rules and the Inference Engine – Evidence-based hypothesis analysis – Rule and Ontology Matching – Partially Learned Knowledge – Reasoning with Partially Learned Knowledge.

UNIT V	LEARNING AND RULE LEARNING	9

Machine Learning – Concepts – Generalization and Specialization Rules – Types – Formal definition of Generalization. Modelling, Learning and Problem Solving – Rule learning and Refinement – Overview – Rule Generation and Analysis – Hypothesis Learning.

TOTAL: 45 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
1. Perform operations with Evidence Based Reasoning 2. Perform Evidence based Analysis. 3. Perform operations on Probability Based Reasoning. 4. Perform Believability Analysis. 5. Implement Rule Learning and refinement. 6. Perform analysis based on learned patterns. 7. Construction of Ontology for a given domain.
TOTAL : 75 PERIODS

TEXT BOOKS:	
1	Gheorghe Tecuci, Dorin Marcu, Mihai Boicu, David A. Schum, Knowledge Engineering Building Cognitive Assistants for Evidence-based Reasoning, Cambridge University Press, First Edition, 2016. (Unit 1 – Chapter 1 / Unit 2 – Chapter 3,4 / Unit 3 – Chapter 5, 6 / Unit 4 - 7 , Unit 5 – Chapter 8, 9)
REFERENCES:	
1	Ronald J. Brachman, Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.
2	Ela Kumar, Knowledge Engineering, I K International Publisher House, 2018.
3	John F. Sowa: Knowledge Representation: Logical, Philosophical, and Computational Foundations, Brooks/Cole, Thomson Learning, 2000.
4	King , Knowledge Management and Organizational Learning , Springer, 2009.

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Course Name: KNOWLEDGE ENGINEERING		Course Code: 22ADV101			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the basics of Knowledge Engineering.	**I**	K1,K2	1,2,3,4,6,9, 10,11	1,2
CO2	Apply methodologies and modelling for Agent Design and Development.	**II**	K3,K4	1,2,3,4,5,6, 9,11,12	1,2
CO3	Design and develop ontologies.	**III**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Apply reasoning with ontologies and rules.	**IV**	K5	1,2,3,4,6,9, 10, 11,12	1,2
CO5	Understand learning and rule learning.	**V**	K1,K2	1,2,4,5,6,1 0, 11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	1	1	-	-	1	2	1	2	1	1
CO2	3	2	3	2	2	-	-	-	2	1	2	1	3	3
CO3	2	2	3	2	2	-	-	-	3	2	2	2	3	2
CO4	2	2	3	1	1	-	-	-	2	2	2	2	2	1
CO5	2	2	2	1	1	-	-	-	2	1	1	1	2	1
CO	2.4	1.8	2.4	1.4	1.4	0.2	0	0	2	1.6	1.6	1.6	2.2	1.6

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22ADV102	RECOMMENDER SYSTEMS	L	T	P	C
		2	0	2	3

Course Objectives:

- To understand the foundations of the recommender system.
- To learn the significance of machine learning and data mining algorithms for Recommender systems
- To learn about collaborative filtering
- To make students design and implement a recommender system.
- To learn collaborative filtering.

UNIT I	INTRODUCTION	6

Introduction and basic taxonomy of recommender systems - Traditional and non-personalized Recommender Systems - Overview of data mining methods for recommender systems- similarity measures- Dimensionality reduction – Singular Value Decomposition (SVD)

Suggested Activities:

- Practical learning – Implement Data similarity measures.
- External Learning – Singular Value Decomposition (SVD) applications

Suggested Evaluation Methods:

- Quiz on Recommender systems.
- Quiz of python tools available for implementing Recommender systems

UNIT II	CONTENT-BASED RECOMMENDATION SYSTEMS	6

Methods for learning user profiles, Similarity-based retrieval, and Classification algorithms.

Suggested Activities:

- Assignment on content-based recommendation systems
- Assignment of learning user profiles

Suggested Evaluation Methods:

- Quiz on similarity-based retrieval.
- Quiz of content-based filtering

UNIT III	COLLABORATIVE FILTERING	6

A systematic approach, Nearest-neighbor collaborative filtering (CF), user-based and item-based CF, components of neighborhood methods (rating normalization, similarity weight computation, and neighborhood selection

Suggested Activities:

- Practical learning – Implement collaborative filtering concepts

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• Assignment of security aspects of recommender systems Suggested Evaluation Methods: • **Quiz on collaborative filtering** • Seminar on security measures of recommender systems		
UNIT IV	**ATTACK-RESISTANT RECOMMENDER SYSTEMS**	**6**
Introduction – Types of Attacks – Detecting attacks on recommender systems – Individual attack – Group attack – Strategies for robust recommender design - Robust recommendation algorithms. **Suggested Activities:** • Group Discussion on attacks and their mitigation • Study of the impact of group attacks • External Learning – Use of CAPTCHAs **Suggested Evaluation Methods:** • Quiz on attacks on recommender systems • Seminar on preventing attacks using the CAPTCHAs		
UNIT V	**EVALUATING RECOMMENDER SYSTEMS**	**6**
Evaluating Paradigms – User Studies – Online and Offline evaluation – Goals of evaluation design – Design Issues – Accuracy metrics – Limitations of Evaluation measures **Suggested Activities:** • Group Discussion on goals of evaluation design • Study of accuracy metrics **Suggested Evaluation Methods:** • Quiz on evaluation design • Problems on accuracy measures		
		TOTAL: 30PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
1. Implement Data similarity measures using Python
2. Implement dimension reduction techniques for recommender systems
3. Implement user profile learning
4. Implement content-based recommendation systems
5. Implement collaborative filter techniques
6. Create an attack for tampering with recommender systems
7. Implement accuracy metrics like Receiver Operated Characteristic curves
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Charu C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.
2	Dietmar Jannach , Markus Zanker , Alexander Felfernig and Gerhard Friedrich, Recommender Systems: An Introduction, Cambridge University Press (2011), 1st ed.
3	Francesco Ricci , Lior Rokach , Bracha Shapira , Recommender Sytems Handbook, 1st ed, Springer (2011),
4	Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of massive datasets, 3rd edition, Cambridge University Press, 2020.v

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Course Name: RECOMMENDER SYSTEMS		Course Code: 22ADV102			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the basic concepts of recommender systems.	**I**	K1,K2	1,2,3,4,6,9, 10,11	1,2
CO2	Implement machine-learning and data-mining algorithms in recommender systems data sets.	**II**	K3,K4	1,2,3,4,5,6, 9,11,12	1,2
CO3	Implementation of Collaborative Filtering in carrying out performance evaluation of recommender systems based on various metrics.	**III**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Design and implement a simple recommender system.	**IV**	K5	1,2,3,4,6,9, 10, 11,12	1,2
CO5	Learn about advanced topics of recommender systems applications	**V**	K1,K2	1,2,4,5,6,1 0, 11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	1	-	-	-	1	-	-	1	-	-
CO2	1	2	-	-	1	-	-	-	-	-	-	1	-	-
CO3	2	2	1	-	1	-	-	-	2	-	-	-	-	-
CO4	3	2	2	2	1	-	-	-	2	-	-	2	-	-
CO5	2	2	1	1	1	-	-	-	-	-	-	1	-	-
CO	2	2	1.3	1.8	1	-	-	-	1.8	-	-	1.3	-	-

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22ADV103	EXPLORATORY DATA ANALYSIS	L	T	P	C
		2	0	2	3

Course Objectives:

- To outline an overview of exploratory data analysis.
- To implement data visualization using Matplotlib.
- To perform univariate data exploration and analysis.
- To apply bivariate data exploration and analysis.
- To use Data exploration and visualization techniques for multivariate and time series data.

UNIT I	INTRODUCTION	6

EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA - Visual Aids for EDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques.

UNIT II	EDA USING PYTHON	6

Data Manipulation using Pandas – Pandas Objects – Data Indexing and Selection – Operating on Data – Handling Missing Data – Hierarchical Indexing – Combining datasets – Concat, Append, Merge and Join – Aggregation and grouping – Pivot Tables – Vectorized String Operations.

UNIT III	UNIVARIATE ANALYSIS	6

Introduction to Single variable: Distribution Variables - Numerical Summaries of Level and Spread - Scaling and Standardizing – Inequality.

UNIT IV	BIVARIATE ANALYSIS	6

Relationships between Two Variables - Percentage Tables - Analysing Contingency Tables - Handling Several Batches - Scatterplots and Resistant Lines.

UNIT V	MULTIVARIATE AND TIME SERIES ANALYSIS	6

Introducing a Third Variable - Causal Explanations - Three-Variable Contingency Tables and Beyond – Fundamentals of TSA – Characteristics of time series data – Data Cleaning – Time-based indexing – Visualizing – Grouping – Resampling.

TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
1. Install the data Analysis and Visualization tool: R/ Python /Tableau Public/ Power BI.
2. Perform exploratory data analysis (EDA) with datasets like email data set. Export all your emails as a dataset, import them inside a pandas data frame, visualize them and get different insights from the data.
3. Working with Numpy arrays, Pandas data frames, Basic plots using Matplotlib.
4. Explore various variable and row filters in R for cleaning data. Apply various plot features in R on sample data sets and visualize.
5. Perform Time Series Analysis and apply the various visualization techniques.
6. Perform Data Analysis and representation on a Map using various Map data sets with Mouse Rollover effect, user interaction, etc..
7. Build cartographic visualization for multiple datasets involving various countries of the world; states and districts in India etc.
8. Perform EDA on Wine Quality Data Set.
9. Use a case study on a data set and apply the various EDA and visualization techniques and present an analysis report.
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Suresh Kumar Mukhiya, Usman Ahmed, "Hands-On Exploratory Data Analysis with Python", Packt Publishing, 2020. (Unit 1)
2	Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", First Edition, O Reilly, 2017. (Unit 2)
3	Catherine Marsh, Jane Elliott, "Exploring Data: An Introduction to Data Analysis for Social Scientists", Wiley Publications, 2nd Edition, 2008. (Unit 3,4,5)
REFERENCES:	
1	Eric Pimpler, Data Visualization and Exploration with R, GeoSpatial Training service, 2017.
2	Claus O. Wilke, "Fundamentals of Data Visualization", O'reilly publications, 2019.
3	Matthew O. Ward, Georges Grinstein, Daniel Keim, "Interactive Data Visualization: Foundations, Techniques, and Applications", 2nd Edition, CRC press, 2015.

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Course Name: EXPLORATORY DATA ANALYSIS		Course Code: 22ADV103			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the fundamentals of exploratory data analysis.	**I**	K1,K2	1,2,3,4,6,9, 10,11	1,2
CO2	Implement the data visualization using Matplotlib.	**II**	K3,K4	1,2,3,4,5,6, 9,11,12	1,2
CO3	Perform univariate data exploration and analysis.	**III**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Apply bivariate data exploration and analysis.	**IV**	K5	1,2,3,4,6,9, 10, 11,12	1,2
CO5	Use Data exploration and visualization techniques for multivariate and time series data.	**V**	K1,K2	1,2,4,5,6, 10, 11,12	1,2

CO-PO-PSO Mapping

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

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22ADV104	TEXT AND SPEECH ANALYSIS	L	T	P	C
		2	0	2	3

Course Objectives:

- Understand natural language processing basics
- Apply classification algorithms to text documents
- Build question-answering and dialogue systems
- Develop a speech recognition system
- Develop a speech synthesizer

UNIT I	NATURAL LANGUAGE BASICS	6

Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stop-words – Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model

Suggested Activities

- Flipped classroom on NLP
- Implementation of Text Preprocessing using NLTK
- Implementation of TF-IDF models

Suggested Evaluation Methods

- Quiz on NLP Basics
- Demonstration of Programs

UNIT II	TEXT CLASSIFICATION	6

Vector Semantics and Embeddings -Word Embeddings - Word2Vec model – Glove model – FastText model – Overview of Deep Learning models – RNN – Transformers – Overview of Text summarization and Topic Models

Suggested Activities

- Flipped classroom on Feature extraction of documents
- Implementation of SVM models for text classification
- External learning: Text summarization and Topic models

Suggested Evaluation Methods

- Assignment on above topics
- Quiz on RNN, Transformers
- Implementing NLP with RNN and Transformers



UNIT III	QUESTION ANSWERING AND DIALOGUE SYSTEMS	6

Information retrieval – IR-based question answering – knowledge-based question answering – language models for QA – classic QA models – chatbots – Design of dialogue systems – evaluating dialogue systems

Suggested Activities:

- Flipped classroom on language models for QA
- Developing a knowledge-based question-answering system
- Classic QA model development

Suggested Evaluation Methods

- Assignment on the above topics
- Quiz on knowledge-based question answering system
- Development of simple chatbots

UNIT IV	TEXT-TO-SPEECH SYNTHESIS	6

Overview. Text normalization. Letter-to-sound. Prosody, Evaluation. Signal processing - Concatenative and parametric approaches, WaveNet and other deep learning-based TTS systems

Suggested Activities:

- Flipped classroom on Speech signal processing
- Exploring Text normalization
- Data collection
- Implementation of TTS systems

Suggested Evaluation Methods

- Assignment on the above topics
- Quiz on wavenet, deep learning-based TTS systems
- Finding accuracy with different TTS systems

UNIT V	AUTOMATIC SPEECH RECOGNITION	6

Speech recognition: Acoustic modelling – Feature Extraction - HMM, HMM-DNN systems

Suggested Activities:

- Flipped classroom on Speech recognition.
- Exploring Feature extraction

Suggested Evaluation Methods

- Assignment on the above topics
- Quiz on acoustic modelling

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TOTAL: 30 PERIODS

LIST OF EXPERIMENTS: 30 PERIODS
1.Create Regular expressions in Python for detecting word patterns and tokenizing text
2.Getting started with Python and NLTK - Searching Text, Counting Vocabulary, Frequency Distribution, Collocations, Bigrams
3. Accessing Text Corpora using NLTK in Python
4. Write a function that finds the 50 most frequently occurring words of a text that are not stop words.
5. Implement the Word2Vec model
6. Use a transformer for implementing classification
7. Design a chatbot with a simple dialog system
8. Convert text to speech and find accuracy
9. Design a speech recognition system and find the error rate.
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Daniel Jurafsky and James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Third Edition, 2022.
REFERENCES:	
1	Dipanjan Sarkar, "Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data", APress,2018.
2	Tanveer Siddiqui, Tiwary U S, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.
3	Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, "Fundamentals of Speech Recognition" 1st Edition, Pearson, 2009.
4	Steven Bird, Ewan Klein, and Edward Loper, "Natural language processing with Python", O'REILLY.

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Course Name: TEXT AND SPEECH ANALYSIS		Course Code: 22ADV104			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Explain existing and emerging deep learning architectures for text and speech processing	**I**	K1,K2	1,2,3,4,6,9, 10,11	1,2
CO2	Apply deep learning techniques for NLP tasks, language modelling and machine translation	**II**	K3,K4	1,2,3,4,5,6, 9,11,12	1,2
CO3	Explain coreference and coherence for text processing	**III**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Build question-answering systems, chatbots and dialogue systems	**IV**	K5	1,2,3,4,6,9, 10, 11,12	1,2
CO5	Apply deep learning models for building speech recognition and text-to-speech systems	**V**	K1,K2	1,2,4,5,6, 10, 11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	1	3	-	-	-	1	2	1	2	1	1
CO2	3	1	2	1	3	-	-	-	2	2	1	3	3	1
CO3	2	2	1	3	1	-	-	-	3	3	1	2	3	1
CO4	2	1	1	1	2	-	-	-	2	1	2	2	3	1
CO5	1	3	2	2	1	-	-	-	3	2	1	1	2	1
CO	2.2	1.8	1.8	1.6	2	-	-	-	2.2	2	1.2	2	2.4	1

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22ADV105	BUSINESS ANALYTICS	L	T	P	C
		2	0	2	3

Course Objectives:

- To understand the Analytics Life Cycle.
- To comprehend the process of acquiring Business Intelligence
- To understand various types of analytics for Business Forecasting
- To model the supply chain management for Analytics.
- To apply analytics for different functions of a business

UNIT I	INTRODUCTION TO BUSINESS ANALYTICS	6

Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration

UNIT II	BUSINESS INTELLIGENCE	6

Data Warehouses and Data Mart - Knowledge Management –Types of Decisions - Decision Making Process - Decision Support Systems – Business Intelligence –OLAP – Analytic functions

UNIT III	BUSINESS FORECASTING	6

Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models –Data Mining and Predictive Analysis Modelling –Machine Learning for Predictive analytics.

UNIT IV	HR & SUPPLY CHAIN ANALYTICS	6

Human Resources – Planning and Recruitment – Training and Development - Supply chain network - Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain - Applying HR Analytics to make a prediction of the demand for hourly employees for a year.

UNIT V	MARKETING & SALES ANALYTICS	6

Marketing Strategy, Marketing Mix, Customer Behaviour –selling Process – Sales Planning – Analytics applications in Marketing and Sales - predictive analytics for customers' behaviour in marketing and sales.

TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
Use MS-Excel and Power-BI to perform the following experiments using a Business data set, and make presentations. Students may be encouraged to bring their own real-time socially relevant data set. **I Cycle – MS Excel** 1. Explore the features of Ms-Excel. 2. (i) Get the input from user and perform numerical operations (MAX, MIN, AVG, SUM, SQRT, ROUND) ii) Perform data import/export operations for different file formats. 3. Perform statistical operations - Mean, Median, Mode and Standard deviation, Variance, Skewness, Kurtosis 4. Perform Z-test, T-test & ANOVA 5. Perform data pre-processing operations i) Handling Missing data ii) Normalization 6. Perform dimensionality reduction operation using PCA, KPCA & SVD 7. Perform bivariate and multivariate analysis on the dataset. 8. Apply and explore various plotting functions on the data set. **II Cycle – Power BI Desktop** 9. Explore the features of Power BI Desktop 10. Prepare & Load data 11. Develop the data model 12. Perform DAX calculations 13. Design a report 14. Create a dashboard and perform data analysis 15. Presentation of a case study
TOTAL : 60 PERIODS

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TEXT BOOKS:	
1	R. Evans James, Business Analytics, 2nd Edition, Pearson, 2017
2	R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2nd Edition, Wiley, 2016
3	Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016
4	VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2010.
5	Mahadevan B, "Operations Management -Theory and Practice",3rd Edition, Pearson Education,2018.

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Course Name: BUSINESS ANALYTICS		Course Code: 22ADV105			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Explain the real world business problems and model with analytical solutions.	**I**	K1,K2	1,2,3,4,6,9, 10,11	1,2
CO2	Identify the business processes for extracting Business Intelligence	**II**	K3,K4	1,2,3,4,5,6, 9,11,12	1,2
CO3	Apply predictive analytics for business fore-casting	**III**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Apply analytics for supply chain and logistics management	**IV**	K5	1,2,3,4,6,9, 10,11,12	1,2
CO5	Use analytics for marketing and sales.	**V**	K1,K2	1,2,4,5,6, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PS2O2
CO1	2	2	3	1	1	-	-	-	1	2	1	1	3	1
CO2	3	3	3	2	3	-	-	-	1	2	21	2	3	1
CO3	2	2	3	3	2	-	-	-	3	1	1	3	3	2
CO4	2	1	1	2	2	-	-	-	3	3	2	1	1	3
CO5	2	3	2	3	2	-	-	-	3	3	1	3	3	1
CO	2.2	2.2	2.4	2.2	2	-	-	-	2.2	2.2	1.4	2	2.6	1.6

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22ADV106	IMAGE AND VIDEO ANALYTICS	L	T	P	C
		2	0	2	3
Course Objectives:	To understand the basics of image processing techniques for computer vision. To learn the techniques used for image pre-processing. To discuss the various object detection techniques. To understand the various Object recognition mechanisms. To elaborate on the video analytics techniques.				
UNIT I	**INTRODUCTION**				**6**
Computer Vision – Image representation and image analysis tasks - Image representations – digitization – properties – color images – Data structures for Image Analysis - Levels of image data representation - Traditional and Hierarchical image data structures.					
UNIT II	**IMAGE PRE-PROCESSING**				**6**
Local pre-processing - Image smoothing - Edge detectors - Zero-crossings of the second derivative - Scale in image processing - Canny edge detection - Parametric edge models - Edges in multi-speralct images - Local pre-processing in the frequency domain - Line detection by local pre-processing operators - Image restoration.					
UNIT III	**OBJECT DETECTION USING MACHINE LEARNING**				**6**
Object detection– Object detection methods – Deep Learning framework for Object detection– bounding box approach-Intersection over Union (IoU) –Deep Learning Architectures-R-CNN-Faster R-CNN-You Only Look Once(YOLO)-Salient features-Loss Functions-YOLO architectures					
UNIT IV	**FACE RECOGNITION AND GESTURE RECOGNITION**				**6**
Face Recognition-Introduction-Applications of Face Recognition-Process of Face Recognition-DeepFace solution by Facebook-FaceNet for Face Recognition- Implementation using FaceNet-Gesture Recognition.					
UNIT V	**VIDEO ANALYTICS**				**6**
Video Processing – use cases of video analytics-Vanishing Gradient and exploding gradient problem- RestNet architecture-RestNet and skip connections-Inception Network-GoogleNet architecture- Improvement in Inception v2-Video analytics-RestNet and Inception v3.					
					TOTAL: 30PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
1. Write a program that computes the T-pyramid of an image.
2. Write a program that derives the quad tree representation of an image using the homogeneity criterion of equal intensity
3. Develop programs for the following geometric transforms: (a) Rotation (b) Change of scale (c) Skewing (d) Affine transform calculated from three pairs of corresponding points (e) Bilinear transform calculated from four pairs of corresponding points.
4. Develop a program to implement Object Detection and Recognition
5. Develop a program for motion analysis using moving edges, and apply it to your image sequences.
6. Develop a program for Facial Detection and Recognition
7. Write a program for event detection in video surveillance system
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision", 4nd edition, Thomson Learning, 2013.
2	Vaibhav Verdhan,(2021, Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras,Apress 2021(UNIT-III,IV and V)
REFERENCES:	
1	Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer Verlag London Limited,2011.
2	Caifeng Shan, FatihPorikli, Tao Xiang, Shaogang Gong, "Video Analytics for Business Intelligence", Springer, 2012.
3	D. A. Forsyth, J. Ponce, "Computer Vision: A Modern Approach", Pearson Education, 2003.
4	E. R. Davies, (2012), "Computer & Machine Vision", Fourth Edition, Academic Press.

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Course Name: IMAGE AND VIDEO ANALYTICS		Course Code: 22ADV106			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the basics of image processing techniques for computer vision and video analysis.	**I**	K1,K2	1,2,3,4,6,9, 10,11	1,2
CO2	Explain the techniques used for image pre-processing.	**II**	K3,K4	1,2,3,4,5,6, 9,11,12	1,2
CO3	Develop various object detection techniques.	**III**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Understand the various face recognition mechanisms.	**IV**	K5	1,2,3,4,6,9, 10,11,12	1,2
CO5	Elaborate on deep learning-based video analytics.	**V**	K1,K2	1,2,4,5,6, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	1	2	-	-	-	1	2	2	1	3	1
CO2	3	3	3	2	3	-	-	-	1	2	1	2	3	1
CO3	1	2	3	3	3	-	-	-	3	1	1	3	3	2
CO4	1	1	1	2	3	-	-	-	3	3	2	1	1	3
CO5	3	3	2	3	2	-	-	-	3	3	1	3	3	1
CO	2	1.8	2.2	2.4	2.6	-	-	-	2.2	2	1.4	2	1.6	2

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22ADV107	COMPUTER VISION	L	T	P	C
		2	0	2	3

Course Objectives:

- To understand the fundamental concepts related to Image formation and processing.
- To learn feature detection, matching and detection
- To become familiar with feature based alignment and motion estimation
- To develop skills on 3D reconstruction
- To understand image based rendering and recognition

UNIT I	INTRODUCTION TO IMAGE FORMATION AND PROCESSING	6

Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization.

UNIT II	FEATURE DETECTION, MATCHING AND SEGMENTATION	6

Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods.

UNIT III	FEATURE-BASED ALIGNMENT & MOTION ESTIMATION	6

2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow - Layered motion.

UNIT IV	3D RECONSTRUCTION	6

Shape from X - Active range finding - Surface representations - Point-based representations- Volumetric representations - Model-based reconstruction - Recovering texture maps and albedosos.

UNIT V	IMAGE-BASED RENDERING AND RECOGNITION	6

View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes - Video-based rendering-Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding- Recognition databases and test sets.

TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
Software needed: OpenCV computer vision Library for OpenCV in Python / PyCharm or C++ / Visual Studio or or equivalent
1. OpenCV Installation and working with Python
2. Basic Image Processing - loading images, Cropping, Resizing, Thresholding, Contour analysis, Bolb detection
3. Image Annotation – Drawing lines, text circle, rectangle, ellipse on images
4. Image Enhancement - Understanding Color spaces, color space conversion, Histogram equialization, Convolution, Image smoothing, Gradients, Edge Detection
5. Image Features and Image Alignment – Image transforms – Fourier, Hough, Extract ORB Image features, Feature matching, cloning, Feature matching based image alignment
6. Image segmentation using Graphcut / Grabcut
7. Camera Calibration with circular grid
8. Pose Estimation
9. 3D Reconstruction – Creating Depth map from stereo images
10. Object Detection and Tracking using Kalman Filter, Camshift
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer- Texts in Computer Science, Second Edition, 2022.
2	Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.
REFERENCES:	
1	Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2	Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
3	E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.

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Course Name: COMPUTER VISION		Course Code: 22ADV107			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	To understand basic knowledge, theories and methods in image processing and computer vision.	**I**	K1,K2	1,2,3,4,6,9, 10,11	1,2
CO2	To implement basic and some advanced image processing techniques in OpenCV.	**II**	K3,K4	1,2,3,4,5,6, 9,11,12	1,2
CO3	To apply 2D a feature-based based image alignment, segmentation and motion estimations.	**III**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	To apply 3D image reconstruction techniques	**IV**	K5	1,2,3,4,6,9, 10,11,12	1,2
CO5	To design and develop innovative image processing and computer vision applications.	**V**	K1,K2	1,2,4,5,6, 10,11,12	1,2

CO-PO-PSO Mapping

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

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22ADV108	DATA WAREHOUSING AND DATA MINING	L	T	P	C
		2	0	2	3

Course Objectives:

- To know the details of data warehouse Architecture and OLAP Technology
- To understand the concepts of Data Mining
- To understand the various data preprocessing methods
- To know about Frequent pattern mining
- To understand the applications of Data Mining.

UNIT I	DATA WAREHOUSING	9

Data warehousing Components –Building a Data warehouse, Data warehouse architecture – Data warehouse modeling – Data Extraction, Cleanup, and Transformation Tools – Metadata – reporting – Query tools and Applications. Data cube – OLAP operations – Data warehouse design and usage – Data warehouse implementation – Data generalization by attribute oriented induction.

UNIT II	INTRODUCTION TO DATA MINING	9

Data Mining – Steps in Knowledge Discovery Process – Kinds of Data and Patterns – Technologies used – Targeted applications – Major issues in Data Mining – Data objects and attribute types – Statistical descriptions of data – Measuring data similarity and dissimilarity.

UNIT III	DATA PREPROCESSING	9

Major tasks in data preprocessing - Data Cleaning – Data Integration – Data Reduction – Data Transformation – Data Discretization and Concept hierarchy generation.

UNIT IV	FREQUENT PATTERN MINING	9

Basic concepts – Frequent item set mining methods: Apriori algorithm – A pattern growth approach for mining frequent item sets – Pattern evaluation methods – Multilevel – Multi dimensional frequent pattern mining.

UNIT V	DATA MINING APPLICATIONS	9

Mining complex data types – Other methodologies of data mining – Data mining applications – Data mining and Society – Data mining trends

TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
1. Create a simple Data Warehouse Schema
2. OLAP operations using SQL
3. Data type identification and pattern exploration
4. Similarity and Dissimilarity measures
5. Data cleaning and integration
6. Data Transformation and Discretization
7. Apriori algorithm for Market Basket Analysis
8. Pattern Growth Approach
9. Clustering with K-means
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Alex Berson and Stephen J. Smith "Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill Edition, Thirteenth Reprint 2008.
2	Ralph Kimball, "The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling", Third edition, 2013.
3	Han Jiawei, and Kamber Micheline, "Data Mining: Concepts and Techniques", 3rd Edition, Morgan Kaufmann Publishers, 2012.
REFERENCES:	
1	Paul Raj Ponniah, "Data warehousing fundamentals for IT Professionals", 2012.
2	K.P. Soman, ShyamDiwakar and V. Ajay "Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2006.

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Course Name: DATA WAREHOUSING AND DATA MINING		Course Code: 22ADV108			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	To perform OLAP operations by constructing data warehouse	**I**	K3	1,2,3	1,2
CO2	To describe the concepts of data mining and perform statistical analysis of data.	**II**	K3	1,2,3	1,2
CO3	To apply various preprocessing techniques	**III**	K3	1,2,3	1,2
CO4	To apply association rule mining methods to solve the problem	**IV**	K3	1,2,3	1,2
CO5	To discuss about data mining applications.	**V**	K3	1,2,3	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	-	-	-	1	1	2
CO2	3	2	2	2	3	-	-	-	-	-	2	1	1	1
CO3	3	3	3	3	-	-	-	-	-	-	-	1	2	2
CO4	3	3	3	3	-	-	-	-	-	-	-	1	2	1
CO5	3	2	2	2	-	-	-	-	-	-	2	1	1	2
CO	3	2.6	2.6	2.4	2.5	-	-	-	-	-	2	1	1.6	1.8

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VERTICAL II: FULL STACK DEVELOPMENT

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22ADV201	Full Stack Software Development	PE	2	0	2	4	3
2.	22ADV202	App Development	PE	2	0	2	4	3
3.	22ADV203	Cloud Services Management	PE	2	0	2	4	3
4.	22ADV204	UI and UX Design	PE	2	0	2	4	3
5.	22ADV205	Software Testing and Automation	PE	2	0	2	4	3
6.	22ADV206	Web Development 5.0	PE	2	0	2	4	3
7.	22ADV207	DevOps	PE	2	0	2	4	3
8.	22ADV208	Agile Methodologies	PE	2	0	2	4	3

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22ADV201	FULL STACK WEB DEVELOPMENT	L	T	P	C
		2	0	2	3
Course Objectives:	• To understand the various components of full stack development • To learn Node.js features and applications • To develop applications with MongoDB • To understand the role of Angular and Express in web applications • To develop simple web applications with React				
UNIT I	**BASICS OF FULL STACK**				**6**
Understanding the Basic Web Development Framework - User - Browser – Webserver - Backend Services – MVC Architecture - Understanding the different stacks –The role of Express – Angular – Node – Mongo DB -- React					
UNIT II	**NODE JS**				**6**
Basics of Node JS – Installation – Working with Node packages – Using Node package manager – Creating a simple Node.js application – Using Events – Listeners –Timers - Callbacks – Handling Data I/O – Implementing HTTP services in Node.js					
UNIT III	**MONGO DB**				**6**
Understanding NoSQL and MongoDB – Building MongoDB Environment – User accounts – Access control – Administering databases – Managing collections – Connecting to MongoDB from Node.js – simple applications					
UNIT IV	**EXPRESS AND ANGULAR**				**6**
Implementing Express in Node.js - Configuring routes - Using Request and Response objects - Angular - Typescript - Angular Components - Expressions - Data binding - Built-in directives					
UNIT V	**REACT**				**6**
MERN STACK – Basic React applications – React Components – React State – Express REST APIs - Modularization and Webpack - Routing with React Router – Server-side rendering					
					TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
1. Develop a portfolio website for yourself which gives details about yourself for a potential recruiter.
2. Create a web application to manage the TO-DO list of users, where users can login and manage their to-do items
3. Create a simple micro blogging application (like twitter) that allows people to post their content which can be viewed by people who follow them.
4. Create a food delivery website where users can order food from a particular restaurant listed in the website.
5. Develop a classifieds web application to buy and sell used products.
6. Develop a leave management system for an organization where users can apply different types of leaves such as casual leave and medical leave. They also can view the available number of days.
7. Develop a simple dashboard for project management where the statuses of various tasks are available. New tasks can be added and the status of existing tasks can be changed among Pending, InProgress or Completed.
8. Develop an online survey application where a collection of questions is available and users are asked to answer any random 5 questions.
TOTAL : 60 PERIODS

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TEXT BOOKS:	
1	Brad Dayley, Brendan Dayley, Caleb Dayley, 'Node.js, MongoDB and Angular Web Development', Addison-Wesley, Second Edition, 2018
2	Vasan Subramanian, 'Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node', Second Edition, A press, 2019.
REFERENCES:	
1	Chris Northwood, 'The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer', Apress; 1st edition, 2018
2	Kirupa Chinnathambi, 'Learning React: A Hands-On Guide to Building Web Applications Using React and Redux', Addison-Wesley Professional, 2nd edition, 2018
3	https://www.tutorialspoint.com/the_full_stack_web_development/index.asp
4	https://www.coursera.org/specializations/full-stack-react
5	https://www.udemy.com/course/the-full-stack-web-development/

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Course Name: FULL STACK SOFTWARE DEVELOPMENT		Course Code: 22ADV201			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the various stacks available for web application development	**I**	K1,K2	1,2,3,4,6,9, 10,11	1,2
CO2	Use Node.js for application development	**II**	K3,K4	1,2,3,4,5,6, 9,11,12	1,2
CO3	Develop applications with MongoDB	**III**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Use the features of Angular and Express	**IV**	K5	1,2,3,4,6,9, 10,11,12	1,2
CO5	Develop React applications	**V**	K1,K2	1,2,4,5,6, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	1	1	1	1	1	0
CO2	3	3	2	3	2	2	-	-	2	0	2	3	2	1
CO3	3	3	3	2	2	2	-	-	2	2	2	3	2	1
CO4	3	3	2	2	2	2	-	-	1	1	2	2	2	1
CO5	3	3	2	3	3	3	-	-	-	0	2	2	2	1
CO	3	3	2	2	2	2	-	-	1	1	2	2	2	1

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22ADV202	APP DEVELOPMENT	L	T	P	C
		2	0	2	3
Course Objectives:	To learn development of native applications with basic GUI Components To develop cross-platform applications with event handling To develop applications with location and data storage capabilities To develop web applications with database access To learn non-functional characteristics of app frameworks				
UNIT I	**INTRODUCTION**				**6**
Basics of Web and Mobile application development, Native App, Hybrid App, Cross-platform App, What is Progressive Web App, Responsive Web design.					
UNIT II	**NATIVE APP DEVELOPMENT USING JAVA**				**6**
Native Web App, Benefits of Native App, Scenarios to create Native App, Tools for creating Native App, Cons of Native App, Popular Native App Development Frameworks, Java & Kotlin for Android, Swift & Objective-C for iOS, Basics of React Native, Native Components, JSX, State, Props					
UNIT III	**HYBRID APP DEVELOPMENT**				**6**
Hybrid Web App, Benefits of Hybrid App, Criteria for creating Native App, Tools for creating Hybrid App, Cons of Hybrid App, Popular Hybrid App Development Frameworks, Ionic, Apache Cordova.					
UNIT IV	**CROSS-PLATFORM APP DEVELOPMENT USING REACT-NATIVE**				**6**
What is Cross-platform App, Benefits of Cross-platform App, Criteria for creating Cross-platform App, Tools for creating Cross-platform App, Cons of Cross-platform App, Popular Cross-platform App Development Frameworks, Flutter, Xamarin, React-Native, Basics of React Native, Native Components, JSX, State, Props					
UNIT V	**NON-FUNCTIONAL CHARACTERISTICS OF APP FRAMEWORKS**				**6**
Comparison of different App frameworks, Build Performance, App Performance, Debugging capabilities, Time to Market, Maintainability, Ease of Development, UI/UX, Reusability					
	TOTAL: 30 PERIODS				

LIST OF EXPERIMENTS: 30 PERIODS
1. Using react native, build a cross platform application for a BMI calculator.
2. Build a cross platform application for a simple expense manager which allows entering expenses and income on each day and displays category wise weekly income and expense.
3. Develop a cross platform application to convert units from imperial system to metric system (km to miles, kg to pounds etc.,)
4. Design and develop a cross platform application for day to day task (to-do) management.
5. Design an android application using Cordova for a user login screen with username, password, reset button and a submit button. Also, include header image and a label. Use layout managers.
6. Design and develop an android application using Apache Cordova to find and display the current location of the user.
7. Write programs using Java to create Android application having Databases • For a simple library application. • For displaying books available, books lend, book reservation. Assume that student information is available in a database which has been stored in a database server.
TOTAL : 60 PERIODS

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TEXT BOOKS:	
1	Head First Android Development, Dawn Griffiths, O'Reilly, 1st edition
2	Apache Cordova in Action, Raymond K. Camden, Manning. 2015
3	Full Stack React Native: Create beautiful mobile apps with JavaScript and React Native, Anthony Accomazzo, Houssein Djirdeh, Sophia Shoemaker, Devin Abbott, FullStack publishing
REFERENCES:	
1	Android Programming for Beginners, John Horton, Packt Publishing, 2nd Edition
2	Native Mobile Development by Shaun Lewis, Mike Dunn
3	Building Cross-Platform Mobile and Web Apps for Engineers and Scientists: An Active Learning Approach, Pawan Lingras, Matt Triff, Rucha Lingras
4	Apache Cordova 4 Programming, John M Wargo, 2015
5	React Native Cookbook, Daniel Ward, Packt Publishing, 2nd Edition

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NH-47, Sankari Main Road, Periyaseeragapadi, Salem-636308, Tamil Nadu.
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Course Name: APP DEVELOPMENT		Course Code: 22ADV202			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Develop Native applications with GUI Components.	**I**	K1,K2	1,2,3,4,6,9, 10,11	1,2
CO2	Develop hybrid applications with basic event handling.	**II**	K3,K4	1,2,3,4,5,6, 9,11,12	1,2
CO3	Implement cross-platform applications with location and data storage capabilities.	**III**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Implement cross platform applications with basic GUI and event handling.	**IV**	K5	1,2,3,4,6,9, 10,11,12	1,2
CO5	Develop web applications with cloud database access.	**V**	K1,K2	1,2,4,5,6, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	3	-	-	-	1	1	2	1	2	3
CO2	2	1	3	2	2	-	-	-	3	2	2	3	3	2
CO3	2	2	2	1	2	-	-	-	1	1	1	1	1	1
CO4	1	3	1	1	3	-	-	-	1	1	3	2	1	3
CO5	1	1	3	1	3	-	-	-	1	1	2	1	3	2
CO	1.6	1.8	2	1.4	2.6	-	-	-	1.4	1.2	2	1.6	2	2.2

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22ADV203	CLOUD SERVICES MANAGEMENT	L	T	P	C
		2	0	2	3

Course Objectives:

- To introduce fundamentals of Cloud Service Management.
- To provide Cloud strategies and key drivers for cloud adoption.
- Explain cloud service life cycle and operations.
- To understand the running cloud-based services in a business environment
- To explore the benefits and drive the adoption of cloud-based services to solve real world problems

UNIT I	CLOUD SERVICE MANAGEMENT FUNDAMENTALS	6

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

UNIT II	CLOUD SERVICES STRATEGY	6

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

UNIT III	CLOUD SERVICE MANAGEMENT	6

Cloud Service Reference Model, Cloud Service LifeCycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud Service Capacity Planning, Cloud Service Deployment and Migration, Cloud Marketplace, Cloud Service Operations Management

UNIT IV	CLOUD SERVICE ECONOMICS	6

Pricing models for Cloud Services, Freemium, Pay Per Reservation, Pay per User, Subscription based Charging, Procurement of Cloud-based Services, Capex vs Opex Shift, Cloud service Charging, Cloud Cost Models

UNIT V	CLOUD SERVICE GOVERNANCE & VALUE	6

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

TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
1. Create a Cloud Organization in AWS/Google Cloud/or any equivalent Open Source cloud softwares like Openstack, Eucalyptus, OpenNebula with Role-based access control 2. Create a Cost-model for a web application using various services and do Cost-benefit analysis 3. Create alerts for usage of Cloud resources 4. Create Billing alerts for your Cloud Organization 5. Compare Cloud cost for a simple web application across AWS, Azure and GCP and suggest the best one
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Cloud Service Management and Governance: Smart Service Management in Cloud Era by Enamul Haque, Enel Publications
2	Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, Ricardo Puttini, Zaigham Mohammad 2013.
3	Cloud Computing Design Patterns by Thomas Erl, Robert Cope, Amin Naserpour
REFERENCES:	
1	Economics of Cloud Computing by Praveen Ayyappa, LAP Lambert Academic Publishing
2	Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya, Christian Vechhiola, S. Thamarai Selvi

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Course Name: CLOUD SERVICES MANAGEMENT		Course Code: 22ADV203			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Describe the characteristics of cloud services and various cloud service models.	**I**	K2	1,2,5,12	1,2
CO2	Develop a basic cloud service strategy considering policies, risks, and demand factors.	**II**	K3	1,2,3,5, 11, 12	1,2
CO3	Apply cloud service lifecycle concepts to design and manage cloud-based solutions.	**III**	K3	1,2,3,5,9, 10,11,12	1,2
CO4	Analyze cloud pricing models and evaluate cloud service costs and investments.	**IV**	K4	1,2,3,4,5, 11,12	1,2
CO5	Explain governance frameworks and assess the value and performance of cloud services.	**V**	K4	1,2,3,4,5,6, 7,8, 9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	1	-	-	-	2	-	-	-	2	3
CO2	3	1	1	-	2	-	-	-	1	-	-	2	2	2
CO3	1	1	2	-	3	-	-	-	3	1	1	2	3	1
CO4	1	1	2	2	3	-	-	-	2	-	-	2	1	1
CO5	1	3	1	2	2	-	-	1	1	1	1	2	1	2
CO	1.8	1.8	1.5	2	2.2	-	-	1	1.8	1	1	2	1.8	1.8

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22ADV204	UI AND UX DESIGN	L	T	P	C
		2	0	2	3
Course Objectives:	• To provide a sound knowledge in UI & UX • To understand the need for UI and UX • To understand the various Research Methods used in Design • To explore the various Tools used in UI & UX • Creating a wireframe and prototype				
UNIT I	**FOUNDATIONS OF DESIGN**		**6**		
UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Brainstorming and Game storming - Observational Empathy					
UNIT II	**FOUNDATIONS OF UI DESIGN**		**6**		
Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles – Branding - Style Guides.					
UNIT III	**FOUNDATIONS OF UX DESIGN**		**6**		
Introduction to User Experience - Why You Should Care about User Experience - Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goals					
UNIT IV	**WIREFRAMING, PROTOTYPING AND TESTING**		**6**		
Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing - Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration					
UNIT V	**RESEARCH, DESIGNING, IDEATING, & INFORMATION ARCHITECTURE**		**6**		
Identifying and Writing Problem Statements - Identifying Appropriate Research Methods - Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams - Flow Mapping - Information Architecture					
			TOTAL: 30 PERIODS		

LIST OF EXPERIMENTS: 30 PERIODS
1. Designing a Responsive layout for an societal application
2. Exploring various UI Interaction Patterns
3. Developing an interface with proper UI Style Guides
4. Developing Wireflow diagram for application using open source software
5. Exploring various open source collaborative interface Platform
6. Hands on Design Thinking Process for a new product
7. Brainstorming feature for proposed product
8. Defining the Look and Feel of the new Project
9. Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles)
10. Identify a customer problem to solve
11. Conduct end-to-end user research - User research, creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping
12. Sketch, design with popular tool and build a prototype and perform usability testing and identify improvements
TOTAL : 60 PERIODS

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TEXT BOOKS:	
1	Joel Marsh, "UX for Beginners", O'Reilly , 2022
2	Jon Yablonski, "Laws of UX using Psychology to Design Better Product & Services" O'Reilly 2021
REFERENCES:	
1	Jenifer Tidwell, Charles Brewer, Aynne Valencia, "Designing Interface" 3 rd Edition , O'Reilly 2020
2	Steve Schoger, Adam Wathan "Refactoring UI", 2018
3	Steve Krug, "Don't Make Me Think, Revisited: A Commonsense Approach to Web & Mobile", Third Edition, 2015
4	https://www.nngroup.com/articles/
5	https://www.interaction-design.org/literature

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Course Name: UI AND UX DESIGN		Course Code: 22ADV204			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Build UI for user Applications	**I**	K3	1,2,3,5,9, 10,11,12	1,2
CO2	Evaluate UX design of any product or application	**II**	K5	1,2,3,4,5,8, 9, 10,11,12	1,2
CO3	Demonstrate UX Skills in product development	**III**	K3	1,2,3,5,6,9, 10,11,12	1,2
CO4	Implement Sketching principles	**IV**	K3	1,2,3,5,9, 10,11,12	1,2
CO5	Create Wireframe and Prototype	**V**	K6	1,2,3,5,9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	3	-	2	-	-	-	1	2	1	1	1	1
CO2	2	2	2	2	2	-	-	1	1	2	1	2	2	1
CO3	2	2	3	-	2	1	-	-	2	2	2	2	1	2
CO4	2	1	2	-	2	-	-	-	1	2	1	1	2	1
CO5	2	1	3	-	2	-	-	-	2	2	2	2	2	2
CO	2	1.3	2.6	2	2	1	-	1	1.4	2	1.5	1.5	1.5	1.5

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22ADV205	SOFTWARE TESTING AND AUTOMATION	L	T	P	C
		2	0	2	3

Course Objectives:

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

UNIT I	FOUNDATIONS OF SOFTWARE TESTING	6

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

UNIT II	TEST PLANNING	6

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

UNIT III	TEST DESIGN AND EXECUTION	6

Test Objective Identification, Test Design Factors, Requirement identification, Testable Requirements, Modeling a Test Design Process, Modeling Test Results, Boundary Value Testing, Equivalence Class Testing, Path Testing, Data Flow Testing, Test Design Preparedness Metrics, Test Case Design Effectiveness, Bug Reporting, Bug Life Cycle.

UNIT IV	ADVANCED TESTING CONCEPTS	6

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

UNIT V	TEST AUTOMATION AND TOOLS	6

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

TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
1. Develop the test plan for testing an e-commerce web/mobile application (www.amazon.in).
2. Design the test cases for testing the e-commerce application
3. Test the e-commerce application and report the defects in it.
4. Develop the test plan and design the test cases for an inventory control system.
5. Execute the test cases against a client server or desktop application and identify the defects.
6. Test the performance of the e-commerce application.
7. Automate the testing of e-commerce applications using Selenium.
8. Integrate TestNG with the above test automation.
9. Mini Project: a) Build a data-driven framework using Selenium and TestNG b) Build Page object Model using Selenium and TestNG c) Build BDD framework with Selenium, TestNG and Cucumber
TOTAL : 30 PERIODS

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

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Course Name: SOFTWARE TESTING AND AUTOMATION		Course Code: 22ADV205			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the basic concepts of software testing and the need for software testing	**I**	K2	1,2,5,10,12	1,2
CO2	Design Test planning and different activities involved in test planning	**II**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO3	Design effective test cases that can uncover critical defects in the application	**III**	K4	1,2,3,4,5, 10,11,12	1,2
CO4	Carry out advanced types of testing	**IV**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO5	Automate the software testing using Selenium and TestNG	**V**	K4	1,2,3,4,5,9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	1	-	-	-	-	1	-	1	-	1
CO2	2	2	2	1	2	-	-	-	1	2	2	2	1	2
CO3	2	2	3	2	2	-	-	-	1	2	2	2	2	2
CO4	2	2	2	2	3	-	-	-	-	1	2	2	2	2
CO5	2	2	2	2	3	-	-	-	1	2	2	3	2	2
CO	2	1.8	1.2	1.8	2.6	-	-	-	1	1.8	2	2	1.8	1.8

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22ADV206	WEB DEVELOPMENT 5.0	L	T	P	C
		2	0	2	3

Course Objectives:

- To define the evolution of web development from static websites to modern web applications
- To explore the concepts of components, JSX, and state management.
- To define Node.js and Express.js and their roles in server-side development.
- To integrate databases with web applications.
- To understand various deployment strategies for web applications.

UNIT I	INTRODUCTION TO MODERN WEB DEVELOPMENT	6

Evolution of Web Development- Historical overview of Web development- Introduction to Web Development 5.0 and its characteristics- Modern Web Development Ecosystem- Overview of front-end and back-end technologies- Introduction to popular frameworks and libraries

UNIT II	FRONT-END DEVELOPMENT WITH REACT.JS	6

Introduction to React.js- Overview of React.js and its key features- Understanding JSX syntax and component-based architecture- Components and State Management- Creating functional and class components- Managing state and props in React applications

UNIT III	BACK-END DEVELOPMENT WITH NODE.JS AND EXPRESS.JS	6

Introduction to Node.js and Express.js- Overview of Node.js and its event-driven architecture- Introduction to Express.js as a web application framework- Building RESTful APIs- Understanding RESTful principles- Creating a simple RESTful API with Express.js

UNIT IV	DATABASE INTEGRATION AND AUTHENTICATION	6

Database Integration- Overview of database options (MongoDB, MySQL, etc.)- Integrating MongoDB with Express.js- User Authentication and Authorization- Introduction to authentication and authorization- Implementing user authentication using Passport.js

UNIT V	DEPLOYMENT AND PROJECT WORK	6

Deployment Strategies- Traditional Server Hosting- Cloud Hosting- Containerization- Container Orchestration- Serverless Architecture- Continuous Deployment- Blue-Green Deployment- Feature Toggles- Best Practices- Project Work Guidelines- Tips for effective project planning, collaboration, and troubleshooting

TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
1. Installation and configuration of development tools.
2. Introduction to version control using Git.
3. Creating a basic HTML5 and CSS3 web page.
4. Introduction to responsive design principles.
5. Building a simple React application.
6. Implementing components and managing state.
7. Practical exercises on creating stateful and stateless components.
8. Implementing interactivity in React applications.
9. Creating a basic web server using Node.js.
10. Implementing asynchronous programming with callbacks and Promises.
11. Integration of MongoDB with Express.js.
TOTAL : 60PERIODS

TEXT BOOKS:	
1	"Learning React" by Alex Banks and Eve Porcello
2	"Node.js Design Patterns" by Mario Casciaro
3	"The DevOps Handbook" by Gene Kim, Jez Humble, Patrick Debois, and John Willis.
REFERENCES:	
1	"Express in Action" by Evan Hahn
2	"MongoDB: The De□initive Guide" by Shannon Bradshaw, Eoin Brazil, Kristina Chodorow



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Course Name: WEB DEVELOPMENT 5.0		Course Code: 22ADV206			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the Modern Web Development Concepts.	**I**	K2		1,2
CO2	Apply interactive and dynamic user interfaces with React.js.	**II**	K3		1,2
CO3	Understand the design patterns of new projects and re-factor existing code.	**III**	K2		1,2
CO4	Know to Integrate databases with web applications	**IV**	K3		1,2
CO5	Understand various deployment strategies and hosting platforms.	**V**	K4		1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	2	-	-	-	-	-	-	-	1	-
CO2	3	2	3	-	3	-	-	-	-	-	-	-	2	-
CO3	3	3	3	-	3	-	-	-	-	-	-	-	2	-
CO4	3	2	3	-	3	-	-	-	-	-	-	-	1	-
CO5	3	-	2	-	2	-	-	-	-	-	-	-	2	-
CO	3	2.5	2.8	-	2.6	-	-	-	-	-	-	-	1.8	-

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22ADV207	DEVOPS	L	T	P	C
		2	0	2	3
Course Objectives:	• To introduce DevOps terminology, definition & concepts • To understand the different Version control tools like Git, Mercurial • To understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment) • To understand Configuration management using Ansible • Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve real world problems				
UNIT I	**INTRODUCTION TO DEVOPS**				**6**
Devops Essentials - Introduction To AWS, GCP, Azure - Version control systems: Git and Github.					
UNIT II	**COMPILE AND BUILD USING MAVEN & GRADLEV**				**6**
Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases(compile build, test, package) Maven Profiles, Maven repositories(local, central, global),Maven plugins, Maven create and build Artificats, Dependency management, Installation of Gradle, Understand build using Gradle					
UNIT III	**CONTINUOUS INTEGRATION USING JENKINS**				**6**
Install & Configure Jenkins, Jenkins Architecture Overview, Creating a Jenkins Job, Configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, Commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace.					
UNIT IV	**CONFIGURATION MANAGEMENT USING ANSIBLE**				**6**
Ansible Introduction, Installation, Ansible master/slave configuration, YAML basics, Ansible modules, Ansible Inventory files, Ansible playbooks, Ansible Roles, adhoc commands in ansible					
UNIT V	**BUILDING DEVOPS PIPELINES USING AZURE**				**6**
Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines.yaml file					
					TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
1. Create Maven Build pipeline in Azure 2. Run regression tests using Maven Build pipeline in Azure 3. Install Jenkins in Cloud 4. Create CI pipeline using Jenkins 5. Create a CD pipeline in Jenkins and deploy in Cloud 6. Create an Ansible playbook for a simple web application infrastructure 7. Build a simple application using Gradle 8. Install Ansible and configure ansible roles and to write playbooks
TOTAL : 60 PERIODS

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

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Course Name: DEVOPS		Course Code: 22ADV207			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand different actions performed through Version control tools like Git.	**I**	K2	1,2,3,4,5,9, 10,11,12	1,2
CO2	Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle.	**II**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO3	Ability to Perform Automated Continuous Deployment	**III**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO4	Ability to do configuration management using Ansible	**IV**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO5	Understand to leverage Cloud-based DevOps tools using Azure DevOps	**V**	K2	1,2,3,4,5,9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	3	-	-	-	1	3	1	3	3	1
CO2	3	1	2	1	2	-	-	-	1	2	2	1	2	1
CO3	2	2	1	2	3	-	-	-	2	1	1	3	2	1
CO4	2	3	3	1	1	-	-	-	2	2	2	2	1	2
CO5	1	2	1	3	1	-	-	-	3	2	1	3	3	3
CO	2.2	1.8	1.6	1.6	2	-	-	-	1.8	2	1.4	2.4	2.4	1.6

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22ADV208	AGILE METHODOLOGIES	L	T	P	C
		2	0	2	3

Course Objectives:

- Outline the purpose of agile's core principles and apply for project development
- Utilize the scrum's emphasis on project management and self-organization
- Experiment various user practices using XP practices
- Model applications using incremental design and lean to empower the team
- Make use of Kanban's practices help deliver great software by managing flow

UNIT I	AGILE PRINCIPLES	6

Understanding the Agile Values– Agile to the Rescue – Agile Manifesto and Purpose behind each practice – 12 principles of Agile Software – Delivering the project – Communicating and Working Together – Project Execution – Agile Project.

UNIT II	SCRUM FRAMEWORK AND PRACTICES	6

Basic pattern for a Scrum Project – Rules of Scrum – Self-Organizing Teams - Scrum Values – Daily Scrum – Sprints, Planning and Retrospectives - User stories – and Velocity – Burndown Charts – Planning and Running a Sprint – Scrum Values Revisited.

UNIT III	EXTREME PROGRAMMING(XP) AND AGILE MINDSET	6

Practices Do Work Without the Values – Primary Practices of XP – The XP values help the team change their mindset – An effective mindset starts with the XP values – Understanding the XP principles – Feedback Loops – Code and Design.

UNIT IV	LEAN THINKING IN AGILE DEVELOPMENT	6

Incremental Design and the Holistic XP-Lean Thinking – Eliminate Waste – Value Stream Map – Deliver As Fast As Possible.

UNIT V	KANBAN AND AGILE COACH	6

The Principles of Kanban – Improving Your Process with Kanban – Measure and Manage Flow – Emergent Behavior with Kanban – The Agile Coach.

TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
1. Understand the background and driving forces for taking an Agile Approach to Software development. 2. Build out a backlog and user stories. 3. To study automated build tool. 4. To study version control tool. 5. To study Continuous Integration tool. 6. Apply Design principle and Refactoring to achieve agility. 7. Perform Testing activities within an agile project.
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Andrew Stellman and Jennifer Greene, "Learning Agile: Understanding Scrum, XP, Lean and Kanban", 1st Edition, O'Reilly Media Inc, 2015.
2	David J. Anderson and Eli Schragenheim, —Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall, 2003.
REFERENCES:	
1	Eric Brechner, "Agile Project Management with Kanban", 1st Edition, Microsoft Press, 2015.
2	Robert C. Martin, "Agile Software Development: Principles, Patterns, and Practices", Pearson Prentice Hall, 2011.
3	Craig Larman, —Agile and Iterative Development: A Manager_s Guide, Addison-Wesley, 2004.
4	Kevin C. Desouza, —Agile Information Systems: Conceptualization, Construction, and Management, Butterworth-Heinemann, 2007.

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Course Name: AGILE METHODOLOGIES		Course Code: 22ADV208			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Outline the purpose of agile's core principles and apply for project development Applying.	**I**	K3	1,2,3,4,9, 10,11	1,2
CO2	Utilize the scrum's emphasis on project management and self-organization Applying.	**II**	K3	1,2,3,4,9, 10,11	1,2
CO3	Experiment various user practices using XP practices Applying.	**III**	K3	1,2,3,4,9, 10,11	1,2
CO4	Model applications using incremental design and lean to empower the team Applying.	**IV**	K3	1,2,3,4,9, 10,11	1,2
CO5	Make use of Kanban's practices help deliver great software by managing flow.	**V**	K3	1,2,3,4,9, 10,11	1,2

CO-PO-PSO Mapping

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

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PROFESSIONAL ELECTIVE COURSES

VERTICALS

VERTICAL 3: CLOUD COMPUTING

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22ADV301	Cloud Computing	PE	2	0	2	4	3
2.	22ADV302	Virtualization	PE	2	0	2	4	3
3.	22ADV303	Cloud Architectures	PE	2	0	2	4	3
4.	22ADV304	Cloud Application Development	PE	2	0	2	4	3
5.	22ADV305	Storage Technologies	PE	2	0	2	4	3
6.	22ADV306	Software Defined Network	PE	2	0	2	4	3
7.	22ADV307	Stream Processing	PE	2	0	2	4	3
8.	22ADV308	Security and Privacy in Cloud	PE	2	0	2	4	3

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22ADV301	CLOUD COMPUTING	L	T	P	C
		2	0	2	3

Course Objectives:

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

UNIT I	CLOUD ARCHITECTURE MODELS AND INFRASTRUCTURE	6

Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud deployment models – Cloud service models; Cloud Infrastructure: Architectural Design of Compute and Storage Clouds – Design Challenges

UNIT II	VIRTUALIZATION BASICS	6

Virtual Machine Basics – Taxonomy of Virtual Machines – Hypervisor – Key Concepts – Virtualization structure – Implementation levels of virtualization – Virtualization Types: Full Virtualization – Para Virtualization – Hardware Virtualization – Virtualization of CPU, Memory and I/O devices.

UNIT III	VIRTUALIZATION INFRASTRUCTURE AND DOCKER	6

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

UNIT IV	CLOUD DEPLOYMENT ENVIRONMENT	6

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

UNIT V	CLOUD SECURITY	6

Virtualization System-Specific Attacks: Guest hopping – VM migration attack – hyperjacking. Data Security and Storage; Identity and Access Management (IAM) - IAM Challenges - IAM Architecture and Practice.

TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
1. Install Virtualbox/VMware/ Equivalent open source cloud Workstation with different flavours of Linux or Windows OS on top of windows 8 and above. 2. Install a C compiler in the virtual machine created using a virtual box and execute Simple Programs 3. Install Google App Engine. Create a hello world app and other simple web applications using python/java. 4. Use the GAE launcher to launch the web applications. 5. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim. 6. Find a procedure to transfer the files from one virtual machine to another virtual machine. 7. Install Hadoop single node cluster and run simple applications like wordcount. 8. Creating and Executing Your First Container Using Docker. 9. Run a Container from Docker Hub
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2	James Turnbull, "The Docker Book", O'Reilly Publishers, 2014.
3	Krutz, R. L., Vines, R. D, "Cloud security. A Comprehensive Guide to Secure Cloud Computing", Wiley Publishing, 2010.
REFERENCES:	
1	James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
2	Tim Mather, Subra Kumaraswamy, and Shahed Latif, "Cloud Security and Privacy: an enterprise perspective on risks and compliance", O'Reilly Media, Inc., 2009.

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Course Name: CLOUD COMPUTING		Course Code: 22ADV301			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the design challenges in the cloud.	**I**	K2	1,2,3,4,6,9, 10,11	1,2
CO2	Apply the concept of virtualization and its types.	**II**	K3	1,2,3,4,5,6, 9,11,12	1,2
CO3	Experiment with virtualization of hardware resources and Docker.	**III**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Develop and deploy services on the cloud and set up a cloud environment.	**IV**	K5	1,2,3,4,6,9, 10, 11,12	1,2
CO5	Explain security challenges in the cloud environment.	**V**	K2	1,2,4,5,6, 10, 11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	1	-	-	-	1	2	1	2	1	1
CO2	3	2	3	2	2	-	-	-	2	1	2	1	3	3
CO3	2	2	3	2	2	-	-	-	3	2	2	2	3	2
CO4	2	2	3	1	1	-	-	-	2	2	2	2	2	1
CO5	2	2	2	1	1	-	-	-	2	1	1	1	2	1
CO	2.4	1.8	2.4	1.4	1.4	-	-	-	2	1.6	1.6	1.6	2.2	1.6

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22ADV302	VIRTUALIZATION	L	T	P	C
		2	0	2	3

Course Objectives:

- To Learn the basics and types of Virtualization
- To understand the Hypervisors and its types
- To Explore the Virtualization Solutions
- To Experiment the virtualization platforms

UNIT I	INTRODUCTION TO VIRTUALIZATION	6

Virtualization and cloud computing - Need of virtualization – cost, administration, fast deployment, reduce infrastructure cost – limitations- Types of hardware virtualization: Full virtualization - partial virtualization - Paravirtualization-Types of Hypervisors

UNIT II	SERVER AND DESKTOP VIRTUALIZATION	6

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

UNIT III	NETWORK VIRTUALIZATION	6

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

UNIT IV	STORAGE VIRTUALIZATION	6

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

UNIT V	VIRTUALIZATION TOOLS	6

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

TOTAL: 30PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
1. Installation and Configuration of Oracle VirtualBox with Guest OS 2. Experimenting with Type-1 and Type-2 Hypervisors 3. Server Virtualization using VMware Workstation 4. Desktop Virtualization using Windows Remote Desktop Services (RDS) 5. Network Virtualization using VLAN Configuration on GNS3/Packet Tracer 6. WAN Virtualization using WAN Emulator (WANem) 7. Configuring Storage Virtualization with FreeNAS and ISCSI Target 8. Implementing RAID Levels using Virtual Storage Devices 9. Cloud Virtualization: Deploying and Managing Virtual Servers on AWS EC2
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010
2	Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011
REFERENCES:	
1	David Marshall, Wade A. Reynolds, Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach
2	Chris Wolf, Erick M. Halter, "Virtualization: From the Desktop to the Enterprise", APress, 2005.
3	James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.

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Course Name: VIRTUALIZATION		Course Code: 22ADV302			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Analyse the virtualization concepts and Hypervisor	**I**	K1,K2	1,2,3,4,6,9, 10,11	1,2
CO2	Apply the Virtualization for real-world applications	**II**	K3,K4	1,2,3,4,5,6, 9,11,12	1,2
CO3	Install & Configure the different VM platforms	**III**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Experiment with the VM with various software	**IV**	K5	1,2,3,4,6,9, 10, 11,12	1,2
CO5	Gain practical knowledge on the usage of popular virtualization platforms	**V**	K1,K2	1,2,4,5,6,1 0, 11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	1	-	-	-	1	-	-	1	-	-
CO2	1	2	-	-	1	-	-	-	-	-	-	1	-	-
CO3	2	2	1	-	1	-	-	-	2	-	-	-	-	-
CO4	3	2	2	2	1	-	-	-	2	-	-	2	-	-
CO5	2	2	1	1	1	-	-	-	-	-	-	1	-	-
CO	2	2	1.3	1.8	1	-	-	-	1.8	-	-	1.3	-	-

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22ADV303	CLOUD ARCHITECTURES	L	T	P	C
		2	0	2	3
Course Objectives:	• Understand the Fundamentals of Cloud Computing • Explore Key Concepts in Cloud Architectures • Evaluate Cloud Service Providers and Deployment Models • Apply Design Principles for Building Cloud Architectures • Analyze Architectural Patterns and Networking Strategies in the Cloud				
UNIT I	**FOUNDATIONS OF CLOUD COMPUTING & ARCHITECTURE**				**6**
Introduction to Cloud Computing – Definition and Characteristics, Evolution of Cloud Computing, Cloud Service Models (IaaS, PaaS, SaaS), Deployment Models (Public Cloud, Private Cloud, Hybrid Cloud). Key Concepts in Cloud Architectures – Virtualization, Scalability and Elasticity, Reliability and Availability, Security in the Cloud, Compliance and Governance.					
UNIT II	**CLOUD SERVICE PROVIDERS & ARCHITECTURAL DESIGN PRINCIPLES**				**6**
Cloud Service Providers – Overview of Major Cloud Providers (AWS, Azure, Google Cloud, etc.), Comparative Analysis of Cloud Providers, Choosing the Right Cloud Service Provider. Design Principles for Cloud Architectures – Microservices Architecture, Serverless Computing, Containerization (Docker, Kubernetes), Decoupling and Asynchronous Communication.					
UNIT III	**CLOUD ARCHITECTURE PATTERNS AND NETWORKING**				**6**
Architectural Patterns in the Cloud – Multi-Tier Applications, Event-Driven Architectures, Big Data Architectures, IoT (Internet of Things) Architectures. Cloud Networking and Connectivity - Virtual Private Clouds, Content Delivery Networks (CDN), Hybrid Networking.					
UNIT IV	**CLOUD DATA MANAGEMENT**				**6**
Data Management in the Cloud – Cloud Databases (SQL and NoSQL), Data Storage Services, Data Backup and Recovery, Data Transfer and Migration Strategies.					
UNIT V	**PERFORMANCE OPTIMIZATION**				**6**
Performance Optimization and Monitoring – Resource Scaling and Auto-Scaling, Performance Monitoring and Logging, Cost Optimization Strategies, Troubleshooting and Debugging in the Cloud - Case Studies in Real-world Applications.					
	TOTAL: 30 PERIODS				

ANNAPOORANA ENGINEERING COLLEGE AUTONOMOUS SALEM

LIST OF EXPERIMENTS: 30 PERIODS
1. Deploy a virtual machine on AWS. Install a web server and share the public IP address for verification. 2. Set up auto-scaling for an Azure web app. Show how it responds to a simulated increase in user traffic. 3. Create an AWS VPC with security groups. Launch an EC2 instance with a secure connection. Share access details. 4. Dockerize three microservices (e.g., Node.js, Python, Java). Show how they communicate using Docker Compose. 5. Write an AWS Lambda function in Python. Con□igure an S3 bucket to trigger the function on object creation. 6. Build an AWS-based big data pipeline using S3, Lambda, and Athena. Show data ingestion and query results. 7. Set up an Azure VNet with front-end and back-end subnets. Implement Azure CDN for a web application. 8. Use Google Cloud Monitoring to track the performance of a Compute Engine instance. Implement auto-scaling based on metrics. 9. Analyze Netflix's cloud architecture. Identify key decisions, challenges, and benefits of their migration to the cloud.
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	"Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl, Ricardo Puttini, Zaigham Mahmood
2	"Architecting the Cloud: Design Decisions for Cloud Computing Service Models" by Michael J.Kavisv
3	"Cloud Native Patterns: Designing Change-tolerant Software" by Cornelia Davis
REFERENCES:	
1	"The Art of Cloud Computing: Building Cloud-Based Applications and Infrastructure" by Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi
2	"Cloud Computing: From Beginning to End" by Ray J. Rafaels
3	"Cloud Application Architectures: Building Applications and Infrastructure in the Cloud" by George Reese

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Course Name: CLOUD ARCHITECTURES		Course Code: 22ADV303			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the Core Concepts of Cloud Computing	**I**	K1,K2	1,2,3,4,6,9, 10,11	1,2
CO2	Demonstrate Proficiency in Designing Secure and Scalable Cloud Architectures	**II**	K3,K4	1,2,3,4,5,6, 9,11,12	1,2
CO3	Evaluate and Select Appropriate Cloud Service Providers	**III**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Apply Architectural Patterns to Real-world Cloud Solutions	**IV**	K5	1,2,3,4,6,9, 10, 11,12	1,2
CO5	Implement Efficient Networking and Data Management Strategies in Cloud Environments	**V**	K1,K2	1,2,4,5,6, 10, 11,12	1,2

CO-PO-PSO Mapping

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

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22ADV304	CLOUD APPLICATION DEVELOPMENT	L	T	P	C
		2	0	2	3

Course Objectives:

- Understand the use cases for cloud application development
- Know the appropriate cloud platforms requirements
- Understand the Cloud applications using APIs and Cloud services
- Understand the agile application development
- Manage the application life cycle using DevOps

UNIT I	INTRODUCTION TO APLLICATION DESIGN	6

Business case for implementing cloud application, Requirements, collection for cloud application development, Cloud service models and deployment models, Open challenges in Cloud Computing: Cloud inter-operability and standards, scalability and fault tolerance, security, trust and privacy.

UNIT II	APPLICATION DEVELOPMENT FRAMEWORK	6

Accessing the clouds: Web application vs Cloud Application, Frameworks: Model View Controller (MVC), Struts, Spring. Cloud platforms in Industry – Google AppEngine, Microsoft Azure, Openshift, Cloud Foundry

UNIT III	CLOUD SERVICE DELIVERY ENVIRONMENT AND API	6

Storing objects in the Cloud, Session management, Working with third party APIs: Overview of interconnectivity in Cloud ecosystems. Facebook API, Twitter API, Google API. **Architecting for the Cloud :** Best practices Best practices in architecture cloud applications in AWS cloud, Amazon Simple Queue Service (SQS), RabbitMQ, Amazon Simple Notification Service (Amazon SNS), multi-player online game hosting on cloud resources, Building content delivery networks using clouds.

UNIT IV	DEVOPS IN CLOUD	6

Continuous Integration/Continuous Deployment (CI/CD), collaboration among development, operations, and other stakeholders, Agile and lean principles: Embracing agile methodologies and lean practices to enable faster development and delivery cycles..

UNIT V	IMPLEMENTATION	6

Automating development pipelines, Monitoring and Logging, Implementing monitoring solutions for cloud applications, Containerization: Docker basics and container orchestration with Kubernetes PROJECTS: Projects involving Google AppEngine, Microsoft Azure, Openshift, Cloud Foundry services will be done

TOTAL: 30 PERIODS

ANNAPOORANA ENGINEERING COLLEGE AUTONOMOUS SALEM

LIST OF EXPERIMENTS: 30 PERIODS
1. Design a Cloud Application with Business Requirements 2. Develop a Simple MVC Web Application Using Spring Framework 3. Deploy a Sample Application in Google App Engine or Microsoft Azure 4. Consume Third-Party APIs (Google Maps, Twitter, or Facebook API) 5. Implement AWS Messaging Services: SQS and SNS 6. Build a Continuous Integration Pipeline using GitHub Actions/Jenkins 7. Dockerize a Web Application and Run it in a Container 8. Deploy a Containerized Application in Kubernetes Cluster
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Cloud Application Architectures: Building Applications and Infrastructure in the Cloud by George Reese, Oreilly Publication, 2021.
REFERENCES:	
1	Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation by Jez Humble and David Farley, 2020.
2	https://www.coursera.org/specializations/ibm-cloud-application-development-foundations
3	https://www.udemy.com/course/cloud-computing-development-essentials/

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Course Name: CLOUD APPLICATION DEVELOPMENT		Course Code: 22ADV304			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Analyse the use cases for cloud application development	**I**	K1,K2	1,2,3,4,6,9, 10,11	1,2
CO2	Compare web and cloud application and analyze appropriate cloud platforms requirements	**II**	K3,K4	1,2,3,4,5,6, 9,11,12	1,2
CO3	Build applications using APIs and Cloud services	**III**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Apply agile application development and manage application life cycle using DevOps	**IV**	K5	1,2,3,4,6,9, 10, 11,12	1,2
CO5	Develop, containerize, and deploy end-to-end cloud applications using container orchestration	**V**	K1,K2	1,2,4,5,6, 10, 11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	1	3	-	-	-	1	2	1	2	1	1
CO2	3	1	2	1	3	-	-	-	2	2	1	3	3	1
CO3	2	2	1	3	1	-	-	-	3	3	1	2	3	1
CO4	2	1	1	1	2	-	-	-	2	1	2	2	3	1
CO5	1	3	2	2	1	-	-	-	3	2	1	1	2	1
CO	2.2	1.8	1.8	1.6	2	-	-	-	2.2	2	1.2	2	2.4	1

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22ADV305	STORAGE TECHNOLOGIES	L	T	P	C
		2	0	2	3

Course Objectives:

- Characterize the functionalities of logical and physical components of storage
- Describe various storage networking technologies
- Identify different storage virtualization technologies
- Discuss the different backup and recovery strategies
- Understand common storage management activities and solutions

UNIT I	STORAGE SYSTEMS	6

Introduction to Information Storage: Digital data and its types, Information storage, Key characteristics of data center and Evolution of computing platforms. Information Lifecycle Management. Third Platform Technologies: Cloud computing and its essential characteristics, Cloud services and cloud deployment models, Big data analytics, Social networking and mobile computing.

UNIT II	DATA CENTER ENVIRONMENT	6

Data Center Environment: Building blocks of a data center, Compute systems and compute virtualization and Software-defined data center, Components of an intelligent storage system, Components, addressing, and performance of hard disk drives and solid-state drives.

UNIT III	RAID TECHNOLOGY	6

Introduction to RAID, Architecture, Levels, Hardware RAIDs, Software RAIDs, Implementation methods, Modern Alternatives and Extensions, Scale-up and Scale-out Storage Architecture.

UNIT IV	BACKUP, ARCHIVE AND REPLICATION	6

Introduction to Business Continuity, Backup architecture, Backup targets and methods, Data deduplication, Cloud-based and mobile device backup, Data archive, Uses of replication and its characteristics, Compute based, storage-based, and network-based replication, Data migration, Disaster Recovery as a Service (DRaaS).

UNIT V	SECURING STORAGE INFRASTRUCTURE	6

Information security goals, Storage security domains, Threats to a storage infrastructure, Security controls to protect a storage infrastructure, Governance, risk, and compliance, Storage infrastructure management functions, Storage infrastructure management processes.

TOTAL: 30 PERIODS

ANNAPOORANA ENGINEERING COLLEGE AUTONOMOUS SALEM

LIST OF EXPERIMENTS: 30 PERIODS
1. Exploring Cloud Storage Solutions (Google Drive, AWS S3) 2. Setting Up a Basic Information Lifecycle Management (ILM) Policy 3. Understanding Compute Virtualization Using VirtualBox/VMware 4. Performance Comparison: HDD vs SSD in Local Systems 5. Implementing RAID Levels (RAID 0, RAID 1, RAID 5) Using Software RAID Tools (Linux mdadm) 6. Configuring Data Backup and Recovery Using Duplicati or Veeam Backup 7. Setting up Data Replication Between Two Virtual Machines **8.** Configuring Storage Security Policies Using Encryption Tools (e.g., VeraCrypt or LUKS)
TOTAL : 60 PERIODS

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

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Course Name: STORAGE TECHNOLOGIES		Course Code: 22ADV305			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Demonstrate the fundamentals of information storage management	**I**	K1,K2	1,2,3,4,6,9, 10,11	1,2
CO2	Discuss the various models of Cloud infrastructure services and deployment	**II**	K3,K4	1,2,3,4,5,6, 9,11,12	1,2
CO3	Illustrate the usage of advanced intelligent storage systems and RAID	**III**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Examine the different role in providing disaster recovery and remote replication technologies	**IV**	K5	1,2,3,4,6,9, 10,11,12	1,2
CO5	Infer the security needs and security measures to be employed in information storage management	**V**	K1,K2	1,2,4,5,6, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PS2O2
CO1	2	2	3	1	1	-	-	-	1	2	1	1	3	1
CO2	3	3	3	2	3	-	-	-	1	2	21	2	3	1
CO3	2	2	3	3	2	-	-	-	3	1	1	3	3	2
CO4	2	1	1	2	2	-	-	-	3	3	2	1	1	3
CO5	2	3	2	3	2	-	-	-	3	3	1	3	3	1
CO	2.2	2.2	2.4	2.2	2	-	-	-	2.2	2.2	1.4	2	2.6	1.6

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22ADV306	SOFTWARE DEFINED NETWORK	L	T	P	C
		2	0	2	3
Course Objectives:	• To understand the need for SDN and its data plane operations • To understand the functions of control plane • To comprehend the migration of networking functions to SDN environment • To explore various techniques of network function virtualization • To comprehend the concepts behind network virtualization				
UNIT I	**SDN: INTRODUCTION**				**6**
Evolving Network Requirements – The SDN Approach – SDN architecture - SDN Data Plane , Control plane and Application Plane					
UNIT II	**SDN DATA PLANE AND CONTROL PLANE**				**6**
Data Plane functions and protocols - OpenFLow Protocol - Flow Table - Control Plane Functions - Southbound Interface, Northbound Interface – SDN Controllers - Ryu, OpenDaylight, ONOS - Distributed Controllers					
UNIT III	**SDN APPLICATIONS**				**6**
SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking					
UNIT IV	**NETWORK FUNCTION VIRTUALIZATION**				**6**
Network Virtualization - Virtual LANs – OpenFlow VLAN Support - NFV Concepts – Benefits and Requirements – Reference Architecture					
UNIT V	**NFV FUNCTIONALITY**				**6**
NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFV Use cases – SDN and NFV					
					TOTAL: 30PERIODS

ANNAPOORANA ENGINEERING COLLEGE AUTONOMOUS SALEM

LIST OF EXPERIMENTS: 30 PERIODS
1. Introduction to SDN and Mininet Network Emulator 2. Implementation of OpenFlow Protocol Using Mininet and Wireshark 3. Working with SDN Controllers (Ryu/OpenDaylight) 4. Developing Simple SDN Applications for Traffic Engineering 5. Configuring Network Function Virtualization (NFV) using Open Source Tools (e.g., OpenStack or simple VM-based VNFs) 6. Integration of SDN and NFV: Use Case Implementation
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud", Pearson Education, 1st Edition, 2015.
2	Thomas D Nadeau, Ken Gray, "SDN: Software Defined Networks", O'Reilly Media, 2013.
REFERENCES:	
1	Ken Gray, Thomas D. Nadeau, "Network Function Virtualization", Morgan Kauffman, 2016.
2	Fei Hu, "Network Innovation through OpenFlow and SDN: Principles and Design", 1st Edition, CRC Press, 2014.

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Course Name: SOFTWARE DEFINED NETWORK		Course Code: 22ADV306			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Describe the motivation behind SDN	**I**	K1,K2	1,2,3,4,6,9, 10,11	1,2
CO2	Identify the functions of the data plane and control plane	**II**	K3,K4	1,2,3,4,5,6, 9,11,12	1,2
CO3	Design and develop network applications using SDN	**III**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Orchestrate network services using NFV	**IV**	K5	1,2,3,4,6,9, 10,11,12	1,2
CO5	Explain various use cases of SDN and NFV	**V**	K1,K2	1,2,4,5,6, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	1	2	-	-	-	1	2	2	1	3	1
CO2	3	3	3	2	3	-	-	-	1	2	1	2	3	1
CO3	1	2	3	3	3	-	-	-	3	1	1	3	3	2
CO4	1	1	1	2	3	-	-	-	3	3	2	1	1	3
CO5	3	3	2	3	2	-	-	-	3	3	1	3	3	1
CO	2	1.8	2.2	2.4	2.6	-	-	-	2.2	2	1.4	2	1.6	2

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22ADV307	STREAM PROCESSING	L	T	P	C
		2	0	2	3

Course Objectives:

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

UNIT I	FOUNDATIONS OF DATA SYSTEMS	6

Introduction to Data Processing, Stages of Data processing, Data Analytics, Batch Processing, Stream processing, Data Migration, Transactional Data processing, Data Mining, Data Management Strategy.

UNIT II	REAL-TIME DATA PROCESSING	6

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

UNIT III	DATA MODELS AND QUERY LANGUAGES	6

Relational Model, Document Model, Key-Value Pairs, NoSQL, Object-Relational Mismatch, Many- to-One and Many-to-Many Relationships, Network data models, Schema Flexibility, Structured Query Language, Data Locality for Queries, Declarative Queries.

UNIT IV	EVENT PROCESSING WITH APACHE KAFKA	6

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

UNIT V	REAL-TIME PROCESSING USING SPARK STREAMING	6

Structured Streaming, Basic Concepts, Handling Event-time and Late Data, Fault-tolerant Semantics, Exactly-once Semantics, Creating Streaming Datasets, Schema Inference, Partitioning of Streaming datasets, Operations on Streaming Data, Selection, Aggregation, Projection.

TOTAL: 30 PERIODS

ANNAPOORANA ENGINEERING COLLEGE AUTONOMOUS SALEM

LIST OF EXPERIMENTS: 30 PERIODS
1. Exploring Batch and Stream Processing using Python 2. Setup and Demonstration of Lambda and Kappa Architecture 3. Working with NoSQL Databases (MongoDB or Redis) 4. Basic Event Streaming Using Apache Kafka 5. Data Stream Partitioning and Aggregation in Kafka 6. Real-Time Data Processing using Apache Spark Streaming 7. Handling Late Data and Fault-Tolerant Stream Processing in Spark
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Streaming Systems: The What, Where, When and How of Large-Scale Data Processing by Tyler Akidau, Slava Chemyak, Reuven Lax, O'Reilly publication
2	Designing Data-Intensive Applications by Martin Kleppmann, O'Reilly Media.
REFERENCES:	
1	Practical Real-time Data Processing and Analytics : Distributed Computing and Event Processing using Apache Spark, Flink, Storm and Kafka, Packt Publishing
2	https://spark.apache.org/docs/latest/streaming-programming-guide.html
3	Kafka.apache.org

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Course Name: STREAM PROCESSING		Course Code: 22ADV307			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the applicability and utility of different streaming algorithms	**I**	K1,K2	1,2,3,4,6,9, 10,11	1,2
CO2	Describe and apply current research trends in data-stream processing.	**II**	K3,K4	1,2,3,4,5,6, 9,11,12	1,2
CO3	Analyze the suitability of stream mining algorithms for data stream systems	**III**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Program and build stream processing systems, services and applications.	**IV**	K5	1,2,3,4,6,9, 10,11,12	1,2
CO5	Solve problems in real-world applications that process data streams.	**V**	K1,K2	1,2,4,5,6, 10,11,12	1,2

CO-PO-PSO Mapping

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

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22ADV308	SECURITY AND PRIVACY IN CLOUD	L	T	P	C
		2	0	2	3

Course Objectives:

- To Introduce Cloud Computing terminology, definition & concepts
- To understand the security design and architectural considerations for Cloud
- To understand the Identity, Access control in Cloud
- To follow best practices for Cloud security using various design patterns
- To be able to monitor and audit cloud applications for security

UNIT I	FUNDAMENTALS OF CLOUD SECURITY CONCEPTS	6

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

UNIT II	SECURITY DESIGN AND ARCHITECTURE FOR CLOUD	6

Security design principles for Cloud Computing - Comprehensive data protection - End-to-end access control - Common attack vectors and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies

UNIT III	ACCESS CONTROL AND IDENTITY MANAGEMENT	6

Access control requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles-based Access Control - Multi-factor authentication - Single Sign-on, Identity Federation - Identity providers and service consumers

UNIT IV	CLOUD SECURITY DESIGN PATTERNS	6

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

UNIT V	MONITORING, AUDITING AND MANAGEMENT	6

Proactive activity monitoring - Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges - Events and alerts - Auditing – Record generation, Reporting and Management.

TOTAL: 30 PERIODS

ANNAPOORANA ENGINEERING COLLEGE AUTONOMOUS SALEM

LIST OF EXPERIMENTS: 30 PERIODS
1. Basic Cryptographic Techniques in Cloud (Encryption, Decryption using OpenSSL) 2. Implementing Hashing and Digital Signatures for Data Integrity 3. Configuring Secure Network Isolation using Virtual Private Cloud (AWS VPC / OpenStack Neutron) 4. Designing Cloud Access Control using Role-Based Access Control (RBAC) 5. Setting up Multi-Factor Authentication (MFA) for Cloud Accounts (AWS/GCP) 6. Applying Cloud Security Design Patterns (Geo-Tagging or Secure Cloud Interfaces) 7. Monitoring Cloud Resources for Unauthorized Access Using AWS CloudTrail or OpenStack Audit 8. Incident Response and Alert Configuration Using Cloud Monitoring Tools (CloudWatch, Grafana)
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Raj Kumar Buyya , James Broberg, andrzejGoscinski, —Cloud Computing:‖, Wiley 2013
2	Dave shackleford, —Virtualization Security‖, SYBEX a wiley Brand 2013.
3	Mather, Kumaraswamy and Latif, —Cloud Security and Privacy‖, OREILLY 2011
REFERENCES:	
1	Mark C. Chu-Carroll —Code in the Cloud‖,CRC Press, 2011
2	Mastering Cloud Computing Foundations and Applications Programming RajkumarBuyya, Christian Vechhiola, S. ThamaraiSelvi

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Course Name: SECURITY AND PRIVACY IN CLOUD		Course Code: 22ADV308			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the cloud concepts and fundamentals.	**I**	K3	1,2,3	1,2
CO2	Explain the security challenges in the cloud.	**II**	K3	1,2,3	1,2
CO3	Define cloud policy and Identity and Access Management.	**III**	K3	1,2,3	1,2
CO4	Understand various risks and audit and monitoring mechanisms in the cloud.	**IV**	K3	1,2,3	1,2
CO5	Define the various architectural and design considerations for security in the cloud.	**V**	K3	1,2,3	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	-	-	-	1	1	2
CO2	3	2	2	2	3	-	-	-	-	-	2	1	1	1
CO3	3	3	3	3	-	-	-	-	-	-	-	1	2	2
CO4	3	3	3	3	-	-	-	-	-	-	-	1	2	1
CO5	3	2	2	2	-	-	-	-	-	-	2	1	1	2
CO	3	2.6	2.6	2.4	2.5	-	-	-	-	-	2	1	1.6	1.8

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VERTICAL IV: CYBER SECURITY

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22ADV401	Ethical Hacking	PE	2	0	2	4	3
2.	22ADV402	Digital and Mobile Forensics	PE	2	0	2	4	3
3.	22ADV403	Social Network Security	PE	2	0	2	4	3
4.	22ADV404	Modern Cryptography	PE	2	0	2	4	3
5.	22ADV405	Engineering Secure Software Systems	PE	2	0	2	4	3
6.	22ADV406	Web Application Security	PE	2	0	2	4	3
7.	22ADV407	Data and Information Security	PE	2	0	2	4	3
8.	22ADV408	Cyber Security	PE	2	0	2	4	3

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22ADV401	ETHICAL HACKING	L	T	P	C
		2	0	2	3

Course Objectives:

- To understand the basics of computer based vulnerabilities.
- To explore different foot printing, reconnaissance and scanning methods.
- To expose the enumeration and vulnerability analysis methods.
- To understand hacking options available in Web and wireless applications.
- To explore the options for network protection.

UNIT I	INTRODUCTION	6

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

UNIT II	FOOTPRINTING	6

Footprinting Concepts - Footprinting through Search Engines, Web Services, Social Networking Sites, Website, Email – Competitive Intelligence – Footprinting through Social Engineering-Footprinting Tools.

UNIT III	ENUMERATION AND VULNERABILITY ANALYSIS	6

Enumeration Concepts – Net BIOS Enumeration– SNMP, LDAP, NTP, SMTP and DNS Enumeration - Vulnerability Assessment Concepts- Desktop and Server OS Vulnerabilities-Windows OS Vulnerabilities

UNIT IV	SYSTEM HACKING	6

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

UNIT V	NETWORK PROTECTION SYSTEMS	6

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

TOTAL: 30 PERIODS

ANNAPOORANA ENGINEERING COLLEGE AUTONOMOUS SALEM

LIST OF EXPERIMENTS: 30 PERIODS
1. Study of Malware Types and Protection Techniques Using Antivirus Tools 2. Performing Footprinting Using Search Engines and Social Media 3. Using Footprinting Tools (e.g., Nmap, Maltego) for Active Scanning 4. Enumeration of Network Services Using SNMP, LDAP, and NetBIOS Tools 5. Conducting Vulnerability Assessment Using OpenVAS or Nessus 6. Web Application Hacking Using OWASP ZAP or Burp Suite 7. Wireless Network Hacking Simulation Using Wireshark and Aircrack-ng (Simulation Purpose Only) 8. Firewall Configuration and IDS/IPS Testing Using Snort or Security Onion
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Michael T. Simpson, Kent Backman, and James E. Corley, Hands-On Ethical Hacking and Network Defense, Course Technology, Delmar Cengage Learning, 2010.
2	The Basics of Hacking and Penetration Testing - Patrick Engebretson, SYNGRESS, Elsevier, 2013.
3	The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, DafyddStuttard and Marcus Pinto, 2011.
REFERENCES:	
1	Black Hat Python: Python Programming for Hackers and Pentesters, Justin Seitz , 2014.

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Course Name: ETHICAL HACKING		Course Code: 22ADV401			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand fundamental concepts of ethical hacking, security testing methodologies, malware types, and protection mechanisms.	**I**	K1,K2	1,2,3,4,6,9, 10,11	1,2
CO2	Perform footprinting, reconnaissance, and scanning techniques to gather information about target systems and networks.	**II**	K3,K4	1,2,3,4,5,6, 9,11,12	1,2
CO3	Analyze and identify system and network vulnerabilities through enumeration and vulnerability assessment tools.	**III**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Evaluate and demonstrate hacking techniques in web applications and wireless networks using ethical tools and environments.	**IV**	K5	1,2,3,4,6,9, 10,11,12	1,2
CO5	Apply network protection strategies using firewalls, access control mechanisms, IDS/IPS systems, and risk analysis tools.	**V**	K1,K2	1,2,4,5,6, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	1	1	1	1	1	0
CO2	3	3	2	3	2	2	-	-	2	0	2	3	2	1
CO3	3	3	3	2	2	2	-	-	2	2	2	3	2	1
CO4	3	3	2	2	2	2	-	-	1	1	2	2	2	1
CO5	3	3	2	3	3	3	-	-	-	0	2	2	2	1
CO	3	3	2	2	2	2	-	-	1	1	2	2	2	1

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22ADV402	DIGITAL AND MOBILE FORENSICS	L	T	P	C
		2	0	2	3

Course Objectives:

- To understand basic digital forensics and techniques.
- To understand digital crime and investigation.
- To understand how to be prepared for digital forensic readiness.
- To understand and use forensics tools for Ios devices.
- To understand and use forensics tools for Android devices.

UNIT I	INTRODUCTION TO DIGITAL FORENSICS	6

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

UNIT II	DIGITAL CRIME AND INVESTIGATION	6

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

UNIT III	DIGITAL FORENSIC READINESS	6

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

UNIT IV	iOS FORENSICS	6

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

UNIT V	ANDROID FORENSICS	6

Android basics – Key Codes – ADB – Rooting Android – Boot Process – File Systems – Security – Tools – Android Forensics – Forensic Procedures – ADB – Android Only Tools – Dual Use Tools – Oxygen Forensic.

TOTAL: 30 PERIODS

ANNAPOORANA ENGINEERING COLLEGE AUTONOMOUS SALEM

LIST OF EXPERIMENTS: 30 PERIODS
1. Study of Digital Forensics Process and Identification of Digital Evidence
2. Collecting and Preserving Digital Evidence from Storage Media
3. Analyzing a Digital Crime Case using Open-Source Forensics Tools
4. Understanding Forensic Readiness through Enterprise Log Collection
5. Mobile Forensic Data Extraction from iOS Devices Using Oxygen Forensics or MobilEdit
6. File System Analysis of iOS Device Backups
7. Android Device Data Extraction Using ADB and Mobile Forensic Tools
8. Android Forensic Investigation Using Autopsy/MobSF (Mobile Security Framework)
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Andre Arnes, "Digital Forensics", Wiley, 2018.
2	Chuck Easttom, "An In-depth Guide to Mobile Device Forensics", First Edition, CRC Press, 2022.
REFERENCES:	
1	Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.

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Course Name: DIGITAL AND MOBILE FORENSICS		Course Code: 22ADV402			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Have knowledge on digital forensics.	**I**	K1,K2	1,2,3,4,6,9, 10,11	1,2
CO2	Know about digital crime and investigations.	**II**	K3,K4	1,2,3,4,5,6, 9,11,12	1,2
CO3	Be forensic ready.	**III**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Investigate, identify and extract digital evidence from iOS devices.	**IV**	K5	1,2,3,4,6,9, 10,11,12	1,2
CO5	Investigate, identify and extract digital evidence from Android devices.	**V**	K1,K2	1,2,4,5,6, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	3	-	-	-	1	1	2	1	2	3
CO2	2	1	3	2	2	-	-	-	3	2	2	3	3	2
CO3	2	2	2	1	2	-	-	-	1	1	1	1	1	1
CO4	1	3	1	1	3	-	-	-	1	1	3	2	1	3
CO5	1	1	3	1	3	-	-	-	1	1	2	1	3	2
CO	1.6	1.8	2	1.4	2.6	-	-	-	1.4	1.2	2	1.6	2	2.2

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22ADV403	SOCIAL NETWORK SECURITY	L	T	P	C
		2	0	2	3

Course Objectives:

- To develop semantic web-related simple applications.
- To explain privacy and security issues in social networking.
- To explain data extraction and mining of social networks.
- To discuss the prediction of human behavior in social communities.
- To describe access control, privacy, and security management of social network

UNIT I	FUNDAMENTALS OF SOCIAL NETWORKING	6

Introduction to Semantic Web, Limitations of current Web, Development of Semantic Web, Emergence of the Social Web, Social Network analysis, Development of Social Network Analysis, Key concepts and measures in network analysis.

UNIT II	SECURITY ISSUES IN SOCIAL NETWORKS	6

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

UNIT III	EXTRACTION AND MINING IN SOCIAL NETWORKS	6

Extracting evolution of Web Community from a series of Web Archive, detecting communities in social networks, definition of community, evaluating communities, methods for community detection and mining, applications of community mining algorithms.

UNIT IV	PREDICTING HUMAN BEHAVIOUR AND PRIVACY ISSUES	6

Understanding and predicting human behavior for social communities, User dataManagement, Inference and Distribution, Enabling new human experiences, Reality mining, Context, Awareness, Privacy in online social networks, Trust in online environment.

UNIT V	ACESS CONTROL AND PRIVACY	6

Understand the access control requirements for Social Network, Enforcing Access Control Strategies, Authentication and Authorization, Roles-based Access Control, Host, storage and network access control options, Firewalls, Authentication, and Authorization in Social Network.

TOTAL: 30 PERIODS

ANNAPOORANA ENGINEERING COLLEGE AUTONOMOUS SALEM

LIST OF EXPERIMENTS: 30 PERIODS
1. Develop a Semantic Web Application using RDF and OWL to describe relationships between users in a social network.
2. Analyze a Social Network Graph using Gephi or NetworkX to compute centrality, degree, and clustering coefficient
3. Implement Privacy Settings Simulation to demonstrate user-level control over visibility and data sharing.
4. Extract Communities from a Social Graph using community detection algorithms like Girvan-Newman or Louvain.
5. Mine Social Media Data (e.g., Twitter or Reddit) using Python APIs and perform basic sentiment or trend analysis.
6. Design a Role-Based Access Control (RBAC) model for a social media application scenario.
7. Simulate Anonymity and Identity Masking in a chat-based network using pseudonyms or encryption techniques.
8. Case Study on Privacy Breach in Social Networks and propose countermeasures using access control and firewalls.
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Peter Mika, Social Networks and the Semantic Web, First Edition, Springer 2007.
2	BorkoFurht, Handbook of Social Network Technologies and Application, First Edition, Springer, 2010.
3	Learning Neo4j 3.x –Second Edition By Jérôme Baton, Rik Van Bruggen, Packt publishing.
REFERENCES:	
1	David Easley, Jon Kleinberg, Networks, Crowds, and Markets: Reasoning about a Highly Connected World‖, First Edition, Cambridge University Press, 2010.
2	asley D. Kleinberg J., Networks, Crowds, and Markets – Reasoning about a Highly Connected World‖, Cambridge University Press, 2010.
3	GuandongXu ,Yanchun Zhang and Lin Li, Web Mining and Social Networking – Techniques and applications‖, First Edition, Springer, 2011.
4	Dion Goh and Schubert Foo, Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively‖, IGI Global Snippet, 2008.

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Course Name: SOCIAL NETWORK SECURITY		Course Code: 22ADV403			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Develop semantic web related simple applications	**I**	K2	1,2,5,12	1,2
CO2	Address Privacy and Security issues in Social Networking	**II**	K3	1,2,3,5, 11, 12	1,2
CO3	Explain the data extraction and mining of social networks	**III**	K3	1,2,3,5,9, 10,11,12	1,2
CO4	Discuss the prediction of human behavior in social communities	**IV**	K4	1,2,3,4,5, 11,12	1,2
CO5	Describe the applications of social networks	**V**	K4	1,2,3,4,5,6, 7,8, 9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	1	-	-	-	2	-	-	-	2	3
CO2	3	1	1	-	2	-	-	-	1	-	-	2	2	2
CO3	1	1	2	-	3	-	-	-	3	1	1	2	3	1
CO4	1	1	2	2	3	-	-	-	2	-	-	2	1	1
CO5	1	3	1	2	2	-	-	1	1	1	1	2	1	2
CO	1.8	1.8	1.5	2	2.2	-	-	1	1.8	1	1	2	1.8	1.8

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22ADV404	MODERN CRYPTOGRAPHY	L	T	P	C
		2	0	2	3

Course Objectives:

- To learn about modern cryptography.
- To focus on how cryptographic algorithms and protocols work and how to use them.
- To build a pseudorandom permutation.
- To construct basic cryptanalytic techniques.

UNIT I	INTRODUCTION	6

Basics of Symmetric Key Cryptography, Basics of Asymmetric Key Cryptography, Hardness of Functions. Notions of Semantic Security (SS) and Message Indistinguishability (MI): Proof of Equivalence of SS and MI, Hard Core Predicate.

UNIT II	FORMAL NOTIONS OF ATTACKS	6

Trap-door permutation, Goldwasser-Micali Encryption. Goldreich-Levin Theorem: Relation between Hardcore Predicates and Trap-door permutations, Attacks under Message Indistinguishability: Chosen Plaintext Attack (IND-CPA), Chosen Ciphertext Attacks (IND-CCA1 and IND-CCA2)

UNIT III	ATTACK MODELS	6

Attacks under Message Non-malleability: NM-CPA and NM-CCA2, Inter-relations among the attack model, Provable Security and asymmetric cryptography, hash functions. One-way functions: Weak and Strong one-way functions.

UNIT IV	RANDOM ORACLES	6

Pseudo-random Generators (PRG): Blum-Micali-Yao Construction, Construction of more powerful PRG, Relation between One-way functions and PRG, Pseudo- random Functions (PRF)

UNIT V	BUILDING A PSEUDORANDOM PERMUTATION	6

The LubyRackoff Construction: Formal Definition, Application of the LubyRackoff Construction to the construction of Block Ciphers, The DES in the light of LubyRackoff Construction.

TOTAL: 30 PERIODS

ANNAPOORANA ENGINEERING COLLEGE AUTONOMOUS SALEM

LIST OF EXPERIMENTS: 30 PERIODS
1. Implement Symmetric and Asymmetric Encryption (AES and RSA)
2. Demonstration of Semantic Security and Message Indistinguishability
3. Implementing Trapdoor Permutation and Goldwasser-Micali Encryption
4. Simulating Chosen Plaintext and Chosen Ciphertext Attacks (CPA, CCA)
5. Analysis of One-Way Functions and Hash Functions (SHA-256)
6. Pseudo-Random Number Generation using Blum-Micali Algorithm
7. Pseudo-Random Function (PRF) Implementation and Testing
8. Building a Simple Block Cipher using Luby-Rackoff Construction
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Hans Delfs and Helmut Knebl, Introduction to Cryptography: Principles and Applications, Springer Verlag.
2	Wenbo Mao, Modern Cryptography, Theory and Practice, Pearson Education (Low Priced Edition)
REFERENCES:	
1	ShaffiGoldwasser and MihirBellare, Lecture Notes on Cryptography, Available at http://citeseerx.ist.psu.edu/.
2	OdedGoldreich, Foundations of Cryptography, CRC Press (Low Priced Edition Available), Part 1 and Part 23
3	William Stallings, "Cryptography and Network Security: Principles and Practice", PHI 3rd Edition, 2006.

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Course Name: MODERN CRYPTOGRAPHY		Course Code: 22ADV404			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Interpret the basic principles of cryptography and general cryptanalysis.	**I**	K3	1,2,3,5,9, 10,11,12	1,2
CO2	Determine the concepts of symmetric encryption and authentication.	**II**	K5	1,2,3,4,5,8, 9, 10,11,12	1,2
CO3	Identify the use of public key encryption, digital signatures, and key establishment.	**III**	K3	1,2,3,5,6,9, 10,11,12	1,2
CO4	Articulate the cryptographic algorithms to compose, build and analyze simple cryptographic solutions.	**IV**	K3	1,2,3,5,9, 10,11,12	1,2
CO5	Express the use of Message Authentication Codes.	**V**	K6	1,2,3,5,9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	3	-	2	-	-	-	1	2	1	1	1	1
CO2	2	2	2	2	2	-	-	1	1	2	1	2	2	1
CO3	2	2	3	-	2	1	-	-	2	2	2	2	1	2
CO4	2	1	2	-	2	-	-	-	1	2	1	1	2	1
CO5	2	1	3	-	2	-	-	-	2	2	2	2	2	2
CO	2	1.3	2.6	2	2	1	-	1	1.4	2	1.5	1.5	1.5	1.5

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22ADV405	ENGINEERING SECURE SOFTWARE SYSTEMS	L	T	P	C
		2	0	2	3

Course Objectives:

- Know the importance and need for software security.
- Know about various attacks.
- Learn about secure software design.
- Understand risk management in secure software development.
- Know the working of tools related to software security.

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

Software Assurance and Software Security - Threats to software security - Sources of software insecurity - Benefits of Detecting Software Security - Properties of Secure Software – Memory- Based Attacks: Low-Level Attacks Against Heap and Stack - Defense Against Memory-Based Attacks

UNIT II	SECURE SOFTWARE DESIGN	6

Requirements Engineering for secure software - SQUARE process Model - Requirements elicitation and prioritization- Isolating The Effects of Untrusted Executable Content - Stack Inspection – Policy Specification Languages – Vulnerability Trends.

UNIT III	SECURITY RISK MANAGEMENT	6

Risk Management Life Cycle – Risk Profiling – Risk Exposure Factors – Risk Evaluation and Mitigation – Risk Assessment Techniques – Threat and Vulnerability Management

UNIT IV	SECURITY TESTING	6

Traditional Software Testing – Comparison - Secure Software Development Life Cycle - Risk Based Security Testing – Prioritizing Security Testing With Threat Modeling – Penetration Testing– Planning and Scoping.

UNIT V	SECURE PROJECT MANAGEMENT	6

Governance and security - Adopting an enterprise software security framework - Security and project management - Maturity of Practice.

TOTAL: 30 PERIODS

ANNAPOORANA ENGINEERING COLLEGE AUTONOMOUS SALEM

LIST OF EXPERIMENTS: 30 PERIODS
1. Demonstration of Common Software Security Vulnerabilities (OWASP Top 10) 2. Demonstration of Memory-Based Attacks (Buffer Overflow Attack Simulation) 3. Secure Requirements Elicitation Using SQUARE Process Model 4. Threat Modeling Using Microsoft Threat Modeling Tool or OWASP Threat Dragon 5. Performing Security Risk Profiling Using Simple Risk Assessment Matrix 6. Penetration Testing and Vulnerability Scanning Using Open-Source Tools (e.g., Nikto, Nmap) 7. Secure Code Review Using Static Analysis Tools (e.g., SonarQube)
TOTAL : 30 PERIODS

TEXT BOOKS:	
1	Julia H. Allen, "Software Security Engineering", Pearson Education, 2008
2	Evan Wheeler, "Security Risk Management: Building an Information Security Risk Management Program from the Ground Up", First edition, Syngress Publishing, 2011
REFERENCES:	
1	Robert C. Seacord, "Secure Coding in C and C++ (SEI Series in Software Engineering)", Addison-Wesley Professional, 2005.
2	Jon Erickson, "Hacking: The Art of Exploitation", 2nd Edition, No Starch Press, 2008.
3	Mike Shema, "Hacking Web Apps: Detecting and Preventing Web Application Security Problems", First edition, Syngress Publishing, 2012
4	Bryan Sullivan and Vincent Liu, "Web Application Security, A Beginner's Guide", Kindle Edition, McGraw Hill, 2012
5	Lee Allen, "Advanced Penetration Testing for Highly-Secured Environments: The Ultimate Security Guide (Open Source: Community Experience Distilled)", Kindle Edition, Packt Publishing,2012

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Course Name: ENGINEERING SECURE SOFTWARE SYSTEMS		Course Code: 22ADV405			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the fundamentals of software security and identify common low-level attacks in software systems.	**I**	K2	1,2,5,10,12	1,2
CO2	Apply secure software design principles and utilize secure requirement engineering techniques.	**II**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO3	Analyze and manage software security risks using appropriate risk assessment techniques and frameworks.	**III**	K4	1,2,3,4,5, 10,11,12	1,2
CO4	Perform security testing, including threat modeling, penetration testing.	**IV**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO5	Demonstrate knowledge of governance, secure project management practices.	**V**	K4	1,2,3,4,5,9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	1	-	-	-	-	1	-	1	-	1
CO2	2	2	2	1	2	-	-	-	1	2	2	2	1	2
CO3	2	2	3	2	2	-	-	-	1	2	2	2	2	2
CO4	2	2	2	2	3	-	-	-	-	1	2	2	2	2
CO5	2	2	2	2	3	-	-	-	1	2	2	3	2	2
CO	2	1.8	1.2	1.8	2.6	-	-	-	1	1.8	2	2	1.8	1.8

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22ADV406	WEB APPLICATION SECURITY	L	T	P	C
		2	0	2	3

Course Objectives:

- To understand the fundamentals of web application security
- To focus on wide aspects of secure development and deployment of web applications
- To learn how to build secure APIs
- To learn the basics of vulnerability assessment and penetration testing
- To get an insight about Hacking techniques and Tools

UNIT I	FUNDAMENTALS OF WEB APPLICATION SECURITY	6

The history of Software Security-Recognizing Web Application Security Threats, Web Application Security, Authentication and Authorization, Secure Socket layer, Transport layer Security, Session Management-Input Validation

UNIT II	SECURE DEVELOPMENT AND DEPLOYMENT	6

Web Applications Security - Security Testing, Security Incident Response Planning,The Microsoft Security Development Lifecycle (SDL), OWASP Comprehensive Lightweight Application Security Process (CLASP), The Software Assurance Maturity Model (SAMM)

UNIT III	SECURE API DEVELOPMENT	6

API Security- Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, Securing service-to-service APIs: API Keys , OAuth2, Securing Microservice APIs: Service Mesh, Locking Down Network Connections, Securing Incoming Requests.

UNIT IV	VULNERABILITY ASSESSMENT AND PENETRATION TESTING	6

Vulnerability Assessment Lifecycle, Vulnerability Assessment Tools: Cloud-based vulnerability scanners, Host-based vulnerability scanners, Network-based vulnerability scanners, Database- based vulnerability scanners, Types of Penetration Tests: External Testing, Web Application Testing, Internal Penetration Testing, SSID or Wireless Testing, Mobile Application Testing.

UNIT V	HACKING TECHNIQUES AND TOOLS	6

Social Engineering, Injection, Cross-Site Scripting(XSS), Broken Authentication and Session Management, Cross-Site Request Forgery, Security Misconfiguration, Insecure Cryptographic Storage, Failure to Restrict URL Access, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite, etc.

TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
1. Install wireshark and explore the various protocols
a. Analyze the difference between HTTP vs HTTPS
b. Analyze the various security mechanisms embedded with different protocols.
2. Identify the vulnerabilities using OWASP ZAP tool
3. Create simple REST API using python for following operation
. GET
a. PUSH
b. POST
c. DELETE
4. Install Burp Suite to do following vulnerabilities:
. SQL injection
a. cross-site scripting (XSS)
5. Attack the website using Social Engineering method
TOTAL : 60PERIODS

TEXT BOOKS:	
1	Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for Modern Web Applications, First Edition, 2020, O'Reilly Media, Inc.
2	Bryan Sullivan, Vincent Liu, Web Application Security: A Beginners Guide, 2012, The McGraw- Hill Companies.
3	Neil Madden, API Security in Action, 2020, Manning Publications Co., NY, USA.
REFERENCES:	
1	Michael Cross, Developer's Guide to Web Application Security, 2007, Syngress Publishing, Inc.
2	Ravi Das and Greg Johnson, Testing and Securing Web Applications, 2021, Taylor & Francis Group, LLC.

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Course Name: WEB APPLICATION SECURITY		Course Code: 22ADV406			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understanding the basic concepts of web application security and the need for it	**I**	K2	1,2,3,5	1,2
CO2	Be acquainted with the process for secure development and deployment of web applications	**II**	K3	1,2,3,5	1,2
CO3	Acquire the skill to design and develop Secure Web Applications that use Secure APIs	**III**	K2	1,2,3,5	1,2
CO4	Be able to get the importance of carrying out vulnerability assessment and penetration testing	**IV**	K3	1,2,3,5	1,2
CO5	Acquire the skill to think like a hacker and to use hackers tool sets	**V**	K4	1,2,3,5	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	2	-	-	-	-	-	-	-	1	-
CO2	3	2	3	-	3	-	-	-	-	-	-	-	2	-
CO3	3	3	3	-	3	-	-	-	-	-	-	-	2	-
CO4	3	2	3	-	3	-	-	-	-	-	-	-	1	-
CO5	3	-	2	-	2	-	-	-	-	-	-	-	2	-
CO	3	2.5	2.8	-	2.6	-	-	-	-	-	-	-	1.8	-

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22ADV407	DATA AND INFORMATION SECURITY	L	T	P	C
		2	0	2	3

Course Objectives:

- To understand the basics of Information Security
- To know the legal, ethical and professional issues in Information Security
- To equip the students' knowledge on digital signature, email security and web security

UNIT I	INTRODUCTION	6

What is Information Security?, Critical Characteristics of Information, NSTISSC Security Model, Components of an Information System, Securing the Components, Balancing Security and Access, The SDLC, The Security SDLC

UNIT II	SECURITY INVESTIGATION	6

Need for Security, Business Needs, Threats, Attacks, Legal, Ethical and Professional Issues - An Overview of Computer Security - Access Control Matrix, Policy-Security policies, Confidentiality policies, Integrity policies and Hybrid policies

UNIT III	DIGITAL SIGNATURE AND AUTHENTICATION	6

Digital Signature and Authentication Schemes: Digital signature-Digital Signature Schemes and their Variants- Digital Signature Standards-Authentication: Overview- Requirements Protocol.

UNIT IV	E-MAIL AND IP SECURITY	6

E-mail and IP Security: Electronic mail security: Email Architecture -PGP – Operational Descriptions- Key management- Trust Model- S/MIME. IP Security: Overview- Architecture - ESP, AH Protocols IPSec Modes – Security association - Key management.

UNIT V	WEB SECURITY	6

Web Security: Requirements- Secure Sockets Layer- Objectives-Layers -SSL secure communication- Protocols - Transport Level Security. Secure Electronic Transaction- Entities DS Verification-SET processing.

TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
1. Simulate basic threats (phishing, weak passwords, unsecured data) using virtual environments (e.g., DVWA).
2. Map security requirements across SDLC phases using a sample project.
3. Perform threat modeling using STRIDE or DREAD models on a sample system.
4. Implement and simulate an Access Control Matrix.
5. Create digital signatures using RSA or DSA and verify them.
6. Encrypt and decrypt emails using PGP.
7. Implement S/MIME with digital certificate integration.
8. Simulate IPsec communication using Wireshark and VirtualBox
9. Set up a secure web server (HTTPS) with a self-signed SSL certificate.
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Michael E Whitman and Herbert J Mattord, "Principles of Information Security, Course Technology, 6th Edition, 2017.
2	Stallings William. Cryptography and Network Security: Principles and Practice, Seventh Edition, Pearson Education, 2017.
REFERENCES:	
1	Harold F. Tipton, Micki Krause Nozaki,, "Information Security Management Handbook, Volume 6, 6th Edition, 2016.
2	Stuart McClure, Joel Scrambray, George Kurtz, "Hacking Exposed", McGraw- Hill, Seventh Edition, 2012.
3	Matt Bishop, "Computer Security Art and Science, Addison Wesley Reprint Edition, 2015.
4	Behrouz A Forouzan, Debdeep Mukhopadhyay, Cryptography And network security, 3rd Edition, . McGraw-Hill Education, 2015.

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Course Name: DATA AND INFORMATION SECURITY		Course Code: 22ADV407			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the basics of data and information security	**I**	K2	1,2,3,4,5,9, 10,11,12	1,2
CO2	Understand the legal, ethical and professional issues in information security	**II**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO3	Understand the various authentication schemes to simulate different applications.	**III**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO4	Understand various security practices and system security standards	**IV**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO5	Understand the Web security protocols for E-Commerce applications	**V**	K2	1,2,3,4,5,9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	3	-	-	-	1	3	1	3	3	1
CO2	3	1	2	1	2	-	-	-	1	2	2	1	2	1
CO3	2	2	1	2	3	-	-	-	2	1	1	3	2	1
CO4	2	3	3	1	1	-	-	-	2	2	2	2	1	2
CO5	1	2	1	3	1	-	-	-	3	2	1	3	3	3
CO	2.2	1.8	1.6	1.6	2	-	-	-	1.8	2	1.4	2.4	2.4	1.6

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22ADV408	CYBER SECURITY	L	T	P	C
		2	0	2	3

Course Objectives:

- To learn cybercrime and cyberlaw.
- To understand the cyber attacks and tools for mitigating them.
- To understand information gathering.
- To learn how to detect a cyber attack.
- To learn how to prevent a cyber attack.

UNIT I	INTRODUCTION	6

Cyber Security – History of Internet – Impact of Internet – CIA Triad; Reason for Cyber Crime – Need for Cyber Security – History of Cyber Crime; Cybercriminals – Classification of Cybercrimes – A Global Perspective on Cyber Crimes; Cyber Laws – The Indian IT Act – Cybercrime and Punishment.

UNIT II	ATTACKS AND COUNTERMEASURES	6

OSWAP; Malicious Attack Threats and Vulnerabilities: Scope of Cyber-Attacks – Security Breach – Types of Malicious Attacks – Malicious Software – Common Attack Vectors – Social engineering Attack – Wireless Network Attack – Web Application Attack – Attack Tools – Countermeasures.

UNIT III	RECONNAISSANCE	6

Harvester – Whois – Netcraft – Host – Extracting Information from DNS – Extracting Information from E-mail Servers – Social Engineering Reconnaissance; Scanning – Port Scanning – Network Scanning and Vulnerability Scanning – Scanning Methodology – Ping Sweer Techniques – Nmap Command Switches – SYN – Stealth – XMAS – NULL – IDLE – FIN Scans – Banner Grabbing and OS Finger printing Techniques

UNIT IV	INTRUSION DETECTION	6

Host -Based Intrusion Detection – Network -Based Intrusion Detection – Distributed or Hybrid Intrusion Detection – Intrusion Detection Exchange Format – Honeypots – Example System Snort.

UNIT V	INTRUSION PREVENTION	6

Firewalls and Intrusion Prevention Systems: Need for Firewalls – Firewall Characteristics and Access Policy – Types of Firewalls – Firewall Basing – Firewall Location and Configurations – Intrusion Prevention Systems – Example Unified Threat Management Products.

TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS	
1.	Install Kali Linux on Virtual box
2.	Explore Kali Linux and bash scripting
3.	Perform open source intelligence gathering using Netcraft, Whois Lookups, DNS Reconnaissance, Harvester and Maltego
4.	Understand the nmap command d and scan a target using nmap
5.	Install metasploitable2 on the virtual box and search for unpatched vulnerabilities
6.	Use Metasploit to exploit an unpatched vulnerability
7.	Install Linus server on the virtual box and install ssh
8.	Use Fail2banto scan log files and ban Ips that show the malicious signs
9.	Launch brute-force attacks on the Linux server using Hydra.
10.	Perform real-time network traffic analysis and data pocket logging using Snort
	TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Anand Shinde, "Introduction to Cyber Security Guide to the World of Cyber Security", Notion Press, 2021 (Unit 1)
2	Nina Godbole, Sunit Belapure, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley Publishers, 2011 (Unit 1)
REFERENCES:	
1	David Kim, Michael G. Solomon, "Fundamentals of Information Systems Security", Jones & Bartlett Learning Publishers, 2013 (Unit 2)
2	Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made easy", Elsevier, 2011 (Unit 3)
3	Kimberly Graves, "CEH Official Certified Ethical hacker Review Guide", Wiley Publishers, 2007 (Unit 3)
4	William Stallings, Lawrie Brown, "Computer Security Principles and Practice", Third Edition, Pearson Education, 2015 (Units 4 and 5)
5	Georgia Weidman, "Penetration Testing: A Hands-On Introduction to Hacking", No Starch Press, 2014 (Lab)

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Course Name: CYBER SECURITY		Course Code: 22ADV408			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Explain the basics of cyber security, cyber crime and cyber law (K2)	**I**	K3	1,2,3,4,9, 10,11	1,2
CO2	Classify various types of attacks and learn the tools to launch the attacks (K2)	**II**	K3	1,2,3,4,9, 10,11	1,2
CO3	Apply various tools to perform information gathering (K3)	**III**	K3	1,2,3,4,9, 10,11	1,2
CO4	Apply intrusion techniques to detect intrusion (K3)	**IV**	K3	1,2,3,4,9, 10,11	1,2
CO5	Apply intrusion prevention techniques to prevent intrusion (K3)	**V**	K3	1,2,3,4,9, 10,11	1,2

CO-PO-PSO Mapping

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

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PROFESSIONAL ELECTIVE COURSES

VERTICALS

VERTICAL 5: CREATIVE MEDIA

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22ADV501	Augmented Reality/ Virtual Reality	PE	2	0	2	4	3
2.	22ADV502	Multimedia and Animation	PE	2	0	2	4	3
3.	22ADV503	Video Creation & Editing	PE	2	0	2	4	3
4.	22ADV504	3D Modeling and Game Design	PE	2	0	2	4	3
5.	22ADV505	Digital Marketing	PE	2	0	2	4	3
6.	22ADV506	Multimedia Data Compression and Storage	PE	2	0	2	4	3
7.	22ADV507	Game Development	PE	2	0	2	4	3
8.	22ADV508	Visual Effects	PE	2	0	2	4	3

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22ADV501	AUGMENTED REALITY/VIRTUAL REALITY	L	T	P	C
		2	0	2	3

Course Objectives:

- To impart the fundamental aspects and principles of AR/VR technologies.
- To know the internals of the hardware and software components involved in the development of AR/VR enabled applications.
- To learn about the graphical processing units and their architectures.
- To gain knowledge about AR/VR application development.
- To know the technologies involved in the development of AR/VR based applications.

UNIT I	INTRODUCTION	6

Introduction to Virtual Reality and Augmented Reality – Definition – Introduction to Trajectories and Hybrid Space-Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Introduction to AR-AR Technologies-Input Devices – 3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System.

UNIT II	VR MODELING	6

Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants –Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management.

UNIT III	VR PROGRAMMING	6

VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D

UNIT IV	APPLICATIONS	6

Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society-Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications – Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – VR in Business – VR in Entertainment – VR in Education.

UNIT V	AUGMENTED REALITY	6

Introduction to Augmented Reality-Computer vision for AR-Interaction-Modelling and Annotation-Navigation-Wearable devices

TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
1. Study of tools like Unity, Maya, 3DS MAX, AR toolkit, Vuforia and Blender. 2. Use the primitive objects and apply various projection types by handling camera. 3. Download objects from asset store and apply various lighting and shading effects. 4. Model three dimensional objects using various modelling techniques and apply Textures over them. 5. Create three dimensional realistic scenes and develop simple virtual reality enabled mobile applications which have limited interactivity. 6. Add audio and text special effects to the developed application. 7. Develop VR enabled applications using motion trackers and sensors incorporating full haptic interactivity. 8. Develop AR enabled applications with interactivity like E learning environment, Virtual walkthroughs and visualization of historic places. 9. Develop AR enabled simple applications like human anatomy visualization, DNA/RNA structure visualization and surgery simulation. 10. Develop simple MR enabled gaming applications
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Charles Palmer, John Williamson, "Virtual Reality Blueprints: Create compelling VR experiences for mobile", Packt Publisher, 2018
2	Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles & Practice", Addison Wesley, 2016
3	John Vince, "Introduction to Virtual Reality", Springer-Verlag, 2004
REFERENCES:	
1	William R. Sherman, Alan B. Craig: Understanding Virtual Reality – Interface, Application, Design", Morgan Kaufmann, 2003

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Course Name: AUGMENTED REALITY/VIRTUAL REALITY		Course Code: 22ADV501			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the basic concepts of AR and VR	**I**	K2	1,2,3,4,6,9, 10,11	1,2
CO2	Understand the tools and technologies related to AR/VR	**II**	K3	1,2,3,4,5,6, 9,11,12	1,2
CO3	Know the working principle of AR/VR related Sensor devices	**III**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Design of various models using modeling techniques	**IV**	K5	1,2,3,4,6,9, 10, 11,12	1,2
CO5	Develop AR/VR applications in different domains	**V**	K2	1,2,4,5,6, 10, 11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	1	-	-	-	1	2	1	2	1	1
CO2	3	2	3	2	2	-	-	-	2	1	2	1	3	3
CO3	2	2	3	2	2	-	-	-	3	2	2	2	3	2
CO4	2	2	3	1	1	-	-	-	2	2	2	2	2	1
CO5	2	2	2	1	1	-	-	-	2	1	1	1	2	1
CO	2.4	1.8	2.4	1.4	1.4	-	-	-	2	1.6	1.6	1.6	2.2	1.6

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22ADV502	MULTIMEDIA AND ANIMATION	L	T	P	C
		2	0	2	3

Course Objectives:

- To grasp the fundamental knowledge of Multimedia elements and systems
- To get familiar with Multimedia file formats and standards
- To learn the process of Authoring multimedia presentations
- To learn the techniques of animation in 2D and 3D and for the mobile UI
- To explore different popular applications of multimedia

UNIT I	INTRODUCTION TO MULTIMEDIA	6

Definitions, Elements, Multimedia Hardware and Software, Distributed multimedia systems, challenges: security, sharing / distribution, storage, retrieval, processing, computing. Multimedia metadata, Multimedia databases, Hypermedia, Multimedia Learning.

UNIT II	MULTIMEDIA FILE FORMATS AND STANDARDS	6

File formats – Text, Image file formats, Graphic and animation file formats, Digital audio and Video file formats, Color in image and video, Color Models. Multimedia data and file formats for the web.

UNIT III	MULTIMEDIA AUTHORING	6

Authoring metaphors, Tools Features and Types: Card and Page Based Tools, Icon and Object Based Tools, Time Based Tools, Cross Platform Authoring Tools, Editing Tools, Painting and Drawing Tools, 3D Modeling and Animation Tools, Image Editing Tools, audio Editing Tools, Digital Movie Tools, Creating interactive presentations, virtual learning, simulations.

UNIT IV	ANIMATION	6

Principles of animation: staging, squash and stretch, timing, onion skinning, secondary action, 2D, 2 ½ D, and 3D animation, Animation techniques: Keyframe, Morphing, Inverse Kinematics, Hand Drawn, Character rigging, vector animation, stop motion, motion graphics, , Fluid Simulation, skeletal animation, skinning Virtual Reality, Augmented Reality.

UNIT V	MULTIMEDIA APPLICATIONS	6

Multimedia Big data computing, social networks, smart phones, surveillance, Analytics, Multimedia Cloud Computing, Multimedia streaming cloud, media on demand, security and forensics, Online social networking, multimedia ontology, Content based retrieval from digital libraries.

TOTAL: 30PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS

Working with Image Editing tools:

- Install tools like GIMP/ InkScape / Krita / Pencil and perform editing operations:
- Use different selection and transform tools to modify or improve an image
- Create logos and banners for home pages of websites.

Working with Audio Editing tools:

- Install tools like, Audacity / Ardour for audio editing, sound mixing and special effects like fade-in or fade-out etc.,
- Perform audio compression by choosing a proper codec.

Working with Video Editing and conversion tools:

Install tools like OpenShot / Cinelerra / HandBrake for editing video content.

- Edit and mix video content, remove noise, create special effects, add captions.
- Compress and convert video file format to other popular formats.

Working with web/mobile authoring tools:

Adapt / KompoZer/ BlueGriffon / BlueFish / Aptana Studio/ NetBeans / WordPress /Expression Web:

- Design simple Home page with banners, logos, tables quick links etc
- Provide a search interface and simple navigation from the home page to the inside pages of the website.
- Design Responsive web pages for use on both web and mobile interfaces.

Working with Animation tools:

Install tools like, Krita, Wick Editor, Blender:

- Perform a simple 2D animation with sprites
- Perform simple 3D animation with keyframes, kinematics Working with Mobile UI animation tools: Origami studio / Lottie / Framer etc.,

Working with E-Learning authoring tools:

Install tools like EdApp / Moovly / CourseLab/ IsEazy and CamStudio/Ampache, VideoLAN:

- Demonstrate screen recording and further editing for e-learning content.
- Create a simple E-Learning module for a topic of your choice.

Creating VR and AR applications:

- Any affordable VR viewer like Google Cardboard and any development platform like Openspace 3D / ARCore etc.

Note: all tools listed are open source. Usage of any proprietary tools in place of open source tools is not restricted.

TOTAL : 60 PERIODS

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WEB REFERENCES	
1	https://itsfoss.com, https://www.ucl.ac.uk/slade/know/3396 https://handbrake.fr/
2	https://opensource.com/article/18/2/open-source-audio-visual-production-tools

TEXT BOOKS:	
1	Ze-Nian Li, Mark S. Drew, Jiangchuan Liu, Fundamentals of Multimedia", Third Edition, Springer Texts in Computer Science, 2021. (UNIT-I, II, III)
2	John M Blain, The Complete Guide to Blender Graphics: Computer Modeling & Animation, CRC press, 3rd Edition, 2016.
3	Gerald Friedland, Ramesh Jain, "Multimedia Computing", Cambridge University Press, 2018.
REFERENCES:	
1	Prabhat K.Andleigh,Kiran Thakrar, "Multimedia System Design", Pearson Education, 1st Edition, 2015.
2	Mohsen Amini Salehi, Xiangbo Li, "Multimedia Cloud Computing Systems", Springer Nature, 1st Edition, 2021.
3	Mark Gaimbruno, "3D Graphics and Animation", Second Edition, New Riders, 2002.
4	Rogers David, "Animation: Master – A Complete Guide (Graphics Series)", Charles River Media, 2006.
5	Rick parent, "Computer Animation: Algorithms and Techniques", Morgan Kauffman, 3rd Edition, 2012.
6	Emilio Rodriguez Martinez, Mireia Alegre Ruiz, "UI Animations with Lottie and After Effects: Create, render, and ship stunning After Effects animations natively on mobile with React Native", Packt Publishing, 2022

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Course Name: MULTIMEDIA AND ANIMATION		Course Code: 22ADV502			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Get the bigger picture of the context of Multimedia and its applications	**I**	K1,K2	1,2,3,4,6,9, 10,11	1,2
CO2	Use the different types of media elements of different formats on content pages	**II**	K3,K4	1,2,3,4,5,6, 9,11,12	1,2
CO3	Author 2D and 3D creative and interactive presentations for different target multimedia applications.	**III**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Use different standard animation techniques for 2D, 21/2 D, 3D applications	**IV**	K5	1,2,3,4,6,9, 10, 11,12	1,2
CO5	Understand the complexity of multimedia applications	**V**	K1,K2	1,2,4,5,6,1 0, 11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	1	-	-	-	1	-	-	1	-	-
CO2	1	2	-	-	1	-	-	-	-	-	-	1	-	-
CO3	2	2	1	-	1	-	-	-	2	-	-	-	-	-
CO4	3	2	2	2	1	-	-	-	2	-	-	2	-	-
CO5	2	2	1	1	1	-	-	-	-	-	-	1	-	-
CO	2	2	1.3	1.8	1	-	-	-	1.8	-	-	1.3	-	-

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22ADV503	VIDEO CREATION AND EDITING	L	T	P	C
		2	0	2	3
Course Objectives:	• To introduce the broad perspective of linear and nonlinear editing concepts. • To understand the concept of Storytelling styles. • To be familiar with audio and video recording. To apply different media tools. • To learn and understand the concepts of AVID XPRESS DV 4.				
UNIT I	**FUNDAMENTALS**				**6**
Evolution of filmmaking - linear editing - non-linear digital video - Economy of Expression - risks associated with altering reality through editing.					
UNIT II	**STORYTELLING**				**6**
Storytelling styles in a digital world through jump cuts, L-cuts, match cuts, cutaways, dissolves, split edits - Consumer and pro NLE systems - digitizing images - managing resolutions - mechanics of digital editing - pointer files - media management.					
UNIT III	**USING AUDIO AND VIDEO**				**6**
Capturing digital and analog video importing audio putting video on exporting digital video to tape recording to CDs and VCDs					
UNIT IV	**WORKING WITH FINAL CUT PRO**				**6**
Working with clips and the Viewer - working with sequences, the Timeline, and the canvas - Basic Editing - Adding and Editing Testing Effects - Advanced Editing and Training Techniques - Working with Audio - Using Media Tools - Viewing and Setting Preferences.					
UNIT V	**WORKING WITH AVID XPRESS DV 4**				**6**
Starting Projects and Working with Project Window - Using Basic Tools and Logging - Preparing to Record and Recording - Importing Files - Organizing with Bins - Viewing and Making Footage - Using Timeline and Working in Trim Mode - Working with Audio - Output Options.					
	TOTAL: 30 PERIODS				

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LIST OF EXPERIMENTS: 30 PERIODS
1. Write a Movie Synopsis (Individual/Team Writing) 2. Present team stories in class. 3. Script/Storyboard Writing (Individual Assignment) 4. Pre-Production: Personnel, budgeting, scheduling, location scouting, casting, contracts & agreements. 5. Production: Single camera production personnel & equipment, Documentary Production 6. Writing The Final Proposal: Overview, Media Treatments, Summary, Pitching 7. Write Documentary & Animation Treatment 8. Post-production: Editing, Sound design, Finishing
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Avid Xpress DV 4 User Guide, 2007.
2	Final Cut Pro 6 User Manual, 2004.
3	Keith Underdahl, "Digital Video for Dummies", Third Edition, Dummy Series, 2001.
REFERENCES:	
1	Robert M. Goodman and Partick McGarth, "Editing Digital Video: The Complete Creative and Technical Guide", Digital Video and Audio, McGraw – Hill 2003

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Course Name: VIDEO CREATION AND EDITING		Course Code: 22ADV503			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Compare the strengths and limitations of Nonlinear editing.	**I**	K1,K2	1,2,3,4,6,9,10, 11	1,2
CO2	Identify the infrastructure and significance of storytelling.	**II**	K3,K4	1,2,3,4,5,6,9,1 1,12	1,2
CO3	Apply suitable methods for recording to CDs and VCDs.	**III**	K4	1,2,3,4,5,6,9,1 0,11,12	1,2
CO4	Address the core issues of advanced editing and training techniques.	**IV**	K5	1,2,3,4,6,9,10, 11,12	1,2
CO5	Design and develop projects using AVID XPRESS DV 4	**V**	K1,K2	1,2,4,5,6, 10, 11,12	1,2

CO-PO-PSO Mapping

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

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22ADV504	3D MODELING AND GAME DESIGN	L	T	P	C
		2	0	2	3

Course Objectives:

- Understand the foundational knowledge of 3D modeling and apply on a real time scenario in creating object and environment
- Design and analyse the usage of Game objects and Assets using Physics and Lights
- Apply Navigations, Particle systems and audio develop simple games

UNIT I	BUILDING BLOCKS	6

3D space- 3D objects- viewports and cPlane basics- selecting objects- solid object creation- outputting images- Boolean modeling and figured space- object snaps and transforms- Boolean modeling- Clipping plane

UNIT II	OBJECT AND SURFACE MODELING	6

Profile modeling – surface- cPlane- revolve- object modeling- project and pull- curves from objects- trimming surfaces- surface modeling – lofting- surface filleting and blending- surface from edge curves- patch surfaces.

UNIT III	GAME OBJECTS AND ASSETS	6

Native Game Objects -Manipulating Game Objects - Components in the Game engine – Fundamentals working concept - Materials- Defining the Role of the Prefab - Textures: UV Mapping and Texturing Techniques - Discovering the Standard Shader

UNIT IV	IMPLEMENTATION OF ASSETS WITH PHYSICS AND LIGHTING	6

Creating Hierarchies - Using Empty Game Objects as Pivots -Understanding the Physics System – Rigid body Components - Colliders - Scripting Collision Events - Lighting in Games- Analyzing the Different Lights and Properties.

UNIT V	NAVIGATION AND ANIMATIONS	6

Animation in Game Development - Creating Animation in the Editor-Refining Animation- NavMesh - NavMesh Agent - NavMesh Obstacle-Creating the Player Controller Game Object- Particles in Video Games-Analyzing Existing Particle Effects-Audio in Game Development - Audio Effects.

TOTAL: 30 PERIODS

LIST OF EXPERIMENTS: 30 PERIODS
1. Basic 3D Object Creation and Transformation 2. Boolean Modeling and Object Clipping 3. Surface Modeling using Lofting and Filleting 4. Creating Curves and Surfaces from Objects 5. Game Object Creation and Prefab Design in Unity 6. Applying Textures and Shaders 7. Adding Physics and Colliders to Game Objects 8. Implementing Game Lighting and Shadows 9. Character Navigation and Animation using NavMesh 10. Adding Particle Effects and Audio in Unity
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	"The Ultimate Guide to Game Development with Unity" by Unity Technologies,2023.
REFERENCES:	
1	The Art of Game Design: A Book Of Lenses, THIRD EDITION, Jesse Schell, CRC Press; 3rd edition , 2019.
2	Paris Buttfield-Addison, Jon Manning, TimNugent,"Unity Game Development Cookbook", O'Reilly Media, Inc. 2019
3	3D Modeling for Beginners: Learn Everything You Need to Know About 3d Modeling!, Danan Thilakanathan,2016
4	1. https://www.coursera.org/learn/introduction-to-3d-modeling 2. https://www.coursera.org/specializations/game-design-and-development 3. https://www.coursera.org/learn/game-design 4. Control physics with C# in Unity (coursera.org) 5. Create basic behavior with C# in Unity (coursera.org) 6. The Complete Guide to 3D Modeling with Blender | Udemy

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Course Name: 3D MODELING AND GAME DESIGN		Course Code: 22ADV04			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the foundational knowledge of 3D modeling and apply on a real time	**I**	K1,K2	1,2,3,4,6,9, 10,11	1,2
CO2	Design and analyse the usage of Game objects and Assets using Physics and Lights	**II**	K3,K4	1,2,3,4,5,6, 9,11,12	1,2
CO3	Apply Navigations, Particle systems and audio develop simple games	**III**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Implement physics-based behaviors, lighting systems, and object hierarchies in game development	**IV**	K5	1,2,3,4,6,9, 10, 11,12	1,2
CO5	Develop interactive 3D games by incorporating animation, navigation (NavMesh), particle effects, and audio.	**V**	K1,K2	1,2,4,5,6, 10, 11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	1	3	-	-	-	1	2	1	2	1	1
CO2	3	1	2	1	3	-	-	-	2	2	1	3	3	1
CO3	2	2	1	3	1	-	-	-	3	3	1	2	3	1
CO4	2	1	1	1	2	-	-	-	2	1	2	2	3	1
CO5	1	3	2	2	1	-	-	-	3	2	1	1	2	1
CO	2.2	1.8	1.8	1.6	2	-	-	-	2.2	2	1.2	2	2.4	1

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22ADV505	DIGITAL MARKETING	L	T	P	C
		2	0	2	3

Course Objectives:

- The primary objective of this module is to examine and explore the role and importance of digital marketing in today's rapidly changing business environment.
- It also focuses on how digital marketing can be utilized by organizations and how its effectiveness can be measured.

UNIT I	INTRODUCTION TO ONLINE MARKET	6

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

UNIT II	SEARCH ENGINE OPTIMISATION	6

Search Engine optimisation - Keyword Strategy- SEO Strategy - SEO success factors -On-Page Techniques - Off-Page Techniques. Search Engine Marketing- How Search Engine works- SEM components- PPC advertising -Display Advertisement

UNIT III	E- MAIL MARKETING	6

E- Mail Marketing - Types of E- Mail Marketing - Email Automation - Lead Generation - Integrating Email with Social Media and Mobile- Measuring and maximizing email campaign effectiveness. Mobile Marketing- Mobile Inventory/channels- Location based; Context based; Coupons and offers, Mobile Apps, Mobile Commerce, SMS Campaigns-Profiling and targeting

UNIT IV	SOCIAL MEDIA MARKETING	6

Social Media Marketing - Social Media Channels- Leveraging Social media for brand conversations and buzz. Successful /benchmark Social media campaigns. Engagement Marketing- Building Customer relationships - Creating Loyalty drivers - Influencer Marketing.

UNIT V	DIGITAL TRANSFORMATION	6

Digital Transformation & Channel Attribution- Analytics- Ad-words, Email, Mobile, Social Media, Web Analytics - Changing your strategy based on analysis- Recent trends in Digital marketing.

TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
1. Subscribe to a weekly/quarterly newsletter and analyze how its content and structure aid with the branding of the company and how it aids its potential customer segments. 2. Perform keyword search for a skincare hospital website based on search volume and competition using Google keyword planner tool. 3. Demonstrate how to use the Google WebMasters Indexing API 4. Discuss an interesting case study regarding how an insurance company manages leads. 5. Discuss negative and positive impacts and ethical implications of using social media for political advertising. 6. Discuss how Predictive analytics is impacting marketing automation
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Fundamentals of Digital Marketing by Puneet Singh Bhatia;Publisher: Pearson Education; First edition (July 2017);ISBN-10: 933258737X;ISBN-13: 978-9332587373
2	Digital Marketing by Vandana Ahuja ;Publisher: Oxford University Press (April 2015). ISBN- 10: 0199455449
3	Marketing 4.0: Moving from Traditional to Digital by Philip Kotler;Publisher: Wiley; 1st edition (April 2017); ISBN10: 9788126566938;ISBN 13: 9788126566938;ASIN: 8126566930.
4	Ryan, D. (2014). Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation, Kogan Page Limited..
5	Barker, Barker, Bormann and Neher(2017), Social Media Marketing: A Strategic Approach, 2E South-Western ,Cengage Learning.

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Course Name: DIGITAL MARKETING		**Course Code: 22ADV505**			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	To examine and explore the role and importance of digital marketing in today's rapidly changing business environment	**I**	K1,K2	1,2,3,4,6,9, 10,11	1,2
CO2	To focuses on how digital marketing can be utilized by organizations and how its effectiveness can be measured.	**II**	K3,K4	1,2,3,4,5,6, 9,11,12	1,2
CO3	To know the key elements of a digital marketing strategy.	**III**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	To study how the effectiveness of a digital marketing campaign can be measured	**IV**	K5	1,2,3,4,6,9, 10,11,12	1,2
CO5	To demonstrate advanced practical skills in common digital marketing tools such as SEO, SEM, Social media and Blogs.	**V**	K1,K2	1,2,4,5,6, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PS2O2**
CO1	2	2	3	1	1	-	-	-	1	2	1	1	3	1
CO2	3	3	3	2	3	-	-	-	1	2	21	2	3	1
CO3	2	2	3	3	2	-	-	-	3	1	1	3	3	2
CO4	2	1	1	2	2	-	-	-	3	3	2	1	1	3
CO5	2	3	2	3	2	-	-	-	3	3	1	3	3	1
CO	2.2	2.2	2.4	2.2	2	-	-	-	2.2	2.2	1.4	2	2.6	1.6

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22ADV506	MULTIMEDIA DATA COMPRESSION AND STORAGE	L	T	P	C
		2	0	2	3

Course Objectives:

- To understand the basics of compression techniques
- To understand the categories of compression for text, image and video
- To explore the modalities of text, image and video compression algorithms
- To know about basics of consistency of data availability in storage devices
- To understand the concepts of data streaming services

UNIT I	BASICS OF DATA COMPRESSION	6

Introduction —Lossless and Lossy Compression– Basics of Huffmann coding- Arithmetic coding- Dictionary techniques- Context based compression - Applications

UNIT II	IMAGE COMPRESSION	6

Lossless Image compression – JPEG-CALIC-JPEG LS-Prediction using conditional averages – Progressive Image Transmission – Lossless Image compression formats – Applications - Facsimile encoding

UNIT III	VIDEO COMPRESSION	6

Introduction – Motion Compensation – Video Signal Representation – H.261 – MPEG-1- MPEG-2- H.263.

UNIT IV	DATA PLACEMENT ON DISKS	6

Statistical placement on Disks – Striping on Disks – Replication Placement on Disks – Constraint allocation on Disks – Tertiary storage Devices – Continuous Placement on Hierarchical storage system – Statistical placement on Hierarchical storage systems – Constraint allocation on Hierarchical storage system

UNIT V	DISK SCHEDULING METHODS	6

Scheduling methods for disk requests – Feasibility conditions of concurrent streams– Scheduling methods for request streams

TOTAL: 30PERIODS

ANNAPOORANA ENGINEERING COLLEGE AUTONOMOUS SALEM

LIST OF EXPERIMENTS: 30 PERIODS
1. Construct Huffman codes for given symbol probabilities. 2. Encode run lengths with fixed-length code. 3. Lempel-Ziv algorithm for adaptive variable-length encoding 4. Compress the given word using arithmetic coding based on the frequency of the letters. 5. Write a shell script, which converts all images in the current directory in JPEG. 6. Write a program to split images from a video without using any primitives. 7. Create a photo album of a trip by applying appropriate image dimensions and format. 8. Write the code for identifying the popularity of content retrieval from media server. 9. Write the code for ensuring data availability in disks using strip based method. 10. Program for scheduling requests for data streams.
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Khalid Sayood, Introduction to Data Compression, Morgan Kaufmann Series in Multimedia Information and Systems, 2018, 5th Edition.
2	Philip K.C.Tse, Multimedia Information Storage and Retrieval: Techniques and Technologies, 2008
REFERENCES:	
1	David Salomon, A concise introduction to data compression, 2008
2	Lenald Best, Best's Guide to Live Stream Video Broadcasting, BCB Live Teaching series, 2017
3	Yun-Qing Shi, Image And Video Compression For Multimedia Engineering Fundamentals Algorithms And Standards, Taylor& Francis,2019
4	Irina Bocharova, Compression for Multimedia, Cambridge University Press; 1st edition, 2009

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Course Name: MULTIMEDIA DATA COMPRESSION AND STORAGE		Course Code: 22ADV506			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the basics of text, Image and Video compression	**I**	K1,K2	1,2,3,4,6,9, 10,11	1,2
CO2	Understand the various compression algorithms for multimedia content	**II**	K3,K4	1,2,3,4,5,6, 9,11,12	1,2
CO3	Explore the applications of various compression techniques	**III**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Explore knowledge on multimedia storage on disks	**IV**	K5	1,2,3,4,6,9, 10,11,12	1,2
CO5	Understand scheduling methods for request streams	**V**	K1,K2	1,2,4,5,6, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	1	2	-	-	-	1	2	2	1	3	1
CO2	3	3	3	2	3	-	-	-	1	2	1	2	3	1
CO3	1	2	3	3	3	-	-	-	3	1	1	3	3	2
CO4	1	1	1	2	3	-	-	-	3	3	2	1	1	3
CO5	3	3	2	3	2	-	-	-	3	3	1	3	3	1
CO	2	1.8	2.2	2.4	2.6	-	-	-	2.2	2	1.4	2	1.6	2

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22ADV507	GAME DEVELOPMENT	L	T	P	C
		2	0	2	3

Course Objectives:

- To know the basics of 2D and 3D graphics for game development.
- To know the stages of game development.
- To understand the basics of a game engine.
- To survey the gaming development environment and tool kits.
- To learn and develop simple games using Pygame environment

UNIT I	3D GRAPHICS FOR GAME DESIGN	6

Genres of Games, Basics of 2D and 3D Graphics for Game Avatar, Game Components – 2D and 3D Transformations – Projections – Color Models – Illumination and Shader Models – Animation – Controller Based Animation.

UNIT II	GAME DESIGN PRINCIPLES	6

Character Development, Storyboard Development for Gaming – Script Design – Script Narration, Game Balancing, Core Mechanics. Principles of Level Design – Proposals – Writing for Preproduction, Production and Post – Production

UNIT III	GAME ENGINE DESIGN	6

Rendering Concept – Software Rendering – Hardware Rendering – Spatial Sorting Algorithms – Algorithms for Game Engine– Collision Detection – Game Logic – Game AI – Pathfinding

UNIT IV	OVERVIEW OF GAMING PLATFORMS AND FRAMEWORKS	6

Pygame Game development – Unity – Unity Scripts –Mobile Gaming, Game Studio, Unity Single player and Multi-Player games

UNIT V	GAME DEVELOPMENT USING PYGAME	6

Developing 2D and 3D interactive games using Pygame – Avatar Creation – 2D and 3D Graphics Programming – Incorporating music and sound – Asset Creations – Game Physics algorithms Development – Device Handling in Pygame – Overview of Isometric and Tile Based arcade Games – Puzzle Games

TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
1. Installation of a game engine, e.g., Unity, Unreal Engine, familiarization of the GUI. Conceptualize the theme for a 2D game. 2. Character design, sprites, movement and character control 3. Level design: design of the world in the form of tiles along with interactive and collectible objects. 4. Design of interaction between the player and the world, optionally using the physics engine. 5. Developing a 2D interactive using Pygame 6. Developing a Puzzle game 7. Design of menus and user interaction in mobile platforms. 8. Developing a 3D Game using Unreal 9. Developing a Multiplayer game using unity
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Sanjay Madhav, "Game Programming Algorithms and Techniques: A Platform Agnostic Approach", Addison Wesley,2013.
2	Will McGugan, "Beginning Game Development with Python and Pygame: From Novice to Professional", Apress,2007
REFERENCES:	
1	Paul Craven, "Python Arcade games", Apress Publishers,2016.
2	David H. Eberly, "3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics", Second Edition, CRC Press,2006.
3	Jung Hyun Han, "3D Graphics for Game Programming", Chapman and Hall/CRC, 2011

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Course Name: GAME DEVELOPMENT		Course Code: 22ADV507			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Explain the concepts of 2D and 3d Graphics	**I**	K1,K2	1,2,3,4,6,9, 10,11	1,2
CO2	Design game design documents.	**II**	K3,K4	1,2,3,4,5,6, 9,11,12	1,2
CO3	Implementation of gaming engines.	**III**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Survey gaming environments and frameworks.	**IV**	K5	1,2,3,4,6,9, 10,11,12	1,2
CO5	Implement a simple game in Pygame	**V**	K1,K2	1,2,4,5,6, 10,11,12	1,2

CO-PO-PSO Mapping

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

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22ADV508	VISUAL EFFECTS	L	T	P	C
		2	0	2	3

Course Objectives:

- To get a basic idea on animation principles and techniques
- To get exposure to CGI, color and light elements of VFX
- To have a better understanding of basic special effects techniques
- To have a knowledge of state of the art vfx techniques
- To become familiar with popular compositing techniques

UNIT I	ANIMATION BASICS	6

VFX production pipeline, Principles of animation, Techniques: Keyframe, kinematics, Full animation, limited animation, Rotoscoping, stop motion, object animation, pixilation, rigging, shape keys, motion paths

UNIT II	CGI, COLOR, LIGHT	6

CGI – virtual worlds, Photorealism, physical realism, function realism, 3D Modeling and Rendering: color - Color spaces, color depth, Color grading, color effects, HDRI, Light – Area and mesh lights, image based lights, PBR lights, photometric light, BRDF shading model

UNIT III	SPECIAL EFFECTS	6

Special Effects – props, scaled models, animatronics, pyro techniques, Schüfftan process, Particle effects – wind, rain, fog, fire

UNIT IV	VISUAL EFFECTS TECHNIQUES	6

Motion Capture, Matt Painting, Rigging, Front Projection. Rotoscoping, Match Moving – Tracking, camera reconstruction, planar tracking, Calibration, Point Cloud Projection, Ground plane determination, 3D Match Moving

UNIT V	COMPOSITING	6

Compositing – chroma key, blue screen/green screen, background projection, alpha compositing, deep image compositing, multiple exposure, matting, VFX tools - Blender, Natron, GIMP

TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
Using Natron: o Understanding Natron Environment: o Working with color and using color grading o using Channels o Merging images o Using Rotopaint o performing Tracking and stabilizing o Transforming elements o Stereoscopic compositing Using Blender: Ø Motion Tracking – camera and object tracking Ø Camera fx, color grading, vignettes Ø Compositing images and video files Ø Multilayer rendering
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Chris Roda, Real Time Visual Effects for the Technical Artist, CRC Press, 1st Edition, 2022.
2	Steve Wright, Digital Compositing for film and video, Routledge, 4th Edition, 2017.
3	John Gress, Digital Visual Effects and Compositing, New Riders Press, 1st Edition, 2014
REFERENCES:	
1	Jon Gress, "Digital Visual Effects and Compositing", New Riders Press, 1st Edition, 2014.
2	Robin Brinkman, The Art and Science of Digital Compositing: Techniques for Visual Effects, Animation and Motion Graphics", Morgan Kauffman, 2008.
3	Luiz Velho, Bruno Madeira, "Introduction to Visual Effects A Computational Approach", Routledge, 2023
4	Jasmine Katatikarn, Michael Tanzillo, "Lighting for Animation: The art of visual storytelling , Routledge, 1st Edition, 2016
5	Eran Dinur, "The Complete guide to Photorealism, for Visual Effects, Visualization

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Course Name: VISUAL EFFECTS		Course Code: 22ADV508			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	To implement animation in 2D / 3D following the principles and techniques	**I**	K3	1,2,3	1,2
CO2	To use CGI, color and light elements in VFX applications	**II**	K3	1,2,3	1,2
CO3	To create special effects using any of the state of the art tools	**III**	K3	1,2,3	1,2
CO4	To apply popular visual effects techniques using advanced tools	**IV**	K3	1,2,3	1,2
CO5	To use compositing tools for creating VFX for a variety of applications	**V**	K3	1,2,3	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	-	-	-	1	1	2
CO2	3	2	2	2	3	-	-	-	-	-	2	1	1	1
CO3	3	3	3	3	-	-	-	-	-	-	-	1	2	2
CO4	3	3	3	3	-	-	-	-	-	-	-	1	2	1
CO5	3	2	2	2	-	-	-	-	-	-	2	1	1	2
CO	3	2.6	2.6	2.4	2.5	-	-	-	-	-	2	1	1.6	1.8

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VERTICAL VI: EMERGING TECHNOLOGIES

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22ADV601	Natural Language Processing	PE	2	0	2	4	3
2.	22ADV602	Robotic Process Automation	PE	2	0	2	4	3
3.	22ADV603	Intelligent Automation Systems	PE	2	0	2	4	3
4.	22ADV604	Neural Networks and Deep Learning	PE	2	0	2	4	3
5.	22ADV605	Quantum Computing	PE	2	0	2	4	3
6.	22ADV606	Cryptocurrency and Block Chain Technologies	PE	2	0	2	4	3
7.	22ADV607	Fog and Edge Computing	PE	2	0	2	4	3
8.	22ADV608	3D Printing and Design	PE	2	0	2	4	3

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22ADV601	NATURAL LANGUAGE PROCESSING	L	T	P	C
		2	0	2	3

Course Objectives:

- To learn the fundamentals of natural language processing.
- To learn the word level analysis methods .
- To explore the syntactic analysis concepts.
- To understand the semantics and pragmatics.
- To learn to analyze discourses and Lexical Resources

UNIT I	INTRODUCTION	6

Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM - Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance

UNIT II	WORD LEVEL ANALYSIS	6

Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models

UNIT III	SYNTACTIC ANALYSIS	6

Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing - Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs.

UNIT IV	SEMANTICS	6

Feature structures, Unification of feature structures - Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses.

UNIT V	PRAGMATICS	6

Thematic Roles, Selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.

TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
1. Word Analysis
2. Word Generation
3. Morphology
4. N-Grams
5. N-Grams Smoothing
6. POS Tagging: Hidden Markov Model
7. POS Tagging: Viterbi Decoding
8. Building POS Tagger
9. Chunking
10. Building Chunker
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Daniel Jurafsky, James H. Martin—Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014
2	Steven Bird, Ewan Klein and Edward Loper, —Natural Language Processing with Python, First Edition, O'Reilly Media, 2009
REFERENCES:	
1	Breck Baldwin, —Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015
2	Richard M Reese, —Natural Language Processing with Javal, O'Reilly Media, 2015
3	Nitin Indurkhya and Fred J. Damerau, —Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010
4	Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008

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Course Name: NATURAL LANGUAGE PROCESSING		Course Code: 22ADV601			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Tag a given text with basic Language features	**I**	K1,K2	1,2,3,4,6,9, 10,11	1,2
CO2	Implement a rule-based system to tackle morphology/ syntax of a language	**II**	K3,K4	1,2,3,4,5,6, 9,11,12	1,2
CO3	Design a tag set to be used for statistical processing for real-time applications	**III**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Compare and contrast the use of different statistical approaches for different types of NLP applications.	**IV**	K5	1,2,3,4,6,9, 10,11,12	1,2
CO5	Use tools to process natural language and design innovative NLP applications.	**V**	K1,K2	1,2,4,5,6, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	1	1	1	1	1	0
CO2	3	3	2	3	2	2	-	-	2	0	2	3	2	1
CO3	3	3	3	2	2	2	-	-	2	2	2	3	2	1
CO4	3	3	2	2	2	2	-	-	1	1	2	2	2	1
CO5	3	3	2	3	3	3	-	-	-	0	2	2	2	1
CO	3	3	2	2	2	2	-	-	1	1	2	2	2	1

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22ADV602	ROBOTIC PROCESS AUTOMATION	L	T	P	C
		2	0	2	3

Course Objectives:

- To understand the basic concepts of Robotic Process Automation.
- To expose to the key RPA design and development strategies and methodologies.
- To learn the fundamental RPA logic and structure.
- To explore the Exception Handling, Debugging and Logging operations in RPA.
- To learn to deploy and Maintain the software bot.

UNIT I	INTRODUCTION TO ROBOTIC PROCESS AUTOMATION	6

Emergence of Robotic Process Automation (RPA), Evolution of RPA, Differentiating RPA from Automation - Benefits of RPA - Application areas of RPA, Components of RPA, RPA Platforms. Robotic Process Automation Tools - Templates, User Interface, Domains in Activities, Workflow Files.

UNIT II	AUTOMATION PROCESS ACTIVITIES	6

Sequence, Flowchart & Control Flow: Sequencing the Workflow, Activities, Flowchart, Control Flow for Decision making. Data Manipulation: Variables, Collection, Arguments, Data Table, Clipboard management, File operations Controls: Finding the control, waiting for a control, Act on a control, UiExplorer, Handling Events

UNIT III	APP INTEGRATION, RECORDING AND SCRAPING	6

App Integration, Recording, Scraping, Selector, Workflow Activities. Recording mouse and keyboard actions to perform operation, Scraping data from website and writing to CSV. Process Mining

UNIT IV	EXCEPTION HANDLING AND CODE MANAGEMENT	6

Exception handling, Common exceptions, Logging- Debugging techniques, Collecting crash dumps, Error reporting. Code management and maintenance: Project organization, Nesting workflows, Reusability, Templates, Commenting techniques, State Machine

UNIT V	DEPLOYMENT AND MAINTENANCE	6

Publishing using publish utility, Orchestration Server, Control bots, Orchestration Server to deploy bots, License management, Publishing and managing updates. RPA Vendors - Open Source RPA, Future of RPA

TOTAL: 30 PERIODS

LIST OF EXPERIMENTS: 30 PERIODS
Setup and Configure a RPA tool and understand the user interface of the tool: **1.** Create a Sequence to obtain user inputs display them using a message box; 2. Create a Flowchart to navigate to a desired page based on a condition; 3. Create a State Machine workflow to compare user input with a random number. 4. Buiid a process in the RPA platform using UI Automation Activities. 5. Create an automation process using key System Activities, Variables and Arguments 6. Also implement Automation using System Trigger 7. Automate login to (web)Email account 8. Recording mouse and keyboard actions. 9. Scraping data from website and writing to CSV 10. Implement Error Handling in RPA platform
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath by Alok Mani Tripathi, Packt Publishing, 2018
2	Tom Taulli , "The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems", Apress publications, 2020
3	Frank Casale (Author), Rebecca Dilla (Author), Heidi Jaynes (Author), Lauren Livingston (Author), Introduction to Robotic Process Automation: a Primer, Institute of Robotic Process Automation, Amazon Asia-Pacific Holdings Private Limited, 2018
REFERENCES:	
1	Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant, Amazon Asia-Pacific Holdings Private Limited, 2018
2	A Gerardus Blokdyk, "Robotic Process Automation Rpa A Complete Guide ", 2020

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Course Name: ROBOTIC PROCESS AUTOMATION		Course Code: 22ADV602			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Enunciate the key distinctions between RPA and existing automation techniques and platforms.	**I**	K1,K2	1,2,3,4,6,9, 10,11	1,2
CO2	Use UiPath to design control flows and work flows for the target process	**II**	K3,K4	1,2,3,4,5,6, 9,11,12	1,2
CO3	Implement recording, web scraping andprocess mining by automation	**III**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Use UIPath Studio to detect, and handle exceptions in automation processes	**IV**	K5	1,2,3,4,6,9, 10,11,12	1,2
CO5	Implement and use Orchestrator for creation, monitoring, scheduling, and controlling of automated bots and processes	**V**	K1,K2	1,2,4,5,6, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	3	-	-	-	1	1	2	1	2	3
CO2	2	1	3	2	2	-	-	-	3	2	2	3	3	2
CO3	2	2	2	1	2	-	-	-	1	1	1	1	1	1
CO4	1	3	1	1	3	-	-	-	1	1	3	2	1	3
CO5	1	1	3	1	3	-	-	-	1	1	2	1	3	2
CO	1.6	1.8	2	1.4	2.6	-	-	-	1.4	1.2	2	1.6	2	2.2

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22ADV603	INTELLIGENT AUTOMATION SYSTEMS	L	T	P	C
		2	0	2	3

Course Objectives:	• Analyze and articulate the benefits of implementing automation in production Systems • Identify industries best-suited for RPA adoption and evaluate case studies showcasing successful RPA implementations • Develop automation solutions with practical examples using Sequence and Flowchart Activities • Implement best practices in recording and selector strategies to optimize automation workflows

UNIT I	**INTRODUCTION TO AUTOMATION**	6

Automation in production system-Automation principles and strategies-Basic elements of an automated system-advanced automation Functions-levels of Automation-Hardware components for automation-sensors and actuators- Benefits of Automation -Limitations to Automation.

UNIT II	**RPA AND ITS PLATFORMS**	6

Introduction to Robotic Process Automation- Benefits of RPA- Overview of Industries Best- Suited for RPA- Advancements in RPA and Its Integration with AI. Components of RPA- RPA Platforms- About Ui Path- The future of automation.

UNIT III	**WORKFLOW AND CONTROL FLOW**	6

Sequencing the workflow Activities-Control flow, various types of loops, and decision-making using Sequence and Flowchart-Data Manipulation-Variables and Scope Collections-Arguments - Data table usage with examples

UNIT IV	**RECORDERS**	6

Clipboard Management-File operation mouse and keyboard activities- Working with UiExplorer-Handling events- Screen Scraping - UiPath Studio Recording -Recorder Overview-Components of Recording Wizard - Comparison of Recording Types-Automatic Recording Activities-Manual Recording activities -Basic Recorder- Desktop Recorder-Web Recorder.

UNIT V	**SELECTORS**	6

Selector-Selector Editor-Selectors with wild cards-UI Explorer in Selector-UI Explorer Window-Full Selectors and Partial Selectors-Errors, Exception and Debugging.

TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
Sample list of Experiments: 1. Study on UI path Tool 2. Recording Modes 3. Notepad/Word Automation 4. Screen Scrapping Techniques to extract text from Images/Web/Document 5. YouTube Search Engine-BMI Calculator Robot-Excel Automation Basics 6. Fees Concession Robot 7. PDF Automation 8. Invoice Automation Robot 9. Exception Handling / Running Multiple Robots 10. Data Scrapping (Web) with AI Techniques in UiPath 11. Gmail Automation Robot 12. Orchestrator - UiPath Dashboard
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	M.P.Groover, "Automation, Production Systems and computer Integrated Manufacturing", 4th edition, Pearson Education, 2016.
2	Tom Taulli, The Robotic Process Automation Handbook : A Guide to Implementing RPA Systems,2020, ISBN-13 (electronic): 978-1-4842-5729-6, Publisher : A press
3	Frank Casale, Rebecca Dilla, Heidi Jaynes ,Lauren Livingston, "Introduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation.2015.
REFERENCES:	
1	Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant,2018.
2	1. https://www.coursera.org/specializations/roboticprocessautomation 2. https://www.coursera.org/professional-certificates/google-it-automation.

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Course Name: INTELLIGENT AUTOMATION SYSTEMS		Course Code: 22ADV603			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Analyze and articulate the benefits of implementing automation in production Systems	**I**	K2	1,2,5,12	1,2
CO2	Identify industries best-suited for RPA adoption and evaluate case studies showcasing successful RPA implementations	**II**	K3	1,2,3,5, 11, 12	1,2
CO3	Develop automation solutions with practical examples using Sequence and Flowchart Activities	**III**	K3	1,2,3,5,9, 10,11,12	1,2
CO4	Implement best practices in recording and selector strategies to optimize automation workflows.	**IV**	K4	1,2,3,4,5, 11,12	1,2
CO5	Implement selector strategies to optimize automation workflows	**V**	K4	1,2,3,4,5,6, 7,8, 9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	1	-	-	-	2	-	-	-	2	3
CO2	3	1	1	-	2	-	-	-	1	-	-	2	2	2
CO3	1	1	2	-	3	-	-	-	3	1	1	2	3	1
CO4	1	1	2	2	3	-	-	-	2	-	-	2	1	1
CO5	1	3	1	2	2	-	-	1	1	1	1	2	1	2
CO	1.8	1.8	1.5	2	2.2	-	-	1	1.8	1	1	2	1.8	1.8

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22ADV604	NEURAL NETWORKS AND DEEP LEARNING	L	T	P	C
		2	0	2	3

Course Objectives:

- To understand the basics in deep neural networks
- To understand the basics of associative memory and unsupervised learning networks
- To apply CNN architectures of deep neural networks
- To analyze the key computations underlying deep learning, then use them to build and train deep neural networks for various tasks.
- To apply autoencoders and generative models for suitable applications

UNIT I	INTRODUCTION	6

Neural Networks-Application Scope of Neural Networks-Artificial Neural Network: An Introduction-Evolution of Neural Networks-Basic Models of Artificial Neural Network- Important Terminologies of ANNs-Supervised Learning Network.

UNIT II	ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS	6

Training Algorithms for Pattern Association-Autoassociative Memory Network-Heteroassociative Memory Network-Bidirectional Associative Memory (BAM)-Hopfield Networks-Iterative Autoassociative Memory Networks-Temporal Associative Memory Network-Fixed Weight Competitive Nets-Kohonen Self-Organizing Feature Maps-Learning Vector Quantization-Counter propagation Networks-Adaptive Resonance Theory Network

UNIT III	THIRD-GENERATION NEURAL NETWORKS	6

Spiking Neural Networks-Convolutional Neural Networks-Deep Learning Neural Networks-Extreme Learning Machine Model-Convolutional Neural Networks: The Convolution Operation – Motivation – Pooling – Variants of the basic Convolution Function – Structured Outputs – Data Types – Efficient Convolution Algorithms – Neuroscientific Basis – Applications: Computer Vision, Image Generation, Image Compression.

UNIT IV	DEEP FEEDFORWARD NETWORKS	6

History of Deep Learning- A Probabilistic Theory of Deep Learning- Gradient Learning – Chain Rule and Backpropagation - Regularization: Dataset Augmentation – Noise Robustness -Early Stopping, Bagging and Dropout - batch normalization- VC Dimension and Neural Nets.

UNIT V	RECURRENT NEURAL NETWORKS	6

Recurrent Neural Networks: Introduction – Recursive Neural Networks – Bidirectional RNNs – Deep Recurrent Networks – Applications: Image Generation, Image Compression, Natural Language Processing. Complete Auto encoder, Regularized Autoencoder, Stochastic Encoders and Decoders, Contractive Encoders.

TOTAL: 30 PERIODS

LIST OF EXPERIMENTS: 30 PERIODS
1. Implement simple vector addition in TensorFlow.
2. Implement a regression model in Keras.
3. Implement a perceptron in TensorFlow/Keras Environment.
4. Implement a Feed-Forward Network in TensorFlow/Keras.
5. Implement an Image Classifier using CNN in TensorFlow/Keras.
6. Improve the Deep learning model by fine tuning hyper parameters.
7. Implement a Transfer Learning concept in Image Classification.
8. Using a pre trained model on Keras for Transfer Learning
9. Perform Sentiment Analysis using RNN
10. Implement an LSTM based Autoencoder in TensorFlow/Keras
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016
2	Francois Chollet, "Deep Learning with Python", Second Edition, Manning Publications, 2021.
REFERENCES:	
1	Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow", Oreilly, 2018.
2	Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017.
3	Charu C. Aggarwal, "Neural Networks and Deep Learning: A Textbook", Springer International Publishing, 1st Edition, 2018.
4	Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
5	Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020

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Course Name: NEURAL NETWORKS AND DEEP LEARNING		Course Code: 22ADV604			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Apply Convolution Neural Network for image processing	**I**	K3	1,2,3,5,9, 10,11,12	1,2
CO2	Understand the basics of associative memory and unsupervised learning networks.	**II**	K5	1,2,3,4,5,8, 9, 10,11,12	1,2
CO3	Apply CNN and its variants for suitable applications.	**III**	K3	1,2,3,5,6,9, 10,11,12	1,2
CO4	Analyze the key computations underlying deep learning and use them to build and train deep neural networks for various tasks.	**IV**	K3	1,2,3,5,9, 10,11,12	1,2
CO5	Apply autoencoders and generative models for suitable applications	**V**	K6	1,2,3,5,9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	3	-	2	-	-	-	1	2	1	1	1	1
CO2	2	2	2	2	2	-	-	1	1	2	1	2	2	1
CO3	2	2	3	-	2	1	-	-	2	2	2	2	1	2
CO4	2	1	2	-	2	-	-	-	1	2	1	1	2	1
CO5	2	1	3	-	2	-	-	-	2	2	2	2	2	2
CO	2	1.3	2.6	2	2	1	-	1	1.4	2	1.5	1.5	1.5	1.5



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22ADV605	QUANTUM COMPUTING	L	T	P	C
		2	0	2	3

Course Objectives:

- To know the background of classical computing and quantum computing.
- To learn the fundamental concepts behind quantum computation.
- To study the details of quantum mechanics and its relation to Computer Science.
- To gain knowledge about the basic hardware and mathematical models of quantum computation.
- To learn the basics of quantum information and the theory behind it

UNIT I	QUANTUM COMPUTING BASIC CONCEPTS	6

Complex Numbers - Linear Algebra - Matrices and Operators - Global Perspectives Postulates of Quantum Mechanics – Quantum Bits - Representations of Qubits - Superposition

UNIT II	QUANTUM GATES AND CIRCUITS	6

Universal logic gates - Basic single qubit gates - Multiple qubit gates - Circuit development - Quantum error correction

UNIT III	QUANTUM ALGORITHMS	6

Quantum parallelism - Deutsch's algorithm - The Deutsch–Jozsa algorithm - Quantum Fourier transform and its applications - Quantum Search Algorithms: Grover's Algorithm

UNIT IV	QUANTUM INFORMATION THEORY	6

Data compression - Shannon's noiseless channel coding theorem - Schumacher's quantum noiseless channel coding theorem - Classical information over noisy quantum channels

UNIT V	QUANTUM CRYPTOGRAPHY	6

Classical cryptography basic concepts - Private key cryptography - Shor's Factoring Algorithm - Quantum Key Distribution - BB84 - Ekart 91

TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
1. Single qubit gate simulation - Quantum Composer 2. Multiple qubit gate simulation - Quantum Composer 3. Composing simple quantum circuits with q-gates and measuring the output into classical bits. 4. IBM Qiskit Platform Introduction 5. Implementation of Shor's Algorithms 6. Implementation of Grover's Algorithm 7. Implementation of Deutsch's Algorithm 8. Implementation of Deutsch-Jozsa's Algorithm 9. Integer factorization using Shor's Algorithm 10. QKD Simulation
TOTAL : 30 PERIODS

TEXT BOOKS:	
1	Parag K Lala, Mc Graw Hill Education, "Quantum Computing, A Beginners Introduction", First edition (1 November 2020).
2	Michael A. Nielsen, Issac L. Chuang, "Quantum Computation and Quantum Information", Tenth Edition, Cambridge University Press, 2010.
3	Chris Bernhardt, The MIT Press; Reprint edition (8 September 2020), "Quantum Computing for Everyone"
REFERENCES:	
1	Scott Aaronson, "Quantum Computing Since Democritus", Cambridge University Press, 2013.
2	N. David Mermin, "Quantum Computer Science: An Introduction", Cambridge University Press, 2007

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Course Name: QUANTUM COMPUTING		Course Code: 22ADV605			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the basics of quantum computing.	**I**	K2	1,2,5,10,12	1,2
CO2	Understand the background of Quantum Mechanics.	**II**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO3	Analyze the computation models.	**III**	K4	1,2,3,4,5, 10,11,12	1,2
CO4	Model the circuits using quantum computation. environments and frameworks	**IV**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO5	Understand the quantum operations such as noise and error–correction	**V**	K4	1,2,3,4,5,9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	1	-	-	-	-	1	-	1	-	1
CO2	2	2	2	1	2	-	-	-	1	2	2	2	1	2
CO3	2	2	3	2	2	-	-	-	1	2	2	2	2	2
CO4	2	2	2	2	3	-	-	-	-	1	2	2	2	2
CO5	2	2	2	2	3	-	-	-	1	2	2	3	2	2
CO	2	1.8	1.2	1.8	2.6	-	-	-	1	1.8	2	2	1.8	1.8

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22ADV606	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES	L	T	P	C
		2	0	2	3
Course Objectives:	• To understand the basics of Blockchain • To learn Different protocols and consensus algorithms in Blockchain • To learn the Blockchain implementation frameworks • To understand the Blockchain Applications • To experiment the Hyperledger Fabric, Ethereum networks				
UNIT I	INTRODUCTION TO BLOCKCHAIN				6
Blockchain- Public Ledgers, Blockchain as Public Ledgers - Block in a Blockchain, Transactions- The Chain and the Longest Chain - Permissioned Model of Blockchain, Cryptographic -Hash Function, Properties of a hash function-Hash pointer and Merkle tree.					
UNIT II	BITCOIN AND CRYPTOCURRENCY				6
A basic crypto currency, Creation of coins, Payments and double spending, FORTH – the precursor for Bitcoin scripting, Bitcoin Scripts , Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay.					
UNIT III	BITCOIN CONSENSUS				6
Bitcoin Consensus, Proof of Work (PoW)- Hashcash PoW , Bitcoin PoW, Attacks on PoW ,monopoly problem- Proof of Stake- Proof of Burn - Proof of Elapsed Time - Bitcoin Miner, Mining Difficulty, Mining Pool-Permissioned model and use cases.					
UNIT IV	HYPERLEDGER FABRIC & ETHEREUM				6
Architecture of Hyperledger fabric v1.1- chain code- Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity.					
UNIT V	BLOCKCHAIN APPLICATIONS				6
Smart contracts, Truffle Design and issue- DApps- NFT. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance,etc- Case Study.					
	TOTAL: 30 PERIODS				

LIST OF EXPERIMENTS: 30 PERIODS
1. Install and understand Docker container, Node.js, Java and Hyperledger Fabric, Ethereum and perform necessary software installation on local machine/create instance on cloud to run. 2. Create and deploy a blockchain network using Hyperledger Fabric SDK for Java Set up and initialize the channel, install and instantiate chain code, and perform invoke and query on your blockchain network. 3. Interact with a blockchain network. Execute transactions and requests against a blockchain network by creating an app to test the network and its rules. 4. Deploy an asset-transfer app using blockchain. Learn app development within a Hyperledger Fabric network. 5. Use blockchain to track fitness club rewards. Build a web app that uses Hyperledger Fabric to track and trace member rewards. 6. Car auction network: A Hello World example with Hyperledger Fabric Node SDK and IBM Blockchain Starter Plan. Use Hyperledger Fabric to invoke chain code while storing results and data in the starter plan
TOTAL : 60PERIODS

TEXT BOOKS:	
1	Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, 2017.
2	Andreas Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly, 2014
3	Daniel Drescher, "Blockchain Basics", First Edition, Apress, 2017
REFERENCES:	
1	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016
2	Melanie Swan, "Blockchain: Blueprint for a New Economy", O'Reilly, 2015

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Course Name: CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES		Course Code: 22ADV606			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand emerging abstract models for Blockchain Technology	**I**	K2	1,2,5	1,2
CO2	Identify major research challenges and technical gaps existing between theory and practice in the crypto currency domain	**II**	K3	1,2,3,5	1,2
CO3	It provides conceptual understanding of the function of Blockchain as a method of securing distributed ledgers	**III**	K2	1,2,3,5	1,2
CO4	Understand the hyperledger Fabric and Ethereum network	**IV**	K3	1,2,3,5	1,2
CO5	Apply hyperledger Fabric and Ethereum platform to implement the Block chain Application.	**V**	K4	1,2,3,5	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	2	-	-	-	-	-	-	-	1	-
CO2	3	2	3	-	3	-	-	-	-	-	-	-	2	-
CO3	3	3	3	-	3	-	-	-	-	-	-	-	2	-
CO4	3	2	3	-	3	-	-	-	-	-	-	-	1	-
CO5	3	-	2	-	2	-	-	-	-	-	-	-	2	-
CO	3	2.5	2.8	-	2.6	-	-	-	-	-	-	-	1.8	-

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22ADV607	FOG AND EDGE COMPUTING	L	T	P	C
		2	0	2	3

Course Objectives:

- To enhance real-time data processing and analytics at the network edge.
- To optimize resource utilization and reduce latency in fog computing environments.
- To improve scalability and flexibility for edge devices and applications.
- To Enhance security and privacy for data processing at the edge.
- To Facilitate seamless integration of fog and edge computing with cloud services

UNIT I	INTRODUCTION TO FOG AND EDGE COMPUTING	6

Definition and Fundamentals: Overview of Fog and Edge Computing, Key concepts and characteristics, Motivations and Advantages: Reasons for adopting Fog and Edge Computing, Comparative advantages over traditional Cloud Computing, Use Cases and Applications: Challenges and Limitations: Security concerns, privacy issues, and compliance, Comparison with Cloud Computing: Contrasting characteristics and use cases, Complementary roles in a hybrid computing environment.

UNIT II	ARCHITECTURES AND COMPONENTS	6

Edge Computing Architecture Models: Design principles and characteristics, Hierarchical vs. flat architectures. Fog Nodes and Infrastructure: Role and capabilities of Fog nodes, Infrastructure components supporting Edge Computing. Edge Device Types and Capabilities: Categorization of Edge devices (e.g., gateways, sensors, actuators), Capabilities and limitations of different device types. Edge-to-Cloud Communication Models; Middleware and Software Frameworks: Middleware solutions for Edge Computing

UNIT III	SECURITY AND PRIVACY IN EDGE COMPUTING	6

Security Challenges in Edge Computing: Identifying security threats in Edge Computing, Risks associated with decentralized architectures. Methods for secure access control: Role of authentication in ensuring device integrity, Data Encryption in Edge Environments: Encryption strategies for data at rest and in transit. Privacy Concerns and Regulatory Compliance; Risk Management and Incident Response

UNIT IV	EDGE APPLICATION DEVELOPMENT	6

Programming Models and Frameworks: Overview of programming models for Edge Computing, Exploration of popular frameworks for Edge application development, Integration with IoT Devices: Techniques for integrating Edge Computing with Internet of Things (IoT) devices. Edge Application Deployment Strategies; Edge-to-Cloud Communication Patterns; Optimizing Edge Application Performance: Performance considerations in Edge Computing, Strategies for optimizing resource usage and responsiveness

UNIT V	PERFORMANCE OPTIMIZATION AND FUTURE TRENDS	6

Performance Metrics and Optimization: Metrics for evaluating performance in Edge Computing Strategies for optimizing Edge applications; Energy-Efficient Edge Architectures: Techniques for optimizing energy consumption, Green computing practices in Edge environments, Real- time Processing and Analytics: Approaches for real-time data processing at the Edge, Analytics capabilities in decentralized architectures. Scalability and Flexibility in Edge Architectures; Emerging Trends in Fog and Edge Computing.

TOTAL: 30 PERIODS

ANNAPOORANA ENGINEERING COLLEGE AUTONOMOUS SALEM

LIST OF EXPERIMENTS: 30 PERIODS
1. Design and deploy a fog computing architecture for a smart city application. 2. Optimize data processing algorithms for edge devices in a real-time monitoring system. 3. Evaluate resource utilization in a fog computing environment using simulation tools. 4. Implement security protocols for edge devices to protect sensitive data. 5. Develop a scalable edge computing solution for IoT devices in a manufacturing setting. 6. Integrate fog computing with cloud services to enhance overall system efficiency. 7. Perform a hands-on deployment of edge computing nodes in a network infrastructure 8. Design and implement a fault-tolerant edge computing solution for critical applications. 9. Conduct performance testing to assess the latency reduction achieved through edge computing
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	"Fog and Edge Computing: Principles and Paradigms" by Rajkumar Buyya and Amir Vahid Dastjerdi (Wiley, 1st Edition, 2018),
2	"Edge Computing: A Primer" by Shiwen Mao and Ying-Chang Liang (Wiley, 1st Edition, 2019),
3	"Fog Computing in the Internet of Things: Intelligence at the Edge" by Yogesh Simmhan, Nalini Venkatasubramanian, and Viktor K. Prasanna (Springer, 1st Edition, 2018),
4	"Fog Computing: Concepts, Frameworks and Technologies" by Flavio Bonomi, Rodolfo Milito, Jiang Zhu, and Sateesh Addepalli (Springer, 1st Edition, 2018),
5	"Edge Computing – The Dawn of Industry 4.0 Revolution" by Satya Prakash Ghrera (CRC Press, 1st Edition, 2020)
6	"Fog Computing: Towards Minimizing Latency and Improving QoE in the Internet of Things" by Mohammad Mehedi Hassan, Saad B. Qaisar, and Abdelgadir Mohammed Ahmed (Springer, 1st Edition, 2018).

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Course Name: FOG AND EDGE COMPUTING		Course Code: 22ADV607			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Proficiently deploy and manage fog and edge computing solutions in diverse environments	**I**	K2	1,2,3,4,5,9, 10,11,12	1,2
CO2	Demonstrate expertise in optimizing data processing and analytics at the network edge	**II**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO3	Evaluate and enhance resource efficiency for fog computing deployments	**III**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO4	Implement robust security measures for safeguarding edge computing data	**IV**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO5	Successfully integrate fog and edge computing technologies to address real-world challenges	**V**	K2	1,2,3,4,5,9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	3	-	-	-	1	3	1	3	3	1
CO2	3	1	2	1	2	-	-	-	1	2	2	1	2	1
CO3	2	2	1	2	3	-	-	-	2	1	1	3	2	1
CO4	2	3	3	1	1	-	-	-	2	2	2	2	1	2
CO5	1	2	1	3	1	-	-	-	3	2	1	3	3	3
CO	2.2	1.8	1.6	1.6	2	-	-	-	1.8	2	1.4	2.4	2.4	1.6

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22ADV608	3D PRINTING AND DESIGN	L	T	P	C
		2	0	2	3

Course Objectives:

- To discuss on basics of 3D printing
- To explain the principles of 3D printing technique
- To explain and illustrate inkjet technology
- To explain and illustrate laser technology
- To discuss the applications of 3D printing

UNIT I	INTRODUCTION	6

Introduction; Design considerations – Material, Size, Resolution, Process; Modelling and viewing - 3D; Scanning; Model preparation – Digital; Slicing; Software; File formats

UNIT II	PRINCIPLE	6

Processes – Extrusion, Wire, Granular, Lamination, Photopolymerisation; Materials - Paper, Plastics, Metals, Ceramics, Glass, Wood, Fiber, Sand, Biological Tissues, Hydrogels, Graphene; Material Selection - Processes, applications, limitations

UNIT III	INKJET TECHNOLOGY	6

Printer - Working Principle, Positioning System, Print head, Print bed, Frames, Motion control; Print head Considerations – Continuous Inkjet, Thermal Inkjet, Piezoelectric Drop-On-Demand; Material Formulation for jetting; Liquid based fabrication – Continous jet, Mulitjet; Powder based fabrication – Colourjet

UNIT IV	LASER TECHNOLOGY	6

Light Sources – Types, Characteristics; Optics – Deflection, Modulation; Material feeding and flow – Liquid, powder; Printing machines – Types, Working Principle, Build Platform, Print bed Movement, Support structures

UNIT V	INDUSTRIAL APPLICATIONS	6

Product Models, manufacturing – Printed electronics, Biopolymers, Packaging, Healthcare, Food, Medical, Biotechnology, Displays; Future trends

TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
1. Study the interface and basic tools in the CAD software 2. Study 3D printer(s) including print heads, build envelope, materials used and related support removal system 3. Review of geometry terms of a 3D mesh. 4. Commands for moving from 2D to 3D 5. Advanced CAD commands to navigate models in 3D space 6. Design any four everyday object 7. Use the CAM software to prepare files for 3D printing 8. Manipulate machine movement and material layering. 9. Repair a 3D mesh using a) Freeware utilities: Autodesk MeshMixer (http://goo.gl/x5nhYc), MeshLab (http://goo.gl/fgztLl) or Netfabb Basic or Cloud Service (http://goo.gl/Q1P47a) b) Freeware tool tutorials: Netfabb Basic or Cloud Service (http://goo.gl/Q1P47a), Netfabb and MeshLab (http://goo.gl/WPOVec) c)Professional tools: Magics or Netfabb
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Christopher Barnatt, 3D Printing: The Next Industrial Revolution, CreateSpace Independent Publishing Platform, 2013.
2	Ian M. Hutchings, Graham D. Martin, Inkjet Technology for Digital Fabrication, John Wiley & Sons, 2013
REFERENCES:	
1	Chua, C.K., Leong K.F. and Lim C.S., Rapid prototyping: Principles and applications, second edition, World Scientific Publishers, 2010
2	Ibrahim Zeid, Mastering CAD CAM Tata McGraw-Hill Publishing Co., 2007
3	Joan Horvath, Mastering 3D Printing, APress, 2014

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Course Name: 3D PRINTING AND DESIGN		Course Code: 22ADV608			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Outline and examine the basic concepts of 3D printing technology	I	K3	1,2,3,4,9, 10,11	1,2
CO2	Outline 3D printing workflow	II	K3	1,2,3,4,9, 10,11	1,2
CO3	Explain and categorise the concepts and working principles of 3D printing using inkjet technique	III	K3	1,2,3,4,9, 10,11	1,2
CO4	Explain and categorise the working principles of 3D printing using laser technique	IV	K3	1,2,3,4,9, 10,11	1,2
CO5	Explain various method for designing and modeling for industrial applications	V	K3	1,2,3,4,9, 10,11	1,2

CO-PO-PSO Mapping

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

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VERTICAL VII: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22ADV701	Bio-Inspired Optimization Techniques	PE	2	0	2	4	3
2.	22ADV702	Soft Computing	PE	2	0	2	4	3
3.	22ADV703	Health Care Analytics	PE	2	0	2	4	3
4.	22ADV704	Generative AI	PE	2	0	2	4	3
5.	22ADV705	Optimization Techniques	PE	2	0	2	4	3
6.	22ADV706	Game Theory	PE	2	0	2	4	3
7.	22ADV707	Cognitive Science	PE	2	0	2	4	3
8.	22ADV708	Ethics and AI	PE	2	0	2	4	3

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22ADV701	BIO-INSPIRED OPTIMIZATION TECHNIQUES	L	T	P	C
		2	0	2	3

Course Objectives:

- To understand fundamental topics in bio-inspired optimization techniques
- To Learn the collective systems such as ACO, PSO, and BCO
- To develop skills in biologically inspired algorithm design with an emphasis on solving real world problems
- To understand the most appropriate types of algorithms for different data analysis problems and to introduce some of the most appropriate implementation strategies.
- To implement the Bio-inspired technique with other traditional algorithms.

UNIT I	INTRODUCTION	6

Optimization Techniques: Introduction to Optimization Problems – Single and Muti- objective Optimization – Classical Techniques – Overview of various Optimization methods – Evolutionary Computing: Genetic Algorithm and Genetic Programming: Basic concept – encoding – representation – fitness function – Reproduction

UNIT II	SWARM INTELLIGENCE	6

Introduction – Biological foundations of Swarm Intelligence – Swarm Intelligence in Optimization – Ant Colonies: Ant Foraging Behavior – Towards Artificial Ants – Ant Colony Optimization (ACO) – S- ACO – Ant Colony Optimization Metaheuristic: Combinatorial Optimization – ACO Metaheuristic – Problem solving using ACO

UNIT III	NATURAL TO ARTIFICIAL SYSTEMS	6

Evolution of neural networks – hybrid neural systems – Biological Inspirations in problem solving – Behavior of Social Insects: Foraging –Division of Labor – Task Allocation – Cemetery Organization and Brood Sorting – Nest Building – Cooperative transport

UNIT IV	SWARM ROBOTICS	6

Foraging for food – Clustering of objects – Collective Prey retrieval – Scope of Swarm Robotics – Social Adaptation of Knowledge: Particle Swarm – Particle Swarm Optimization (PSO) – Particle Swarms for Dynamic Optimization Problems

UNIT V	CASE STUDIES	6

Case Studies: ACO and PSO for NP-hard problems – Routing problems – Assignment problems – Scheduling problems – Subset problems – Machine Learning Problems – Travelling Salesman problem.

TOTAL: 30 PERIODS

LIST OF EXPERIMENTS: 30 PERIODS
1. Implementation of Genetic Algorithm (GA) 2. Solving TSP using Ant Colony Optimization (ACO) 3. Particle Swarm Optimization (PSO) for Function Optimization 4. Compare Classical vs Bio-Inspired Optimization 5. Task Allocation Simulation using Swarm Intelligence 6. Hybrid Neural-PSO System for Classification 7. Scheduling Problem using Genetic Algorithm 8. Case Study: Optimization in Machine Learning using PSO/ACO
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	A. E. Elben and J. E. Smith, "Introduction to Evolutionary Computing", Springer, 2010.
2	Floreano D. and Mattiussi C., "Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies", MIT Press, Cambridge, MA, 2008
3	Leandro Nunes de Castro, " Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications", Chapman & Hall/ CRC, Taylor and Francis Group, 2007
REFERENCES:	
1	Eric Bonabeau, Marco Dorigo, Guy Theraulaz, "Swarm Intelligence: From Natural to Artificial Systems", Oxford University press, 2000
2	Christian Blum, Daniel Merkle (Eds.), "Swarm Intelligence: Introduction and Applications", Springer Verlag, 2008
3	Leandro N De Castro, Fernando J Von Zuben, "Recent Developments in Biologically Inspired Computing", Idea Group Inc., 2005
4	Albert Y.Zomaya, "Handbook of Nature-Inspired and Innovative Computing", Springer, 2006
5	C. Ebelhart et al., "Swarm Intelligence", Morgan Kaufmann, 2001

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Course Name: BIO-INSPIRED OPTIMIZATION TECHNIQUES		Course Code: 22ADV701			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Familiarity with the basics of several biologically inspired optimization techniques.	**I**	K1,K2	1,2,3,4,6,9, 10,11	1,2
CO2	Familiarity with the basics of several biologically inspired computing paradigms.	**II**	K3,K4	1,2,3,4,5,6, 9,11,12	1,2
CO3	Ability to select an appropriate bio-inspired computing method and implement for any application and data set.	**III**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Theoretical understanding of the differences between the major bio-inspired computing methods.	**IV**	K5	1,2,3,4,6,9, 10,11,12	1,2
CO5	Learn Other Swarm Intelligence algorithms and implement the Bio-inspired technique with other traditional algorithm	**V**	K1,K2	1,2,4,5,6, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	1	1	1	1	1	0
CO2	3	3	2	3	2	2	-	-	2	0	2	3	2	1
CO3	3	3	3	2	2	2	-	-	2	2	2	3	2	1
CO4	3	3	2	2	2	2	-	-	1	1	2	2	2	1
CO5	3	3	2	3	3	3	-	-	-	0	2	2	2	1
CO	3	3	2	2	2	2	-	-	1	1	2	2	2	1

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22ADV702	SOFT COMPUTING	L	T	P	C
		2	0	2	3

Course Objectives:

- To introduce the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience.
- To provide the mathematical background for carrying out the optimization associated with neural network learning
- To learn various evolutionary Algorithms.
- To become familiar with neural networks that can learn from available examples and generalize to form appropriate rules for inference systems.
- To introduce case studies utilizing the above and illustrate the Intelligent behavior of programs based on soft computing

UNIT I	INTRODUCTION TO SOFT COMPUTING AND FUZZY LOGIC	6

Introduction - Fuzzy Logic - Fuzzy Sets, Fuzzy Membership Functions, Operations on Fuzzy Sets, Fuzzy Relations, Operations on Fuzzy Relations, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems

UNIT II	NEURAL NETWORKS	6

Supervised Learning Neural Networks – Perceptrons - Backpropagation -Multilayer Perceptrons – Unsupervised Learning Neural Networks – Kohonen Self-Organizing Networks

UNIT III	GENETIC ALGORITHMS	6

Chromosome Encoding Schemes -Population initialization and selection methods – Evaluation function - Genetic operators- Cross over – Mutation - Fitness Function – Maximizing function

UNIT IV	NEURO FUZZY MODELING	6

ANFIS architecture – hybrid learning – ANFIS as universal approximator – Coactive Neuro fuzzy modeling – Framework – Neuron functions for adaptive networks – Neuro fuzzy spectrum - Analysis of Adaptive Learning Capability

UNIT V	APPLICATIONS	6

Modeling a two input sine function - Printed Character Recognition – Fuzzy filtered neural networks – Plasma Spectrum Analysis – Hand written neural recognition - Soft Computing for Color Recipe Prediction

TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
1.Implementation of fuzzy control/ inference system 2. Programming exercise on classification with a discrete perceptron 3. Implementation of XOR with backpropagation algorithm 4. Implementation of self organizing maps for a specific application 5. Programming exercises on maximizing a function using Genetic algorithm 6. Implementation of two input sine function 7. Implementation of three input non linear function
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	SaJANG, J.-S. R., SUN, C.-T., & MIZUTANI, E. (1997). Neuro-fuzzy and soft computing: A computational approach to learning and machine intelligence. Upper Saddle River, NJ, Prentice Hall,1997
2	Himanshu Singh, Yunis Ahmad Lone, Deep Neuro-Fuzzy Systems with Python
3	With Case Studies and Applications from the Industry, Apress, 2020
REFERENCES:	
1	roj Kaushik and Sunita Tiwari, Soft Computing-Fundamentals Techniques and Applications, 1st Edition, McGraw Hill, 2018.
2	S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 2003
3	Samir Roy, Udit Chakraborthy, Introduction to Soft Computing, Neuro Fuzzy and Genetic Algorithms, Pearson Education, 2013
4	S.N. Sivanandam, S.N. Deepa, Principles of Soft Computing, Third Edition, Wiley India Pvt Ltd, 2019
5	R.Eberhart, P.Simpson and R.Dobbins, "Computational Intelligence - PC Tools", AP Professional, Boston, 1996

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Course Name: SOFT COMPUTING		Course Code: 22ADV702			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the fundamentals of fuzzy logic operators and inference mechanisms	**I**	K1,K2	1,2,3,4,6,9, 10,11	1,2
CO2	Understand neural network architecture for AI applications such as classification and clustering	**II**	K3,K4	1,2,3,4,5,6, 9,11,12	1,2
CO3	Learn the functionality of Genetic Algorithms in Optimization problems	**III**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Use hybrid techniques involving Neural networks and Fuzzy logic	**IV**	K5	1,2,3,4,6,9, 10,11,12	1,2
CO5	Apply soft computing techniques in real world applications	**V**	K1,K2	1,2,4,5,6, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	3	-	-	-	1	1	2	1	2	3
CO2	2	1	3	2	2	-	-	-	3	2	2	3	3	2
CO3	2	2	2	1	2	-	-	-	1	1	1	1	1	1
CO4	1	3	1	1	3	-	-	-	1	1	3	2	1	3
CO5	1	1	3	1	3	-	-	-	1	1	2	1	3	2
CO	1.6	1.8	2	1.4	2.6	-	-	-	1.4	1.2	2	1.6	2	2.2

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22ADV703	HEALTH CARE ANALYTICS	L	T	P	C
		2	0	2	3

Course Objectives:

- Understand the health data formats, health care policy and standards
- Learn the significance and need of data analysis and data visualization
- Understand the health data management frameworks
- Learn the use of machine learning and deep learning algorithms in healthcare
- Apply healthcare analytics for critical care applications

UNIT I	INTRODUCTION TO HEALTHCARE ANALYSIS	6

Overview - History of Healthcare Analysis Parameters on medical care systems- Health care policy- Standardized code sets – Data Formats – Machine Learning Foundations: Tree Like reasoning , Probabilistic reasoning and Bayes Theorem, Weighted sum approach

UNIT II	ANALYTICS ON MACHINE LEARNING	6

Machine Learning Pipeline – Pre-processing –Visualization – Feature Selection – Training model parameter – Evaluation model : Sensitivity , Specificity , PPV ,NPV, FPR ,Accuracy , ROC , Precision Recall Curves , Valued target variables

UNIT III	HEALTH CARE MANAGEMENT	6

IOT- Smart Sensors – Migration of Healthcare Relational database to NoSQL Cloud Database – Decision Support System – Matrix block Cipher System – Semantic Framework Analysis.

UNIT IV	HEALTHCARE AND DEEP LEARNING	6

Introduction on Deep Learning – DFF network CNN- RNN for Sequences – Biomedical Image and Signal Analysis – Natural Language Processing and Data Mining for Clinical Data – Mobile Imaging and Analytics – Clinical Decision Support System

UNIT V	CASE STUDIES	6

Predicting Mortality for cardiology Practice –Smart Ambulance System using IOT –Hospital Acquired Conditions (HAC) program- Healthcare and Emerging Technologies – ECG Data Analysis

TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
1. Pre-processing of Healthcare Dataset
2. Health Data Visualization
3. Evaluation Metrics in Healthcare
4. Feature Selection from EHR Data
5. Heart Disease Prediction using Machine Learning
6. IoT-based Smart Sensor Simulation
7. ECG Signal Classification using CNN
8. Clinical Text Mining using NLP
9. Hospital Acquired Condition Prediction
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Chandan K.Reddy, Charu C. Aggarwal, "Health Care data Analysis", First edition, CRC, 2015
2	Vikas Kumar, "Health Care Analysis Made Simple", Packt Publishing, 2018
3	Nilanjan Dey, Amira Ashour , Simon James Fong, Chintan Bhatl, "Health Care Data Analysis and Management, First Edition, Academic Press, 2018
REFERENCES:	
1	Hui Jang, Eva K.Lee, "HealthCare Analysis : From Data to Knowledge to Healthcare Improvement", First Edition, Wiley, 2016.
2	Kulkarni , Siarry, Singh ,Abraham, Zhang, Zomaya , Baki, "Big Data Analytics in HealthCare", Springer, 2020

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Course Name: HEALTH CARE ANALYTICS		Course Code: 22ADV703			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Use machine learning and deep learning algorithms for health data analysis	I	K2	1,2,5,12	1,2
CO2	Apply the data management techniques for healthcare data	II	K3	1,2,3,5,9	1,2
CO3	Evaluate the need of healthcare data analysis in e-healthcare, telemedicine and other critical care applications	III	K3	1,2,3,5,9, 10,11,12	1,2
CO4	Design health data analytics for real time applications	IV	K4	1,2,3,4,5, 11,12	1,2
CO5	Design emergency care system using health data analysis	V	K4	1,2,3,4,5,8, 9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	1	-	-	-	2	-	-	-	2	3
CO2	3	1	1	-	2	-	-	-	1	-	-	2	2	2
CO3	1	1	2	-	3	-	-	-	3	1	1	2	3	1
CO4	1	1	2	2	3	-	-	-	2	-	-	2	1	1
CO5	1	3	1	2	2	-	-	1	1	1	1	2	1	2
CO	1.8	1.8	1.5	2	2.2	-	-	1	1.8	1	1	2	1.8	1.8



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22ADV704	GENERATIVE AI	L	T	P	C
		2	0	2	3

Course Objectives:

- Understand the principles and theory behind generative AI.
- Gain practical experience in developing generative AI models.
- Analyze and evaluate the ethical and societal implications of generative AI.
- Apply generative AI techniques to real-world problems and domains.
- Keep up-to-date with the latest developments and trends in the field of generative AI

UNIT I	INTRODUCTION TO GENERATIVE AI	6

Overview of Generative AI and its applications – Difference between generative and discriminative models – Introduction to Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), Long Short-Term Memory Networks (LSTMs), Transformers, and Large Language Models (LLMs)

UNIT II	GENERATIVE MODELS	6

Introduction to Autoencoders – Variational Autoencoders (VAE) – Generative Adversarial Networks (GAN) – Flow-based models – Practical implementation and hands-on exercises (using TensorFlow, PyTorch, Jupyter Notebook, Keras, etc)

UNIT III	TRANSFORMER MODELS	6

Overview of Transformer models and their role in Generative AI – Practical implementation of Transformers and LLMs (e.g., BERT, GPT) - Image generation and manipulation - Text generation and natural language processing

UNIT IV	APPLICATIONS OF GENERATIVE AI	6

– Anomaly detection and data augmentation – Style transfer and artistic applications – Real-world use cases (Art & Design, Medical Imaging, Content creation, Chatbots, Virtual Assistants, Cybersecurity, etc.) and industry examples – Advanced applications of CNNs in image processing, Applications of RNNs and LSTMs in sequential data

UNIT V	EVALUATION AND ETHICAL CONSIDERATIONS	6

Metrics for evaluating generative models (e.g., Inception Score, FID) – Ethical concerns in generative AI, including bias and fairness – Privacy and security considerations – Future trends and emerging technologies in Generative AI – Ethical implications of using LLMs – Case studies on ethical challenges in deploying generative models.

TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
1. Implementation of a Convolutional Neural Network (CNN) for image classification using Keras/TensorFlow.
2. Build a Recurrent Neural Network (RNN) for text sequence prediction
3. Autoencoder for Image Reconstruction
4. Variational Autoencoder (VAE)
5. Generative Adversarial Network (GAN)
6. Transformer-based Text Generation using a pre-trained GPT model via HuggingFace Transformers.
7. Style Transfer using CNN
8. Anomaly Detection using Autoencoder on medical data or synthetic sensor data.
9. Evaluate GAN using FID Score
10. Case Study on Ethical Implications of Generative AI
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	David Foster, "Generative Deep Learning", Second Edition, O'Reilly Media, 2023.
2	Joseph Babcock and Raghav Bali, "Generative AI with Python and TensorFlow 2", Packt Publishing, 2021
3	Denis Rothman, "Transformers for Natural Language Processing", Second Edition, Packt Publishing, 2022
REFERENCES:	
1	Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", The MIT Press, 2016.
2	Alberto Chierici, "The Ethics of AI", New Degree Press, 2021.
3	Jacob Emerson, "Ripples of Generative AI", IngramSpark, 2023.
4	Francois Chollet, "Deep Learning with Python", Second Edition, Manning, 2021
5	Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", The MIT Press, 2016.

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Course Name: GENERATIVE AI		Course Code: 22ADV704			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the fundamental principles and applications of Generative Artificial Intelligence	**I**	K3	1,2,3,5,9, 10,11,12	1,2
CO2	Apply probability and statistics concepts to analyze and model data, with a focus on their role in generative models.	**II**	K5	1,2,3,4,5,8, 9, 10,11,12	1,2
CO3	Implement and evaluate various generative models, including Autoencoders, Variational Autoencoders (VAE), and Generative Adversarial Networks (GANs).	**III**	K3	1,2,3,5,6,9, 10,11,12	1,2
CO4	Apply generative AI techniques to solve real-world problems.	**IV**	K3	1,2,3,5,9, 10,11,12	1,2
CO5	Evaluate generative models using appropriate metrics and critically analyze the ethical implications.	**V**	K6	1,2,3,5,9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	3	-	2	-	-	-	1	2	1	1	1	1
CO2	2	2	2	2	2	-	-	1	1	2	1	2	2	1
CO3	2	2	3	-	2	1	-	-	2	2	2	2	1	2
CO4	2	1	2	-	2	-	-	-	1	2	1	1	2	1
CO5	2	1	3	-	2	-	-	-	2	2	2	2	2	2
CO	2	1.3	2.6	2	2	1	-	1	1.4	2	1.5	1.5	1.5	1.5

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22ADV705	OPTIMIZATION TECHNIQUES	L	T	P	C
		2	0	2	3
Course Objectives:	• Formulate and solve linear programming problems (LPP) • Evaluate Integer Programming Problems, Transportation and Assignment Problems. • Obtain a solution to network problems using CPM and PERT techniques. • Able to optimize the function subject to the constraints. • Identify and solve problems under Markovian queuing models				
UNIT I	**LINEAR MODELS**				**6**
Introduction of Operations Research - mathematical formulation of LPP- Graphical Methods to solve LPP- Simplex Method- Two-Phase method					
UNIT II	**INTEGER PROGRAMMING AND TRANSPORTATION PROBLEMS**				**6**
Integer programming: Branch and bound method- Transportation and Assignment problems - Traveling salesman problem					
UNIT III	**PROJECT SCHEDULING**				**6**
Project network -Diagram representation – Floats - Critical path method (CPM) – PERT- Cost considerations in PERT and CPM					
UNIT IV	**CLASSICAL OPTIMIZATION THEORY**				**6**
Unconstrained problems – necessary and sufficient conditions - Newton-Raphson method, Constrained problems – equality constraints – inequality constraints - Kuhn-Tucker conditions					
UNIT V	**QUEUING MODELS**				**6**
Introduction, Queuing Theory, Operating characteristics of a Queuing system, Constituents of a Queuing system, Service facility, Queue discipline, Single channel models, multiple service channels					
					TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
1. Solving simplex maximization problems using R programming.
2. Solving simplex minimization problems using R programming.
3. Solving mixed constraints problems – Big M & Two phase method using TORA.
4. Solving transportation problems using R.
5. Solving assignment problems using R.
6. Solving optimization problems using LINGO.
7. Studying Primal-Dual relationships in LP using TORA.
8. Solving LP problems using dual simplex method using TORA.
9. Sensitivity & post optimality analysis using LINGO.
10. Solving shortest route problems using optimization software
11. Solving Project Management problems using optimization software
TOTAL : 30 PERIODS

TEXT BOOKS:	
1	Hamdy A Taha, Operations Research: An Introduction, Pearson, 10th Edition, 2017
2	ND Vohra, Quantitative Techniques in Management, Tata McGraw Hill, 4th Edition, 2011.
3	J. K. Sharma, Operations Research Theory and Applications, Macmillan, 5th Edition, 2012.
4	Hiller F.S, Liberman G.J, Introduction to Operations Research, 10th Edition McGraw Hill, 2017.
5	Jit. S. Chandran, Mahendran P. Kawatra, KiHoKim, Essentials of Linear Programming, Vikas Publishing House Pvt.Ltd. New Delhi, 1994.
6	Ravindran A., Philip D.T., and Solberg J.J., Operations Research, John Wiley, 2nd Edition, 2007

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Course Name: OPTIMIZATION TECHNIQUES		Course Code: 22ADV705			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Formulate and solve linear programming problems (LPP)	**I**	K2	1,2,5,10,12	1,2
CO2	Evaluate Integer Programming Problems, Transportation and Assignment Problems.	**II**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO3	Obtain a solution to network problems using CPM and PERT techniques.	**III**	K4	1,2,3,4,5, 10,11,12	1,2
CO4	Able to optimize the function subject to the constraints.	**IV**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO5	Identify and solve problems under Markovian queuing models	**V**	K4	1,2,3,4,5,9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	1	-	-	-	-	1	-	1	-	1
CO2	2	2	2	1	2	-	-	-	1	2	2	2	1	2
CO3	2	2	3	2	2	-	-	-	1	2	2	2	2	2
CO4	2	2	2	2	3	-	-	-	-	1	2	2	2	2
CO5	2	2	2	2	3	-	-	-	1	2	2	3	2	2
CO	2	1.8	1.2	1.8	2.6	-	-	-	1	1.8	2	2	1.8	1.8

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22ADV706	GAME THEORY	L	T	P	C
		2	0	2	3

Course Objectives:

- To introduce the student to the notion of a game, its solutions concepts, and other basic notions and tools of game theory.
- To formalize the notion of strategic thinking and rational choice by using the tools of game theory, and to provide insights into using game theory in 41odelling applications.
- To draw the connections between game theory, computer science, and economics, especially emphasizing the computational issues.
- To introduce contemporary topics in the intersection of game theory, computer science, and economics.
- To apply game theory in searching, auctioning and trading

UNIT I	INTRODUCTION	6

Introduction — Making rational choices: basics of Games — strategy — preferences — payoffs — Mathematical basics — Game theory — Rational Choice — Basic solution concepts-non- cooperative versus cooperative games — Basic computational issues — finding equilibria and learning in games- Typical application areas for game theory

UNIT II	GAMES WITH PERFECT INFORMATION	6

Games with Perfect Information — Strategic games — prisoner's dilemma, matching pennies - Nash equilibria —mixed strategy equilibrium — zero-sum games

UNIT III	GAMES WITH IMPERFECT INFORMATION	6

Games with Imperfect Information — Bayesian Games — Motivational Examples — General Definitions — Information aspects — Illustrations — Extensive Games with Imperfect — Information — Strategies — Nash Equilibrium —Repeated Games — The Prisoner's Dilemma — Bargaining

UNIT IV	NON-COOPERATIVE GAME THEORY	6

Non-cooperative Game Theory — Self-interested agents — Games in normal form — Analyzing games: from optimality to equilibrium — Computing Solution Concepts of Normal — Form Games

— Computing Nash equilibria of two-player, zero-sum games —Computing Nash equilibria of two- player, general- sum games — Identifying dominated strategies

UNIT V	MECHANISM DESIGN	6

Aggregating Preferences — Social Choice — Formal Model — Voting — Existence of social functions — Ranking systems — Protocols for Strategic Agents: Mechanism Design — Mechanism design with unrestricted preferences

TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
• Prisoner's dilemma • Pure Strategy Nash Equilibrium • Extensive Form – Graphs and Trees, Game Trees • Strategic Form – Elimination of dominant strategy • Minimax theorem, minimax strategies • Perfect information games: trees, players assigned to nodes, payoffs, backward Induction, subgame perfect equilibrium, • imperfect-information games - Mixed Strategy Nash Equilibrium - Finding mixed-strategy Nash equilibria for zero sum games, mixed versus behavioral strategies. • Repeated Games • Bayesian Nash equilibrium
TOTAL : 60PERIODS

TEXT BOOKS:	
1	M. J. Osborne, An Introduction to Game Theory. Oxford University Press, 2012.
2	M. Machler, E. Solan, S. Zamir, Game Theory, Cambridge University Press, 2013.
3	N. Nisan, T. Roughgarden, E. Tardos, and V. V. Vazirani, Algorithmic Game Theory. Cambridge University Press, 2007
REFERENCES:	
1	A.Dixit and S. Skeath, Games of Strategy, Second Edition. W W Norton & Co Inc, 2004.
2	YoavShoham, Kevin Leyton-Brown, Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, Cambridge University Press 2008

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Course Name: GAME THEORY		Course Code: 22ADV706			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Discuss the notion of a strategic game and equilibria and identify the characteristics of main applications of these concepts.	**I**	K2	1,2,3,4,5,9, 10,11,12	1,2
CO2	Discuss the use of Nash Equilibrium for other problems.	**II**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO3	Identify key strategic aspects to appropriate game theoretic concepts given a real world situation.	**III**	K2	1,2,3,4,5,9, 10,11,12	1,2
CO4	Identify some applications that need aspects of Bayesian Games.	**IV**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO5	Implement a typical Virtual Business scenario using Game theory	**V**	K4	1,2,3,4,5,9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	2	-	-	-	3	2	1	2	1	2
CO2	3	2	3	2	3	-	-	-	2	2	2	1	2	2
CO3	3	3	3	3	3	-	-	-	3	3	1	2	2	3
CO4	3	2	3	1	3	-	-	-	1	3	3	3	1	3
CO5	3	1	2	2	2	-	-	-	2	3	2	2	2	3
CO	3	2.5	2.8	2.2	2.6	-	-	-	2.2	2.6	2	2	1.8	2.6

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22ADV707	COGNITIVE SCIENCE	L	T	P	C
		2	0	2	3

Course Objectives:

- To know the theoretical background of cognition.
- To understand the link between cognition and computational intelligence.
- To explore probabilistic programming language.
- To study the computational inference models of cognition.
- To study the computational learning models of cognition

UNIT I	PHILOSOPHY, PSYCHOLOGY AND NEUROSCIENCE	6

Philosophy: Mental-physical Relation – From Materialism to Mental Science – Logic and the Sciences of the Mind – Psychology: Place of Psychology within Cognitive Science – Science of Information Processing –Cognitive Neuroscience – Perception – Decision – Learning and Memory – Language Understanding and Processing

UNIT II	COMPUTATIONAL INTELLIGENCE	6

Machines and Cognition – Artificial Intelligence – Architectures of Cognition – Knowledge Based Systems – Logical Representation and Reasoning – Logical Decision Making –Learning – Language – Vision.

UNIT III	PROBABILISTIC PROGRAMMING LANGUAGE	6

WebPPL Language – Syntax – Using Javascript Libraries – Manipulating probability types and distributions – Finding Inference – Exploring random computation – Coroutines: Functions that receive continuations –Enumeration

UNIT IV	INFERENCE MODELS OF COGNITION	6

Generative Models – Conditioning – Causal and statistical dependence – Conditional dependence – Data Analysis – Algorithms for Inference

UNIT V	LEARNING MODELS OF COGNITION	6

Learning as Conditional Inference – Learning with a Language of Thought – Hierarchical Models– Learning (Deep) Continuous Functions – Mixture Models.

TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
1. Demonstration of Mathematical functions using WebPPL. 2. Implementation of reasoning algorithms. 3. Developing an Application system using generative model. 4. Developing an Application using conditional inference learning model. 5. Application development using hierarchical model. 6. Application development using Mixture model
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	Vijay V Raghavan,Venkat N.Gudivada, VenuGovindaraju, C.R. Rao, Cognitive Computing: Theory and Applications: (Handbook of Statistics 35), Elsevier publications, 2016
2	Judith Hurwitz, Marcia Kaufman, Adrian Bowles, Cognitive Computing and Big Data Analytics, Wiley Publications, 2015
REFERENCES:	
1	Robert A. Wilson, Frank C. Keil, "The MIT Encyclopedia of the Cognitive Sciences",The MIT Press, 1999.
2	Jose Luis Bermúdez, Cognitive Science -An Introduction to the Science of the Mind, Cambridge University Press 2020
3	Noah D. Goodman, Andreas Stuhlmuller, "The Design and Implementation of Probabilistic Programming Languages", Electronic version of book, https://dippl.org/.
4	Noah D. Goodman, Joshua B. Tenenbaum, The ProbMods Contributors, "Probabilistic Models of Cognition", Second Edition, 2016, https://probmods.org/

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Course Name: COGNITIVE SCIENCE		Course Code: 22ADV707			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the underlying theory behind cognition.	**I**	K2	1,2,3,4,5,9, 10,11,12	1,2
CO2	Connect to the cognition elements computationally	**II**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO3	Implement mathematical functions through WebPPL	**III**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO4	Develop applications using cognitive inference model	**IV**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO5	Develop applications using cognitive learning model	**V**	K2	1,2,3,4,5,9, 10,11.12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	3	-	-	-	1	3	1	3	3	1
CO2	3	1	2	1	2	-	-	-	1	2	2	1	2	1
CO3	2	2	1	2	3	-	-	-	2	1	1	3	2	1
CO4	2	3	3	1	1	-	-	-	2	2	2	2	1	2
CO5	1	2	1	3	1	-	-	-	3	2	1	3	3	3
CO	2.2	1.8	1.6	1.6	2	-	-	-	1.8	2	1.4	2.4	2.4	1.6

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22ADV708	ETHICS AND AI	L	T	P	C
		2	0	2	3

Course Objectives:

- Study the morality and ethics in AI
- Learn about the Ethical initiatives in the field of artificial intelligence
- Study about AI standards and Regulations
- Study about social and ethical issues of Robot Ethics
- Study about AI and Ethics- challenges and opportunities

UNIT I	INTRODUCTION	6

Definition of morality and ethics in AI-Impact on society-Impact on human psychology-Impact on the legal system-Impact on the environment and the planet-Impact on trust

UNIT II	ETHICAL INITIATIVES IN AI	6

International ethical initiatives-Ethical harms and concerns-Case study: healthcare robots, Autonomous Vehicles , Warfare and weaponization

UNIT III	AI STANDARDS AND REGULATION	6

Model Process for Addressing Ethical Concerns During System Design - Transparency of Autonomous Systems-Data Privacy Process- Algorithmic Bias Considerations - Ontological Standard for Ethically Driven Robotics and Automation Systems

UNIT IV	ROBOETHICS: SOCIAL AND ETHICAL IMPLICATION OF ROBOTICS	6

Robot-Roboethics- Ethics and Morality- Moral Theories-Ethics in Science and Technology - Ethical Issues in an ICT Society- Harmonization of Principles- Ethics and Professional Responsibility-Roboethics Taxonomy

UNIT V	AI AND ETHICS- CHALLENGES AND OPPORTUNITIES	6

Challenges - Opportunities- ethical issues in artificial intelligence- Societal Issues Concerning the Application of Artificial Intelligence in Medicine- decision-making role in industries-National and International Strategies on AI

TOTAL: 30 PERIODS

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LIST OF EXPERIMENTS: 30 PERIODS
1. Recent case study of ethical initiatives in healthcare, autonomous vehicles and defense 2. Exploratory data analysis on a 2 variable linear regression model 3. Experiment the regression model without a bias and with bias 4. Classification of a dataset from UCI repository using a perceptron with and without bias 5. Case study on ontology where ethics is at stake 6. Identification on optimization in AI affecting ethics
TOTAL : 60 PERIODS

TEXT BOOKS:	
1	y. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield ,"The ethics of artificial intelligence: Issues and initiatives", EPRS | European Parliamentary Research Service Scientific Foresight Unit (STOA) PE 634.452 – March 2020
2	Patrick Lin, Keith Abney, George A Bekey," Robot Ethics: The Ethical and Social Implications of Robotics", The MIT Press- January 2014
REFERENCES:	
1	Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms) by Paula Boddington, November 2017
2	Mark Coeckelbergh," AI Ethics", The MIT Press Essential Knowledge series, April 2020
3	https://sci-hub.mksa.top/10.1007/978-3-540-30301-5_65
4	https://www.scu.edu/ethics/all-about-ethics/artificial-intelligence-and-ethics-sixteen-challenges-and-opportunities/

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Course Name: ETHICS AND AI		**Course Code: 22ADV708**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Learn about morality and ethics in AI	**I**	K3	1,2,3,4,9, 10,11	1,2
CO2	Acquire the knowledge of real time application ethics, issues and its challenges.	**II**	K3	1,2,3,4,9, 10,11	1,2
CO3	Understand the ethical harms and ethical initiatives in AI	**III**	K3	1,2,3,4,9, 10,11	1,2
CO4	Learn about AI standards and Regulations like AI Agent, Safe Design of Autonomous and Semi-Autonomous Systems	**IV**	K3	1,2,3,4,9, 10,11	1,2
CO5	Understand the concepts of Roboethics and Morality with professional responsibilities.	**V**	K3	1,2,3,4,9, 10,11	1,2

CO-PO-PSO Mapping

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

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